RESPONSES TO BUILDING OWNERS AND MANAGERS ASSOCIATION, GREATER TORONTO INTERROGATORIES

INTERROGATORY 1:

Reference(s): **Exhibit 1A, Updated Evidence, Appendix A, Table of Revisions, page 1, to letter dated September 23, 2014 from Daliana Coban to OEB**

Please explain why the forecast 2015 Capital Investments have increased from $523.6 million to $539.6 million, an increase of $16.0 million, when the components of the total, mandated obligations, and safety have increased by only $2.8 million and $0.7 million (decrease), respectively.

RESPONSE:

Due to a formatting error, the table entitled "Capital Investments by Trigger Driver ($ Millions)" at page 1 of Appendix A to the Updated Evidence Cover letter, did not capture all the changes that were made to Exhibit 1A, Tab 2, Schedule 1, page 17, Table 2 (Filed: 2014 Jul 31, Corrected 2014 Sep 23). More specifically, it did not reflect that the System Maintenance and Capital Investment Support driver increased by $10.76 million and that the Capacity Constraints driver increased by $3.16 million as a result of the update. For greater clarity, below is the correct table that should have been filed at page 1 of Appendix A to the Updated Evidence Cover Letter:

RESPONSES TO BUILDING OWNERS AND MANAGERS ASSOCIATION, GREATER TORONTO INTERROGATORIES

1 **Capital Investments by Trigger Driver ($ Millions)**

Trigger Driver	2015	2016	2017	2018	2019
Failure Risk	~~156.9~~ 156.91	~~130.3~~ 130.31	~~134.9~~ 134.93	~~151.4~~ 151.42	~~156.8~~ 156.76
Functional Obsolescence	~~80.6~~ 80.61	~~105.5~~ 105.54	~~78.3~~ 78.31	~~75.1~~ 75.05	~~74.5~~ 74.54
Customer Service Requests / Third Party Requests	~~55.3~~ 55.31	~~71.7~~ 71.74	~~82.9~~ 82.94	~~76.6~~ 76.58	~~69.8~~ 69.77
System Maintenance & Capital Investment Support	~~69.5~~ 80.26	~~50.8~~ 52.14	~~32.3~~ 28.93	~~32.1~~ 32.13	~~27.9~~ 27.88
Capacity Constraints	~~51.2~~ 54.36	~~31.0~~ 30.95	~~37.1~~ 37.10	~~22.5~~ 22.50	~~44.4~~ 44.35
Failure	~~31.9~~ 31.90	~~32.7~~ 32.71	~~33.1~~ 33.11	~~33.6~~ 33.61	~~34.2~~ 34.18
Other	~~10.3~~ 10.28	~~19.9~~ 19.75	~~28.8~~ 28.65	~~38.3~~ 37.89	~~49.9~~ 49.37
Mandated Service Obligations	~~28~~ 30.82	~~20.6~~ 21.8	~~16.7~~ 17.99	~~12.9~~ 13.83	~~14.6~~ 15.69
Reliability	~~11~~ 10.97	~~9.4~~ 9.38	~~13.8~~ 13.83	~~13.8~~ 13.81	~~17.4~~ 17.36
System Efficiency	~~11.7~~ 11.68	~~16.2~~ 16.20	~~11.6~~ 11.58	~~13.2~~ 13.23	~~12.2~~ 12.24
Safety	~~17.2~~ 16.50	~~13.7~~ 13.73	0.0	0.0	0.0
Total Capital Expenditures	~~523.6~~ 539.61	~~501.7~~ 504.24	~~469.6~~ 467.36	~~469.4~~ 470.05	~~501.6~~ 502.16

RESPONSES TO BUILDING OWNERS AND MANAGERS ASSOCIATION, GREATER TORONTO INTERROGATORIES

INTERROGATORY 2:

Reference(s): **Exhibit 1A, Tab 2, Schedule 1, page 4**

"Toronto Hydro has been an efficient organization."

a) Please provide data which validates Toronto Hydro's claim that it is efficient, and shows the organizations relative to which Toronto Hydro has been efficient.

b) Please indicate what period of time Toronto Hydro has measured its efficiency relative to what it considers to be an appropriate peer group.

c) Please provide a copy of Toronto Hydro's distribution licence.

RESPONSE:

a) Please see Exhibit 1B, Tab 2, Schedule 5, Appendix B, a report prepared by Power System Engineering Inc. ("PSE") *Econometric Benchmarking of Toronto Hydro's Historical and Projected Total Cost and Reliability Levels*.

b) The PSE study referenced in (a) covers a 2002-2019 timeframe. Toronto Hydro began exploring this approach to benchmarking its cost efficiency in 2012.

c) Toronto Hydro's distribution licence is provided as Appendix A.

Electricity Distribution Licence

ED-2002-0497

Toronto Hydro-Electric System Limited

Valid Until

October 16, 2023

Original signed by

____

Jennifer Lea
Counsel, Special Projects
Ontario Energy Board
Date of Issuance: October 17, 2003
Date of Amendment: November 12, 2010
Date of Amendment: February, 22, 2012

Ontario Energy Board	Commission de l'énergie de l'Ontario
P.O. Box 2319	C.P. 2319
2300 Yonge Street	2300, rue Yonge
27th. Floor	27e étage
Toronto, ON M4P 1E4	Toronto ON M4P 1E4

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1 Definitions

In this Licence:

"**Accounting Procedures Handbook**" means the handbook, approved by the Board which specifies the accounting records, accounting principles and accounting separation standards to be followed by the Licensee;

"**Act**" means the *Ontario Energy Board Act, 1998*, S.O. 1998, c. 15, Schedule B;

"**Affiliate Relationships Code for Electricity Distributors and Transmitters**" means the code, approved by the Board which, among other things, establishes the standards and conditions for the interaction between electricity distributors or transmitters and their respective affiliated companies;

"**distribution services**" means services related to the distribution of electricity and the services the Board has required distributors to carry out, including the sales of electricity to consumers under section 29 of the Act, for which a charge or rate has been established in the Rate Order;

"**Conservation and Demand Management**" and "**CDM**" means distribution activities and programs to reduce electricity consumption and peak provincial electricity demand;

"**Conservation and Demand Management Code for Electricity Distributors**" means the code approved by the Board which, among other things, establishes the rules and obligations surrounding Board approved programs to help distributors meet their CDM Targets;

"**Distribution System Code**" means the code approved by the Board which, among other things, establishes the obligations of the distributor with respect to the services and terms of service to be offered to customers and retailers and provides minimum, technical operating standards of distribution systems;

"**Electricity Act**" means the *Electricity Act, 1998*, S.O. 1998, c. 15, Schedule A;

"**Licensee**" means Toronto Hydro-Electric System Limited;

"**Market Rules**" means the rules made under section 32 of the Electricity Act;

"**Net Annual Peak Demand Energy Savings Target**" means the reduction in a distributor's peak electricity demand persisting at the end of the four-year period (i.e. December 31, 2014) that coincides with the provincial peak electricity demand that is associated with the implementation of CDM Programs;

"**Net Cumulative Energy Savings Target**" means the total amount of reduction in electricity consumption associated with the implementation of CDM Programs between 2011-2014;

"**OPA**" means the Ontario Power Authority;

“**Performance Standards**” means the performance targets for the distribution and connection activities of the Licensee as established by the Board in accordance with section 83 of the Act;

“**Provincial Brand**” means any mark or logo that the Province has used or is using, created or to be created by or on behalf of the Province, and which will be identified to the Board by the Ministry as a provincial mark or logo for its conservation programs;

“**Rate Order**” means an Order or Orders of the Board establishing rates the Licensee is permitted to charge;

“**regulation”** means a regulation made under the Act or the Electricity Act;

“**Retail Settlement Code**” means the code approved by the Board which, among other things, establishes a distributor’s obligations and responsibilities associated with financial settlement among retailers and consumers and provides for tracking and facilitating consumer transfers among competitive retailers;

“**service area**” with respect to a distributor, means the area in which the distributor is authorized by its licence to distribute electricity;

“**Standard Supply Service Code**” means the code approved by the Board which, among other things, establishes the minimum conditions that a distributor must meet in carrying out its obligations to sell electricity under section 29 of the Electricity Act;

“**wholesaler**” means a person that purchases electricity or ancillary services in the IESO administered markets or directly from a generator or, a person who sells electricity or ancillary services through the IESO-administered markets or directly to another person other than a consumer.

2 Interpretation

2.1 In this Licence, words and phrases shall have the meaning ascribed to them in the Act or the Electricity Act. Words or phrases importing the singular shall include the plural and vice versa. Headings are for convenience only and shall not affect the interpretation of the Licence. Any reference to a document or a provision of a document includes an amendment or supplement to, or a replacement of, that document or that provision of that document. In the computation of time under this Licence, where there is a reference to a number of days between two events, they shall be counted by excluding the day on which the first event happens and including the day on which the second event happens and where the time for doing an act expires on a holiday, the act may be done on the next day that is not a holiday.

3 Authorization

3.1 The Licensee is authorized, under Part V of the Act and subject to the terms and conditions set out in this Licence:

a) to own and operate a distribution system in the service area described in Schedule 1 of this Licence;

b) to retail electricity for the purposes of fulfilling its obligation under section 29 of the Electricity Act in the manner specified in Schedule 2 of this Licence; and

c) to act as a wholesaler for the purposes of fulfilling its obligations under the Retail Settlement Code or under section 29 of the Electricity Act.

4 Obligation to Comply with Legislation, Regulations and Market Rules

4.1 The Licensee shall comply with all applicable provisions of the Act and the Electricity Act and regulations under these Acts, except where the Licensee has been exempted from such compliance by regulation.

4.2 The Licensee shall comply with all applicable Market Rules.

5 Obligation to Comply with Codes

5.1 The Licensee shall at all times comply with the following Codes (collectively the "Codes") approved by the Board, except where the Licensee has been specifically exempted from such compliance by the Board. Any exemptions granted to the licensee are set out in Schedule 3 of this Licence. The following Codes apply to this Licence:

a) the Affiliate Relationships Code for Electricity Distributors and Transmitters;

b) the Distribution System Code;

c) the Retail Settlement Code; and

d) the Standard Supply Service Code.

5.2 The Licensee shall:

a) make a copy of the Codes available for inspection by members of the public at its head office and regional offices during normal business hours; and

b) provide a copy of the Codes to any person who requests it. The Licensee may impose a fair and reasonable charge for the cost of providing copies.

6 Obligation to Provide Non-discriminatory Access

6.1 The Licensee shall, upon the request of a consumer, generator or retailer, provide such consumer, generator or retailer with access to the Licensee's distribution system and shall convey electricity on behalf of such consumer, generator or retailer in accordance with the terms of this Licence.

7 Obligation to Connect

7.1 The Licensee shall connect a building to its distribution system if:

a) the building lies along any of the lines of the distributor's distribution system; and

b) the owner, occupant or other person in charge of the building requests the connection in writing.

7.2 The Licensee shall make an offer to connect a building to its distribution system if:

a) the building is within the Licensee's service area as described in Schedule 1; and

b) the owner, occupant or other person in charge of the building requests the connection in writing.

7.3 The terms of such connection or offer to connect shall be fair and reasonable and made in accordance with the Distribution System Code, and the Licensee's Rate Order as approved by the Board.

7.4 The Licensee shall not refuse to connect or refuse to make an offer to connect unless it is permitted to do so by the Act or a regulation or any Codes to which the Licensee is obligated to comply with as a condition of this Licence.

8 Obligation to Sell Electricity

8.1 The Licensee shall fulfill its obligation under section 29 of the Electricity Act to sell electricity in accordance with the requirements established in the Standard Supply Service Code, the Retail Settlement Code and the Licensee's Rate Order as approved by the Board.

9 Obligation to Maintain System Integrity

9.1 The Licensee shall maintain its distribution system in accordance with the standards established in the Distribution System Code and Market Rules, and have regard to any other recognized industry operating or planning standards adopted by the Board.

10 Market Power Mitigation Rebates

10.1 The Licensee shall comply with the pass through of Ontario Power Generation rebate conditions set out in Appendix A of this Licence.

11 Distribution Rates

11.1 The Licensee shall not charge for connection to the distribution system, the distribution of electricity or the retailing of electricity to meet its obligation under section 29 of the Electricity Act except in accordance with a Rate Order of the Board.

12 Separation of Business Activities

12.1 The Licensee shall keep financial records associated with distributing electricity separate from its financial records associated with transmitting electricity or other activities in accordance with the Accounting Procedures Handbook and as otherwise required by the Board.

13 Expansion of Distribution System

13.1 The Licensee shall not construct, expand or reinforce an electricity distribution system or make an interconnection except in accordance with the Act and Regulations, the Distribution System Code and applicable provisions of the Market Rules.

13.2 In order to ensure and maintain system integrity or reliable and adequate capacity and supply of electricity, the Board may order the Licensee to expand or reinforce its distribution system in accordance with Market Rules and the Distribution System Code, or in such a manner as the Board may determine.

14 Provision of Information to the Board

14.1 The Licensee shall maintain records of and provide, in the manner and form determined by the Board, such information as the Board may require from time to time.

14.2 Without limiting the generality of paragraph 14.1, the Licensee shall notify the Board of any material change in circumstances that adversely affects or is likely to adversely affect the business, operations or assets of the Licensee as soon as practicable, but in any event no more than twenty (20) days past the date upon which such change occurs.

15 Restrictions on Provision of Information

15.1 The Licensee shall not use information regarding a consumer, retailer, wholesaler or generator obtained for one purpose for any other purpose without the written consent of the consumer, retailer, wholesaler or generator.

15.2 The Licensee shall not disclose information regarding a consumer, retailer, wholesaler or generator to any other party without the written consent of the consumer, retailer, wholesaler or generator, except where such information is required to be disclosed:

a) to comply with any legislative or regulatory requirements, including the conditions of this Licence;

b) for billing, settlement or market operations purposes;

c) for law enforcement purposes; or

d) to a debt collection agency for the processing of past due accounts of the consumer, retailer, wholesaler or generator.

15.3 The Licensee may disclose information regarding consumers, retailers, wholesalers or generators where the information has been sufficiently aggregated such that their particular information cannot reasonably be identified.

15.4 The Licensee shall inform consumers, retailers, wholesalers and generators of the conditions under which their information may be released to a third party without their consent.

15.5 If the Licensee discloses information under this section, the Licensee shall ensure that the information provided will not be used for any other purpose except the purpose for which it was disclosed.

16 Customer Complaint and Dispute Resolution

16.1 The Licensee shall:

a) have a process for resolving disputes with customers that deals with disputes in a fair, reasonable and timely manner;

b) publish information which will make its customers aware of and help them to use its dispute resolution process;

c) make a copy of the dispute resolution process available for inspection by members of the public at each of the Licensee's premises during normal business hours;

d) give or send free of charge a copy of the process to any person who reasonably requests it; and

e) subscribe to and refer unresolved complaints to an independent third party complaints resolution service provider selected by the Board. This condition will become effective on a date to be determined by the Board. The Board will provide reasonable notice to the Licensee of the date this condition becomes effective.

17 Term of Licence

17.1 This Licence shall take effect on October 17, 2003 and expire on October 16, 2023. The term of this Licence may be extended by the Board.

18 Fees and Assessments

18.1 The Licensee shall pay all fees charged and amounts assessed by the Board.

19 Communication

19.1 The Licensee shall designate a person that will act as a primary contact with the Board on matters related to this Licence. The Licensee shall notify the Board promptly should the contact details change.

19.2 All official communication relating to this Licence shall be in writing.

19.3 All written communication is to be regarded as having been given by the sender and received by the addressee:

a) when delivered in person to the addressee by hand, by registered mail or by courier;

b) ten (10) business days after the date of posting if the communication is sent by regular mail; and

c) when received by facsimile transmission by the addressee, according to the sender's transmission report.

20 Copies of the Licence

20.1 The Licensee shall:

a) make a copy of this Licence available for inspection by members of the public at its head office and regional offices during normal business hours; and

b) provide a copy of this Licence to any person who requests it. The Licensee may impose a fair and reasonable charge for the cost of providing copies.

21 Conservation and Demand Management

21.1 The Licensee shall achieve reductions in electricity consumption and reductions in peak provincial electricity demand through the delivery of CDM programs. The Licensee shall meet its 2014 Net Annual Peak Demand Savings Target of 286.270 MW, and its 2011-2014 Net Cumulative Energy Savings Target of 1,303.990 GWh (collectively the “CDM Targets”), over a four-year period beginning January 1, 2011.

21.2 The Licensee shall meet its CDM Targets through:

a) the delivery of Board approved CDM Programs delivered in the Licensee’s service area (“Board-Approved CDM Programs”);

b) the delivery of CDM Programs that are made available by the OPA to distributors in the Licensee’s service area under contract with the OPA (“OPA-Contracted Province-Wide CDM Programs”); or

c) a combination of a) and b).

21.3 The Licensee shall make its best efforts to deliver a mix of CDM Programs to all consumer types in the Licensee’s service area.

21.4 The Licensee shall comply with the rules mandated by the Board’s Conservation and Demand Management Code for Electricity Distributors.

21.5 The Licensee shall utilize the common Provincial brand, once available, with all Board-Approved CDM Programs, OPA-Contracted Province-Wide Programs, and in conjunction with or co-branded with the Licensee’s own brand or marks.

SCHEDULE 1 DEFINITION OF DISTRIBUTION SERVICE AREA

This Schedule specifies the area in which the Licensee is authorized to distribute and sell electricity in accordance with paragraph 8.1 of this Licence.

1. The City of Toronto as of January 1, 1998.

SCHEDULE 2 PROVISION OF STANDARD SUPPLY SERVICE

This Schedule specifies the manner in which the Licensee is authorized to retail electricity for the purposes of fulfilling its obligation under section 29 of the Electricity Act.

The Licensee is authorized to retail electricity directly to consumers within its service area in accordance with paragraph 8.1 of this Licence, any applicable exemptions to this Licence, and at the rates set out in the Rate Orders.

SCHEDULE 3 LIST OF CODE EXEMPTIONS

This Schedule specifies any specific Code requirements from which the Licensee has been exempted.

1. The Licensee is exempt from the requirements of section 2.5.3 of the Standard Supply Service Code with respect to the price for small volume/residential consumers, subject to the Licensee offering an equal billing plan as described in its application for exemption from Fixed Reference Price, and meeting all other undertakings and material representations contained in the application and the materials filed in connection with it.

2. The Licensee is exempt from the requirements of section 2.4.26A, 2.6.5, and 4.2.2.4 of the Distribution System Code. These exemptions will expire December 17, 2012.

3. The Licensee is exempt from the requirements of section 7.7.1 of the Retail Settlement Code only with respect to the 10 day timeline to notify retailers and customers (whose accounts meet the criteria established in section 7.7.1) of a billing error. This exemption will expire December 17, 2012.

APPENDIX A

MARKET POWER MITIGATION REBATES

4. **Definitions and Interpretations**

In this Licence

"embedded distributor" means a distributor who is not a market participant and to whom a host distributor distributes electricity;

"embedded generator" means a generator who is not a market participant and whose generation facility is connected to a distribution system of a distributor, but does not include a generator who consumes more electricity than it generates;

"host distributor" means a distributor who is a market participant and who distributes electricity to another distributor who is not a market participant.

In this Licence, a reference to the payment of a rebate amount by the IESO includes interim payments made by the IESO.

5. **Information Given to IESO**

a Prior to the payment of a rebate amount by the IESO to a distributor, the distributor shall provide the IESO, in the form specified by the IESO and before the expiry of the period specified by the IESO, with information in respect of the volumes of electricity withdrawn by the distributor from the IESO-controlled grid during the rebate period and distributed by the distributor in the distributor's service area to:

i consumers served by a retailer where a service transaction request as defined in the Retail Settlement Code has been implemented; and

ii consumers other than consumers referred to in clause (i) who are not receiving the fixed price under sections 79.4, 79.5 and 79.16 of the *Ontario Energy Board Act, 1998.*

b Prior to the payment of a rebate amount by the IESO to a distributor which relates to electricity consumed in the service area of an embedded distributor, the embedded distributor shall provide the host distributor, in the form specified by the IESO and before the expiry of the period specified in the Retail Settlement Code, with the volumes of electricity distributed during the rebate period by the embedded distributor's host distributor to the embedded distributor net of any electricity distributed to the embedded distributor which is attributable to embedded generation and distributed by the embedded distributor in the embedded distributor's service area to:

i consumers served by a retailer where a service transaction request as defined in the Retail Settlement Code has been implemented; and

ii consumers other than consumers referred to in clause (i) who are not receiving the fixed price under sections 79.4, 79.5 and 79.16 of the *Ontario Energy Board Act, 1998*.

c Prior to the payment of a rebate amount by the IESO to a distributor which relates to electricity consumed in the service area of an embedded distributor, the host distributor shall provide the IESO, in the form specified by the IESO and before the expiry of the period specified by the IESO, with the information provided to the host distributor by the embedded distributor in accordance with section 2.

The IESO may issue instructions or directions providing for any information to be given under this section. The IESO shall rely on the information provided to it by distributors and there shall be no opportunity to correct any such information or provide any additional information and all amounts paid shall be final and binding and not subject to any adjustment.

For the purposes of attributing electricity distributed to an embedded distributor to embedded generation, the volume of electricity distributed by a host distributor to an embedded distributor shall be deemed to consist of electricity withdrawn from the IESO-controlled grid or supplied to the host distributor by an embedded generator in the same proportion as the total volume of electricity withdrawn from the IESO-controlled grid by the distributor in the rebate period bears to the total volume of electricity supplied to the distributor by embedded generators during the rebate period.

3. Pass Through of Rebate

A distributor shall promptly pass through, with the next regular bill or settlement statement after the rebate amount is received, any rebate received from the IESO, together with interest at the Prime Rate, calculated and accrued daily, on such amount from the date of receipt, to:

a retailers who serve one or more consumers in the distributor’s service area where a service transaction request as defined in the Retail Settlement Code has been implemented;

b consumers who are not receiving the fixed price under sections 79.4, 79.5 and 79.16 of the *Ontario Energy Board Act, 1998* and who are not served by a retailer where a service transaction request as defined in the Retail Settlement Code has been implemented; and

c embedded distributors to whom the distributor distributes electricity.

The amounts paid out to the recipients listed above shall be based on energy consumed and calculated in accordance with the rules set out in the Retail Settlement Code. These payments may be made by way of set off at the option of the distributor.

If requested in writing by OPGI, the distributor shall ensure that all rebates are identified as coming from OPGI in the following form on or with each applicable bill or settlement statement:

“ONTARIO POWER GENERATION INC. rebate”

Any rebate amount which cannot be distributed as provided above or which is returned by a retailer to the distributor in accordance with its licence shall be promptly returned to the host distributor or IESO as applicable, together with interest at the Prime Rate, calculated and accrued daily, on such amount from the date of receipt.

Nothing shall preclude an agreement whereby a consumer assigns the benefit of a rebate payment to a retailer or another party.

Pending pass-through or return to the IESO of any rebate received, the distributor shall hold the funds received in trust for the beneficiaries thereof in a segregated account.

ONTARIO POWER GENERATION INC. REBATES

For the payments that relate to the period from May 1, 2006 to April 30, 2009, the rules set out below shall apply.

1. Definitions and Interpretations

In this Licence

"embedded distributor" means a distributor who is not a market participant and to whom a host distributor distributes electricity;

"embedded generator" means a generator who is not a market participant and whose generation facility is connected to a distribution system of a distributor, but does not include a generator who consumes more electricity than it generates;

"host distributor" means a distributor who is a market participant and who distributes electricity to another distributor who is not a market participant.

In this Licence, a reference to the payment of a rebate amount by the IESO includes interim payments made by the IESO.

2. Information Given to IESO

a Prior to the payment of a rebate amount by the IESO to a distributor, the distributor shall provide the IESO, in the form specified by the IESO and before the expiry of the period specified by the IESO, with information in respect of the volumes of electricity withdrawn by the distributor from the IESO-controlled grid during the rebate period and distributed by the distributor in the distributor's service area to:

i consumers served by a retailer where a service transaction request as defined in the Retail Settlement Code has been implemented and the consumer is not receiving the prices established under sections 79.4, 79.5 and 79.16 of the *Ontario Energy Board Act, 1998*; and

ii consumers other than consumers referred to in clause (i) who are not receiving the fixed price under sections 79.4, 79.5 and 79.16 of the *Ontario Energy Board Act, 1998*.

b Prior to the payment of a rebate amount by the IESO to a distributor which relates to electricity consumed in the service area of an embedded distributor, the embedded distributor shall provide the host distributor, in the form specified by the IESO and before the expiry of the period specified in the Retail Settlement Code, with the volumes of electricity distributed during the rebate period by the embedded distributor's host distributor to the embedded distributor net of any electricity distributed to the embedded distributor which is attributable to embedded generation and distributed by the embedded distributor in the embedded distributor's service area to:

i consumers served by a retailer where a service transaction request as defined in the Retail Settlement Code has been implemented; and

ii consumers other than consumers referred to in clause (i) who are not receiving the fixed price under sections 79.4, 79.5 and 79.16 of the *Ontario Energy Board Act, 1998*.

c Prior to the payment of a rebate amount by the IESO to a distributor which relates to electricity consumed in the service area of an embedded distributor, the host distributor shall provide the IESO, in the form specified by the IESO and before the expiry of the period specified by the IESO, with the information provided to the host distributor by the embedded distributor in accordance with section 2.

The IESO may issue instructions or directions providing for any information to be given under this section. The IESO shall rely on the information provided to it by distributors and there shall be no opportunity to correct any such information or provide any additional information and all amounts paid shall be final and binding and not subject to any adjustment.

For the purposes of attributing electricity distributed to an embedded distributor to embedded generation, the volume of electricity distributed by a host distributor to an embedded distributor shall be deemed to consist of electricity withdrawn from the IESO-controlled grid or supplied to the host distributor by an embedded generator in the same proportion as the total volume of electricity withdrawn from the IESO-controlled grid by the distributor in the rebate period bears to the total volume of electricity supplied to the distributor by embedded generators during the rebate period.

3. Pass Through of Rebate

A distributor shall promptly pass through, with the next regular bill or settlement statement after the rebate amount is received, any rebate received from the IESO, together with interest at the Prime Rate, calculated and accrued daily, on such amount from the date of receipt, to:

a retailers who serve one or more consumers in the distributor's service area where a service transaction request as defined in the Retail Settlement Code has been implemented and the consumer is not receiving the prices established under sections 79.4, 79.5 and 79.16 of the *Ontario Energy Board Act, 1998*;

b consumers who are not receiving the fixed price under sections 79.4, 79.5 and 79.16 of the *Ontario Energy Board Act, 1998* and who are not served by a retailer where a service transaction request as defined in the Retail Settlement Code has been implemented; and

c embedded distributors to whom the distributor distributes electricity.

The amounts paid out to the recipients listed above shall be based on energy consumed and calculated in accordance with the rules set out in the Retail Settlement Code. These payments may be made by way of set off at the option of the distributor.

If requested in writing by OPGI, the distributor shall ensure that all rebates are identified as coming from OPGI in the following form on or with each applicable bill or settlement statement:

"ONTARIO POWER GENERATION INC. rebate"

Any rebate amount which cannot be distributed as provided above or which is returned by a retailer to the distributor in accordance with its licence shall be promptly returned to the host distributor or IESO as applicable, together with interest at the Prime Rate, calculated and accrued daily, on such amount from the date of receipt.

Nothing shall preclude an agreement whereby a consumer assigns the benefit of a rebate payment to a retailer or another party.

Pending pass-through or return to the IESO of any rebate received, the distributor shall hold the funds received in trust for the beneficiaries thereof in a segregated account.

RESPONSES TO BUILDING OWNERS AND MANAGERS ASSOCIATION, GREATER TORONTO INTERROGATORIES

INTERROGATORY 3:

Reference(s): Exhibit 1A, Tab 2, Schedule 1, page 7 of 30, line 14

Please discuss, in detail, the pressures from economics (system load) growth and capacity contracts from "the increased proliferation of distributed generation". Please provide both qualitative and quantitative analyses to explain those pressures, and their magnitude.

RESPONSE:

Please refer to Exhibit 2B, Section E5.5 for a Qualitative and Quantitative Analysis of the ongoing challenges from increased distributed generation and how Toronto Hydro intends to address them.

RESPONSES TO BUILDING OWNERS AND MANAGERS ASSOCIATION, GREATER TORONTO INTERROGATORIES

INTERROGATORY 4:

Reference(s): **Exhibit 1A, Tab 2, Schedule 1, page 7, lines 4-12**

Does the percentage of assets described to be at the end of the useful lives by 2015 take into account of the replacement assets that have been installed in 2013, 2014 to date, and will be installed in 2015? Does the phrase by 2015, mean over by January 1, 2016 or December 31, 2014?

RESPONSE:

Toronto Hydro states that by 2015, 26% of assets will be operating beyond their useful lives. This statement takes into consideration assets that have been installed in 2013, as well as those planned to be installed during 2014. The reference to 'by 2015' refers to January 1, 2015.

RESPONSES TO BUILDING OWNERS AND MANAGERS ASSOCIATION, GREATER TORONTO INTERROGATORIES

INTERROGATORY 5:

Reference(s): **Exhibit 1A, Tab 2, Schedule 1, page 8, 2.3 Toronto Hydro Corporate Strategy**

"The utility's strategic vision is to continuously maximize customers' and stakeholders' satisfaction by operating in a safe, reliable and environmentally responsible manner at optimal costs. To realize this vision, Toronto Hydro employs a framework consisting of four strategic pillars:

1. *Customer Service: deliver value-for-money to Toronto Hydro's customers, including making it easier for them to work with the utility, helping them conserve energy and providing them with tools and technology;*
2. *Operations: improve reliability through optimal and sustainable system management, including keeping the system safe, building a grid that supports a modern city and maintaining productivity;*
3. *People: fully-engages, safe and healthy workforce, that meets the changing business environment; and*
4. *Financial Strength: meet financial objectives including obtaining a fair return.*
5. *These strategic pillars guide the establishment of the utility's goals and business plans, and focus the organization."*

Why does your Corporate Strategy not include Public Policy Responsiveness, which is one of the four Performance Outcomes described in the RRFE?

RESPONSES TO BUILDING OWNERS AND MANAGERS ASSOCIATION, GREATER TORONTO INTERROGATORIES

RESPONSE:

As discussed in further detail in Exhibit 1C, Tab 3, Schedule 1, Toronto Hydro's corporate pillars are aligned with the OEB's performance outcomes described in the Renewed Regulatory Framework for Electricity ("RRFE") report, among other things. In Toronto Hydro's view, public policy is a component of the legislative and regulatory environment in which LDCs operate. The utility's corporate pillars represent its strategic drivers, which are necessarily underpinned by the legislative and regulatory environment.

Toronto Hydro's track record demonstrates its commitment to public policy, as articulated in the OEB's RRFE. Examples include:

- Connecting 890 unique Distributed Generation ("DG") projects to the utility's system since 2009, which amounts to 110 MW of generation capacity made up of various technologies (See Exhibit 2B, Section E3).
- Planning for system upgrades and modifications required to integrate future DG resources into the system, such as eliminating short circuit constraints, enhancing generation control and monitoring capabilities etc (See Exhibit 2B, Section E3).
- Connecting 100% of eligible micro-generation projects and performing 100% of DG-related connection impact assessments within the prescribed timelines.
- Achieving 99.8% of the utility's net cumulative energy savings target and 32.7% of net peak demand savings target by the end of 2013 (See Toronto Hydro's Regulatory Scorecard and the response to Interrogatory 2B-EP-14 part (d)).

Toronto Hydro also notes that it developed its corporate pillars prior to the OEB's articulation of the RRFE performance outcomes in 2012.

RESPONSES TO BUILDING OWNERS AND MANAGERS ASSOCIATION, GREATER TORONTO INTERROGATORIES

INTERROGATORY 6:

Reference(s): Exhibit 1A, Tab 2, Schedule 1, page 11

"Toronto Hydro assesses that since amalgamation in 1998, its productivity efforts have resulted in significant savings for ratepayers."

Please describe in detail each element of its productivity efforts since 1998 and the savings that result from each effort. To what extent have the savings persisted?

RESPONSE:

For a comprehensive description of Toronto Hydro's productivity initiatives and the associated benefits addressed by the reference, please see Exhibit 1B, Tab 2, Schedule 5, Appendix A, *Toronto Hydro-Electric-System Limited: Historic Performance and Productivity Initiatives from Amalgamation to Present*.

RESPONSES TO BUILDING OWNERS AND MANAGERS ASSOCIATION, GREATER TORONTO INTERROGATORIES

INTERROGATORY 7:

Reference(s): Exhibit 1A, Tab 2, Schedule 1, page 13

Please provide copies of any climate change adaptation studies that Toronto Hydro has done.

RESPONSE:

Please refer to Appendix A to this response for a copy of the Toronto Hydro-Electric System Public Infrastructure Engineering Vulnerability Assessment Pilot Case Study, which was issued in June 2012.

Planning, Environment and Resources

Clean Air Partnership, in partnership with Toronto Hydro-Electric System Engineers Canada

Toronto Hydro-Electric System Public Infrastructure Engineering Vulnerability Assessment Pilot Case Study

Electrical Distribution Infrastructure

Interim Report, Revision 3

60263582

June 2012

Acknowledgements

AECOM would like to acknowledge the funding contributions of Natural Resources Canada and Engineers Canada which made this project possible. The Toronto region's WeatherWise Partnership is also acknowledged for its work on bringing the issue of climate related threats on electrical infrastructure to the forefront, and for its efforts in bringing about this study. AECOM would like to thank the Clean Air Partnership and Engineers Canada for the opportunity to undertake this study.

AECOM would also like to acknowledge Toronto Hydro-Electric System staff for their time and effort in gathering the necessary inputs and providing insight into the characteristics and functionality of their equipment. Without their valuable contributions, this study could not have proceeded.

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1 Introduction

1.1 Project Background

The Public Infrastructure Engineering Vulnerability Committee (*PIEVC) Engineering Protocol* (the Protocol) is a structured, documented methodology for infrastructure vulnerability assessment and adaptation to a changing climate. It is based on standard risk assessment designed to assist owners and operators of public infrastructure evaluate the risks posed by a changing climate to their infrastructure. The Protocol, currently in version 10, also allows users to evaluate the risks posed by current climate to the infrastructure as part of the overall risk assessment.

Electrical distribution infrastructure is a key asset in the delivery of electricity within Canada's cities. Electrical service is key in virtually countless ways, and vital to a city's socio-economic activities and environment, as well as the health, safety and well-being of its population. However, climate events, such as storms, wind, lightning and flooding, pose threats to the electrical systems and can cause disruptions to service. Furthermore, these threats are changing as a consequence of a changing climate. The need to understand the evolving nature of these threats, and to maintain robust and resilient electrical distribution systems, is clear.

Key stakeholders in the City of Toronto such as the WeatherWise Partnership have recognized the importance of the electrical sector and its vulnerability to a changing climate, and targeted it in 2011 as a priority area for further investigation. As part of this endeavour, Engineers Canada engaged the Clean Air Partnership to work with Toronto Hydro-Electrical System Limited (THESL) in order to **demonstrate the applicability of the Protocol on Toronto Hydro owned electrical distribution infrastructure** in the City of Toronto. THESL is Canada's largest municipal electrical distribution utility. It owns and operates the city's electrical distribution infrastructure system which supplies power to over 700,000 residential, commercial and industrial customers.

This application of the Protocol thus serves as an opportunity for THESL and other main stakeholders in the City of Toronto to better understand the threats posed by climate change on the electrical distribution system. This can lead to the identification of priority areas for further action and investment, thereby allowing THESL to better prioritize its response to climate related threats and continue to provide a safe, reliable supply of electricity to Canada's largest city.

1.2 Project Scope and Objective

The Protocol is composed of five key steps:

- Step 1 – Project Definition;
- Step 2 – Data Gathering and Sufficiency;
- Step 3 – Risk Assessment;
- Step 4 – Engineering Analysis;
- Step 5 – Recommendations and Conclusions.

To accommodate the budget and short time available to conduct this study, the scope of this Protocol case study was purposefully limited to the completion of Steps 1 to 3 of the Protocol, and only evaluates risks posed by current climate. Similarly, activities such as data gathering and analysis were prioritized to focus only on the elements that were necessary to complete the risk assessment workshop, a key step in demonstrating the applicability of the Protocol on electrical systems. The activities undertaken comprise a project referred to in the following report as the **pilot case study**, and represents a subset of the efforts that would normally be required as part of a full Protocol case study. Similarly, this report has been identified as an **interim report** because it represents a subset of the documentation that would normally be required in a full Protocol case study. Additional work required to complete a full Protocol case study is presented at the end of this interim report.

Thus, the objective of this pilot case study is to evaluate the vulnerability of selected THESL distribution infrastructure to current climate, using the Protocol, Steps 1 to 3, to structure the evaluation. The infrastructure components selected by THESL for this project are seven feeder systems from three sub-stations:

- Area A Station: Three 27.6 kV feeders: **A-1**, **A-2** and **A-3**;
- Area B Station: Two 13.8 kV feeders: **B-1**; **B-2**;
- Area C Station: Two 13.8 kV feeders: **C-1**; **C-2**.

The following elements, which are normally part of a full Protocol case study, were not completed as part of the pilot case study:

- Site visit;
- Collection and examination of condition assessments, maintenance records and practices, emergency planning procedures and practices;
- Application of the Protocol using changing climate data projections;
- Steps 4 and 5 of the Protocol;
- Completion of all Protocol worksheets: 1, 2, 4 and 5.

Nonetheless, the pilot case study's objective was still achieved in spite of these limitations, namely the lack of a site visit by AECOM or examination of infrastructure information as described above, due to the contributions, participation and expertise of Toronto Hydro staff throughout the pilot case study.

1.3 Project Team

For this pilot case study, the Clean Air Partnership acted as the contract administrator and client side project manager. CAP retained the services of AECOM Consulting to conduct the risk assessment on the identified THESL electrical distribution infrastructure. Risk Sciences International was retained to provide climate expertise and data on current climate. XTN Sustainable Life-cycle Asset Management Consulting was also retained as facilitator for the workshop that was held as part of this pilot case study.

The members of the project team involved in the completion of this pilot case study are presented in the following table.

Table 1.1 Project Team Members

Organization	Team Member	Role in Team
Clean Air Partnership	Eva Ligeti Kevin Behan Shazia Mirza	Client Side Project Manager Funding Partner
Engineers Canada	David Lapp	Funding Partner and National Vulnerability Assessment Coordinator
Toronto Hydro-Electric System Limited	Sheikh Nahyaan Joyce McLean Mary Byrne John Hecimovic	Infrastructure Owner
Toronto Environment Office	David MacLeod	Project Coordinator
City of Burlington	Sam Sidawi	Project Coordinator

AECOM Consulting	Chee F. Chan Chris Harabaras James Jorgensen	Consultant - Risk Analysis
Risk Sciences International	Heather Auld	Consultant - Climate Analysis
XTN Sustainable Life-cycle Asset Management Consulting	Brian Kyle	Consultant - Workshop Facilitator

2 Infrastructure

The following chapter provides an overview of the infrastructure that is being assessed in this pilot case study. The characteristics, function and geographical context of each infrastructure component are described.

Information about infrastructure components was obtained from the following documents:

- Toronto Hydro Environmental Impact Risk Assessment Study, Mar. 21, 2012;
- Toronto Hydro Distribution System Planning Guidelines, Nov. 28, 2007;
- Distribution Construction Standards – various components (1999 and older);
- Distribution Construction Standards – various components (2000 and newer);
- Overview of Toronto Area Transmission Grid and Distribution Systems, May 2010;
- Overview of Toronto Hydro Distribution Systems, May 2010;
- B-1 (2009), B-2 (2010), C-1(2011), C-2 (2008) Feeder prints;
- 13.8 kV Network System Summer Switching Restrictions Report, April 2010.

2.1 Feeder Systems

Toronto is supplied electricity from its transmission service provider, Hydro One Networks Inc., at two voltages: 230 kV in the areas around downtown Toronto and 115 kV in downtown Toronto. The 230 kV is a newer, high capacity system that supplies customers as well as connects portions of the larger network, including generating stations, together.

Power is delivered by two main 230 kV transmission paths to two transformer stations, Leaside and Manby, which step the voltage down from 230 kV to 115 kV for use in the downtown system. The southernmost point of the 115 kV system is connected to the Portlands Energy Centre, a 550 MW generating facility.

Figure 2.1 Hydro One Toronto Transmission Grid and Terminal Stations

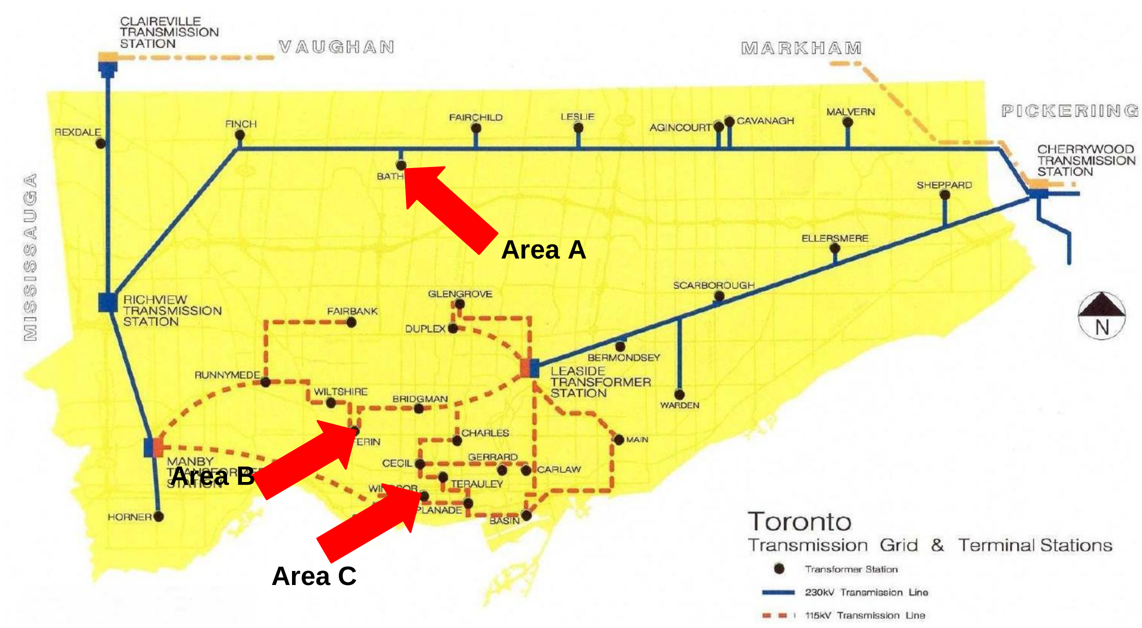


Image source: Toronto Hydro-Electric System

Seven feeders and their components from the Area A, Area B and Area C transformer stations were selected by THESL for this study (see figure 2.1). They were chosen because they are representative of the different types of equipment and electrical configurations that are used by THESL. The feeders are:

- Area A Station: Three 27.6 kV feeders: **A-1**, **A-2** and **A-3**;
- Area B Station: Two 13.8 kV feeders: **B-1**; **B-2**;
- Area C Station: Two 13.8 kV feeders: **C-1**; **C-2**.

For this study, feeders are assumed to operate normally. Loading criteria on any given feeder is generally limited to 400 Amps. Under emergency conditions, a feeder can be loaded as high as 600A although it cannot be maintained for long time durations without causing undue wear or damage to equipment. Ideally, feeders are loaded to 200 – 250 Amps. This operating guideline allows for the entire feeder's load to be transferred to a supporting feeder without causing failure of the latter if the former is taken off-line, either for maintenance or due to electrical fault problems[1].

2.1.1 Area A Station Feeders

The three 27.6 kV feeders from the Area A Station selected for this study are A-1, A-2 and A-3. These feeders serve suburban neighbourhoods in the north end of the City of Toronto.

The feeders are radial, open loop distribution systems with a mix of overhead and underground infrastructure. Feeders have open points (switches) between adjacent feeders that can supply power in the event of a fault on one feeder. Figure 2.2 presents a schematic of the three Area A feeders.

Figure 2.2 Schematic of Area A Feeders A-1, A-2 and A-3

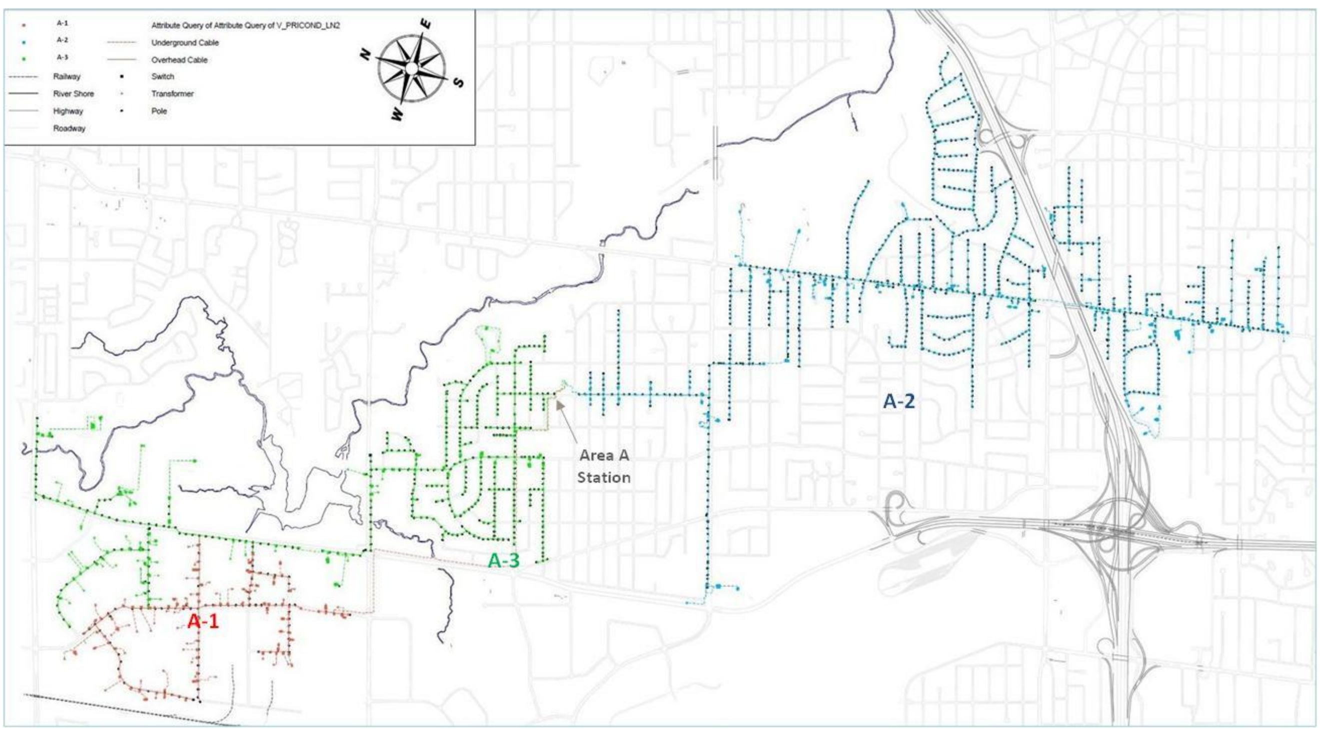


Image source: Toronto Hydro-Electric System

[1] The system is under 'first contingency' when a feeder is taken offline and its load is transferred to another feeder. As feeders are assumed to operate normally for the purposes of this study, first contingency condition is not part of the scope of this assessment.

Feeder A-2 primarily serves a residential neighbourhood to the south of Area A Station. This feeder supplies 3315 customers, including one key account (highest kW: 1256). This feeder is largely an overhead distribution system with a large proportion of equipment (~80%) mounted on poles.

Feeder A-3 serves residential neighbourhoods and an industrial sector to the northwest of Area A Station. This feeder supplies 490 customers, including one key account (highest kW: 2161). Like feeder A-2, feeder A-3 is largely an overhead distribution system with a greater proportion of equipment (~70%) mounted on poles than at grade or underground.

Feeder A-1 serves an industrial sector to the northwest of Area A Station. The main line of the feeder travels northwest of the Area A Station underground before transitioning approximately 3 km later to the overhead feeder system. This feeder supplies 1780 customers, including 3 key accounts who are industrial customers (highest kW: 1452). This feeder is made up of a greater proportion of below-grade equipment (~60%) than at grade or overhead.

2.1.2 Area B Station Feeders

The two 13.8 kV feeders from the Area B Station selected for this pilot case study are B-1 and B-2. These feeders are located in an inner city neighbourhood approximately 5 km to the northwest of downtown Toronto (see figure 2.3).

Figure 2.3 Schematic of Area B Feeders B-1 and B-2

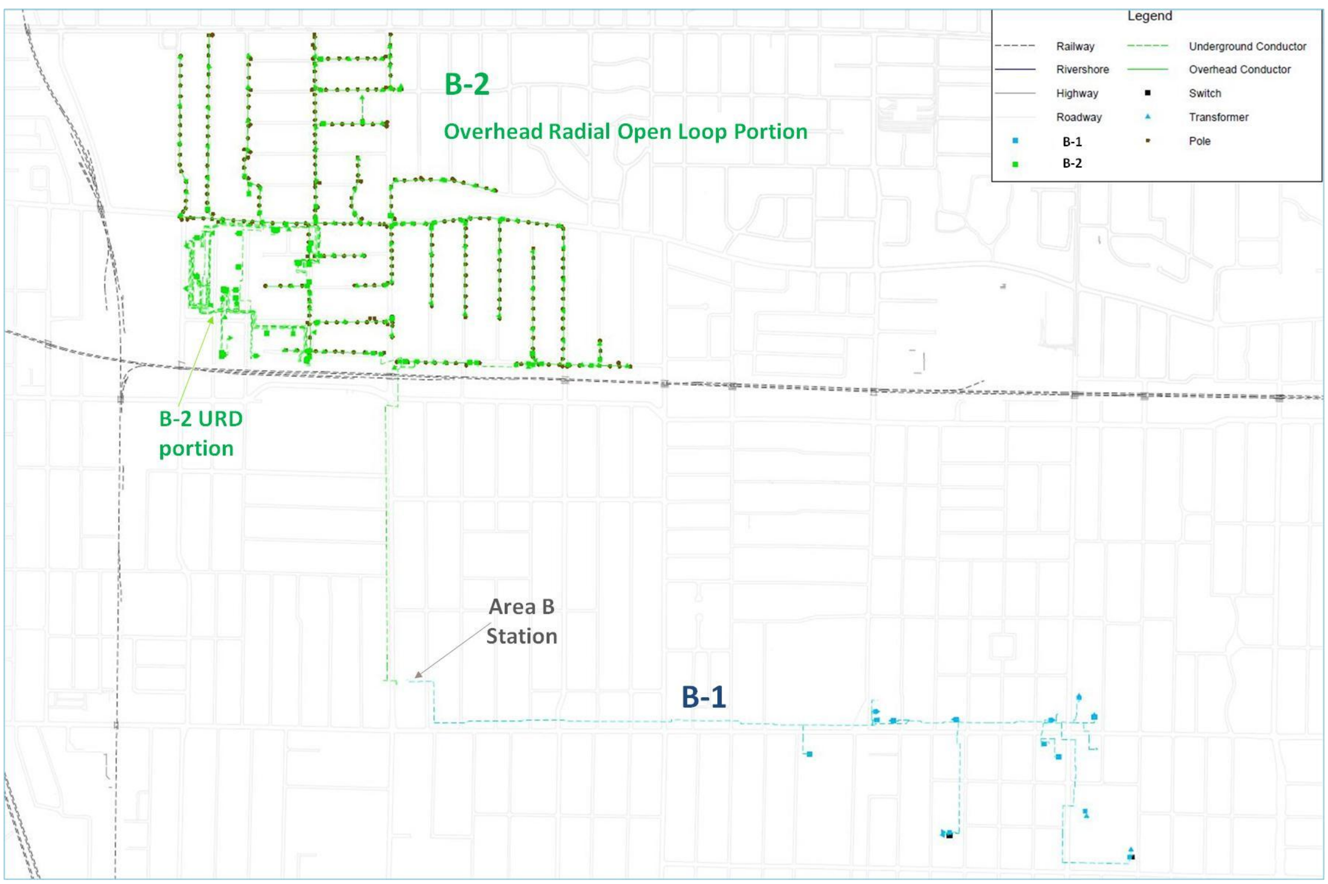


Image source: Toronto Hydro-Electric System

Feeder B-1 is a dual radial underground system that supplies five customers. It includes no key accounts. As a dual radial system, all customers on this feeder have 100% redundancy in their power supply, as this feeder is backed up by feeder B-3 (not included in this pilot case study). Portions of the feeder also exhibit network reliability, as small spot networks exist around certain customers.

Feeder B-2 is composed of two types of systems, an overhead (OH) open loop distribution system that is similar in character to the Area A feeders, as well as an underground residential distribution system (URD). It supplies 2141 customers, which are generally inner city residential and commercial properties. There are no key accounts on this feeder.

2.1.3 Area C Station Feeders

The two 13.8 kV feeders from the Area C Station selected for this study are C-1 and C-2. These feeders run entirely underground and are located in downtown Toronto. They serve predominantly high-rise buildings (see figure 2.4).

Feeder C-1 is an underground dual radial system. All transformers and switches on this feeder are customer owned and are not within the scope of this pilot case study. THESL is responsible for the cable chambers and underground cables that supply power to customer locations. This feeder supplies 12 customers, including one key account (highest kW: 5745).

Figure 2.4 Schematic of Area C Feeders C-1 and C-2

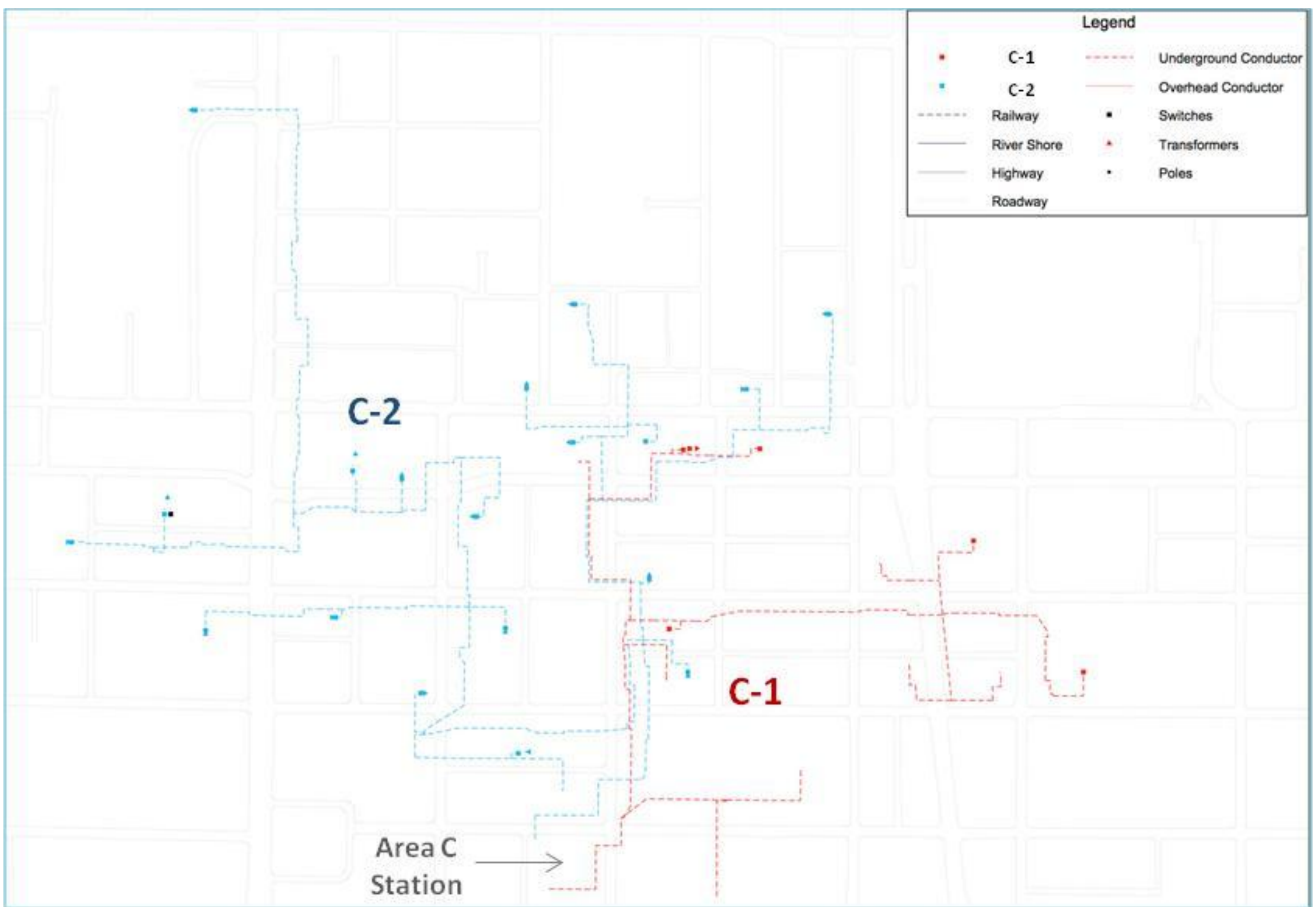


Image source: Toronto Hydro-Electric System

Feeder C-2 is an underground network secondary distribution system. A network secondary system affords a high degree of redundancy and reliability to customers. All equipment on this feeder is owned by THESL. The feeder supplies 5 customers, including 1 key account holder (highest kW: 1664).

Table 2.1 presents several characteristics of each of the seven feeders, as well as loading, outage data and THESL performance indices. In terms of outage performance over the last decade and last year, the Area A Station feeder A-2 performs more poorly than A-3, which in turn performs more poorly than feeder A-1. This is highly correlated to the fact that the three feeders, A-2, A-3 and A-1 respectively, have successively more infrastructure below grade than at-grade or overhead. This same tendency can be observed between the two Area B feeders, as B-1 is entirely underground while B-2 has some overhead distribution. The three underground feeders, two from Area C and one from Area B perform similarly to one another in terms of outage performance.

Table 2.1 Feeder Loading and Performance Characteristics

Feeder	A-2	A-3	A-1	B-1	B-2	C-1	C-2
Number of customers on Feeder	3315	490	1780	5	2141	12	5
# of Key Accounts	1	1	3	0	0	1	1
Average Feeder Loading 2011	12.3 MVA 258 Amps	9.1 MVA 190 Amps	8.6 MVA 180 Amps	4.6 MVA 194 Amps	4.4 MVA 183 Amps	1.92 MVA 81 Amps	3.4 MVA 144 Amps
Number of outages 2001 – Feb 2012	147	71	37	6	51	5	2
FESI[1] - # Outages in last 12 months (up to Feb 2012)	12	8	2	3	4	0	1
Worst Performing Feeder Ranking[2]	15	24	183	566	56	N/A	653
2011 SAIFI - Average number of customer power interruptions[3]	0.031643	0.0083	0.004338	0.000029	0.015217	0	0.0000056
2011 SAIDI - Average duration of customer power interruptions[4]	0.704792	1.048305	0.060144	0.002436	0.64296	0	0.000382

1 FESI – Feeders Experiencing Sustained Interruptions.
2 Based on customers impacted and duration of outages over last 24 months. Rank 1 is worst out of approximately 700 feeders that have a ranking.
3 SAIFI – System Average Interruption Frequency Index.
4 SAIDI – System Average Interruption Duration Index.

2.2 Components

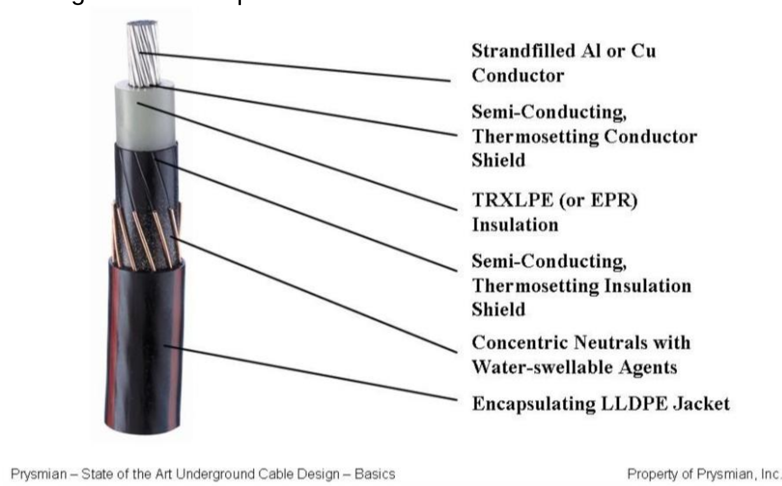
A brief description of infrastructure components is provided in the following section. A detailed breakdown of these components can be found in appendix A.

2.2.1 Primary Conductors

Primary conductors (wires) are used to transmit electricity through the system. Overhead wires suspended between poles employ bare aluminum stranded conductors, or aluminum stranded conductors with a steel reinforced centre cable. Underground conductors in this study are aluminum stranded conductors sheathed with a crosslinked polyethylene (XLPE) insulator. In Area C feeders, older paper-insulated lead-covered copper cables (PILC) are also used (see figure 2.5). Primary conductors in this study all carry high voltage, and underground conductors are fed through polyvinyl chloride (PVC) ducts that are encased in concrete.

Figure 2.5 Underground Cables

Underground XLPE power cables



Underground PILC power cables

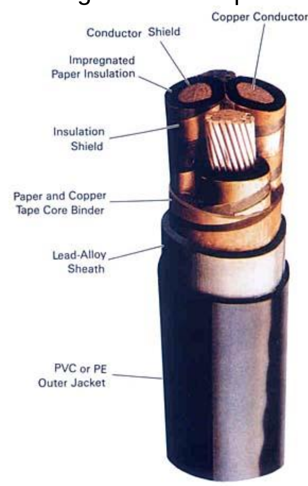
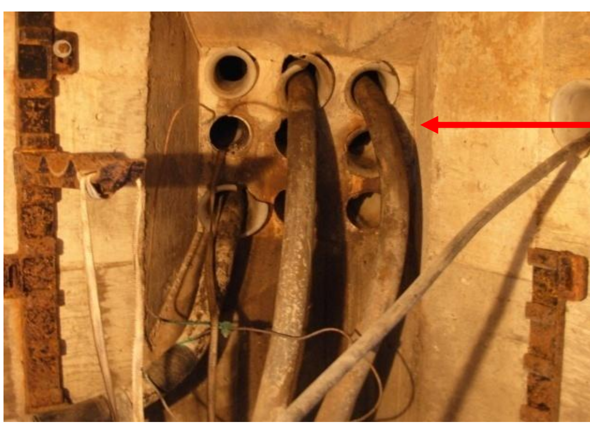


Image source: www.otds.co.uk



Underground cables encased in a concrete duct bank entering a vault

Image source: Toronto Hydro-Electric System

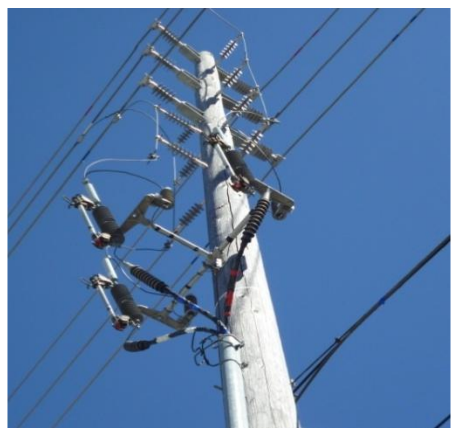
2.2.2 Switches

Switches provide control over the routing and distribution of electricity across feeder systems. They allow THESL staff to isolate sections of the electrical distribution system for maintenance or repairs of electrical faults. There are a variety of electrical switch types in place in the feeders under study (figure 2.6). However, the various switch types were not considered as part of this study, as they were not indicative of their sensitivity to climate events. Rather, switches were categorized only according to their location on the feeder, and their construction orientation. For the purposes of this study, the following switch categorizations are used:

- Overhead (pole mounted) main feeder switches – switches located along the primary powerline, or backbone, of the overhead Area A and Area B feeders.
- Overhead (pole mounted) lateral line switches – switches located on branches connected to the main line of overhead Area A and Area B feeders. Lateral lines generally feed a group of customers;
- Overhead (pole mounted) customer switches – switches on powerlines that only feed a single customer;
- Pad mounted switches – switches located at grade in a metal enclosure on a concrete footing;
- Underground switches – switches located below grade in vaults.

Figure 2.6 Switches

Scada Mate Pole mounted switch


Pole mounted switches


SF_6 Pad mounted switch


Mini-rupter switches located below-grade

Image source: Toronto Hydro-Electric System

2.2.3 Transformers

Transformers are used in electrical systems to convert voltages and facilitate the distribution of energy. In a distribution system, transformers step voltages down from the distribution voltage (27.6 or 13.8 kV) to the lower voltages that used by customers (120 – 600V). Transformers, like switches, can be located above grade on poles, at grade in metal enclosures on concrete pads, or in buildings, as well as below grade in vaults (see figure 2.7). Transformers are filled with either mineral or vegetable oil for cooling. Below grade transformers are submersible, as they are sealed in water tight metal enclosures.

Figure 2.7 Transformers

3 phase pole mounted transformers

Pad mounted transformer

Submersible transformer
Image source: Toronto Hydro-Electric System

3 Phase submersible transformer

2.2.4 Network Units

Network units are made up of a transformer, network protector and switch (see figure 2.8). These units are used only in downtown feeders in secondary network distribution systems. The role of the network protector is essentially to act as a low voltage circuit breaker that can automatically cut the electrical connection if power from feeder fails or is taken offline for service. In this study, network units, like below-grade transformers, are located in vaults and are submersible.

Figure 2.8 Network Unit

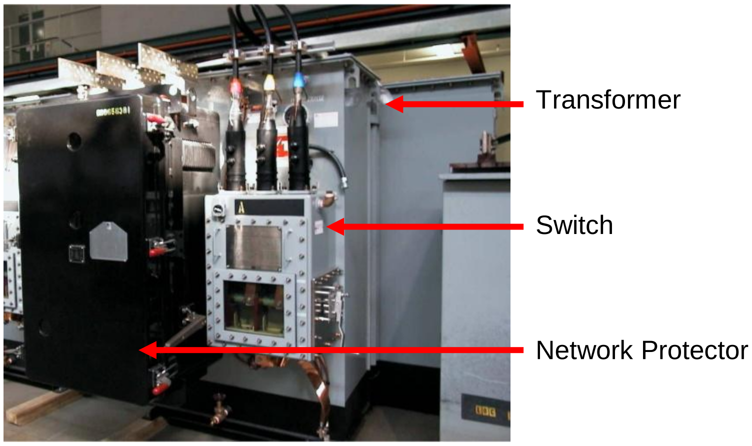


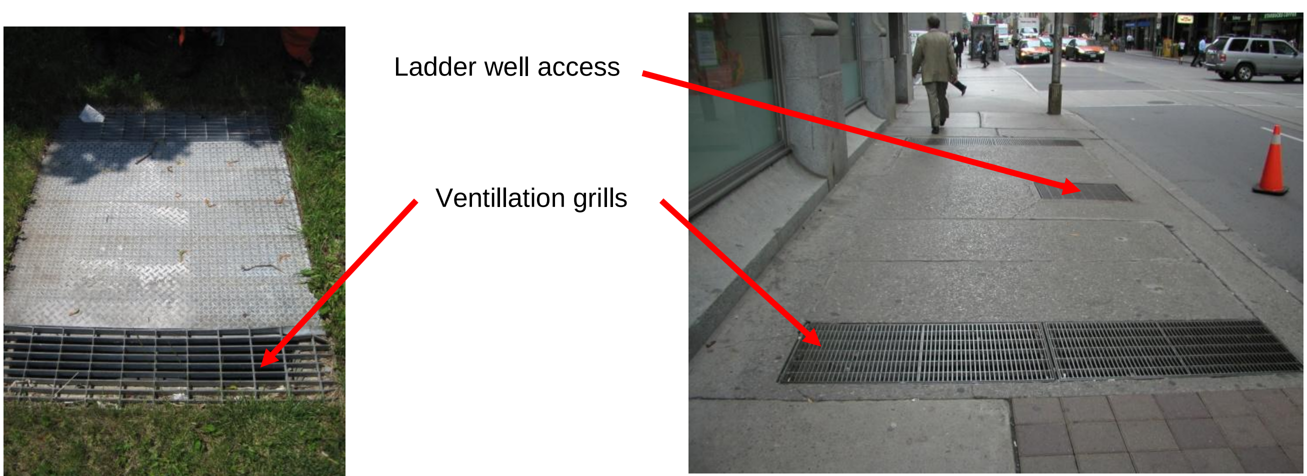
Image source: Toronto Hydro-Electric System

2.2.5 Vaults

Equipment below grade are located in vaults, underground concrete box structures that are accessible through a ladder well (see figure 2.9). Small vault chambers, for example with only one transformer, are generally covered by metal lids. Larger vaults, such as those found in inner city or downtown locations, are covered by concrete slabs. 95% of THESL vaults are naturally ventilated, with grills in the vault ceiling open to the street level. Where grills cannot be located directly in the ceiling due to at-grade infrastructure, air ducts are used to allow air circulation.

Vaults have sumps and drains connected to the storm water or combined storm water and sewer network. Backflow valves are present on drains to prevent drainage backflow from entering the vaults. Sump pumps are also present in some vaults. THESL staff have indicated that drains do become clogged with debris when not regularly maintained.

Figure 2.9 Vaults



Vault under a sidewalk in downtown

View up to ladder well access
Image source: Toronto Hydro-Electric System

Drain and sump

2.2.6 Poles

Poles are used to suspend primary conductors above ground and may also carry transformers and switches (see figure 2.10). Poles are either made from cedar wood tree trunks, concrete or steel, though the majority of poles in this study are made of wood (>99%). In this study, poles are only found in the three Area A feeders and part of the Area B B-2 feeder, and range in height from 30 to 60 ft. Generally, poles of lower height carry less equipment (transformers, switches) than poles of greater height. Conductor cable tension between poles provides some lateral support to poles, while poles at the end of a linear segment or at a street corner may be guyed with steel cables for additional support.

Figure 2.10 Poles

Wood poles
Image source: Toronto Hydro-Electric System

Concrete poles

2.3 Time Horizon

This pilot case study deals with current climate only. The infrastructure design life by component is presented in the table below.

Table 2.2 Useful Design Life

Component	Useful Design Life*	Comments
Overhead **conductor**	63	
Poles	45	All types
Underground TRXLPE **conductor**	50	
Underground PILC **conductor**	75	Downtown Area C Station only
Overhead **switch**	40 – 45	
Pad mount **switch** (PMH)	30	
Underground **switch**	40	
Overhead, pad mount, underground **transformer**	33 – 35	
Underground **network** unit	20	Switch, transformer, network protector
Vault	35	
Network **vault**	60	Downtown Area C Station only. Network vault ceilings are replaced once every 30 years.
Cable Chamber	65	

*values based on THESL Kinetrics useful life modelling system for asset planning and management

Generally, the design life of electrical equipment is in the range of 30 – 40 years. An analysis of the installation date of components in this case study reveal that most were installed in the 1980s and 90s (see table 2.3 below). A detailed breakdown of equipment by date of installation is also presented in appendix A. Based on the design life for equipment and their date of installation, the majority of equipment will be approaching the limits of their design lives by the 2020s.

Table 2.3 Date of Installation for Assets within Feeders Under Study

	Approximate % of assets by period of installation		
Station / Feeder	60s	80s / 90s	After 2000
Area A			
A-2		**O**	o
A-3	O	O	o
A-1	O	o	o
Area B			
B-1	o	O	o
B-2	o	**O**	o
Area C			
C-1		**O**	
C-2	o	**O**	

O ≥ 80% of equipment O ~ 50% of all equipment o < 20% of all equipment

2.4 Jurisdictional Considerations

Some of the jurisdictions, laws, regulations, guidelines and administrative processes, external to Toronto Hydro, that are applicable to the THESL distribution infrastructure are as follows:

Jurisdictions that have direct control/influence on the infrastructure:

- The City of Toronto
- Ontario Energy Board
- Electrical Safety Authority

Laws and bylaws that are relevant to the infrastructure:

Federal

- Transportation of Dangerous Goods Act;

Provincial

- Electricity Act, 1998;
- Ontario Energy Board Act, 1998;
- Green Energy and Green Economy Act;
- Environmental Protection Act;
- Technical Standards and Safety Act;
- Fire Protection and Prevention Act;
- Dangerous Goods Transportation Act;
- Ontario Occupational Health and Safety Act;

Local

- City of Toronto Municipal by-laws;

Regulations that are relevant to the infrastructure:

- OEB Transmission System Code;
- OEB Distribution System Code;

- OEB Standard Supply Service Code;
- Ontario Regulation 22/04 Electrical Distribution Safety
- Ontario Electrical Safety Code;
- Electric Utility Safety Rules;

Industry Standards relevant to the design, operation and maintenance of the infrastructure:
- CSA C22.3 No. 1 and 7National Building Code;
- Ontario Building Code;
- Canadian Electrical Code, Part 1;
- O.Reg. 213/91 Construction Projects;
- Harmonized Electric Utility Safety Association Rulebook;

2.5 Other Potential Changes that May Affect Infrastructure

Planned load transfers, generally for maintenance purposes, will increase loads temporarily on the feeder systems. Increased summertime temperatures will increase load demand for air conditioning. Urban development and the addition of new customers are the largest contributors to increased loads over time. Planned service upgrades may provide new load capacity.

2.6 Data Sufficiency

Given the available study time and budget, data gathering activities during this project were targeted at obtaining information essential to conducting the workshop. The following points illustrate some areas where more data can be gathered towards the completion of a full PIEVC case study assessment:

- No site visit was conducted as part of the assessment;
- Complete information gaps in inventory of elements, such as the quantity, location and/or characteristics of certain components. They are:
  - All Area A feeders (switches, vaults and cable chambers);
  - Area B feeder B-2 (switches, vaults and cable chambers);
  - Area C feeder C-1 (switches).
- Toronto Hydro derived aggregate infrastructure component condition ratings (health indices) were available for only a small proportion of the infrastructure components under study. A fuller examination of information on condition assessments can be undertaken;
- Maintenance records and information on maintenance practices were not collected. This information would be useful to determine whether maintenance has increased or decreased the capacity or useful life of the infrastructure;
- Information on emergency plans, procedures and practices were not collected or analysed;

3 Climate Analysis

The climate analysis used in this pilot case study was carried out by Risk Sciences International. A summary of that analysis is presented in the following chapter while the full text is presented in appendix B.

This pilot case study is concerned with the impacts of current climate on electrical distribution infrastructure. A variety of climate information sources were used to complete the climate analysis. These include:

- The National Building Code of Canada, Appendix C, Climate Information (2010) and CSA/CEA overhead systems standard;
- Environment Canada's Climate Normals; National Climate Archive online access, including CDCD and IDF values, etc.;
- Environment Canada (and partners) Hazards Portal and web site (www.hazards.ca – no longer available);
- Environment Canada (and partners) Climate Change Scenarios website (www.ontario.cccsn.ca) – only a national version now available;
- Environment Canada's Rainfall Intensity - Duration – Frequency (IDF) curves and publications on regional IDF values for southern Ontario;
- Peer-reviewed journal articles on downscaling methodologies for an ensemble of climate change models (>10 international journal articles on projections of ice storm, wind gust, temperature, heat-air quality-mortality risks for the Toronto region);
- Expert climate judgement.

3.1 Climate Parameters and Thresholds

24 climate events were identified in collaboration with THESL for inclusion in this study based on a list of climate events known to affect southwestern Ontario. Thresholds beyond which climate-infrastructure interactions could cause negative impacts were identified for all 24 climate events. Thresholds for temperature (high and low extremes) and wind were specifically known for electrical distribution infrastructure. Some of these were drawn from thresholds for related electrical infrastructure systems such as building code design winds, Canadian Standard Association C22.3 No. 1 "Overhead Systems" and Canadian Electrical Code, Part 1 overhead systems design temperatures. For all other climate events, thresholds were drawn from a previous PIEVC case study, the Toronto and Region Conservation Authority Flood Control Dam Water Resources Infrastructure Assessment (TRCA study). The list of climate events and thresholds used in this pilot case study are presented in the table below.

Table 3.1 Climate Events and Thresholds for Pilot Case Study

	Climate event	Threshold	Threshold Data Source
	Temperature		
1	High Temperature	Average annual # days with T≥ 30°C	CSA
2	Low Temperature	Average annual # days < -20°C	CSA
3	Heat Wave	3 or more days with Tmax ≥ 30°C	Professional judgment
4	Extreme Humidity	# Days with Humidex ≥ 40°C	Professional judgment
5	Severe Heat Wave	3 or more days with Humidex ≥ 40°C	Professional judgment
6	Cold Wave	3 or more days with Tmin ≤20°	Professional judgment

	Climate event	Threshold	Threshold Data Source
7	Temperature Variability	Daily T ranges ≥ 25°C	TRCA study
8	Freeze-thaw cycle	Annual Probability of at least 70 freeze-thaw cycles (Tmax>0 and Tmin<0):	TRCA study
9	Fog	~15 hours/year (average) with visibility <= 0 km	TRCA study
10	Frost	Could not be determined	n/a
	Wind		
11	High wind/downburst	Gusts > 70 km/h (~21days / year at Airport)	Professional judgment
12	High wind/downburst	Gusts > 90 km/h (~2 days / year at Airport)	CSA C22.3 No. 1
13	Tornadoes	Tornado vortex extending from surface to cloud base (near infrastructure)	TRCA study
	Precipitation		
14	Heavy Rain	Daily Rainfall > 50 mm/day	TRCA study
15	Heavy 5 day total rainfall	5 days of cumulative rain > 70 mm of rain	TRCA study
16	Ice Storm	Average annual probability of at least 25 mm of freezing rain per event	TRCA study
17	Freezing Rain	Average annual probability of freezing rain events lasting 6h or more *(i.e. typically more than 10 mm of freezing rain)*	TRCA study
18	Blowing snow/Blizzard	Average # of days / year with blowing snow (7.8 / y)	TRCA study
19	Heavy Snowfall	Snowfall > 10cm *(2-3days/y)*	TRCA study
20	Snow accumulation	Snow on ground with depths ≥ 30 cm and persisting for 5 or more days *(0.17 events/y)*	TRCA study
21	Hail	Average # of hail days (~1.1/y)	TRCA study
	Other		
22	Severe thunderstorms	Average # of Thunderstorm Days (~2.8/y)	TRCA study
23	Lightning	Average # Days/Year with cloud - ground lightning strikes *(~25)*	TRCA study
24	Drought/Dry periods	At least one month at Ontario low water response level II *(i.e. with mandatory water conservation)*	Professional judgment

3.2 Standardized Probability Scoring

The Protocol version 10 methodology for assessing the probability of a climate event exceeding (or triggering) a given threshold is measured on a *standardized probability scoring* scale of 0 – 7. A score of 0 indicates that a climate-infrastructure threshold will likely not be triggered, while a score of 7 indicates that the threshold will certainly be triggered within the service life of the infrastructure.

To convert the probability of a climate event triggering a threshold into the 0 – 7 scale, two methods are suggested by the Protocol, method A and method B. For this pilot case study, method B, the quantitative approach was selected. The quantitative approach is based upon determining the *annualized probability* of a climate event triggering the threshold. This is based on an examination of historical data from the last 10 to 50 years. Once the annualized probability is determined, it can be converted into the 0-7 scale according to method

B as shown in table 3.2. A detailed explanation of this procedure for each of the 24 climate events is presented in appendix B. Standardized probability scores are shown in appendix B and on the risk matrices of appendix D.

Table 3.2 Protocol Probability Scoring Scale

Score	Probability PIEVC Method A	Probability PIEVC Method B
0	Negligible Not Applicable	< 0.1 %, < 1 in 1,000
1	Highly Unlikely Improbable	1% 1 in 100
2	Remotely Possible	5% 1 in 20
3	Possible Occasional	10% 1 in 10
4	Somewhat Likely Normal	20% 1 in 5
5	Likely Frequent	40% 1 in 2.5
6	Probable Often	70% 1 in 1.4
7	Highly Probable Approaching Certainty	> 99% >1 in 1.01

3.3 Data Sufficiency

The climate data used in this study came from a variety of current and historically based data sources. It can be used to determine standardized probability scores with a high degree of confidence given that the analysis was focused on current climate.

Due to study time constraints, specific electrical distribution infrastructure thresholds for some climate events could not be determined. To make up for this shortcoming, many of the thresholds used in this study were adapted from a previous PIEVC TRCA Study. The latter study was chosen because its infrastructure is located adjacent to the Area A feeders under study. It was found that many of the climate events used in the TRCA study were applicable to electrical distribution systems. However, some of the thresholds that were used in the TRCA study, and hence this pilot case study, likely require further fine-tuning to have greater relevance to the power distribution sector. Therefore, it is recommended that future study should involve an analysis of operations and maintenance information, as well as a detailed/forensic review of available outage data to identify thresholds which were more specific to THESL electrical distribution infrastructure.

The impact of potential cumulative or synergistic effects was not adequately evaluated in this pilot case study. Climate events like high wind, freezing rain and/or lightning often occur in tandem. However, it was difficult to generalize about the frequency or magnitude of individual climate parameters within cumulative events. As an example, thunderstorms, an event involving high wind and lighting strikes, was identified. It was difficult to generalize about the magnitude and frequency of high wind and lighting strikes for thunderstorm events due to significant variations that exist between one thunderstorm to the next. This in turn made it difficult to quantify thresholds for thunderstorm events that would trigger an infrastructure response. Further work to assess the impacts of potential cumulative or synergistic effects is recommended within the context of a full PIEVC case study.

4 Risk Assessment

In Step 3 of the Protocol, a risk assessment based around a risk assessment workshop is conducted. The various tasks and results of the risk assessment are documented in the following chapter.

4.1 Preparation for the Risk Assessment Workshop

4.1.1 Risk Assessment Methodology

The Protocol methodology for identifying risks involves multiplying the standardized probability score of a climate event-infrastructure interaction with a severity score for that interaction. The determination of the standardized probability score was described in the previous chapter and in appendix B. The severity score is measured on a scale of 0 – 7; the Protocol version 10 provides two methods for determining the severity score, method D and E. For this pilot case study, method E was selected. As this pilot case study represents the first time the Protocol has been applied to electrical distribution infrastructure, examples of impacts across the 7 point scoring scale were determined in collaboration with THESL. The severity scoring scale and electrical distribution system specific examples of impacts are shown in the table below.

Table 4.1 Protocol Severity Scoring Scale with Electrical Distribution Examples

Score	Severity of Consequences / Description PIEVC Method E	Electrical Distribution System Specific Examples
0	Negligible or Not Applicable	Negligible
1	Very Low - Some Measurable Change	Arrestor failure
2	Low - Slight Loss of Serviceability	Overheating transformer
3	Moderate Loss of Serviceability	One distribution transformer out
4	Major Loss of Serviceability - Some Loss of Capacity	Broken spring in underground switchgear
5	Loss of Capacity - Some Loss of Function	Flooded vault that cannot be pumped
6	Major - Loss of Function	Leaning pole / Downed lines
7	Extreme – Loss of Asset	Downed pole, line and transformers

Next, the reference set of risk tolerance thresholds was reviewed with THESL. The thresholds for risk used in this project follow those set out by the Protocol, as shown in the table below.

Table 4.2 Reference Risk Tolerance Thresholds

Risk Score	Threshold	Response
< 12	Low Risk	No action necessary
12 – 36	Medium Risk	Action may be required; Engineering analysis may be required*
> 36	High Risk	Action required

**Step 4 Engineering analysis is out of scope in this study*

4.1.2 Relevant Infrastructure Performance Responses

For each of the infrastructure components, the most likely responses to climate events as well as impacts arising from climate event-infrastructure interactions were identified. Infrastructure performance responses served as the basis on which to judge the severity of a climate event-infrastructure interaction. The following infrastructure responses were used in this pilot case study:

- Structural design - *Structural integrity, cracking, deformation, foundation anchoring ,etc.*
- Functionality - *Effective load capacity, efficiency, etc.*
- Serviceability - *Ability to conduct maintenance or refurbishment, etc.*
- Operations, maintenance and materials performance - *Occupational safety, worksite access, operations and maintenance practices (frequency and type), etc.*
- Emergency Response - *Planning, access, response time*
- Insurance Considerations (TH perspective) - *claimable for repair, cause 3rd party payment, affect insurance rates*
- Policy and Procedure Considerations - *Planning, public sector, operations, maintenance policies and procedures, etc.*
- Health and Safety - *Injury, death, health and safety of THESL employees, the public, etc.*
- Social Effects - *Use and enjoyment, access, commerce, damage to community assets (buildings), public perception, etc.*
- Environmental Effects - *Release or harm to natural systems (air, water, ground, flora, fauna)*

The infrastructure performance responses were validated during the workshop. The results are presented in the completed risk matrices presented in appendix D.

This study acknowledges that there are consequences to public health and safety, as well as social effects, from electrical equipment damage and failure. However, the extent or severity associated with those consequences was not examined in this case study because they were out of the study's scope and budget. Information was not collected on the presence of key public facilities (hospitals, community centres, schools, water pumps, drainage, etc), their backup power capabilities, or the redundancies provided by other THESL feeders not considered in this study. This study also did not explore the risks to vulnerable populations from weather such as heat waves[2], or the importance and role that the electrical distribution system plays in mitigating these risks. Thus, study participants were asked to exclude consideration of the wider societal impacts of equipment damage or failure when assessing severity. The performance response measures listed above were examined from THESL' perspective in terms of consequences on their assets, planning, operations and maintenance practices.

4.1.3 Yes/No Weather – Infrastructure Interaction Screening

A yes/no screening analysis was done in order to determine whether a given climate event would interact with a given infrastructure component. Where no interaction occurred, no severity or risk score was calculated. The yes/no screening analysis was done as part of workshop activities. The results of the yes/no screening analysis are presented in the completed risk matrix presented in appendix D.

4.2 Risk Assessment Workshop

A full day risk assessment workshop was held on May 11th, 2012 in THESL offices in Toronto. A total of 25 participants from a variety of organizations and disciplines were involved in the workshop. The organizations and experience present at the workshop are listed in the following table.

[2] Populations vulnerable to heat include the elderly, infants and young children, people with pre-existing medical conditions or living alone.

Table 4.3 Organizations and Experience Present at the Workshop

Organization	Expertise
Toronto Hydro-Electric Systems	Standards and Policy Planning System Reliability Planning Strategic Affairs Stations Network Planning Construction Control Centre Dispatch
Hydro One	Electrical Transmission
Engineers Canada	Protocol Specialist
AECOM	Electrical Engineering, Risk Assessment
Risk Sciences International	Climate Sciences
Xtn Sustainable Lifecycle Asset Management	Facilitation and asset management
Clean Air Partnership	Project Management
City of Burlington	Infrastructure asset management
Natural Resources Canada	Natural Resources Planning
Canadian Standards Association	Built Environment and Structures
Toronto Environment Office	Environmental Specialist
Toronto Water	Water Utilities and Resources
Utilities Kingston	Utilities Engineering

Participants were split into four groups. Two groups were assigned one of the two Area A station feeders, A-1 and A-2. One group was assigned to complete the assessment for both Area B station feeders, and the last group was assigned to complete the assessment of the two Area C station feeders. Area A station feeder A-3 was not evaluated during the workshop as there were not enough participants or time to assess the feeder. However, due to the similarities between feeder A-3 and the other two Area A feeders, the results for the latter two should adequately represent results for A-3.

During the morning, participants were provided with an overview of the Protocol, current climate, THESL infrastructure under study and instructions for the workshop exercise. Workshop breakout sessions began late morning on validating infrastructure performance responses, completing the yes/no screening analysis, and the assignment of severity scores to weather-infrastructure interactions. The breakout sessions continued into the afternoon until all tables had completed their assigned feeders. Participants recorded their work on 11x17 risk assessment matrices that were provided. The results of this analysis are presented in the risk matrices in appendix D.

4.3 Assessment Results

4.3.1 General

As described in the Protocol, thresholds represent limits beyond which a climate event can have an adverse impact on the infrastructure. Thresholds were established for all 24 of the climate events of interest. However, only the thresholds for temperature (high and low extremes) as well as wind were known specifically for this THESL electrical distribution infrastructure case study. For the majority of climate events, threshold data was adapted from a previous PIEVC case study, the TRCA Water Resource Dam infrastructure system. For this reason, the results of this risk analysis should be considered preliminary. For the majority of climate events, there is some uncertainty as to whether climate events that exceed the thresholds used in this analysis actually cause damage to electrical infrastructure. It is recommended that future study include a detailed forensic analysis of outage event data as well as examination of maintenance and operations records in order to refine thresholds for electrical distribution infrastructure.

This analysis attempted to determine whether differences in risk existed between feeders with the same type of infrastructure (e.g. between overhead feeder systems). In terms of severity, this component level risk analysis revealed no significant differences in severity scores between similar types of feeders; the impact of a climate event on an overhead conductor, transformer or switch is no different between an Area A feeder as compared to a Area B feeder[3].

Since many of the infrastructure components were repeated across the different feeders, a range of severity scores were often attributed by different tables to the same infrastructure components. For example, overhead conductors received severity scores ranging from 2 to 4 for high heat (>30°C). These differences cannot be attributed to the differences between overhead feeders or components; for example, no significant differences in the characteristics of overhead conductors, poles or distribution systems could be determined between Area A feeders A-1 and A-2 that would suggest that this variation in severity was feeder specific. As participants brought different types of experiences and expertise to the workshop, discussions about problems and severities likely differed between groups. This is the most likely reason for variations in severity scoring for a given component across different feeders. Nonetheless, while some severity scores were adjusted by AECOM following a review of workshop materials and comments, different severity scores for a given component were not entirely reconciled between different feeders. This was done in order to maintain the diversity of opinions that were expressed in the workshop.

While it may be uncertain whether the numerical differences between two closely scoring risk values represent an actual difference in risk, the Protocol contains a procedure to handle such variations. It does so through the application of a coarser – low, medium and high – risk categorization scheme (see Table 4.2) to group weather-infrastructure interaction risks. By doing so, the small variations in risk scores are de-emphasized and focus is placed on the overall pattern of risk, thereby making it easier for practitioners and decision-makers to identify the most important risks and set priorities. Therefore, the low, medium, high risk categories are reported instead of numerical risks scores in the following sections.

In THESL staff experience, overhead infrastructure is more vulnerable to climate events than underground infrastructure due to the increased likelihood of climate event-infrastructure interactions. The pattern of risks revealed in this case study supports this experience, with the majority of above ground equipment being affected by wind, freezing rain, lightning and other storm events. Below grade infrastructure was found to be vulnerable to some types of climate events as well, with risks arising primarily from heat, rain and snowfall. In general, the pattern of risk indicates that all high risks and higher-medium risks tended to affect feeders with overhead infrastructure, while lower-medium risks and low risks were mostly associated with underground feeder infrastructure. The following section presents specific climate event-infrastructure interactions by risk category, while Table 4.4 at the end of the chapter provides a summary overview of these risks.

4.3.2 Low Risk

Assessment of climate event-infrastructure interactions resulting in risk scores below 12 are considered low risk. Generally, no further action is required. A summary of low risk interactions are presented below.

[3] Differences in risk scores could have arisen from differences in the probability score for a climate event for a downtown location as compared to a suburban location. However, location specific climate data was not always available for all climate events under consideration, and thus the same climate event probability scores were used across all feeder systems.

High Temperature, Heat Waves, Extreme Humidity, and Severe Heat Wave

- Increases in CO_2 and temperature are known to cause the accelerated deterioration of concrete through carbonization. Compounded with increased freeze-thaw cycles and de-icing salt application, concrete structures such as vaults, cable chambers and equipment pads, may deteriorate more quickly. However, knowledge of concrete carbonization is still in its infancy. Furthermore it was suggested that increased rates of deterioration are only perceptible when examining infrastructure lifespan over decades. This, high heat events are only a concern when considering the overall design life of structures, and is considered a low risk;

Low temperature and cold wave

- Low temperatures cause overhead conductor materials to contract, increasing cable tension in overhead conductors. Underground XLPE cables may become brittle and experience reduced life if installed in cold temperatures;
- Vegetable oils used in some newer transformers may not circulate adequately in cold temperatures, causing transformers to overheat;

Freeze-thaw cycles

- Freeze thaw events can cause cracking and deterioration of underground vaults and cable chambers over time;

Temperature variability

- Temperature variability may cause underground cables to fail. However, temperature variability generally presents a low risk;

Fog

- Fog events are linked with issues of visibility and access to overhead equipment. Equipment may be more difficult to locate in heavy fog;

Frost

- Most groups did not judge frost to be an issue as equipment design standards include consideration for frost. However, one group did cite that moisture in the air can freeze within above ground equipment, leading to failure of insulation and electrical faults. Frost generally presents a negligible or low risk;

Blowing snow, heavy snowfall and snow accumulation

- Snowfall events are linked with issues of visibility and access. Equipment may be difficult to find under blizzard conditions, and snow banks and snow accumulation that is pushed aside by snow clearing equipment may bury pad mounted switches and transformers. Time to access equipment is lengthened;
- Snowfall events often lead to the application of road and sidewalk de-icing salts. De-icing salts present a long term corrosion risk to at grade and underground electrical equipment and structures (see special case below, section 4.3.6);
- Snow may block ventilation grills of underground vault;

Heavy Rain and Heavy 5 day total rainfall

- Rainfall generally causes no issues for above ground equipment, but may cause faults in underground cables, where sheathing has been damaged, or at cable splice points (joints);
- Vaults and cable chambers may be flooded if rainfall cannot be drained quickly enough, if drains, sumps or backwater valves are clogged with debris, or if sump pumps are not functioning well. This is an issue in terms of access to below grade equipment, but the impacts on the vault or cable chamber itself are minimal;

Hail

- Hail interacts with overhead equipment, but was considered to be of negligible or low risk;

Lightning strikes on equipment

- Lightning strikes impact all above ground equipment. Direct lighting strikes on pad mounted switches and transformers presented a low risk, as grounding protection can safely dissipate the energy;

Drought periods

- Drought periods may result in loss of soil moisture content. Soil moisture is required for conductivity, which is in turn required for all equipment to be adequately grounded. Loss of soil moisture may cause subsidence, which in turn may weaken support for equipment and foundations. However, workshop participants generally considered drought to pose a negligible or low risk, and did not report any issues with soil subsidence.

4.3.3 Medium Risk

Medium risks arising from infrastructure-weather interactions are those whose risk score falls between 12 and 36. The following list summarizes interactions at medium risk. Further analysis and action may be required.

High Temperature, Heat Waves, Extreme Humidity, and Severe Heat Wave

- Increases load demand for air conditioning. The additional loads increase heat generated by transformers which can lead to shut downs and outages;
- Underground vaults and cable chambers can be uncomfortable for work crews, and collective bargaining agreements restrict worker access when temperatures are too high;
- Overhead cables can be derated, reducing some capacity;

High wind/downburst at 70 km/h and 90 km/h

- Wind can cause trees or tree limbs to fall onto overhead equipment, potentially damaging or bringing down pole-mounted equipment (switches, transformers). Higher wind speeds have the potential to cause greater damage due to increased forces on trees and equipment;

Heavy Rain and Heavy 5 day total rainfall

- Rainfall is a risk to below-grade switches as they are not submersible;
- Vault rooms may be flooded if rainfall cannot be drained quickly enough, if drains, sumps or backwater valves are clogged with debris, or if sump pumps are not functioning well. Access to below grade equipment becomes an issue as equipment cannot be accessed or maintained until water is drained;
- There is an ongoing risk of failure of other city infrastructure due to heavy rainfall, such as culverts washing out, that may lead to damage or failure of electrical distribution equipment. This concern was mentioned in the workshop but was not quantified as part of this study;

Freezing Rain and Ice Storms

- Freezing rain and ice storms leads to ice build up on trees and electrical equipment. Ice buildup does not affect the functionality of electrical equipment until the point where the weight of ice causes conductors or poles to break. Ice buildup on tree limbs can also cause them to break and fall onto overhead equipment in turn potentially damaging or bringing down overhead conductors, pole mounted equipment, or poles themselves;

- Freezing rain and ice storms can freeze vault and cable chamber access covers. Additional tools and time are then required to gain access to underground equipment;
- The risk scores due to freezing rain and ice storms did not vary by pole height or material;

Lightning strikes on equipment

- Lightning strikes impact all overhead equipment, and lightning arrestors usually divert energy safely to ground. However, severe, direct lighting strikes can exceed the capacity of protection equipment, and cause switches and poles to fail. Equipment must be replaced;

4.3.4 High Risk

High risks arising from infrastructure-weather interactions are those whose risk score is above 36. The following high risk interactions were identified:

High wind/downburst at 70 km/h and 90 km/h

- Poles are categorized under high risk for high wind and downbursts as compared with overhead switches and transformers (medium risk) as they bear the brunt of wind forces on the overhead system. Wind on conductors and overhead equipment increase forces on poles. High wind speeds can thus cause poles to snap, bringing down conductors and overhead equipment with them. While poles are designed to withstand winds up to 90 km/h winds, THESL staff experience suggests that poles have leaned or failed when wind was between 70 – 90 km/h.
- Poles greater than 50 ft are of greater risk as they generally carry more overhead equipment. The loss of poles of higher than 50 ft is of greater severity than poles of lower height.
- Wind can cause trees or tree limbs to fall onto overhead conductors and bringing them down. Higher wind speeds have the potential to cause greater damage due to increased forces on trees and tree limbs;

Lightning strikes on equipment

- Lightning strikes impact all overhead equipment, and lightning arrestors usually divert energy safely to ground. However, severe, direct lighting strikes on transformers can exceed the capacity of protection equipment and cause transformers to fail. Transformers must be replaced;

4.3.5 Special Cases – High Severity, Low Probability Events

Tornadoes represent a high severity, low probability event. While the resultant risk category for tornadoes is low, tornadoes were judged to have catastrophic consequences on all above ground infrastructure. Underground infrastructure is not affected by tornadoes. However, underground infrastructure may become inaccessible during a tornado event. A review of emergency procedures and practices should be done in order to ascertain whether further action is required for this special case.

4.3.6 Special Cases - Low Severity, High Probability Events

High probability, low severity events climate event-infrastructure interactions generally have implications for operations and maintenance. Their occurrence on a regular basis presents a weathering hazard that may lead to decreases in the performance, durability and resilience of electrical infrastructure over time. However, as discussed in section 4.3.1 above, the majority of weather thresholds used in this study actually come from another PIEVC Protocol case study on water resource infrastructure. There is uncertainty as to whether any negative impacts on electrical distribution infrastructure are actually triggered by climate events at these thresholds.

Thus, given the patterns of risk that emerge from the above analysis, and the aforementioned caveat on thresholds, this report identifies *blowing snow and heavy snowfall* as two high probability, low severity events that may warrant further study in terms of long term weathering due to de-icing salt application. A review of operations and maintenance procedures, and equipment condition assessments with respect to snowfall events should be done in order to ascertain whether further action is required for this special case.

Table 4.4 Summary Current Weather Related Risks to Electrical Distribution Infrastructure

Events	Area A (all)	Area B B-2	Area B B-1	Area C (all)	Components
Low risk					
High Temp, Heat Wave, Extreme Humidity, Severe Heat Wave	•	•	•	•	All concrete structures – vaults, cable chambers, equipment pads, poles
Low temperature, cold wave	•	•	•	•	Overhead and underground conductors Transformers filled with vegetable oils
Freeze-thaw cycle	•	•	•	•	Vaults and cable chambers
Temperature variability	•	•	•	•	Underground conductors
Fog	•	•			Overhead and at grade equipment
Frost	•	•			Above ground conductors and equipment
Blowing snow, heavy snowfall, snow accumulation	•	•	•	•	Overhead and at-grade equipment Vaults and cable chambers
Heavy Rainfall, Heavy 5 Day Total Rainfall	•	•	•	•	Underground conductors Vaults and cable chambers
Lightning strikes on equipment	•	•			Pad mounted switches and transformers
Drought	•	•	•	•	Grounding of all equipment
Medium Risk					
High Temp, Heat Wave, Extreme Humidity, Severe Heat Wave	•	•	•	•	Transformers Vaults and cable chambers
High Temp, Heat Wave, Extreme Humidity, Severe Heat Wave	•	•			Overhead conductors
High wind/downburst	•	•			Pole mounted switches and transformers
Heavy Rain, Heavy 5 Day Total Rainfall	•	•	•	•	Below-grade switches
Freezing Rain, Ice Storms	•	•			Overhead conductors Pole mounted switches and transformers
Freezing Rain, Ice Storms	•	•	•	•	Vault and cable chambers
Lightning strikes on equipment	•	•			Overhead switches and poles Overhead conductors
High Risk					
High wind/downburst	•	•			Poles Overhead conductors
Lightning strikes on equipment	•	•			Overhead transformers
Special Cases					
Tornadoes	•	•			Above ground equipment and poles Overhead conductors
Blowing snow, heavy snowfall	•	•	•	•	At grade and underground infrastructure

- *dot indicates where an event affects feeder components*

5 Preliminary Conclusions

5.1 Findings and Limitations

This infrastructure vulnerability assessment pilot case study was successful in demonstrating the applicability and utility of the PIEVC Protocol on electrical distribution infrastructure. The results obtained from this assessment reflect and confirm the experiences of workshop participants and provide a useful first screening of the patterns of risk that affect overhead and underground electrical distribution infrastructure. However, the scope of this pilot case study is a subset of the work required to complete a full Protocol case study, and there remain areas that warrant further exploration. The results of this pilot case study, as well as areas of further work are summarized in this chapter.

This pilot case study examined the risks of 24 separate climate events on seven feeder systems. In general, the patterns of risk show that overhead infrastructure is more vulnerable to climate events than underground infrastructure, though the latter are not immune to weather impacts. Climate events resulting in the highest risks are high winds and lightning strikes on equipment, and affect above ground distribution equipment. These risks are especially important in feeders such as Area A, A-1, A-2 and A-3, where the majority of infrastructure is located above ground. Under the medium risk category, freezing rain, heavy rainfall, and high heat (including heat waves, and high humidity events) were the principal climate events affecting both above ground and underground equipment. Tornadoes represented a low probability-high severity risk to all above ground infrastructure. Snowfall events constitute high probability-low severity risks to at grade and underground infrastructure, and constitute a long term weathering issue due to the application of de-icing salts.

Area A feeder A-3 was not examined in the workshop due to time and personnel constraints. However, the risk pattern of feeder A-3 can be assumed to be similar to the other two Area A feeders given the proximity and similarities of the infrastructure components which make up all three feeders.

It was difficult for workshop participants to quantify the impacts of *severe thunderstorms* on electrical equipment as impacts are largely due to the intensity of wind and lightning events. These latter two events were evaluated independently during the workshop. Thunderstorms represent a compound event, for which the thresholds for wind and lightning were not sufficiently defined as to allow workshop participants to adequately evaluate severity.

The climate data used in this exercise can be used with a high degree of confidence as the analysis was focused on current climate. In turn, the derived standardized probability scores, which represent the probability of exceeding a threshold, can be judged accurate with a high degree of confidence. What is less understood is whether, and to what extent, thresholds actual trigger negative impacts and damage to electrical infrastructure. This is due to the fact that the majority of electrical distribution infrastructure specific thresholds were adapted from a previous PIEVC case study; despite the availability of outage data, the short timeline for this study did not allow for more electrical distribution infrastructure specific thresholds to be determined. Thus, to strengthen this exercise, it is necessary to develop a better understanding of the thresholds which trigger damage in electrical infrastructure. This does not however negate the quality of the assessment. The quality, method and results of the severity evaluation remain valid, and the refinement of thresholds should only change probability scores.

Risks at the feeder system level were not explicitly explored in this analysis. This analysis considered the electrical distribution system at the level of the components within each feeder. However, the feeder systems examined in this case study all had one or more adjacent supporting feeders. These supporting feeders provide varying levels of power supply redundancy to customers depending on the electrical configuration of the interconnected systems. The ability and constraints of adjacent supporting feeders to provide power in the event of a fault on one feeder, and thus mitigate the severity of weather related impacts, warrants further analysis. Under such circumstances, the wear and strain on support feeders can also be explored. This would provide a better understanding of climate-related risks at a feeder system level.

For example, area wide climate events with the ability to knock out entire sections of feeders, such as high winds, freezing rain and tornadoes, constitute risks which warrant further exploration at a feeder system level. Another example where a feeder level analysis would be useful is for high heat related events. This pilot case study revealed that high ambient temperatures and/or humidity do not physically affect electrical equipment. However, increased air-conditioning use during these events results in higher load demands on feeders. During the summer time months, the shutdown of inner city and downtown feeders for maintenance purposes are restricted due to heat related load demands that would be transferred to adjacent supporting feeders. Any additional weather related stresses, such as heavy rainfall causing flooding in underground vaults, would thus impact an operationally restricted situation, potentially worsening system level vulnerabilities. Heat related impacts on feeders, and the ability and response of adjacent support feeders to provide power, are areas that warrant further analysis.

This study did not explicitly explore the public health and safety risks arising from damage or failure of THESL equipment and impacts to key public facilities or vulnerable populations. For example, electricity is vital to the operations of key facilities such as hospitals, emergency dispatch facilities and telecommunications. Air-conditioning, and thus electricity, plays an important role in mitigating the impacts of heat on vulnerable populations such as the elderly, young children, infants and individuals with pre-existing medical conditions. While the potential impacts of outages to these facilities and groups were acknowledged during the workshop, participants were asked not to consider these wider public health and safety impacts when evaluating risks because the information necessary to do so was not obtained within the confines of this study; an investigation of the relationship between critical facilities, vulnerable populations, electrical equipment and resultant risks is a complex task. However, it remains an important area of work and requires further consideration in terms of how it may be handled through a Protocol-type or similar study.

The infrastructure components under evaluation were limited to physical pieces of infrastructure, while other crucial infrastructure support components were not considered. These include personnel, telecommunications, supplies and records. For example, threats such as West Nile and Lyme disease from insect vectors are expected to intensify due to warming temperatures and milder winters. These threats to worker health and safety were not investigated. Weather impacts on communications equipment, as well as the ability to obtain replacement parts and supplies may affect THESL's response times to outages. Finally, no analysis of maintenance records, operations, procedures or emergency response plans was completed as part of this study. An analysis of these elements was not essential to conducting the workshop, nor would it likely change the overall patterns of risk revealed through this pilot case study. However, assessing weather impacts on these support components could help to refine the understanding of climate event-infrastructure responses and severities, and thus provide a more nuanced portrait of the patterns of risk.

Finally, climate change is expected to alter the intensity and frequency all climate events, with the exception of cold temperatures, for the worse. In light of the vulnerabilities revealed in this pilot case study, it can be hypothesized that climate change will only increase the vulnerabilities of electrical distribution equipment. The current study provides an excellent baseline on which to evaluate how risks change with a changing climate.

5.2 Additional Work

This pilot case study and interim report present a subset of the efforts and documentation normally required to complete a full Protocol case study. The following elements could be part of further work on completing a full Protocol case study:

- Complete inventory of infrastructure components, particularly on switches, vaults and cable chambers. Consider including infrastructure support components, such as personnel, telecommunications, supplies and records;
- Collect and analyse information on condition assessments;
- Collect and examine maintenance records and information on maintenance practices;
- Collect and analyse information on emergency planning procedures and practices;

- Determine electrical distribution infrastructure specific climate thresholds through analysis of maintenance practices and detailed/forensic review of outage data. This is especially pertinent for cumulative events, such as thunderstorms;
- Identify and define potential cumulative or synergistic events more clearly;
- Conduct portions of Steps 1 to 3 as relevant to a climate change risk assessment;
- Devise feeder system level analysis to account for feeder system redundancies, reactions, and consequences in terms of severity and risk ratings. Consider revising infrastructure feeders and components under study to facilitate feeder system level analysis;
- Complete Steps 4, Engineering Analysis on identified medium risk infrastructure components;
- Complete Step 5, Recommendations for addressing vulnerability of infrastructure components falling into medium and high risk categories;
- Complete all Protocol worksheets.

Appendix A
Detailed Breakdown of Infrastructure Components

Breakdown of Infrastructure Components for Risk Assessment Matrix, Health and Date of Installation

Infrastructure Component	Subcomponent		Quantity	Health Index (HI)	Date of Installation
Area A Station	**27.6 kV feeders**				
Feeder A-2					
Primary Conductors	Overhead		30394.3 m	n/a	113.6 m in 1983 18515.2 m in 1998 11765.5 m after 2000
	Underground		6458.3 m	n/a	195 m in 1983 5659.6 m in 1998 603.7 m after 2000
Switches (202 units)	Overhead		Approx. 136 units	4 with HI above 90% 132 n/a	3 built in 1983, 80 built in '98, and 52 built after 2005
	At grade or underground		Approx. 66	n/a	7 in 1983, 42 in 1998, and 17 after 2010
Transformers (314 units)	Pole		260 units	n/a	129 built in 1998, 131 built after 2000
	Pad		21 units	18 in 80%+ 3 n/a	19 in '98, 2 after 2000
	Submersible		33 units	9 in 80%+ 7 in 60-80% 2 below 60%, 15 n/a	32 in 1998, 1 in 2007
Civil Structures	Vault		n/a	n/a	n/a
	Cable Chambers		n/a	n/a	n/a
Poles (1117 units)	Steel	Wood	Concrete	110 in 80%+ 190 in 60 – 80% 27 less than 60% 790 n/a	4 in 83, 632 in 1998, 481 after 2005
30 < 40 ft	1	154	3		
40 < 50 ft		888	4		
50 to 55 ft		35			
Unknown height		32			
Feeder A-3					
Primary Conductors	Overhead		15272.7m	n/a	4334.5 m in 1963 9516.3 m in 1983 1382.4 m in 1998 39.5 after 2000
	Underground		6395.8m	n/a	2583 m in 1963 2248.9 m in 1983 473.3 m in 1998 299.8 m after 2000
Switches (114 units)	Overhead		Approx 90	n/a	43 in 1963 34 in 1983 13 after 1998
	At grade or underground		Approx 24	n/a	5 in 63, 9 in 83, 10 after 2004
Transformers (150 units)	Pole		103 units	n/a	4 in 63, 84 in 83, 15 after '98
	Pad		19 units	10 in 80%+	7 in 63

Infrastructure Component	Subcomponent		Quantity	Health Index (HI)	Date of Installation
				9 n/a	8 in 83 4 after 98
	Submersible		28 units	11 in 80%+ 14 in 60 – 80% 3 n/a	17 in 63 9 in 83 2 after 2008
Civil Structures	Vault		n/a	n/a	n/a
	Cable Chambers		n/a	n/a	n/a
Poles (427 units)	Steel	Wood	Concrete	106 in 80%+ 113 in 60-80% 112 below 60% 96 n/a	98 in 63 273 in 83 56 after 98
30 < 40 ft	2	223			
40 < 50 ft		144	1		
50 to 60 ft		51			
Unknown height		6			
Feeder A-1					
Primary Conductors	Overhead		4803.4 m	n/a	3897.4 m in 1963 906 m after 2000
	Underground		7676.3 m	n/a	6226.8 m in 1963 776.6 m in 1983 388.9 m in 1998 284 m after 2000
Switches (119 units)	Overhead		Approx 84	83 n/a 1 with 75% HI	69 built in 1963, 15 built after 2000
	At grade		Approx 35	n/a	25 in 63, 10 in 2010
Transformers (78 units)	Pole		15 units	n/a	14 in '63, 1 in '79
	Pad		29 units	25 with 80%+ 3 n/a	27 in 63, 2 after 2005
	Submersible		34 units	15 with 80%+ 16 in 60-80% 1 at 58%, 2 n/a	All built in 63
Civil Structures	Vault		n/a	n/a	n/a
	Cable Chambers		n/a	n/a	n/a
Poles (113 units)	Steel	Wood	Concrete	12 in 80%+ 20 in 60-80% 31 below 60% 50 n/a	90 in 63, 23 after 2007
30 < 40 ft		40	14		
40 < 50 ft		20			
50 to 60 ft		39			
Area B Station	**13.8 kV feeders**				
Feeder B-1					
Primary Conductors	Underground		4214.4 m		655.9 m in 1963 2278.8 m in 1990's 1279.4 m in 2000's
Switches (15 units)	Underground		15 units	n/a	3 in 63, 8 in 93, 4 in 2003
Transformers (13 units)	Submersible only		13 units	7 in 80%+ 2 in 60 – 80% 4 n/a	3 in 63 6 in '93 4 in '2003
Civil Structures	Vault		n/a	n/a	n/a
	Cable Chambers		n/a	n/a	n/a
Feeder B-2					
Primary Conductors	Overhead		8666.8 m		65.9 m in 1951

Infrastructure Component	Subcomponent		Quantity	Health Index (HI)	Date of Installation
					303.8 m in 1963 2715.3 m in 1988 4782 m in 1990's 799.8 m in 2000's
	Underground		11203.6 m		734.3 in 1980's 10395.9 m in 1990's 73.4 m after 2000
Switches (90 units)	Overhead		Breakdown n/a, likely proportional to tx	n/a	1 in 63, 19 in 88, 66 in 93 – 95, 4 after 2000
	At grade				
	Underground				
Transformers (103 units)	Pole		79 units	n/a	9 in 63 25 in 88 45 in 93
	Pad		8 units	7 in 80%+ 1 in 60-80%	1 in 63 7 in 93
	Submersible		16 units	1 in 80%+ 15 n/a	14 in '88 to '93 2 after 2010
Poles (362 units)	Steel	Wood	Concrete	58 in 60-80% 304 n/a	16 in 63, 314 before 2000, 48 after 2000
Unknown height	n/a	n/a	n/a		
Civil Structures	Vault		n/a	n/a	n/a
	Cable Chambers		n/a	n/a	n/a
Area C Station	**13.8 kV feeder**				
Feeder C-1					
Primary Conductors	Underground		2809.6 m	n/a	2416.8 m in 1986 392.8 m after 2000
Switches (3 units)	At grade		Likely all underground	n/a	1 in 90 2 in 2003
	Underground				
Transformers			All transformers are client owned		
Civil Structures	Cable Chamber		43 units	n/a	42 in 1986, 1 in 2008
	Vault		6 units	n/a	5 in 86-90, 1 in 2003
Feeder C-2					
Primary Conductors	Underground		5358.7 m		912.6 m in 1963 2017.2 m in 1986 813 m in 1990's 1615.9 m after 2000
Switches (19 units)	Underground		19 units	n/a	All in 1985
Network Units (17 units)	Submersible		17 units	12 in 80%+ 2 in 60 – 80% 3 n/a	3 in '63, 13 others before 2000, 1 in 2010
Civil Structures (96 units)	Cable Chamber		69 units	n/a	14 in 63, 45 in 86, 8 after 1993
	Vault		18 units	10 in 80%+ 4 in 60 – 80% 4 n/a	4 in 63, 14 in 86-93

Breakdown of Infrastructure Components – Electrical Types

Infrastructure Component	Type	Quantity
Area A Station 27.6 kV feeders		
Feeder A-2		
Primary Conductors	Overhead 1-Phase Conductor	20005.5 m
	Overhead 3 Phase Conductor	10388.8 m
	Underground 1-Phase Conductor	994.3 m
	Underground 3-Phase Conductor	5464 m
Switches	Fused	125 units
	Live Line Opener 1 End	1 unit
	Load Break	9 units
	Load Break Gang Operated	53 units
	Non-Load Break	14 units
Transformers	Pad: 1-3 Phase Delta Delta	1 unit
	Pad: 1-3 Phase Wye Wye	20 units
	Pole: 1-1 Phase	241 units
	Pole: 2-1 Phase Parallel	2 units
	Pole: 3-1 Phase Delta	1 unit
	Pole: 3-1 Phase Wye	16 units
	Submersible: 1-1 Phase	8 units
	Submersible: 1-3 Phase Delta Wye	3 units
	Submersible: 3-1 Phase Wye	22 units
Poles	See table above	1117 units
Feeder A-3		
Primary Conductors	Overhead 1-Phase Conductor	7985.1 m
	Overhead 3 Phase Conductor	7287.6 m
	Underground 1-Phase Conductor	790.8 m
	Underground 3-Phase Conductor	5605 m
Switches	Fused	61 units
	Live Line Opener 1 End	3 units
	Load Break	9 units
	Load Break Gang Operated	36 units
	Non-Load Break	5 units
Transformers	Pad: 1-3 Phase Delta Wye	3 units
	Pad: 1-3 Phase Wye Delta	1 unit
	Pad: 1-3 Phase Wye Wye	15 units
	Pole: 1-1 Phase	95 units
	Pole: 3-1 Phase Wye	8 units
	Submersible: 1-1 Phase	4 units
	Submersible: 1-3 Phase Delta Wye	3 units
	Submersible: 3-1 Phase Wye	21 units
Poles	See table above	427 units
Feeder A-1		
Primary Conductors	Overhead 1-Phase Conductor	9.7 m
	Overhead 3 Phase Conductor	4793.7 m
	Underground 3-Phase Conductor	7676.3 m
Switches	Fused	73 units
	Live Line Opener 1 End	1 unit
	Load Break	10 units

Infrastructure Component	Type	Quantity
	Load Break Gang Operated	29 units
	Non-Load Break	6 units
Transformers	Pad: 1-3 Phase Delta Wye	2 units
	Pad: 1-3 Phase Wye Wye	27 units
	Pole: 1-1 Phase	9 units
	Pole: 3-1 Phase Delta	2 units
	Pole: 3-1 Phase Wye	4 units
	Submersible: 3-1 Phase Wye	34 units
Poles	See table above	113 units
Area B Station 13.8 kV feeders		
Feeder B-1		
Primary Conductors	Underground 3-Phase Conductor	4214.4 m
Switches	Load Break Gang Operated	6 units
	Non-Load Break	9 units
Transformers	Submersible: 1-3 Phase Delta Wye	12 units
	Submersible: 3-1 Phase Delta	1 unit
Feeder B-2		
Primary Conductors	Overhead 1-Phase Conductor	4398.3 m
	Overhead 3 Phase Conductor	4268.5 m
	Underground 1-Phase Conductor	7000.3 m
	Underground 3-Phase Conductor	4203.3 m
Switches	Fused	23 units
	Load Break	17 units
	Load Break Gang Operated	30 units
	Non-Load Break	20 units
Transformers	Pad: 1-3 Phase Delta Delta	4 units
	Pad: 1-3 Phase Wye Wye	4 units
	Pole: 1-1 Phase	69 units
	Pole: 3-1 Phase Wye	10 units
	Submersible: 1-1 Phase	10 units
	Submersible: 1-3 Phase Delta Wye	1 units
	Submersible: 1-3 Phase Wye Wye	2 units
	Submersible: 3-1 Phase Delta	1 units
	Submersible: 3-1 Phase Wye	2 units
Poles	See table above	362 units
Area C Station 13.8 kV feeders		
Feeder C-1		
Primary Conductors	Underground 3-Phase Conductor	2809.6 m
Switches	Load Break Gang Operated	3 units
Civil Structures	Cable Chamber	43 units
	Vault	6 units
Feeder C-2		
Primary Conductors	Underground 3-Phase Conductor	5358.7 m
Switches	Load Break Gang Operated	4 units
	Non-Load Break	15 units
Transformers	Submersible: 1-3 Phase Delta Wye	17 units
Civil Structures	Cable Chamber	69 units
	Vault	18 units

Appendix B
Current Climate Analysis

Current Weather and Climate Hazards for Toronto Hydro's Electrical Distribution System

for Toronto Hydro-Electric System Public Infrastructure Engineering Vulnerability Assessment (PIEVC) Pilot Case Study

Risk Sciences International

Introduction

An examination of Toronto Hydro's 2011 power outages for the sections of the network under consideration highlighted a pattern in the major weather-related of threat to the system. The following events were most frequently associated with power outages and emergencies:

- strong winds generally gusting above 70 km/hr;
- lightning;
- winter storms with mixed precipitation types, freezing rain events;
- heavy rainfalls and flooding; and,
- severe heat waves.
- These weather hazards are consistent with the weather-related hazards identified in a Canadian Standards Association (CSA 2010a, 2010b) studies of transmission systems sensitivities and needs for climate and weather information. The CSA study identified the following weather-related information priorities for above ground transmission line systems: Combined Ice and Wind events (i.e. ice accretion loadings);
- Wet snow;
- Severe Wind Events;
- Temperatures - Variability and Extremes;
- Lightning strikes; and,
- (Flooding) – for electrical distribution systems.

A number of utilities in the CSA study reported that distribution and transmission systems had been increasingly hard-hit by extreme wind events, with convective or thunderstorm downbursts being the most commonly-cited concern. They also reported that combined wind and ice accretion events were the single most significant weather-climate gap needed for the updating of line design standards. Many respondents suggested that lightning has become increasingly problematic over recent years and expressed interest in better understanding trends in the frequency and distribution of lightning strikes for surge protection. Most respondents to the CSA study also identified either variability or extremes in temperature as important. Climates, like those of Toronto, that can bring cold snaps in the winter and excessive heat and humidity in the summer were identified as posing particularly difficult challenges.

Utility operators from across Canada emphasized the importance of having spatially and temporally comprehensive and consistently high quality climate/weather data sets and analyses and suggested "bolstering the baseline" information as a first step to climate change adaptation in order to:

- assist in the updating of climatic design values already included in key codes and standards;
- allow for the development of climate hazards information that still need to be expressly incorporated into key codes and standards. These hazards could become more problematic as the result of climate change.

Toronto Hydro Thresholds

The Engineers Canada PIEVC Protocol typically requires guidance on critical thresholds of significance or risk to the infrastructure system under consideration. Due to time constraints, many of the thresholds identified for this study of current risks were adapted from an earlier PIEVC case study on the Toronto and Region Conservation Authority Flood Control Dam Water Resources Infrastructure Assessment (TRCA Study). While the weather sensitivities of dams may be quite different than those for electrical distribution systems, many of the climate variables were found to also be applicable to the electrical distribution system. However, the climate thresholds and their frequencies that were used in this study may require further fine-tuning to have greater relevance to the power distribution sector. Where related infrastructure breaking point thresholds were known (e.g. building code design winds, CSA/CEA overhead systems design temperatures), their thresholds were used in for this study.

The climate thresholds of interest to Toronto Hydro are shown in Table 1 and are derived in part from the earlier Toronto dams study.

Toronto Hydro climate thresholds of interest for the PIEVC vulnerability study.

	Category	Category derived parameters	Thresholds for Toronto Hydro	Threshold Data Source
1	**Temperature**	High Temperature	Average annual # days with T≥ 30°C	CEC, Part 1
2		Low Temperature	Average annual # days < -20°C	CSA C22.3 No. 1
3		Heat Wave	3 or more days with Tmax ≥ 30°C	Professional judgment
4		Extreme Humidity	# Days with Humidex ≥ 40°C	Professional judgment
5		Severe Heat Wave	3 or more days with Humidex ≥ 40°C	Professional judgment
6		Cold Wave	3 or more days with Tmin ≤20°	Professional judgment
7		Temperature Variability	Daily T ranges ≥ 25°C	TRCA study
8		Freeze-thaw cycle	Annual Probability of at least 70 freeze-thaw cycles (Tmax>0 and Tmin<0):	TRCA study
9		Fog	~15 hours/year (average) with visibility <= 0 km	TRCA study
10		Frost	Undetermined	
11	**Wind**	High wind/downburst	Gusts > 70 km/h (~21days / year at Airport)	Professional judgment
12		High wind/downburst	Gusts > 90 km/h (~2 days / year at Airport)	CSA C22.3 No. 1
13		Tornadoes	Tornado vortex extending from surface to cloud base (near infrastructure)	TRCA study
14	**Precipitation**	Heavy Rain	Daily Rainfall > 50 mm/day	TRCA study
15		Heavy 5 day total rainfall	5 days of cumulative rain > 70 mm of rain	TRCA study
16		Ice Storm	Average annual probability of at least 25 mm of freezing rain per event	TRCA study
17		Freezing Rain	Average annual probability of freezing rain events lasting 6h or more (i.e. typically more than 10 mm of freezing rain)	TRCA study
18		Blowing snow/Blizzard	Average # of days / year with blowing snow (7.8 / y)	TRCA study
19		Heavy Snowfall	Snowfall > 10cm (2-3days/y)	TRCA study
20		Snow accumulation	Snow on ground with depths ≥ 30 cm and persisting for 5 or more days (0.17 events/y)	TRCA study
21		Hail	Average # of hail days (~1.1/y)	TRCA study
22	**Other**	Severe thunderstorms	Average # of Thunderstorm Days (~2.8/y)	TRCA study
23		Lightning	Average # Days/Year with cloud - ground lightning strikes (~25)	TRCA study
24		Drought/Dry periods	At least one month at Ontario low water response level II (i.e. with mandatory water conservation)	Professional judgment

Climate Data and Analyses

A variety of climate information sources were used in completing the climate hazards study for the Toronto Hydro-Electrical Distribution pilot case study. These include:

- The National Building Code of Canada, Appendix C, Climate Information (2010) and CSA 22.3 No. 1 – “Overhead Systems” standard;
- Environment Canada’s Climate Normals; National Climate Archive online access, including CDCD and IDF values, etc.;
- Environment Canada (and partners) Hazards Portal and web site (www.hazards.ca – no longer available);
- Environment Canada (and partners) Climate Change Scenarios website (www.ontario.cccsn.ca) – only a national version now available;
- Environment Canada’s Rainfall Intensity - Duration – Frequency (IDF) curves and publications on regional IDF values for southern Ontario;
- Peer-reviewed journal articles on downscaling methodologies for an ensemble of climate change models (>10 international journal articles on projections of ice storm, wind gust, temperature, heat-air quality-mortality risks for the Toronto region);
- Expert climate judgment.

Climate Information for the PIEVC Protocol

Climate hazards can be associated with two types of events, analogous to “shock” and “stress” events: (1) rare, extreme and rapid/sudden-onset hazards or “shock events” and (2) slow onset “creeping” or recurring threats or “stress events”. The threats or shock events are factored into codes, standards and practices through use of extreme value or return period climate probabilities. The recurring climate events, on the other hand, occur several times annually and have implications for operations and maintenance. Failure to deal with these recurring climate hazards (e.g. weathering processes) can lead to lost resilience, reduced durability and a decrease in the ability of the system to withstand the extreme events.

Standardized Probability Scores

The PIEVC Protocol makes use of standardized climate probability scores ranging from 0 to 7, with a score of 0 referring to a climate event that likely will not occur while a score of 7 refers to an event that likely will occur over the service life of the structure. For this study, the PIEVC Version 10 Beta Protocol Method B or quantitative approach was used to convert annual probabilities into standardized values.

PIEVC Version 10 Beta Probability Scores based on Methods A and B.

Score	Probability	
	Method A	Method B
0	Negligible Not Applicable	< 0.1 % < 1 in 1,000
1	Highly Unlikely Improbable	1 % 1 in 100
2	Remotely Possible	5 % 1 in 20
3	Possible Occasional	10 % 1 in 10
4	Somewhat Likely Normal	20 % 1 in 5
5	Likely Frequent	40 % 1 in 2.5
6	Probable Often	70 % 1 in 1.4
7	Highly Probable Approaching Certainty	> 99 % > 1 in 1.01

Extreme Winds

High winds and their short duration gusts predominantly affect overhead power lines. The impacts of winds on power lines can be greatly exacerbated by trees and debris being blown onto the lines. Not surprising, the impact of trees and winds on lines is affected by the season, maintenance work carried out on the trees, types of trees (deciduous, coniferous), leaf state of the deciduous trees, length of the growing season and whether the ground is saturated at the time of the high winds. Future projections of wind gusts in the Toronto area under climate change indicates that high winds above thresholds of 70, 80 and 90 km/hr may increase in future.

The CSA study (2009) sought input from the electrical distribution and transmission sectors on critical thesholds for the impacts of windstorms and other atmospheric hazards on electrical distribution and transmission infrastructure. The study found that damage to and failure of power distribution and transmission structures and lines starts to occur at certain wind speed thresholds:

- Trees impact power distribution when wind speeds reach or exceed 50-70 km/h;
- High-voltage power lines will be impacted when wind speeds reach or exceed 80-100 km/h.

The PIEVC study calculated the frequencies of winds reaching or exceeding 70 and 90 km/hr from recent wind speed and gust data for Toronto Pearson International Airport. Wind gusts are measured and the data quality controlled only at a limited number of weather stations in Canada. These wind monitoring stations must meet standard conditions for wind anemometer siting in an open grass-covered area and measured at 10m above ground). Most hourly wind measurements are taken at synoptic weather stations (e.g. airports) and analyses of winds is only valid if the station operated a 24 hour monitoring and recording program. Toronto Pearson Airport was considered the most representative wind monitoring station.   While the Toronto Island Airport measures winds, the local wind conditions on Toronto Island are most representative of a Lake Ontario near shore site.

Wind Storms	Historical Annual Probability	Standardized Annual Probability Score (0-7)
NBCC 10 and 50 year return period SUSTAINED WIND pressures	0.34 & 0.44 kPa (82 & 94 kph)	3 & 1 (10 yr) & (50 yr)
Average # days with gusts ≥ 70 kph	21	7
Average # days with gusts ≥ 90 kph	2	7

Windstorms vary in terms of their spatial extent, duration of the extreme winds and the weather processes that generate them. Intense **large-scale** (synoptic scale) **storms** or cyclones can produce damaging winds over large areas, with the highest wind speeds usually associated with low pressure systems that are deepening or intensifying rapidly. Other damaging winds can result from s**evere thunderstorms** that are typically associated with very thunderstorm downbursts, or can be more extensive in spatial coverage along organized squall lines producing what are known as straight-line winds. The storms usually pass through any one location very quickly, with the damaging winds lasting only 20 to 30 minutes. Organized thunderstorms and clusters or lines of thunderstorms can have longer lifespans with damaging winds lasting for several hours.

Lightning

At the time of this study, specific information on critical thresholds of lightning activity for power distribution system failures were not known. The climatological frequency of cloud-to-ground lightning strikes was provided, based on recently updated information. It is likely that lightning activity could occur more often in future due to an increase in days with stronger convection.

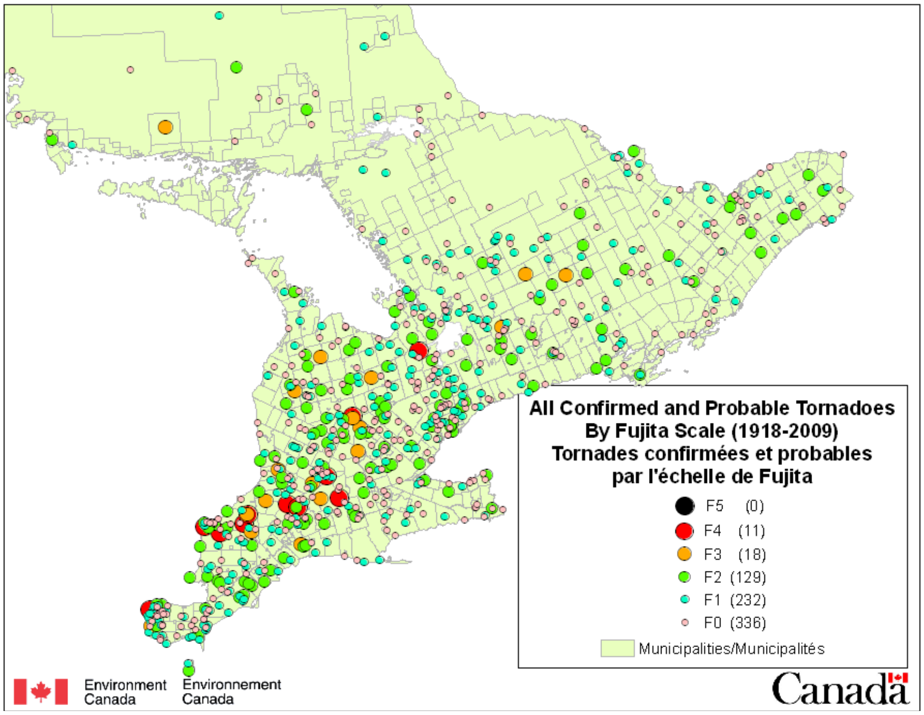
Lightning flashes are detected by the **Canadian Lightning Detection Network** (CLDN), which was established in 1998 as part of the North American Lightning Detection Network. The majority of flashes that are detected are cloud to ground (CG) with a small fraction of cloud to cloud (CC) lightning flashes. Some of the highest lightning flash densities in Canada occur in southwestern and south-central Ontario.

Thunderstorm and Lightning Probabilities	Historical Annual Probability	Standardized annual probability score (0-7)
Average # thunderstorm days (Toronto Pearson A)	28	7
Average # days with hail	1.1	6
Average # days with lightning cloud-ground strikes	~25 (excludes CN Tower strikes)	7
Average annual flash density (flashes/km^2/year)	~1.7	7

Tornado Risks

The most devastating tornadoes to have affected Ontario have been located in a narrow corridor from southwestern Ontario near Lake St Clair, northeastward to Stratford, Shelburne and then to Barrie (King *et al.*, 2003; Newark, 1983, 1984) and avoiding the Toronto area. This corridor is often referred to as Ontario and Canada's 'tornado alley'.

Confirmed and Probable Tornadoes by Fujita Scale (1918 - 2009)



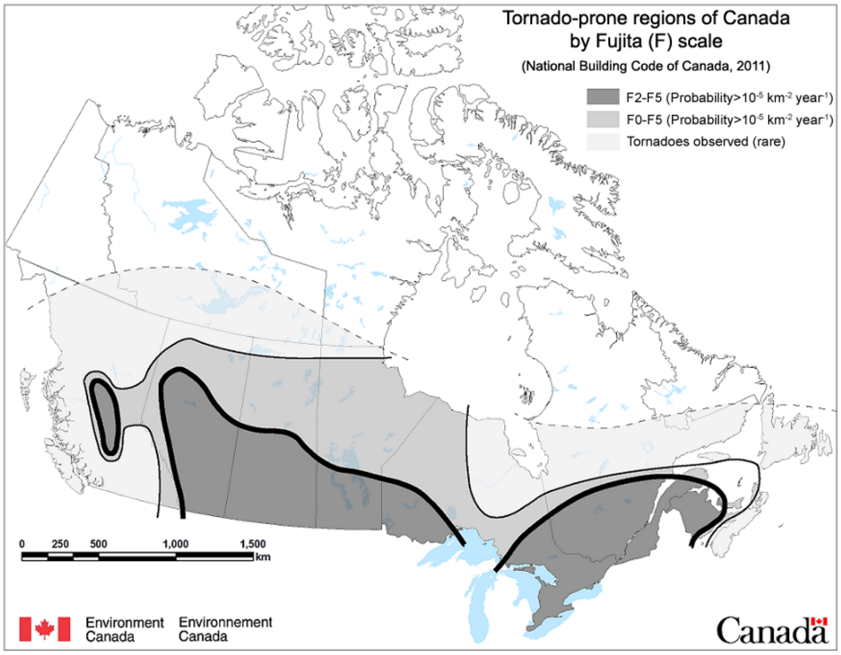
Source: *Environment Canada, 2011c. Internal. Data provided courtesy of David Sills, Severe Weather Scientist, Environment Canada.*

Information on tornado occurrences in a recently updated Ontario tornado database (Environment Canada, 2011a) are based on reports from a variety of sources, including volunteer severe weather observers and an investigation of newspaper archives. The occurrence of tornadoes is verified through several types of evidence, including damage surveys, videos, photographs, and eyewitness accounts. Additional reports of tornadic wind damage from newspapers or through first-hand accounts are sometimes also used to help determine tornado occurrence (Sills, 2002).

TORNADO RISKS	HISTORICAL	STANDARDIZED ANNUAL PROBABILITY (0-7)
Estimated tornado density for a point in downtown Toronto (probabilities higher for linear distances). Note that probabilities would be higher for power lines and linear distances.	$0.00002 km^{-2} yr^{-1}$ ($2X10^{-5}$)	0
Estimated tornado density for point locations just outside of Toronto (suburbs). Note that probabilities would be higher for power lines.	$> 0.0001 km^{-2} yr^{-1}$ ($1X10^{-4}$)	0
2010 NBCC – requirement for implementation of building tornado prone measures	<u>**IN**</u> national tornado prone region	N/A

The 2010 issue of the National Building Code of Canada (NBCC) contains life-proofing structural measures that are required in “tornado-prone” regions of Canada. Toronto lies within this “tornado-prone” region identified in the figure below and taken from the 2010 NBCC.

Tornado-prone regions of Canada by Fujita (F) Scale



Source: *NBC, 2011. Users Guide - National Building Code of Canada (NBC) Structural Commentaries (Part 4 of Division B); issued by the Canadian Commission on Building and Fire Codes, National Research Council of Canada, Ottawa, Ontario. Tornado prone map and commentary contributed by Environment Canada (Adaptation and Impacts Research, Cloud Physics and Severe Weather Research; Science and Technology Branch), Toronto, Ontario.*

Winter Storms with freezing rain, wet snow and ice-wind events

Many winter-time power distribution failures are caused by a combination of freezing rain under light wind conditions or wet snow with stronger winds causing ice or frozen precipitation to accrete on the lines. The climate information used to identify probabilities for the freezing rain hazard were taken from a recent peer-reviewed study of longer-lasting freezing rain storms in the Toronto area and from a study of estimated extreme annual freezing rain amounts for Woodbridge that was undertaken following Ice Storm ’98.

Within Canada, freezing precipitation is defined as freezing rain or drizzle, which falls in liquid form and then freezes upon contact with the ground or a cold object near the ground, forming a coating of ice. The greatest ice accumulations and impacts generally result from freezing rain events. Typically, the occurrence of freezing rain or freezing drizzle is reported at the main synoptic weather stations having 24 hour weather observation programs. The amounts of freezing rain have to be estimated from total daily or 6 hour precipitation amounts while ice buildup amounts typically are estimated from ice accretion models that consider the shape of the object or sometimes from observations.

The amount of ice accumulation is normally directly related to the amount of freezing precipitation. Usually, shorter duration events (i.e. 1-2 hours) will have lower ice accumulation amounts than those of longer duration (i.e. 6-12 hours or longer). The most severe freezing rain events are labeled as 'ice storms” and ice storms of any duration and magnitude can have serious impacts on human safety, critical infrastructure and community emergencies. As the duration of the freezing rain increases, trees, electricity distribution and communications infrastructure can collapse under the weight of the accumulated ice.

Damage and outages in the power distribution system are often caused by broken or weakened and sagged tree limbs. Under the weight of accumulating ice, tree branches can fall or sag into overhead electrical distribution lines. Accumulations of ice can increase the branch weight of trees by 30 times or greater. Small branches and weak tree limbs break with ice accumulations *between ~6-12 mm, while ~12-25 mm* accumulations can cause larger branches to break. If high storm winds are combined with the ice loading, the damage to trees and infrastructure will increase. Without the presence of trees, power outages during ice storms occur at relatively higher ice loads.

An Environment Canada review of severe ice storms that have affected Southern Ontario and the eastern United States over the past century suggests that the risks of major power outages lasting several days in Southern Ontario tends to increase for freezing rain amounts reaching or exceeding approximately 30 mm. Historical evidence indicates that the potential for long power outages and community disasters becomes likely when freezing rain *totals exceed approximately 40 mm* in these regions.

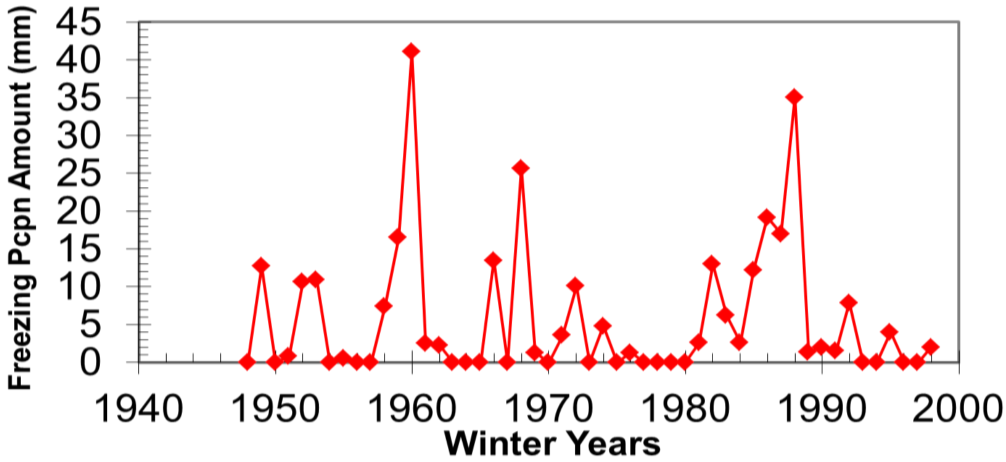
It is expected that climate change will initially increase risks for freezing rain storms. As winter temperatures warm initially, mixed phase precipitation (e.g. wet snow, freezing precipitation) becomes more frequent and winter precipitation amounts as well as number of days with precipitation increase, while mixed phase precipitation becomes more frequent, the frequency and intensity of freezing precipitation events may increase. Recent peer-reviewed studies indicate the potential for longer duration freezing rain storms to increase in the core winter months in the Toronto area under climate change.

Freezing rain and ice storm probabilities	Historical Annual Probability	Standardized annual probability score (0-7)
Average # Days with freezing rain/drizzle	8.8	7
Average # Days with freezing rain lasting at least 4 hours	1.4	6
Average # Days with freezing rain lasting at least 6 hours	0.65	5
Estimated annual multi-day probability of severe ice storms with ≥ 25 mm of accumulated ice (approaching design amounts)	0.06	2

The hourly weather data for Toronto Pearson Airport was analyzed to determine the average number of days/year with at least one observation of freezing rain or freezing drizzle (averages 8.8 days/year). The hourly data was also analyzed to obtain the frequencies of freezing rain events lasting at least 4 hours and at least 6 hours for the period of record. Typically, light freezing drizzle events accumulate ice on the ground at rates of 0.1-0.3mm/hr while moderate freezing drizzle accumulates ice on the ground at an estimated 0.3mm/hr). Freezing rain events bring much greater ice accumulations, with typical freezing rain rates of around 1.5-2mm/hr for light freezing rain and up to 5 mm/hr for moderate freezing rain. A freezing rain storm lasting 4 hours could be expected to bring 6-8mm of freezing precipitation accumulations and as much as 15mm, causing small tree limbs to start breaking and impacting power cables. Storms lasting 6 hours or more can bring 9-12mm of ice on the ground for light freezing rain precipitation and amounts up to 25mm, resulting in sufficient ice accretion to break large tree branches or impact power lines. Freezing rain amounts of 25 mm or more are approaching ice design criteria for overhead (230kV) cables/lines (although freezing rain amounts and ice accretion amounts are not the same).

The probability of freezing rain amounts exceeding 25 mm was estimated roughly using daily climate data for the Woodbridge weather station located just north of the Toronto boundaries. The results from this rough approximation approach indicate that the most severe ice storms with 25 mm or more of freezing rain have occurred 3 times in 50 years or have an annual probability of ~0.06. The Woodbridge station was chosen since the greatest risks for severe ice storms within the Toronto area lie in locations away from Lake Ontario and the downtown core where freezing rain events tend to be longer lasting (i.e. slower to change to rain). The estimated annual maximum freezing rain amounts were derived using conservative assumptions (i.e methodology assumed that freezing rain resulted on days when rain was measured but temperatures remained below zero). The results of this rough estimation approach were confirmed by a 1960 observation of more than 41 mm of freezing rain at Woodbridge.

Estimated 6 day Duration Annual Maximum Freezing Precipitation for Woodbridge Weather Station



Flooding

Heavy rainfall and in-situ flooding conditions can have impacts for underground components of the system. As a minimum, flooding events can hamper access to underground facilities and delay restoration efforts when underground quarters have to be safety pumped. Peer-reviewed studies indicate that the extreme rainfall conditions may increase in future under climate change.

Ontario's most expensive weather disaster ever, in excess of $500 Million in damages, was the result of organized severe thunderstorms tracking from Kitchener, across and north of Toronto to Oshawa on August 19, 2005. At its worst, the thunderstorm system spawned two F2 tornadoes west of Toronto but brought torrential rains, quarter- to golf-ball size hail, strong winds and flash flooding to Toronto. At its height, 1,400 lightning strikes per minute were reported and rainfall accumulations broke several national rainfall records for the 10, 15 and 30 minute rainfall durations as well as the 2 hour national rainfall record based on Environment Canada's rainfall intensity-duration-frequency network of stations. This amount compares to 53 mm in one hour from Hurricane Hazel in 1954.

PRECIPITATION ELEMENTS	HISTORICAL	STANDARDIZED PROBABILITY - ANNUAL
Average # Days with Rainfall > 50mm	0.53 (City) & 0.47 (Airport)	5
Annual Prob of ≥ 70mm in 5-Day period	0.2 (City)	4
Annual Prob of ≥ 100mm rainfall accumulation in a 5-Day period *(i.e. # 5-day events/30 years)*	0.03 (City) & 0.07 (Airport)	2
10 year return period of 15 minute rainfall – NBCC	~ 25mm (both)	3
50 year return period 24 hour rainfall – NBCC	102 mm (Airport) & 87 mm (City)	1
Average # days with snowfall ≥ 10cm	3.1 (City) & 2 (Airport)	7
Average # days with snow depths ≥ 30cm	2.2 (City) & 1.3 (Airport)	6
Average # days with snow depths ≥ 30cm and persisting for 5 or more days	0.17 (City)	3
Average # days with Blowing Snow	7.8 (Airport)	7

Drought

The severe droughts in Ontario over the past 15 years, coupled with the risk of an increase in severity and frequency of drought under climate change and growing demands on water resources led the province to develop the Ontario Low Water Response (OLWR) Plan in 1999-2000. The Plan was further revised in 2003 and is intended to ensure that provincial and local authorities could be advised of and prepared to take action in the event of low water conditions in watersheds.

Three water level conditions and action points, Levels I, II and III, are defined using specific precipitation and streamflow indicators. The Level II response framework conditions call for Conservation and Restrictions on Non-Essential Use of water at the municipal and regional government scales.

Based on daily rainfall measurements for the warm season from May-September for the Toronto City station, equivalent Ontario Low Water Response Level II low water response criteria lasting at least one month have occurred 18 times in 60 years for a probability of 0.3 while Level III conditions lasting at least one month are quite rare, occurring only twice in the 60 year period. For the Toronto Pearson Airport station, Level II criteria have been reached the same number of times while the Level III conditions have reached thresholds more often (4 occurrences in 60 years). There is no compelling reason for drought conditions to be more frequent near the airport location than the city centre.

DROUGHT (Toronto City)	HISTORICAL	STANDARDIZED PROBABILITY - ANNUAL
Frequency of at least one month in the warm season (May-Sept) meeting **Ontario Low Water Response Level II** (precipitation) criteria (1946-2005)	0.3	4
Frequency of at least one month in the warm season (May-Sept) meeting **Ontario Low Water Response Level III** (precipitation) criteria (1946-2005)	0.033	1

Extreme Heat and Cold

In Toronto, where the increased use of summertime air conditioning can push summer peak loads close to the limit, extreme and prolonged periods of high temperatures and high Humidex values can pose a threat to the demands on equipment and the grid. Building space cooling, lighting and other facility uses tend to be the largest loads in Toronto's commercial sector while space cooling, appliances and home electronics dominate demand in the residential sector. The space cooling electrical demand tends to be on-peak. Space cooling demand is significantly driven by "hot" temperatures and particularly by cooling degree days or accumulated warm temperatures and higher humidities.

As the Table below indicates, the extreme maximum and minimum temperatures as well as cooling and heating degree days vary considerably from the relatively warmer downtown core to the outer boundaries of the Toronto Hydro service area. Where the data allows, frequencies for the City (downtown) and Toronto Pearson Airport are provided as representative of downtown and city border conditions. In addition, the Table also provides NBCC design values of critical importance for the design and operation of buildings in Toronto. Not surprisingly, these building thresholds of 31°C and -20°C match the temperature thresholds provided by Toronto Hydro. The Table also provides frequencies for the more severe heat waves and characterizes these using frequencies above high Humidex thresholds.

TEMPERATURE ELEMENT (Toronto area)	HISTORICAL - ANNUAL	STANDARDIZED PROBABILITY
Average annual # days ≥ 30°C	12.6 (City) & 9.5 (Airport)	7
Average annual # days ≤ -20°C	1.4 (City) & 5.2 (Airport)	6
2.5 percentile July Drybulb Hot temperature – NBCC	31°C	1
2.5 percentile January Drybulb Cold temperature – NBCC	-20°C	1
Heat Wave – 3 or more days with maximum temperatures ≥ 30°C	1.0 (City) & 0.6 (Airport)	6
Cold Wave – 3 or more days with minimum temperatures ≤ -20°C	0.17 (Airport)	3
Variability – Daily temperature ranges ≥ 25 degrees C	0.17 (Airport)	3
Extreme Humidex	50.3 (Airport in 1955) & ~49 (City in 2011)	0
Severe Heat Wave: annual frequency of 3 or more days with Humidex ≥ 40	0.3 (Airport)	4
Extreme Heat Wave: Average Annual # Days with Humidex ≥ 45	0.13 (Airport)	3
Average annual Cooling Degree Days	359 (City) & 252 (Airport)	7
Average Annual Number of incremental heat mortalities	~ 120	5 (expected to increase in future)

The City of Toronto, like many other municipalities in Ontario, has a Heat-Health Alert System in place to warn its population of potentially dangerous hot temperature related conditions and advises vulnerable populations to seek cooler buildings and cooling centres for relief. The Toronto Heat-Health Alert system uses weather map typing or a synoptic/airmass classification approaches together with epidemiological evidence to forecast risks for increased heat-related mortality. These same conditions can be associated with peak electrical demands.

Recently updated climate Normals information indicates that significant warming has taken place in the past few decades in the Toronto region and needs to be considered in planning and operations. The updated (but unofficial) climate temperature Normals or average annual temperatures for Toronto Pearson Airport confirm that the mean annual temperatures for the historical 30-year Normals periods have increased as shown in the Table below. These increasing trends will likely continue into the unforeseeable future. Projections from an ensemble of climate change models indicates that cooling degree days for Toronto's downtown core could double by the 2050s, highlighting trends for electricity building cooling demand.

Toronto Pearson Airport's 30-year climate Normals for various historical reference periods - The results indicate significant warming since 1961.

Normals Period (30 years) for Toronto Pearson Airport	Average Annual Temperature	Average No. Days with mean temperatures above 0°C
1961-1990	7.3°C	212
1971-2000	7.7°C	219
1981-2010	8.8°C	228

Trends for extreme cold temperatures and cold waves are decreasing in Toronto, with days with minimum temperatures below -20°C becoming less common each decade.

Weathering

As well as extreme weather events, the cumulative effects of day-to-day weathering processes can lead to premature deterioration of the electrical grid. These processes include freeze-thaw cycles, use of salt (due to freeze-thaw cycles and snowfall events), UV radiation, fog and deposit of salt on overhead assets, and the impacts of higher temperatures and humidities on deterioration of assets. Many of these processes have the potential to increase through to the 2050s, as indicated in the Table below.

WEATHERING & PREMATURE DETERIORATION	HISTORICAL (usually 1971-2000)	STANDARDIZED PROBABILITY – ANNUAL
Average annual freeze-thaw cycles (Tmin≤0°C and Tmax≥0°C)	55 (City) & 87 (Airport)	7
Annual Probability of at least 70 freeze-thaw cycles (as per Toronto dam study)	0.1 for City but probable in North	3 (City) and 6 (Airport)
Average annual # hours with fog visibilities ~ ZERO	15 hours/year	7
Cement carbonization & deterioration (due to increasing CO_2 and temperatures)	Likely increasing over the long-term	N/A
Other weathering processes – humidities, temperatures, UV, some pollutants, rain wetting days	All increasing or expected to increase into the future	N/A

Climate Change Risks

With the exception of cold temperatures, climate change is expected to exacerbate almost all of the current weather and climate risks. For example, high temperatures and cooling degree day values are all expected to increase in frequency and intensity, leading to potentially more frequent reductions in line capacity, increases in transformer loading and increased line sag. As winter temperatures increase and more moisture becomes available for winter storms, the potential may increase for more icing from more frequent and intense freezing rain and wet snow storms. Summer convective activity and intense rainfall events are also at risk of increasing under climate change, along with day-to-day weathering and carbonization impacts on assets. All of these impacts will require reactive and proactive adaptation risk management actions in the form of changes to codes and standards, increased structural resilience, greater redundancy of assets, increased asset management and changed maintenance, operations and engineering practices.

References

CSA, 2010a. Characterizing the Atmospheric Hazards Information Needs of the Electricity Transmission Sector in Canada. Available from Canadian Standards Association, Mississauga, Ontario. 74pp.

CSA, 2010b. Climatic Information Requirements of Built Infrastructure Codes and Standards and their Users: Report on an Inventory and Expert Interviews Conducted by the Canadian Standards Association. Available from Canadian Standards Association, Mississauga, Ontario, 23pp.

Appendix C
May 11 Workshop Presentations

Appendix D
Risk Assessment Matrices

Toronto Hydro-Electric System Pilot Public Infrastructure Vulnerability Committee Workshop

	Infrastructure Components	Structural Design	Functionality	Serviceability	O/M & Materials Performance	Emergency Response	Insurance Considerations	Policy and Procedure	Public Health and Safety	Social Impacts	Environmental Impacts	1 High Temperature: Average annual # days with T≥ 30°C				2 Low Temperature: Average annual # days < -20°C				3 Heat Wave: 3 or more days with Tmax ≥ 30°C				4 Extreme Humidity: # Days with Humidex ≥ 40°C				5 Severe Heat Wave: 3 or more days with Humidex ≥ 40°C				6 Cold Wave: 3 or more days with Tmin ≤20°				7 Temperature Variability: Daily T ranges ≥ 25°C				8 Freeze-thaw cycle: Annual Probability of at least 70 freeze-thaw cycles (Tmax>0 and Tmin<0): Standard Prob of 3 for City and 6 for airport				9 Fog: ~15 hours/year (average) with visibility <= 0 km				10 Frost: To be discussed			
		Mark Relevant Responses with ✓										Y/N	P	S	R	Y/N	P	S	R	Y/N	P	S	R	Y/N	P	S	R	Y/N	P	S	R	Y/N	P	S	R	Y/N	P	S	R	Y/N	P	S	R	Y/N	P	S	R	Y/N	P	S	R
	Feeder A-2											Y/N	P	S	R	Y/N	P	S	R	Y/N	P	S	R	Y/N	P	S	R	Y/N	P	S	R	Y/N	P	S	R	Y/N	P	S	R	Y/N	P	S	R	Y/N	P	S	R	Y/N	P	S	R
	Primary Conductors																																																		
1	Overhead	✓	✓	✓	✓	✓	✓	✓	✓	✓		Y	7	4	28	Y	6	1	6	Y	6	5	30	Y	3	4	12	Y	4	5	20	Y	3	1	3	N	3			N	3			N	7			N			
2	Underground			✓	✓	✓		✓	✓	✓		Y	7	4	28	Y	6	1	6	Y	6	5	30	Y	3	4	12	Y	4	5	20	Y	3	1	3	N	3			N	3			N	7			N			
	Switches																																																		
3	Overhead - Main Line	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	N	7			Y	6	1	6	N	6			N	3			N	4			Y	3	1	3	N	3			N	3			Y	7	2	14	N			
4	Overhead - Lateral Line	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	N	7			Y	6	1	6	N	6			N	3			N	4			Y	3	1	3	N	3			N	3			Y	7	2	14	N			
5	Overhead - Customer	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	N	7			Y	6	1	6	N	6			N	3			N	4			Y	3	1	3	N	3			N	3			Y	7	2	14	N			
6	Pad Mount Switches	✓	✓	✓	✓	✓		✓	✓	✓	✓	N	7			Y	6	1	6	N	6	4		Y	3	3	9	Y	4	4	16	Y	3	1	3	N	3			N	3			Y	7	1	7	N			
7	Underground			✓	✓	✓		✓	✓	✓	✓	N	7			Y	6	1	6	N	6			N	3			N	4			Y	3	1	3	N	3			N	3			N	7			N			
	Transformers																																																		
8	Pole mounted	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	Y	7	4	28	Y	6	0	0	Y	6	3	18	Y	3	4	12	Y	4	5	20	Y	3	0	0	N	3			N	3			Y	7	2	14	N			
9	Pad mounted	✓	✓	✓	✓	✓		✓	✓	✓	✓	Y	7	4	28	Y	6	0	0	Y	6	3	18	Y	3	4	12	Y	4	5	20	Y	3	0	0	N	3			N	3			Y	7	1	7	N			
10	Submersible			✓	✓	✓		✓	✓	✓	✓	Y	7	4	28	Y	6	0	0	Y	6	3	18	Y	3	4	12	Y	4	5	20	Y	3	0	0	N	3			N	3			N	7			N			
	Civil Structures																																																		
11	Vault				✓	✓		✓	✓	✓		N	7			N	6			N	6			N	3			N	4			Y	3	1	3	N	3			Y	3	1	3	N	7			N			
12	Cable Chamber				✓	✓		✓	✓	✓		N	7			N	6			N	6			N	3			N	4			Y	3	1	3	N	3			Y	3	1	3	N	7			N			
	Poles																																																		
13	30 < 40 ft Steel	✓	✓	✓	✓	✓	✓	✓	✓	✓		N	7			Y	6	1	6	N	6			N	3			N	4			N	3			N	3			Y	3	0	0	N	7			N			
14	30 < 40 ft Wood	✓	✓	✓	✓	✓	✓	✓	✓	✓		N	7			Y	6	1	6	N	6			N	3			N	4			N	3			N	3			Y	3	0	0	N	7			N			
15	30 < 40 ft Concrete	✓	✓	✓	✓	✓	✓	✓	✓	✓		N	7			Y	6	1	6	N	6			N	3			N	4			N	3			N	3			Y	3	1	3	N	7			N			
16	40 < 50 ft Wood	✓	✓	✓	✓	✓	✓	✓	✓	✓		N	7			Y	6	1	6	N	6			N	3			N	4			N	3			N	3			Y	3	0	0	N	7			N			
17	40 < 50 ft Concrete	✓	✓	✓	✓	✓	✓	✓	✓	✓		N	7			Y	6	1	6	N	6			N	3			N	4			N	3			N	3			Y	3	1	3	N	7			N			
18	50 ≤ 60 ft Wood	✓	✓	✓	✓	✓	✓	✓	✓	✓		N	7			Y	6	2	12	N	6			N	3			N	4			N	3			N	3			Y	3	0	0	N	7			N			
	Feeder A-1											Y/N	P	S	R	Y/N	P	S	R	Y/N	P	S	R	Y/N	P	S	R	Y/N	P	S	R	Y/N	P	S	R	Y/N	P	S	R	Y/N	P	S	R	Y/N	P	S	R	Y/N	P	S	R
	Primary Conductors																																																		
36	Overhead	✓	✓	✓	✓	✓	✓	✓	✓	✓		Y	7	2	14	Y	6	0	0	Y	6	1	6	Y	3	0	0	Y	4	1	4	Y	3	0	0	N	3			N	3			N	7	0		N			
37	Underground			✓	✓	✓		✓	✓	✓		Y	7	2	14	Y	6	0	0	Y	6	4	24	Y	3	0	0	Y	4	2	8	Y	3	0	0	N	3			N	3			N	7	0		N			
	Switches																																																		
38	Overhead - Main Line	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	N	7			Y	6	1	6	N	6			Y	3	1	3	Y	4	1	4	Y	3	1	3	N	3			Y	3	1	3	Y	7	2	14	N			
39	Overhead - Lateral Lines	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	N	7			Y	6	1	6	N	6			Y	3	1	3	Y	4	1	4	Y	3	1	3	N	3			Y	3	0	0	Y	7	2	14	N			
40	Overhead - Customer	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	N	7			Y	6	1	6	N	6			Y	3	1	3	Y	4	1	4	Y	3	1	3	N	3			Y	3	0	0	Y	7	2	14	N			
41	Pad Mount	✓	✓	✓	✓	✓		✓	✓	✓	✓	N	7			Y	6	1	6	N	6			Y	3	1	3	Y	4	1	4	Y	3	1	3	N	3			N	3			Y	7	1	7	N			
42	Underground			✓	✓	✓		✓	✓	✓	✓	N	7			Y	6	1	6	N	6			Y	3	1	3	Y	4	1	4	Y	3	1	3	N	3			N	3			N	7			N			
	Transformers																																																		
43	Pole mounted	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	Y	7	1	7	Y	6		0	Y	6	2	12	Y	3	1	3	Y	4	1	4	Y	3		0	N	3			N	3			Y	7	2	14	N			
44	Pad mounted	✓	✓	✓	✓	✓		✓	✓	✓	✓	Y	7	2	14	Y	6		0	Y	6	2	12	Y	3	2	6	Y	4	2	8	Y	3		0	N	3			N	3			Y	7	1	7	N			
45	Submersible			✓	✓	✓		✓	✓	✓	✓	Y	7	2	14	Y	6		0	Y	6	2	12	Y	3	2	6	Y	4	2	8	Y	3		0	N	3			N	3			N	7			N			
	Civil Structures																																																		
46	Vault				✓	✓		✓	✓	✓		N	7			Y	6	2	12	N	6			N	3			N	4			Y	3	1	3	N	3			Y	3	1	3	N	7			N			
47	Cable Chamber				✓	✓		✓	✓	✓		N	7			Y	6	2	12	N	6			N	3			N	4			Y	3	1	3	N	3			Y	3	1	3	N	7			N			
	Poles																																																		
48	35 < 40 ft Wood	✓	✓	✓	✓	✓	✓	✓	✓	✓		N	7			N	6			N	6			N	3			N	4			N	3			N	3			N	3			N	7			N			
49	35 < 40 ft Concrete	✓	✓	✓	✓	✓	✓	✓	✓	✓		N	7			N	6			N	6			N	3			N	4			N	3			N	3			Y	3	1	3	N	7			N			
50	40 < 50 ft Wood	✓	✓	✓	✓	✓	✓	✓	✓	✓		N	7			N	6			N	6			N	3			N	4			N	3			N	3			N	3			N	7			N			
51	50 ≤ 60 ft Wood	✓	✓	✓	✓	✓	✓	✓	✓	✓		N	7			N	6			N	6			N	3			N	4			N	3			N	3			N	3			N	7			N			
	Feeder C-1											Y/N	P	S	R	Y/N	P	S	R	Y/N	P	S	R	Y/N	P	S	R	Y/N	P	S	R	Y/N	P	S	R	Y/N	P	S	R	Y/N	P	S	R	Y/N	P	S	R	Y/N	P	S	R
	Primary Conductors																																																		
72	Underground			✓	✓	✓		✓	✓	✓		N	7			N	6			N	6			N	3			N	4			N	3			Y	3	3	9	N	3			N	7			N			
	Switches																																																		
73	Underground			✓	✓	✓		✓	✓	✓	✓	N	7			N	6			N	6			N	3			N	4			N	3			N	3			N	3			N	7			N			
	Civil Structures																																																		
74	Vault				✓	✓		✓	✓	✓		N	7			N	6			N	6			N	3			N	4			N	3			N	3			N	3			N	7			N			
75	Cable Chamber				✓	✓		✓	✓	✓		N	7			N	6			Y	6	1	6	Y	3	1	3	Y	4	1	4	N	3			N	3			Y	3	1	3	N	7			N			
	Feeder C-2											Y/N	P	S	R	Y/N	P	S	R	Y/N	P	S	R	Y/N	P	S	R	Y/N	P	S	R	Y/N	P	S	R	Y/N	P	S	R	Y/N	P	S	R	Y/N	P	S	R	Y/N	P	S	R
	Primary Conductors																																																		
76	Underground			✓	✓	✓		✓	✓	✓		N	7			N	6			N	6			N	3			N	4			N	3			Y	3	3	9	N	3			N	7			N			
	Switches																																																		
77	At grade in customer vault or				✓	✓		✓	✓	✓	✓	N	7			N	6			N	6			N	3			N	4			N	3			N	3			N	3			N	7			N			
78	Underground			✓	✓	✓		✓	✓	✓	✓	N	7			N	6			N	6			N	3			N	4			N	3			N	3			N	3			N	7			N			
	Transformers																																																		
79	Submersible network type			✓	✓	✓		✓	✓	✓	✓	N	7			N	6			Y	6	3	18	Y	3	3	9	Y	4	3	12	N	3			N	3			N	3			N	7			N			
	Civil Structures																																																		
81	Vault				✓	✓		✓	✓	✓		N	7			N	6			N	6			N	3			N	4			N	3			N	3			Y	3	1	3	N	7			N			
82	Cable Chamber				✓	✓		✓	✓	✓		N	7			N	6			Y	6	1	6	Y	3	1	3	Y	4	1	4	N	3			N	3			Y	3	1	3	N	7			N			

Toronto Hydro-Electric System Pilot Public Infrastructure Vulnerability Committee Workshop

#	Infrastructure Components	11 High wind/downburst: Gusts > 70 km/h (~21days / year at Airport)				12 High wind/downburst: Gusts > 90 km/h (~2days / year at Airport)				13 Tornadoes: Tornado vortex extending from surface to cloud base (near infrastructure): tornado densities from 2X10-5km-2yr-1 to 1X10-4km-2yr-1.				14 Heavy Rain: Daily Rainfall > 50 mm/day				15 Heavy 5 day total rainfall: 5 days of cumulative rain > 70 mm of rain				16 Ice Storm: Average annual probability of at least 25 mm of freezing rain per event				17 Freezing Rain: Average annual probability of freezing rain events lasting 6h or more *(i.e. typically more than 10 mm of freezing rain)*			
		Y/N	P	S	R	Y/N	P	S	R	Y/N	P	S	R	Y/N	P	S	R	Y/N	P	S	R	Y/N	P	S	R	Y/N	P	S	R
	Feeder A-2	Y/N	P	S	R	Y/N	P	S	R	Y/N	P	S	R	Y/N	P	S	R	Y/N	P	S	R	Y/N	P	S	R	Y/N	P	S	R
	Primary Conductors																												
1	Overhead	Y	7	5	35	Y	7	6	42	Y	1	7	7	N	5			N	4			Y	2	7	14	Y	5	5	25
2	Underground	N	7			N	7			Y	1	2	2	Y	5	2	10	Y	4	2	8	N	2			N	5		
	Switches																												
3	Overhead - Main Line	Y	7	4	28	Y	7	4	28	Y	1	7	7	N	5			N	4			Y	2	3	6	Y	5	3	15
4	Overhead - Lateral Line	Y	7	4	28	Y	7	4	28	Y	1	7	7	N	5			N	4			Y	2	3	6	Y	5	3	15
5	Overhead - Customer	Y	7	4	28	Y	7	4	28	Y	1	7	7	N	5			N	4			Y	2	3	6	Y	5	3	15
6	Pad Mount Switches	N	7			N	7			Y	1	7	7	N	5			N	4			Y	2	1	2	Y	5	1	5
7	Underground	N	7			N	7			N	1			Y	5	3	15	Y	4	3	12	N	2			N	5		
	Transformers																												
8	Pole mounted	Y	7	3	21	Y	7	3	21	Y	1	7	7	N	5			N	4			Y	2	2	4	Y	5	7	35
9	Pad mounted	N	7			N	7			Y	1	7	7	N	5			N	4			Y	2	1	2	Y	5	1	5
10	Submersible	N	7			N	7			N	1			Y	5	2	10	Y	4	2	8	N	2			Y	5		0
	Civil Structures																												
11	Vault	N	7			N	7			N	1			Y	5	1	5	Y	4	1	4	Y	2	1	2	Y	5	1	5
12	Cable Chamber	N	7			N	7			N	1			Y	5	1	5	Y	4	1	4	Y	2	1	2	Y	5	1	5
	Poles																												
13	30 < 40 ft Steel	Y	7	6	42	Y	7	6	42	Y	1	7	7	N	5			N	4			Y	2	7	14	Y	5	5	25
14	30 < 40 ft Wood	Y	7	6	42	Y	7	6	42	Y	1	7	7	N	5			N	4			Y	2	7	14	Y	5	5	25
15	30 < 40 ft Concrete	Y	7	6	42	Y	7	6	42	Y	1	7	7	N	5			N	4			Y	2	7	14	Y	5	5	25
16	40 < 50 ft Wood	Y	7	6	42	Y	7	6	42	Y	1	7	7	N	5			N	4			Y	2	7	14	Y	5	5	25
17	40 < 50 ft Concrete	Y	7	6	42	Y	7	6	42	Y	1	7	7	N	5			N	4			Y	2	7	14	Y	5	5	25
18	50 ≤ 60 ft Wood	Y	7	7	49	Y	7	7	49	Y	1	7	7	N	5			N	4			Y	2	7	14	Y	5	6	30
	Feeder A-1	Y/N	P	S	R	Y/N	P	S	R	Y/N	P	S	R	Y/N	P	S	R	Y/N	P	S	R	Y/N	P	S	R	Y/N	P	S	R
	Primary Conductors																												
36	Overhead	Y	7	5	35	Y	7	6	42	Y	1	7	7	N	5			N	4			Y	2	7	14	Y	5	5	25
37	Underground	N	7	0		N	7			N	1	7		Y	5	1	5	Y	4	1	4	N	2	0		N	5		
	Switches																												
38	Overhead - Main Line	Y	7	4	28	Y	7	4	28	Y	1	7	7	N	5	0		N	4			Y	2	3	6	Y	5	3	15
39	Overhead - Lateral Lines	Y	7	4	28	Y	7	4	28	Y	1	7	7	N	5	0		N	4			Y	2	3	6	Y	5	3	15
40	Overhead - Customer	Y	7	4	28	Y	7	4	28	Y	1	7	7	N	5	0		N	4			Y	2	3	6	Y	5	3	15
41	Pad Mount	N	7			N	7			Y	1	7	7	N	5	0		N	4	0		Y	2	1	2	Y	5	1	5
42	Underground	N	7			N	7			N	1			Y	5	3	15	Y	4	3	12	N	2	1		N	5	0	
	Transformers																												
43	Pole mounted	Y	7	3	21	Y	7	3	21	Y	1	7	7	N	5	0		N	4			N	2	3		N	5	0	
44	Pad mounted	N	7			N	7			Y	1	7	7	N	5	0		N	4			N	2	3		N	5	0	
45	Submersible	N	7			N	7			N	1			Y	5	2	10	Y	4	2	8	N	2	3		N	5	0	
	Civil Structures																												
46	Vault	N	7			N	7			N	1			Y	5	1	5	Y	4	0	0	Y	2	1	2	Y	5	1	5
47	Cable Chamber	N	7			N	7			N	1			Y	5	1	5	Y	4	0	0	Y	2	1	2	Y	5	1	5
	Poles																												
48	35 < 40 ft Wood	Y	7	6	42	Y	7	6	42	Y	1	7	7	N	5	0		N	4			Y	2	7	14	Y	5	5	25
49	35 < 40 ft Concrete	Y	7	6	42	Y	7	6	42	Y	1	7	7	N	5	0		N	4			Y	2	7	14	Y	5	5	25
50	40 < 50 ft Wood	Y	7	6	42	Y	7	6	42	Y	1	7	7	N	5	0		N	4			Y	2	7	14	Y	5	5	25
51	50 ≤ 60 ft Wood	Y	7	7	49	Y	7	7	49	Y	1	7	7	N	5	0		N	4			Y	2	7	14	Y	5	5	25
	Feeder C-1	Y/N	P	S	R	Y/N	P	S	R	Y/N	P	S	R	Y/N	P	S	R	Y/N	P	S	R	Y/N	P	S	R	Y/N	P	S	R
	Primary Conductors																												
72	Underground	N	7			N	7			N	1			Y	5		0	Y	4		0	N	2			N	5		
	Switches																												
73	Underground	N	7			N	7			N	1			N	5			N	4			N	2			N	5		
	Civil Structures																												
74	Vault	N	7			N	7			N	1			Y	5	1	5	Y	4	1	4	Y	2	1	2	Y	5	1	5
75	Cable Chamber	N	7			N	7			N	1			Y	5	1	5	Y	4	1	4	Y	2	1	2	Y	5	1	5
	Feeder C-2	Y/N	P	S	R	Y/N	P	S	R	Y/N	P	S	R	Y/N	P	S	R	Y/N	P	S	R	Y/N	P	S	R	Y/N	P	S	R
	Primary Conductors																												
76	Underground	N	7			N	7			N	1			Y	5	1	5	Y	4	1	4	N	2			N	5		
	Switches																												
77	At grade in customer vault or	N	7			N	7			N	1			N	5			N	4			N	2			N	5		
78	Underground	N	7			N	7			N	1			Y	5	3	15	Y	4	3	12	N	2			N	5		
	Transformers																												
79	Submersible network type	N	7			N	7			N	1			Y	5	1	5	Y	4	1	4	N	2			N	5		
	Civil Structures																												
81	Vault	N	7			N	7			N	1			Y	5	1	5	Y	4	1	4	Y	2	1	2	Y	5	1	5
82	Cable Chamber	N	7			N	7			N	1			Y	5	1	5	Y	4	1	4	Y	2	1	2	Y	5	1	5

#	Infrastructure Components	18 Blowing snow/Blizzard: Average # of days / year with blowing snow (7.8 / y)				19 Heavy Snowfall: Snowfall > 10cm *(2-3days/y)*				20 Snow accumulation: Snow on ground with depths ≥ 30 cm and persisting for 5 or more days *(0.17 events/y)*				21 Hail: Average # of hail days (~1.1/y)				22 Severe thunderstorms: Average # of Thunderstorm Days (~28/y)				23 Lightning: Average # Days/Year with cloud - ground lightning strikes (~25)				24 Drought/Dry periods: At least one month at Ontario low water response level II *(i.e. with mandatory water conservation)*			
		Y/N	P	S	R	Y/N	P	S	R	Y/N	P	S	R	Y/N	P	S	R	Y/N	P	S	R	Y/N	P	S	R	Y/N	P	S	R
	Feeder A-2	Y/N	P	S	R	Y/N	P	S	R	Y/N	P	S	R	Y/N	P	S	R	Y/N	P	S	R	Y/N	P	S	R	Y/N	P	S	R
	Primary Conductors																												
1	Overhead	Y	7	0	0	Y	7	2	14	Y	3	2	6	Y	6	1	6	?	7		n/a	Y	7	2	14	N	4		
2	Underground	N	7			N	7			N	3			N	6			N	7			Y	7	2	14	N	4		
	Switches																												
3	Overhead - Main Line	Y	7	1	7	Y	7	1	7	Y	3	0	0	Y	6	1	6	?	7		n/a	Y	7	5	35	N	4		
4	Overhead - Lateral Line	Y	7	1	7	Y	7	1	7	Y	3	0	0	Y	6	1	6	?	7		n/a	Y	7	5	35	N	4		
5	Overhead - Customer	Y	7	1	7	Y	7	1	7	Y	3	0	0	Y	6	1	6	?	7		n/a	Y	7	4	28	N	4		
6	Pad Mount Switches	Y	7	1	7	Y	7	1	7	Y	3	1	3	Y	6	0	0	?	7		n/a	Y	7	1	7	N	4		
7	Underground	N	7	1		N	7	1		N	3	1		N	6			N	7			N	7			N	4		
	Transformers																												
8	Pole mounted	Y	7	1	7	Y	7	1	7	Y	3	0	0	Y	6	1	6	?	7		n/a	Y	7	6	42	N	4		
9	Pad mounted	Y	7	1	7	Y	7	1	7	Y	3	1	3	Y	6	0	0	?	7		n/a	Y	7	1	7	N	4		
10	Submersible	N	7	1		Y	7	1	7	Y	3	1	3	N	6			N	7			N	7			N	4		
	Civil Structures																												
11	Vault	Y	7	1	7	Y	7	2	14	Y	3	2	6	N	6			N	7			N	7			N	4		
12	Cable Chamber	Y	7	1	7	Y	7	2	14	Y	3	2	6	N	6			N	7			N	7			N	4		
	Poles																												
13	30 < 40 ft Steel	N	7			Y	7	0	0	Y	3	0	0	Y	6	0	0	?	7		n/a	Y	7	4	28	N	4		
14	30 < 40 ft Wood	N	7			Y	7	0	0	Y	3	0	0	Y	6	0	0	?	7		n/a	Y	7	4	28	N	4		
15	30 < 40 ft Concrete	N	7			Y	7	1	7	Y	3	1	3	Y	6	0	0	?	7		n/a	Y	7	4	28	N	4		
16	40 < 50 ft Wood	N	7			Y	7	0	0	Y	3	0	0	Y	6	0	0	?	7		n/a	Y	7	4	28	N	4		
17	40 < 50 ft Concrete	N	7			Y	7	1	7	Y	3	1	3	Y	6	0	0	?	7		n/a	Y	7	4	28	N	4		
18	50 ≤ 60 ft Wood	N	7			Y	7	0	0	Y	3	0	0	Y	6	0	0	?	7		n/a	Y	7	4	28	N	4		
	Feeder A-1	Y/N	P	S	R	Y/N	P	S	R	Y/N	P	S	R	Y/N	P	S	R	Y/N	P	S	R	Y/N	P	S	R	Y/N	P	S	R
	Primary Conductors																												
36	Overhead	Y	7	1	7	Y	7	2	14	Y	3	2	6	Y	6	1	6	?	7		n/a	Y	7	2	14	N	4		
37	Underground	N	7			N	7			Y	3	1	3	N	6			?	7		n/a	N	7			N	4		
	Switches																												
38	Overhead - Main Line	Y	7	1	7	Y	7	1	7	Y	3	0	0	Y	6	1	6	?	7		n/a	Y	7	5	35	N	4		
39	Overhead - Lateral Lines	Y	7	1	7	Y	7	1	7	Y	3	0	0	Y	6	1	6	?	7		n/a	Y	7	5	35	N	4		
40	Overhead - Customer	Y	7	1	7	Y	7	1	7	Y	3	0	0	Y	6	1	6	?	7		n/a	Y	7	4	28	N	4		
41	Pad Mount	Y	7		0	Y	7	1	7	Y	3	1	3	Y	6	0	0	?	7		n/a	Y	7	1	7	N	4		
42	Underground	N	7			N	7	1		N	3	1		N	6			?	7		n/a	N	7			N	4		
	Transformers																												
43	Pole mounted	Y	7	1	7	Y	7	1	7	Y	3	0	0	Y	6	1	6	?	7		n/a	Y	7	6	42	N	4		
44	Pad mounted	Y	7	1	7	Y	7	1	7	Y	3	1	3	Y	6	0	0	?	7		n/a	Y	7	1	7	N	4		
45	Submersible	N	7			Y	7	1	7	Y	3	1	3	N	6			?	7		n/a	N	7			N	4		
	Civil Structures																												
46	Vault	Y	7	1	7	Y	7	1	7	Y	3	1	3	N	6			?	7		n/a	N	7			N	4		
47	Cable Chamber	Y	7	1	7	Y	7	1	7	Y	3	1	3	N	6			?	7		n/a	N	7			N	4		
	Poles																												
48	35 < 40 ft Wood	N	7			N	7			N	3			N	6			?	7		n/a	Y	7	4	28	N	4		
49	35 < 40 ft Concrete	N	7			N	7			N	3			N	6			?	7		n/a	Y	7	4	28	N	4		
50	40 < 50 ft Wood	N	7			N	7			N	3			N	6			?	7		n/a	Y	7	4	28	N	4		
51	50 ≤ 60 ft Wood	N	7			N	7			N	3			N	6			?	7		n/a	Y	7	4	28	N	4		
	Feeder C-1	Y/N	P	S	R	Y/N	P	S	R	Y/N	P	S	R	Y/N	P	S	R	Y/N	P	S	R	Y/N	P	S	R	Y/N	P	S	R
	Primary Conductors																												
72	Underground	N	7			Y	7	1	7	Y	3	1	3	N	6			N	7			N	7			N	4		
	Switches																												
73	Underground	N	7			Y	7	1	7	Y	3	1	3	N	6			N	7			N	7			N	4		
	Civil Structures																												
74	Vault	N	7			Y	7	1	7	Y	3	1	3	N	6			N	7			N	7			N	4		
75	Cable Chamber	N	7			Y	7	1	7	Y	3	1	3	N	6			N	7			N	7			N	4		
	Feeder C-2	Y/N	P	S	R	Y/N	P	S	R	Y/N	P	S	R	Y/N	P	S	R	Y/N	P	S	R	Y/N	P	S	R	Y/N	P	S	R
	Primary Conductors																												
76	Underground	N	7			Y	7	1	7	Y	3	1	3	N	6			N	7			N	7			N	4		
	Switches																												
77	At grade in customer vault or	N	7			Y	7	1	7	Y	3	1	3	N	6			N	7			N	7			N	4		
78	Underground	N	7			Y	7	1	7	Y	3	1	3	N	6			N	7			N	7			N	4		
	Transformers																												
79	Submersible network type	N	7			Y	7	1	7	Y	3	1	3	N	6			N	7			N	7			N	4		
	Civil Structures																												
81	Vault	N	7			Y	7	1	7	Y	3	1	3	N	6			N	7			N	7			N	4		
82	Cable Chamber	N	7			Y	7	1	7	Y	3	1	3	N	6			N	7			N	7			N	4		

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	Infrastructure Components	Structural Design	Functionality	Serviceability	O/M & Materials Performance	Emergency Response	Insurance Considerations	Policy and Procedure	Public Health and Safety	Social Impacts	Environmental Impacts
		Infrastructure Response Considerations									
		Mark Relevant Responses with ✓									
	Feeder B-1										
	Primary Conductors										
52	Underground			✓	✓	✓		✓	✓	✓	
	Switches										
53	Underground			✓	✓	✓		✓	✓	✓	✓
	Transformers										
54	Submersible			✓	✓	✓		✓	✓	✓	✓
	Civil Structures										
55	Vault				✓	✓		✓	✓	✓	
56	Cable Chamber				✓	✓		✓	✓	✓	
	Feeder B-2										
	Primary Conductors										
57	Overhead	✓	✓	✓	✓	✓	✓	✓	✓	✓	
58	Underground			✓	✓	✓		✓	✓	✓	
	Switches										
59	Overhead - Main Line	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
60	Overhead - Lateral Line	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
61	Overhead - Customer	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
62	Pad mounted	✓	✓	✓	✓	✓		✓	✓	✓	✓
63	Underground - URD			✓	✓	✓		✓	✓	✓	✓
	Transformers										
64	Pole mounted	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
65	Pad mount	✓	✓	✓	✓	✓		✓	✓	✓	✓
66	Submersible - URD			✓	✓	✓		✓	✓	✓	✓
	Civil Structures										
67	Vault				✓	✓		✓	✓	✓	
68	Cable Chamber				✓	✓		✓	✓	✓	
	Poles										
69	Steel	✓	✓	✓	✓	✓	✓	✓	✓	✓	
70	Wood	✓	✓	✓	✓	✓	✓	✓	✓	✓	
71	Concrete	✓	✓	✓	✓	✓	✓	✓	✓	✓	

	Infrastructure Components	1 High Temperature: Average annual # days with T≥ 30°C				2 Low Temperature: Average annual # days < -20°C				3 Heat Wave: 3 or more days with Tmax ≥ 30°C				4 Extreme Humidity: # Days with Humidex ≥ 40°C				5 Severe Heat Wave: 3 or more days with Humidex ≥ 40°C			
		Y/N	P	S	R	Y/N	P	S	R	Y/N	P	S	R	Y/N	P	S	R	Y/N	P	S	R
	Feeder B-1	Y/N	P	S	R	Y/N	P	S	R	Y/N	P	S	R	Y/N	P	S	R	Y/N	P	S	R
	Primary Conductors																				
52	Underground	Y	7	2	14	Y	6	0	0	Y	6	2	12	Y	3	2	6	Y	4	2	8
	Switches																				
53	Underground	Y	7	0	0	Y	6	1	6	Y	6	1	6	Y	3	1	3	Y	4	1	4
	Transformers																				
54	Submersible	Y	7	2	14	Y	6	1	6	Y	6	2	12	Y	3	2	6	Y	4	2	8
	Civil Structures																				
55	Vault	N	7	0		N	6	0		N	6	0		N	3	0		N	4	0	
56	Cable Chamber	N	7	0		N	6	0		N	6	0		N	3	0		N	4	0	
	Feeder B-2	Y/N	P	S	R	Y/N	P	S	R	Y/N	P	S	R	Y/N	P	S	R	Y/N	P	S	R
	Primary Conductors																				
57	Overhead	Y	7	2	14	Y	6	1	6	Y	6	2	12	Y	3	2	6	Y	4	2	8
58	Underground	Y	7	2	14	Y	6	0	0	Y	6	2	12	Y	3	2	6	Y	4	2	8
	Switches																				
59	Overhead - Main Line	Y	7	0	0	Y	6	1	6	Y	6	1	6	Y	3	1	3	Y	4	1	4
60	Overhead - Lateral Line	Y	7	0	0	Y	6	1	6	Y	6	1	6	Y	3	1	3	Y	4	1	4
61	Overhead - Customer	Y	7	0	0	Y	6	1	6	Y	6	1	6	Y	3	1	3	Y	4	1	4
62	Pad mounted	Y	7	0	0	Y	6	1	6	Y	6	1	6	Y	3	1	3	Y	4	1	4
63	Underground - URD	Y	7	0	0	Y	6	1	6	Y	6	1	6	Y	3	1	3	Y	4	1	4
	Transformers																				
64	Pole mounted	Y	7	2	14	Y	6	1	6	Y	6	2	12	Y	3	2	6	Y	4	2	8
65	Pad mount	Y	7	2	14	Y	6	1	6	Y	6	2	12	Y	3	2	6	Y	4	2	8
66	Submersible - URD	Y	7	2	14	Y	6	1	6	Y	6	2	12	Y	3	2	6	Y	4	2	8
	Civil Structures																				
67	Vault	N	7	0		N	6	0		N	6	0		N	3	0		N	4	0	
68	Cable Chamber	N	7	0		N	6	0		N	6	0		N	3	0		N	4	0	
	Poles																				
69	Steel	N	7	0		N	6	0		N	6	0		N	3	0		N	4	0	
70	Wood	N	7	0		N	6	0		N	6	0		N	3	0		N	4	0	
71	Concrete	N	7	0		N	6	0		N	6	0		N	3	0		N	4	0	

	Infrastructure Components	6 Cold Wave: 3 or more days with Tmin ≤20°				7 Temperature Variability: Daily T ranges ≥ 25°C				8 Freeze-thaw cycle: Annual Probability of at least 70 freeze-thaw cycles (Tmax>0 and Tmin<0): Standard Prob of 3 for City and 6 for airport				9 Fog: ~15 hours/year (average) with visibility <= 0 km				10 Frost: To be discussed			
		Y/N	P	S	R	Y/N	P	S	R	Y/N	P	S	R	Y/N	P	S	R	Y/N	P	S	R
	Feeder B-1	Y/N	P	S	R	Y/N	P	S	R	Y/N	P	S	R	Y/N	P	S	R	Y/N	P	S	R
	Primary Conductors																				
52	Underground	Y	3	0	0	Y	3	0	0	N	3	0		N	7	0		N	6	0	
	Switches																				
53	Underground	Y	3	1	3	Y	3	0	0	N	3	0		N	7	0		N	6	0	
	Transformers																				
54	Submersible	Y	3	1	3	Y	3	0	0	N	3	0		N	7	0		N	6	0	
	Civil Structures																				
55	Vault	N	3	0		N	3	0		Y	3	1	3	N	7	0		N	6	0	
56	Cable Chamber	N	3	0		N	3	0		Y	3	1	3	N	7	0		N	6	0	
	Feeder B-2	Y/N	P	S	R	Y/N	P	S	R	Y/N	P	S	R	Y/N	P	S	R	Y/N	P	S	R
	Primary Conductors																				
57	Overhead	Y	3	1	3	Y	3	0	0	N	3	0		Y	7	2	14	Y	6	2	12
58	Underground	Y	3	0	0	Y	3	0	0	N	3	0		N	7	0		N	6	0	
	Switches																				
59	Overhead - Main Line	Y	3	1	3	Y	3	0	0	N	3	0		Y	7	2	14	Y	6	2	12
60	Overhead - Lateral Line	Y	3	1	3	Y	3	0	0	N	3	0		Y	7	2	14	Y	6	2	12
61	Overhead - Customer	Y	3	1	3	Y	3	0	0	N	3	0		Y	7	2	14	Y	6	2	12
62	Pad mounted	Y	3	1	3	Y	3	0	0	N	3	0		Y	7	1	7	Y	6	1	6
63	Underground - URD	Y	3	1	3	Y	3	0	0	N	3	0		N	7	0		N	6	0	
	Transformers																				
64	Pole mounted	Y	3	1	3	Y	3	0	0	N	3	0		Y	7	2	14	Y	6	2	12
65	Pad mount	Y	3	1	3	Y	3	0	0	N	3	0		Y	7	1	7	Y	6	1	6
66	Submersible - URD	Y	3	1	3	Y	3	0	0	N	3	0		N	7	0		N	6	0	
	Civil Structures																				
67	Vault	N	3	0		N	3	0		Y	3	1	3	N	7	0		N	6	0	
68	Cable Chamber	N	3	0		N	3	0		Y	3	1	3	N	7	0		N	6	0	
	Poles																				
69	Steel	N	3	0		N	3	0		Y	3		0	N	7	0		N	6	0	
70	Wood	N	3	0		N	3	0		Y	3		0	N	7	0		N	6	0	
71	Concrete	N	3	0		Y	3	0	0	Y	3		0	N	7	0		N	6	0	

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	Infrastructure Components	11 High wind/downburst				12 High wind/downburst				13 Tornadoes				14 Heavy Rain				15 Heavy 5 day total rainfall				16 Ice Storm				17 Freezing Rain			
		Gusts > 70 km/h (~21days / year at Airport)				Gusts > 90 km/h (~2days / year at Airport)				Tornado vortex extending from surface to cloud base (near infrastructure): tornado densities from 2X10-5km-2yr-1 to 1X10-4km-2yr-1.				Daily Rainfall > 50 mm/day				5 days of cumulative rain > 70 mm of rain				Average annual probability of at least 25 mm of freezing rain per event				Average annual probability of freezing rain events lasting 6h or more *(i.e. typically more than 10 mm of freezing rain)*			
		Y/N	P	S	R	Y/N	P	S	R	Y/N	P	S	R	Y/N	P	S	R	Y/N	P	S	R	Y/N	P	S	R	Y/N	P	S	R
	Feeder B-1	Y/N	P	S	R	Y/N	P	S	R	Y/N	P	S	R	Y/N	P	S	R	Y/N	P	S	R	Y/N	P	S	R	Y/N	P	S	R
	Primary Conductors																												
52	Underground	N	7	0		N	7	0		Y	1	0	0	Y	5	0	0	Y	4	0	0	N	2	0		N	5	0	
	Switches																												
53	Underground	N	7	0		N	7	0		Y	1	0	0	Y	5	5	25	Y	4	4	16	Y	2	0	0	Y	5	0	0
	Transformers																												
54	Submersible	N	7	0		N	7	0		Y	1	0	0	Y	5	2	10	Y	4	1	4	Y	2	0	0	Y	5	0	0
	Civil Structures																												
55	Vault	N	7	0		N	7	0		Y	1	2	2	Y	5	1	5	Y	4	1	4	Y	2	1	2	Y	5	1	5
56	Cable Chamber	N	7	0		N	7	0		Y	1	2	2	Y	5	1	5	Y	4	1	4	Y	2	1	2	Y	5	1	5
	Feeder B-2	Y/N	P	S	R	Y/N	P	S	R	Y/N	P	S	R	Y/N	P	S	R	Y/N	P	S	R	Y/N	P	S	R	Y/N	P	S	R
	Primary Conductors																												
57	Overhead	Y	7	6	42	Y	7	7	49	Y	1	7	7	Y	5	1	5	Y	4	1	4	Y	2	7	14	Y	5	5	25
58	Underground	N	7	0		N	7	0		Y	1	0	0	Y	5	0	0	Y	4	0	0	N	2	0		N	5	0	
	Switches																												
59	Overhead - Main Line	Y	7	4	28	Y	7	4	28	Y	1	7	7	N	5	1		N	4	1		Y	2	3	6	Y	5	3	15
60	Overhead - Lateral Line	Y	7	4	28	Y	7	4	28	Y	1	7	7	N	5	1		N	4	1		Y	2	3	6	Y	5	3	15
61	Overhead - Customer	Y	7	4	28	Y	7	4	28	Y	1	7	7	N	5	1		N	4	1		Y	2	3	6	Y	5	3	15
62	Pad mounted	N	7	0		N	7	0		Y	1	7	7	Y	5	1	5	Y	4	1	4	Y	2	0	0	Y	5	0	0
63	Underground - URD	N	7	0		N	7	0		N	1	0		Y	5	3	15	Y	4	3	12	N	2	0		N	5	0	
	Transformers																												
64	Pole mounted	Y	7	3	21	Y	7	3	21	Y	1	7	7	N	5	1		N	4	1		Y	2	3	6	Y	5	3	15
65	Pad mount	N	7	0		N	7	0		Y	1	7	7	Y	5	1	5	Y	4	1	4	Y	2	0	0	Y	5	0	0
66	Submersible - URD	N	7	0		N	7	0		N	1	0		Y	5	2	10	Y	4	2	8	Y	2	0	0	Y	5	0	0
	Civil Structures																												
67	Vault	N	7	0		N	7	0		N	1	2		Y	5	1	5	Y	4	1	4	Y	2	1	2	Y	5	1	5
68	Cable Chamber	N	7	0		N	7	0		N	1	2		Y	5	1	5	Y	4	1	4	Y	2	1	2	Y	5	1	5
	Poles																												
69	Steel	Y	7	6	42	Y	7	7	49	Y	1	7	7	N	5	0		N	4	0		Y	2	7	14	Y	5	7	35
70	Wood	Y	7	6	42	Y	7	7	49	Y	1	7	7	N	5	0		N	4	0		Y	2	7	14	Y	5	7	35
71	Concrete	Y	7	6	42	Y	7	7	49	Y	1	7	7	N	5	0		N	4	0		Y	2	7	14	Y	5	7	35

	Infrastructure Components	18 Blowing snow/Blizzard				19 Heavy Snowfall				20 Snow accumulation				21 Hail				22 Severe thunderstorms				23 Lightning				24 Drought/Dry periods			
		Average # of days / year with blowing snow (7.8 / y)				Snowfall > 10cm *(2-3days/y)*				Snow on ground with depths ≥30 cm and persisting for 5 or more days *(0.17 events/y)*				Average # of hail days (~1.1/y)				Average # of Thunderstorm Days (~28/y)				Average # Days/Year with cloud - ground lightning strikes (~25)				At least one month at Ontario low water response level II *(i.e. with mandatory water conservation)*			
		Y/N	P	S	R	Y/N	P	S	R	Y/N	P	S	R	Y/N	P	S	R	Y/N	P	S	R	Y/N	P	S	R	Y/N	P	S	R
	Feeder B-1	Y/N	P	S	R	Y/N	P	S	R	Y/N	P	S	R	Y/N	P	S	R	Y/N	P	S	R	Y/N	P	S	R	Y/N	P	S	R
	Primary Conductors																												
52	Underground	N	7	0		N	7	0		Y	3	0	0	N	6	0		N	7	0		N	7	0		Y	4	2	8
	Switches																												
53	Underground	N	7	0		N	7	0		N	3	0		N	6	0		N	7	0		Y	7	0	0	N	4	0	
	Transformers																												
54	Submersible	N	7	0		Y	7	1	7	Y	3	1	3	N	6	0		N	7	0		Y	7	0	0	N	4	0	
	Civil Structures																												
55	Vault	Y	7	1	7	Y	7	1	7	Y	3	1	3	N	6	0		N	7	0		N	7	0		N	4	1	
56	Cable Chamber	Y	7	1	7	Y	7	1	7	Y	3	1	3	N	6	0		N	7	0		N	7	0		N	4	1	
	Feeder B-2	Y/N	P	S	R	Y/N	P	S	R	Y/N	P	S	R	Y/N	P	S	R	Y/N	P	S	R	Y/N	P	S	R	Y/N	P	S	R
	Primary Conductors																												
57	Overhead	Y	7	2	14	Y	7	2	14	Y	3	2	6	Y	6	1	6	Y	7	2	14	Y	7	2	14	N	4	0	
58	Underground	N	7	0		N	7	0		Y	3	0	0	N	6	0		N	7	0		N	7	0		Y	4	2	8
	Switches																												
59	Overhead - Main Line	Y	7	1	7	Y	7	1	7	Y	3	0	0	Y	6	1	6	Y	7	5	35	Y	7	5	35	N	4	0	
60	Overhead - Lateral Line	Y	7	1	7	Y	7	1	7	Y	3	0	0	Y	6	1	6	Y	7	5	35	Y	7	5	35	N	4	0	
61	Overhead - Customer	Y	7	1	7	Y	7	1	7	Y	3	0	0	Y	6	1	6	Y	7	4	28	Y	7	4	28	N	4	0	
62	Pad mounted	Y	7	0	0	Y	7	1	7	Y	3	1	3	Y	6	0	0	Y	7	1	7	Y	7	1	7	N	4	0	
63	Underground - URD	N	7	0		N	7	1		N	3	1		N	6			N	7			N	7			N	4	0	
	Transformers																												
64	Pole mounted	Y	7	2	14	Y	7	2	14	Y	3	2	6	Y	6	1	6	Y	7	6	42	Y	7	6	42	N	4	0	
65	Pad mount	Y	7	1	7	Y	7	1	7	Y	3	1	3	Y	6	0	0	Y	7	0	0	Y	7	1	7	N	4	0	
66	Submersible - URD	N	7	1		Y	7	1	7	Y	3	1	3	N	6			N	7	0		N	7	0		N	4	0	
	Civil Structures																												
67	Vault	Y	7	1	7	Y	7	1	7	Y	3	1	3	N	6	0		N	7	0		N	7	0		Y	4	3	12
68	Cable Chamber	Y	7	1	7	Y	7	1	7	Y	3	1	3	N	6	0		N	7	0		N	7	0		Y	4	3	12
	Poles																												
69	Steel	Y	7	2	14	Y	7	2	14	Y	3	2	6	Y	6	0	0	Y	7	0	0	Y	7	0	0	Y	4	3	12
70	Wood	Y	7	2	14	Y	7	2	14	Y	3	2	6	Y	6	0	0	Y	7	0	0	Y	7	0	0	Y	4	3	12
71	Concrete	Y	7	2	14	Y	7	2	14	Y	3	2	6	Y	6	0	0	Y	7	0	0	Y	7	0	0	Y	4	3	12

RESPONSES TO BUILDING OWNERS AND MANAGERS ASSOCIATION, GREATER TORONTO INTERROGATORIES

INTERROGATORY 8:

Reference(s): Exhibit 1A, Tab 2, Schedule 1, page 15, line 13 (updated)

a) In what manner is Toronto Hydro's forecast 2015 capital expenditures or its 2015-2019 average capital expenditures of $500 million per year "comparable" to its average capital expenditure in the last rebasing in 2011 ($440 million per year)? The planned five year average is $60 million, or 13% higher than the average of the 2011-2012 numbers.

b) Please provide the comparable numbers for 2012, 2013, and the 9 and 3 estimate for 2014.

c) What has the 2014 capex been to date?

d) Please compare the 2012, 2013, and 2014 actual capex either Board approved, or settled amounts or amounts incurred for those years, and explain any differences.

e) Please provide the compound growth rate of actual capital expenditures over the 2006-2015 period, and the increase year over year for the same period.

RESPONSE:

a) To clarify, the full statement referenced is as follows: "Toronto Hydro's requested Capital Expenditures for the period 2015-2019 are approximately $500 million per year, which is comparable to <u>the average annual spending since the utility's last rebasing</u> in 2011 (approximately $440 million per year)" [emphasis added]. Therefore, the $440 million per year figure is derived from the annual spending from years 2012 onwards to 2014. Annual spending between 2012 and 2014 was further broken apart as part of Toronto Hydro's response to Interrogatory 1B-SEC-5. This

RESPONSES TO BUILDING OWNERS AND MANAGERS ASSOCIATION, GREATER TORONTO INTERROGATORIES

average annual spending figure will exceed the $500 million threshold when focusing on those years containing more complete capital spending activities – 2013 and 2014 respectively.

b) The following table includes actual and forecast capital expenditures incurred in 2012, 2013 and 2014. The September 2014 financial statements have not yet been finalized and therefore actuals are presented as year-to-date June 2014 and a forecast of year-end 2014.

	2012 Actual	2013 Actual	2014 Actual (YTD June)	2014 Forecast (Annual)
Total Capital Expenditures ($M)	$288.0	$445.7	$240.7	$589.2

c) Please see response to part b.

d) The following table represents actual and forecast capital expenditures compared to Board approved amounts for 2012, 2013 and 2014. For programs authorized in Toronto Hydro's previous ICM/IRM application, a discussion of variances can be found in the response to Interrogatory 2B-OEBStaff-39. Please note that the actual/forecast amounts shown in the following table include additional expenditures that were not authorized as part of the previous application (e.g., costs associated with the Operating Centres Consolidation program).

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	Phase 1: Approved Capex			Phase 2: Approved Capex	Phase 1 + 2: Actual / Forecast		
	2012 Approved Capex	2013 Approved Capex	2014 Approved Capex	2014 Approved Capex	2012 Actual Capex	2013 Actual Capex	2014 Q3 Fcst Capex (Annual)
Total Capital Expenditures ($M)	$203.3	$484.2	$71.6	$327.2	$288.0	$445.7	$589.2

e) The following table represents the year over year percentage growth rate of actual Capital Expenditure for the period 2006 – 2015:

Year	Total Cost ($M)	Year over Year %
2006	$193	-
2007	$276	43%
2008	$234	-15%
2009	$262	12%
2010	$401	53%
2011	$446	11%
2012	$288	-35%
2013	$446	55%
2014	$589	32%
2015	$540	-8%

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The compound growth rate of actual capital expenditure is 12% for the period 2006 – 2015.

RESPONSES TO BUILDING OWNERS AND MANAGERS ASSOCIATION, GREATER TORONTO INTERROGATORIES

INTERROGATORY 9:

Reference(s): **Exhibit 1A, Tab 2, Schedule 1, page 15**

Please provide a copy of Toronto Hydro's Conditions of Service.

RESPONSE:

Toronto Hydro's current Conditions of Service are attached as Appendix A to this response.

CONDITIONS OF SERVICE

REVISION #13

Effective Date: May 1, 2014

***Comments to these revisions can be emailed to**:* ConditionsofService@torontohydro.com

Customers without e-mail access can submit inquiries through regular mail to:
Standards & Policy Planning Department
Toronto Hydro-Electric System Limited
500 Commissioners Street
Toronto, Ontario
M4M 3N7

To contact Toronto Hydro call (416) 542-8000 or e-mail at: ConditionsofService@torontohydro.com

Toronto Hydro-Electric System Limited

PREFACE

CONDITIONS OF SERVICE

The Distribution System Code (DSC) requires that every distributor produce its own "Conditions of Service" document. The purpose of this document is to provide a means for communicating the types and level of service available to the Customers and Consumers within Toronto Hydro's service area. The Distribution System Code requires that the Conditions of Service be readily available for review by the general public. In addition, the most recent version of the document must be provided to the Ontario Energy Board (OEB), which in turn will retain it on file for the purpose of facilitating dispute resolutions in the event that a dispute cannot be resolved between the Customer and its distributor.

The acceptance of supply of electricity or related services from Toronto Hydro constitutes the acceptance of a binding contract with Toronto Hydro which includes this Conditions of Service ("Conditions") and all terms thereunder. The person so accepting the supply of electricity or related services shall be liable for payment for same, and such contract shall be binding upon the person's heirs, administrators, executors, successors or assigns.

This document follows the form and general content of the Condition of Service template appended to the DSC. The template was prepared to assist distributors in developing their own "Conditions of Service" document based on current practice and the DSC. The text of the template is shown *in italics* throughout this Conditions, right after each of the subheadings. The template outlines the minimum requirements. However, as suggested by the DSC, Toronto Hydro has expanded on the contents to encompass local characteristics and other specific requirements.

Section 2 (Distribution Activities (General)) contains references to services and requirements that are common to all Customer classes. This section covers items such as Rates, Billing, Hours of Work, Emergency Response, Power Quality, Available Voltages and Metering.

Section 3 (Customer Class Specific) contains references to services and requirements specific to the respective Customer class. This section covers items such as Service Entrance Requirements, Delineation of Ownership, Special Contracts, etc.

Other sections include the *Glossary of Terms, Tables* and *References.*

Subsequent changes will be incorporated with each submission to the OEB.

A Revision Summary of the latest revisions to the Conditions of Service is posted on Toronto Hydro's website. Comments to these revisions can be emailed to ConditionsofService@torontohydro.com . Toronto Hydro will file to the Ontario Energy Board a summary of public comments received from customers about the changes.

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Section 1 – INTRODUCTION

1 INTRODUCTION

1.1 Identification of Distributor and Service Area

In this section the distributor should identify its service area as defined in the Distributor's License.

Toronto Hydro-Electric System Limited, referred to herein as "Toronto Hydro," is a corporation incorporated under the laws of the Province of Ontario and a distributor of electricity.

Toronto Hydro is licensed by the Ontario Energy Board ("OEB") to supply electricity to Customers as described in the Electricity Distribution License issued to Toronto Hydro on October 17, 2003 by the OEB and expiring October 16, 2023 ("Distribution License"). Additionally, there are requirements imposed on Toronto Hydro by the various codes referred to in the Distribution License and by the *Electricity Act, 1998* and the *Ontario Energy Board Act, 1998*.

Toronto Hydro may only operate distribution facilities within its Licensed Territory as defined in its Distribution License. This service area is subject to change with the OEB's approval.

Nothing contained in this Conditions of Service ("this Conditions") or in any contract for the supply of electricity by Toronto Hydro shall prejudice or affect any rights, privileges, or powers vested in Toronto Hydro by law under any Act of the Legislature of Ontario or the Parliament of Canada, or any regulations thereunder.

1.1.1 Distribution Overview

Toronto Hydro distributes electrical power through 13.8 kV and 27.6 kV primary distribution systems. On the 27.6 kV system all feeders are arranged to run in an open-loop fashion with open points between adjacent feeders. These feeders supply distribution transformers either directly or through 13.8 kV or 4 kV sub-distribution systems. There are presently four types of distribution design systems at the 13.8kV primary voltage level:

- 13.8 kV underground radial
- 13.8 kV overhead open loop
- 13.8 kV underground open-loop
- 13.8 kV underground network

The underground network system is distinct from the other systems. This low-voltage secondary network system may be available to some Customers in the

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downtown core of the City of Toronto as a source of supply at 120/208 V, depending on the local capacity of the system and the energy requirements of the Customer.

The supply of electricity by Toronto Hydro to any Customer will be at one of the following primary voltage levels: 27.6 kV or 13.8 kV depending on the proximity of the Customer's premises to the nearest distribution facility. For connection of a Customer at 4 kV level, Toronto Hydro will carry out a special study to justify the investment. The cost of this study may be charged to the Customer.

1.2 Related Codes and Governing Laws

This section should reference any legislation that is applicable to the distributor – Customer relationship.

The supply of electricity or related services by Toronto Hydro to any Customer or Consumer shall be subject to various laws, regulations, and codes, including the provisions of the latest editions of the following acts, codes and licences:

1. *Electricity Act, 1998* } part of the Energy Competition
2. *Ontario Energy Board Act, 1998* } Act, 1998
3. Distribution Licence
4. Affiliate Relationships Code
5. Transmission System Code
6. Distribution System Code
7. Retail Settlement Code
8. Standard Supply Service Code

In the event of a conflict between this document and the Distribution License or regulatory codes issued by the OEB, or the Energy Competition Act, 1998 (the "Act"), the provisions of the Act, the Distribution License and associated regulatory codes shall prevail in the order of priority indicated above.

When planning and designing for electricity service, Customers and their agents must refer to all applicable provincial and Canadian electrical codes, and all other applicable federal, provincial, and municipal laws, regulations, codes and by-laws to also ensure compliance with their requirements. Without limiting the foregoing, the work shall be conducted in accordance with the latest edition of the *Ontario Occupational Health and Safety Act* (OHSA), the Regulations for Construction Projects and the harmonized Electric Utility Safety Association (EUSA) rulebook.

1.3 Interpretations

This section should describe the rules for interpretation of the Conditions of Service document.

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In this Conditions, unless the context otherwise requires:

- Headings, paragraph numbers and underlining are for convenience only and do not affect the interpretation of this Conditions;
- Words referring to the singular include the plural and vice versa;
- Words referring to a gender include any gender

1.4 Amendments and Changes

This section should outline the process for making changes to this document. Include any public notice provisions.

The provisions of this Conditions in effect at the time Toronto Hydro signs the contract shall form part of any contract made between Toronto Hydro and any connected Customer, Consumer or Retailer. This Conditions supercedes all previous conditions of service, oral or written, of Toronto Hydro including any of its predecessor municipal electric utilities as of its effective date.

In the event of changes to this Conditions, Toronto Hydro will issue a notice with the Consumer's bill. Toronto Hydro may also issue a public notice in a local newspaper.

The Customer is responsible for contacting Toronto Hydro to obtain the current version of this Conditions. Toronto Hydro may charge a reasonable fee for providing the Customer with a copy of this document. The current version of this document is also posted on the Toronto Hydro website and can be downloaded from www.torontohydro.com.

1.5 Contact Information

This section should provide information on how a Customer can contact the distributor. Include such items as:

- ***Address of the distributor,***
- ***Telephone numbers,***
- ***Normal business hours, and***
- ***Emergency contact numbers.***

Toronto Hydro can be contacted 24 hours a day at 416-542-8000 or such other numbers as Toronto Hydro may advise through its website, invoices or otherwise. Normal working hours is Monday to Friday between 8:30 a.m. and 4:30 p.m. The mailing address is 14 Carlton Street, Toronto Ontario M5B 1K5.

Section 1 – INTRODUCTION

1.6 Customer Rights

This section should outline the rights and obligations a Customer or embedded generator has with respect to the distributor that are not covered elsewhere in this document.

Toronto Hydro shall only be liable to a Customer and a Customer shall only be liable to Toronto Hydro for any damages that arise directly out of the willful misconduct or negligence:

- of Toronto Hydro in providing distribution services to the Customer;
- of the Customer in being connected to Toronto Hydro's distribution system; or
- of Toronto Hydro or Customer in meeting their respective obligations under this Conditions, their licences and any other applicable law.

Notwithstanding the above, neither Toronto Hydro nor the Customer shall be liable under any circumstances whatsoever for any loss of profits or revenues, business interruption losses, loss of contract or loss of goodwill, or for any indirect, consequential, incidental or special damages, including but not limited to punitive or exemplary damages, whether any of the said liability, loss or damages arise in contract, tort or otherwise.

The Customer shall indemnify and hold harmless Toronto Hydro, its directors, officers, employees and agents from any claims made by any third parties in connection with the construction and installation of an embedded generation facility or other electrical apparatus by or on behalf of the Customer.

1.7 Distributor Rights

This section should outline the rights a distributor has with respect to a Customer or embedded generator that are not covered elsewhere in this document.

1.7.1 Access to Customer Property

Toronto Hydro shall have access to Customer's property in accordance with section 40 of the *Electricity Act, 1998*.

1.7.2 Safety of Equipment

The Customer shall comply with all aspects of the Ontario Electrical Safety Code with respect to insuring that equipment is properly identified and connected for metering and operation purposes and will take whatever steps necessary to correct any deficiencies, in particular cross wiring situations, in a timely fashion. If the Customer does not take such action within a reasonable time, Toronto Hydro may disconnect the supply of electricity to the Customer.

Section 1 – INTRODUCTION

The Customer shall not use or interfere with the facilities of Toronto Hydro except in accordance with a written agreement with Toronto Hydro. Toronto Hydro has the right to seal any point where a connection may be made on the line side of the metering equipment.

The Customer shall not build, plant or maintain or cause to be built, planted or maintained any structure, tree, shrub or landscaping that would or could obstruct the running of distribution lines, endanger the equipment of Toronto Hydro, interfere with the proper and safe operation of Toronto Hydro’s facilities or adversely affect compliance with any applicable legislation in the sole opinion of Toronto Hydro. Where an obstruction is discovered, Toronto Hydro will notify the Customer and provide a reasonable time for the Customer to correct any obstructions. If the Customer does not remove such obstruction within the reasonable time designated by Toronto Hydro, Toronto Hydro may disconnect the supply of electricity to the Customer and/or remove, relocate or, in the case of shrubs or other vegetation, trim such obstructions at the Customer's expense, and Toronto Hydro shall not be liable to the Customer for any damages arising as a result thereof, other than physical damage to facilities arising directly from entry on the Customer’s property. Toronto Hydro's policies and procedures with respect to the disconnection process are further described in this Conditions.

1.7.3 Tree and Vegetation Management

To ensure public safety and the continued reliable operation of its distribution system Toronto Hydro will maintain clearance around its distribution lines on a cyclical or as-needed basis in close cooperation with the City’s forestry department. The tree trimming cycle may vary depending on extent of storm damage, health of trees, and vegetation type.

Toronto Hydro will coordinate and maintain tree clearance around all its distribution lines that are located on public allowance. Toronto Hydro will also maintain tree clearance around its overhead lines over 750 Volts that may be located on private property at no cost to the Customer. Toronto Hydro will endeavour to discuss the planned re-clearing with property owners prior to work being performed in order to mitigate the impacts to the environment and the property. However, in the event of emergencies, Toronto Hydro may be unable to notify the property owner prior to performing the work.

Customers are responsible for all initial tree trimming for all new overhead lines that will be located on private property. Customers are also responsible for continuing tree trimming, tree and brush removal around service lines that are less than 750 Volts that are located on private property as well as around overhead lines over 750 Volts when these lines are owned by the Customer. Clearances must conform to the Electrical Safety Code.

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To permit the safe clearance of trees and vegetation from overhead lines over 750 Volts located on private property Toronto Hydro will, upon at least ten days prior notice from the Customer, once each year during normal business hours, disconnect and reconnect the Customer's supply without charge.

1.7.4 Operating Control

The Customer shall provide a convenient and safe place, satisfactory to Toronto Hydro, for installing, maintaining and operating its equipment in, on, or about the Customer's premises or in, on, or about the public road allowance for non-metered connections. Toronto Hydro assumes no risk and will not be liable for damages resulting from the presence of its equipment on the Customer's premises or in, on, or about the public road allowance for non-metered connections, or approaches thereto, or any acts, omissions or events beyond its control, or the negligence or willful misconduct of any Persons over whom Toronto Hydro has no control.

Unless an employee or an agent of Toronto Hydro, or other Person lawfully entitled to do so, no Person shall remove, replace, alter, repair, inspect or tamper with Toronto Hydro's equipment.

Customers will be required to pay the cost of repairs or replacement of Toronto Hydro's equipment that has been damaged or lost by the direct or indirect act or omission of the Customer or its agents.

The physical location on Customer's premises or the public road allowance for non-metered connections at which a distributor's responsibility for operational control of distribution equipment ends is defined by the Distribution System Code as the "operational demarcation point".

1.7.5 Customer-Owned Equipment, Infrastructure, and Property

The Customer is responsible for providing, inspecting, maintaining, repairing and replacing, in a safe condition satisfactory to Toronto Hydro, all equipment and infrastructure that is owned by the Customer on private property or in the public road allowance for non-metered connections. Equipment and infrastructure includes but is not limited to transformers, cable, switches, poles, fences, gates, duct banks, conduits, cable chambers, cable pull rooms, transformer rooms, transformer vaults, transformer pads, tap boxes, handwells, service masts, and junction boxes.

The Customer is also responsible for maintaining its property in a condition that is safe and that does not inhibit the operation or threaten the integrity or reliability of equipment or infrastructure owned by the Customer or Toronto Hydro. The Customer's responsibility to maintain its property includes, but is not limited to,

Section 1 – INTRODUCTION

clearing vegetation, keeping storm drains clear and drainage systems fully functional, removing debris, maintaining operational and electrical clearances, and maintaining proper grading and surfaces.

The Customer shall inspect and maintain its equipment, infrastructure, and property at regular intervals. When access to the equipment, infrastructure, or property is under the control of Toronto Hydro (e.g. a transformer vault, a fenced off transformer), the Customer shall contact Toronto Hydro at the phone number posted on Toronto Hydro's website to make appropriate arrangements (e.g. access, temporary disconnection) prior to undertaking any inspections, maintenance, repairs, or replacements.

If the Customer does not inspect, maintain, repair, or replace its equipment, infrastructure, and property as required, Toronto Hydro may disconnect the supply of electricity to the Customer.

Notwithstanding the above, unless otherwise agreed to by the parties, subject to the Customer providing an easement to Toronto Hydro, Toronto Hydro will provide, maintain, repair and replace those civil infrastructure (such as poles, duct banks, conduits, cable chambers, cable pull rooms, transformer vaults, transformer pads, and switching vaults) that are required to house the primary distribution systems built along private streets that supply Customers of Multi-unit Residential developments (part of Class 3B). Effective November 15, 2004, Toronto Hydro will treat such infrastructure in the same way as those located in the public road allowance.

Where Toronto Hydro identifies, through an inspection or other activity, deficiencies relating to the equipment, infrastructure, or property owned by the Customer, such as deficiencies to walls, ceilings, floors, doors, vents, drains, electrical devices or other elements, Toronto Hydro may:

- notify the Customer of the deficiencies;
- provide a reasonable time for the Customer to correct the deficiencies; and
- if circumstances merit, request the Customer to correct the deficiency in a manner that brings the equipment, infrastructure, or property up to current standards even if the equipment, infrastructure, or property was designed, installed, or constructed to an older standard. (Examples of circumstances that may merit the application of a current standard include, but are not limited to, the existence of health or safety hazards, legal or regulatory requirements, and conditions that may impact the integrity, reliability, or operability of the distribution system or any equipment that supplies the Customer.)

If notified of deficiencies, or requested to correct deficiencies in a particular manner, the Customer shall correct the deficiencies and comply with any requests.

Section 1 – INTRODUCTION

If the Customer does not correct the deficiencies within the reasonable time, or if the corrections are not considered adequate by Toronto Hydro or an inspection authority, Toronto Hydro may disconnect the supply of electricity to the Customer or may correct the deficiencies at the Customer's expense, and Toronto Hydro shall not be liable to the Customer for any damages arising as a result of or in the course of disconnecting supply or correcting the deficiencies other than physical damage to facilities arising directly from entry on the Customer’s property. Toronto Hydro's policies and procedures with respect to the disconnection process are further described in this Conditions.

1.8 Disputes

Any dispute between Customers or Retailers and the Distributor shall be settled according to the dispute resolution process specified in the Distributor Licence. In this section, the Distributor should outline the Customer Complaint and Dispute Resolution process that has been established as a condition of licence.

If a Customer, Consumer or other market participant has a complaint about Toronto Hydro regarding services provided by Toronto Hydro under its Electricity Distribution License, the Consumer may contact one of Toronto Hydro's Customer Care representatives at 416-542-8000 during regular business hours, between 8:30 AM and 4:30 PM Monday to Friday, or e-mail the complaint to contactus@torontohydro.com.

Upon receipt of a complaint, a Toronto Hydro Customer Care representative will contact the Customer, Consumer or other market participant to acknowledge receipt of the complaint and, if possible, to resolve the complaint, and will investigate and follow-up on the complaint as required to resolve the complaint. If a Customer, Consumer or other market participant complaint cannot be resolved by contacting one of Toronto Hydro's Customer Care representatives, Toronto Hydro will refer the unresolved complaint to an independent third party complaints resolution agency that has been approved by the Ontario Energy Board. Until such time as the Ontario Energy Board approves such an independent third party complaints resolution agency, such complaints will be referred to the Ontario Energy Board, which has assumed this role.

Section 2 – DISTRIBUTION ACTIVITIES (GENERAL)

2 DISTRIBUTION ACTIVITIES (GENERAL)

This section should include information that is applicable to all Customer classes of the distributor. Items that are applicable to only a specific Customer class are covered in Section 3.

2.1 Connections - Process and Timing

Under the terms of the Distribution System Code, Toronto Hydro has the obligation to either connect or to make an offer to connect any Customers that lie in its service area. The form of the offer and its terms and conditions may vary in accordance with Toronto Hydro's requirements for connecting a Customer to Toronto Hydro's distribution system.

The Customer or its representative shall consult with Toronto Hydro concerning the availability of supply, the supply voltage, service location, metering, and any other details. These requirements are separate from and in addition to those of the Electrical Safety Authority (ESA). Toronto Hydro will confirm, in writing, the characteristics of the electricity supply.

The Customer or its authorized representative shall apply for new or upgraded electricity services and temporary power services in writing. The Customer is required to provide Toronto Hydro with sufficient lead-time in order to ensure:

- the timely provision of electricity supply to new and upgraded premises or
- the availability of adequate capacity for additional loads to be connected in existing premises.

Toronto Hydro shall make every reasonable effort to respond promptly to a Customer's request for connection. Toronto Hydro shall respond to a Customer's written request for a Customer connection within 15 calendar days of receipt of the written request. Toronto Hydro will make an offer to connect within 60 calendar days of receipt of the written request, unless other necessary information is required from the Customer before the offer can be made.

Toronto Hydro may collect a Design Pre-payment in order to initiate and perform a design review in the preparation of an offer to connect. Upon acceptance of the offer to connect, the Design Pre-payment will be credited towards the Customer's financial obligations for the project. If the Customer does not accept Toronto Hydro's offer to connect, or if the applicant withdraws its application, or if Toronto Hydro is unable to provide an offer to connect, then Toronto Hydro may refund the Design Pre-Payment less any costs incurred by Toronto Hydro.

Toronto Hydro shall make every reasonable effort to respond promptly to another distributor's request for connection. Toronto Hydro shall provide an initial consultation with another distributor regarding the connection process within thirty

Section 2 – DISTRIBUTION ACTIVITIES (GENERAL)

(30) days of receiving a written request for connection. A final offer to connect the distributor to Toronto Hydro's distribution system shall be made within ninety (90) days of receiving the written request for connection, unless other necessary information outside the distributor's control is required before the offer can be made.

If special equipment is required or equipment delivery problems occur, then longer lead times may be necessary. Toronto Hydro will notify the Customer of any extended lead times.

In addition to any other requirements in this Conditions, the supply of electricity is conditional upon Toronto Hydro being permitted and able to provide such a supply, obtaining the necessary apparatus, material, and easements, and constructing works to provide the service. Should Toronto Hydro not be permitted or able to do so, it is under no responsibility to the Customer whatsoever and the Customer releases Toronto Hydro from any liability in respect thereto.

Requirements regarding Connection Agreements are set forth in Sections 2.1.7.4, 3.7, and in Section 6, Reference #3 – "Toronto Hydro Distributed Generation Requirements" for load Customer, a Generator, Wholesale Market Participant, and Embedded Distributor.

2.1.1 Building that Lies Along

In this section, the Distributor should describe the standard connection allowance or charge used by the Distributor in its service territory, and describe any variable connection fees that would be charged beyond the standard allowance.
The Distributor also may stipulate in this section other terms and conditions by which a Customer requesting a Connection must abide, as long as it is within the terms of the DSC code.

For the purpose of this Conditions "lies along" means a Customer property or parcel of land that is directly adjacent to or abuts onto the public road allowance where Toronto Hydro has distribution facilities of the appropriate voltage and capacity.

Under the terms of the Distribution System Code, Toronto Hydro has the obligation to connect (under Section 28 of the *Electricity Act, 1998*) a building or facility that "lies along" its distribution line, provided:

a) the building can be connected to Toronto Hydro's distribution system without an expansion or enhancement and,
b) the service installation meets the conditions listed in the Conditions of Service of the distributor that owns and operates the distribution line.

The location of the Customer's service entrance equipment is subject to the approval of Toronto Hydro and the Electrical Safety Authority.

Section 2 – DISTRIBUTION ACTIVITIES (GENERAL)

2.1.1.1 Connection Charges

Toronto Hydro shall recover costs associated with the installation of connection assets by Customer Class via Basic Connection Costs through the economic evaluation for Expansions and Variable Connection Costs, collected directly from the Customer, as applicable.

The Variable Connection Costs shall be calculated as the costs associated with the installation of Connection assets **above and beyond** the Standard Allowance for Basic Connection as described in Tables 1.1, 1.2, 1.3, and 1.4. Toronto Hydro will recover these Variable Connection Costs, which shall be based on actual cost, directly from the Customer.

2.1.2 Expansions / Offer to Connect

Under the terms of the DSC, a Distributor has the Obligation to make an Offer to Connect any Building that is in the distributor' s service territory that cannot be connected without an expansion, or "lies along" its distribution system, but may be denied connection for the reasons described in subsection 2.1.3 of the distributor's Conditions of Service.

The Offer to Connect must be fair and reasonable and be based on the distributor's design standard. The Offer to Connect also must be made within a reasonable time from the request for connection.

In this section, the Distributor should outline, in detail, the process followed to determine any required capital contributions. This section also should describe any fixed connection fees as well as variable connection fees, by Customer class.

If a Customer requests to connect a new Customer load, either through a new connection or by increasing the load at an existing connection, to Toronto Hydro's distribution system, and the new load necessitates an expansion of Toronto Hydro's distribution system, then Toronto Hydro will provide Customers requesting connections that necessitate an expansion with an offer to connect for expansions ("Offer to Connect"). Toronto Hydro will perform an economic evaluation of the expansion project in accordance with the Capital Contribution policy set out in Section 2.1.2.2. The economic evaluation will determine if the forecasted future revenue ("Estimated Incremental Revenues") from the new load ("Estimated Incremental Demand") and from the Customer(s) will pay for the costs associated with the expansion. The costs associated with the expansion include but are not limited to:

1) the distribution system expansion capital cost *"*Expansion Costs*"*;
2) on-going operating, maintenance and administration costs including those actually incurred and those apportioned in the manner set forth below *"*OM&A Costs*"*; and
3) the basic cost of connection outlined in Tables 1.1, 1.2, and 1.3 "Basic Connection Costs".

Section 2 – DISTRIBUTION ACTIVITIES (GENERAL)

The Expansion Costs that Toronto Hydro will include in the economic evaluation are capital costs that are associated with the installation of expansion facilities and equipment on Toronto Hydro's main distribution system. The expansion facilities and equipment will typically meet the following criteria:

- Are required to accommodate the new Customer load;
- Are not necessary to serve the needs of existing Customers and their existing loads; and
- Are designed and installed in accordance with Toronto Hydro's planning, design, and construction standards.

For the purpose of determining OM&A Costs, Toronto Hydro will use system average operating, maintenance and administrative costs as a proxy for incremental OM&A Costs associated with the expansion facilities and apportion them as fixed costs (for Rate Class 1 and 2) or as a function of $/kW of demand (for Rate Class 3, 4, and 5).

The Expansion Costs are in addition to any Variable Connection Costs. Refer to Table 1.1, 1.2, and 1.3 in Section 5 for each Customer Class.

For the purpose of establishing the Estimated Incremental Demand to be used in the economic evaluation, the Customer shall provide a valid estimate of the proposed new load (incremental demand) for evaluation and acceptance by Toronto Hydro. If the Customer and Toronto Hydro are unable to agree on a valid incremental demand for new Class 3, 4, and 5 Customers or in the absence of adequate billing history for existing Customers, Toronto Hydro will set the Estimated Incremental Demand to 90% of the incremental installed transformer capacity.

Using the Estimated Incremental Demand, Toronto Hydro shall then calculate the Estimated Incremental Revenues that would be received from the Customer(s) based on the new load. Toronto Hydro will use the "fixed charge" and the "variable charge" that have been approved by the Ontario Energy Board by Rate Class to determine the Estimated Incremental Revenues. For existing Customers Toronto Hydro shall apportion the "fixed charge" based on the ratio between the new (incremental) load and the combined load.

In performing the economic evaluation, should the Net Present Value (NPV) of the costs and revenues associated with the Expansion be less than zero, the Customer shall pay a capital contribution in the amount of the shortfall (i.e. the amount below zero) to Toronto Hydro. Toronto Hydro has elected to collect this shortfall from the Customer in accordance with its Capital Contribution policy as outlined in Section 2.1.2.2.

Section 2 – DISTRIBUTION ACTIVITIES (GENERAL)

For the purposes of connecting a generator, the amount charged by Toronto Hydro to the generator to construct an expansion to connect a generation facility to the Toronto Hydro distribution system shall not exceed the generator's share of the present value of the projected capital costs and on-going maintenance costs for the equipment. Projected revenue and avoided costs from the generation facility shall be assumed to be zero, unless otherwise determined by rates approved by the Ontario Energy Board. In the case of a renewable energy generation facility, Toronto Hydro shall not charge the generator for any costs of the expansion that are at or below the renewable energy expansion costs cap for renewable energy generation facilities as set by the Ontario Energy Board.

The methodology and inputs that Toronto Hydro will use for all new load and new connection economic evaluations are presented in Appendix B of the Distribution System Code.

2.1.2.1 Offer to Connect & Alternative Bid Work

Toronto Hydro will provide one firm Offer to Connect to the Customer, at no expense to the Customer, for plans submitted to Toronto Hydro that necessitate an expansion to Toronto Hydro's main distribution system. If the Customer submits revised plans, Toronto Hydro may provide a new firm Offer to Connect for the revised plans at the Customer's expense.

In the Offer to Connect, Toronto Hydro will advise the Customer of any eligible work for which the Customer has the choice to obtain alternative bids from a qualified contractor. The Customer may obtain an alternative bid to construct the eligible work portions of the expansion and connection facilities:

- that do not make physical contact with Toronto Hydro's distribution system; and
- that only require work to be completed within Toronto Hydro's safe limits of approach to energized facilities or equipment,

unless otherwise directed by Toronto Hydro.

If the Customer chooses to utilize an alternative bid, the Customer shall only use qualified contractors. To qualify to undertake work that is eligible for alternative bid, contractors shall submit a "Construction Contractor Pre-Qualification Application" (refer to Section 6) and meet the requirements no later than 30 business days prior to their selection by the Customer to undertake work that is eligible for alternative bid. To avoid delay in the start of the work that is eligible for alternative bid, the Customer shall engage a contractor that is qualified.

Section 2 – DISTRIBUTION ACTIVITIES (GENERAL)

Toronto Hydro does not make any representation or warranty regarding any contractor selected by the Customer to do any work regardless of whether the contractor has completed the requirements set by Toronto Hydro or not and shall have no liability to the Customer in respect of such work.

Toronto Hydro will also include in the Offer to Connect or by separate document an estimate of any additional costs ("Additional Alternative Bid Costs") that will be incurred by Toronto Hydro in the event that the Customer decides to pursue an alternative bid for the work that is eligible for alternative bid. Additional Alternative Bid Costs may include, but are not limited to, the following:

- costs for additional design, engineering, or installation of facilities required to complete the project;
- costs associated with any temporary de-energization of any portion of the existing distribution system that is required in relation to an expansion that is constructed under the alternative bid option;
- costs associated to review and approve the plans for the design, engineering, layout, and work execution for the work that is eligible for alternative bid to ensure conformance to Toronto Hydro's distribution system planning standards and specifications prior to commencing that work;
- costs for administering the contract between the Customer and the contractor hired by the Customer if Toronto Hydro is asked to administer the contract by the Customer and Toronto Hydro agrees to administer the contract; and
- costs for inspection or approval by Toronto Hydro of the work performed by the contractor hired by the Customer.

Within sixty (60) days of receiving the Offer to Connect, the Customer shall return a signed copy of the Offer to Connect indicating the Customer has accepted the offer, and whether the Customer is electing to pursue an alternative bid. After sixty (60) days, if the Customer has not accepted the Offer to Connect in writing, Toronto Hydro may revoke the Offer to Connect without providing any notification to the Customer.

If the Customer decides to pursue an alternative bid, the Customer and his qualified contractor shall only use materials that meet the same specifications as Toronto Hydro approved materials (i.e. same manufacturers and same part numbers). Once the Customer has hired a qualified contractor, the Customer may request, and if requested, Toronto Hydro shall provide the listing of approved materials that may be required for the alternative bid work.

Upon accepting an Offer to Connect, regardless of whether the Customer will be pursuing an alternative bid or not, the Customer shall provide Toronto

Hydro the payables (e.g. costs) and security amounts (e.g. deposits) as required and stipulated in the Offer to Connect.

2.1.2.2 Capital Contribution Policy

The capital contribution policy elected by Toronto Hydro shall be consistent with the policy outlined below for each Customer Class:

Class 1 – Residential Single Service: No Transformation required on private property

- Overhead or Underground: *Capital contribution **not** collected from Customer*

Class 2 - General Service, (Below 50 kW): No Transformation required on private property

- Overhead or Underground: *Capital contribution **not** collected from Customer*

Class 3 - General Service (50 kW – 999 kW): Capital contribution collected from Customer

Class 4 - General Service (1000 kW – 4999 kW): Capital contribution collected from Customer.

Class 5 – Large User (5000 kW and above): Capital contribution collected from Customer

For the purpose of determining the amount of Capital Contribution payable by a Customer the following clarification and exception shall apply:

- Condominium apartments and apartment buildings that have a demand less than 1,000 kW are part of Class 3A General Services
- Condominium townhouse units intended to remain in private property are part of Class 3B General Service
- Townhouse units built (or intended to be) fronting public road allowances are part of Class 3C “Residential Subdivision”
- Townhouse units built as “freehold” (i.e. on property owned by the individual townhouse owner) are part of Class 3C “Residential Subdivision”
- Low-rise residential developments involving more than 5 lots regardless of demand are classified as Class 3C “Residential Subdivision”.

Section 2 – DISTRIBUTION ACTIVITIES (GENERAL)

However, notwithstanding the treatment of capital contribution, Toronto Hydro shall in all cases calculate the "Estimated Incremental Revenues" of new Customers using the "fixed charge" and the "variable charge" that have been approved by the Ontario Energy Board for the Rate Class applicable to each individual new meter installed in connection with the expansion project.

To determine the amount of Capital Contribution required from a Class 3, 4, or 5 Customer for an expansion project, Toronto Hydro will perform an economic evaluation by inputting the project specific information together with a set of standardized assumptions and specific annual parameters into a proprietary "Business Economic Model" developed for Toronto Hydro in accordance with the methodology and inputs outlined in Appendix B of the Distribution System Code ("Economic Evaluation").

2.1.2.2.1 Offer to Connect – Content & Process

Based on the output of its Economic Evaluation, Toronto Hydro will set out in the Offer to Connect the following, as applicable:

(a) Whether the offer is a firm offer or an estimate of costs that would be revised in the final payment to reflect actual costs incurred;

(b) the amount of the capital contribution;

(c) the calculation used to determine the amount of the capital contribution including all of the assumptions and inputs used to produce the economic evaluation;

(d) a statement as to whether the offer includes work for which the Customer may obtain an alternative bid, and, if so, the process by which the Customer may obtain the alternative bid;

(e) a description of, and costs for, the work that is eligible for alternative bid and the work that is not eligible for alternative bid associated with the expansion broken down into the following categories:
  (i) labour (including design, engineering and construction);
  (ii) materials;
  (iii) equipment; and
  (iv) overhead costs (including administration);

(f) the amount for any Additional Alternative Bid Costs;

(g) the amount for the basic cost of connection; and

(h) the expansion deposit amount.

If there is a conflict between an Offer to Connect and this Conditions, the Offer to Connect shall govern.

Section 2 – DISTRIBUTION ACTIVITIES (GENERAL)

2.1.2.2.2 Transfer Price for Work that is Eligible for Alternative Bid

The transfer price for the expansion work that is eligible for alternative bid shall be the lower of the cost to the Customer ("Customer's Cost") to construct the expansion facilities or the amount set out in the initial Offer to Connect to do the expansion work that is eligible for alternative bid. The Customer's Cost shall mean:

(a) The costs the Customer paid to have the eligible alternative bid expansion work performed, as supported by evidence satisfactory to Toronto Hydro; and
(b) Any costs incurred by Toronto Hydro and charged to the Customer as a result of the Customer selecting to perform expansion work using an alternative bid.

For greater clarity, the cost referred to in (a) does not include any costs associated with completing connection work as identified in the Offer to Connect.

If the Customer does not provide the cost to construct the expansion facilities as referred to in (a), to Toronto Hydro within 30 days of the expansion facilities being energized, then the amount of the transfer price shall be the amount set out in the initial Offer to Connect to do expansion the work that is eligible for alternative bid.

Toronto Hydro will assume ownership of the facilities as of the date that the facilities were energized unless otherwise specified in the Offer to Connect.

2.1.2.2.3 Alternative Bid Final Economic Evaluation & Capital Contribution Settlement

If the Offer to Connect is a firm offer and the Customer has exercised the alternative bid option, Toronto Hydro will carry out a final Economic Evaluation once the expansion facilities are energized. The final Economic Evaluation will be based on the amounts used in the firm offer for costs and forecasted revenues, plus any transfer price to be paid to the Customer. If the required capital contribution amount from the final Economic Evaluation ("Final Capital Contribution") differs from the required capital contribution amount from the initial Economic Evaluation ("Initial Capital Contribution"), the Customer will be responsible for the Final Capital Contribution and not the Initial Capital

Contribution. Toronto Hydro and the Customer shall arrange to settle any amounts owing as necessary, including by way of set off.

Toronto Hydro will provide the Customer with the calculation used to determine the final capital contribution amount including all of the assumptions and inputs used to produce the final Economic Evaluation at no cost to the Customer.

2.1.2.3 Expansion Deposit

As noted above, an expansion to Toronto Hydro's distribution system results in Expansion Costs and OM&A Costs. Given that the capital contribution that the Customer shall pay to Toronto Hydro may not fully offset these costs for Toronto Hydro, Toronto Hydro may require the Customer to provide an expansion deposit in addition to the capital contribution. The expansion deposit is intended to hold Toronto Hydro harmless with respect to the expansion.

For Class 3, 4, and 5 Customers an Offer to Connect may require the Customers to provide an expansion deposit to cover the difference between the Expansion Costs and the amount of the capital contribution paid by the Customer, in accordance with Toronto Hydro's Economic Evaluation of the expansion.

Where a Customer does not intend to pursue the alternative bid option, Toronto Hydro may require the Customer to provide the full expansion deposit, as contained in the Offer to Connect, prior to the commencement of any expansion work or the installation of any connection assets.

Where a Customer intends to exercise the alternative bid option, Toronto Hydro may require the Customer to post an initial expansion deposit in an amount equal to the costs for the expansion work that is ineligible for alternative bid, prior to the commencement of any expansion work or the installation of any connection assets. Once the expansion facilities are energized, and Toronto Hydro has conducted a final Economic Evaluation and determined a final capital contribution amount, Toronto Hydro may require the Customer to post an additional deposit to be added to the initial expansion deposit such that the total expansion deposit, made up of the initial expansion deposit and the additional deposit (collectively the "Total Expansion Deposit") is equal to the difference between the actual Expansion Costs, including the transfer price, and the amount of the final capital contribution.

Toronto Hydro may retain or realize on any expansion deposit from the Customer for the purposes of covering any amounts that the Customer owes to

Section 2 – DISTRIBUTION ACTIVITIES (GENERAL)

Toronto Hydro pursuant to the Offer to Connect. These amounts may include an outstanding capital contribution, and the costs associated with completing, repairing, or bringing up to standard the expansion facilities (e.g. bringing expansion facilities up to proper design and technical specifications; ensuring that facilities operate properly when energized).

In addition, for Customers that exercise the alternative bid option, Toronto Hydro may retain 10% of the Total Expansion Deposit, for a warranty period of up to two years and may apply such deposit to any work required to repair the expansion facilities within the two-year warranty period. At the end of the warranty period, Toronto Hydro shall return to the Customer the unused portion of the expansion deposit that was retained for the warranty period.

The two-year warranty period begins at the end of the Realization Period. The Realization Period for a project ends:

- For residential developments, upon the first to occur of the materialization of the last forecasted connection in the expansion project, or five (5) years after energization of the expansion facilities,
- For commercial and industrial developments, upon the first to occur of the materialization of the last forecasted demand, or five (5) years after energization of the expansion facilities, or
- For residential developments combined with commercial or industrial developments, upon the first to occur of the materialization of both the last forecasted connection and the last forecasted demand, or five (5) years after energization of the expansion facilities.

The expansion deposit must be either in the form of (i) cash or (ii) an irrevocable commercial letter of credit issued by a Schedule I bank as defined in the *Bank Act*, or (iii) surety bond, but the form of deposit must expressly provide for its use to cover the events for which it is held as a deposit.

Except for the warranty portion of the expansion deposit which shall be retained for the duration of the warranty period, once the facilities are energized, Toronto Hydro shall agree to reduce the expansion deposit amount at the end of each 365-day period.

The amount of the reduction at the end of each 365-day period is calculated by multiplying the expansion deposit (or Total Expansion Deposit in the case of an alternative bid) by a percentage, less any portion that Toronto Hydro has retained or realized. The percentage is derived by dividing the actual connections (for residential developments) or actual demand (for commercial and industrial developments) completed or materialized in that 365-day period, incremental to any connections completed or demand that materialized in any previous 365-day period, by the total number of connections (for residential developments) or actual demand (for commercial and industrial developments) contemplated in the Offer to Connect. (For example, if twenty percent of the forecasted connections or demand materialized in a year, and Toronto Hydro has not retained or realized any portion of the expansion deposit in accordance with the Offer to Connect, then Toronto Hydro will return to the Customer twenty percent of the expansion deposit.)

However, if after five (5) years from the energization date of the expansion facilities the total number of connections (for residential developments) or the actual demand (for commercial and industrial developments) contemplated by the Offer to Connect have not materialized, Toronto Hydro shall retain any cash held as an expansion deposit, or be entitled to realize on any letter of credit or bond held as an expansion deposit and retain any cash resulting therefrom, with no obligation to return any portion of such monies to the Customer at any time.

If the Customer has provided any expansion deposit in the form of cash, any portion of the expansion deposit held as cash returned to the Customer shall include interest on the returned amount from the date of receipt of the full amount of the expansion deposit at the Prime Business Rate set by the Bank of Canada less 2 percent.

2.1.2.4 Supply Agreement

Class 3, 4 and 5 Customers may be required to enter into a Supply Agreement with Toronto Hydro to clarify the responsibilities of each party pertaining to the construction and maintenance of the expansion and or connection assets.

2.1.2.5 Rebates of Capital Contribution

As noted above, when a new Customer connection or the addition of new load necessitates an expansion to Toronto Hydro’s distribution system, Toronto Hydro conducts an economic evaluation. The economic evaluation considers costs associated with the expansion and forecasts revenues that the expansion will enable. If, within five (5) years of the energization of the expansion facilities, a subsequent Customer:

- connects new load to Toronto Hydro’s distribution system;
- derives a benefit from the expansion facilities;
- the new load had not been forecasted and not included in the economic evaluation; and
- the subsequent Customer is a Class 3, 4, or 5 Customer,

then the subsequent Customer ("Unforecasted Customer") shall contribute a fair share of the cost that was incurred to construct the expansion. In such a case, Toronto Hydro shall collect the fair share from the Unforecasted Customer and shall provide that share as a rebate to the initial contributor (i.e. the Customer that initially paid the required capital contribution) to the expansion.

The amount of the fair share of the Unforecasted Customer, and therefore the amount of the rebate to the capital contribution of the initial contributor(s), will be determined by Toronto Hydro by apportioning the overall benefits associated with the expansion between the Unforecasted Customer and the initial (or previous) contributor(s). If applicable, Toronto Hydro may consider any or all of the following factors when apportioning the overall benefits:

(a) the relative name-plate rated capacity of the connections;
(b) the relative load levels;
(c) the line length that the Unforecasted Customer requires in comparison to the line length that the initial contributor(s) requires in the context of the expansion;
(d) the proportion of the five (5) year period of time after the energization date of the expansion that the Unforecasted Customer will be connected to the Toronto Hydro distribution system; and
(e) any other factor that Toronto Hydro, in its sole discretion, considers to be relevant to the determination.

2.1.2.6 Feeder Capacity Optimization

Toronto Hydro will provide service to the Customer during the Realization Period based upon the Estimated Incremental Demand indicated in the Offer to Connect that has been signed by the Customer. However, unused capacity will not be reserved past the Realization Period.

After the Realization Period Toronto Hydro reserves the right to examine the Customer's peak demand with a view to optimizing its feeder capacity. If the actual peak demand is lower than the Estimated Incremental Demand, then Toronto Hydro will adjust downwards its internal peak demand forecast and may re-assign any unused capacity if it determines this is appropriate to meet other demand needs.

After the Realization Period the Customer shall obtain the consent of Toronto Hydro prior to effecting any substantial increase its peak demand, regardless of the Estimated Incremental Demand set forth in the Offer to Connect, or through past demand history.

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2.1.3 Connection Denial

The DSC sets outs the conditions for a Distributor to deny connections. The DSC lists reasons for which a Building that "lies along" a distribution line may be refused connection to that line. This section should describe reasons why a distributor may not be obligated to connect the Customer and provide additional details, where relevant, about specific conditions that may result in a refused connection in accordance with the DSC code. For example, the criteria for establishing an unsafe connection or a connection, which adversely affects the system, should be further documented within the Conditions of Service.

The Distribution System Code provides for the ability of a Distributor to deny connections. Toronto Hydro is not obligated to connect a Customer within its service area if the connection would result in any of the following:

- Contravention of existing laws of Canada or the Province of Ontario, including the Ontario Electrical Safety Code
- Violations of conditions in Toronto Hydro's Licence
- Use of a Toronto Hydro distribution system line for a purpose that it does not serve and that Toronto Hydro does not intend to serve
- Adverse affect on the reliability or safety of Toronto Hydro's distribution system
- Public safety reasons or imposition of an unsafe work situation beyond normal risks inherent in the operation of Toronto Hydro's distribution system
- A material decrease in the efficiency of the Toronto Hydro's distribution system
- A materially adverse effect on the quality of distribution services received by an existing connection
- If the person requesting the connection owes Toronto Hydro money for distribution services
- Potential increases in monetary amounts that already are in arrears with Toronto Hydro
- If an electrical connection to Toronto Hydro's distribution system does not meet Toronto Hydro's design requirements
- Any other conditions documented in Toronto Hydro's Conditions.

If Toronto Hydro refuses to connect a Customer in its service area that lies along one of its distribution lines, Toronto Hydro shall inform the person requesting the connection of the reasons for the denial, and where Toronto Hydro is able to provide a remedy, make an Offer to Connect in accordance with Section 2.1.2 of this Conditions. If Toronto Hydro is not capable of resolving the issue, it is the responsibility of the Customer to do so before a connection can be made.

Section 2 – DISTRIBUTION ACTIVITIES (GENERAL)

2.1.4 Inspections Before Connections

In this section, the Distributor should state the requirement for inspection by the Electrical Safety Authority prior to the commencement of electricity supply.

All Customer electrical installations shall be inspected and approved by the Electrical Safety Authority and must also meet Toronto Hydro's requirements. Toronto Hydro requires notification from the Electrical Safety Authority of this approval prior to the energization of a Customer's supply of electricity. Where a "Connection Authorization" from the Electrical Safety Authority has been issued to Toronto Hydro, it is valid for the connection of a service for a period of up to six months from the date of issue. If the connection of service has not been completed after six months, a new "Connection Authorization" is required. Services that have been disconnected for a period of six months or longer must also be re-inspected and approved by the Electrical Safety Authority, prior to reconnection.

Temporary services, typically used for construction purposes and for a period of twelve months or less, must be approved by the Electrical Safety Authority and must be re-inspected should the period of use exceed twelve months.

Customer owned substations must be inspected by both the Electrical Safety Authority and Toronto Hydro.

Transformer rooms shall be inspected and approved by Toronto Hydro prior to the installation of Toronto Hydro's equipment.

Duct banks shall be inspected and approved by Toronto Hydro prior to the pouring of concrete and again before backfilling. The completed ducts must be rodded by the site contractor in the presence of a Toronto Hydro inspector and shall be clear of all extraneous material. A mandrel, approved by Toronto Hydro for a nominal diameter of duct, will be passed through each duct. In the event of ducts blocked by ice, the owner's representative will be responsible for clearing the ducts prior to the cable installation. Connection to existing concrete duct banks or cable chamber shall be done only by a contractor approved by Toronto Hydro. All work done on existing Toronto Hydro's plant must be authorized by Toronto Hydro and carried out in accordance with all applicable safety acts and regulations.

Provision for metering shall be inspected and approved by Toronto Hydro prior to energization.

2.1.5 Relocation of Plant

This section should specify the distributor' s policy with respect to requests for relocation of plant and the conditions under which the requestor is or may be required to pay for the relocation of plant should be specified. Sharing arrangements also should be noted.

Section 2 – DISTRIBUTION ACTIVITIES (GENERAL)

When requested to relocate distribution plant, Toronto Hydro will exercise its rights and discharge its obligations in accordance with existing acts, by-laws and regulations including the *Public Service Works on Highways Act*, agreements, easements and law. In the absence of existing agreements, Toronto Hydro is not obligated to relocate the plant. However, Toronto Hydro shall resolve the issue in a fair and reasonable manner. Resolution in a fair and reasonable manner shall include consideration of the impact of the proposed relocation on the other Customers of Toronto Hydro. The response to the requesting party shall explain the feasibility or unfeasibility of the relocation and a fair and reasonable charge for relocation based on cost recovery principles.

The Customer shall contact Toronto Hydro prior to undertaking work that may result in an encroachment on Toronto Hydro plant.

If a Customer proposes to:

a) alter existing buildings, structures or apparatus; or
b) construct new buildings, structures or apparatus

that may result in an encroachment on the electrical and working clearances required by Toronto Hydro for the existing Toronto Hydro distribution plant, the Customer shall:

1) Notify Toronto Hydro; and
2) Toronto Hydro will determine in a fair and reasonable manner whether the relocation of the existing distribution plant is acceptable; and
3) If approved, pay for the relocation costs incurred by Toronto Hydro to have the required Toronto Hydro distribution plant relocated, based on cost recovery principles.

If a Customer encroaches upon the electrical and working clearances set by Toronto Hydro, Toronto Hydro shall determine in a fair and reasonable manner whether the Customer shall be required to remove the encroachment at its own expense, or shall pay, based on cost recovery for work required, the costs incurred by Toronto Hydro to have the required distribution plant relocated.

In the course of maintaining and enhancing Toronto Hydro's distribution plant, Toronto Hydro may need to relocate distribution plant that is owned by Toronto Hydro. Costs associated with such relocation(s) shall be borne by Toronto Hydro, except that, in accordance with Section 3.2(g) hereof, if the Customer requests that such maintenance or construction activities be done outside Toronto Hydro's normal working hours, the Customer shall pay for any incremental costs incurred by Toronto Hydro as a result thereof.

Section 2 – DISTRIBUTION ACTIVITIES (GENERAL)

2.1.6 Easements

In this section, any requirements for easements should be described.

To maintain the reliability, integrity and efficiency of the distribution system, Toronto Hydro has the right to have supply facilities on private property and to have easements registered against title to the property. Easements are required where facilities serve property other than property where the facilities are located and/or where Toronto Hydro deems it necessary.

The Customer will prepare at its own cost any required reference plan to the satisfaction of Toronto Hydro. Easement documents are prepared by the Toronto Hydro Legal Services Department. Four copies of the deposited reference plan must be supplied to Toronto Hydro prior to the preparation of the easement documents. Details will be provided upon application for service.

2.1.7 Contracts

This section should outline the types of contracts that are available for each type of Customer, including standard, implied and special contracts. Connection agreements and operating agreements should be listed and referenced as appendices to the Conditions of Service, if applicable.

2.1.7.1 Contract for New or Modified Electricity Service

Toronto Hydro shall only connect a Customer for a new or modified supply of electricity upon receipt by Toronto Hydro of the following:

- a completed and signed contract for service in a form acceptable to Toronto Hydro;
- payment to Toronto Hydro of any applicable connection fee;
- an inspection and approval by the Electrical Safety Authority of the electrical equipment for the new service; and
- a Connection Agreement as requested or required pursuant to Section 2.1.7.4.

2.1.7.2 Implied Contract

In all cases, notwithstanding the absence of a written contract, Toronto Hydro has an implied contract with any Customer that is connected to Toronto Hydro's distribution system and receives distribution services from Toronto Hydro. The terms of the implied contract are embedded in Toronto Hydro's Conditions of Service, the Rate Handbook, Toronto Hydro's rate schedules, Toronto Hydro's licence, the Distribution System Code, the Standard Supply Service Code and the Retail Settlement Code, all as amended from time to time.

Section 2 – DISTRIBUTION ACTIVITIES (GENERAL)

The acceptance of supply of electricity or related services from Toronto Hydro constitutes a binding contract with Toronto Hydro, which includes this Conditions and all terms thereunder. The person so accepting the supply of electricity or related services shall be liable for payment for same, and such contract shall be binding upon such person's heirs, administrators, executors, successors or assigns.

2.1.7.3 Special Contracts

Special contracts that are customized in accordance with the service requested by the Customer normally include, but are not necessarily limited to, the following examples:

- construction sites
- mobile facilities
- non-permanent structures
- special occasions, etc.
- embedded generation facilities

2.1.7.4 Connection Agreements

Toronto Hydro may require a Customer to enter into a Connection Agreement in a form acceptable to Toronto Hydro. Until such time as the Customer executes such a Connection Agreement with Toronto Hydro, the Customer shall be deemed to have accepted and agreed to be bound by all of the terms in the Connection Agreement attached to this as Schedule A in Section 6.

A Generator, and a Wholesale Market Participant shall enter into a Connection Agreement as per Section 6, Reference #3 – "Toronto Hydro Distributed Generation Requirements".

An Embedded Distributor shall enter into a Connection Agreement in a form acceptable to Toronto Hydro. Until such time as the Embedded Distributor executes such a Connection Agreement with Toronto Hydro, the Embedded Distributor shall be deemed to have accepted and agreed to be bound by all of the terms in this Conditions that apply to such Embedded Distributor.

Toronto Hydro shall make a good faith effort to enter into a Connection Agreement with a distributor connected to Toronto Hydro's distribution system in accordance with the requirements in the Distribution System Code issued by the Ontario Energy Board.

If there is a conflict between a Connection Agreement with a Customer, Generator, Wholesale Market Participant or Embedded Distributor and this Conditions of Service, the Connection Agreement shall govern.

2.1.7.5 Payment by Building Owner

The owner of a Building is responsible for paying for the supply of electricity by Toronto Hydro to the owner's Building except for any supply of electricity to the Building by Toronto Hydro in accordance with a request for electricity by an occupant(s) of the Building.

A Building owner wishing to terminate the supply of electricity to its Building must notify Toronto Hydro in writing. Until Toronto Hydro receives such written notice from the Building owner or its authorized representative, the Building owner and/or the occupant(s), as applicable, shall be responsible for payment to Toronto Hydro for the supply of electricity to such Building. Toronto Hydro may refuse to terminate the supply of electricity to an owner's Building when there are occupant(s) in the Building (i.e. during certain periods of the winter).

Effective April 1, 2011, after closure of an account opened pursuant to a request, directly or indirectly, from an occupant of the property other than the owner or its authorized representative, Toronto Hydro shall not seek to recover any charges for service provided to a rental unit in a residential complex or residential property from the owner of the residential complex or residential property, unless the owner has agreed to assume responsibility for those charges. An owner, either personally or through an authorized representative, may enter into an agreement with Toronto Hydro whereby the owner agrees to assume responsibility for paying for continued service to the rental unit after closure of an occupant account. Where the owner has not agreed to assume responsibility for charges for continued service, Toronto Hydro may disconnect the service without notice. Toronto Hydro will not be responsible for any liabilities or damages, which may occur as a result of the service being disconnected.

Where a non-residential property has been vacated by an occupant of the property, and Toronto Hydro has not been notified that a new occupant should be billed for the electricity supplied to the property and the owner has not submitted a written request to disconnect the electricity supply, Toronto Hydro will bill the owner for the electricity supply to the property until such time as Toronto Hydro is notified by the owner or a new occupant that the occupant should be billed for the electricity supply.

Section 2 – DISTRIBUTION ACTIVITIES (GENERAL)

2.1.7.6 Opening and Closing of Accounts

A Consumer who wishes to open or close an account for the supply of electricity by Toronto Hydro shall contact Toronto Hydro's Call Centre by phone, by written request (including requests submitted by facsimile), through Toronto Hydro's web site, or other means acceptable to Toronto Hydro.

The Consumer shall be responsible for payment to Toronto Hydro for the supply of electricity to the property up to the date Toronto Hydro is notified of the termination of the account.

2.2 Disconnection

In this section, the Distributor should specify under what circumstances it has the right or obligation to disconnect a Customer. This section also should outline the business processes used by the distributor, including notification and timing provisions.

Toronto Hydro reserves the right to disconnect service for reasons not limited to:

- Contravention of the laws of Canada or the Province of Ontario, including the Ontario's Electrical Safety Code.
- A material adverse effect on the reliability and safety of Toronto Hydro's distribution system.
- Imposition of an unsafe worker situation beyond normal risks inherent in the operation of Toronto Hydro's distribution system.
- A material decrease in the efficiency of Toronto Hydro's distribution system.
- A materially adverse effect on the quality of distribution services received by an existing connection.
- Inability of Toronto Hydro to perform planned inspections and maintenance.
- Failure of the Consumer or Customer to comply with a directive of Toronto Hydro that Toronto Hydro makes for purposes of meeting its licence obligations.
- Overdue amounts payable to Toronto Hydro including the non-payment of a security deposit.
- Electrical disturbance propagation caused by Customer equipment that is not corrected in a timely fashion.
- Any other conditions identified in this Conditions.

Toronto Hydro may disconnect the supply of electricity without notice in accordance with a court order, or for emergency, safety or system reliability reasons.

A Customer intending to demolish any buildings that house Toronto Hydro's distribution equipment shall notify Toronto Hydro at least four (4) months in advance of demolition. The Customer shall pay Toronto Hydro for the costs of removing all electrical equipment owned by Toronto Hydro that is located on private property.

Section 2 – DISTRIBUTION ACTIVITIES (GENERAL)

Provided the Customer has made all necessary arrangements, Toronto Hydro shall remove all its equipment by the date agreed to with the Customer.

2.2.1 Disconnection & Reconnection – Process and Charges

Immediately following the due date, steps will be taken to collect the full amount of the electricity bill. If the bill is still unpaid sixteen calendar days after the due date and ten calendar days after a disconnect notice has been delivered to the Customer, the service may be disconnected and not restored, or a Timed Load Interrupter Device may be installed, until payment arrangements satisfactory to Toronto Hydro have been made, including any costs of reconnection. Such discontinuance or restriction of service does not relieve the Customer of the liability for arrears or other applicable charges for the balance of the term of contract, nor shall Toronto Hydro be liable for any damage to the Customer's premises resulting from such discontinuance or restriction of service, other than physical damage to facilities arising directly from entry on the Customer's property. Disconnect notices will be in writing and if given by mail shall be deemed to be received on the third business day after mailing.

Notwithstanding the foregoing, Toronto Hydro shall not shut off the supply of electricity to a property for non-payment as set forth above during such periods as may be prescribed by regulations under the *Electricity Act, 1998*. Upon discovery that a hazardous condition or disturbance propagation (feedback) exists, Toronto Hydro will notify the Customer to rectify the condition at once. If the Customer fails to make satisfactory arrangements to remedy the condition within seven calendar days after a disconnect notice has been given to the Customer, the service may be disconnected and not restored until satisfactory arrangements to remedy the condition have been made. Toronto Hydro shall not be liable for any damage to the Customer's premises resulting from such discontinuance of service, except for physical damage to facilities arising directly from Toronto Hydro's entry on the Customer's property. Disconnect notices will be in writing and if given by mail shall be deemed to be received on the third business day after mailing.

Notwithstanding the above, in the case of a residential Customer that has provided Toronto Hydro with documentation from a physician confirming that disconnection poses a risk of significant adverse effects on the physical health of the Customer or on the physical health of the Customer's spouse, or dependent family member or other person that regularly resides with the Customer, shall not be disconnected for non-payment until 60 days from the date on which the disconnection notice is delivered.

At the request of a residential Customer, Toronto Hydro shall send a copy of any disconnection notice issued to the Customer for non-payment to a third party designated by the Customer for that purpose provided that the request is made no later than the last day of the applicable minimum notice period. As well, residential

Section 2 – DISTRIBUTION ACTIVITIES (GENERAL)

Customers may at any time prior to disconnection, designate a third party to also receive any future notice of disconnection.

Upon receipt of a Disconnection request by the Customer, Toronto Hydro will disconnect and/or remove Toronto Hydro's connection assets at the Customer's cost as outlined in Table 2 in Section 5 of this Conditions.

Where Toronto Hydro installs a Timed Load Interrupter Device or disconnects a Customer for non-payment, Toronto Hydro will provide (i) the Fire Safety Notice of the Office of the Fire Marshal; (ii) any other public safety notices or information bulletins issued by public safety authorities and provided to Toronto Hydro, which provide information to consumers respecting dangers associated with the disconnection of electricity service, and when applicable, (iii) written notice to the Customer explaining the effect of a Timed Load Interrupter Device on service, along with a telephone number for the Customer to obtain further information.

Where a Timed Load Interrupter Device is installed or a service is disconnected by Toronto Hydro for non-payment, Toronto Hydro will remove the Timed Load Interrupter Device or reconnect the service within 2 business days of the outstanding account balance being paid in full or the Customer entering into an arrears payment agreement. A Customer may request the continued use of the Timed Load Interrupter Device during the course of the arrears payment agreement.

Customers working within the limits of approach to Toronto Hydro's overhead service conductors shall contact Toronto Hydro Line Protection for a quotation to have the service wires protected. If a disconnection and reconnection is required, Toronto Hydro will provide this service for a fee of $370.00 plus HST ($185.00 plus HST for disconnection and $185.00 plus HST for reconnection) during regular hours, and $830.00 plus HST ($415.00 plus HST for disconnection and $415.00 plus HST for reconnection) after regular hours.

2.2.2 Unauthorized Energy Use

Notwithstanding the provisions of Section 2.1.7.2 (Implied Contract) and Section 2.1.7.5 (Payment by Building Owner), Toronto Hydro reserves the right to disconnect the supply of electricity to a building or property where the building or property has, or appears to have, been used for unlawful purposes, including energy diversion or theft of power. The supply of electricity to the building or property may not be reconnected for the existing customer until Toronto Hydro receives full payment from the existing customer of all reasonable costs and losses incurred by Toronto Hydro arising from the unauthorized energy use, including costs of inspections, repair costs, commodity costs, disconnection costs, and reconnection costs. If other than the existing customer requests reconnection, Toronto Hydro may recover any reconnection charges approved by the Ontario Energy Board.

Section 2 – DISTRIBUTION ACTIVITIES (GENERAL)

2.3 Conveyance of Electricity

2.3.1 Limitations on the Guaranty of Supply

In this section, the Distributor should specify its limitations on the guaranty of supply. The Distributor also should reference the provisions for "Powers of Entry" described in section 40 of the Electricity Act, 1998.

Toronto Hydro will endeavour to use reasonable diligence in providing a regular and uninterrupted supply of electricity but does not guarantee a constant supply or the maintenance of unvaried frequency or voltage and will not be liable in damages to the Consumer or Customer by reason of any failure in respect thereof.

Consumers or Customers requiring a 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.

Customers requiring a three-phase supply should install protective apparatus to avoid damage to their equipment, which may be caused by the interruption of one phase, or non-simultaneous switching of phases of Toronto Hydro's electricity supply.

During an emergency, Toronto Hydro may interrupt supply to a Consumer in response to a shortage of supply of electricity, or to effect repairs on its distribution system, or while repairs are being made to Consumer or Customer-owned equipment. Toronto Hydro shall have rights to access property in accordance with section 40 of the *Electricity Act, 1998* and any successor acts thereto.

To assist with distribution system outages or emergency response, Toronto Hydro may require a Consumer or Customer to provide Toronto Hydro with emergency access to Consumer or Customer-owned distribution equipment that normally is operated by Toronto Hydro or Toronto Hydro-owned equipment on Consumer's property.

2.3.2 Power Quality

This section should outline the guidelines and policies to which the Distributor will endeavor to adhere to in conveying electricity supply, such as service voltage guidelines and outage notification processes. This section also should indicate the process the distributor uses for handling voltage disturbances and power quality testing and remedial action.

This section also should include conditions under which supply of electricity to Customers may be interrupted. Additionally, conditions under which the supply may become unreliable or intermittent should be described.

Section 2 – DISTRIBUTION ACTIVITIES (GENERAL)

2.3.2.1 Power Quality Testing

Where a Consumer or Customer provides evidence or data indicating that a power quality or EMI problem may be originating from Toronto Hydro's distribution system, Toronto Hydro will perform investigative analysis to attempt to identify the underlying cause. Depending on the circumstances, this may include review of relevant power interruption data, trend analysis, and power quality monitoring.

Upon determination that the cause resulting in the power quality concern originates from the Toronto Hydro distribution system, where it is deemed a system delivery issue and where industry standards are not met, Toronto Hydro will recommend and/or take appropriate mitigation measures. Toronto Hydro will take appropriate actions to control power disturbances found to be detrimental to the Consumers or Customers. If Toronto Hydro is unable to correct the problem without adversely affecting other Toronto Hydro Consumers or Customers, then it is not obligated to make the corrections. Toronto Hydro will use appropriate industry standards (such as IEC or IEEE standards) and good utility practice as a guideline. If the problem lies on the Customer side of the system, Toronto Hydro may seek reimbursement from the Customer for the costs incurred in its investigation.

2.3.2.2 Prevention of Voltage Distortion on Distribution

Customers having non-linear load shall not be connected to Toronto Hydro's distribution system unless power quality is maintained by implementing proper corrective measures such as installing proper filters, and/or grounding. Further, to ensure the distribution system is not adversely affected, power electronics equipment installed must comply with IEEE Standard 519-1992. The limit on individual harmonic distortion is 3%, while the limit on total harmonic distortion is 5%.

2.3.2.3 Obligation to Help in the Investigation

If Toronto Hydro determines the Customer's equipment may be the source causing unacceptable harmonics, voltage flicker or voltage level on Toronto Hydro's distribution system, the Customer is obligated to help Toronto Hydro by providing required equipment information, relevant data and necessary access for monitoring the equipment.

The Customer shall assist in the investigation and resolution of power quality problems by:

(a) maintaining and providing Toronto Hydro with a detailed log of exact times and dates of poor power quality;

(b) ensuring corrective measures such as filters and/or grounding are installed for non-linear loads connected to the distribution system;
(c) assisting Toronto Hydro in determining whether the Customer's equipment may be a source of undesirable system disturbances; and
(d) ceasing operation of equipment deemed to be the cause of system disturbances until satisfactory remedial action has been taken;

The Consumer or Customer should be aware that some distribution system events such as capacitor switching may cause problems with highly sensitive equipment, and the Consumer or Customer shall be responsible for mitigating these effects.

2.3.2.4 Timely Correction of Deficiencies

If an undesirable system disturbance is being caused by Customer's equipment, the Customer will be required to cease operation of the equipment until satisfactory remedial action has been taken by the Customer at the Customer's cost. If the Customer does not take such action within a reasonable time, Toronto Hydro may disconnect the supply of electricity to the property.

2.3.2.5 Notification for Interruptions

Although it is Toronto Hydro's policy to minimize inconvenience to Consumers, it is necessary to occasionally interrupt a Consumer's supply of electricity to allow work on Toronto Hydro's electrical system. Toronto Hydro will endeavor to provide such Consumers with reasonable notice of planned power interruptions. However, interruption times may change due to inclement weather or other unforeseen circumstances. Toronto Hydro shall not be liable in any manner to such Consumers for failure to provide such notice of planned power interruptions or for any change to the schedule for planned power interruptions.

During an emergency, Toronto Hydro may interrupt supply of electricity to a property without notice in response to a shortage of supply of electricity or to effect repairs on Toronto Hydro's distribution system or while repairs are being made to Customer-owned equipment, or to conduct work of an emergency nature involving the possibility of injury to persons or damage to property or equipment.

2.3.2.6 Notification to Consumers on Life Support

Consumers who require an uninterrupted source of power for life support equipment must provide their own equipment for these purposes. Consumers with life support system are encouraged to inform Toronto Hydro of their medical needs and their available backup power. These Consumers are responsible for ensuring that the information they provide Toronto Hydro is accurate and up-to-date.

With planned interruptions, the same procedure as prescribed in section 2.3.2.5 will be observed. For those unplanned power interruptions that extend beyond two hours and the time expected to restore power is longer than what was indicated by Consumers (registered on life support) as their available backup power, Toronto Hydro will endeavor to contact these Consumers but will not be liable in any manner to the Consumers for failure to do so.

2.3.2.7 Emergency Interruptions for Safety

Toronto Hydro will endeavour to notify Consumers prior to interrupting the supply of electricity. However, if an unsafe or hazardous condition is found to exist, or if the use of electricity by apparatus, appliances, or other equipment is found to be unsafe or potentially damaging to Toronto Hydro or the public, the supply of electricity may be interrupted without notice.

2.3.2.8 Emergency Service (Trouble Calls)

Toronto Hydro will exercise reasonable diligence and care to deliver a continuous supply of electricity to the Consumer. However, Toronto Hydro cannot guarantee a supply that is free from interruption.

When power is interrupted, the Consumer should first ensure that failure is not due to blowing of fuses within the installation. If there is a partial power failure, the Consumer should obtain the services of an electrical contractor to carry out necessary repairs. If, on examination, it appears that Toronto Hydro’s main source of supply has failed, the Consumer should report these conditions at once to Toronto Hydro’s Call Centre by calling 416-542-8000.

Toronto Hydro operates a Call Centre 24 hours a day to provide emergency service to Consumers. Toronto Hydro will initiate restoration efforts as rapidly as practicable.

2.3.2.9 Outage Reporting

Depending on the outage, duration and the number of Consumers affected, Corporate Communications of Toronto Hydro may issue a news release to advise the general public of the outage. In turn, news radio stations may call for information on a 24-hour basis when they hear of an outage.

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2.3.3 Electrical Disturbances

This section should outline the guidelines to which the Distributor and the Customer will be expected to adhere to regarding electrical disturbances.

Toronto Hydro shall not be held liable for the failure to maintain supply voltages within standard levels due to Force Majeure as defined in Section 2.3.5 of this Conditions.

Voltage fluctuations and other disturbances can cause flickering of lights and other serious difficulties for Consumers connected to Toronto Hydro's distribution system. Customers must ensure that their equipment does not cause disturbances such as harmonics and spikes that might interfere with the operation of adjacent Consumer equipment. Equipment that may cause disturbances includes large motors, welders and variable speed drives, etc. In planning the installation of such equipment, the Customer must consult with Toronto Hydro.

Some types of electronic equipment, such as video display terminals, can be affected by the close proximity of high electrical currents that may be present in transformer rooms. Toronto Hydro will assist in attempting to resolve any such difficulties at the Customer's expense.

Consumers who may require an uninterrupted source of power supply or a supply completely free from fluctuation and disturbance must provide their own power conditioning equipment for these purposes.

2.3.4 Standard Voltage Offerings

This section should specify the voltages that the distributor may provide to each type of Customer, based on their supply requirements. This section should include both the primary and secondary voltages that are available. Additionally, any physical or geographic constraints on a particular voltage, or conditions under which voltages may not be provided should be detailed in this section.

2.3.4.1 Primary Voltage

The primary voltage to be used will be determined by Toronto Hydro for both Toronto Hydro-owned and Customer-owned transformation. Depending on the voltage of the plant that "lies along", the preferred primary voltage will be at 27.6/ 16 kV grounded wye, three phase, four-wire system. However, in the downtown core of the City of Toronto the primary voltage will be 13.8/8 kV grounded wye, three phase, four wire; or 13.8 kV three phase, three wire, depending on the area.

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2.3.4.2 Supply Voltage

Toronto Hydro's preferred secondary voltage is:

- 120/240 V, single phase, and
- 120/208 V or 347/600 V, three phase.

Depending on the system availability in the area, 120/208 V two phase, three wire may be supplied in place of 120/240 V.

The supply voltage governs the limit of supply capacity for any Customer.

<u>When supply is from secondary street circuits the demand load shall be as follows</u>:

(i) residential: if at 120/240 V, single phase or 120/208 V, two phase, three wire, then up to 200A service size;

residential: if at 120/240 V, single phase or 120/208 V, two phase, three wire, then a 400A service size feeding from the overhead distribution system must be connected directly to transformation via underground supply arrangement;

commercial: if at 120/240 V, single phase or 120/208 V, two phase, three wire, then up to 75 kVA demand load;

(ii) if at 347/600 V, three phase, four wire, then up to 80 kVA demand load;

(iii) if at both 120/240 V, single phase and 347/600 V, three phase, four wire, then up to 100 kVA sum total demand load; or

(iv) if at 120/208 V, three phase, four wire, then up to 100 kVA demand load.

For supply exceeding the above capacity, the Customer is required to provide a transformer, pad mounted or in a building vault, on private property, to receive supply of electricity up to the following capacities:

<u>When a pad-mounted transformer is used the demand load shall be as follows</u>:

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(i) if fed from 4.16/2.4 kV primary at 120/208 V or 347/600 V, three phase, four wire, then supply is available for loads up to 300 kVA demand load;

(ii) if fed from 13.8/8 kV primary at 120/208 V or 347/600 V, three phase, four wire, then supply is available for loads up to 750 kVA demand load; or

(iii) if fed from 27.6/16 kV primary at 120/208 V or 347/600 V, three phase, four wire, then supply is available for loads up to 750 kVA and 1500 kVA demand load respectively.

<u>When a transformer vault is used</u>:

(i) if fed from 4.16/2.4 kV primary at 120/208 V or 347/600 V, three phase, four wire, then supply is available for loads up to 300 kVA demand load;

(ii) if fed from 13.8/8 kV primary at 120/208 V or 347/600 V, three phase, four wire, then supply is available for loads up to 1500 kVA or and 2500 kVA demand load respectively depending on system availability in the area, (i.e. three phase) ; or

(iii) if fed from 27.6/16 kV primary at 120/208 V or 347/600 V, three phase, four wire, then supply is available for loads up to 1500 kVA and 2500 kVA demand load respectively (i.e. three phase).

When the Customer requires voltages other than at the available supply voltage, or demands by a single occupant exceed the limits indicated above, the Customer shall consult with Toronto Hydro. Toronto Hydro may advise the Customer of any special conditions and requirements to obtain such non-standard services. However, Toronto Hydro is under no obligations to provide any non-standard services.

When a Customer is required to provide transformation facilities on private property in accordance with this section, and the Customer is unable to do so or is severely constrained from doing so, the Customer may request Toronto Hydro to provide the transformation facilities from Toronto Hydro's existing underground distribution system. If requested by the Customer, and if Toronto Hydro determines in its sole discretion that it is able to do so, then Toronto Hydro may provide these transformation facilities. By requesting this option, the Customer agrees to pay Toronto Hydro a fee for providing the transformation facilities as part of the Customer's connection costs, in addition to any associated expansion costs.

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2.3.4.3 Multiple Connections to Main Distribution System

Customers will be generally connected to one point of the main Toronto Hydro distribution system. Toronto Hydro may offer a second point of connection to another point of the main Toronto Hydro distribution system when:

a) the Customer is fed by the 13.8 kV underground radial system as defined in section 1.1.1 or
b) the Customer's point load exceeds the maximum set in section 2.3.4.2 for service from a transformer vault.

In the case of Customers supplied from the 13.8 kV underground radial system, Customers will not be eligible to ask for service from Sketch 1(h) unless the demand exceeds the limit set for transformer vaults as set out in section 2.3.4.2.

Where multiple connections exist, and unless otherwise agreed by Toronto Hydro, load should be distributed evenly across all active connections. Load must not be transferred from one active connection to another without the permission of Toronto Hydro.

Toronto Hydro will determine the location of any connection points to its main distribution system. Although Toronto Hydro will give consideration to arguments relating to a need for diversity of supply, it retains the right to determine in its sole discretion, not to allow a second point of connection to another part of the main distribution system.

2.3.5 Voltage Guidelines

This section should specify what voltages the distributor's Customers can reasonably expect, with reference to CSA Standard CAN3-235 current edition.

Toronto Hydro maintains service voltage at the Customer's service entrance within the voltage variation limits shown in the table below:

Nominal Voltage	Voltage Variation Limits			
	Extreme Operating Conditions			
		Normal Operating Conditions		
Single Phase				
120/240	106/212	110/220	125/250	127/254
Two Phase 3 Wire				
120/208	110/190	112/194	125/216	127/220
Three Phase 4 Wire				
120/208Y	110/190	112/194	125/216	127/220
240/416Y (*)	220/380	224/388	250/432	254/440
347/600Y	306/530	318/550	360/625	367/635

(*) 240/416Y is no longer a standard voltage offered by Toronto Hydro.

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The Voltage Variation Limits, with the exception of the limits for Two Phase 3 Wire 120/208, are based on C.S.A. Standard CAN3-C235-83. Where voltages lie outside the indicated limits for Normal Operating Conditions but within the indicated limits for Extreme Operating Conditions as noted above, improvement or corrective action will be taken by Toronto Hydro on a planned or programmed basis, but not necessarily on an emergency basis. Where voltages lie outside the indicated limits for Extreme Operating Conditions, improvement or corrective action may be taken on an emergency basis depending on a number of factors, which include, but are not limited to, the location and nature of load or circuit, the extent to which voltage limits are exceeded, and the duration of time for which the limits have been exceeded.

Toronto Hydro shall practice reasonable diligence in maintaining voltage levels, but is not responsible for variations in voltage related to external factors. External factors include, but are not limited to, those factors that necessitate operating contingencies, and exceptionally high loads and low voltage supply from the transmitter or host distributor. Toronto Hydro shall not be liable for any delay or failure in the performance of any of its obligations under this Conditions due to any events or causes beyond the reasonable control of Toronto Hydro, including, without limitation, severe weather, flood, fire, lightning, other forces of nature, acts of animals, epidemic, quarantine restriction, war, sabotage, act of a public enemy, earthquake, insurrection, riot, civil disturbance, strike, restraint by court order or public authority, or action or non-action by or inability to obtain authorization or approval from any governmental authority, or any combination of these causes (“Force Majeure”).

2.3.6 Emergency Backup Generation Facilities

Distributors should include the following statements in this section:

- ***Customers with portable or permanently connected emergency generation capability shall comply with all applicable criteria of the Ontario Electrical Safety Code and in particular, shall ensure that Customer emergency generation does not back feed into the Distributor's system.***

- ***Customers with permanently connected emergency generation equipment shall notify their Distributor regarding the presence of such equipment.***

Any other requirements the Distributor imposes on Customers with emergency backup generation facilities should be described in this section.

Emergency backup generation is installed by Customers for backup of load when utility power supply is not available. A Customer with portable or permanently connected emergency backup generation shall comply with all applicable criteria of the Ontario Electrical Safety Code (OESC) and in particular, shall ensure that its Emergency Backup Generation Facility does not back feed into the Distributor's system.

Section 2 – DISTRIBUTION ACTIVITIES (GENERAL)

A Customer with an Emergency Backup Generation Facility in Open-Transition mode shall further ensure that its facility does not parallel with, nor adversely affect Toronto Hydro's distribution system.

Customers who consider installing a Closed-Transition switch shall notify Toronto Hydro and shall submit documentation that satisfies Toronto Hydro's technical requirements. Customers shall obtain written authorization from Toronto Hydro prior to commissioning the switch in Closed-Transition mode. Closed-Transition switches must not operate the generator in parallel with Toronto Hydro's distribution system for longer than 100 ms under any circumstances. Further requirements are specified in Section 6, Reference #3 – "Toronto Hydro Distributed Generation Requirements", Section 3.2 Emergency Backup Generation Technical Requirements.

For parallel generation refer to Section 6, Reference #3 – "Toronto Hydro Distributed Generation Requirements".

Customers with a permanently connected Emergency Backup Generation Facility operating in parallel shall notify Toronto Hydro regarding the presence of such equipment and shall enter into a connection agreement as required in Section 6, Reference #3 – "Toronto Hydro Distributed Generation Requirements".

2.3.7 Metering

This section should specify the options available to a Customer for metering equipment. The Distributor also should outline the technical requirements for meter installations including location and associated main switch.

Toronto Hydro will supply, install, own, and maintain all meters, instrument transformers, ancillary devices, and secondary wiring that are required for revenue metering.

A generation facility on the Toronto Hydro distribution system shall follow the conditions as specified in Section 6, Reference #3 – "Toronto Hydro Distributed Generation Requirements".

2.3.7.1 General

Describe the Distributor's access to meter installation requirements here.

Toronto Hydro will typically install metering equipment at the Customer supply voltage. The Customer must provide a convenient and safe location, satisfactory to Toronto Hydro, for the installation of meters, wires and ancillary equipment. Meters for new or upgraded residential services will be mounted outdoors on an approved meter socket as specified in Section 6, Reference #6 –

Section 2 – DISTRIBUTION ACTIVITIES (GENERAL)

"Toronto Hydro Metering Requirements 750 Volts or Less" Table I.

No person, except those authorized by Toronto Hydro, may remove, connect, or otherwise interfere with meters, wires, or ancillary equipment owned by Toronto Hydro.

The Customer will be responsible for the care and safekeeping of Toronto Hydro meters, wires and ancillary equipment on the Customer's premises. If any Toronto Hydro equipment installed on Customer premises is damaged, destroyed, or lost other than by ordinary wear and tear, tempest or lightning, the Customer will be liable to pay to Toronto Hydro the value of such equipment, or at the option of Toronto Hydro, the cost of repairing the same.

The location allocated by the owner for Toronto Hydro metering shall provide direct access for Toronto Hydro staff and shall be subject to satisfactory environmental conditions, some of which are:

- Maintain a safe and adequate working space in front of equipment, not less than 1.2 metres (48") and a minimum ceiling height of 2.1 metres (84")
- Maintain an unobstructed working space in front of equipment, free from, or protected against, the adverse effects of moving machinery, vibration, dust, moisture or fumes

Where Toronto Hydro deems self-contained meters to be in a hazardous location, the Customer shall provide a meter cabinet or protective housing.

Any compartments, cabinets, boxes, sockets, or other workspace provided for the installation of Toronto Hydro's metering equipment shall be for the exclusive use of Toronto Hydro. No equipment, other than that provided and installed by Toronto Hydro, may be installed in any part of the Toronto Hydro metering workspace.

2.3.7.1.1 Metering Requirements for Multi-Unit Residential Rental Buildings and Condominiums

Developers of new multi-unit residential rental buildings and new and existing condominiums (collectively, "MURBs"), or boards of directors of condominiums, or authorized persons in charge of any other applicable class of unit under Ontario Regulation 389/10, may choose to have Toronto Hydro install unit smart metering, or to have Toronto Hydro install a bulk interval meter for the purpose of enabling unit sub-metering by a licensed unit sub-meter provider.

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Installation of Unit Smart Metering by Toronto Hydro

Upon the request of a MURB developer or a condominium board of directors, Toronto Hydro will install unit smart metering that meets the functional specification of Ontario Regulation 425/06 – *Criteria and Requirements for Meters and Metering Equipment, Systems and Technology* (smart metering). In that case, each separate residential and commercial unit, as well as common areas, will become direct individual customers of Toronto Hydro, with the common area accounts held by the developer, condominium corporation or the landlord as the case may be.

The MURB developer or condominium board of directors may choose an Alternative Bid for the installation of unit smart metering. In that case, the MURB developer, landlord or condominium board of directors is required to:

(i) select and hire a qualified contractor;
(ii) ensure all work that is eligible for alternative bid is done in accordance with Toronto Hydro's technical standards and specifications: and
(iii) assume full responsibility for the installation and warranty all aspects for a period of 2 years from date of commissioning.

Where the MURB developer or condominium board of directors transfers the metering facilities installed under the alternative bid option to Toronto Hydro, and provided Toronto Hydro has inspected and approved the facilities installed, Toronto Hydro shall pay the condominium corporation, landlord or developer a transfer price. The transfer price shall be the lower of the cost to the MURB developer or condominium board of directors to install the metering facilities or Toronto Hydro's fully allocated cost to install the metering facilities.

Common Area Metering

Where units in a MURB are to be unit smart metered, the responsible party (MURB developer, condominium board of directors, or landlord) shall enter into a contract with Toronto Hydro for the supply of electrical energy for all common or shared services. Common or shared services typically include lighting of all common areas shared by the tenants, or unit owners, and common services such as heating, air conditioning, water heating, elevators, and common laundry facilities. In such cases, consumption for all common areas will be separately metered.

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Installation of Bulk Interval Metering by Toronto Hydro

Where bulk interval metering is supplied by Toronto Hydro to an exempt distributor for the purpose of enabling unit sub-metering, the responsible party (i.e., the developer, condominium corporation, or landlord, but not the unit sub-meter provider) shall enter into a contract with Toronto Hydro for the supply of electrical energy to the building.

2.3.7.1.2 Main Switch and Meter Mounting Devices

The Customer's main switch immediately preceding the meter shall be installed so that the top of the switch is no higher than 1.83 m and that the bottom of the switch is no lower than 1.0 m from the finished floor and shall permit the sealing and padlocking of:

(a) the handle in the "open" position; and
(b) the cover or door in the closed position.

Meter mounting devices for use on Commercial/Industrial accounts shall be installed on the load side of the Customer's main switch and be located indoor.

The Customer is required to supply and install a Canadian Standards Association (CSA) approved meter socket for the use of Toronto Hydro's self-contained socket meters for the main switch ratings and supply voltages listed in Table 5 in Section 5 of this Conditions.

The Customer is required to supply and install a meter cabinet to contain Toronto Hydro's metering equipment for the main switch ratings and supply voltages listed in Table 6 in Section 5 of this Conditions.

Meter centers installed for individual metering applications must meet the requirements specified in Table 8 in Section 5 of this Conditions.

The Customer shall permanently and legibly identify each metered service with respect to its specific address, including unit or apartment number. The identification shall be applied to all service switches, circuit breakers, meter cabinets, and meter mounting devices.

2.3.7.1.3 Service Mains Limitations

The metering provision and arrangement for service mains in excess of either 600 A or 600 V shall be submitted to Toronto Hydro for approval before building construction begins. Additional standards and requirements for services metered above 600 V can be made available upon request.

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2.3.7.1.4 Special Enclosures

Specially constructed meter entrance enclosures will be permitted for outdoor use upon Toronto Hydro's approval of a written application for use.

2.3.7.1.5 Meter Cables

The Customer shall provide meter loops having a length of 610-mm in addition to the length between line and load entry points.
Line and load entry points shall be approved by Toronto Hydro prior to installation. Where more than two conductors per phase are used, the connectors shall be provided by the Customer (see Table 6 in Section 5 of this Conditions for required cabinets). Mineral insulated, solid or hard drawn wire conductors are not acceptable for meter loops.

Any variation from the above must first be checked and approved by Toronto Hydro prior to installation.

2.3.7.1.6 Barriers

Barriers are required in each section of switchgear or service entrance equipment between metered and unmetered conductors and/or between sections reserved for Toronto Hydro use and sections for Customer use.

2.3.7.1.7 Doors

Side-hinged doors shall be installed over all live electrical equipment where Toronto Hydro personnel may be required to work (i.e. line splitters, unmetered sections of switchgear, breakers, switches, metering compartments, meter cabinets and enclosures). These hinged doors shall have provision for sealing and padlocking. Where bolts are used, they shall be of the captive knurled type. All outer-hinged doors shall open no less than 135°. All inner-hinged doors shall open to a full 90°.

2.3.7.1.8 Auxiliary Connections

All connections to circuits such as fire alarms, exit lights and Customer instrumentation shall be made to the load side of Toronto Hydro's metering. No Customer equipment shall be connected to any part of the Toronto Hydro metering circuit.

2.3.7.1.9 Working Space

Clear working space shall be maintained in front of all equipment and from all side panels in accordance with the Ontario Electrical Safety Code.

2.3.7.2 Current Transformer Boxes

Where current transformers are required, the Distributor should outline the technical requirements to be followed for such installations.

Where instrument transformers are incorporated in low voltage switchgear, the size of the chamber and number of instrument transformers shall be as shown in Table 7 in Section 5 of to this Conditions. A separate meter cabinet must be supplied and installed by the Customer, located to the satisfaction of Toronto Hydro and as close as possible to the instrument transformer compartment.

The cabinet and the compartment will be connected by an empty 1½ inch conduit, the length of which shall not exceed 30 m, and which shall include a maximum of three 90° bends. The conduit will be provided for the exclusive use of Toronto Hydro. No fittings with removable covers are permitted.

The meter cabinet shall be grounded by a minimum #6 copper grounding conductor, not installed in the above conduit. The Customer shall install a strong nylon or polyrope pull line in the conduit, with an excess of 1500 mm loop left at each end.

The final layout and arrangements of components must be approved by Toronto Hydro prior to fabrication of equipment.

Where two or more circuits are totalized, or where remote totalizing is involved, or where instrument transformers are incorporated in high voltage switchgear (greater than 750 V), Toronto Hydro will issue specific metering requirements.

2.3.7.3 Interval Metering

Where interval metering is required or requested, the Distributor should outline the technical requirements to be followed for such installations. Included with the technical specifications should be the conditions under which interval metering will be supplied.

Interval meters will be installed for all new or upgraded services where the peak demand is forecast to be 200 kW or greater, or for any Customer wishing to participate in the spot market pass-through pricing. Prior to the installation of an interval meter, the Customer must provide a ½ inch conduit from their telephone room to the meter cabinet. Toronto Hydro will arrange for the installation of a telephone line, terminated in the meter cabinet for the exclusive use of Toronto Hydro to retrieve interval meter data. The Customer will be responsible for the installation of the telephone infrastructure and ongoing monthly costs of operating the phone line. The phone line will be Toronto Hydro owned, direct dial, voice quality, active 24 hours per day, and energized prior to meter installation.

Other Customers that request interval metering shall compensate Toronto Hydro for all incremental costs associated with that meter, including the capital cost of the interval meter, installation costs associated with the interval meter, ongoing maintenance (including allowance for meter failure), verification and reverification of the meter, installation and ongoing provision of communication line or communication link with the Customer's meter, and cost of metering made redundant by the Customer requesting interval metering.

2.3.7.4 Meter Reading

This section should outline the requirements for access to meters for the purposes of obtaining readings and the process to be used if a reading is not obtained.

The Customer or Consumer must provide or arrange free, safe and unobstructed access during regular business hours to any authorized representative of Toronto Hydro for the purpose of meter reading, meter changing, or meter inspection. Where premises are closed during Toronto Hydro’s normal business hours, the Customer or Consumer must, on reasonable notice, arrange such access at a mutually convenient time.

2.3.7.5 Final Meter Reading

This section should outline any requirements associated with obtaining a final meter reading on termination of a contract for service.

When a service is no longer required, the Customer or Consumer shall provide sufficient notice of the date the service is to be discontinued so that Toronto Hydro can obtain a final meter reading as close as possible to the final reading date. The Customer or Consumer shall provide access to Toronto Hydro or its agents for this purpose. If a final meter reading is not obtained, the Consumer shall pay a sum based on an estimated demand and/or energy for electricity used since the last meter reading, as determined by Toronto Hydro.

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2.3.7.6 Faulty Registration of Meters

In this section, the Distributor should outline the process for dealing with metering errors.

Metering electricity usage for the purpose of billing is governed by the federal *Electricity and Gas Inspection Act* and associated regulations, under the jurisdiction of Measurement Canada, Industry Canada. Toronto Hydro's revenue meters are required to comply with the accuracy specifications established by the regulations under the above Act.

In the event of incorrect electricity usage registration, Toronto Hydro will determine the correction factors based on the specific cause of the metering error and the Consumer's electricity usage history. The Consumer shall pay for all the electricity supplied a reasonable sum based on the reading of any meter formerly or subsequently installed on the premises by Toronto Hydro, due regard being given to any change in the characteristics of the installation and/or the demand. If Measurement Canada, Industry Canada determines that the Consumer was overcharged, Toronto Hydro will reimburse the Consumer for the amount incorrectly billed.

If the incorrect measurement is due to reasons other than the accuracy of the meter, such as incorrect meter connection, incorrect connection of auxiliary metering equipment, or incorrect meter multiplier used in the bill calculation, the billing correction will apply for the duration of the error. Toronto Hydro will correct the bills for that period in accordance with the regulations under the *Electricity and Gas Inspection Act*.

2.3.7.7 Meter Dispute Testing

This section should outline the process by which a Customer can dispute a meter measurement or read and seek redress.

Metering inaccuracy is an extremely rare occurrence. Most billing inquiries can be resolved between the Customer or Consumer and Toronto Hydro without resorting to the meter dispute test.

Either Toronto Hydro or the Customer or Consumer may request the service of Measurement Canada to resolve a dispute. If the Customer or Consumer initiates the dispute, Toronto Hydro will charge the Customer or Consumer a meter dispute fee if the meter is found to be accurate and Measurement Canada rules in favor of the utility.

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2.4 Tariffs and Charges

2.4.1 Service Connection

The Distributor should outline the rates that have been established for providing the Customer with a connection to the electrical distribution system and all services provided by the Distributor as per the rules and regulations laid out by all applicable codes.

Charges for distribution services are made as set out in the Schedule of Rates available from Toronto Hydro. Notice of Rate revisions shall be published in major local newspapers. Information about changes will also be mailed to all Consumers with the first billing issued at revised rates.

2.4.1.1 Customers Switching to Retailer

There are no physical service connection differences between Standard Service Supply (SSS) customers and third party retailers' customers. The supply of electricity to both types of customers is delivered through Toronto Hydro's distribution system with the same distribution requirements. Therefore, all service connection requirements applicable to the SSS customers are applicable to third party retailers' customers.

2.4.2 Energy Supply

This section should outline the process the Distributor has established for the following:

- ***Provision of Standard Service Supply to the Customer, per the rules and regulations laid out in the Retail Settlement Code and the Standard Service Supply Code.***
- ***Provision of Supply to the Customer through a Retailer, per the rules and regulations laid out in the Retail Settlement Code.***
- ***Wheeling of energy and all associated tariffs.***

2.4.2.1 Standard Service Supply (SSS)

All Toronto Hydro Consumers are Standard Service Supply (SSS) Consumers until Toronto Hydro is informed by the Consumer or the Consumer's authorized retailers of their switch to a competitive electricity supplier. The Service Transfer Request (STR) must be made by the Consumer or the Consumer's authorized retailer.

2.4.2.2 Retailer Supply

Consumers transferring from Standard Service Supply (SSS) to a retailer shall comply with the Service Transfer Request (STR) requirements as outlined in

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sections 10.5 through 10.5.6 of the Retail Settlement Code. All requests shall be submitted as electronic file and transmitted through EBT Express. Service Transfer Request (STR) shall contain information as set out in section 10.3 of the Retail Settlement Code.

If the information is incomplete, Toronto Hydro shall notify the retailer or Consumer about the specific deficiencies and await a reply before proceeding to process the transfer.

2.4.2.3 Wheeling of Energy

All Customers or Consumers considering delivery of electricity through the Toronto Hydro distribution system are required to contact Toronto Hydro for technical requirements and applicable tariffs.

2.4.3 Deposits

This section should outline any deposit and prudential requirements the Distributor has established for providing a Customer with Distribution Services, supply through Standard Service Supply or through a Retailer, per the rules and regulations laid out in the Distribution System Code.

Whenever required by Toronto Hydro, including, but not limited to, as a condition of supplying or continuing to supply Distribution Services, Consumers and Customers shall provide and maintain security in an amount that Toronto Hydro deems necessary and reasonable. Toronto Hydro will not discriminate among customers with similar risk profiles or risk related factors except where expressly permitted under the Distribution System Code.

Except for Consumers or Customers who meet the security deposit waiver conditions described below, all Consumers or Customers are required to provide an account security deposit to Toronto Hydro, which, at the Consumer's or Customer's election, must be in the form of (i) cash, cheque or Money Order, or, if approved by Toronto Hydro, Visa or MasterCard or (ii) for non residential Consumers or Customers an automatically renewing irrevocable commercial letter of credit from a bank defined in the *Bank Act, 1991*, c.46. Toronto Hydro will not accept third party guarantees.

The amount of the account security deposit will be based on the billing factor times the estimated average bill during the most recent 12 months. The billing factors are as follows:

- 2.5 for monthly billed Consumers or Customers
- 1.75 for bi-monthly billed Consumers or Customers

Where there is no established historical electricity consumption information for the service premises, the deposit will be based on a reasonable estimate using information from a like property used for similar purposes.

Where the Consumer or Customer, other than a residential electricity Customer, has more than one disconnection notice in a relevant 12 month period, the highest bill in the period will be used for the calculation of the deposit.

If requested by the Consumer or Customer, Consumers or Customers will be permitted to pay the security deposit in equal installments over a maximum of 4 months, or over a period of 6 months for residential Customers (including where a new security deposit is required due to Toronto Hydro having to apply the existing security deposit against amounts owing).

The security deposit may be waived based on the following criteria:

a) The Consumer or Customer has a good payment history based on the most recent customer history with some portion in the most recent 24 months, during which time the Consumer or Customer:

- had no more than one (1) notice of disconnection; AND
- had no more than one (1) payment returned for insufficient funds (“NSF”); AND
- had no disconnect/collection trip; AND
- had no security deposit applied for amounts owing.

The minimum time period for good payment history is as follows:

- Residential - 1 year
- Non-residential <50 kW demand rate class - 5 years
- All other classes - 7 years

or

b) The Consumer or Customer provides a letter from another electricity or gas distributor in Canada confirming good payment history. The letter must contain information consistent with the good payment criteria described in this document.

or

c) The Consumer or Customer (other than those in a >5000 kW demand rate class) provides a satisfactory credit check at its expense. The acceptable Equifax Credit scores are as follows:

- Residential - Consumer Score of 700 or greater

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- Business - Commercial Score of 20 or lower

or

d) Residential account deposits may be waived where the Consumer or Customer enrolls in the Toronto Hydro's pre-authorized payment plan and supplies at least two pieces of identification information, provided that a deposit will be required if the pre-authorized payment plan is cancelled.

or

e) The customer is a bulk-metered residential condominium as defined in the *Condominium Act*, 1998 and has provided Toronto Hydro with a signed declaration attesting to their legal status as a residential condominium corporation.

or

f) The residential Customer has been qualified as an "eligible low-income customer" and requests a waiver.

The security deposit may be reduced for non residential Consumers or Customers with 50 kW or greater demand, based on the following criteria:

Where the Consumer or Customer has a credit rating from a recognized credit rating agency, (***Dominion Bond Rating Service, Standard & Poor's or Moody's***) the maximum amount of deposit required will be reduced as follows:

Credit Rating (Using Standard & Poor's Rating Terminology)	**Allowable Reduction**
AAA- and above	100%
AA-, AA, AA+	95%
A-, From A, A+ to below AA	85%
BBB-, From BBB, BBB+ to below A	75%
Below BBB-	0%

Equivalent ratings from other bond rating agencies would apply for the same reductions.

In the above case, the commodity price used to calculate the deposit shall be the same as the price used by the IESO for the purpose of determining maximum net exposures and prudential support obligations for market participants other than distributors, low-volume Consumers and designated Consumers.

Interest will accrue monthly on security deposits commencing when the total deposit has been received. The rate shall be at the average Chartered Bank Prime Rate as published on the Bank of Canada Web site, less 2%. The interest rate shall be updated by Toronto Hydro at a minimum on a quarterly basis. The interest will be calculated and applied to the existing deposit prior to each update and at a minimum on a yearly basis.

Toronto Hydro will undertake an annual review of all security deposit requirements for each Consumer or Customer based on the ***Good Payment History*** described in this document.

- Where it is determined that all or part of the deposit is no longer required, the account will be credited with the amount of the deposit plus accumulated interest.

- Where it is determined that a deposit is now required or needs to be adjusted upward, the amount of the deposit will be added to the next regular bill and is payable by the due date of that bill, except for residential Customers which they shall be permitted to pay the adjusted amount in equal installments paid over a period of at least 6 months. As with all outstanding balances payment arrangements that are satisfactory to Toronto Hydro may be made.

- For Consumers or Customers in the >5000 kW demand rate class, where the Consumer or Customer is in a position to have some or all of the deposit refunded, only 50% of the deposit will be returned. A higher refund requires a credit rating from a recognized credit rating agency based on the criteria previously stated.

  Note: Where no deposit is on file or there is a deposit that does not meet the maximum amount, and the Consumer or Customer meets the good payment history criteria but does not meet the time frame, a new or increased deposit amount will not be added.

Upon closure of the Consumer's or Customer's account with Toronto Hydro, including a Consumer or Customer move from standard supply service ("SSS") to a competitive retailer where the retailer is performing the billing function (retailer consolidated billing), for all accounts types, the balance of the security deposit plus accumulated interest, after all amounts owing are paid, will be returned to the Consumer or Customer within six weeks of the closure of the account.

No earlier than 12 months after the payment of a security deposit or the making of a prior demand for a review, a Consumer or Customer may request in writing that the deposit amount be reviewed to determine whether the entire amount of the security deposit, or some portion of it, should be returned to the Consumer or Customer as it is no longer required.

Section 2 – DISTRIBUTION ACTIVITIES (GENERAL)

2.4.4 Billing

This section should outline the billing methods and billing cycles the Distributor has established to provide a Customer with Distribution Services, supply through Standard Service Supply or through a Retailer, per the rules and regulations laid out in the Retail Settlement Code.

Toronto Hydro may, at its option, render bills to its Customers on either a monthly, every two months, quarterly or annual basis. Bills for the use of electrical energy may be based on either a metered rate or a flat rate, as determined by Toronto Hydro.

A Customer may elect aggregated billing for multiple services provided all of the following conditions are met:

- the premises and businesses are situated on one contiguous parcel of land i.e. not separated by public roadway
- all premises are under one ownership
- the services are supplied at the same voltage
- the meters are of the interval type, allowing logical totalization of the coincident demands. If interval meters are not already in place, the Customer will install the necessary equipment, at the Customer's own cost, to Toronto Hydro specifications.

The Customer may dispute charges shown on the Customer's bill or other matters by contacting and advising Toronto Hydro of the reason for the dispute. Toronto Hydro will promptly investigate all disputes and advise the Customer of the results.

2.4.5 Payments and Overdue Account Interest Charges

This section should outline payment methods that the Distributor has established to provide the Customer with Distribution Services, supply through Standard Service Supply or through a Retailer as per the rules and regulations laid out in the Retail Settlements Code.

Toronto Hydro accepts payments in the form of a cheque (either mailed or delivered to a Toronto Hydro drop box), and through most financial institutions (either directly or through Pre-Authorized Payments).

Payment plans are available to Customers as per section 2.6.2 of the Standard Supply Service Code. Except where the Customer is in arrears on payment to Toronto Hydro for electricity charges and has not entered into an arrears payment agreement with Toronto Hydro, an equal monthly payment plan option, whereby an equalized payment amount is automatically withdrawn from a Customer's account with a financial institution on a monthly basis, is available for qualifying residential Customers. Except where the Customer is in arrears on payment to Toronto Hydro for electricity charges and has not entered into an arrears payment agreement with Toronto Hydro, an equal monthly billing plan option, whereby a monthly bill is issued to a Customer and the amount due in each bill is equalized over the course of a

Section 2 – DISTRIBUTION ACTIVITIES (GENERAL)

year, is available to Eligible Low-Income Customers.

Bills are payable in full by the due date; otherwise, overdue interest charges will apply at a rate of 1.5% monthly (compounded) or 19.56% annually**.** Where a partial payment has been made by the Customer on or before the due date, the interest charge will apply only to the amount of the bill outstanding at the due date. The Customer will be required to pay additional charges for the processing of non-sufficient fund (N.S.F.) cheques.

Outstanding bills are subject to the collection process and may ultimately lead to the service being discontinued. Service will be restored once satisfactory payment and/or payment arrangements have been made (refer to section 2.2.1).

2.5 Customer Information

The Conditions of Service shall describe the provision of information with respect to chapter 11 of the Retail Settlement Code. This specifies the rights of Consumers and retailers to access current and historical usage information and related data and the obligations of distributors in providing access to such information. The Conditions of Service should include reference to include information subject to privacy regulations and load profile information.

Any processes for handling requests for information outside of the requirements of the Retail Settlement Code should be described in this section.

A third party who is not a retailer may request historical usage information with the written authorization of the Consumer to provide their historical usage information.

Toronto Hydro will provide information appropriate for operational purposes that has been aggregated sufficiently, such that an individual's Consumer information cannot reasonably be identified, at no charge to another distributor, a transmitter, the IESO or the OEB. Toronto Hydro may charge a fee that has been approved by the OEB for all other requests for aggregated information.

At the request of a Consumer, Toronto Hydro will provide a list of retailers who have Service Agreements in effect within its distribution service area. The list will inform the Consumer that an alternative retailer does not have to be chosen in order to ensure that the Consumer receives electricity and the terms of service that are available under Standard Supply Service.

Upon receiving an inquiry from a Consumer connected to its distribution system, Toronto Hydro will either respond to the inquiry if it deals with its own distribution services or provide the Consumer with contact information for the entity responsible for the item of inquiry, in accordance with chapter 7 of the Retail Settlement Code.

An embedded distributor that receives electricity from Toronto Hydro shall provide load forecasts or any other information related to the embedded distributor's system

Section 2 – DISTRIBUTION ACTIVITIES (GENERAL)

load to Toronto Hydro, as determined and required by Toronto Hydro. A distributor shall not require any information from another distributor unless it is required for the safe and reliable operation of either distributor's distribution system or to meet a distributor's licence obligations.

Section 3 – CUSTOMER CLASS SPECIFIC

3 CUSTOMER CLASS SPECIFIC

The Customer Class Specific section shall contain references to services and requirements, which are specific to individual Customer classes. This section should cover such items as:

- ***Demarcation Point.***
- ***Metering.***
- ***Service Entrance Requirements.***
- ***Delineation of Ownership and Operational Points of Demarcation.***
- ***Special Contracts.***
- ***Other conditions specific to Customer class.***

The following are examples of Customer specific subsections. It is recognized that Customer Classifications are unique to each Distributor. The Distributor is not limited by these examples to the range and scope of their Customer Classifications. Each Distributor therefore should review their current Classifications and ensure that all of their existing Customer Classifications are adequately covered by the Distributor' s Conditions of Service document.

3.1 Residential

Include all items that apply specifically to Residential Customers not covered under the General section.

Refer to Tables 1.1, 1.2 and 1.3 and Table 2 under Section 5 of this Conditions for Point of Demarcation, Standard Allowance and Connection Fees for Residential Services.

3.1.1 Overhead Services

3.1.1.1 Minimum Requirements

In addition to the requirements of the Ontario Electrical Safety Code (latest edition), the following conditions shall apply:

(i) A clevis type insulator is to be supplied and installed by the Customer.

(ii) This point of attachment device must be located:

(a) Not less than 4.5 metres (15 feet) nor greater than 5.5 metres (18 feet) above grade (to facilitate proper ladder handling techniques). Building must have a minimum offset from property line of 1.2 metres (4 feet).

(b) Between 150 millimetres and 300 millimetres (6-12 inches) below the service head.

Section 3 – CUSTOMER CLASS SPECIFIC

(c) Within 914 millimetres (3 feet) of the face of the building.

(iii) Clearance must be provided between utility conductors and finished grade of at least 6 metres (19 feet) over traveled portions of the road allowance and 4.5 metres (15 feet) over all other areas.

A minimum horizontal clearance of 1.0 metres (39 inches) must be provided from utility conductors and any second storey windows.

(iv) A 4 jaw approved meter socket as specified in Section 6, Reference #6 – "Toronto Hydro Metering Requirements 750 Volts or Less" Table I shall be provided. Certain areas will require a 5-jaw socket as determined by Toronto Hydro. The Customer should contact Toronto Hydro to confirm details.

(v) Clear unobstructed access must be maintained to and in front of the meter location.

(vi) Service locations requiring access to adjacent properties (mutual drives, narrow side set-backs, etc.) will require the completion of an easement or written consent from the property owner(s) involved.

Proposed new or service changes in areas with mutual access (such as driveways, walkways) require:

- at least 50% ownership of the walkway or driveway by the property owner requesting the service when the width of the mutual property is less than 2 m. (Right of way access is not considered ownership);
- a minimum of 1 m width (for meter only installation) and a minimum 1.5 m width (for overhead connection access);
- absence of fences or other property separation;
- unobstructed access to service; and
- customer responsibility for disclosure of all property encumbrances.

Toronto Hydro assumes no liability for any property or meter location disputes between owner(s).

(vii) The approved meter socket shall be mounted directly below the service mast such that the midpoint of the meter is 1.7 m (± 100 mm) above finished grade within 914 mm of the face of the building (in front of any existing or proposed fence), unless otherwise approved by Toronto Hydro.

Section 3 – CUSTOMER CLASS SPECIFIC

3.1.1.2 Services Over Swimming Pools

Although the Ontario Electrical Safety Code allows electrical conductors to be located at adequate height, Toronto Hydro will **not** allow electrical conductors to be located above swimming pools.

Where a new swimming pool is to be installed it will be necessary to relocate, at the property owner's expense, any electrical conductors located directly over the proposed pool location.

Where overhead service conductors are in place over an existing swimming pool, Toronto Hydro will provide up to 30 metres of overhead service conductors, at no charge, to allow rerouting of the service. The property owner will pay any other costs.

3.1.2 Underground Services for Individual Residences

Customers requesting an underground service in an overhead area will be required to pay 100% connection costs for the underground service less the Standard Allowance for an overhead service.

The owner shall pay for any necessary road crossings.

The trench route must be approved by Toronto Hydro and is to follow the route indicated on the underground drawing supplied by Toronto Hydro. Any deviation from this route must be approved by Toronto Hydro. The Customer will be responsible for Toronto Hydro's costs associated with re-design and inspection services due to changes or deviations initiated by the Customer or its agents.

The owner will assure the provision for the service entrance and meter meets Toronto Hydro approval.

Where there are other services to be installed (e.g. gas, telephone, and cable) these shall be coordinated to avoid conflict with Toronto Hydro's underground cables. Toronto Hydro's installation will not normally commence until all other servicing and grading have been completed.

It is the responsibility of the owner or his/her contractor to obtain clearances from all of the utility companies (including Toronto Hydro) before digging.

It is the responsibility of the owner to contact Toronto Hydro to inspect each trench prior to the installation of Toronto Hydro's service cables.

The owner shall provide unimpeded access for Toronto Hydro to install the service.

Section 3 – CUSTOMER CLASS SPECIFIC

The owner shall ensure that any intended tree planting has appropriate clearance from underground electrical plant.

3.2 General Service

Include all items that apply specifically to general service Customers not covered under the other sections, and broken down (by load demand).

a) The Customer shall supply the following to Toronto Hydro well in advance of installation commencement:

- Required in-service date
- Proposed Service Entrance equipment's Rated Capacity (Amperes) and Voltage rating and metering requirements
- Propose Total Load details in kVA and/or kW (Winter and Summer)
- Locations of other services, gas, telephone, water and cable TV.
- Details respecting heating equipment, air-conditioners, motor starting current limitation and any appliances which demand a high consumption of electricity
- Survey plan and site plan indicating the proposed location of the service entrance equipment with respect to public rights-of-way and lot lines.
- For General Service (50 – 999 kW and 1000 kW and above) Class Customers, electrical, architectural and/or mechanical drawings as required by Toronto Hydro.

b) The Customer shall construct and install all civil infrastructure (including but not limited to poles, UG conduits, cable chambers, cable pull rooms, transformer room/vault/pad) on private property, that is deemed required by Toronto Hydro as part of its connection assets. All such civil infrastructures are to be in accordance with Toronto Hydro's current standards, practices, specifications and this Conditions and are subject to Toronto Hydro's inspection and acceptance.

Should the Customer construct and install the civil infrastructure related to connection assets, Toronto Hydro shall not include the associated civil component in its calculation of Basic and Variable Connection Fees.

c) Alternatively, the Customer may have Toronto Hydro construct and install the civil infrastructure that forms part of Toronto Hydro's connection assets on private property and the Customer will therefore be responsible for all costs via Basic Connection and Variable connection Fees (as applicable).

d) Toronto Hydro is responsible for the maintenance and repairs of its connection assets but not the transformer room(s) or any other civil structure that is part of the Customer's building.

Section 3 – CUSTOMER CLASS SPECIFIC

e) When effecting changes the Customer shall maintain sufficient clearances between electrical equipment and buildings and other permanent structures to meet the requirements of the Ontario Electrical Safety Code and the *Occupational Health & Safety Act* and Regulations.

f) It is the responsibility of the owner or his/her contractor to obtain clearances from all of the utility companies (including Toronto Hydro) before digging.

g) Provided the existing civil infrastructure has been maintained in satisfactory conditions by the Customer, Toronto Hydro will undertake the necessary programs to enhance its distribution plant at its expense, as part of its planned activities during normal business hours, Monday to Friday.

When a Customer requests that such planned activities be done outside Toronto Hydro's normal business hours, then the Customer shall pay the incremental costs incurred by Toronto Hydro as a result thereof. A Customer contribution may not be required for work performed outside of normal business hours if the work is part of planned maintenance programs on Toronto Hydro distribution system.

In the event that services or facilities to a Customer need to be restored as a result of these construction or maintenance activities by Toronto Hydro, they will be restored to an equivalent condition.

In addition, Toronto Hydro will carry out the necessary construction and electrical work to maintain existing supplies by providing standard overhead or underground supply services to Customers affected by Toronto Hydro's construction activities. If a Customer requests special construction beyond the normal Toronto Hydro standard installation in accordance with the program, the Customer shall pay the additional cost associated therewith, including engineering and administration fees.

h) Toronto Hydro shall install, maintain, and replace, at its own cost, all those civil infrastructures that are part of its main distribution system (i.e. not including connection assets) that may be located on private property and which serve Customers that are located outside of that private property. These Toronto Hydro civil infrastructures will require an easement.

i) The Customer shall install, maintain, and replace, at its own cost, all those civil infrastructures located on private property that are required to house the connection assets (i.e. the electrical equipment owned by Toronto Hydro) that serve Customers that are located on that private property.

Section 3 – CUSTOMER CLASS SPECIFIC

Where changes to Customer's civil infrastructure are part of a Toronto Hydro initiated enhancement project, Toronto Hydro may absorb the costs of modifications to the Customer's civil infrastructure, provided the existing civil infrastructure has been maintained in satisfactory condition by the Customer.

j) The Customer shall maintain in proper working conditions all Customer-owned service disconnecting devices (such as main switch and secondary breakers) that Toronto Hydro may need to operate for safety of its operations. Toronto Hydro shall not be liable if a switch / breaker were become inoperative or get damaged during its operation.

Refer to Tables 1.1, 1.2 and 1.3 and Table 2 of Section 5 of this Conditions for Point of Demarcation, Standard Allowance and Connection Fees for General Service.

3.2.1 Electrical Requirements (as applicable)

For low voltage supply, the Customer's service entrance equipment shall be suitable to accept conductors installed by Toronto Hydro. The Customer's cables shall be brought to a point determined by Toronto Hydro for connection to Toronto Hydro's supply.

The owner is required to supply and maintain an electrical room of sufficient size to accommodate the service entrance and meter requirements of the tenants and provide clear working space in accordance with the Ontario Electrical Safety Code.

In order to allow for an increase in load, the owner shall provide spare wall space so that at least 30% of the Customers supplied through meter sockets can accommodate meter cabinets at a later date.

Access doors, panels, slabs and vents shall be kept free from obstructing objects. The Customer will provide unimpeded and safe access to Toronto Hydro at all times for the purpose of installing, removing, maintaining, operating or changing transformers and associated equipment.

The electrical room must be located to provide safe access from the outside or main hallway, and not from an adjoining room, so that it is readily accessible to Toronto Hydro's employees and agents at all hours to permit meter reading and to maintain electric supply. This room must be locked. The owner shall install a pad bolt with mortise strike (Ackland Hardware, Cat. No. 199-10 or equivalent). Toronto Hydro shall provide a secure arrangement so that Toronto Hydro's padlock can be installed as well as the Customer's lock.

The electrical room shall not be used for storage or contain equipment foreign to the electrical installation within the area designated as safe working space. All stairways leading to electrical rooms above or below grade shall have a handrail on at least one side as per the Ontario Building Code and shall be located indoors.

Section 3 – CUSTOMER CLASS SPECIFIC

Outside doors providing access to electrical rooms must have at least 150-mm clearance between final grade and the bottom of the door. Electrical rooms 'on' or 'below' grade must have a drain including a "P" trap complete with a non-mechanical priming device and a backwater valve connected to the sanitary sewer. The electrical room floor must slope 6-mm/300 mm or 2% towards the drain.

The electrical room shall have a minimum ceiling height of 2.2 m clear, be provided with adequate lighting at the working level, in accordance with Illuminating Engineering Society (I.E.S.) standards, and a 120 V convenience outlet. The lights and convenience outlet noted above and any required vault circuit shall be supplied from a panel located and clearly identified in the electrical room.

3.2.2 Underground Service Requirements

The Customer shall construct or install all civil infrastructure (including but not limited to poles, UG conduits, cable chambers, cable pull rooms, transformer room/vault/pad) on private property, that is deemed required by Toronto Hydro as part of its Connection Assets. All civil infrastructures are to be in accordance with Toronto Hydro’s current standards, practices, specifications and this Conditions and are subject to Toronto Hydro’s inspection/acceptance.

The Customer is responsible to maintain all its structural and mechanical facilities on private property in a safe condition satisfactory to Toronto Hydro.

The trench route must be approved by Toronto Hydro. Any deviation from this route must also be approved by Toronto Hydro. The Customer will be responsible for Toronto Hydro’s costs associated with re-design and inspection services due to changes or deviations initiated by the Customer or its agents or any other body having jurisdiction.

It is the responsibility of the owner or his/her contractor to obtain clearances from all of the utility companies (including Toronto Hydro) before digging.

It is the responsibility of the owner to contact Toronto Hydro to inspect each trench prior to the installation of Toronto Hydro's cables.

3.2.3 Temporary Services (other than Residential)

A temporary service is a normally metered service provided for construction purposes or special events. Temporary services can be supplied overhead or underground. The Customer will be responsible for all associated costs for the installation and removal of equipment required for a temporary service to Toronto Hydro's point of supply. Temporary services may be provided for a period of no more than 12 months. Temporary services must be renewed thereafter if an extension

Section 3 – CUSTOMER CLASS SPECIFIC

is required and the equipment for such temporary service must be reinspected at the end of the 12-month period.

Where a temporary service is to be provided, the Customer shall provide and maintain a designated area for posting Toronto Hydro information. The Customer is responsible to ensure that the posted information is not tampered with or obstructed in any way. The entire site relating to where the temporary service is to be installed, which includes the route to and from all work areas, must be maintained at all times in accordance with all laws and regulations and in a safe condition which allows Toronto Hydro employees and representatives to carry out all work in a safe environment. The Customer shall be responsible for all damages and related costs sustained by any Toronto Hydro employee or representative in carrying out such work.

Subject to the requirements of Toronto Hydro, supply will be connected after receipt of a 'Connection Authorization' from the Electrical Safety Authority, an account opened and payment is received from the Customer.

Where self-contained meter sockets are required, they must be CSA approved and shall be securely mounted on a pole or nominal 152 mm x 152 mm treated wood post (or alternative if approved by Toronto Hydro) so that the midpoint of the meter is 1.73 m (± 100 mm) from finished grade.

In the case of temporary overhead services, the Customer shall leave 760 mm of cable at the masthead for connection purposes.

In the case of temporary underground services, the Customer's cable shall extend to Toronto Hydro’s point of supply.

3.3 General Service (Above 50 kW)

Include all items that apply specifically to General Service Customers (above 50 kW) not covered under the General section. Describe the criteria to determine how a Customer is classified as being above 50 kW.

All non-residential Customers with an average peak demand between 50 kW and 999 kW over the past twelve months are to be classified as General Services above 50 kW.

3.3.1 New Residential Subdivisions or Multi-Unit Developments

Customers of new Residential Subdivisions involving the construction of new city streets and roadways, or of Multi-unit Developments that are supplied from primary distribution systems built along private streets, are treated as Non-Residential Class Customers and will be subject to capital contribution for “expansion” work, in addition to any applicable Connection Fees. Should the Economic Evaluation

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identify a shortfall for the Expansion, the Developer has a choice of either completing the portion of plant not yet connected to Toronto Hydro's system or have Toronto Hydro complete this work in accordance with Section 3.3 of the DSC Code, titled "Alternative Bids". The Customer will not be allowed to complete construction work on Toronto Hydro's existing distribution system.

All other Residential Subdivisions or Multi-unit complexes will follow the general terms and conditions for Connection Fees and capital contribution for the appropriate General Class Customers.

In all cases, all of the electrical service must be constructed to Toronto Hydro's standards and in compliance with the Ontario Electrical Safety Code, applicable laws, regulations and codes.

All design work including service locations and trench routes must be approved by Toronto Hydro.

3.3.2 Electrical Requirements

Where the size of the Customer's electrical service warrants, as determined by Toronto Hydro, the Customer will be required to provide facilities on its property and an easement as required (i.e. on the premises to be served), acceptable to Toronto Hydro, to house the necessary transformer(s) and/or switching equipment. Toronto Hydro will provide planning details upon application for service.

Toronto Hydro will supply, install and maintain the electrical transformation equipment within the transformer vault or pad supplied by the Customer, at its expense, on the property. Toronto Hydro has the right to have this equipment connected to its distribution system.

The owner is required to supply and maintain an electrical room of sufficient size to accommodate the service entrance and meter requirements of the tenants and provide clear working space in accordance with the Ontario Electrical Safety Code.

In order to allow for an increase in load, the owner shall provide spare wall space so that at least 30% of the Customers supplied through meter sockets can accommodate meter cabinets at a later date.

The electrical room must be separate from, but adjacent to, the transformer vault. It must be located to provide safe access from the outside or main hallway, and not from an adjoining room, so that it is readily accessible to Toronto Hydro's employees and agents at all hours to permit meter reading and to maintain electric supply. This room must be locked. The owner shall install a pad bolt with mortise strike (Ackland Hardware, Cat. No. 199-10 or equivalent). Toronto Hydro shall

Section 3 – CUSTOMER CLASS SPECIFIC

provide a secure arrangement so that Toronto Hydro’s padlock can be installed as well as the Customer's lock.

The electrical room shall not be used for storage or contain equipment not related to the electrical installation within the area designated by Toronto Hydro as safe working space. All stairways leading to electrical rooms above or below grade shall have a handrail on at least one side as per the Ontario Building Code, and shall be located indoors.

Outside doors providing access to electrical rooms must have at least 150-mm clearance between final grade and the bottom of the door. Electrical rooms 'on' or 'below' grade must have a drain including a "P" trap complete with a non-mechanical priming device and a backwater valve connected to the sanitary sewer. The electrical room floor must slope 6-mm/300 mm or 2% towards the drain.

The electrical room shall have a minimum ceiling height of 2.2 m clear, be provided with adequate lighting at the working level, in accordance with Illuminating Engineering Society (I.E.S.) standards, and a 120 V convenience outlet. The lights and convenience outlet noted above and any required vault circuit shall be supplied from a panel located and clearly identified in the electrical room.

The owner shall identify each tenant's metered service by address and/or unit number in a permanent and legible manner. The identification shall apply to all main switches, breakers and to all meter cabinets or meter mounting devices that are not immediately adjacent to the switch or breaker. The electrical room shall be visibly identified from the outside.

3.3.3 Technical Information

Where project drawings are required for Toronto Hydro’s approval, for items under Toronto Hydro’s jurisdiction, the Customer or its authorized representative must ensure that proposal drawings are fully in compliance with Toronto Hydro’s standards. Approval of project drawings by Toronto Hydro shall not relieve the Customer of its responsibility in respect of full compliance with Toronto Hydro’s standards and all applicable laws, regulations and codes. In all cases, one copy of all relevant drawings must be submitted to Toronto Hydro. Where the Customer requires an approved copy to be returned, two copies of all plans must be submitted.

Prior to the preparation of a design for a service, the Customer will provide the following information to Toronto Hydro as well as the approximate date that the Customer requires the electrical service and the due date that Toronto Hydro’s civil construction drawings are required in order to co-ordinate with site construction.

Section 3 – CUSTOMER CLASS SPECIFIC

3.3.3.1 Site & Grading Plans

Indicate the lot number, plan numbers and, when available, the street number. The site plan shall show the location of the Building on the property relative to the property lines, any driveways and parking areas and the distance to the nearest intersection. All elevations shall be shown for all structures and proposed installations.

3.3.3.2 Mechanical Servicing Plan

Show the location on the property of all services proposed and/or existing such as water, gas, storm and sanitary sewers, telephone, et cetera.

3.3.3.3 Floor Plan

Show the service location, other services location, driveway, parking and indicate the total gross floor area of the building.

3.3.3.4 Duct Bank Location

Show the preferred routing of the underground duct bank on the property. This is subject to approval by Toronto Hydro.

3.3.3.5 Transformer Location

Indicate the preferred location on the property for the high voltage transformation. This is subject to approval by Toronto Hydro. Transformation will be vault, pad, submersible type or polemounted depending on the project load requirements.

3.3.3.6 Electrical Meter Room

Indicate preferred location in the building of the meter room and the main switchboard.

3.3.3.7 Single Line Diagram

Show the main service entrance switch capacity, the required supply voltage, and the number and capacity of all sub-services showing provision for metering facilities, as well as the connected load breakdown for lighting, heating, ventilation, air conditioning et cetera. Also, indicate the estimated initial kilowatt demand and ultimate maximum demands. Provide protection equipment information where coordination is required between Toronto Hydro and Customer owned equipment. Fusing will be determined later by Toronto Hydro to co-ordinate with the transformer size selected.

Section 3 – CUSTOMER CLASS SPECIFIC

3.3.3.8 Switchgear

Submit three copies of any service entrance switchgear to be installed for Toronto Hydro's approval, including interlocking arrangement if required.

3.3.3.9 Substation Information

Where a Customer owned substation is to be provided, the owner will be required to provide the following in addition to the site information outlined above.

- All details of the transformer, including kVA capacity, short circuit rating (in accordance with 3.3.4.1), primary and secondary voltages, impedance and cooling details.
- A site plan of the transformer station showing the equipment layout, proposed primary connections, grounding and fence details, where applicable.
- A coordination study for protection review.

3.3.4 Technical Considerations

3.3.4.1 Short Circuit Ratings

16000/27600 V Supply: The Customer's protective equipment shall have a three phase, short circuit rating of 800 MVA symmetrical. The asymmetrical current is 27,000 A (1.6 factor used).

8000/13800 V Supply: The Customer's protective equipment shall have a three phase, short circuit rating of 500 MVA symmetrical. The asymmetrical current is 34,000 A (1.6 factor used.)

2400/4160 V Supply: The Customer's protective equipment shall have a three phase, short circuit rating of 250 MVA symmetrical or 56,000 A asymmetrical (1.6 factor used).

600/347 V Supply: The Customer's protective equipment shall have a minimum short circuit rating of 50,000 A.

208/120 V Supply: Available short circuit current may be obtained upon request to Toronto Hydro.

3.3.4.2 Primary Fusing

All equipment connected to the Toronto Hydro's distribution system shall satisfy the short circuit ratings specified in clause 3.3.4.1. The Customer

Section 3 – CUSTOMER CLASS SPECIFIC

and/or the Customer's consultant shall specify the fuse link rating and demonstrate coordination with Toronto Hydro's upstream protection including station breakers and/or distribution fuses. The Customer shall submit, at its expense, a coordination study to Toronto Hydro for verification to ensure coordination with upstream protection including station breakers and/or distribution fuses. The Customer shall maintain an adequate supply of spare fuses to ensure availability for replacement in the event of a fuse blowing.

3.3.4.3 Ground Fault Interrupting

Where ground fault protection is required to comply with the Ontario Electrical Safety Code, the method and equipment used shall be compatible with Toronto Hydro's practice of grounding transformer neutral terminals in vaults. Zero sequence sensing will normally apply. Where ground strap sensing is used, the ground sensing devices shall be set to operate at 600 A if transformer and switchboard buses are not bonded and 400 A if buses are bonded. Ground fault protection proposals for dual secondary supply arrangements shall be submitted to Toronto Hydro for approval, before construction of the switchboard.

3.3.4.4 Lightning Arresters

Customer installations that are directly supplied from Toronto Hydro's primary underground system are not protected with lightning arresters. If the Customer wishes to install lightning arresters they shall be located on the load side of the first protective devices. For Customer installations that are supplied from Toronto Hydro's primary overhead system, Toronto Hydro, at its expense, will install lightning arresters at the pole and the Customer, at its expense, may install lightning arresters in the switchgear on the load side of the incoming disconnect device. The mimic diagram shall indicate the presence of such devices in the switchgear.

3.3.4.5 Basic Impulse Level (B.I.L.)

The Customer's apparatus shall have a minimum Basic Impulse Level in accordance with the following:

2400/4160 supply voltage - 60 kV B.I.L.
8000/13800 supply voltage - 95 kV B.I.L
16000/27600 supply voltage - Delta primary 150 kV B.I.L.
16000/27000 supply voltage - Grounded Wye primary 125 kV B.I.L.

3.3.4.6 Unbalanced Loads

On three-phase service, the unbalance due to single-phase loads shall not exceed 20% of the Customer's balanced phase loading expressed in kilowatts.

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3.4 General Service (Above 1000 kW)

Include all items that apply specifically to General Service Customers (above 1000 kW) not covered under the General section. Describe the criteria to determine how a Customer is classified as being above 1000 kW.

All non-residential Customers with an average monthly demand of 1000 kW or higher, averaged over twelve consecutive months, as determined by Toronto Hydro, are to be classified as Customers over 1000 kW.

3.4.1 Electrical Requirements

Where a primary service is provided to a Customer-owned substation, the Customer shall install and maintain such equipment in accordance with all applicable laws, codes, regulations, and Toronto Hydro’s Customer Owned Substation requirements for high voltage installations. Toronto Hydro will provide planning details upon application for service.

Customer owned substations are a collection of transformers and switchgear located in a suitable room or enclosure owned and maintained by the Customer, and supplied at primary voltage: i.e. the Supply Voltage is greater than 750 volts.

High voltage distribution services are three-phase, three-wire or four-wire depending on the supply feeder. The Customer is required to bring out a neutral conductor for connection to the system neutral. If not required for Customer's use, this neutral shall be terminated to the Customer's station ground system. Toronto Hydro will provide Customer interface details and requirements for high voltage supplies.

Customer must provide transformers having voltage taps in their primary windings and configurations as shown in Table 4 in section 5 of this Conditions for all new, upgraded and refurbished installations. Transformers other than listed in Table 4 may be considered in like-for-like repair but shall not be connected without the specific written approval of Toronto Hydro.

Customer owned substations must be inspected by both the Electrical Safety Authority and Toronto Hydro. The owner will provide a pre-service inspection report to Toronto Hydro. A contractor acceptable to Toronto Hydro will prepare the certified report to Toronto Hydro.

The Customer and Toronto Hydro shall inspect their own respective substations in accordance with the Distribution System Code. The minimum inspection cycles for Customer specific substations are one year for open substations and three years for enclosed substations. To facilitate and encourage the maintenance of this equipment, including, without limitation, the installation, maintenance, and testing of vault fire alarm detectors, Toronto Hydro will provide one power interruption annually, at no

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charge. This no-charge service would be scheduled during Toronto Hydro's normal business hours, Monday to Friday, and appointment times are not necessarily guaranteed. Toronto Hydro will charge Customers for power interruptions arranged at times other than as outlined above.

3.4.2 Technical Information and Considerations

The same information and considerations apply as for other General Service Customers. Refer to Subsection 3.3.3 and 3.3.4 for applicable requirements.

3.5 Embedded Generation Facilities

This section should include all terms and conditions applicable to the connection of embedded generation facility to the distributor (e.g., application process, engineering standards and operating agreements).

For the terms and conditions applicable to the connection of a generation facility on the Toronto Hydro distribution system refer to the requirements outlined in Section 6, Reference #3 – "Toronto Hydro Distributed Generation Requirements".

3.6 Wholesale Market Participant

Criteria for a Customer that is classified as being a Market Participant needs to be established. This section should describe any specific requirements for Customers that also are Market Participants.

Refer to the requirements outlined in Section 6, Reference #3 – "Toronto Hydro Distributed Generation Requirements".

3.7 Embedded Distributor

This section should include all terms and conditions applicable to the connection of an Embedded Distributor.

All embedded distributors within the service jurisdiction of Toronto Hydro are required to inform Toronto Hydro of their status in writing 30 days prior to the supply of electricity from Toronto Hydro. The terms and conditions applicable to the connection of an embedded distributor shall be included in the Connection Agreement with Toronto Hydro.

An Embedded Distributor shall enter into a Connection Agreement in a form acceptable to Toronto Hydro. Until such time as the Embedded Distributor executes such a Connection Agreement with Toronto Hydro, the Embedded Distributor shall be deemed to have accepted and agreed to be bound by all of the terms in this Conditions that apply to such Embedded Distributor.

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3.8 Unmetered Connections

This section will include all terms and conditions applicable to unmetered connection.

Toronto Hydro, at its sole discretion, may provide for new service connections without a meter being installed. These loads would generally be small in size, non-variable, and supply a single device. Examples of services that are considered for unmetered supply include traffic & railway crossing signals, pedestrian x-walk signals/beacons, bus shelters, telephone booths, CATV amplifiers, TTC switching devices and other miscellaneous small fixed loads. Other loads less than 2 kW may also be considered for unmetered connections.

In all cases, the Customer shall contact Toronto Hydro for service supply requirements. The Customer shall provide manufacturer information and documentation with regard to electrical demand and expected hours of operation of the proposed unmetered load. Toronto Hydro may require, at its sole discretion, that the Customer provide at its sole cost, a load study acceptable to Toronto Hydro in order to determine energy consumption.

The Customer shall notify Toronto Hydro prior to making any changes to existing equipment or adding new equipment that is to be supplied from the Toronto Hydro distribution system.

Where installations involve Toronto Hydro owned poles, the method and location of attachment are subject to the approval of Toronto Hydro. Toronto Hydro may, in its sole discretion, require the Customer to enter into agreement with Toronto Hydro governing such attachments.

The Customer shall construct, at its expense, the civil infrastructure (including but not limited to poles, UG conduits, tap boxes) on public road allowances or private property that is deemed required by Toronto Hydro to house or support Toronto Hydro's electrical equipment. These civil infrastructures shall be in accordance with Toronto Hydro's current standards, practices, specifications and this Conditions and are subject to inspection and acceptance by Toronto Hydro. After energization the Customer assets between the supply connection to the demarcation point shall be owned and maintained by Toronto Hydro.

Toronto Hydro will provide, at the Customer's expense, for all breakouts of the Toronto Hydro civil infrastructure (i.e. cable chambers, vaults), which may be required to make the service connection. The Customer's service connection equipment shall be suitable to accept conductors installed by Toronto Hydro. The Customer shall bring its cables to a point determined by Toronto Hydro.

Toronto Hydro shall make all new connections and final disconnections to and from Toronto Hydro's distribution system. The Customer shall pay the applicable

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Connection Fees as outlined in Sections 3.8.1 to 3.8.3 and Table #3. Where “variable connection fees” apply, Toronto Hydro shall provide an estimate of the proposed work to the unmetered Customer. In turn, the unmetered Customer shall provide a response to proceed or not with the proposed work to Toronto Hydro within two weeks.

The Customer shall maintain its civil infrastructure in a safe condition satisfactory to Toronto Hydro. Toronto Hydro will undertake the necessary programs to maintain and enhance its distribution plant. However, if during the course of Toronto Hydro’s work, relocation of Customer equipment is necessary, the Customer shall reimburse Toronto Hydro for all costs incurred for in relocating Customer’s infrastructure. More specifically, Toronto Hydro will provide standard overhead or underground supply services to unmetered Customers affected by Toronto Hydro’s construction activities at its own cost. However, where the unmetered Customer requests special construction beyond the normal Toronto Hydro standard installation in accordance with its program, the unmetered Customer shall pay the additional cost, including engineering and administration fees.

Request for payment shall be subject to Toronto Hydro having provided the unmetered Customer with adequate advance notice, prior to effecting the relocation. The unmetered Customer shall respond within two weeks of its intended plan to modify, upgrade, or remove its plant. Customer’s unmetered loads include, but are not limited to the following:

3.8.1 Street Lighting

All services supplied to street lighting equipment owned by or operated for a municipality or the Province of Ontario shall be classified as Street Lighting Service.

In addition to complying with this Conditions, all Street Lighting plant, facilities, or equipment owned by the Customer must comply with all Electrical Safety Authority (ESA) requirements.

The method and location of underground supply to Street Lighting plant from the Toronto Hydro distribution system will be established for each application through consultation with Toronto Hydro.

Charges related to the Connections of Street Lighting will be recovered via a Basic Connection Fee for a Standard Allowance/Basic Connection and a Variable Connection Fee (if applicable) consistent with the Ownership Demarcation Point defined in Table 3 in Section 5 of this Conditions for various Street Lighting Distribution systems.

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3.8.2 Traffic & Railway Crossing Signals, Pedestrian X-Walk Signals/Beacons, Bus Shelters, Telephone Booths, CATV Amplifiers, TTC Switching Devices, and Miscellaneous Small Fixed Loads

The above service types shall be classified as Unmetered Scattered Load Class Customers. Each unmetered location is reviewed individually and is connected to Toronto Hydro's low voltage distribution system. Electrical Safety Authority (ESA) "Authorization to Connect" is required prior to connecting the service.

The nominal service voltage will be 120 Volts, single phase. The method and location of supply will be established for each application through consultation with Toronto Hydro. Supply connections to the municipal or the Province of Ontario's street lighting systems will not be permitted.

The Ownership Demarcation Point for Customer electrical equipment attached to poles owned by Toronto Hydro is as follows:

- For Overhead Supply - the top of the Customer's service standpipe/mast.
- For Underground Supply - the line side of the Customer's circuit breaker panel on the pole (effective as of January 9, 2012).

The Ownership Demarcation Point for Customer owned electrical equipment, which is not attached to Toronto Hydro poles, is at the Customer's disconnect enclosure attached to its structure (effective as of January 9, 2012), or at the top of the Customer's service standpipe/mast.

Toronto Hydro may connect new Unmetered Scattered Load Customers using either an overhead or an underground supply. Overhead supply connections fall into two categories:

1) The source connection is made at an existing Toronto Hydro supply pole and the service mast is located on the same supply pole; or
2) The source connection is made at an existing Toronto Hydro distribution supply pole or line, without any extension of the secondary bus, and the service mast is located within 30 m of the existing pole or lines.

Toronto Hydro will recover the cost of the above two categories of overhead supply connections from the Customer via an Unmetered Basic Connection cost and if necessary, a Variable Connection cost. The Basic Connection cost is different depending on the category of overhead supply connection as described in Table 2 of Section 5 of these Conditions. Variable Connection costs are charged for installing assets that go beyond the assets included in the Basic Connection and are recovered on an actual cost basis. Both the Basic Connection and Variable Connection costs are charged to the Customer on a per location/installation basis.

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For an underground supply connection, Toronto Hydro will recover the actual costs of the connection from the Customer. (As of May 1, 2014, Toronto Hydro does not define a basic connection or charge a Basic Connection cost for underground supply connections.)

Re-design and inspection services are at the expense of the Customer. The Customer is responsible for maintaining and repairing its equipment and/or facilities.

3.8.3 Other Loads (<2 kW) - Decorative Lighting and Tree Lighting Services

This section applies to the distribution and supply of electrical energy for decorative lighting. These installations are typically owned and maintained by a local Business Improvement Association (BIA) as a way to improving streetscape or for specific festive occasions. In addition to complying with this Conditions, all such installations must comply with the Ontario Electric Safety Code and are subject to the approval of ESA.

This section does not apply to decorative lighting that is owned by, or operated for, a municipality or the Province of Ontario.

Decorative Lighting and Tree Lighting connected to Toronto Hydro's distribution system shall have the same terms and conditions as outlined in Section 3.8.2 of this Conditions.

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4 GLOSSARY OF TERMS

The Conditions of Service document may contain a variety of terms that should be defined in the context of this document. Where possible, glossary terms should reflect definitions in existing documents that apply to the distributor, such as the DSC Code, the Distributor's licence and Standard Supply Service Code. The text of the Conditions of Service document should be used to expand on these definitions as applicable to the Distributor.

Sources for definitions:

A *Electricity Act*, *1998*, Schedule A, Section 2, Definitions
MR Market Rules for the Ontario Electricity Market, Chapter 11, Definitions
DSC Distribution System Code Definitions
RSC Retail Settlement Code Definitions
EDL Electricity Distribution Licence

"Accounting Procedures Handbook" means the handbook approved by the Board and in effect at the relevant time, which specifies the accounting records, accounting principles and accounting separation standards to be followed by the distributor; (DSC)

"Affiliate Relationships Code" means the code, approved by the Board and in effect at the relevant time, which among other things, establishes the standards and conditions for the interaction between electricity distributors or transmitters and their respective affiliated companies; (DSC)

"ancillary services" means services necessary to maintain the reliability of the IESO-controlled grid; including frequency control, voltage control, reactive power and operating reserve services; (MR, DSC)

"apartment building" means a structure containing four or more dwelling units having access from an interior corridor system or common entrance;

"apparent power" means the total power measured in kiloVolt Amperes (kVA);

"application for service" means the agreement or contract with Toronto Hydro under which electrical service is requested;

"bandwidth" means a distributor's defined tolerance used to flag data for further scrutiny at the stage in the VEE (validating, estimating and editing) process where a current reading is compared to a reading from an equivalent historical billing period. For example, a 30 percent bandwidth means a current reading that is either 30 percent lower or 30 percent higher than the measurement from an equivalent historical billing period will be identified by the VEE process as requiring further scrutiny and verification; (DSC)

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"billing demand" means the metered demand or connected load after necessary adjustments have been made for power factor, intermittent rating, transformer losses and minimum billing. A measurement in kiloWatts (kW) of the maximum rate at which electricity is consumed during a billing period;

“Board” or “OEB” means the Ontario Energy Board; (A, DSC)

“building” means a building, portion of a building, structure or facility;

“competitive sector multi-unit residential service” means a service where electricity is used exclusively for residential purposes in a multi-unit residential building, where unit metering is provided using technology that is substantially similar to that employed by competitive sector sub-metering providers;

“complex metering installation” means a metering installation where instrument transformers, test blocks, recorders, pulse duplicators and multiple meters may be employed; (DSC)

“Conditions of Service” means the document developed by a distributor in accordance with subsection 2.4 of the Code that describes the operating practices and connection rules for the distributor; (DSC)

“connection” means the process of installing and activating connection assets in order to distribute electricity; (DSC)

“Connection Agreement” means an agreement entered into between a distributor and a person connected to its distribution system that delineates the conditions of the connection and delivery of electricity to or from that connection; (DSC)

“connection assets” means that portion of the distribution system used to connect a Customer to the existing main distribution system, and consists of the assets between the point of connection on a distributor’ s main distribution system and the ownership demarcation point with that Customer; (DSC)

“Consumer” means a person who uses, for the person’ s own consumption, electricity that the person did not generate; (A, MR, DSC)

“Customer” means a person that has contracted for or intends to contract for connection of a building or an embedded generation facility. This includes developers of residential or commercial sub-divisions; (DSC)

"demand" means the average value of power measured over a specified interval of time, usually expressed in kilowatts (kW). Typical demand intervals are 15, 30 and 60 minutes; (DSC)

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“demand meter” means a meter that measures a Consumer’s peak usage during a specified period of time; (DSC)

"developer" means a person or persons owning property for which new or modified electrical services are to be installed;

“disconnection” means a deactivation of connection assets that results in cessation of distribution services to a Consumer; (DSC)

“distribute”, with respect to electricity, means to convey electricity at voltages of 50 kilovolts or less; (A, MR, DSC)

“distribution losses” means energy losses that result from the interaction of intrinsic characteristics of the distribution network such as electrical resistance with network voltages and current flows; (DSC)

“distribution loss factor” means a factor or factors by which metered loads must be multiplied such that when summed equal the total measured load at the supply point(s) to the distribution system; (RSC)

“distribution services” means services related to the distribution of electricity and the services the Board has required distributors to carry out; (RSC, DSC)

“distribution system” means a system for distributing electricity, and includes any structures, equipment or other things used for that purpose. A distribution system is comprised of the main system capable of distributing electricity to many Customers and the connection assets used to connect a Customer to the main distribution system; (A, MR, DSC)

“Distribution System Code” means the code, approved by the Board, and in effect at the relevant time, which, among other things, establishes the obligations of the distributor with respect to the services and terms of service to be offered to Customers and retailers and provides minimum technical operating standards of distribution systems; (DSC)

“distributor” means a person who owns or operates a distribution system; (A, MR, DSC)

"duct bank" means two or more ducts that may be encased in concrete used for the purpose of containing and protecting underground electric cables;

“*Electricity Act*” means the *Electricity Act, 1998*, S.O. 1998, c.15, Schedule A; (MR, EDL, DSC)

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“Electrical Safety Authority” or “ESA” means the person or body designated under the *Electricity Act* regulations as the Electrical Safety Authority; (DSC)

"electric service" means the Customer’s conductors and equipment for energy from Toronto Hydro;

“eligible low-income customer” means a residential electricity customer who has been qualified by a social service agency that partners with Toronto Hydro, based on criteria contained in section 1.2 of the Distribution System Code;

“embedded distributor” means a distributor who is not a wholesale market participant and that is provided electricity by a host distributor; (RSC, DSC)

“embedded generation facility” means a generation facility which is not directly connected to the IESO-controlled grid but instead is connected to a distribution system, and has the extended meaning given to it in section 1.9; (DSC)

“emergency” means any abnormal system condition that requires remedial action to prevent or limit loss of a distribution system or supply of electricity that could adversely affect the reliability of the electricity system; (DSC)

“emergency backup generation facility” means a generation facility that has a transfer switch that isolates it from a distribution system; (DSC)

"energy" means the product of power multiplied by time, usually expressed in kilowatt-hours (kWH);

“*Energy Competition Act*” means the *Energy Competition Act*, *1998*, S.O. 1998, c. 15; (MR)

"energy diversion" means the electricity consumption unaccounted for but that can be quantified through various measures upon review of the meter mechanism, such as unbilled meter readings, tap off load(s) before revenue meter or meter tampering;

“enhancement” means a modification to the main distribution system that is made to improve system operating characteristics such as reliability or power quality or to relieve system capacity constraints resulting, for example, from general load growth, but does not include a renewable enabling improvement; (DSC)

“expansion” means a modification or addition to the main distribution system in response to one or more requests for one or more additional customer connections that otherwise could not be made, for example, by increasing the length of the main distribution system, and includes the modifications or additions to the main distribution system identified in section 3.2.30 but in respect of a renewable energy generation facility excludes a renewable enabling improvement; (DSC)

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"extreme operating conditions" means extreme operating conditions as defined in the Canadian Standards Association ("CSA") Standard CAN3-C235-87 (latest edition);
“four-quadrant interval meter” means an interval meter that records power injected into a distribution system and the amount of electricity consumed by the Customer; (DSC)

"general service" means any service supplied to premises other than those designated as Residential and less than 50kW, Large User, or Municipal Street Lighting. This includes multi-unit residential establishments such as apartments buildings supplied through one service (bulk-metered);

“generate”, with respect to electricity, means to produce electricity or provide ancillary services, other than ancillary services provided by a transmitter or distributor through the operation of a transmission or distribution system; (A, DSC)

“generation facility” means a facility for generating electricity or providing ancillary services, other than ancillary services provided by a transmitter or distributor through the operation of a transmission or distribution system, and includes any structures, equipment or other things used for that purpose; (A, MR, DSC)

“generator” means a person who owns or operates a generation facility; (A, MR, DSC)

“geographic distributor,” with respect to a load transfer, means the distributor that is licensed to service a load transfer Customer and is responsible for connecting and billing the load transfer Customer; (DSC)

“good utility practice” means any of the practices, methods and acts engaged in or approved by a significant portion of the electric utility industry in North America during the relevant time period, or any of the practices, methods and acts which, in the exercise of reasonable judgement in light of the facts known at the time the decision was made, could have been expected to accomplish the desired result at a reasonable cost consistent with good practices, reliability, safety and expedition. Good utility practice is not intended to be limited to the optimum practice, method, or act to the exclusion of all others, but rather to be acceptable practices, methods, or acts generally accepted in North America; (MR, DSC)

“host distributor” means the distributor who provides electricity to an embedded distributor; (DSC)

"house service" means that portion of the electrical service in a multiple occupancy facility which is common to all occupants, (i.e. parking lot lighting, sign service, corridor and walkway lighting, et cetera);

“IEC” means International Electrotechnical Commission;

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“IEEE” means Institute of Electrical and Electronics Engineers;
“IESO” means the Independent Electricity System Operator;

“IESO-controlled grid” means the transmission systems with respect to which, pursuant to agreements, the IESO has authority to direct operation; (A, DSC)

“interval meter” means a meter that measures and records electricity use on an hourly or sub-hourly basis; (RSC, DSC)

"large user" means a Customer with a monthly peak demand of 5000 kW or greater, regardless the demand occurs in the peak or off-peak periods, averaged over 12 months;

"load factor" means the ratio of average demand for a designated time period (usually one month) to the maximum demand occurring in that period;

“load transfer” means a network supply point of one distributor that is supplied through the distribution network of another distributor and where this supply point is not considered a wholesale supply or bulk sale point; (DSC)

“load transfer Customer” means a Customer that is provided distribution services through a load transfer; (DSC)

“main distribution system” means a distribution system less the connection assets;

"main service" refers to Toronto Hydro’s incoming cables, bus duct, disconnecting and protective equipment for a Building or from which all other metered sub-services are taken;

“market participant” has the meaning prescribed in the Market Rules;

“Market Rules” means the rules made under section 32 of the *Electricity Act*; (MR, EDL, DSC)

“Measurement Canada” means the Special Operating Agency established in August 1996 by the *Electricity and Gas Inspection Act, 1980-81-82-83*, c. 87., and Electricity and Gas Inspection Regulations (SOR/86-131; (DSC)

“meter service provider” means any entity that performs metering services on behalf of a distributor or generator; (DSC)

“meter installation” means the meter and, if so equipped, the instrument transformers, wiring, test links, fuses, lamps, loss of potential alarms, meters, data recorders, telecommunication equipment and spin-off data facilities installed to measure power

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past a meter point, provide remote access to the metered data and monitor the condition of the installed equipment; (RSC, DSC)
"meter socket" means the mounting device for accommodating a socket type revenue meter;

“metering services” means installation, testing, reading and maintenance of meters; (DSC)

“MIST meter” means an interval meter from which data is obtained and validated within a designated settlement timeframe. MIST refers to “Metering Inside the Settlement Timeframe;” (RSC, DSC)

“MOST meter” means an interval meter from which data is only available outside of the designated settlement timeframe. MOST refers to “Metering Outside the Settlement Timeframe;” (RSC, DSC)

"multiple dwelling" means a Building which contains more than one self-contained dwelling unit;

"municipal street lighting" means all services supplied to street lighting equipment owned and operated for a municipal corporation;

“non-competitive electricity costs” means costs for services from the IESO that are not deemed by the Board to be competitive electricity services plus costs for distribution services, other than Standard Supply Service (SSS); (RSC)

"normal operating conditions" means the operating conditions comply with the standards set by the Canadian Standards Association ("CSA") Standard CAN3-C235-87 (latest edition);

“Ontario Electrical Safety Code” means the code adopted by O. Reg. 164/99 as the Electrical Safety Code; (DSC)

“*Ontario Energy Board Act*” means the *Ontario Energy Board Act, 1998,* S.O. 1998, c.15, Schedule B; (MR, DSC)

“operational demarcation point” means the physical location at which a distributor’ s responsibility for operational control of distribution equipment including connection assets ends at the Customer; (DSC)

“ownership demarcation point” means the physical location at which a distributor’ s ownership of distribution equipment including connection assets ends at the Customer; (DSC)

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“performance standards” means the performance targets for the distribution and connection activities of the distributor as established by the Board pursuant to the *Ontario Energy Board Act* and in the Rate Handbook;
"person" includes an individual, a corporation, sole proprietorship, partnership, unincorporated organization, unincorporated association, body corporate, and any other legal entity;

“physical distributor,” with respect to a load transfer, means the distributor that provides physical delivery of electricity to a load transfer Customer, but is not responsible for connecting and billing the load transfer Customer directly; (DSC)

"plaza" means any Building containing two or more commercial business tenants;

“point of supply,” with respect to an embedded generation facility, means the connection point where electricity produced by the generation facility is injected into the distribution system; (DSC)

"power factor" means the ratio between Real Power and Apparent Power (i.e. kW/kVA);

"primary service" means any service which is supplied with a nominal voltage greater than 750 volts;

"private property" means the property beyond the existing public street allowances;

“rate” means any rate, charge or other consideration, and includes a penalty for late payment; (DSC)

“Rate Handbook” means the document approved by the Board that outlines the regulatory mechanisms that will be applied in the setting of distributor rates; (RSC, DSC)

"reactive power" means the power component which does not produce work but is necessary to allow some equipment to operate, and is measured in kiloVolt Amperes Reactive (kVAR);

"real power" means the power component required to do real work, which is measured in kiloWatts (kW);

“Regulations” means the regulations made under the *Ontario Energy Board Act* or the *Electricity Act*;

“reinforcement” means an investment that a distributor makes to increase the distribution system capacity to accommodate new load on the distributor’s

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distribution system, consistent with the distributor's planning, design, and construction standard.

"residential customer" means a Customer that receives either a "residential service" or a "competitive sector multi-unit residential service";

"residential service" means a service where electricity is used exclusively for residential purposes in a separately metered living accommodation, where the "competitive sector multi-unit residential service" is not applicable. Eligibility is restricted to a dwelling unit that consists of a detached house or one unit of a semi-detached, duplex, triplex or quadruplex building, with a residential zoning; a separately metered dwelling within a town house complex or apartment building; and bulk metered residential buildings with six or fewer units;

"retail", with respect to electricity means,

a) to sell or offer to sell electricity to a Consumer
b) to act as agent or broker for a retailer with respect to the sale or offering for sale of electricity, or
c) to act or offer to act as an agent or broker for a Consumer with respect to the sale or offering for sale of electricity; (A, MR, DSC)

"Retail Settlement Code" means the code approved by the Board and in effect at the relevant time, which, among other things, establishes a distributor's obligations and responsibilities associated with financial settlement among retailers and Consumers and provides for tracking and facilitating Consumers transfers among competitive retailers; (DSC)

"retailer" means a person who retails electricity; (A, MR, DSC)

"secondary service" means any service which is supplied with a nominal voltage less than 750 Volts;

"service agreement" means the agreement that sets out the relationship between a licensed retailer and a distributor, in accordance with the provisions of Chapter 12 of the Retail Settlement Code; (RSC)

"service area," with respect to a distributor, means the area in which the distributor is authorized by its license to distribute electricity; (A, EDL, DSC)

"service date" means the date that the Customer and Toronto Hydro mutually agree upon to begin the supply of electricity by Toronto Hydro;

"Standard Supply Service Code" means the code approved by the Board which, among other things, establishes the minimum conditions that a distributor must meet

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in carrying out its obligations to sell electricity under section 29 of the *Electricity Act*; (EDL)

"sub-service" means a separately metered service that is taken from the main Building service;

"supply voltage" means the voltage measured at the Customer's main service entrance equipment (typically below 750 volts). Operating conditions are defined in the Canadian Standards Association ("CSA") Standard CAN3-C235 (latest edition);

"temporary service" means an electrical service granted temporarily for such purposes as construction, real estate sales, trailers, et cetera;

"terminal pole" refers to the Toronto Hydro's distribution pole on which the service supply cables are terminated;

"Timed Load Interrupter Device" means a device that will completely interrupt the customer's electricity intermittently for periods of time and allows full load capacity outside of the time periods that the electricity is interrupted; (DSC)

"total losses" means the sum of distribution losses and unaccounted for energy; (DSC)

"transformer room" means an isolated enclosure built to applicable codes to house transformers and associated electrical equipment;

"transmission system" means a system for transmitting electricity, and includes any structures, equipment or other things used for that purpose; (A, MR, DSC)

"Transmission System Code" means the code, approved by the Board, that is in force at the relevant time, which regulates the financial and information obligations of the Transmitter with respect to its relationship with Customers, as well as establishing the standards for connection of Customers to, and expansion of a transmission system; (DSC)

"transmit", with respect to electricity, means to convey electricity at voltages of more than 50 kilovolts; (A, DSC)

"transmitter" means a person who owns or operates a transmission system; (A, MR, DSC)

"unaccounted for energy" means all energy losses that can not be attributed to distribution losses. These include measurement error, errors in estimates of

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distribution losses and unmetered loads, energy theft and non-attributable billing errors; (DSC)

“unmetered loads” means electricity consumption that is not metered and is billed based on estimated usage; (DSC)

“validating, estimating and editing (VEE)” means the process used to validate, estimate and edit raw metering data to produce final metering data or to replicate missing metering data for settlement purposes; (MR, DSC)

“wholesale market participant”, means a person that sells or purchases electricity or ancillary services through the IESO- administered markets; (RSC, DSC)

Section 5 – TABLES

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TABLE 1.1 Demarcation Points & Charges for Connection Assets and Disconnection

Rate/Customer Class	Ownership Demarcation Point	Standard Allowance (Basic Connection)	Basic Connection Fee (for Std. Allowance)	Variable Connection Fee	Additional Services charged to Customer (as part of Var. Connections)	Service Disconnection Fee (Initiated by customer request)
CLASS 1 Residential - Single service						
Overhead	Top of Customer's service mast	up to 30 m OH service lines from Distributor's "feed" pole or lines. Includes connections at feed pole or lines, at customer's service mast, and equivalent average credit for transformation equipment.	Recovered through Distributor's rates	Customer charged Actual costs for connection assets beyond standard allowance.	Customers requesting an UG service in OH area will be required to pay 100% connection costs less the Standard allowance for an OH service.	Recovered through Distributor's Tariffs or rates. See Table 2
Underground (Not requiring Transformation Facilities on Customer's property)	Line side of Customer's meter base	equivalent credit to Class 1 Residential Overhead Single Service	Recovered through Distributor's rates	Customer charged Actual costs for connection assets beyond standard allowance, including street crossing. *If Customer's load requires transformation facilities on Customer's property, refer to "General Service" Rate Class category for Underground service with Transformation.*		Recovered through Distributor's Tariffs or rates. See Table 2
CLASS 2 General Service 0 < 50 kW						
Overhead - Single Service	Top of Customer's service mast	equivalent credit to Class 1 Residential Overhead Single Service	Recovered through Distributor's rates	Customer charged Actual costs for connection assets beyond standard allowance.	Additional or redesign due to changes in Customer initial proposal; electrical inspections more than standard allowance	Recovered through Distributor's Tariffs or rates. See Table 2
Underground - Single Service	Line side of Customer's main disconnect switch	equivalent credit to Class 1 Residential Overhead Single Service	Recovered through Distributor's rates	Customer charged Actual costs for connection assets beyond standard allowance. Inspections more than standard allowance and all civil inspections.	Additional or redesign due to changes in customer initial proposal; electrical	Recovered through Distributor's Tariffs or rates. See Table 2

Section 5 – TABLES

TABLE 1.2 Demarcation Points & Charges for Connection Assets and Disconnection

Rate/Customer Class	Ownership Demarcation Point	Standard Allowance (Basic Connection)	Basic Connection Fee (for Std. Allowance)	Variable Connection Fee	Additional Services charged to Customer (as part of Var. Connections)	Service Disconnection Fee (Initiated by customer request)
CLASS 3-A General Service 50 kW - 999 kW						
Overhead - Single building Bulk Metered or Suite Metering (Not requiring Transformation Facilities on private property)	Top of Customer's service mast	equivalent credit to Class 1 Residential Overhead Single Service	See Table 2	Customer charged Actual costs for connection assets beyond standard allowance.	Additional or redesign due changes in Customer initial proposal; electrical inspections more than standard allowance	Customer charged fixed, average costs associated with disconnection and/or removal of connection assets up to the demarcation point. See Table 2
Underground - Single Building Bulk Metered or Suite Metering (Not requiring Transformation Facilities on private property)	Line side of Customer's main disconnect switch	equivalent credit to Class 1 Residential Overhead Single Service	See Table 2	Customer charged Actual costs for connection assets beyond standard allowance, including cable chamber(s), UG conduits as required.	Additional or redesign due changes in Customer initial proposal; electrical inspections more than std. allowance and all civil inspections.	Customer charged actual costs associated with disconnection and/or removal of connection assets up to the demarcation point. See Table 2
Overhead - Single Building Bulk Metered or Suite Metering (Requiring Transformation Facilities on private property)	Line side of Customer's main disconnect switch (secondary UG) OR top of Customer's service mast (secondary OH)	equivalent credit to Class 1 Residential Overhead Single Service	See Table 2	Customer charged Actual costs for connection assets beyond standard allowance, including transformer(s), Tx. connections, associated switching equipment, transformer pole(s), cable chamber(s), UG conduits as applicable.	Additional or redesign due changes in Customer initial proposal; electrical inspections more than std. allowance and all civil inspections and related feeder switching/scheduling	Customer charged actual costs associated with the disconnection and/or removal of connection assets including cables, transformers and related vault equipment up to the demarcation point and, related feeder switching and scheduling.
Underground - Single Building Bulk Metered or Suite Metering (Requiring Transformation Facilities on private property)	Line side of Customer's main disconnect switch or Customer's bus	equivalent credit to Class 1 Residential Overhead Single Service	See Table 2	Customer charged Actual costs for connection assets beyond standard allowance, including transformer(s), Tx. connections, associated switching equipment, transformer pads, transformer vaults, cable chambers,cable pull rooms, UG conduits and cabling and road crossing (as applicable).	Additional or redesign due changes in Customer initial proposal; electrical inspections more than std. allowance and all civil inspections and related feeder switching/scheduling	Customer charged actual costs associated with the disconnection and/or removal of connection assets including cables, transformers and related vault equipment up to the demarcation point and related feeder switching and scheduling.

Section 5 – TABLES

TABLE 1.3 Demarcation Points & Charges for Connection Assets and Disconnection

Rate/Customer Class	Ownership Demarcation Point	Standard Allowance (Basic Connection)	Basic Connection Fee (for Std. Allowance)	Variable Connection Fee	Additional Services charged to Customer (as part of Var. Connections)	Service Disconnection Fee (Initiated by customer request)
CLASS 3-B General Service 50 kW - 999 kW						
Underground (Multi-units or Townhouse Complex with Transformation Facilities on private property other than supplied from primary distribution systems built along private streets)	(Bulk meter) First point of connection past transformers on private property as applicable, i.e. a) Tx. Secondary spade b) cable chamber c) tap box d) meter center	equivalent credit to Class 1 Residential Overhead Single Service	See Table 2	Customer charged Actual costs for connection assets beyond standard allowance, including transformer(s), associated switching equipment, transformer pads, transformer vaults, cable chambers, connections in cable chamber(s), tap boxes excess UG conduit & cabling.	Additional or redesign due to changes in Customer initial proposal; electrical inspections more than std. allowance and all civil inspections and related feeder switching/scheduling	Customer charged actual costs associated with the disconnection and/or removal of connection assets including cables, transformers and related vault equipment up to the demarcation point and related feeder switching and scheduling. See Table 2
	(Townhouse individual meter) line side of individual meter base	equivalent credit to Class 1 Residential Overhead Single Service applied to each meter	Recovered through Distributor's rates	Customer charged Actual costs for connection assets beyond standard allowance.		Recovered through Distributor's Tariffs or rates.
Underground (Multi-units or Townhouse Complex with NO Transformation Facilities on private property or supplied from primary distribution system built along private streets)	(Bulk meter) First point of connection past Distributor's system onto private private as applicable I.e. a) cable chamber b) tap box c) meter center	equivalent credit to Class 1 Residential Overhead Single Service	See Table 2	Customer charged Actual costs for connection assets beyond standard allowance, including cable chamber(s), excess UG conduit and cabling.	Additional or redesign due to changes in Customer initial proposal; electrical inspections more than std. allowance and all civil inspections.	Customer charged actual costs associated with the disconnection and/or removal of connection assets up to the demarcation point. See Table 2
	(Townhouse individual meter) line side of individual meter base	equivalent credit to Class 1 Residential Overhead Single Service applied to each meter	Recovered through Distributor's rates	Customer charged Actual costs for connection assets beyond standard allowance.		Recovered through Distributor's Tariffs or rates.
CLASS 3-C Residential Subdivision (development with more than 5 lots)	Line side of customer's meter base (UG) Top of Customer's service mast (OH)	equivalent credit to Class 1 Residential Overhead Single Service	See Table 2	Blended costs net of basic allowance credit		Recovered through Distributor's Tariffs or rates.
CLASS 4 & 5 General Service 1000kW and Up						
Underground Single/Multiple Building Bulk Metered or Suite Metering (Requiring Transformation Facilities on private property)	Line side of Customer's main bus	equivalent credit to Class 1 Residential Overhead Single Service	See Table 2	Customer charged Actual costs for connection assets beyond standard allowance, including transformer(s), Tx. connections, associated switching equipment, transformer pads, transformer vaults, cable chambers, cable pull rooms, UG conduits, excess cabling and street crossings.	Additional or redesign due to changes in Customer initial proposal; electrical inspections more than std. allowance and all civil inspections and related feeder switching/scheduling	Customer charged actual costs associated with the disconnection and/or removal of connection assets including cables, transformers and related vault equipment up to the demarcation point and related feeder switching and scheduling. See Table 2
Underground Single/Multiple Building Bulk Metered or Suite Metering (Customer owned Sub-Station) (Requiring Transformation Facilities on private property)	Pot head Terminations at line side of Customer's high voltage switchgear	equivalent credit to Class 1 Residential Overhead Single Service	See Table 2	Customer charged Actual costs for connection assets beyond standard allowance, including cable chamber(s), cable pullroom, excess UG conduit and cabling and street crossing.	Additional or redesign due changes in Customer initial proposal; electrical & Swgr inspections more than std. allowance; all civil inspection and related feeder switching/ scheduling; additional Hi-pot, protection & control relays, wiring and relay settings associated with pilot wire prot. or other extra reliability systems	Customer charged actual costs associated with the disconnection and/or removal of connection assets including related feeder switching and scheduling. See Table 2

Note: Individual Suite Metering will negate the Transformer Allowance Discount

Section 5 – TABLES

TABLE 1.4 Demarcation Points & Charges for Connection Assets and Disconnection

Rate/Customer Class	Ownership Demarcation Point	Standard Allowance (Basic Connection)	Basic Connection Fee (for Std. Allowance)	Variable Connection Fee	Additional Services charged to customer (as part of Var. Connections)	Service Disconnection Fee (Initiated by customer request)
Unmetered Connections (excluding street lighting)						
Overhead-Supply						
(1) Source connection is made at Distributor's supply pole and the service mast is located on the same supply pole	a) Top of Customer's service mast; or b) Customer's disconnect enclosure	Source connection is made at Distributor's supply pole	See Table 2	Customer charged Actual costs for connection assets beyond standard allowance	Additional or redesign due to changes in Customer initial proposal.	Customer charged actual costs associated with disconnection and/or removal of connection assets up to the demarcation point.
(2) Source connection is made at Distributor's supply pole (or lines), and the service mast is not located on the same supply pole	a) Top of Customer's service mast; or b) Customer's disconnect enclosure	Source connection (up to 30 m of service lines) from Distributor's supply pole or line to service mast that is not located on the same supply pole	See Table 2	Customer charged Actual costs for connection assets beyond standard allowance	Additional or redesign due to changes in Customer initial proposal.	Customer charged actual costs associated with disconnection and/or removal of connection assets up to the demarcation point.
Underground-Supply						
(1) Customer attachments on Distributor's poles	Line side of Customer's circuit breaker panel on pole	No standard allowance	not applicable	Customer charged Actual costs for connection assets.	Additional or redesign due to changes in Customer initial proposal.	Customer charged actual costs associated with disconnection and/or removal of connection assets up to the demarcation point.
(2) Customer attachments not on Distributor's poles	Customer's disconnect enclosure at Customer's structure	Source connection at Distributor's structure (tap box, cable chamber). No standard allowance	not applicable	Customer charged Actual costs for connection assets.	Additional or redesign due to changes in Customer initial proposal.	Customer charged actual costs associated with disconnection and/or removal of connection assets up to the demarcation point.

Section 5 – TABLES

TABLE 2 Service Connection and Disconnection Fee

IMPORTANT:
The range of services listed below may not be applicable in all districts due to the restrictions imposed by the distribution system in certain areas

Rate/Customer Class	Ownership Demarcation Point	Service Connection Fee (*) (Subject to annual review)	Service Disconnection Fee (Initiated by Customer)
CLASS 1 - Residential - Single Service			
Overhead	Top of Customer's service mast	- Basic Connection Charge recovered through hydro rates ($1,396.00)	(No charge - Recovered through rates)
Underground (Not requiring Transformation Facilities on customer's property)	Line side of Customer's meter base	- Variable Connection Charges collected directly from the Customer	(No charge - Recovered through rates)
CLASS 2 - General Service 0 < 50 kW			
Overhead - Single Service	Top of Customer's service mast	- Basic Connection Charge recovered through hydro rates ($1,396.00)	(No charge - Recovered through rates)
Underground - Single Service (Not requiring Transformation Facilities on customer's property)	Line side of Customer's main disconnect switch	- Variable Connection Charges collected directly from the Customer	(No charge - Recovered through rates)
CLASS 3A - General Service 50 kW - 999 kW			
Overhead - Single Service (Not requiring Transformation Facilities on private property)	Top of Customer's service mast	- Basic Connection re Charge covered through hydro rates ($1,396.00) - Variable Connection Charges collected directly from the Customer	All Service sizes: $185.00 during regular hours $415.00 after regular hours
Underground - Single Service (Not requiring Transformation Facilities on private property)	Line side of Customer's main disconnect switch	- Basic Connection Charge recovered through hydro rates ($1,396.00) - Variable Connection Charges collected directly from the Customer	(Variable Disconnection Charge collected directly from the Customer)
(Requiring Transformation Facilities on private property)	Line side of Customer's main disconnect switch or Customer's bus	- Basic Connection Charge recovered through hydro rates ($1,396.00) - Variable Connection Charges collected directly from the Customer	(Variable Disconnection Charge collected directly from the Customer)
CLASS 3B - General Service 50 kW - 999 kW			
Underground (Multi-units or Townhouse Complex with Transformation Facilities on private property other than supplied from primary distribution systems built along private streets)	(Bulk meter) First point of connection past transformers on private property a) Tx. Secondary spade b) meter center c) cable chamber d) tap box	- Basic Connection re Charge covered through hydro rates ($1,396.00) - Variable Connection Charges collected directly from the Customer	(Variable Disconnection Charge collected directly from the Customer)
	(Townhouse individual meter) Line side of Customer's meter base		(No charge - Recovered through rates)
Underground (Multi-units or Townhouse Complex with NO Transformation Facilities on private property or supplied from primary distribution system built along private streets)	(Bulk meter) First point of connection past Distributor's system onto private a) tap box b) meter base/center c) cable chamber	- Basic Connection re Charge covered through hydro rates ($1,396.00) - Variable Connection Charges collected directly from the Customer	(Variable Disconnection Charge collected directly from the Customer)
	(Townhouse individual meter) Line side of Customer's meter base	- Basic Connection Charge recovered through hydro rates ($1,396.00) - Variable Connection Charges collected directly from the Customer	(No charge - Recovered through rates)
CLASS 3C			
Residential Subdivision (development with more than 5 lots)	Line side of Customer's meter base Top of Customer's service mast	- Basic Connection re Charge covered through hydro rates ($1,396.00) - Variable Connection Charges collected directly from the Customer	(No charge - Recovered through rates)

(*) Typical connection costs by Class of Customers are available upon request

Section 5 – TABLES

TABLE 2 (continued) - Service Connection and Disconnection Fee

IMPORTANT:
The range of services listed below may not be applicable in all districts due to the restrictions imposed by the distribution system in certain areas

Rate/Customer Class	Ownership Demarcation Point	Service Connection Fee (*) (Subject to annual review)	Service Disconnection Fee (Initiated by Customer)
CLASS 4 & 5 - General Service 1000 kW and Up			
Underground (Requiring Transformation Facilities on private property)	Line side of Customer's main bus	- Basic Connection Charge recovered through hydro rates ($1,396.00) - Variable Connection Charges collected directly from the Customer	(Variable Disconnection Charge collected directly from the Customer)
Underground (Customer owned Sub-Station)	Pot head Terminations at line side of Customer's high voltage switchgear	- Basic Connection Charge recovered through hydro rates ($1,396.00) - Variable Connection Charges collected directly from the Customer	(Variable Disconnection Charge collected directly from the Customer)
Unmetered Connections (excluding street lighting)			
Overhead Supply-			
(1) Source connection is made at Distributor's supply pole and the service mast is located on the same supply pole	a) Top of Customer's service mast; or b) Customer's disconnect enclosure	- Unmetered Basic Connection Charge collected directly from the Customer ($446.00) - Variable Connection Charges collected directly from the Customer	(Variable Disconnection Charge collected directly from the Customer)
(2) Source connection is made at Distributor's supply pole (or lines), and the service mast is not located on the same supply pole	a) Top of Customer's service mast; or b) Customer's disconnect enclosure	- Unmetered Basic Connection Charge collected directly from the Customer ($1011.00) - Variable Connection Charges collected directly from the Customer	(Variable Disconnection Charge collected directly from the Customer)
Underground Supply-			
(1) Customer attachments on Distributor's poles	Line side of Customer's circuit breaker panel on pole	- Actual connection costs collected directly from the Customer	(Variable Disconnection Charge collected directly from the Customer)
(2) Customer attachments not on Distributor's poles	Customer's disconnect enclosure at Customer's structure	- Actual connection costs collected directly from the Customer	(Variable Disconnection Charge collected directly from the Customer)

(*) Typical connection costs by Class of Customers are available upon request

Section 5 – TABLES

TABLE 3 New or Upgraded Street Lighting Services – Point of Demarcation and Connection Charges

Types of Street Lighting. Distribution Systems	Ownership Demarcation Point	Standard Allowance	Basic Connection Fee (subject to annual review)	Variable Connection Fee(*)
Municipal Lights attached to Distributor's poles and connected to Distributor's *overhead* 120/240 V secondary bus.	Connections at the overhead bus.	Connections made at Distributor's overhead secondary bus.	$533.36	Customer charged actual costs for connection assets above and beyond the Standard Allowance.
Municipal Lights attached to Distributor's poles (in mixed use urban setting)** and connected to Distributor's *underground* 120/240 V secondary bus.	At the base of the Street Lighting bracket connected to the pole.	Connections made in the pole's handhole.	$573.97	Customer charged actual costs for connection assets above and beyond the Standard Allowance. (e.g. cable chamber/tap box breakout, underground conduit and cables, additional connections)
Municipal Lights attached to Municipality's poles (in residential setting) and connected to Distributor's *underground* 120/240 V secondary bus.	Line side of the protective device (i.e. circuit breaker, fuse) in the pole's handhole.	Connections made in the pole's handhole.	$573.97	Customer charged actual costs for connection assets above and beyond the Standard Allowance. (e.g. cable chamber/tap box breakout, underground conduit and cables, additional connections)

*Consulting and engineering work is not included and may be separately charged.

** mixed use urban setting, where streets are classified as Collector or Arterial.

Section 5 – TABLES

TABLE 4   Customer Owned Transformers (Article 3.4.1)

Transformer Voltage		Recommended Primary Tap Voltage					
Primary	Secondary	+5%	+2½%	0	-2 ½%	-5 %	-7 ½%
27600 grd.Y/16000 27600 grd.Y/16000	less than 750 13800 grd.Y/8000	28980	28290	27600	26910	26220	
27600	2400/4160 Y		28290	27600	26910	26220	25530
13860	2400/4160 Y		14206	13860	13513	13167	12820
13860 13860 grd.Y/8000	less than 750	14553	14206	13860	13513	13167	

Section 5 – TABLES

TABLE 5 Meter Sockets (Article 2.3.7.1.2)

SELF-CONTAINED SOCKET METERING			
Voltage	Phase	Wire	Maximum Service Switch Size Rating Amperes
120/240	1	3	200
120/240	1	3	400 *
208/120	2	3	200
208/120	3	4	200
600/347	3	4	200
600 **	3	3	200

* A 400 amp transformer-rated meter socket contains a 3 wire current transformer and transformer type meter. Refer to Section 6, Reference #6 – "Toronto Hydro Metering Requirements 750 Volts or Less" Table I, for a list of manufacturer's meter sockets approved by Toronto Hydro.

** Used only for existing services where grounded supply is not available.

Notes:

1. Only CSA approved meter sockets are to be used.

2. Meter sockets shall be mounted so that the midpoint of the meter is set at 1700 mm ± 100 mm.

3. Where the supply is grounded, 600 V metering shall be 4 wire. Where the Customer does not require a neutral, a full size neutral conductor sized in accordance with Table 17 of the Ontario Electrical Safety Code must be provided to all meter cabinets or sockets. The neutral conductor is to be terminated in the socket (or cabinet) on an insulated block in accordance with the Ontario Electrical Safety Code.

Section 5 – TABLES

TABLE 6 Meter Cabinets (Article 2.3.7.1.2)

METER CABINETS				
Voltage	Phase	Wire	Main Switch Size in Amperes	Meter Cabinets (see description below)
120/240	1	3	Over 400	A
208/120 416/240 600/347	3	4	Over 200 – 800	A
			Over 800	B
600*	3	3	Over 200 – 400	A
			Over 800	B

***** Only for existing services where grounded supply is not available.

Meter Cabinet Descriptions

A – 48” x 48” x 12” complete with removable 44” x 44” backplate.
B – 36” x 36” x 12” connected to switchgear instrument transformer compartment.

Notes:
1. Meter cabinets shall be fabricated of minimum # 16 gauge steel.
2. Cabinets shall have side-hinged doors opening at the center and be equipped with three-point latching and provision for padlocking.
3. The maximum distance from the floor to the top of the cabinet shall be 1830 mm.
4. Where two or more circuits are used in one meter cabinet, Toronto Hydro will issue specific metering requirements.

Section 5 – TABLES

TABLE 7 Instrument Transformers and Enclosures (Article 2.3.7.2)

<table>
<tr><th colspan="7"><u>Metering Transformers and Compartments</u></th></tr>
<tr><th rowspan="2">Voltage (Volts)</th><th rowspan="2">Phase</th><th rowspan="2">Wire</th><th rowspan="2">Service Size (Amperes)</th><th rowspan="2">Compartmen t Size</th><th colspan="2">Number of Metering Transformers (Provision for)</th></tr>
<tr><th>Current</th><th>Voltage</th></tr>
<tr><td rowspan="2">240/120
208/120 N/W</td><td rowspan="2">1
3</td><td rowspan="2">3
3</td><td>Up to 800</td><td>A</td><td rowspan="2">1 or 2</td><td rowspan="2">0</td></tr>
<tr><td>Over 800
Up to 4000</td><td>B</td></tr>
<tr><td rowspan="2">208 / 120
416 / 240
600 / 347</td><td rowspan="2">3</td><td rowspan="2">4</td><td>Up to 800</td><td>A</td><td>3</td><td rowspan="2">3</td></tr>
<tr><td>Over 800
Up to 4000</td><td>B</td><td>3</td></tr>
<tr><td rowspan="2">600 (*)</td><td rowspan="2">3</td><td rowspan="2">3</td><td>Up to 800</td><td>A</td><td>2</td><td rowspan="2">2</td></tr>
<tr><td>Over 800
Up to 4000</td><td>B</td><td>2</td></tr>
<tr><td>Voltages up to 600</td><td>3 (*)
3</td><td>3 (*)
4</td><td>Over 4000</td><td>C</td><td>2
3</td><td>2
3</td></tr>
</table>

***** Only for existing services where grounded supply is not available.

<u>MINIMUM COMPARTMENT SIZES [width x height x depth (from CT mounting plate)]</u>

A - 762mm x 762mm x 210mm (30” x 30” x 8.25”)
B - 915mm x 762mm x 324mm (36” x 30” x 12.75”)
C - 965mm x 914mm x 381mm (38” x 36” x 15”)

NOTES: 1. Instrument transformers will be provided by Toronto Hydro and shall be installed in the switchgear by the manufacturer. The manufacturer shall not disassemble and/or change in any manner the Toronto Hydro equipment sent to the manufacturer.

2. Voltage transformer connections shall be connected on the line side of the current transformers. Current transformers shall be installed with their polarity marks towards the incoming Toronto Hydro supply.

Section 5 – TABLES

TABLE 8 Meter Centres (Article 2.3.7.1.2)

Meter centers may be used for 750 V applications or less, as far as they meet the following specifications:

1) Side-hinged doors or panels shall be installed over all sections of the switchboard where Toronto Hydro may be required to work, such as unmetered sections and those sections containing breakers, switches and meter mounting devices. Hinged doors or panels shall have provision for sealing and padlocking in the closed position. Where bolts are used, they shall be of the captive knurled type. The hinged covers over breakers or switches shall be so constructed that the covers cannot be opened when sealed or padlocked.

2) Breakers or switch handles shall have provision for positive sealing and padlocking in the "off" position.

3) Meter mounting devices shall be wired so as to be on the "load" side of the breakers or switches.

4) Each combination meter socket and breaker panel shall have adequate space for permanent Customer identification with respect to street address and/or unit number.

5) The centre of the bottom row of meter sockets shall be not less than 600 mm from the finished floor. The centre of the top row of meter sockets shall be not less than 1800 mm from the finished floor.

6) The distance between adjacent meter socket rims in the horizontal plane shall not be less than 152 mm.

7) The distance between adjacent meter socket rims in the vertical plane shall be as follows:
    a) For 100 A., 4 or 5 jaw, not less than 76 mm.
    b) For 100 A., 7 jaw, not less than 152 mm.

8) The meter mounting socket and sealing ring shall be acceptable to Toronto Hydro.

9) Where a neutral is required, the meter mounting device shall have a pre-wired, ungrounded neutral connection to the 5th or 7th terminal. The connection, if not made directly to the neutral bus, shall be not less than #12 AWG copper or equivalent.

Section 6 – REFERENCES

6 REFERENCES

1. **Economic Evaluation Model for Distribution System Expansion**
   Refer to Appendix B of the Distribution System Code:
   "Methodology and Assumptions for an Economic Evaluation"

2. **Standard Toronto Hydro Connection Agreements - Terms of Conditions**

   - Schedule A:
     - Toronto Hydro-Electric System Limited Connection Agreement

3. **Toronto Hydro Distributed Generation Requirements**

4. **Toronto Hydro Requirements for the Design and Construction of Customer-Owned High Voltage Substations**

5. **Toronto Hydro Requirements for the Design and Construction of Customer-Owned Structures**

6. **Toronto Hydro Metering Requirements 750 Volts or Less**

7. **Toronto Hydro Metering Requirements for 13.8 kV & 27.6 kV Customer-Owned Substations**

8. **Construction Contractor Pre-Qualification Application**

RESPONSES TO BUILDING OWNERS AND MANAGERS ASSOCIATION, GREATER TORONTO INTERROGATORIES

INTERROGATORY 10:

Reference(s):

Exhibit 1A, Tab 2, Schedule 1, page 17, Table 2

a) Please break out the customer services requests from third party requests in line 3 of the table.

b) Please indicate the contributions from third parties to investments made for that reason, by category, e.g., City of Toronto, Go Transit, Province of Ontario, etc.

c) Please explain in detail what is meant by "functional obsolescence". Provide examples.

RESPONSE:

a) According to Exhibit 2B, Section 00, pages 26-27, Table 4, Customer Service Request is the trigger driver for Customer Connections and Load Demand programs. In the same table, Third Party Request is the trigger driver for Externally-Initiated Plant Relocation & Expansion. The table below shows the breakdown of customer service requests and third party requests.

Trigger Driver	2015	2016	2017	2018	2019
Customer Service Requests	51.3	67.7	78.9	72.6	65.8
Third Party Requests	4.0	4.0	4.0	4.0	4.0

RESPONSES TO BUILDING OWNERS AND MANAGERS ASSOCIATION, GREATER TORONTO INTERROGATORIES

b) Exhibit 2B, Section E5.3, Table C (page 3) presents forecast aggregate customer contributions from 2015-2019. The forecasted contributions cannot be broken down by specific customer as they are forecasted based on historical customer demand.

c) Exhibit 2B, Section E.6, page 2, Table 1 describes functional obsolescence as “the asset/asset installation is no longer aligned to Toronto Hydro processes and practices such that it can no longer be maintained (e.g., lack of spare parts, lack of accessibility or operational constraints) or utilized as intended in the distribution system”. An example of a program which is driven by functional obsolescence is SCADA-Mate R1 Switch Renewal, which is further detailed in Section E6.8 of the Distribution System Plan. Please refer to Exhibit 2B, Section E6.8, Table B (page 2) for discussion of the application of the Functional Obsolescence driver to the SCADA-Mate R1 Switch Renewal program.

RESPONSES TO BUILDING OWNERS AND MANAGERS ASSOCIATION, GREATER TORONTO INTERROGATORIES

INTERROGATORY 11:

Reference(s): **Exhibit 1A, Tab 2, Schedule 1, page 17, Table 2**

The categories of capital expenditures resulting from different drivers peak in different years. For example, Failure Risk, System Maintenance and Capital Support, Capacity Contracts and Mandated Service Obligations related investments peak in 2015. Functional Obsolescence and System Efficiency related investments, Customer Service Requests/Third Party Requests peak in 2017. Failure and reliability driven investments peak in 2019

Please explain the reasons for the differences in the time peak spending related to the various drivers that are the result of plan over the 2015-2019 period. Please explain fully.

RESPONSE:

The finalized spending profiles contained within Table 2 of Exhibit 1A are a product of the individual timing and pacing of each investment program, and do not relate to a specific program driver. Timing and pacing factors and justification are provided for each capital investment program in Sections E5 through to E8 within the Distribution System Plan (Exhibit 2B). The overall investment planning process is discussed in detail in Exhibit 2B, Section D3.1.1.3.

RESPONSES TO BUILDING OWNERS AND MANAGERS ASSOCIATION, GREATER TORONTO INTERROGATORIES

INTERROGATORY 12:

Reference(s): Exhibit 1A, Tab 2, Schedule 1, page 19, Tables 5 and 6

Please confirm that the smart grid investments and regional planning investments are included in the capital investments set out in Table 2 (page 17). If not, please explain.

RESPONSE:

Toronto Hydro confirms that the investments presented in Tables 5 and 6 are included in Table 2, which shows all capital expenditures proposed in Exhibit 2B (Distribution System Plan).

RESPONSES TO BUILDING OWNERS AND MANAGERS ASSOCIATION, GREATER TORONTO INTERROGATORIES

INTERROGATORY 13:

Reference(s): Exhibit 1A, Tab 2, Schedule 1, page 17, Table 2

Rate Base – Addition of street lights into rate base

a) Does System Maintenance in line three refer to only maintenance capital or does it include any OM&A costs?

b) What is the trade-off between capital and OM&A requests displayed in the application.

RESPONSE:

a) The System Maintenance & Capital Investment Support line in Exhibit 1A, Tab 2, Schedule 1, Table 2 represents only capital expenditures.

b) The total requested capital investment per year can be found in Exhibit 1A, Tab 2, Schedule 1, Table 2 on page 17. The total requested OM&A investment per year can be found in Exhibit 4A, Tab 1, Schedule 1, Table 1 on page 4. There is no implicit trade-off between capital and OM&A across the application as a whole; however, some OM&A programs may be slightly affected by capital spending, as outlined in the response to Interrogatory 2B-EP-24 part (a).

RESPONSES TO BUILDING OWNERS AND MANAGERS ASSOCIATION, GREATER TORONTO INTERROGATORIES

INTERROGATORY 14:

Reference(s): **Exhibit 1A, Tab 2, Schedule 1, page 23, Table 7, entitled "OM&A – 2015-19 Cost Drivers"**

page 23, Table 7, entitled "OM&A – 2015-19 Cost Drivers", but the expenditures/drivers in the table are for the test year, bridge year, and historical years

a) What are the comparable drivers for the period 2016-2019?
b) Are they deemed to be identical to the 2011-2015 period?

RESPONSE:

Please note that Exhibit 1A, Tab 2, Schedule 1, page 23, Table 7 should be corrected and entitled "OM&A – 2011-15 Cost Drivers."

a) Toronto Hydro structured its financial planning process for the 2015-2019 timeframe around the principles of the 4th Generation Incentive Rate Making regime (4GIRM) – that is a single detailed Test Year budget, followed by formulaic increases on the basis of the custom Price Cap Index formula, as discussed in the Exhibit 1B, Tab 2, Schedule 3. Consistent with this approach, Toronto Hydro did not produce detailed operational plans for the period 2016-2019 and consequently is not in a position to provide detailed cost drivers for that period.

b) Please see response to part a) above.

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INTERROGATORY 15:

Reference(s): **Exhibit 3, Tab 1, Schedule 1, Appendix C-1, page 1;**
Exhibit 3, Tab 1, Schedule 1 (corrected)

a) Please describe how Toronto Hydro counts customers in condominiums and in both small (4-plex, 6-plex) and large multi-family residential (apartment buildings). Is it on the basis of meters or meters and sub-meters (suite-meters in condominiums and apartment buildings)? What has been the impact of the creation of the Competitive Sector Multi-Unit Residential Class effective January 1, 2013.

b) Assuming that suite-metered customers in apartment units or condominium units constitute a customer, how many suite-meter customers does Toronto Hydro now have? How are they divided between condominiums and multi-unit residential buildings? Does the balance of the 736,974 customers include structures or are some of them additional meters within a structure, for example, tenant meters in a shopping centre? Please explain fully.

c) Table 1 for 2014 (bridge year) shows 736,974 customers (total for all classes) but only 175,545 connections, devices. Please account for the discrepancy. Explain fully. Please describe the distinction between a connection and a "device".

RESPONSE:

a) In the referenced exhibit, customer numbers for the Residential class (which includes 4-plex and 6-plexes) and the Competitive Sector Multi-Unit Residential (CSMUR) class almost exclusively represent a Toronto Hydro-owned meter.

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With the required creation of the CSMUR, customers that were previously included in the Residential class, who meet the criteria for the new class, are now included in that class and are charged distribution rates according to the Competitive Sector Multi-Unit Residential tariffs.

b) As of September 2014, Toronto Hydro has 44,785 customers in the CSMUR class. These customers are all in multi-unit residential condominium or apartment buildings and are individually metered.

In the Residential class, Toronto Hydro has approximately 120,000 individually metered customers in apartment buildings or condominiums that are not part of the CSMUR class. These customers have standard smart meters installed for their residences.

For the remaining rate classes, customer numbers include both a structure with a single meter and structures with multiple meters.

For Toronto Hydro's General Service > 50 kW to Large Use classes, there are premises or structures with single meters and with multiple meters. For example, the GS<50 kW customers numbers may include individual businesses within a mall that each have their own meter and that are each counted as a customer. In the Large User class, a customer may have more than one meter, but the meters are totalized for billing purposes and counted as a single customer.

c) The value of 736,974 is the total number of customers that Toronto Hydro distributes electricity to within its service area, excluding the Streetlighting and Unmetered

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Scattered Load classes. The 175,545 is the combined total number of connections from the Unmetered Scattered Load class and the number of devices from the Street Lighting class. These two numbers – 736,974 and 175,545 – are mutually exclusive. The distinction between a connection and a device in the context of this schedule is related to the billing units used for rate design/billing purposes. For the Streetlighting class, distribution rates are designed and billed based on the number of individual streetlighting devices. For the Unmetered Scattered Load class, distribution rates are designed and billed based on the number of physical connections to the distribution system.

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INTERROGATORY 16:

Reference(s): Exhibit 1A, Tab 2, Schedule 1, page 17, Table 2 (corrected)

Please explain the difference between "safety" and "reliability" as a primary and a secondary driver, respectively. What percentage of programs do the 32 and 23 programs represent?

RESPONSE:

All drivers, including safety and reliability, have been defined Toronto Hydro's Distribution System Plan (Exhibit 2B, Section A2.1, Table 2, pages 7-8). As further explained in the Distribution System Plan (Exhibit 2B, Section A2.1, page 8) the primary or trigger driver indicates the primary reason that a particular program must be carried out. However, secondary drivers may be as or more consequential than the trigger driver as explained in the Distribution System Plan:

> For example, a program's trigger driver may be functional obsolescence, meaning that a type of asset can no longer be maintained due to age, availability of parts, and other issues. However, that functional obsolescence may also result in serious safety or reliability issues. The safety or reliability issues would be listed as secondary drivers for the program because they are a consequence of the functional obsolescence of those assets. However, addressing the resulting safety or reliability issues may ultimately be the most pressing reason for Toronto Hydro to proceed with that program, even though those drivers are listed as "secondary." (Exhibit 2B, Section A2.1, page 8).

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The Safety driver relates to 32 programs, which constitutes approximately 71% of the 45 capital investment programs in the Distribution System Plan. Similarly the Reliability driver relates to 23 programs, which constitutes 51% of the total number of programs.

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INTERROGATORY 17:

Reference(s): **Exhibit 3, Tab 1, Schedule 1, page 27 (original evidence; Accrual)**

In the blue page Ex-Summary, you have removed section 4.5, Budgeting and Accounting Assumptions of the Original Filing. Why was this done, and is the data submitted still applicable? Please explain fully.

RESPONSE:

Toronto Hydro did not remove section 4.5 (page 27) from the Executive Summary in its original filing; the original page remains. In its evidence update filed on September 23, 2014, Toronto Hydro provided the OEB and intervenors blue pages for the updated pages *only*. In other words, page 27 of the Executive Summary was not provided as a blue-page within the update package because Toronto Hydro did not make any changes to page 27 from the original pre-filed evidence submitted on July 31, 2014.

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INTERROGATORY 18:

Reference(s): **Exhibit 3, Tab 1, Schedule 1, page 30**

Why has DVA increased from $55.2 million to $60.4 million?

RESPONSE:

As part of Toronto Hydro's September 23, 2014 update, revisions were made to balances in the LRAMVA account (an increase of $0.6M to reflect updated CDM results – see updated Exhibit 9, Tab 2, Schedule 5) and the IFRS-CGAAP Transitional PP&E account (an increase of $4.7M to reflect a correction for the recovery of return on ratebase associated with deferred PP&E balance – see updated Exhibit 9, Tab 2, Schedule 4).

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INTERROGATORY 19:

Reference(s): Exhibit 3, Tab 1, Schedule 1, page 7

Please describe the manner in which the data set used by PSE is expanded relative to the data set used by PEG. Please explain fully.

RESPONSE (PREPARED BY PSE):

The data set was expanded by adding 85 U.S. investor-owned utilities to the sample used by PEG, which included Ontario utilities only. For a listing of the U.S. utilities used in the data set, please see Table 1 found on page 13 of the PSE Report (Exhibit 4A, Tab 2, Schedule 5, Appendix B).

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INTERROGATORY 20:

Reference(s):

Exhibit 3, Tab 1, Schedule 1, page 9

a) Why are Revenue Offsets assumed to increase by I-X? What are the prospects for the revenue offsets being higher than forecast?

b) Please confirm that the values for interest and ROE will be changed to correspond to the Board's approved cost of capital parameters for each year.

RESPONSE:

a) Toronto Hydro is proposing a custom Price Cap Index ("PCI") for 2016 to 2019 that, like the PCI used in the OEB's 4GIRM framework, essentially entrenches in rates an expectation that Revenue Offsets increase by "I – X". To the extent that Revenue Offsets deviate is to the risk of the company. To be clear, Toronto Hydro has not provided a forecast of Revenue Offsets for 2016 to 2019 nor does Toronto Hydro assume that Revenue Offsets will actually increase by "I – X" for 2016 to 2019.

b) For the purpose of the calculation of the Custom Capital ("C") Factor, Toronto Hydro has applied 2015 interest rates and ROE.

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INTERROGATORY 21:

Reference(s): **Exhibit 3, Tab 1, Schedule 1, page 10, Table 2**

How much of (i) the interest, and (ii) ROE in each year from 2015 to 2019 is due to:

a) changes in forecast interest rates/ROE prices changes;
b) growth in rate base.

RESPONSE:

None of the increase in the Interest and ROE Revenue Requirement Components are a result of changing interest rates or ROE price changes. Annual increases are due solely to the growth in rate base.

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INTERROGATORY 22:

Reference(s): **Exhibit 3, Earnings Sharing**

Why has Toronto Hydro not included earnings sharing in the proposal in light of the Board's decision in EGD, EB-2012-0459? Please discuss fully.

RESPONSE:

Toronto Hydro is proposing an incentive-based rate framework that encourages the utility to continuously seek efficiencies. This incentive is created by including the OEB's productivity factor and a custom stretch factor in the custom Price Cap Index ("PCI"). In doing so, Toronto Hydro is committing to share with its customers the benefits of these efficiencies before they are realized, by directly reducing base rate increases. This approach provides customers with a guaranteed, up-front share in productivity generated by the utility. Toronto Hydro believes that the proposed approach using a productivity and stretch factor within a PCI framework is consistent with the OEB's Renewed Regulatory Framework.

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INTERROGATORY 23:

Reference(s): Exhibit 3, Tab 1, Schedule 1 page 18

Does Toronto Hydro accept that the criteria the Board:

a) should apply to determine whether a particular event should qualify for Z-factor treatment are the criteria the Board adopted in EB-2012-0459.
b) given the criteria the Board adopted, why has Toronto Hydro proposed a list of "events with a one-time impact", and "events with an ongoing impact"?
c) on what basis does Toronto Hydro request that the OEB identify its "concerns with respect to the availability of Z-factor treatment in relation to any of the items set out below", given that the criteria to be applied to any event for which Z-factor treatment is requested is set out in EB-2012-0459. In what form and forum, does Toronto Hydro wish the Board to express its concerns?
d) Is Toronto Hydro saying that it would amend its application in the event that the Board "expressed concerns" about one or more of the events listed at pages 17-18?

RESPONSE:

a) Yes. As detailed in Exhibit 1B, Tab 2, Schedule 3, page 17 Toronto Hydro agrees that the standard Z-factor criteria would apply, as most recently articulated by the OEB in EB-2012-0459 (Enbridge Gas Distribution 2014-2018 rate application).

b) As detailed in Exhibit 1B, Tab 2, Schedule 3, pages17-18, Toronto Hydro has set out the two categories of potential events as examples of what it believes may necessitate Z-factor treatment during the term of its plan. Toronto Hydro's interpretation is that

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the listed potential events would qualify for Z-factor treatment under the articulated Z-factor criteria. Toronto Hydro has requested that, to the extent to the OEB has concerns about the possible availability of Z-factor treatment for any of the listed items, the OEB identify those concerns as part of its decision.

c) Please see response to part (b).

d) Toronto Hydro is not saying this. Toronto Hydro's response would depend on the specific concerns articulated by the OEB. Toronto Hydro cannot speculate as to what actions it might take in the hypothetical circumstance presented.

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INTERROGATORY 24:

Reference(s): **Exhibit 3**
Exhibit 3, Tab 1, Schedule 1, General

Please explain why it is necessary to have both a I-X increase and a customer capital index applied to the capital component and then back out the part of the I-X attributable to capital. Would it not be simpler to apply the I-X only to OM&A? If the two approaches do not produce equivalent results, please explain.

Please provide a calculation showing the impacts on revenue requirement, capital index, and rate impacts if this were done.

RESPONSE:

A full discussion of the rationale for Toronto Hydro's custom Price Cap Index ("PCI") and the justification for each of its constituent components is included in Exhibit 1B, Tab 2, Schedule 3. For ease of reference:

> With the inclusion of C_n in the custom PCI, Toronto Hydro would receive sufficient funding for its capital needs as presented in the DSP. However, the "I – X" increase retained in the custom PCI from the standard 4th Generation IR framework does provide some degree of incremental funding. Absent additional constraints, the custom PCI formula would risk over-funding relative to Toronto Hydro's capital need because a portion of the "I – X" increase could be committed to capital expenditures. Toronto Hydro proposes to remove this risk

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> through an automatic distribution rate reduction captured in the C-factor to constrain the impact of C_n.
>
> An efficient and principled approach is to reduce the C-factor by a capital-related proportion of "I – X". Toronto Hydro proposes that this "scaling" factor be determined by the proportion of the total revenue requirement that is capital-related. Termed S_{cap}, this scaling factor is calculated in the following fashion:
>
> S_{cap} = (capital-related revenue requirement) / (total revenue requirement)

Scaling "I – X" to only S_{OMA} would not lead to the same Price Cap Index as the one proposed in this application. To reach the same outcome, "I – X" must be scaled by the sum of S_{OMA} and S_{RO} as defined in Exhibit 1B, Tab 2, Schedule 3. Because Revenue Offsets reduce Service Revenue Requirement, S_{RO} is a negative number. Consequently, to scale "I – X" by only S_{OMA} would actually result in greater price increases than Toronto Hydro's proposed framework and would be in less alignment with the standard 4GIRM framework. For more information, please see Section 4.2 of Exhibit 1B, Tab 2, Schedule 3.

The net difference between Toronto Hydro's custom PCI and a custom PCI described in the question is therefore:

$$PCI_{TH} - PCI_{BOMA} = S_{RO} * (I - X)$$

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Using the same illustrative parameters as in Table 5 of Exhibit 1B, Tab 2, Schedule 3, the following table provides an example of the difference between the two methodologies. The results indicate that Toronto Hydro's proposed model would result in slightly lower rate increases than the model contemplated in this Interrogatory.

Item	2016	2017	2018	2019	
Revenue Offsets	-$45.7	-$46.4	-$47.0	-$47.6	(1)
Total RR	$692.5	$748.1	$801.2	$844.5	(2)
SRO	-6.6%	-6.2%	-5.9%	-5.6%	(3) = (1)/(2)
I	1.7%	1.7%	1.7%	1.7%	(4)
X	-0.3%	-0.3%	-0.3%	-0.3%	(5)
PCI_{TH} - PCI_{BOMA}	-0.09%	-0.09%	-0.08%	-0.08%	(6) = (3)*(4 + 5)

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INTERROGATORY 25:

Reference(s): Exhibit 3, Tab 1, Schedule 1, page 13

Please provide a full quantitative explanation for reduction in 2016 Custom PCI from 5.62 (original) to 4.56 (blue). Please provide a similar explanation for the changes to the PCI for each of 2017, 2018, and 2019.

RESPONSE:

The table below summarizes the changes in Table 5 of Exhibit 1B, Tab 2, Section 3. Again, Toronto Hydro emphasizes that these values assume an inflation factor of 1.7% for 2016 to 2019 and are provided for illustrative purposes only. The actual values of the custom Price Cap Index will not be known until the OEB determines its inflation factor for a given year.

	Application				Update				Variance			
Custom PCI Component	**2016**	**2017**	**2018**	**2019**	**2016**	**2017**	**2018**	**2019**	**2016**	**2017**	**2018**	**2019**
I	1.70%	1.70%	1.70%	1.70%	1.70%	1.70%	1.70%	1.70%	0.00%	0.00%	0.00%	0.00%
X - productivity	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
X - custom stretch	-0.30%	-0.30%	-0.30%	-0.30%	-0.30%	-0.30%	-0.30%	-0.30%	0.00%	0.00%	0.00%	0.00%
C_n	5.15%	7.77%	6.75%	4.98%	4.10%	7.56%	6.67%	5.01%	-1.05%	-0.21%	-0.09%	0.03%
S_{cap}	66.4%	68.5%	70.2%	71.3%	67.1%	69.2%	70.8%	71.9%	0.7%	0.6%	0.6%	0.6%
Custom PCI	**5.62%**	**8.21%**	**7.17%**	**5.38%**	**4.56%**	**7.99%**	**7.08%**	**5.40%**	**-1.06%**	**-0.22%**	**-0.09%**	**0.02%**

The primary reason for the change in the illustrative custom PCI values above is the change in C_n. The changes in C_n are caused by changes in forecast depreciation for 2016 to 2019 (see Table 3 of Exhibit 1B, Tab 2, Schedule 3) that are consequential to the

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updates made to the DSP and corrections to reflect derecognition amounts as filed in Exhibit 4B, Tab 1, Schedule 2.

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INTERROGATORY 26:

Reference(s): **Exhibit 1B, Tab 2, Schedule 4, Capital, page 5**

What capital expenditure does Toronto Hydro intend to make to facilitate distributed generation over the plan period? Please discuss fully.

RESPONSE:

Please refer to Exhibit 2B, Section E5.5 Generation, Protection, Monitoring and Control for a detailed explanation of the capital expenditures Toronto Hydro expects to initiate in order to facilitate distributed generation over 2015-2019 plan period. Table C on page 3 of this Exhibit presents forecast capital spending in this area for each year of the plan period.

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INTERROGATORY 27:

Reference(s):

Exhibit 1B, Tab 2, Schedule 4, Capital, page 6

Please provide the capital expenditure for 2012, 2013, and the latest (9 and 3) forecast for 2014.

RESPONSE:

Please see response to Interrogatory 1A-BOMA-8 part (b) for the capital expenditures for 2012, 2013 and the 2014 YTD actuals and forecast.

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INTERROGATORY 28:

Reference(s): **Exhibit 1B, Tab 2, Schedule 4, Capital, page 9**

a) In predicting the likely time to failure of an asset, how does the Feeder Investment Model take into account the assets that are judged to be in fair to very good condition in the current year's Asset Condition Survey, notwithstanding the fact that they are beyond the normal life?

b) To what does Toronto Hydro attribute the majority or large minority of customers (depending on rate class) that are not accepting of further rate increases (as evidenced by the Innovation Research Group Report)?

RESPONSE:

a) Please refer to Toronto Hydro's response to interrogatory 1B-BOMA-31 part (b) for further details on how the Feeder Investment Model calculates the probability of failure for a given asset using both an age-based as well as a condition-based failure probability calculation.

b) As detailed in the Innovative Research Group ("Innovative") report, a ***<u>minority</u>*** (not majority) of customers do not accept further rate increases in both the residential (34%) and General Service < 50 kW (41%) rate classes.

   For a complete summary of the reasons given by customers for not accepting further rate increases, please refer to pages 143-148 of the Innovative report (Exhibit 1B, Tab 2, Schedule 7, Appendix B).

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INTERROGATORY 29:

Reference(s): Exhibit 1B, Tab 2, Schedule 4, Capital, page 13

a) Which of the proposed measurement framework measures are in a mature state and can be tracked over the plan period, and which are in a "nascent" state and yet to be fully developed? For the latter, please indicate when each one will be deployed. Please discuss fully. Please discuss each of the twelve performance measurement tests.

b) Please discuss the strengths and weaknesses of the Downtown Toronto infrastructure, feeder back-up is provided by intra station ties rather than inter station feeder lines. Please discuss fully.

RESPONSE:

a) Please see Exhibit 2B, Section C for a comprehensive discussion of Toronto Hydro's proposed 12 performance measures, including their intended use, state of maturity, scope of application and other related considerations.

b) When feeder back-up is provided through ties to feeders from the same station and bus, it ensures that station bus capacity will be available when switching supply from the normal feeder to the back-up feeder (since the load will always appear on the same bus, regardless of which feeder it is being supplied from at any given point in time). However, a consequence of this arrangement is that if supply to the station bus is lost, there are no alternative sources of supply available to restore power to the feeder until the bus can be placed back in service. Please see Exhibit 2B, Section

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E7.7 for an extensive discussion of the downtown system configuration as it pertains to station and feeder ties in the downtown area.

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INTERROGATORY 30:

Reference(s): Exhibit 1B, Tab 2, Schedule 4, Capital, page 4, #7

"There are potential undesirable consequences to system reliability, safety, and performance if Toronto Hydro does not proceed with the proposed project"

a) Please indicate the qualitative and quantitative impact of the planned five year capital program on operating costs (a) over the plan term, and (b) in the five years beyond the plan term. Please discuss fully.

b) In the fifth bullet, Navigant states that customers would likely see higher costs. How likely? Please discuss fully.

RESPONSE (NAVIGANT):

a) Quantifying the impacts of Toronto Hydro's five-year capital plan on operating costs was not part of Navigant's engagement. Qualitatively, it is reasonable to conclude that operating costs would increase if the capital plan is not implemented, as Toronto Hydro has provided ample evidence that reliability and equipment performance would decline if proposed projects are not undertaken. Navigant's experience with electric utilities throughout Ontario and Canada confirms that as reliability and equipment performance declines, operating costs increase due to higher equipment repairs, corrective maintenance, and increased restoration costs associated with failed equipment and outages that otherwise would be avoided if the proposed capital projects are undertaken.

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b) Please see Navigant's response to part (a) above.

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INTERROGATORY 31:

Reference(s): Exhibit 1B, Tab 2, Schedule 4, Capital, page 16

a) Does "steady state" in Toronto Hydro's vocabulary mean a state where no assets (other than as required for efficient execution) operate beyond the useful life, or is there another number, for example, 5% or 10% of assets in service beyond their useful life that represents an acceptable solution?

b) To what extent does Toronto Hydro take into account the different probabilities of failure and the consequences of failure of an asset beyond end of useful life, including the assets that have been found to be in fair, good, very good shape, in the Asset Condition Review? Please discuss fully and provide examples.

c) Please indicate for each year between now and 2037 the impact of the proposed annual investment to achieve the "steady state" condition.

RESPONSE:

a) As stated in Section E2.1 of Toronto Hydro's Distribution System Plan (Exhibit 2B, Section E2, page 1), steady state "reflects an optimal balance between the capital investments required for the distribution system and aggregate risk costs associated with the broader asset population. In order to achieve a steady state, assets across the distribution system must be evaluated and intervened upon based upon their optimal intervention timing results – also known as the economic end-of-life criteria". The achievement of steady state allows total life cycle costs of the assets across the system to be minimized. A reduction in the percentage of assets past useful life would be

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considered an outcome of the steady state achievement, but is not the target by which the steady state is defined.

b) Toronto Hydro's Feeder Investment Model, further described in Exhibit 2B, Section D3.1.2.1(i), page 13, line 24, applies both age-based and condition-based failure probability calculations in order to determine the probability of failure for a given asset. The age-based failure probability calculation is derived from Hazard Rate Distribution Functions (HDF), which account for the typical lifespan of a given asset out of its respective asset class population – for these reasons, the age-based failure probability calculation produces the default, or baseline failure probability for a given asset. Where a health index value is unavailable for a given asset, that asset will be assigned its age-based failure probability value. Where a Health Index value is available for a given asset, that asset will be assigned its corresponding condition-based failure probability result only if the condition-based result exceeds the baseline failure probability produced from the age-based calculation.

Through this relationship between the age-based and condition-based failure probability calculations, the Health Index is being used to identify if the failure probability for a given asset is greater than the baseline value established based on age. In other words, where an asset is experiencing an accelerated failure rate due to its condition, the Health Index and condition-based failure probability calculations are applied to increase the probability of failure. Condition-based probability information is used in this manner due to the fact that the Health Index in itself represents a "defect" analysis. Its parameters are based on degradation factors. Where a given degradation factor has been identified for a given asset, it will reduce the corresponding Health Index score. In contrast, the Health Index calculation does

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not contain any parameters that would result in improvements, or increases, to a given Health Index score.

As an example, consider a wood pole that is 61 years of age and possesses a Health Index score of 100 (Very Good). The Health Index score of 100 would translate into a condition-based failure probability result of 0.00%. However, the asset would receive an age-based failure probability result of 2.63%, which would represent the baseline or default failure probability of that asset given its age. A Health Index score of 100 means that the asset is not failing at an accelerated pace when compared to its baseline age-based failure probability value; it does not mean that the asset's failure probability based on age has been improved. Therefore, the asset will be assigned a failure probability value of 2.63%.

c) For discussion of capital spending requirements beyond 2019, please see Toronto Hydro's response to interrogatory 1A-SEC-1.

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INTERROGATORY 32:

Reference(s): Exhibit 1B, Tab 2, Schedule 4, Capital, Appendix A

Has Toronto Hydro investigated means of challenging the City's use of road moratoria in some fashion? Has it made representation to the City on this matter? If so, please provide copies of the material.

RESPONSE:

Road moratoria are implemented by the City pursuant to its authority over highways (i.e., public roads) under sections 32 and 33 of the *City of Toronto Act*, *2006*, S.O. 2006, C. 11, Sched (the "*City of Toronto Act*"). The purposes of road moratoria are to: 1) ensure the long-term sustainability of the City's infrastructure; 2) protect the integrity of the pavement structure; and, 3) minimize the disruptions and inconvenience to the public resulting from repeated construction activity.

Toronto Hydro's research indicates that the only mechanism available to challenge the City's use of road moratoria is to seek an exemption from the City's General Manager, on a case by case basis. Pursuant to Chapter 3 of the Municipal Consent Requirements for the installation of Plant Within City of Toronto Streets, the City's General Manager may, at his or her sole discretion, make exemptions to road moratoria under certain circumstances, *"such as emergency work, providing service to a new customer, or construction identified by the General Manager as being necessary to ensure public safety"*. To avail itself of such an exemption, Toronto Hydro must demonstrate to the

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City's General Manager, that it has investigated and evaluated all other options and that they are not feasible or practical in the particular circumstances at hand.

Toronto Hydro seeks exemptions where appropriate and consistent with the articulated criteria. As an example, Toronto Hydro sought and received an exemption in 2012 to undertake necessary civil and electrical infrastructure upgrades for the connection of a new residential condominium building in Etobicoke.

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INTERROGATORY 33:

Reference(s): **Exhibit 1B, Tab 2, Schedule 4, Capital, Appendix B – Navigant**

Please explain what is meant by the phrase "Each of the projects proposed offer justification for…and show they can be executed with financial validity". What does the underlined part mean?

RESPONSE (NAVIGANT):

The underlined reference contains an error: Navigant's Report did not use the word "validity". The actual word used in the second bullet on page 2 of the report is "viability". Notwithstanding the error, "financial viability" refers to the net present value (NPV) economic analysis that Toronto Hydro performed and presented in its business cases to justify the proposed capital projects.

RESPONSES TO BUILDING OWNERS AND MANAGERS ASSOCIATION, GREATER TORONTO INTERROGATORIES

INTERROGATORY 34:

Reference(s): Exhibit 1B, Tab 2, Schedule 5, page 14

What were Toronto Hydro's negative productivity factor(s) as determined by PEG in its study over the period studied by PEG (compare with the TP figures from the other Ontario utilities, and Hydro One). What was the TP trend over the relevant period?

RESPONSE:

Toronto Hydro does not possess the information that would enable it to replicate PEG's calculation of the utility's specific TFP trend. To Toronto Hydro's knowledge, PEG reports only quantified the *implications* of including/excluding Toronto Hydro and Hydro One from the industry-wide 2002-2011 TFP calculation, without explicitly breaking out those utilities' historical TFP results and/or trends. Please see Table 1 below for the quantification of the impact of excluding Toronto Hydro and Hydro one from the sector-wide TFP assessment over the 2002-2011, as provided by PEG in its *Supplementary Empirical Analyses* document of June 14, 2013.

Table 1: Average and Aggregate TFP growth (per annum) for the Ontario electricity distribution industry over the 2002-2011 period.

Sample	Average	Aggregate
All distributors	-0.26%	-1.10%
All distributors excluding HONI and THESL	-0.20%	0.10%
All distributors excluding THESL only	-0.23%	-0.81%
All distributors excluding HONI only	-0.24%	-0.56%

RESPONSES TO BUILDING OWNERS AND MANAGERS ASSOCIATION, GREATER TORONTO INTERROGATORIES

INTERROGATORY 35:

Reference(s): Exhibit 1B, DSP Capital Efficiency Metric

a) For each "measure" referred to in line 10, "the efficiency and cost effectiveness of the DSP Planning and implementation", please set out the reduced expenditure or the increased in service quality or both, in:
   i) capitalized supply chain costs;
   ii) capitalized warehousing operations;
   iii) capitalized engineering costs;
   iv) capitalized design costs;
   v) capitalized administrative functions related to (c) and (d) above, as a percentage of total program costs in years 2012, 2013, and 2014 (to provide a base for measurement of subsequent achieved efficiencies). Show both in absolute terms as a percentage of total program capital.

b) Please estimate the savings achievable for each of (i) through (v) over the term of the program, with a full explanation.

RESPONSE:

a) Please see the table on the following page. Toronto Hydro tracks the Supply Chain and Warehousing Operations costs separately; however, Capital Planning, Engineering and Support spending is tracked as a single category and cannot be reliably segregated in the manner requested.

RESPONSES TO BUILDING OWNERS AND MANAGERS ASSOCIATION, GREATER TORONTO INTERROGATORIES

Toronto Hydro notes that as requested in the interrogatory the following table shows the proposed expenditure categories as percentages of total capital expenditures. However, in Exhibit 2B, Supply Chain Efficiency is measured as a percentage of the total material volume processed through the warehouses, while Planning, Engineering and Support Efficiency is measured as a percentage of the Total Capital Spend (Dx Plant). Regarding the service quality improvements of the Supply Chain program (includes Warehousing) please see Exhibit 4A, Tab 2, Schedule 12.

The table below represents the requested information.

	2012	2013	2014
Supply Chain Cost, $	$ 1.5	$ 2.0	$ 1.5
% of Total Capital Expenditure	0.5%	0.5%	0.3%
Warehouse Operations Costs, $	$ 5.6	$ 7.5	$ 8.8
% of Total Capital Expenditure	1.9%	1.7%	1.5%
Capital Planning, Engineering and Support Spend, $	$ 21.5	$ 25.9	$ 26.2
% of Total Capital Expenditure	7.5%	5.8%	4.4%

b) Toronto Hydro is unable to provide the requested estimates of achievable savings. As discussed in Exhibit 2B Section C, Toronto Hydro anticipates that its performance as measured by the Supply Chain Efficiency, and Planning, Engineering, and Support Efficiency metrics to remain consistent with historical levels and/or improve over the 2015-2019 timeframe. Both measures represent the next stage in Toronto Hydro's commitment to continuous improvement, and the utility sees the 2015-2019 CIR period as an appropriate "testing ground" to investigate whether and how it can best

RESPONSES TO BUILDING OWNERS AND MANAGERS ASSOCIATION, GREATER TORONTO INTERROGATORIES

monitor, direct and/or modify its operational practices to achieve performance improvements in both the supply chain /warehousing and engineering/design areas. Toronto Hydro anticipates that the benefits of enhanced capital cost efficiency performance measurement will facilitate the company's ability to operate within the constraints imposed by the Price Cap Index that underlies its CIR rate framework proposal.

As discussed in Exhibit 2B Section C (page 21) Toronto Hydro expects its On-Cost rate (Warehousing and Supply Chain costs) to decline over the 2015-2019 owing to anticipated attrition, efficiencies from the recently deployed warehouse outsourcing arrangement, and other supply chain improvements detailed in Exhibit 4A, Tab Schedule 12.

RESPONSES TO BUILDING OWNERS AND MANAGERS ASSOCIATION, GREATER TORONTO INTERROGATORIES

INTERROGATORY 36:

Reference(s): Exhibit 1B, Tab 2, Schedule 5, page 20

Toronto Hydro states:

"The standard asset assemblies framework in the early stages and will undergo <u>further testing and development</u> during the 2015-2019 CIR timeframe."

Why will it take five years to produce a mature productivity practice, such as this? Why can it not be finalized in two years? Please discuss fully (lines 14-15).

RESPONSE:

Please see Exhibit 2B, Section C for a complete discussion of the proposed framework and the associated development timeline. As stated in the above reference, Toronto Hydro is in the early stages of investigating the possibilities of developing a comprehensive framework for tracking the total number of labour hours required to stage, install and energize a fully assembled unit for each major asset class of the company's electricity distribution plant.

Following the initial investigation, design, and development phase of the conceptual framework and associated tracking system, Toronto Hydro anticipates a two-year data collection period during which work would be performed and monitored using the defined framework. This period is required to assess the viability of the concept and refine the labour hour quantifications used as inputs based on actual field data. A sufficiently large sample size of completed projects must be reviewed for this framework

RESPONSES TO BUILDING OWNERS AND MANAGERS ASSOCIATION, GREATER TORONTO INTERROGATORIES

to be considered suitable to support benchmarking of performance across multiple years and work programs.

As discussed in the above-referenced schedule, Toronto Hydro proposes to report on the progress of this initiative on an annual basis, which will keep the OEB apprised of any changes in the project's implementation schedule.

RESPONSES TO BUILDING OWNERS AND MANAGERS ASSOCIATION, GREATER TORONTO INTERROGATORIES

INTERROGATORY 37:

Reference(s): Exhibit 1B, Tab 2, Schedule 5, page 21

How does the Toronto Hydro absenteeism rate as determined by the 2013 Conference Board of Canada study relate to those of large investor-owned Canadian utilities, e.g., TCPL, Enbridge, etc.? Please provide a copy of the study.

RESPONSE:

A copy of the Conference Board of Canada Report (the “Report”) is attached as Appendix A to this response. The Report does not provide a specific breakdown of attendance rates by individual utility, but rather displays aggregated statistics by industry, province etc. According to the Report, the absenteeism rate for the Utilities sector in Canada was 7.3 days. Toronto Hydro does not possess any information on the absenteeism rates of TCPL, Enbridge or any other large investor-owned Canadian utility. Accordingly, it is not in a position to undertake the specific comparison requested. To enable consistent comparison with the information provided in the Conference Board report and underscore the utility’s continuous improvement in the area of attendance management, the following table provides Toronto Hydro’s absenteeism rates over the 2011-2013 period:

Year	Absenteeism (days / employee)
2011	7.09
2012	4.98
2013	5.23

RESPONSES TO BUILDING OWNERS AND MANAGERS ASSOCIATION, GREATER TORONTO INTERROGATORIES

Toronto Hydro calculates the absenteeism rate by dividing the total days of absenteeism by the total number of employees. For greater clarity, Toronto Hydro did not commission the Conference Board study, nor did it directly participate in the study. Accordingly, the utility's absenteeism rates were derived internally, and not by the Conference Board, as the interrogatory appears to infer.

Toronto Hydro-Electric System Limited
EB-2014-0116
Interrogatory Responses
1B-BOMA-37
Appendix A
Filed: 2014 Nov 5
(12 pages)

The Conference Board of Canada | Le Conference Board du Canada

BRIEFING SEPTEMBER 2013

Compliments of Sun Life Financial

ABSENTEEISM TRENDS IN CANADIAN ORGANIZATIONS

Missing in Action.

At a Glance

- The average absenteeism rate in 2011 was 9.3 days per full-time employee.
- The estimated direct cost of absenteeism to the Canadian economy was $16.6 billion in 2012.
- Despite the enormous cost of absenteeism, less than half of Canadian organizations (46 per cent) currently track employee absences.

Absenteeism contributes to a substantial amount of lost productivity and revenue for Canadian organizations and the economy as a whole. It presents itself in many forms, ranging from casual absences—employees off with minor illnesses lasting one or a few days—to longer-term leaves of absence.

To further examine the issue of absenteeism and lost productivity, The Conference Board of Canada has undertaken a research study to:

- analyze absenteeism rates in Canada;
- identify the key drivers or causes of absenteeism;
- quantify the cost of absenteeism for employers;
- assist employers in establishing an effective disability management program;
- explore opportunities for employers to enhance health promotion and injury prevention in the workplace;
- present effective strategies and best practices for employers in the area of disability management, accommodation, and return to work.

The findings are being published in two briefings and a report:

1. *Missing in Action—Absenteeism Trends in Canadian Organizations*: This first briefing presents data on absenteeism rates in Canada, the key drivers or causes of absenteeism, as well as the cost of employee absences.
2. *Creating an Effective Workplace Disability Management Program*: The second briefing will provide an in-depth guide to creating an effective workplace disability management program.
3. *Disability Management—Opportunities for Employer Action*: The report will feature the perspectives of employees and supervisors from across Canada on their organizations' disability management programs. It provides employers with advice and guidance on how to more effectively manage absenteeism.

The purpose of this first briefing, *Missing in Action: Absenteeism Trends in Canadian Organizations,* is to explore absenteeism rates in Canada. It looks at variations in absenteeism rates across regions, sectors, industries, and employee characteristics, and provides insights into why certain employees may be absent more often than others. By understanding some of the factors and characteristics that influence absenteeism, employers will be better prepared to address absenteeism in their own organizations. The briefing also explores the cost of absenteeism to the Canadian economy. Finally, it highlights how absenteeism rates in Canada compare with those in other international jurisdictions.

Methodology

This briefing features data from two main sources. The data on the numbers of days lost per employee in 2011 are from Statistics Canada. Data on tracking absenteeism and cost of absenteeism are from The Conference Board of Canada.

STATISTICS CANADA DATA

Statistics Canada data for absenteeism benchmark the number of workdays lost for personal reasons—specifically illness, disability, and personal or family responsibilities (excluding maternity leave). The data are collected as part of the Labour Force Survey (LFS) and use the National Occupational Classification for Statistics (NOC-S) 2006 and the North American Industry Classification System (NAICS). The estimated number of days lost per worker per year is calculated by pro-rating the time lost during a reference week for personal reasons over the whole year. The LFS covers the civilian, non-institutionalized population 15 years of age and over. It is conducted nationwide, in both the provinces and territories. Data are collected directly from Canadian workers through a survey.

Several groups are excluded, including part-time workers, self-employed individuals, and unpaid family workers, because they typically have better opportunities to organize their working hours around competing personal and family responsibilities. Multiple job holders are also excluded, since the LFS data do not capture lost time, including reasons for lost time, for specific jobs. Men taking either paid parental or paternity leave (Quebec data only) are included in the calculation up to 2006. Although some human resources professionals exclude those taking leave in excess of one year for long-term disability from their attendance management metrics, Statistics Canada does include these people if they consider themselves employed (they receive full or partial pay from employers while on disability leave). In 2011, an average of 33,200 people per week were on long-term leave for illness or disability. If this group is removed from the calculation, the average weekly work absence for disability or illness drops, from 5.9 to 5.6 per cent. Additionally, the inactivity rate drops from 3.1 to 2.8 per cent.

CONFERENCE BOARD OF CANADA DATA

The Conference Board conducts an annual survey to examine a variety of compensation and human resources management trends across the country. In June 2012, a questionnaire was sent to 1,510 predominately medium-sized and large Canadian organizations operating in a variety of regions and sectors. A total of 401 respondents participated in the survey, representing a response rate of 27 per cent. As part of this survey, organizations were asked a series of questions on absenteeism, including whether they track absenteeism and the cost of absenteeism as a percentage of payroll to their organization.

Sources: The Conference Board of Canada; Statistics Canada.

TRACKING ABSENTEEISM

In 2012, nearly half of organizations (46 per cent) reported that they track absenteeism, up slightly from the 40 per cent in 2009. Public sector organizations are more likely to track absenteeism. Almost two-thirds of public sector organizations (63 per cent) track absences compared with 39 per cent in the private sector. (See Table 1.)

There is an abundance of Canadian data available on the main reasons behind short- and long-term disability claims. However, it can be difficult to pinpoint the causes of casual or intermittent absences because the majority of employers do not track this type of information. There are also privacy laws in Canada that prevent employers from probing too deeply into the reasons for an employee's absence.

By analyzing absenteeism patterns and employee health risks, organizations will be better situated to address the root causes of absences and reduce absenteeism.

In the United Kingdom, employers have more latitude to inquire about the source of casual absences. Research done by the Chartered Institute of Personnel Development (CIPD) found that the primary reason for short-term absences is minor illness (headaches, colds, and the flu) followed by musculoskeletal injuries, back pain, and stress. Stress more commonly affects non-manual workers while musculoskeletal injuries and back pain are frequent among manual workers.[1]

If organizations hope to reduce absenteeism, they need to understand its drivers. Tracking both the frequency of and reasons for absences is one of the first steps in this process. While employers may not be able to ask too many questions about an illness or injury, most employees do provide a reason when calling in sick. Tracking this type of information is important. Organizations can also use data provided by Employee Assistance Program (EAP) providers, employee health risk assessments, anonymous employee surveys, or data on the causes of short- and long-term disability claims to gain a better understanding of the health issues facing their employees. By analyzing their absenteeism patterns and employee health risks, organizations will be better situated to address the root causes of absences and reduce absenteeism.

Table 1
Tracking Absenteeism

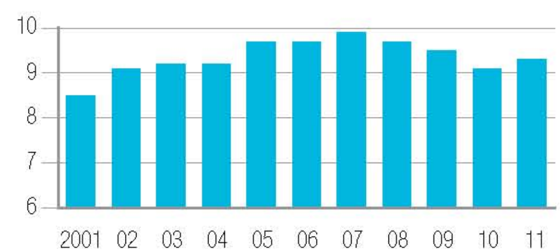
	2009		2012	
	n	per cent	n	per cent
Overall	255	40	344	46
Private sector	179	35	249	39
Public sector	76	54	95	63

Source: The Conference Board of Canada.

OVERALL ABSENTEEISM RATES

According to Statistics Canada, the average absenteeism rate across all regions, sectors, and types of employment was 9.3 days per full-time employee in 2011. Absenteeism rates have remained fairly steady, ranging from a low of 8.5 days in 2001, to a high of 9.9 days in 2007.[2] (See Chart 1.)

Chart 1
Absenteeism Rates, 2001–11
(days lost per worker)

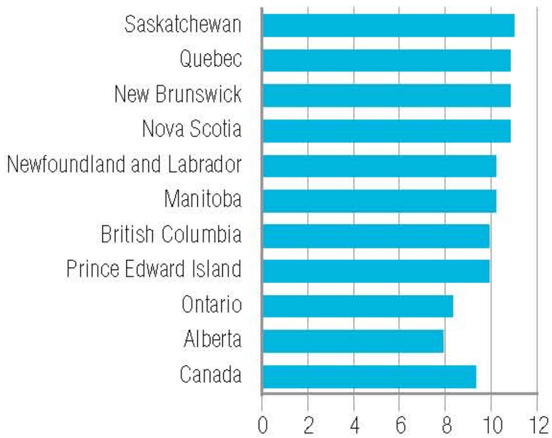


Source: Statistics Canada.

1 CIPD, *Absence Management*, 6.

2 Dabboussy and Uppal, *Work Absences in 2011*, 3.

Chart 2
Absenteeism Rates in 2011, by Province
(days lost per worker)



Source: Statistics Canada.

Table 2
Absenteeism Rates, by Sector, Industry, Union Status, and Organization Size
(days per employee)

Overall	**9.3**
Sector	
Private sector	8.2
Public sector	12.9
Industry	
Health care and social assistance	14.0
Public administration	12.8
Transportation and warehousing	12.3
Business, building, and support services	10.1
Educational services	9.4
Manufacturing	9.1
Information, culture, and recreation	8.6
Finance, insurance, and real estate	8.5
Trade	7.9
Accommodation and food services	7.6
Construction	7.6
Utilities	7.3
Primary	7.2
Other services	6.5
Services—professional, scientific, technical	5.8
Union Status	
Non-unionized	7.5
Unionized	13.2
Organization Size	
Fewer than 20 employees	7.5
20–99 employees	9.3
100–500 employees	10.6
More than 500 employees	11.1

Source: Statistics Canada.

ABSENTEEISM RATES BY PROVINCE

Saskatchewan had the highest absenteeism rate averaging 11 days absent per employee, followed closely by New Brunswick, Nova Scotia, and Quebec, all at 10.8 days per employee. Alberta had the lowest level of absenteeism, with an average of 7.9 days per employee.[3] (See Chart 2.) Alberta and Ontario have the lowest union density rates in Canada, which contributes to their lower absenteeism rates.[4]

ABSENTEEISM RATES BY SECTOR, UNIONIZATION, AND INDUSTRY

In 2011, the public sector absenteeism rate (12.9 days) was higher than that of the private sector (8.2 days).[5] (See Table 2.) There are multiple reasons why absenteeism tends to be higher in public sector organizations.

Public sector absenteeism rates should not be considered in isolation from unionized absenteeism rates. In 2011, 74.7 per cent of public sector employees were union members or covered by a collective agreement.[6] In 2011, the days lost per worker were 13.2 days for union members or those covered by a collective agreement, compared with 7.5 days for non-unionized employees.[7] Included in their collective agreements, unionized employees usually have more generous sick leave entitlements, job security, and better safeguards against punitive actions due to

3 Dabboussy and Uppal, *Work Absences in 2011*, 11.

4 Statistics Canada, *Union Membership.*

5 Dabboussy and Uppal, *Work Absences in 2011*, 8.

6 Statistics Canada, *Union Membership.*

7 Dabboussy and Uppal, *Work Absences in 2011*, 10.

absences.[8] The sick leave and security negotiated by unionized employees also tend to influence benefits received by non-unionized employees in the same organization.

Conference Board of Canada research has shown that public sector employees have access to a greater number of paid sick leave days than those in the private sector (11.6 days per employee compared with 8.2 for the private sector).[9] This could also contribute to higher usage among public sector employees. Often, the more generous the sick leave policy, the more sick days employees will use.

Higher absenteeism rates in the public sector could be a symptom of the tight fiscal restraints and scrutiny that the public sector faces. Many argue this pressure contributes to heightened stress levels and consequently increased absence among employees. For example, the uncertainty and stress felt by federal public servants in the current downsizing of the federal public service could be leading to more absenteeism.[10] It should be noted, however, that higher public sector absenteeism rates relative to the private sector are not a new phenomenon, which would indicate that the pressure on the public sector over the past few years is not the sole contributor.

Research suggests that the more positive the work environment and employee–employer relationship, the less likely employees are to miss work.

Many point to a sense of entitlement around the use of sick days in the public sector, where employees take sick days as they would vacation days. But while perhaps more prominent in the public sector, the abuse of sick time is not unique to the sector and, more importantly, many public sector organizations do not struggle with an entitlement mentality around absenteeism. Even within the federal public sector, there are substantial differences in absenteeism rates among different departments and operating units.

8 Hughes, *Beyond Benefits II*, 12.

9 Ibid.

10 Weston, "What's Behind Rising."

Research suggests that the more positive the work environment and employee–employer relationship, the less likely employees are to miss work.[11] If those public sector organizations struggling with absenteeism could find a way to improve their work environment, it could help to curb their absenteeism rates.

Absenteeism rates were highest in the health care and social assistance sector at 14 days per employee, followed by government or public administration at 12.8 days. Within the health care profession, support staff have the highest rate at 16.6 days followed by nurses at 15.8 days.[12] It is an industry where shift work and overtime are common. Combined, these factors make it difficult for employees to get the rest that they need. Health care workers are in perpetual contact with patients who are ill. When confronted with a stressful work environment, they are even more susceptible to infection. Forty-eight per cent of nurses say they fear contracting a serious illness at work.[13] Twenty-nine per cent of nurses have reported being physically assaulted by a patient and 44 per cent report being emotionally abused.[14] A study funded by the Workplace Safety and Insurance Board found that three in five health care workers report high levels of work overload. The study, based on a survey of nearly 1,400 health care workers, points to a stressful culture where everything is urgent, there is a lack of staff, and the work is extremely complex.[15,16] All of these factors certainly contribute to the high level of absenteeism within the health care sector.

The lowest absenteeism rate (5.8 days) was found in the professional, scientific, and technical services industry.[17] This broad industry category has very low levels of unionization, at only 5.0 per cent union density.[18]

11 Sagie, "Employee Absenteeism,"167.

12 Dabboussy and Uppal, *Work Absences in 2011*, 8–9.

13 Shields and Wilkins, *Findings From the 2005 National Survey*, 39.

14 Ibid., 37–38.

15 May, "Local Hospital Staff Stressed to Limit."

16 Duxbury, Higgins, and Lyons, *The Etiology and Reduction of Role Overload.*

17 Dabboussy and Uppal, *Work Absences in 2011*, 8.

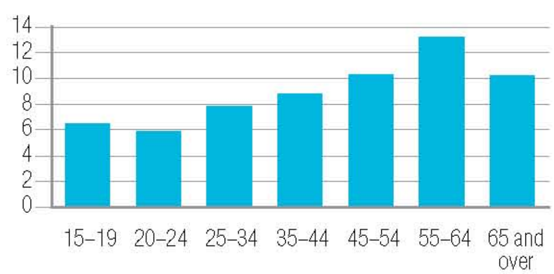
18 Statistics Canada, *Union Membership.*

Smaller organizations tend to have lower absenteeism rates.[19] In smaller organizations, there are fewer people (often no one) to cover in the event of an employee absence, and it is more obvious when an employee is absent.[20] Smaller organizations are also less likely to be unionized. While these factors contribute to lower absenteeism, they can also perpetuate a culture where employees come in to work when they are too ill or contagious. Given their limited resources, it is especially important for smaller organizations to have policies in place that are aimed at limiting the spread of illness.

ABSENTEEISM RATES BY EMPLOYEE CHARACTERISTICS

As workers age, they tend to miss more days of work. This is influenced by illness and disability, not personal/family reasons. Those aged 20 to 24 missed on average 5.9 days, compared with 10.3 days for those aged 45 to 54 and 13.2 days for those aged 55 to 64.[21] (See Chart 3.) The incidence of physical chronic disease increases with age, which contributes to increased illness and disability among this group.[22]

Chart 3
Absenteeism Rates in 2011, by Age Group
(days lost per worker)



Source: Statistics Canada.

Women also have higher rates of absences compared with men across nearly every age category. The average days lost for women is 11.4 days compared with 7.7 for men.[23] There is little debate surrounding the fact that the average absenteeism rates are higher for women than for men. This finding is supported by Statistics Canada, the United States Bureau of Labor Statistics, and several European studies.[24] There is, however, much debate around the reasons why women are absent more often then men. While different studies provide potential reasons for this disparity, there are none that fully explain the gap.

Intuitively, one might believe that the difference can be explained by that fact women tend to carry a larger share of the workload at home. But the trend of higher absenteeism among women exists when comparing men and women whether they have partners, are separated or single, and with or without children.[25]

A study done by the University of Helsinki found that among middle-aged workers (40 to 60 years of age) at the City of Helsinki, women reported more physical health problems, physical work demands, and work fatigue then men, but that "psychosocial working conditions and family-related factors had no effects" on absence rates.[26] It found that women took 46 per cent more casual sick days (one to three days) but that the numbers evened out when it came to long-term medically certified absences.[27] A study done by the Tavistock Institute has suggested that women and men face different workplace cultures when it comes to absenteeism, where it is seen as more acceptable for women to be absent than men.[28] Another report, from the *Journal of Business and Psychology*, found that different sources of stress affect women and men differently, with women being more strongly affected, contributing to higher absenteeism rates.[29]

19 Dabboussy and Uppal, *Work Absences in 2011*, 10.

20 Markussen and others, "The Anatomy of Absenteeism," 283–86.

21 Dabboussy and Uppal, *Work Absences in 2011*, 7.

22 Hopman and others, "Associations Between Chronic Disease," 114.

23 Dabboussy and Uppal, *Work Absences in 2011*, 7.

24 Johns and Patton, "Women's Absenteeism," 1581.

25 Markussen and others, "The Anatomy of Absenteeism," 283.

26 Laaksonen and others, "Explanations for Gender Differences," 329.

27 Ibid., 325.

28 Johns and Patton, "Women's Absenteeism," 1579.

29 Hendrix, Spencer, and Gibson, "Organizational and Extraorganizational Factors Affecting Stress."

The disparity in absenteeism rates between men and women is an area where future research is required. Currently, there is no definitive explanation on why the gap exists.

Perphaps surprisingly, whether or not an employee has children has very little effect on total days lost per worker. However, having children does affect the reason for absences. Those with children under age 5 take almost double the number of days off for personal/family responsibilities than those without children, but make up for it by taking fewer days off due to illness or disability.[30] (See Chart 4.)

Whether or not an employee has children has very little effect on total days lost per worker. However, having children does affect the reason for absences.

A study, based on Norwegian absence rates, published by the *Journal of Health Economics*, looked at some different employee and job characteristics to determine whether they have an effect on absenteeism. The researchers found that employees with higher levels of education (regardless of the area) and higher salaries tend to be absent less. The study also found that absenteeism rises with the number of hours worked.[31]

When looking at non-occupational characteristics, the study found that absenteeism rises in the event of a separation/divorce or death of a family member.[32] Research showed that employees had a higher level of absence in the six months leading up to the death of a parent, as they spend time caring for an ailing parent.[33] As more employees take on the role of elder care provider, it will be beneficial for organizations to consider the types of supports, such as flexible work practices, that they can offer to help alleviate some of the pressure and stress associated with caring for a sick parent.

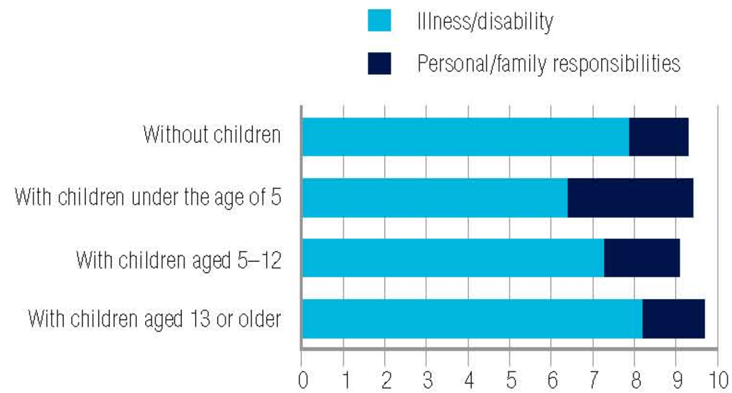
30 Dabboussy and Uppal, *Work Absences in 2011*, 7.

31 Markussen and others, "The Anatomy of Absenteeism," 283–86.

32 Ibid.

33 Ibid.

Chart 4
Absenteeism Rates in 2011, by Presence of Children
(days lost per worker)



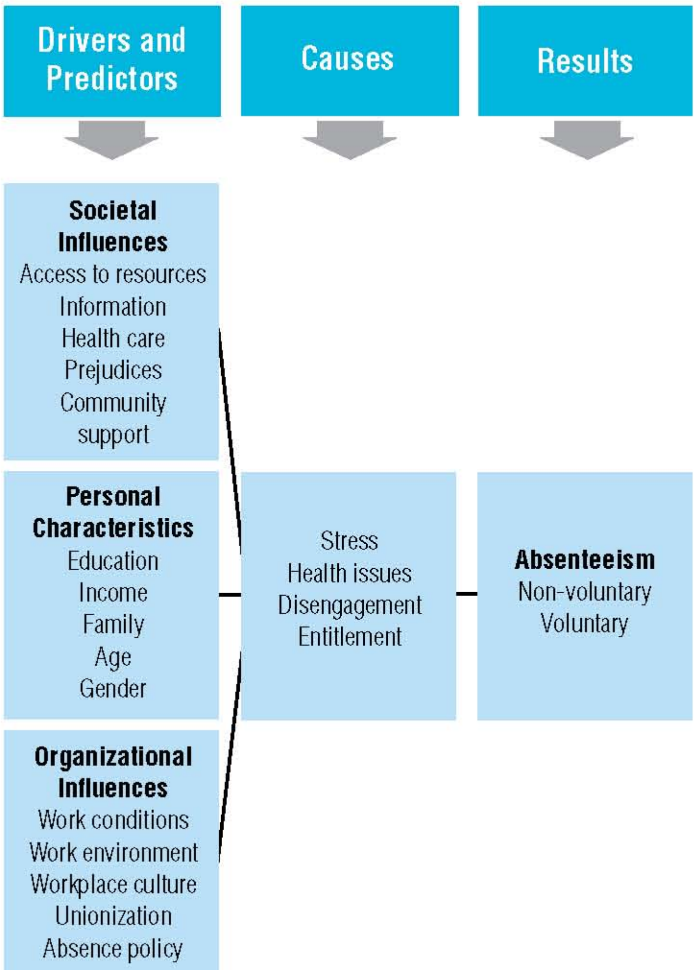
Source: Statistics Canada.

DRIVERS OF ABSENTEEISM

The drivers and predictors of absenteeism are complex. Absenteeism is affected by organizational influences, personal characteristics of the employee, and societal influences. (See Exhibit 1.) Not all drivers or predictors affect the causes (and outcomes) to the same degree. For example, an older worker may be more likely to experience health issues, but not necessarily be more prone to an entitlement mentality around sick leave.

There are certain drivers of absenteeism that an employer can control, such as an unhealthy work environment and lack of a structured absence management program. Other factors are more challenging for employers to address. What organizations can do is look at organizational influences, employee characteristics, societal influences, and their absence patterns, and use the information to determine the best way to approach absenteeism in their organization. For example, an organization with an older workforce may want to put in place health and wellness programs geared to this audience. Similarly, an organization may target unique programs at workers whose jobs are more physical in nature.

Exhibit 1
Drivers, Predictors, and Causes of Absenteeism



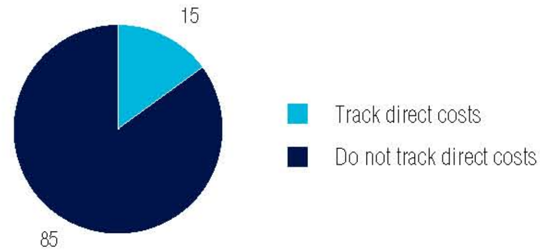
Sources: The Conference Board of Canada; Hendrix, Spencer, and Gibson.

COST OF ABSENTEEISM

Few organizations track the direct costs of absenteeism. In 2012, only 15 per cent of organizations tracked this type of data—unchanged from 2009. (See Chart 5.)

The direct cost of absenteeism is the salary cost associated with the number of workdays lost. For 2011–12, organizations estimated that the direct cost of absenteeism averaged 2.4 per cent of gross annual payroll—down slightly from 2.6 per cent in 2009. (See Table 3.)

Chart 5
Tracking the Cost of Absenteeism
(n = 342; per cent)



Source: The Conference Board of Canada.

This does not not consider any of the indirect costs of absenteeism. Indirect costs, which are harder to quantify, include the replacement costs for absent workers, administrative costs (e.g., time spent finding a replacement), a reduction in employee morale (e.g., from increased workload), a reduction in productivity (e.g., due to delays, missed deadlines), and a reduction in customer satisfaction.[34,35] When these additional costs are considered, the cost of absenteeism to organizations becomes substantially higher. While 2.4 per cent of payroll may seem fairly insignificant, if one considers the total wages for Canadian employees were $691.7 billion in 2012, this translates to a loss of $16.6 billion to the Canadian economy.[36] It should be noted that, in some cases, the loss of productivity is mitigated by employees working extra unpaid hours to catch up on work that was missed while they were away.

One in 10 organizations reports that the cost of absenteeism has risen over the past 12 months, while 5 per cent report that the total direct costs have decreased. (See Chart 6.) Many organizations don't know whether the costs have changed as they do not track this information.

34 Mercer, *Survey on the Total Financial Impact of Employee Absences*, 6.

35 Klachefsky, *Take Control of Employee Absenteeism.*

36 Based on data provided by Statistics Canada (from January 2012 to December 2012).

INTERNATIONAL COMPARISONS

Canada's absenteeism rates are high by international standards, at least when comparing ourselves with our neighbours and closest comparators. It should be noted that it can be difficult to make exact comparisons as different studies define absenteeism slightly differently.

A study done in the U.S. in 2010 found that employees took, on average, 5.4 incidental unplanned absence days (casual absences, lasting five days or less), ranging from 3.9 for non-unionized management employees to 7.3 for hourly unionized workers. The same study found that the direct cost of incidental unplanned absences was 2 per cent of base payroll, and that the total cost (including direct and indirect costs) of incidental unplanned absences averaged 5.8 per cent of payroll. When extended absences (lasting more than a week, including short-term disability, long-term disability, and absences covered under the *Family and Medical Leave Act*) were included, the total cost crept up to 8.7 per cent of base payroll.[37]

In the U.K., research done in 2012 by CIPD found that the average number of days lost per employee was 6.8 days, or 3 per cent of work time lost. As in Canada, this number is higher in the public sector at 7.9 days compared with 5.7 days for private sector employees.[38]

In a separate study done by CBI and Pfizer, the absence rate was found to be 6.5 days per employee in 2010, again higher in the public sector at 8.1 days a year, compared with 5.9 days for the private sector. The study estimates the cost of absenteeism to the U.K. economy at £17 billion, of which £2.7 billion can be attributed to absences occurring with no medical reason.[39]

37 Mercer, *Survey on the Total Financial Impact of Employee Absences*, 8.

38 CIPD, *Absence Management*.

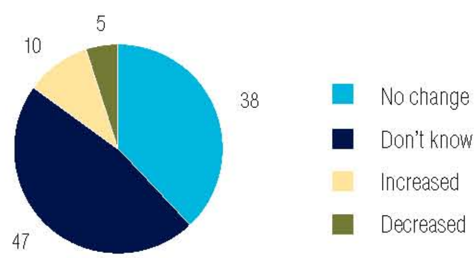
39 Barton, "CBI/Pfizer Research."

Table 3
Direct Cost of Absenteeism
(per cent of gross annual payroll)

	2009		2012	
	n	per cent	n	per cent
Overall	37	2.6	50	2.4
Private sector	18	2.3	31	2.3
Public sector	19	2.9	19	2.6

Source: The Conference Board of Canada.

Chart 6
Changes in Total Direct Costs of Absenteeism
(n = 92; per cent)



Source: The Conference Board of Canada.

GOING FORWARD: REDUCING ABSENTEEISM

Absenteeism is more than a human resources issue. It costs the Canadian economy billions of dollars each year. Unless organizations start proactively addressing absenteeism—beginning with better tracking of the number of absences and reasons for absences—this number will most likely increase as the workforce ages. By looking at absence patterns and identifying the causes of absences, organizations can put in place programs and policies to reduce absenteeism.

How do organizations establish an effective absence and disability management program? What specific actions can they take to reduce absenteeism? These questions will be answered in the second and third parts in this research series: *Creating an Effective Workplace Disability Management Program* and *Disability Management: Opportunities for Employer Action.*

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Insights. Understanding. Impact.

Missing in Action: Absenteeism Trends in Canadian Organizations

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RESPONSES TO BUILDING OWNERS AND MANAGERS ASSOCIATION, GREATER TORONTO INTERROGATORIES

INTERROGATORY 38:

Reference(s): **Exhibit 1B, Tab 2, Schedule 5, page 26**

How many efficiency and/or safety producing improvements arising from Toronto Hydro management meeting with employees described at 2.2.3.4 has Toronto Hydro implemented in each of the last five years? Please provide a brief description of each improvement.

RESPONSE:

Toronto Hydro utilizes both top-down and bottom-up approaches to generate and implement ideas as a part of its continuous improvement culture. The ideas that require capital investments (most commonly, IT-enabled technologies) or significant corporate change management efforts require approval and oversight of senior management. However, Toronto Hydro has considered and/or implemented numerous initiatives driven by division, department and/or supervisory groups without a requirement to secure senior management approvals. In this manner, Toronto Hydro decentralizes continuous improvement efforts and leaves responsibilities for effective and efficient operations at the appropriate organizational levels. Toronto Hydro does not track the information related to these initiatives in a manner that would allow it to produce a specific number and detailed descriptions of all ongoing or implemented productivity and/or safety improvements arising from the meetings with employees.

For examples of initiatives that have been implemented corporate-wide and at the departmental level, please see Exhibit 1B, Tab 2, Schedule 5, Appendix A and Exhibit 4A, Tab 2, Schedules 1 to 18.

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INTERROGATORY 39:

Reference(s): **Exhibit 1B, Tab 2, Schedule 5, page 22**

Are the different Toronto Hydro buildings and work centers also interconnected digitally? Please discuss.

RESPONSE:

Yes, Toronto Hydro buildings and work centers are interconnected digitally via different technologies, such as the fiber-optic network infrastructure.

RESPONSES TO BUILDING OWNERS AND MANAGERS ASSOCIATION, GREATER TORONTO INTERROGATORIES

INTERROGATORY 40:

Reference(s): **Exhibit 1B, Tab 2, Schedule 5, page 23**

How were Baltimore and Chicago utilities chosen as the U.S. utilities to visit to determine best practices?

RESPONSE:

Baltimore and Chicago were chosen as U.S. utilities to visit because Toronto Hydro considers them to be its industry peers – utilities that serve customers in dense, mature, urban environments. Other reasons include geographical proximity, existing organizational contacts, and the utilities' general industry reputation as adopters of productivity best practices.

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INTERROGATORY 41:

Reference(s): Exhibit 1B, Tab 2, Schedule 5, line 26 (corrected)

Describe what senior management does to encourage “effective performance feedback” throughout the organization.

RESPONSE:

Toronto Hydro offers many avenues for employees to provide their peers and management with feedback regarding safety and efficiency. Regular meetings are held at the departmental level; senior leadership team members provide employee updates and facilitate discussions and employees are encouraged to share their insights. Safety inspections are another forum where leaders receive employee feedback and suggestions on safety-related improvements to specific aspects of their respective working environments.

From time to time, Toronto Hydro also facilitates targeted Focus Groups where subject matter experts from various parts of the utility provide their feedback on various subjects, such as performance measurement. Finally, employees are encouraged to share their feedback with their supervisors and managers on an ongoing basis as well as in the course of their annual and mid-year reviews.

RESPONSES TO BUILDING OWNERS AND MANAGERS ASSOCIATION, GREATER TORONTO INTERROGATORIES

INTERROGATORY 42:

Reference(s): Exhibit 1B, Tab 2, Schedule 5, Appendix A, page 3

Please provide the evidence to support the assertion that Toronto Hydro has been a leader in Smart Meter development, web-based customer service, and enabling renewable generation connection across its service area.

RESPONSE:

Toronto Hydro was among the earliest adopters of Smart Meter technology in Ontario. In 2005, Toronto Hydro piloted Smart Meter with Elster and Trilliant companies. In 2006, Elster was selected as the vendor of choice for residential and commercial Smart Meters for Toronto Hydro (<50kW smart meters). At the end of the same year close to 200,000 meters were installed. In 2007, Toronto Hydro and Elster implemented AMI system that lead to the implementation of a Toronto Hydro-owned Operational Data Store ("ODS") – eMeter Product.

In December, 2007 Whitecap Canada Inc., a leading developer of customized e-business and Internet-based applications, and Toronto Hydro-Electric System Limited, announced the successful launch of a new web application allowing utility consumers to easily access and understand Time-of-Use ("TOU") utility consumption rates and pricing: the Smart Meter Customer Self-Service Portal. By 2009 over 200,000 customers were billed on TOU rates and provided access to their hourly data. Toronto Hydro developed initiatives to build customer trust and loyalty through web and wireless technologies, such as the Smart Meter Portal, which allows registered Toronto Hydro customers to

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securely access their personalized usage data over the web. Toronto Hydro has also developed an energy tool (Energy Calculator) that allows users to input characteristics of their home (age, appliances, use patterns), which are then used to develop customized recommendations based on a customer's consumption profile. Granular TOU data also permits call center associates to discuss the customers' load patterns and explain the customer's usage and the associated charges.

As discussed in Exhibit 4A, Tab 2, Schedule 13, by the end of 2014, Toronto Hydro plans to consolidate all of its on-line service offerings (ebills, MyTorontoHydro, TOU portal) into one interface, to provide customers a single sign-on experience, thereby improving usability and uptake. Additional offerings will continue to be incorporated based on customer research and identified opportunities to increase efficiency. This includes offering MyTorontoHydro account management services to commercial customers and a fully automated new customer move-in process.

Toronto Hydro has a dedicated interconnections team which supports renewable generation connection across its service area. Since 2009, Toronto Hydro has responded to over 3,000 inquiries from customers and enabled over 890 distributed generation connections, which included 862 photovoltaic renewable generation projects. In 2013 Toronto Hydro successfully connected 159 solar micro-generation facilities to its distribution system, all of which were connected within the five-day timeline prescribed by the Distribution System Code (DSC), or as negotiated with individual proponents.

Toronto Hydro's interconnections team employs phone-based and web-based application systems to manage the interconnection process using a customer-centric approach. This approach includes pre-assessment services, connection impact analyses, metering field

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support and protection/monitoring /controls commissioning of distributed generation projects. Exhibit 2B Section E5.5 details the Monitoring, Protection and Control investments that Toronto Hydro proposes to implement over the 2015-2019 timeframe to continue fulfilling its obligations with respect to renewable energy integration across its service territory.

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INTERROGATORY 43:

Reference(s): Exhibit 1B, Tab 2, Schedule 5, Appendix A, page 4

"The integration efforts were further complicated by the implementation of sector transformative initiatives, such as smart meters and distributed generation" (our emphasis)

Please provide data on distributed generation installed on Toronto Hydro's system for each of the years between 1998 and 2014, including number of installations, kw of each one, and total annual kW installed, type of fuel, e.g., solar, wind, biomass, waste, natural gas. Please provide connection costs for each year and required network costs, if any, for each year with detail.

RESPONSE:

Please refer to the data on distributed generation installed shown in the table below. In terms of the connection costs, these were recoverable on a project basis and not included in rate base. For the required network costs each year please refer to EB-2014-0116, Exhibit 2B, Section E5.5, page 27, Table 10: Historical and Future Spending.

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		Annual kW Connected						
	No. of Installations	Total kW	Solar	Wind	Biogas	Natural Gas	Diesel	Other
pre-1998	6	20,750	-	-	5,600	11,150	4,000	-
1998	0	-	-	-	-	-	-	-
1999	1	250	-	-	-	250	-	-
2000	7	10,146	1	-	-	4,695	5,450	-
2001	1	1,500	-	-	-	-	1,500	-
2002	3	101	2	-	-	-	-	99
2003	6	9,156	6	750	-	5,300	900	2,200
2004	3	11,736	36	-	4,700	7,000	-	-
2005	5	4,126	1	-	-	2,525	1,600	-
2006	5	1,008	8	-	-	1,000	-	-
2007	48	4,594	191	3	-	1,600	1,800	1,000
2008	22	11,053	103	-	-	9,750	-	1,200
2009	3	506	6	-	-	-	500	-
2010	124	897	897	-	-	-	-	-
2011	192	6,080	6,080	-	-	-	-	-
2012	182	10,692	8,692	-	-	2,000	-	-
2013	203	18,616	9,616	-	-	9,000	-	-
2014	87	2,778	2,778	-	-	-	-	-

RESPONSES TO BUILDING OWNERS AND MANAGERS ASSOCIATION, GREATER TORONTO INTERROGATORIES

INTERROGATORY 44:

Reference(s): **Exhibit 1B, Tab 2, Schedule 5, page 7 (evidence)**

Provide an analysis of the annual savings achieved by partial outsourcing of the call center since 1999. Please describe the current status of the call center. Does it remain outsourced, mixed internal and outsource? Provide details.

RESPONSE:

The following table represents the estimated annual savings achieved by partial outsourcing from 2008-2013. Data prior to 2008 was not available.

Year	Savings ($ Millions)
2008	1.6
2009	2.3
2010	2.9
2011	2.7
2012	3.4
2013	3.5

To further reduce costs, while also providing the ability to offer segmented services to various customer classes, a new business model was implemented in 2012. As a result, residential calls and routine clerical services are now outsourced, while complex commercial inquiries are managed by internal resources. See Exhibit 4A, Tab 2, Schedule 13, Section 5.8, lines 18-25.

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INTERROGATORY 45:

Reference(s): **Exhibit 1B, Tab 2, Schedule 5, page 7**

Please provide the calculation supporting the NPV staff reduction/VEP program savings of $1.9 billion. Please illustrate how the calculation was done. Please quantify the pv of the expenditures for the additional staff hired since 1999; including full time, contract, and part time.

RESPONSE:

The NPV staff reduction / VEP program savings are based on the present value of the cash flow, estimated by multiplying the average annual salary by the number of employees who left Toronto Hydro in the period of the VEP from 1997 to 2003. The present values of the cash flow are summed over the years impacted.

	Avg. Salary	Burden Rate	Headcount decrease	Avoided Cost Per Year (in millions)
1998	$57,973	30.5%	608	$46
1999	$59,770	30.5%	3	$0.2
2000	$61,622	30.5%	6	$0.5
2001	$63,532	30.5%	249	$20.6
2002	$65,501	30.5%	0	$0
2003	$67,531	30.5%	67	$6

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The avoided cost per year was presented in a cash flow for the period from 1999 to 2013 and then converted to the present value (2014). The total benefits of the VEP savings brought to present value is $1.9 billion as presented below.

	Accumulated Avoided Cost (in millions)	PV (2014) (in millions)
1998	$46	$130
1999	$46	$123
2000	$46	$117
2001	$67	$157
2002	$67	$148
2003	$73	$150
2004	$73	$140
2005	$73	$131
2006	$73	$123
2007	$73	$115
2008	$73	$108
2009	$73	$101
2010	$73	$95
2011	$73	$89
2012	$73	$83
2013	$73	$78

The present value of the expenditures for additional headcount increases since 1999 is calculated below using the same methodology, and consists of full time staff only, as Toronto Hydro cannot reliably estimate the part-time and contractor employee turnover over the requested timeframe.

RESPONSES TO BUILDING OWNERS AND MANAGERS ASSOCIATION, GREATER TORONTO INTERROGATORIES

	Avg. Salary	Burden Rate	Headcount increase	Cost of hiring additional personnel (in millions)
1999	$59,770	30.5%		
2000	$61,622	30.5%		
2001	$63,532	30.5%		
2002	$65,501	30.5%	24	$2.0
2003	$67,531	30.5%		
2004	$69,623	30.5%		
2005	$71,781	28.1%	6	$0.6
2006	$73,958	27.5%	10	$1.0
2007	$76,175	30.5%	48	$5.0
2008	$78,533	28.5%		
2009	$81,355	28.3%	44	$5.0
2010	$83,441	30.2%	11	$1.0
2011	$85,541	32.3%	74	$8
2012	$88,835	33.3%		
2013	$91,639	36.1%		

The cost of headcount increase was converted to the present value (2014).

	Accumulated Cost of additional hiring (in millions)	PV (2014) (in millions)
1999		
2000		
2001		
2002	$2.0	$4.49
2003	$2.0	$4.21
2004	$2.0	$3.94

RESPONSES TO BUILDING OWNERS AND MANAGERS ASSOCIATION, GREATER TORONTO INTERROGATORIES

	Accumulated Cost of additional hiring (in millions)	PV (2014) (in millions)
2005	$2.6	$4.7
2006	$3.6	$6.0
2007	$8.3	$13.1
2008	$8.3	$12.3
2009	$13.0	$17.9
2010	$14.1	$18.3
2011	$22.5	$27.3
2012	$22.5	$25.6
2013	$22.5	$24.0

The present value of the headcount increases is $162 million.

Notwithstanding the above findings, Toronto Hydro notes that headcount reductions in 1998-2003 were generally driven by the post-amalgamation restructuring initiative (the Voluntary Exit Program). However, the incremental headcount increase has been in part driven by the expansion of the utility's scope of responsibilities, consistent with the evolution of Ontario's energy policy, (e.g., smart meters, renewables, service quality and billing requirements, etc.), health and safety regulations and other drivers. Therefore, at least a portion of the staff added following the VEP program cannot be seen as equivalent replacements of the positions rationalized through the VEP.

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INTERROGATORY 46:

Reference(s): **Exhibit 1B, Tab 2, Schedule 5, page 8**

To what extent did the VEP contribute to the current shortage of semi-skilled trades? Please explain fully.

Why was the VEP made totally open, without regard to the strategic resources needed to deal with future needs? Please explain fully.

RESPONSE:

Toronto Hydro offered Voluntary Exit Programs ("VEP") upon amalgamation in 1998 and again in 2001, or 16 and 13 years ago, respectively. Given the passage of time, it is impossible to speculate what impact, if any, the VEP had on current staffing issues. The decisions as to the structure of the VEP were made by the management of the day and current management has no ability to meaningfully comment on the rationale for decisions made so long ago.

RESPONSES TO BUILDING OWNERS AND MANAGERS ASSOCIATION, GREATER TORONTO INTERROGATORIES

INTERROGATORY 47:

Reference(s):

Exhibit 1B, Tab 2, Schedule 5, page 9

Please explain what is meant by the following sentence, especially the underlined portion: "The creation of the reporting and control system and its benefits were key to the execution of increased capital work, and the transition from effective to efficient practices".

Please provide Toronto Hydro's understanding of the difference between "effectiveness" and "efficiency" in relation to capital project implementation.

RESPONSE:

The introduction of the Management Control and Reporting System ("MCRS") framework at Toronto Hydro enhanced the scope, frequency and level of detail of internal control steps across the utility, and particularly with regard to project management. Under the "effective" work execution practices, the cited passage denotes the pre-MCRS approach whereby the key control step was project completion itself, with conformance to the intended execution manner and the delivery of expected results as key evaluation criteria. With the adoption of MCRS, Toronto Hydro's project management practices have evolved to incorporate more nuanced, shorter-interval control measures that help ensure that project plans not only deliver the expected results ("effectiveness"), but deliver them in a manner that maximizes the expected utility of resource inputs ("efficiency").

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INTERROGATORY 48:

Reference(s): Exhibit 1B, Tab 2, Schedule 5, page 19

To what extent can the GEAR system be used to facilitate the integration of distributed generation?

RESPONSE:

The GEAR Tool is a database of all assets connected and operating on the Toronto Hydro Grid. Prior to any proposed connection of distributed generation, an analysis is done to determine the suitability of the proposed connection point to accommodate the proposed distributed generation project. Toronto Hydro also uses GEAR to review the list of assets related to that connection point and how they are connected to the grid. Both of these activities are critical to the analysis, which provides information to support the facilitation and integration of distributed generation. In addition, once a distributed generation project is connected to the grid its relevant information is added to GEAR.

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INTERROGATORY 49:

Reference(s): **Exhibit 1B, Tab 2, Schedule 5, page 20**

a) Please describe what the automated Outage Management System does. Illustrate by examples.

b) Please provide an assessment of the reduction of SAIDI over the 1998 to 2014 period, including an estimate of dollar and other benefits which resulted from the introduction of the Outage Management System. What has been the accumulated savings to customers (increase in customer value, over the period)?

RESPONSE:

a) The automated Outage Management System ("OMS") improves customer service by helping reduce outage durations and by facilitating communication with both Toronto Hydro staff and customers. Prior to the implementation of the automated OMS system, the information flow between Customer Service Reps, Dispatchers and customers relied on numerous manual processes, including faxing, scheduling, sorting, prioritization and voice dispatch. Handwritten work reports needed to be keyed into multiple systems for record keeping and analysis. This also created challenges with respect to coordinating outage-related customer communications.

The major functions of OMS include the following:

- Trouble Call Management – OMS allows all events to be automatically entered and captured in a centralized location with the ability to sort based on priority, location, and device. This allows a dispatcher to analyze and recognize which

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event needs to be dispatched based on priority and proximity of an available field crew. Moreover, the OMS has functionality to allow for trouble ticket closing and archiving of event information for analysis.

- Outage Prediction Tool – Automatic grouping and re-grouping of outage calls into possible outage locations, which reduces number of calls in the system and identifies a specific device suspected in causing an outage. Ultimately, the system helps to reduce the number of truck rolls dispatched to calls and facilitates faster restoration times. The OMS predicts outages using a connectivity model and real-time integration with the Distribution Management System.
- Trouble Crew Dispatch and Management – OMS displays all available field crews and their skill sets that can be dispatched to an event. OMS allows the dispatchers to have a real time view on the work that the field crews are performing, as well as the history of events completed, which improves work flow management.

b) The automated OMS system was implemented in 2007. There is no reliable way to calculate the benefits of the OMS system in terms of financial savings, reliability or customer service improvements. OMS is just one of the elements impacting Toronto Hydro's overall performance in these areas. Toronto Hydro cannot estimate the specific impact of OMS introduction on the utility's SAIDI, Customer Service or Financial performance as these parameters are also heavily impacted by other activities. Toronto Hydro's historical SAIDI performance (2009-2013) is described in Exhibit 2A, Tab10, Schedule 2, page 2 of 19. Moreover, please see the PSE Benchmarking Study (Exhibit 1B, Tab 2, Schedule 5, Appendix B), which concludes that Toronto Hydro's historic SAIDI performance has been better than the level expected by the econometric model. Please see response to part (a).

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INTERROGATORY 50:

Reference(s): Exhibit 1B, Tab 2, Schedule 5, page 21

Please provide the data and calculations to justify the $214 million of cost reduction in Table 6, in particular the $165 million of salary savings attributed to measures taken with respect to the Energy Response staff.

RESPONSE:

The estimated salary savings for Emergency Response represent the Present Value of Cash Flow for the average annual salaries of employees who left the utility in the period from 1999 to 2013, with those positions not being replaced.

In 1999, there were 88 Emergency Response representatives working for Toronto Hydro with an average salary of $ 57,973. In 2013, there were only 41 Emergency Response representatives in Toronto Hydro with an average salary of $91,639. Toronto Hydro has thus reduced the number of resources that provide ER services by more than 50%, while delivering improved service levels (SAIDI) and maintaining the OEB-mandated Service Quality targets.

Toronto Hydro notes that there was an error in the initial calculation of the PV for the Emergency Response savings as provided in the pre-filed evidence. The recalculated PV based on the information noted above results in a savings of $40 million. Given the error, Toronto Hydro has reviewed calculations related to other activities and found no further material issues requiring updates.

RESPONSES TO BUILDING OWNERS AND MANAGERS ASSOCIATION, GREATER TORONTO INTERROGATORIES

Year	Salary	Change in Headcount	Avoided Cost Total (in millions)	Cash Flow (in millions)	PV (in millions)
1999	$59,770	6	$0.5	$0.5	$1.2
2000	$61,622	5	$0.4	$0.9	$2.2
2001	$63,532	3	$0.2	$1.1	$2.6
2002	$65,501	1	$0.08	$1.2	$2.6
2003	$67,531	1	$0.09	$1.3	$2.6
2004	$69,623	1	$0.09	$1.4	$2.7
2005	$71,781	1	$0.09	$1.5	$2.7
2006	$73,958	0		$1.5	$2.5
2007	$76,175	0		$1.5	$2.3
2008	$78,533	2	$0.2	$1.7	$2.5
2009	$81,355	0		$1.7	$2.3
2010	$83,441	3	$0.3	$2	$2.6
2011	$85,541	3	$0.3	$2.3	$2.9
2012	$88,835	5	$0.6	$2.9	$3.3
2013	$91,639	16	$2	$4.8	$5.2
Average Burden Rate: 31%		Total PV		$40.2	

Toronto Hydro notes that as previously discussed in footnote 1, page 3 of Exhibit 1B, Tab 2, Schedule 5, Appendix A, that given the limited availability of records from the period immediately following the amalgamation, the cost savings presented in the above-referenced exhibit represents estimates of directional magnitude, rather than precise calculations.

Please see the attached spreadsheet (1B_BOMA_50.xlsx) for the remaining calculations.

RESPONSES TO BUILDING OWNERS AND MANAGERS ASSOCIATION, GREATER TORONTO INTERROGATORIES

INTERROGATORY 51:

Reference(s): Exhibit 1B, Tab 2, Schedule 5, page 22

Please explain how the absenteeism rate is calculated at Toronto Hydro. Please provide a copy of the Nichole Stuart study.

RESPONSE:

Please see response to Interrogatory 1B-BOMA-37.

RESPONSES TO BUILDING OWNERS AND MANAGERS ASSOCIATION, GREATER TORONTO INTERROGATORIES

INTERROGATORY 52:

Reference(s): **Exhibit 1B, Tab 2, Schedule 5, page 27**

Please explain fully the partial outsourcing of metering/billings/payments process and provide evidence to support the $4 million in salary savings (NPV).

RESPONSE:

The evolution of the Accounts Receivable business model from a fully in-house to a partially outsourced model was achieved by reviewing all tasks and categorizing them into two groups: those tasks based on less complex, routine work; and those tasks that were more complex in nature, less routine, and required greater knowledge and skill to successfully accomplish. The tasks outsourced fall into the first group.

Examples of tasks that were outsourced:

a) Meter Data Management:
   1. Meter reading data exceptions that require manual oversight
   2. Manual meter reading processes
   3. Processing meter exchanges in the system
b) Billing:
   1. Billing threshold exceptions that require manual oversight
   2. Manual read processing due to customers moving
c) Payment Processing (Remittance):
   1. Tracing unidentified payments
   2. Account status changes

RESPONSES TO BUILDING OWNERS AND MANAGERS ASSOCIATION, GREATER TORONTO INTERROGATORIES

d) Collections:

1. Tracing "unidentified account holder" accounts
2. Processing returned mail
3. Processing accounts for transfer to Collection Agencies
4. Performing write-off of account activities
5. Updating the Customer Information System upon severance activity completion

Toronto Hydro's third party service provider is able to hire and train resources suitable to performing this level of clerical work, allowing higher cost Toronto Hydro resources to focus solely on the more complex tasks associated with the Accounts Receivable function. By leveraging external service providers, Toronto Hydro has been able to maintain these services while controlling upward pressure on costs.

As such the savings of $4 million have been derived from the difference between OM&A labour costs associated with the services being done by a third party provider, rather than in house. The savings is approximately 40% for every labour resource outsourced versus an in-house resource, and these cost savings are summed over years impacted and brought to present value.

RESPONSES TO BUILDING OWNERS AND MANAGERS ASSOCIATION, GREATER TORONTO INTERROGATORIES

INTERROGATORY 53:

Reference(s): **Exhibit 1B, Tab 2, Schedule 5, page 32**

a) What company provides the outsourced warehousing function?
b) Please provide details of the arrangement, ownership, service contract, staffing, etc.
c) Were the previous three warehouses sold, repurposed? Please discuss.
d) Were proceeds credited to the revenue requirement; in which rate case?

RESPONSE:

a) The outsourced warehousing function is provided by TOC Logistics.

b) TOC Logistics is a privately owned provider of third party logistics services. They were awarded a five-year contract with optional extensions in 2012 through a competitive bid process. TOC Logistics is the main receiving warehouse for Toronto Hydro inventory. TOC Logistics picks material for planned work and delivers it to Toronto Hydro or External contractor staging locations where it is then picked up by work crews. Toronto Hydro maintains three warehouses that are stocked for reactive purposes and TOC Logistics replenishes stock at these warehouses as they get low on material. TOC Logistics is paid based on a percentage of the material issued to Toronto Hydro.

c) The three warehouses are still in use but the space used has been significantly reduced. They now serve reactive work needs and planned work is picked from the outsourced warehouse. The warehouse space reductions were a key enabler of the

RESPONSES TO BUILDING OWNERS AND MANAGERS ASSOCIATION, GREATER TORONTO INTERROGATORIES

operating centre consolidation plan, described in more detail in Exhibit 2B, Section E8.3.

d) Please see response in part (c).

RESPONSES TO BUILDING OWNERS AND MANAGERS ASSOCIATION, GREATER TORONTO INTERROGATORIES

INTERROGATORY 54:

Reference(s): Exhibit 1B, Tab 2, Schedule 5, page 32

What is the material investment referred to?

RESPONSE:

Toronto Hydro is unable to find the referenced "material investment" in Exhibit 1B, Tab 2, Schedule 5.

RESPONSES TO BUILDING OWNERS AND MANAGERS ASSOCIATION, GREATER TORONTO INTERROGATORIES

INTERROGATORY 55:

Reference(s): **Exhibit 1B, Tab 2, Schedule 5, page 32**
D16 – Safety Gains

Please document the reduction of occupational injury costs since 2007.

RESPONSE:

Cost of injuries consists of the direct and indirect cost. The direct cost of injuries is reflected by the Ontario Workplace Safety and Insurance Board (WSIB) – an agency of the Ontario Ministry of Labour. Direct costs are presented as the New Experimental Experience Rating (NEER) amount assigned to an allowed claim. The indirect cost of injuries has been reported by Workplace Safety and Prevention Services (WSPS), an agency of the Ontario Ministry of Labour, as being between three to ten times the direct costs[1].

Table 1 on the following page summarizes both direct and indirect costs for Toronto Hydro since 2007.

[1] http://www.wsps.ca/Information-Resources/Articles/How-prevention-saves-a-small-business-money.aspx

RESPONSES TO BUILDING OWNERS AND MANAGERS ASSOCIATION, GREATER TORONTO INTERROGATORIES

Table 1: Total Occupational Injury Costs ($M)

Year	NEER Costs	Indirect Costs (Minimum)	Indirect Costs (Maximum)	Total Costs (Minimum)	Total Costs (Maximum)	3-Year Rolling Average (Minimum Total)	3-Year Rolling Average (Maximum Total)
2007	0.5	1.6	5.4	2.2	6.0		
2008	0.4	1.2	4.1	1.6	4.5		
2009	0.2	0.6	2.0	0.8	2.2	1.5	4.2
2010	0.6	1.7	5.7	2.3	6.3	1.6	4.3
2011	0.2	0.7	2.3	0.9	2.5	1.3	3.7
2012	0.03	0.1	0.3	0.1	0.3	1.1	3.0
2013	0.05	0.1	0.5	0.2	0.5	0.4	1.1
2014*	0.01	0.04	0.1	0.1	0.1		

*June 30, 2014 most recent report from WSIB

RESPONSES TO BUILDING OWNERS AND MANAGERS ASSOCIATION, GREATER TORONTO INTERROGATORIES

INTERROGATORY 56:

Reference(s): Exhibit 1B, Tab 2, Schedule 5, page 33

Why has Toronto Hydro not already removed asbestos from its work sites? What is its plan to do so? By what date? Have funds been budgeted for this task? Please discuss fully. How many cases of asbestos related illness have Toronto Hydro employees suffered since 1998?

RESPONSE:

Asbestos-containing materials ("ACMs") are ubiquitous in all of Toronto Hydro's buildings and assets, and are a legacy issue. Asbestos was a commonly and legally used building material in Ontario up to 1985 and was routinely used in manufactured equipment until 2000 and later. It is found, for example, in switch gear, underground ducts, entranceways to vaults, as an insulating material in cables, and in building materials including drywall and plaster, roofing materials, window caulking, floor tiles, and ceiling tiles. Toronto Hydro has over 200 buildings including stations, and many of kilometres of cables and underground ducts containing asbestos.

Toronto Hydro complies with its legal obligations regarding ACM. Toronto Hydro replaces ACM at the same pace as the system undergoes renewal. For example, AILC secondary cables may be replaced within the vicinity of the projects associated with Network Unit Renewal, PILC Piece Outs & Leakers, Network Vault Renewal, Legacy Network Equipment Renewal and Load Demand programs.

RESPONSES TO BUILDING OWNERS AND MANAGERS ASSOCIATION, GREATER TORONTO INTERROGATORIES

Since 2008 there has been one Workplace Safety and Insurance Board ("WSIB") claim allowed for mesothelioma and one claim related to asbestos exposure pending a decision by the WSIB.

RESPONSES TO BUILDING OWNERS AND MANAGERS ASSOCIATION, GREATER TORONTO INTERROGATORIES

INTERROGATORY 57:

Reference(s): **Exhibit 1B, Tab 2, Schedule 5, page 34**

Who is the current third party provider of residential customer calls?

RESPONSE:

The current third-party provider of residential customer calls is Optima Communications International Inc.

RESPONSES TO BUILDING OWNERS AND MANAGERS ASSOCIATION, GREATER TORONTO INTERROGATORIES

INTERROGATORY 58:

Reference(s):

Exhibit 1B, Tab 2, Schedule 5, Appendix B (PSE Studies)

Please provide the engagement letter or its equivalent between Toronto Hydro and PSE for both studies it provided, including any amendments, addenda, comments on drafts, or any other written (including e-mail) communications between the parties prior to, during, or after the study period.

RESPONSE:

Please see Toronto Hydro's response to interrogatory 1B-SEC-7 for the copy of the retainer. Toronto Hydro did not provide comments on the drafts of PSE's studies. Toronto Hydro declines, on the basis of relevance, to produce communications between the parties prior to, during, or after the study period, as this request is overly broad and has no probative value in deciding the issues in this proceeding.

RESPONSES TO BUILDING OWNERS AND MANAGERS ASSOCIATION, GREATER TORONTO INTERROGATORIES

INTERROGATORY 59:

Reference(s): Exhibit 1B, Tab 2, Schedule 5, page 4, Figure 2

Why is the "thirty utility observations" described as "being in the same customer range as Ontario Hydro (400,000 to 800,000)" when Toronto Hydro has 709,000 customers? Should not the applicable range be 500,000 to 900,000? What are the implications of such a change for study results?

RESPONSE (PREPARED BY PSE):

These results are only used to illustrate where Toronto Hydro's data values fall within the data range, and do not affect any benchmark values or study results. Specifically, the data values indicate that when data from U.S. utilities are included in the study, Toronto Hydro's customer number is not an outlier, but rather is "surrounded" in the sample by multiple utilities with more customers, and multiple utilities with fewer customers. The range or "bin" in which Toronto Hydro's data falls could as easily be in the 500,000 to 900,000 range, depending on how many histogram bars are generated. However, this has no implications for the study's actual results.

RESPONSES TO BUILDING OWNERS AND MANAGERS ASSOCIATION, GREATER TORONTO INTERROGATORIES

INTERROGATORY 60:

Reference(s): **Exhibit 1B, Tab 2, Schedule 5, pages 60-61**

Why is the peak demand shown as 4,000 units in Figure 25 (Ontario only) but 6,000 for U.S. only and combined data?

RESPONSE (PREPARED BY PSE):

This is a function of how the histogram "bins" are generated, which is dependent on the data used to generate them. The bins are chosen based on the values in the dataset. In the Ontario data case, Toronto Hydro's peak demand falls in the bin whose range is up to 4,000 kW. In the U.S. and Ontario data case, the bin in which Toronto Hydro's value falls into ranges up to 6,000 kW. The bin values were changed because in the U.S. dataset, there are many utilities with peak demand over 6,000 kW, whereas in the Ontario sample there were not. The larger "bins" are needed to accommodate the utilities with larger demand, and depict those utilities in a chart. These figures are meant only to demonstrate the outlier nature of Toronto Hydro's values in the Ontario dataset, where its values tend to be the highest or in the highest ranges. The data bins in no way impact study results.

RESPONSES TO BUILDING OWNERS AND MANAGERS ASSOCIATION, GREATER TORONTO INTERROGATORIES

INTERROGATORY 61:

Reference(s): **Exhibit 1B, Tab 2, Schedule 5, Appendix (8) to Appendix B**

Please provide the full curriculum vitae of each of the five authors of the two PSE studies, including a list of all of the studies each has prepared as sole author, and as joint author, in the last ten years. Please provide copies of any other studies done, similar to the Capital Requirements for Serving Developed Environments (Appendix 8 to Appendix B of Exhibit 1B, Tab 2, Schedule 5 [PSE Study]) by any or all of Erik S. Sonju, Steve Hall, or Amanda Jutrzonka, or other PSE employees in the last ten years.

RESPONSE:

The requested resumes are provided in Appendix A to this response. None of the studies prepared by Erik S. Sonju, Steve Hall, or Amanda Jutrzonka in the last ten years are similar to the Capital Requirements for Serving Developed Environments Study.

A list of more than 200 studies prepared by the PSE authors in the last two years is provided as Appendix B to this response. Upon request, Toronto Hydro will provide interested parties copies of one or more of the studies, subject to any confidentiality protections that Toronto Hydro may request, to be determine on a case by case basis.

Toronto Hydro-Electric System Limited

EB-2014-0116

Interrogatory Responses

1B-BOMA-61

Filed: 2014 Nov 5

Resumes for Power System Engineering, Inc.

1. Steve Fenrick
2. Lullit Getachew
3. Erik Sonju
4. Steve Hall
5. Amanda Jutrzonka

STEVEN A. FENRICK
LEADER, BENCHMARKING AND ECONOMIC STUDIES

SUMMARY OF EXPERIENCE AND EXPERTISE

- Leader of PSE's Economics and Market Research group which conducts research in the fields of performance benchmarking, incentive regulation, value-based reliability planning, DSM, load research and forecasting, and survey design and implementation.
- Manages PSE's cost, productivity, and reliability performance benchmarking practice.
- Directs research on value-based reliability planning efforts for electric utilities.
- Expert in performance-based ratemaking and incentive regulation.
- Directs economic research on investigating the impacts and costs/benefits of DSM programs and designing statistically robust pilot designs.

PROFESSIONAL EXPERIENCE

Power System Engineering, Inc. – Madison, WI (2009 to present)

Leader, Economics and Market Research

Responsible for providing consulting services to utilities and regulators in the areas of reliability and cost benchmarking, incentive regulation, value-based reliability planning, demand-side management including demand response and energy efficiency, load research, load forecasting, end-use surveys, and market research.

- Leads research, on an annual basis, with over a dozen electric utilities in evaluating cost, productivity, and reliability performance and uncovering methods to improve their operations.
- Benchmarking consultant to the Ontario Energy Board regarding their 3rd Generation Incentive Regulation Plan for the last two years.
- In the process of designing and analyzing DSM pilot projects at over 25 electric utilities across the country.
- Testimony experience regarding performance value-based reliability planning, benchmarking and productivity analysis.
- Has given several presentations on performance benchmarking and productivity analysis, costs and benefits of DSM programs, and measurement and verification (M&V) techniques.
- Key speaker at EUCI conferences regarding cost and reliability performance evaluation and productivity analysis of distribution utilities.

Pacific Economics Group – Madison, WI (2001 - 2009)

Senior Economist

Co-authored research reports submitted as testimony in numerous proceedings in several states and in international jurisdictions. Research topics included statistical benchmarking, alternative regulation, and revenue decoupling.

STEVEN A. FENRICK

EDUCATION

University of Wisconsin - Madison, WI
Master of Science, Agriculture and Applied Economics

University of Wisconsin - Madison, WI
Bachelor of Science, Economics (Mathematical Emphasis)

Publications & Papers

- "Cost and Reliability Comparisons of Underground and Overhead Power Lines", *Utilities Policy*, March 2012. (With Lullit Getachew).
- "Formulating Appropriate Electric Reliability Targets and Performance Evaluations, *Electricity Journal*, March 2012. (With Lullit Getachew)
- "Enabling Technologies and Energy Savings: The Case of EnergyWise Smart Meter Pilot of Connexus Energy", November 2012. (With Chris Ivanov, Lullit Getachew, and Bethany Vittetoe)
- "Estimation of the Effects of Price and Billing Frequency on Household Water Demand Using a Panel of Wisconsin Municipalities", *Applied Economics Letters*, 2012, 19:14, 1373-1380.
- "Altreg Rate Designs Address Declining Average Gas Use", *Natural Gas & Electricity*. April 2008. (With Mark Lowry, Lullit Getachew, and David Hovde).
- "Regulation of Gas Distributors with Declining Use per Customer", *Dialogue*. August 2006. (With Mark Lowry and Lullit Getachew).
- "Balancing Reliability with Investment Costs: Assessing the Costs and Benefits of Reliability-Driven Power Transmission Projects." April 2011. *RE Magazine*.
- "Ex-Post Cost, Productivity, and Reliability Performance Assessment Techniques for Power Distribution Utilities". Master's Thesis.

Expert Witness Experience

- Docket No. 6690-CE-198, Wisconsin Public Service Corporation, "Application for Certificate of Authority for System Modernization and Reliability Project".
- Docket No. EB-2012-0064, Toronto Hydro's Incremental Capital Module (ICM) request for added capital funding.
- Docket No. 09-0306, Central Illinois Light rate case filing.
- Docket No. 09-0307, Central Illinois Public Service Company rate case filing.
- Docket No. 09-0308, Illinoi Power rate case filing.

LULLIT GETACHEW, PhD
SENIOR ECONOMIST

SUMMARY OF EXPERIENCE AND EXPERTISE

- Expert in applying econometric methods to utility research topics.
- Provides econometric support and review on all PSE economic and market research practice areas.
- Conducts empirical studies using multiple programming languages.

PROFESSIONAL EXPERIENCE

Power System Engineering, Inc. – Madison, WI (2011-present)

Senior Economist

Provides consulting services to electric utilities nationwide in load forecasting and research, performance benchmarking, customer and end-use surveys, market research, energy efficiency filings, and demand-side management.

Pacific Economics Group Research – Madison, WI (2002-2011)

Senior Economist

Conducted research in support of regulatory filings of energy utilities. Analyzed efficiency of regulated entities using various econometric and non-parametric methods including panel data, frontier methods, and system estimators. Prepared studies and reports for performance-based regulation of transmission and distribution energy businesses, undertook total and operation cost benchmarking, prepared reports for rate settlements, and marketed flexibility in rate designs. Undertook studies on service quality conditions and requirements in regulation.

Rice University Economics Department – Houston, TX (1999-2002)

Research Assistant to Professor Robin Sickles (Summer 1999-Summer 2002)

Performed a time-series analysis of aircraft demand by major world airlines. Worked on a stochastic distance frontier model used to assess the productive performance of a group of European airlines. Developed a detailed panel with input and output data for the private manufacturing sector of Egypt. Used parametric and non-parametric methods to examine total factor productivity improvements of this sector from 1987 to 1996, particularly in light of reforms undertaken in 1991.

Instructor, Principles of Macroeconomics (Spring 2000-Spring 2001)

Prepared lectures and taught the students enrolled in the class. Researched and presented articles related to concepts covered by the course material. Evaluated students' performance.

LULLIT GETACHEW, Ph.D.

EDUCATION

Rice University - Houston, TX
Ph.D., Economics, 2002

The Fletcher School, Tufts University - Medford, MA
Master of Arts in Law and Diplomacy (MALD)

Mount Holyoke College - South Hadley, MA
Bachelor of Arts Degree

PUBLICATIONS

"Formulating Appropriate Electric Reliability Targets and Performance Evaluations," 2012, with S.A. Fenrick, *The Electricity Journal*, 25 (2): 44-53.

"Cost and reliability comparisons of underground and overhead power lines," 2012, with S.A. Fenrick, *Utilities Policy*, 20: 31-37.

"Estimation of the effects of price and billing frequency on household water demand using a panel of Wisconsin municipalities," 2012, with S.A. Fenrick, *Applied Economics Letters*, 19: 1373–1380.

"Econometric TFP Targets, Incentive Regulation and the Ontario Gas Distribution Industry," 2009, with Mark N. Lowry, *Review of Network Economics*, 8 (4): 325-345.

"Alternative Regulation, Benchmarking, and Efficient Diversification," 2009, with Mark N. Lowry, *Dialogue: United States Association for Energy Economics*, 17 (2): 27-31.

"The Market Structure of the Power Transmission and Distribution Industry in the Developed World", 2009, in Hunt, Lester C. and Joanne Evans (eds.). International Handbook on the Economics of Energy. Cheltenham, UK: Edward Elgar Publishing.

"The Economics and Regulation of Power Transmission and Distribution: The Developed World Case," 2009, with Mark N. Lowry, in Hunt, Lester C. and Joanne Evans (eds.). International Handbook on the Economics of Energy. Cheltenham, UK: Edward Elgar Publishing.

"Statistical Benchmarking in Utility Regulation: Role, Standards and Methods," 2009, with Mark N. Lowry, *Energy Policy* 37: 1323-1330.

"Price Control Regulation in North America: Role of Indexing and Benchmarking," 2009, with Mark N. Lowry, *The Electricity Journal*, 22: 63-76.

"AltReg Rate Designs Address Declining Average Gas Use," 2008, with Mark N. Lowry, David Hovde and Steve Fenrick. *Natural Gas & Electricity* 24 (9): 13-18.

"The Policy Environment and Relative Price Efficiency of Egyptian Private Sector Manufacturing," 2007, with R.C. Sickles, *The Journal of Applied Econometrics*, 22 (4): 703-854.

"Regulation of Gas Distributors with Declining Use Per Customer", 2006, with M.N. Lowry and S. Fenrick, *Dialogue: United States Association for Energy Economics*, 14 (2): 17-21.

"Econometric Benchmarking of Cost Performance: The Case of U.S. Power Distributors," 2005, with M.N. Lowry and D. Hovde, *The Energy Journal*, 26 (3): 75-92.

"Specification of Distance Functions Using Semi- and Non-parametric Methods with An Application to the Dynamic Performance of Eastern and Western European Air Carriers," 2002, with R. Sickles and D. Good, *Journal of Productivity Analysis*, 17 (1-2): 133-155.

"A Model of World Aircraft Demand," 1998, with D. Good, A.K. Postert and R. Sickles, in Michael T McNerney (ed.) Airport Facilities: Innovations for the Next Century American Society of Civil Engineers: Reston, VA. 40-59.

ERIK S. SONJU, P.E.
VICE PRESIDENT – POWER DELIVERY PLANNING AND DESIGN

SUMMARY OF EXPERIENCE AND EXPERTISE

- Experienced Professional Engineer in areas of electric transmission and distribution system operations, capital asset planning, design, and reliablity assessment.
- Other areas of expertise include system protection and coordination, power quality investigations, system loss analysis, distributed generation interconnections.
- Instructor for professional development courses in power delivery planning, system protection, and line design.
- Licensed Professional Engineer in 16 states.

PROFESSIONAL EXPERIENCE

Power System Engineering, Inc. –Madison, WI (2006-present)

Vice President – Power Delivery Planning and Design (2010 - Present)

Responsible for PSE's efforts in electric transmission and distribution capital asset planning, substation design, transmission line design and distribution line design. Other responsibilities included overseeing system protection and coordination studies, system operations and maintenance support, distributed generation interconnection studies, and specialty studies.

Leader of System Planning and Line Design (2008 – 2010)

Senior engineer and leader of system planning and line design. Emphasis included short range and long range system planning studies, distributed generation system impact studies, system protection studies, and expert testimony in regulatory proceedings associated with engineering analysis used for State Commission and FERC filed tariffs. Other responsibilities included distribution and transmission line design.

Leader of System Planning (2006 – 2008)

Senior engineer and leader of distribution system planning projects.

Great Lakes Energy –Boyne City, MI (2001-2006)

System Engineer and Manager of Engineering

System engineer and engineering department manager for a newly formed 120,000 customer electric distribution cooperative following the merger of three cooperatives in Michigan.

- Activities included the establishment of an engineering department responsible for system planning, system protection, daily engineering support to operations, mapping, line design, metering, and distribution system technology applications.
- Other activities included representation for the Michigan Electric Cooperative Association in the development of distributed generation interconnection standards for the State of Michigan, Public Service Commission presentations on behalf of the cooperative regarding reliability initiatives, and interconnection agreements with large industrial customers.

Heartland Engineering Services – Rockford, MN (1999-2001)

System Engineer

Co-founder of an engineering consulting firm for utilities owning transmission and distribution facilities.

- Responsible for a wide range of power system engineering projects and client relation functions.
- Emphasis in long range and short range system plans, system protection and coordination, power quality investigations, programming of electric system controls, line design, power factor correction studies, substation construction coordination, post construction inspections, cost of service studies, and capital credit allocation studies for electric cooperatives.

United Services Group – Elk River, MN (1997-1999)

Planning Engineer

Consulting engineer within a department of United Power Association (currently Great River Energy) for its distribution cooperative members and non-member utilities.

- Performed short and long-range distribution planning studies, reliability studies, system protection plans, and distribution design projects.
- Other responsibilities included transmission line design, power quality investigations, field inspections, and motor starting analysis.

EDUCATION

North Dakota State University, Fargo, ND
Bachelor of Science in Electrical Engineering with Emphasis in Power Systems, 1997

University of Nebraska, Lincoln, NE
NRECA Management Internship Program, 2006

Numerous technical and business continuing education courses focusing on issues and topics within the power industry.

TRAINING SEMINARS AND CONFERENCE PRESENTATIONS

- Head instructor for Distribution Line Design Training Courses to Electric Cooperatives, Municipals and Investor Owned Utilities.
- Instructor for NRECA's Introduction to Distribution Engineering Course for topics on:
  - Distribution System Planning
  - Distribution System Protection and Sectionalizing
- Industry conference presentations on:
  - Mechanical Loading of Overhead Electrical Equipment on Wood Poles
  - Distributed Generation Interconnection
  - Application of Series Capacitors on Distribution Systems
  - Impact of Electric Motors, Drives, and Phase Converters on Distribution Systems
  - Substation Protection Considerations

STATES LICENSED AS PROFESIONAL ENGINEER

Arkansas	Indiana	Minnesota	New Mexico
Colorado	Iowa	Montana	South Dakota
Florida	Kansas	Nebraska	Wisconsin
Illinois	Michigan	New Hampshire	Wyoming

EXPERT WITNESS AND TESTIMONY

Utility / Entity	Jurisdiction Body	Case No.	Description	Year
Crow Wing Power	State of Minnesota District Court - Cass County	Court File No: 11-CV-12-1670	Testimony on behalf of CWP in the matter of a stray voltage law suit. Specific evidence related to conditions of underground distribution cable running adjacent to a dairy farm.	2013-14
MidAmerican Energy Company	State of Iowa District Court - Polk County	Law No. CL 114962	Industry expert on behalf of defendant providing engineering analysis showing the probable cause of failure of a 161kV transmission structure while under construction. Included affidavit of the analysis results and deposition by plaintiff attorney.	2013
Toronto Hydro-Electric System Limited (THESL)	Ontario Energy Board	EB-2012-0064	Written and oral testimony regarding the replacement of aging electric infrastructure in the matter of THESL's application for 2012, 2013, and 2014 IRM Rate Adjustments and ICM Rate Adders	2012
Governor Dannel P. Malloy's Two Storm Panel	State of Connecticut	N/A	Expert witness presentation to Governor Malloy's Two Storm Panel regarding distribution system reliability in the aftermath of Tropical Storm Irene and 2011 Halloween nor'easter snow storm.	2011

STEVE HALL
SENIOR DESIGNER

SUMMARY OF EXPERIENCE AND EXPERTISE

- Skilled in electric utility line design projects including line surveying and staking, GPS data collection, easements, and right-of-way acquisition.
- Experienced in use of Stakeout and PLS-POLE line design software.
- Provides construction support services including: completing inspections of electrical distribution and transmission projects, material and construction specifications, and project closeout activities.
- Develops material and labor contract bid packages.
- Develops project cost estimates including engineering, material, and construction.
- Researches property records, negotiates easements, and completes all necessary permits for line design and construction projects.
- Licensed Designer of Engineering Systems - Electrical

PROFESSIONAL EXPERIENCE

Power System Engineering, Inc. – Madison, WI (2011-2012, 2013-present)

Senior Designer

Leads the design of electric utility overhead and underground distribution projects. Uses various automated design and staking packages.

- Completes field survey, staking, project design, plans and specifications, construction contracts, and facility inspections.
- Assists with the management and expansion of PSE's distribution line practice throughout the Midwest.

Intren, Inc. – Union, IL (2012-2013)

Senior Designer

Led design of electrical overhead and underground distribution systems.

- Experienced in use of STORMS, MicroStation, and ARC-GIS software.
- Led the design group in developing standards for use on very large utility projects.

Forster Electrical Engineering, Inc. – Oregon, WI (1984-2011)

Senior Line Designer

Lead design of electrical distribution and transmission systems, surveying, and distribution line staking. Designed electrical and lighting systems for industrial and commercial customers.

- Completed field surveys, staking, project design, plans and specifications, construction contracts, and facility inspections.
- Instructor for distribution line design and staking courses.

Waters and Associates – Madison, WI (1981-1982)

Design Technician

Assisted with design of industrial, commercial, electrical distribution, and transmission systems, surveying, and distribution line staking.

Mead and Hunt, Inc. – Madison, WI (1977-1980)

Design Technician

Assisted with design of industrial, commercial, electrical distribution, and transmission systems, surveying, and distribution line staking

EDUCATION

Wisconsin School of Electronics, Madison, WI
Electronic Specialist

Madison Area Technical College, Madison, WI
Courses in mathematics, computer science, and economics

University of Wisconsin, Platteville, WI
Courses in business management

Continuing Education Courses:

- Electrical Systems Design, University of Wisconsin, Madison
- The Construction Process and Staking
- Selection, Inspection, and Repair of Wood Utility Poles, University of Wisconsin, Madison
- Designing Electrical Overhead Distribution Lines, University of Wisconsin, Madison
- Design of Transmission Line Structures and Foundations, University of Wisconsin, Madison
- Joint Use Construction Conference, Wisconsin Utility Association
- The Engineer in Transition to Management, University of Wisconsin, Madison
- Introduction to Right-of-Way for Utility Engineers, University of Wisconsin, Madison
- Supervisory Leadership Skills, University of Wisconsin, Madison

PROFESSIONAL MEMBERSHIPS

Institute of Electrical and Electronic Engineers
Illuminating Engineering Society of North America

AMANDA K. JUTRZONKA
ADMINISTRATIVE ASSISTANT

SUMMARY OF EXPERIENCE AND EXPERTISE

- Coordinates bid documents related to bid procurement for construction contracts.
- Reviews and edits outgoing PSE material for correct grammar, content, and formatting.

PROFESSIONAL EXPERIENCE

Power System Engineering, Inc. – Madison WI (2013-present)

Administrative Assistant

Assists with management, analysis, documentation, and coordination of various projects in the planning, line design, and substation departments. Provides administrative support to project managers resulting in projects completed on time and within budget.

Farley's House of Pianos – Madison, WI (2009-2013)

Sales Associate and Office Assistant

Sold pianos and assisted customers in person and by telephone and email. Scheduled appointments and recorded detailed phone messages. Created and organized documents for all current and sold inventory.

InvivoSciences, LLC – Madison, WI (2009)

Technical Communications Intern/Specialist

Edited grants and abstracts. Created marketing materials and instruction manuals for products. Maintained company website by uploading and editing web content. Planned for company employees to attend and successfully market products at conferences.

Department of Commerce – Madison, WI (2008-2009)

Communications Intern

Wrote press releases, media advisories, speeches, and articles. Contacted media to communicate details about upcoming area events to encourage attendance. Researched various topics for panel discussions and articles. Maintained spreadsheet of all projects and events.

Wisconsin State Fair Park – Madison, WI (2005-2008)

Seasonal Office Employee – Entry Office (Agriculture Department)

Managed all aspects of cattle shows. Assisted exhibitors before and during the Fair.

EDUCATION

University of Wisconsin, Madison, WI
Bachelor of Science Degree, 2009
Majors: Life Sciences Communications and Piano Performance

Project Start	Project #	Project Name	Dept Name	Project Type
22/01/2014	CO0521406	MPEI 2014 LRP & Sectionalizing Study	Resource & Pwr Delivery Planning & Design	Power System Studies
15/12/2014	CO0521411	MPEI Arc Flash Assessment	Resource & Pwr Delivery Planning & Design	Power System Studies
02/12/2014	CO0581408	Delta-Montrose Drop 2 System Impact Study	Resource & Pwr Delivery Planning & Design	Power System Studies
11/12/2012	DC0021228	NRECA Tech Surveillance: Solid State Dist. Equipment	Resource & Pwr Delivery Planning & Design	Power System Studies
20/11/2013	DC0021317	NRECA CRN - Oil Load Article - Project: CRN R1102-001	Resource & Pwr Delivery Planning & Design	Power System Studies
15/09/2014	DC0021417	NRECA 2014 IDE Unit B	Resource & Pwr Delivery Planning & Design	Power System Studies
01/10/2013	IA0531319	Linn Co. North Liberty Ultimate Buildout Plan	Resource & Pwr Delivery Planning & Design	Power System Studies
01/12/2014	IA0561406	T.I.P. Sectionalizing & Arc Flash Study	Resource & Pwr Delivery Planning & Design	Power System Studies
07/02/2014	IA0951433	ECI Arc Flash Study	Resource & Pwr Delivery Planning & Design	Power System Studies
18/12/2012	IL0441228	UFLS Plan and SVT drawing update	Resource & Pwr Delivery Planning & Design	Power System Studies
13/02/2014	IL0441407	Jo-Carroll 2014 Sectionalizing Study	Resource & Pwr Delivery Planning & Design	Power System Studies
13/02/2014	IL0441408	Jo-Carroll Geneseo Area Sectionalizing Study	Resource & Pwr Delivery Planning & Design	Power System Studies
27/09/2013	IN1101307	NineStar IVVC & CVR Related Engineering Services	Resource & Pwr Delivery Planning & Design	Power System Studies
02/12/2014	IN1101406	Ninestar Community Solar	Resource & Pwr Delivery Planning & Design	Power System Studies
04/08/2014	ME0021402	MRRA Miscellaneous Engineering and Operations	Resource & Pwr Delivery Planning & Design	Power System Studies
07/01/2014	ME0021406	MRRA Electrical Transmission and Distribution Analysis	Resource & Pwr Delivery Planning & Design	Power System Studies
31/03/2014	MI0371406	Thumb 2014-2017 CWP	Resource & Pwr Delivery Planning & Design	Power System Studies
31/03/2014	MI0371407	Thumb 2014-2017 CWP Environmental Report	Resource & Pwr Delivery Planning & Design	Power System Studies
22/01/2013	MI0441306	Cherryland 2014-2018 Work Plan	Resource & Pwr Delivery Planning & Design	Power System Studies
21/08/2012	MN0391209	MVCLP 2014-2017 Construction Work Plan	Resource & Pwr Delivery Planning & Design	Power System Studies
21/01/2013	MN0561306	Crow Wing 2013 LRP & CWP	Resource & Pwr Delivery Planning & Design	Power System Studies
23/08/2013	MN0561308	Crow Wing 2014-2016 CWP ER	Resource & Pwr Delivery Planning & Design	Power System Studies
08/01/2014	MN0561406	Crow Wing Koch Pumping Station	Resource & Pwr Delivery Planning & Design	Power System Studies
09/09/2013	MN0611306	Freeborn 2013 Sectionalizing Study	Resource & Pwr Delivery Planning & Design	Power System Studies
17/09/2014	MN0611407	Freeborn 2014 Sectionalizing Study	Resource & Pwr Delivery Planning & Design	Power System Studies
21/01/2014	MN0621406	Wright-Hennepin 2013 Sectionalizing Study Review	Resource & Pwr Delivery Planning & Design	Power System Studies
25/08/2014	MN0951407	North Star 2015-2018 Work Plan	Resource & Pwr Delivery Planning & Design	Power System Studies
17/11/2014	MN0951408	North Star 2015-2018 WP Environmental Report	Resource & Pwr Delivery Planning & Design	Power System Studies
19/11/2014	MN0971406	Lake States Nashwauk Mapping and Arc Flash	Resource & Pwr Delivery Planning & Design	Power System Studies

Project Start	Project #	Project Name	Dept Name	Project Type
21/03/2014	MN1611406	COOP Danube New Grain Arc Flash	Resource & Pwr Delivery Planning & Design	Power System Studies
16/04/2014	MN1611407	COOP Renville New Grain Arc Flash	Resource & Pwr Delivery Planning & Design	Power System Studies
28/10/2014	MN1831411	LHB Line 93 Power Studies	Resource & Pwr Delivery Planning & Design	Power System Studies
17/09/2013	MN1861306	RPU LRP & CWP	Resource & Pwr Delivery Planning & Design	Power System Studies
09/12/2014	MN1861406	RPU Arc Flash Study - Fdrs 303 &405	Resource & Pwr Delivery Planning & Design	Power System Studies
24/01/2014	MN1871406	Grove City Emergency Feed	Resource & Pwr Delivery Planning & Design	Power System Studies
29/09/2014	NH0041406	NHEC Sectionalizing Review	Resource & Pwr Delivery Planning & Design	Power System Studies
29/04/2013	NY0041306	Stueben REC SPCC	Resource & Pwr Delivery Planning & Design	Power System Studies
08/03/2013	NY0191306	Otsego SPCC	Resource & Pwr Delivery Planning & Design	Power System Studies
27/08/2013	OH0041306	Carroll SPCC Plan	Resource & Pwr Delivery Planning & Design	Power System Studies
24/06/2014	OH0061406	Buckeye System-Wide Voltage Study	Resource & Pwr Delivery Planning & Design	Power System Studies
20/02/2014	OH0391406	PPEC 2015 Distribution Plant Study (CWP)	Resource & Pwr Delivery Planning & Design	Power System Studies
06/11/2014	OH0421407	Darke Arc Flash Study	Resource & Pwr Delivery Planning & Design	Power System Studies
06/11/2014	OH0421408	Darke SPCC Update	Resource & Pwr Delivery Planning & Design	Power System Studies
06/08/2013	OH0501307	Union (OH) 2013 CWP	Resource & Pwr Delivery Planning & Design	Power System Studies
06/12/2013	OH0501308	Union East Liberty Sectionalizing	Resource & Pwr Delivery Planning & Design	Power System Studies
06/12/2013	OH0501309	Union East Logan Sectionalizing	Resource & Pwr Delivery Planning & Design	Power System Studies
16/12/2014	OH0501410	Union Honda Building Construction Analysis	Resource & Pwr Delivery Planning & Design	Power System Studies
21/10/2014	OH0591409	Consolidated Arc Flash Assessment	Resource & Pwr Delivery Planning & Design	Power System Studies
04/08/2014	OH0651411	South Central Belmont Area Sectionalizing Study	Resource & Pwr Delivery Planning & Design	Power System Studies
05/11/2014	OH0651417	South Central 69kV Loop Long Range Plan	Resource & Pwr Delivery Planning & Design	Power System Studies
21/10/2014	OH0651420	South Central Arc Flash Assessments	Resource & Pwr Delivery Planning & Design	Power System Studies
05/05/2014	OH0711406	Logan 2014 Contingency Study	Resource & Pwr Delivery Planning & Design	Power System Studies
31/03/2014	OH0851406	Mid-Ohio 2015-2018 CWP	Resource & Pwr Delivery Planning & Design	Power System Studies
27/05/2014	OH0931407	WEC 4-Year Construction Work Plan	Resource & Pwr Delivery Planning & Design	Power System Studies
05/08/2013	OH0971306	Holmes-Wayne 2013 LRP/CWP	Resource & Pwr Delivery Planning & Design	Power System Studies
09/12/2014	PA0291406	Bedford Long Range Plan	Resource & Pwr Delivery Planning & Design	Power System Studies
29/04/2013	SD0091306	City of Colman Electrical System Model Development	Resource & Pwr Delivery Planning & Design	Power System Studies
06/06/2013	SD0091307	City of Colman Existing Electrical System Review	Resource & Pwr Delivery Planning & Design	Power System Studies

Project Start	Project #	Project Name	Dept Name	Project Type
23/12/2013	SD0091308	City of Colman 10 Year System Plan	Resource & Pwr Delivery Planning & Design	Power System Studies
03/08/2012	SD0381217	Moreau-Grand 2013-2016 CWP	Resource & Pwr Delivery Planning & Design	Power System Studies
05/09/2014	VT0461406	VEC 2014 SPCC Updates	Resource & Pwr Delivery Planning & Design	Power System Studies
13/10/2014	WI0011408	Kaukauna Electrical System Study	Resource & Pwr Delivery Planning & Design	Power System Studies
14/10/2013	WI0141307	Oconto 2015-2018 Work Plan	Resource & Pwr Delivery Planning & Design	Power System Studies
03/03/2014	WI0191406	CVEC 2014 Sectionalizing Study	Resource & Pwr Delivery Planning & Design	Power System Studies
21/11/2014	WI0291407	Clark 2014/2015 System Survey	Resource & Pwr Delivery Planning & Design	Power System Studies
07/02/2014	WI0431406	Scenic Rivers 2015-2018 Work Plan	Resource & Pwr Delivery Planning & Design	Power System Studies
21/07/2014	WI0431407	Scenic Rivers 2014 Sectionalizing Study	Resource & Pwr Delivery Planning & Design	Power System Studies
05/12/2014	WI0431408	Scenic Rivers Environmental Report for 2015-2018 Work Plan	Resource & Pwr Delivery Planning & Design	Power System Studies
19/09/2013	WI0471306	Jackson 2015-2018 CWP	Resource & Pwr Delivery Planning & Design	Power System Studies
09/12/2014	WI0491407	Dunn 2014/2015 Sectionalizing - Ethanol, Colfax, Elk Mound	Resource & Pwr Delivery Planning & Design	Power System Studies
07/05/2013	WI0551307	ACEC 10 Year LRP / 4 Year CWP	Resource & Pwr Delivery Planning & Design	Power System Studies
28/03/2012	WI0631207	Bayfield 2013-2016 CWP/LRP	Resource & Pwr Delivery Planning & Design	Power System Studies
02/12/2013	WI0661306	Central 2013 Sectionalizing Study	Resource & Pwr Delivery Planning & Design	Power System Studies
03/02/2014	WI0661406	Central Wisconsin Arc Flash Study	Resource & Pwr Delivery Planning & Design	Power System Studies
15/09/2014	WI1021406	MG&E Arc Flash Study	Resource & Pwr Delivery Planning & Design	Power System Studies
10/07/2013	CO0521306	MPEI Devils Thumb System Impact Study	Resource & Pwr Delivery Planning & Design	Power System Studies
19/03/2012	DC0021209	NRECA 2012 TechSurveillance Articles	Resource & Pwr Delivery Planning & Design	Power System Studies
23/04/2012	DC0021211	NRECA GridLab-D CVR Project	Resource & Pwr Delivery Planning & Design	Power System Studies
21/05/2013	DC0021311	NRECA 2013 IDE Unit B	Resource & Pwr Delivery Planning & Design	Power System Studies
27/04/2012	IA0401202	Pella Misc Planning, Engineering & Operations	Resource & Pwr Delivery Planning & Design	Power System Studies
27/04/2012	IA0401302	Pella Misc Planning, Engineering & Operations	Resource & Pwr Delivery Planning & Design	Power System Studies
27/04/2012	IA0401402	Pella Misc Planning, Engineering & Operations	Resource & Pwr Delivery Planning & Design	Power System Studies
02/04/2012	IA0531209	Linn 2013-15 Construction Work Plan	Resource & Pwr Delivery Planning & Design	Power System Studies
05/03/2012	IA0921206	ILEC GIS and Windmil Support for CWP	Resource & Pwr Delivery Planning & Design	Power System Studies
14/05/2012	IA0951230	ECI Karr Substation 69kV Conversion	Resource & Pwr Delivery Planning & Design	Power System Studies
14/05/2012	IA0951231	ECI Harrison Substation 69kV Conversion	Resource & Pwr Delivery Planning & Design	Power System Studies
14/05/2012	IA0951232	ECI Spring Creek Substation 69kV Conversion	Resource & Pwr Delivery Planning & Design	Power System Studies

Project Start	Project #	Project Name	Dept Name	Project Type
04/06/2012	IA0951236	ECI 2013-16 Construction Work Plan	Resource & Pwr Delivery Planning & Design	Power System Studies
31/07/2012	IA0951238	ECI Windmil Model Enhancements	Resource & Pwr Delivery Planning & Design	Power System Studies
14/02/2013	IA0951304	ECIREC Sectionalizing Study	Resource & Pwr Delivery Planning & Design	Power System Studies
14/02/2013	IA0951305	ECIREC 2013 CWP Environmental Report	Resource & Pwr Delivery Planning & Design	Power System Studies
14/02/2013	IA0951404	ECIREC Sectionalizing Study	Resource & Pwr Delivery Planning & Design	Power System Studies
14/02/2013	IA0951405	ECIREC 2013 CWP Environmental Report	Resource & Pwr Delivery Planning & Design	Power System Studies
01/06/2012	IA0971202	Guthrie Misc. Engineering	Resource & Pwr Delivery Planning & Design	Power System Studies
01/06/2012	IA0971302	Guthrie Misc. Engineering	Resource & Pwr Delivery Planning & Design	Power System Studies
03/04/2012	IA1021206	Southwest LRP, CWP and ER	Resource & Pwr Delivery Planning & Design	Power System Studies
10/05/2012	IL0441214	JCE WO 12-0274 AGF-2 to CHD Sub Tie	Resource & Pwr Delivery Planning & Design	Power System Studies
10/05/2012	IL0441215	JCE WO 12-0297 MTC-3 to SVC-1 Load Swap	Resource & Pwr Delivery Planning & Design	Power System Studies
10/05/2012	IL0441216	JCE WO 12-0298 CLA-1 to MTC-2 Load Swap	Resource & Pwr Delivery Planning & Design	Power System Studies
10/05/2012	IL0441217	JCE WO 12-0299 CHN-1 to PAL-3 Load Swap	Resource & Pwr Delivery Planning & Design	Power System Studies
14/05/2012	IL0441218	JCE WO 11-0741 Bowen Substation Rebuild	Resource & Pwr Delivery Planning & Design	Power System Studies
12/06/2012	IL0441220	JCE WO 12-0304 Galena WWTP Solar Project	Resource & Pwr Delivery Planning & Design	Power System Studies
19/12/2012	IL0441229	JoCarroll Farmers Mutual: Planning & Operations	Resource & Pwr Delivery Planning & Design	Power System Studies
15/01/2013	IL0441306	Jo-Carroll Metform Sub, Preparing MFA-1 for new load	Resource & Pwr Delivery Planning & Design	Power System Studies
20/05/2013	IN1101302	NineStar Misc. Engineering and Operations	Resource & Pwr Delivery Planning & Design	Power System Studies
03/01/2013	ME0011307	Eastern Maine 4-Year Construction Work Plan	Resource & Pwr Delivery Planning & Design	Power System Studies
22/01/2013	MI0441406	Cherryland 2014-2018 Work Plan	Resource & Pwr Delivery Planning & Design	Power System Studies
02/05/2012	MI0481207	GLE Beaver Island Generating Plant SPCC	Resource & Pwr Delivery Planning & Design	Power System Studies
18/10/2012	MN0291206	Tyler State of the Substation Report	Resource & Pwr Delivery Planning & Design	Power System Studies
08/02/2012	MN0331202	Anoka Misc Eng, Planning & Ops	Resource & Pwr Delivery Planning & Design	Power System Studies
13/02/2012	MN0331206	Anoka Pole Replacements Project	Resource & Pwr Delivery Planning & Design	Power System Studies
10/08/2012	MN0331207	Anoka Sectionalizing Study	Resource & Pwr Delivery Planning & Design	Power System Studies
08/02/2012	MN0331302	Anoka Misc Eng, Planning & Ops	Resource & Pwr Delivery Planning & Design	Power System Studies
16/01/2012	MN0391206	MVCLP Trans System Protection Study	Resource & Pwr Delivery Planning & Design	Power System Studies
19/09/2012	MN0611207	Freeborn 2012 Sectionalizing	Resource & Pwr Delivery Planning & Design	Power System Studies
15/01/2013	MN0721307	Renville 2013 Sectionalizing Update	Resource & Pwr Delivery Planning & Design	Power System Studies

Project Start	Project #	Project Name	Dept Name	Project Type
24/05/2012	MN1041206	Arrowhead 2012 Work Plan	Resource & Pwr Delivery Planning & Design	Power System Studies
05/06/2012	MN1041207	Arrowhead Sectionalizing Study	Resource & Pwr Delivery Planning & Design	Power System Studies
11/10/2012	NY0191206	Otsego EC 4-Year CWP	Resource & Pwr Delivery Planning & Design	Power System Studies
03/12/2012	NY0201202	DCEC Misc Engineering	Resource & Pwr Delivery Planning & Design	Power System Studies
03/12/2012	NY0201302	DCEC Misc Engineering	Resource & Pwr Delivery Planning & Design	Power System Studies
17/07/2012	OH0061302	Buckeye Misc Engineering & Ops	Resource & Pwr Delivery Planning & Design	Power System Studies
30/07/2012	OH0421202	Darke Misc Engineering & Operations	Resource & Pwr Delivery Planning & Design	Power System Studies
18/07/2012	OH0421206	Darke New Substation Environmental Report	Resource & Pwr Delivery Planning & Design	Power System Studies
30/07/2012	OH0421302	Darke Misc Engineering & Operations	Resource & Pwr Delivery Planning & Design	Power System Studies
28/06/2013	OH0591306	Consolidated 4-Year Construction Work Plan	Resource & Pwr Delivery Planning & Design	Power System Studies
19/03/2012	OH0711202	Logan Misc Engineering and Planning	Resource & Pwr Delivery Planning & Design	Power System Studies
19/03/2012	OH0711302	Logan Misc Engineering and Planning	Resource & Pwr Delivery Planning & Design	Power System Studies
17/01/2012	OH0851206	Mid Ohio SPCC	Resource & Pwr Delivery Planning & Design	Power System Studies
17/12/2012	OH0861202	GMEC Miscellaneous Engineering	Resource & Pwr Delivery Planning & Design	Power System Studies
17/12/2012	OH0861302	GMEC Miscellaneous Engineering	Resource & Pwr Delivery Planning & Design	Power System Studies
05/07/2012	OH0871207	HWEC 2012 SPCC Plan	Resource & Pwr Delivery Planning & Design	Power System Studies
11/12/2012	OH0931202	WEC Misc. Engineering	Resource & Pwr Delivery Planning & Design	Power System Studies
04/11/2013	OH0931303	WEC Misc. Engineering and Operations	Resource & Pwr Delivery Planning & Design	Power System Studies
25/07/2013	OH0931306	WEC 4-Year Construction Work Plan	Resource & Pwr Delivery Planning & Design	Power System Studies
06/08/2012	PA0291202	Bedford Misc. Engineering & Operations	Resource & Pwr Delivery Planning & Design	Power System Studies
06/08/2012	PA0291302	Bedford Misc. Engineering & Operations	Resource & Pwr Delivery Planning & Design	Power System Studies
06/04/2012	SD0381214	Moreau Sioux Ckts 3 & 5 Sectionalizing	Resource & Pwr Delivery Planning & Design	Power System Studies
19/12/2012	SD0381220	Moreau 2013-2016 CWP-ER	Resource & Pwr Delivery Planning & Design	Power System Studies
21/08/2012	VT0461206	Vermont Distribution System Loss Study	Resource & Pwr Delivery Planning & Design	Power System Studies
16/09/2013	VT0461306	Vermont Derby #45 Sub SPCC	Resource & Pwr Delivery Planning & Design	Power System Studies
17/02/2012	WI0191207	CVEC 2012 Sectionalizing Study	Resource & Pwr Delivery Planning & Design	Power System Studies
25/02/2013	WI0191306	CVEC 2013 Sectionalizing	Resource & Pwr Delivery Planning & Design	Power System Studies
24/05/2012	WI0321209	Pierce Pepin Trenton Area Sand Mine Analysis	Resource & Pwr Delivery Planning & Design	Power System Studies
22/08/2012	WI0431206	Scenic 2012 Sectionalizing	Resource & Pwr Delivery Planning & Design	Power System Studies

Project Start	Project #	Project Name	Dept Name	Project Type
11/01/2012	WI0491206	Dunn 12 Sect Study-Connorsville,Knapp&Ti	Resource & Pwr Delivery Planning & Design	Power System Studies
20/08/2013	WI0491306	Dunn 2013 Sectionalizing - Downsville, Tainter, Wheeler Substations	Resource & Pwr Delivery Planning & Design	Power System Studies
19/03/2012	WI0511206	St. Croix 2013-2015 CWP and LRP and Sectionalizing	Resource & Pwr Delivery Planning & Design	Power System Studies
28/03/2012	WI0631208	Bayfield Environmental Report	Resource & Pwr Delivery Planning & Design	Power System Studies
22/10/2013	CN0061309	Toronto Hydro Standards Review Study	Resource & Pwr Delivery Planning & Design	Line Design
12/05/2014	CO0521407	MPEI Town of Grand Lake 1/0 Guying Review	Resource & Pwr Delivery Planning & Design	Line Design
09/07/2014	CO0521408	MPEI Grand Lake Shallow Pole Set Analysis	Resource & Pwr Delivery Planning & Design	Line Design
22/10/2014	CO0521410	MPEI Granby Dam Long Span Line Design	Resource & Pwr Delivery Planning & Design	Line Design
30/11/2012	IA0341206	MVEC FEMA 404 #4.8.3 - Cascade 3-ph	Resource & Pwr Delivery Planning & Design	Line Design
30/11/2012	IA0341207	MVEC FEMA 404 # 13.1.3 BACKBONE 3-ph	Resource & Pwr Delivery Planning & Design	Line Design
30/11/2012	IA0341208	MVEC FEMA 404 # 14.4.1 St. Donatus 1-ph	Resource & Pwr Delivery Planning & Design	Line Design
30/11/2012	IA0341209	MVEC FEMA 404 # 17.3.3 Union 3-ph	Resource & Pwr Delivery Planning & Design	Line Design
30/11/2012	IA0341210	MVEC FEMA 404 # 22.8.3 Farley 3-ph	Resource & Pwr Delivery Planning & Design	Line Design
30/11/2012	IA0341211	MVEC FEMA 404 # 29.7.1 Edgewood 1-ph	Resource & Pwr Delivery Planning & Design	Line Design
30/11/2012	IA0341212	MVEC FEMA 404 # 29.7.3 Edgewood 3-ph	Resource & Pwr Delivery Planning & Design	Line Design
30/11/2012	IA0341213	MVEC FEMA 404 # 36.4.1 Mosalem 1-ph	Resource & Pwr Delivery Planning & Design	Line Design
21/12/2012	IA0341214	MVEC 2013 FEMA Contractor Out of Scope	Resource & Pwr Delivery Planning & Design	Line Design
15/01/2013	IA0341307	MVEC FEMA 404 #25.1.1.1 Stone City 1-ph	Resource & Pwr Delivery Planning & Design	Line Design
15/01/2013	IA0341308	MVEC FEMA 404 #38.1.1 Prairie 1-ph	Resource & Pwr Delivery Planning & Design	Line Design
15/01/2013	IA0341309	MVEC FEMA 404 #31.5.2 Lovell 2-ph	Resource & Pwr Delivery Planning & Design	Line Design
15/01/2013	IA0341310	MVEC FEMA 404 #2.1.3 Ryan 3-ph	Resource & Pwr Delivery Planning & Design	Line Design
15/01/2013	IA0341311	MVEC FEMA 404 #28.6.3 Monmouth 3-ph	Resource & Pwr Delivery Planning & Design	Line Design
15/01/2013	IA0341312	MVEC FEMA 404 #11.4.3 Hopkinton 3-ph	Resource & Pwr Delivery Planning & Design	Line Design
15/01/2013	IA0341313	MVEC FEMA 404 #25.1.1.2 Stone City 1-ph	Resource & Pwr Delivery Planning & Design	Line Design
15/01/2013	IA0341314	MVEC FEMA 404 #22.6.3 Farley 3-ph	Resource & Pwr Delivery Planning & Design	Line Design
19/08/2013	IA0341315	MVEC FEMA 404 Project Administration	Resource & Pwr Delivery Planning & Design	Line Design
19/08/2013	IA0341316	MVEC FEMA 404 #14.6.3 St Donatus 3-ph	Resource & Pwr Delivery Planning & Design	Line Design
19/08/2013	IA0341317	MVEC FEMA 404 #18.8.3 Bernard 3-ph	Resource & Pwr Delivery Planning & Design	Line Design
19/08/2013	IA0341318	MVEC FEMA 404 #3.5.1 Graf 1-ph	Resource & Pwr Delivery Planning & Design	Line Design

Project Start	Project #	Project Name	Dept Name	Project Type
19/08/2013	IA0341319	MVEC FEMA 404 #31.7.3 Lovell 3-ph	Resource & Pwr Delivery Planning & Design	Line Design
19/08/2013	IA0341320	MVEC FEMA 404 #21.1.1 Van Buren 1-ph	Resource & Pwr Delivery Planning & Design	Line Design
19/08/2013	IA0341321	MVEC FEMA 404 #18.3.3 Bernard 3-ph	Resource & Pwr Delivery Planning & Design	Line Design
19/08/2013	IA0341322	MVEC FEMA 404 #18.8.1 Bernard 1-ph	Resource & Pwr Delivery Planning & Design	Line Design
19/08/2013	IA0341323	MVEC FEMA 404 #2.6.1 Ryan 1-ph	Resource & Pwr Delivery Planning & Design	Line Design
19/08/2013	IA0341324	MVEC FEMA 404 #8.8.1 New Vienna 1-ph	Resource & Pwr Delivery Planning & Design	Line Design
19/08/2013	IA0341325	MVEC FEMA 404 #8.8.2 New Vienna 2-ph	Resource & Pwr Delivery Planning & Design	Line Design
19/08/2013	IA0341326	MVEC FEMA 404 #15.1.1 Petersburg 1-ph	Resource & Pwr Delivery Planning & Design	Line Design
19/08/2013	IA0341327	MVEC FEMA 404 #11.7.1 Hopkinton 1-ph	Resource & Pwr Delivery Planning & Design	Line Design
19/08/2013	IA0341328	MVEC FEMA 404 #1.4.1 Maquoketa 1-ph	Resource & Pwr Delivery Planning & Design	Line Design
01/11/2013	IA0341329	MVEC FEMA 404 Project Administration	Resource & Pwr Delivery Planning & Design	Line Design
01/11/2013	IA0341330	MVEC FEMA 404 #27.6.3 Paradise 3-ph	Resource & Pwr Delivery Planning & Design	Line Design
01/11/2013	IA0341331	MVEC FEMA 404 #1.4.3 Maquoketa 3-ph	Resource & Pwr Delivery Planning & Design	Line Design
01/11/2013	IA0341332	MVEC FEMA 404 #9.5.3 Spragueville 3-ph	Resource & Pwr Delivery Planning & Design	Line Design
19/03/2012	IA0531208	Linn 2012 OH Work Plan Construction Contract	Resource & Pwr Delivery Planning & Design	Line Design
04/04/2012	IA0531210	Linn Line Design Hwy 30-Cedar River Crossing	Resource & Pwr Delivery Planning & Design	Line Design
04/06/2012	IA0531212	Linn Cty Home Rd 3-ph to Dbl Ckt Conversion	Resource & Pwr Delivery Planning & Design	Line Design
17/08/2012	IA0531214	Linn Palo-Cedar River Crossing	Resource & Pwr Delivery Planning & Design	Line Design
14/01/2013	IA0531304	Linn Co. Misc. Line Design Projects	Resource & Pwr Delivery Planning & Design	Line Design
18/02/2013	IA0531308	Linn Co. Traver Sub ITC UB	Resource & Pwr Delivery Planning & Design	Line Design
18/02/2013	IA0531309	Linn Co. Ely East CKT ITC UB	Resource & Pwr Delivery Planning & Design	Line Design
14/01/2013	IA0531404	Linn Co. Misc. Line Design Projects	Resource & Pwr Delivery Planning & Design	Line Design
19/03/2012	IA0951220	ECI FEMA 404 WO# m2436	Resource & Pwr Delivery Planning & Design	Line Design
19/03/2012	IA0951221	ECI FEMA 404 WO# m2271	Resource & Pwr Delivery Planning & Design	Line Design
19/03/2012	IA0951222	ECI FEMA 404 WO# m2313	Resource & Pwr Delivery Planning & Design	Line Design
19/03/2012	IA0951223	ECI FEMA 404 WO# m2351	Resource & Pwr Delivery Planning & Design	Line Design
19/03/2012	IA0951224	ECI FEMA 404 WO# m2331	Resource & Pwr Delivery Planning & Design	Line Design
19/03/2012	IA0951225	ECI FEMA 404 WO# m9431	Resource & Pwr Delivery Planning & Design	Line Design
19/03/2012	IA0951226	ECI FEMA 404 WO# m9233	Resource & Pwr Delivery Planning & Design	Line Design

Project Start	Project #	Project Name	Dept Name	Project Type
19/03/2012	IA0951227	ECI FEMA 404 WO# m9213	Resource & Pwr Delivery Planning & Design	Line Design
19/03/2012	IA0951228	ECI FEMA 404 WO# m9125	Resource & Pwr Delivery Planning & Design	Line Design
19/03/2012	IA0951229	ECI FEMA 404 WO# m9210-22	Resource & Pwr Delivery Planning & Design	Line Design
21/05/2012	IA0951233	ECI WO# 12735-Old Hwy 20 Rebuild 3-ph	Resource & Pwr Delivery Planning & Design	Line Design
21/05/2012	IA0951234	ECI WO# 12736-Old Hwy 20-Move 3-ph	Resource & Pwr Delivery Planning & Design	Line Design
21/05/2012	IA0951235	ECI WO# 12737-Old Hwy 20-Rebuild 1-ph	Resource & Pwr Delivery Planning & Design	Line Design
12/06/2012	IA0951237	ECI 1-ph Rebuild-Cono Sch - WO# 12780	Resource & Pwr Delivery Planning & Design	Line Design
10/08/2012	IA0951239	ECI FEMA 404 WO# m1415	Resource & Pwr Delivery Planning & Design	Line Design
10/08/2012	IA0951240	ECI FEMA 404 WO# m1370	Resource & Pwr Delivery Planning & Design	Line Design
10/08/2012	IA0951241	ECI FEMA 404 WO# m12136	Resource & Pwr Delivery Planning & Design	Line Design
10/08/2012	IA0951242	ECI FEMA 404 WO# m12128	Resource & Pwr Delivery Planning & Design	Line Design
10/08/2012	IA0951243	ECI FEMA 404 WO# m12117	Resource & Pwr Delivery Planning & Design	Line Design
10/08/2012	IA0951244	ECI FEMA 404 WO# m12116	Resource & Pwr Delivery Planning & Design	Line Design
10/08/2012	IA0951245	ECI FEMA 404 WO# m12424	Resource & Pwr Delivery Planning & Design	Line Design
10/08/2012	IA0951246	ECI FEMA 404 WO# m12130-28	Resource & Pwr Delivery Planning & Design	Line Design
10/08/2012	IA0951247	ECI FEMA 404 WO# m8228	Resource & Pwr Delivery Planning & Design	Line Design
10/08/2012	IA0951248	ECI FEMA 404 WO# m8242	Resource & Pwr Delivery Planning & Design	Line Design
10/08/2012	IA0951249	ECI FEMA 404 WO# m8232	Resource & Pwr Delivery Planning & Design	Line Design
10/08/2012	IA0951250	ECI FEMA 404 WO# m8170	Resource & Pwr Delivery Planning & Design	Line Design
10/08/2012	IA0951251	ECI FEMA 404 WO# m15120-23	Resource & Pwr Delivery Planning & Design	Line Design
10/08/2012	IA0951252	ECI FEMA 404 WO# m15324	Resource & Pwr Delivery Planning & Design	Line Design
10/08/2012	IA0951253	ECI FEMA 404 WO# m15423	Resource & Pwr Delivery Planning & Design	Line Design
10/08/2012	IA0951254	ECI FEMA 404 WO# m5413	Resource & Pwr Delivery Planning & Design	Line Design
10/08/2012	IA0951255	ECI FEMA 404 WO# m5231	Resource & Pwr Delivery Planning & Design	Line Design
10/08/2012	IA0951256	ECI FEMA 404 WO# m5425	Resource & Pwr Delivery Planning & Design	Line Design
10/08/2012	IA0951257	ECI FEMA 404 WO# m3410-35	Resource & Pwr Delivery Planning & Design	Line Design
10/08/2012	IA0951258	ECI FEMA 404 WO# m3119	Resource & Pwr Delivery Planning & Design	Line Design
10/08/2012	IA0951259	ECI FEMA 404 WO# m3136	Resource & Pwr Delivery Planning & Design	Line Design
10/08/2012	IA0951260	ECI FEMA 404 WO# m3416	Resource & Pwr Delivery Planning & Design	Line Design

Project Start	Project #	Project Name	Dept Name	Project Type
10/08/2012	IA0951261	ECI FEMA 404 WO# m3125	Resource & Pwr Delivery Planning & Design	Line Design
10/08/2012	IA0951262	ECI FEMA 404 WO# m3128	Resource & Pwr Delivery Planning & Design	Line Design
10/08/2012	IA0951263	ECI FEMA 404 WO# m14141	Resource & Pwr Delivery Planning & Design	Line Design
10/08/2012	IA0951264	ECI FEMA 404 WO# m14425	Resource & Pwr Delivery Planning & Design	Line Design
10/08/2012	IA0951265	ECI FEMA 404 WO# m11131	Resource & Pwr Delivery Planning & Design	Line Design
10/08/2012	IA0951266	ECI FEMA 404 WO# m11124	Resource & Pwr Delivery Planning & Design	Line Design
10/08/2012	IA0951267	ECI FEMA 404 WO# m11126	Resource & Pwr Delivery Planning & Design	Line Design
10/08/2012	IA0951268	ECI FEMA 404 WO# m11136	Resource & Pwr Delivery Planning & Design	Line Design
10/08/2012	IA0951269	ECI FEMA 404 WO# m59433	Resource & Pwr Delivery Planning & Design	Line Design
10/08/2012	IA0951270	ECI FEMA 404 WO# m59437	Resource & Pwr Delivery Planning & Design	Line Design
18/06/2013	IA0951307	ECI REC JF-202 New 3-Phase 4/0 URD	Resource & Pwr Delivery Planning & Design	Line Design
20/06/2013	IA0951308	ECI FEMA 404 WO# m7312	Resource & Pwr Delivery Planning & Design	Line Design
20/06/2013	IA0951309	ECI FEMA 404 WO# m7335	Resource & Pwr Delivery Planning & Design	Line Design
20/06/2013	IA0951310	ECI FEMA 404 WO# m7336	Resource & Pwr Delivery Planning & Design	Line Design
20/06/2013	IA0951311	ECI FEMA 404 WO# m55114	Resource & Pwr Delivery Planning & Design	Line Design
20/06/2013	IA0951312	ECI FEMA 404 WO# m55133	Resource & Pwr Delivery Planning & Design	Line Design
20/06/2013	IA0951313	ECI FEMA 404 WO# m55152	Resource & Pwr Delivery Planning & Design	Line Design
20/06/2013	IA0951314	ECI FEMA 404 WO# m55170	Resource & Pwr Delivery Planning & Design	Line Design
20/06/2013	IA0951315	ECI FEMA 404 WO# m55327	Resource & Pwr Delivery Planning & Design	Line Design
20/06/2013	IA0951316	ECI FEMA 404 WO# m55370-22	Resource & Pwr Delivery Planning & Design	Line Design
20/06/2013	IA0951317	ECI FEMA 404 WO# m55423	Resource & Pwr Delivery Planning & Design	Line Design
20/06/2013	IA0951318	ECI FEMA 404 WO# m55470	Resource & Pwr Delivery Planning & Design	Line Design
20/06/2013	IA0951319	ECI FEMA 404 WO# m58213	Resource & Pwr Delivery Planning & Design	Line Design
20/06/2013	IA0951320	ECI FEMA 404 WO# m58214	Resource & Pwr Delivery Planning & Design	Line Design
20/06/2013	IA0951321	ECI FEMA 404 WO# m58215	Resource & Pwr Delivery Planning & Design	Line Design
20/06/2013	IA0951322	ECI FEMA 404 WO# m58224	Resource & Pwr Delivery Planning & Design	Line Design
20/06/2013	IA0951323	ECI FEMA 404 WO# m58473	Resource & Pwr Delivery Planning & Design	Line Design
20/06/2013	IA0951324	ECI FEMA 404 WO# m61132	Resource & Pwr Delivery Planning & Design	Line Design
20/06/2013	IA0951325	ECI FEMA 404 WO# m61216	Resource & Pwr Delivery Planning & Design	Line Design

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20/06/2013	IA0951326	ECI FEMA 404 WO# m61217	Resource & Pwr Delivery Planning & Design	Line Design
20/06/2013	IA0951327	ECI FEMA 404 WO# m61225	Resource & Pwr Delivery Planning & Design	Line Design
20/06/2013	IA0951328	ECI FEMA 404 WO# m61236	Resource & Pwr Delivery Planning & Design	Line Design
20/06/2013	IA0951329	ECI FEMA 404 WO# m62222	Resource & Pwr Delivery Planning & Design	Line Design
20/06/2013	IA0951330	ECI FEMA 404 WO# m63413	Resource & Pwr Delivery Planning & Design	Line Design
20/06/2013	IA0951331	ECI FEMA 404 WO# m63475	Resource & Pwr Delivery Planning & Design	Line Design
02/01/2014	IA0951406	ECI FEMA 404 WO# m51135	Resource & Pwr Delivery Planning & Design	Line Design
02/01/2014	IA0951407	ECI FEMA 404 WO# m51123	Resource & Pwr Delivery Planning & Design	Line Design
02/01/2014	IA0951408	ECI FEMA 404 WO# m51126	Resource & Pwr Delivery Planning & Design	Line Design
02/01/2014	IA0951409	ECI FEMA 404 WO# m51216	Resource & Pwr Delivery Planning & Design	Line Design
02/01/2014	IA0951410	ECI FEMA 404 WO# m51218	Resource & Pwr Delivery Planning & Design	Line Design
02/01/2014	IA0951411	ECI FEMA 404 WO# m51325	Resource & Pwr Delivery Planning & Design	Line Design
02/01/2014	IA0951412	ECI FEMA 404 WO# m51333	Resource & Pwr Delivery Planning & Design	Line Design
02/01/2014	IA0951413	ECI FEMA 404 WO# m51121	Resource & Pwr Delivery Planning & Design	Line Design
02/01/2014	IA0951414	ECI FEMA 404 WO# m54313	Resource & Pwr Delivery Planning & Design	Line Design
02/01/2014	IA0951415	ECI FEMA 404 WO# m1752	Resource & Pwr Delivery Planning & Design	Line Design
02/01/2014	IA0951416	ECI FEMA 404 WO# m53123	Resource & Pwr Delivery Planning & Design	Line Design
02/01/2014	IA0951417	ECI FEMA 404 WO# m53124	Resource & Pwr Delivery Planning & Design	Line Design
02/01/2014	IA0951418	ECI FEMA 404 WO# m53425	Resource & Pwr Delivery Planning & Design	Line Design
02/01/2014	IA0951419	ECI FEMA 404 WO# m53436	Resource & Pwr Delivery Planning & Design	Line Design
02/01/2014	IA0951420	ECI FEMA 404 WO# m53438	Resource & Pwr Delivery Planning & Design	Line Design
02/01/2014	IA0951421	ECI FEMA 404 WO# m53270	Resource & Pwr Delivery Planning & Design	Line Design
02/01/2014	IA0951422	ECI FEMA 404 WO# m57322	Resource & Pwr Delivery Planning & Design	Line Design
02/01/2014	IA0951423	ECI FEMA 404 WO# m57412	Resource & Pwr Delivery Planning & Design	Line Design
02/01/2014	IA0951424	ECI FEMA 404 WO# m57436	Resource & Pwr Delivery Planning & Design	Line Design
02/01/2014	IA0951425	ECI FEMA 404 WO# m57374	Resource & Pwr Delivery Planning & Design	Line Design
02/01/2014	IA0951426	ECI FEMA 404 WO# m56342	Resource & Pwr Delivery Planning & Design	Line Design
02/01/2014	IA0951427	ECI FEMA 404 WO# m56332	Resource & Pwr Delivery Planning & Design	Line Design
02/01/2014	IA0951428	ECI FEMA 404 WO# m56315	Resource & Pwr Delivery Planning & Design	Line Design

Project Start	Project #	Project Name	Dept Name	Project Type
02/01/2014	IA0951429	ECI FEMA 404 WO# m56134	Resource & Pwr Delivery Planning & Design	Line Design
02/01/2014	IA0951430	ECI FEMA 404 WO# m60418	Resource & Pwr Delivery Planning & Design	Line Design
02/01/2014	IA0951431	ECI FEMA 404 WO# m60437	Resource & Pwr Delivery Planning & Design	Line Design
29/10/2012	IA0971206	Guthrie FEMA 406 10038 PW06 355 GFG26	Resource & Pwr Delivery Planning & Design	Line Design
22/09/2014	IL0041406	Batavia Fabyan/Western Transmission Line WO#14-120	Resource & Pwr Delivery Planning & Design	Line Design
22/09/2014	IL0041407	Batavia Colonial Village Distribution Rebuild WO#14-121	Resource & Pwr Delivery Planning & Design	Line Design
22/09/2014	IL0041408	Batavia Carlisle Distribution Rebuild WO#14-120	Resource & Pwr Delivery Planning & Design	Line Design
20/01/2012	IL0441207	Jo-Carroll Const Spec Development	Resource & Pwr Delivery Planning & Design	Line Design
20/03/2012	IL0441211	JCE WO 12-038 Danisco to Metform 34.5kV Rebuild	Resource & Pwr Delivery Planning & Design	Line Design
20/03/2012	IL0441212	JCE WO 12-044 SVA-2 34.5kV Rebuild w/SVC-2 Underbuild	Resource & Pwr Delivery Planning & Design	Line Design
20/03/2012	IL0441213	JCE CE WO 12-039 DPT-4 to Whitton 3ph. New Construction	Resource & Pwr Delivery Planning & Design	Line Design
21/08/2012	IL0441221	Jo-Carroll Derinda Rd North 3-Ph Line Design	Resource & Pwr Delivery Planning & Design	Line Design
21/08/2012	IL0441222	Jo-Carroll Derinda Rd South 3-Ph Line Design	Resource & Pwr Delivery Planning & Design	Line Design
21/08/2012	IL0441223	Jo-Carroll Derinda Rd 3-Ph Line Retirement	Resource & Pwr Delivery Planning & Design	Line Design
14/02/2013	IL0441307	Jo-Carroll OH Fiber Standards	Resource & Pwr Delivery Planning & Design	Line Design
18/03/2013	IL0441308	Jo-Carroll WO 13-0063 Fulrath MIll Road 3-Ph Line Design	Resource & Pwr Delivery Planning & Design	Line Design
18/03/2013	IL0441309	Jo-Carroll WO 13-0222 Badger Road 3-Ph Line Design	Resource & Pwr Delivery Planning & Design	Line Design
29/07/2013	IL0441313	Jo-Carroll York to Argo Fay Line Design Support	Resource & Pwr Delivery Planning & Design	Line Design
30/07/2013	IL0441314	Jo-Carroll Fiber Design and Contract	Resource & Pwr Delivery Planning & Design	Line Design
16/08/2013	IL0441315	Jo-Carroll York to Eaton Fiber Design	Resource & Pwr Delivery Planning & Design	Line Design
16/08/2013	IL0441316	Jo-Carroll Savanna to Bowen Fiber Design	Resource & Pwr Delivery Planning & Design	Line Design
18/08/2014	IL0441414	Jo-Carroll Depot Line Relocation Design Support	Resource & Pwr Delivery Planning & Design	Line Design
07/02/2014	ME0021407	MRRA Oxford Networks Service Upgrade	Resource & Pwr Delivery Planning & Design	Line Design
25/09/2014	MI0481409	Great Lakes Energy WO # 212 2015 CWP Staking	Resource & Pwr Delivery Planning & Design	Line Design
25/09/2014	MI0481410	Great Lakes Energy WO # 368-01 2015 CWP Staking	Resource & Pwr Delivery Planning & Design	Line Design
25/09/2014	MI0481411	Great Lakes Energy WO # 368-02 2015 CWP Staking	Resource & Pwr Delivery Planning & Design	Line Design
25/09/2014	MI0481412	Great Lakes Energy WO # 369 2015 CWP Staking	Resource & Pwr Delivery Planning & Design	Line Design
25/09/2014	MI0481413	Great Lakes Energy WO # 215 2015 CWP Staking	Resource & Pwr Delivery Planning & Design	Line Design
25/09/2014	MI0481414	Great Lakes Energy WO # 216 2015 CWP Staking	Resource & Pwr Delivery Planning & Design	Line Design

Project Start	Project #	Project Name	Dept Name	Project Type
25/09/2014	MI0481415	Great Lakes Energy WO # 375-01 2015 CWP Staking	Resource & Pwr Delivery Planning & Design	Line Design
25/09/2014	MI0481416	Great Lakes Energy WO # 375-02 2015 CWP Staking	Resource & Pwr Delivery Planning & Design	Line Design
25/09/2014	MI0481417	Great Lakes Energy WO # 375-03 2015 CWP Staking	Resource & Pwr Delivery Planning & Design	Line Design
25/09/2014	MI0481418	Great Lakes Energy WO # 376 2015 CWP Staking	Resource & Pwr Delivery Planning & Design	Line Design
25/09/2014	MI0481419	Great Lakes Energy WO # 370 2015 CWP Staking	Resource & Pwr Delivery Planning & Design	Line Design
25/09/2014	MI0481420	Great Lakes Energy WO # 222 2015 CWP Staking	Resource & Pwr Delivery Planning & Design	Line Design
25/09/2014	MI0481421	Great Lakes Energy WO # 380-10 2015 CWP Staking	Resource & Pwr Delivery Planning & Design	Line Design
25/09/2014	MI0481422	Great Lakes Energy WO # 380-02 2015 CWP Staking	Resource & Pwr Delivery Planning & Design	Line Design
25/09/2014	MI0481423	Great Lakes Energy WO # 382 2015 CWP Staking	Resource & Pwr Delivery Planning & Design	Line Design
21/05/2013	MI0541309	MJ GNC Primary Meter Pole Review	Resource & Pwr Delivery Planning & Design	Line Design
23/08/2012	MN0031206	Meeker FEMA Line Assessment Report	Resource & Pwr Delivery Planning & Design	Line Design
03/04/2014	MN0031406	Meeker Line Design for FEMA Replacement Projects	Resource & Pwr Delivery Planning & Design	Line Design
24/06/2013	MN0041306	Lake Connections and Northeast Service Cooperative Attachment (Hwy 61 Between Castle Danger and Split Rock)	Resource & Pwr Delivery Planning & Design	Line Design
25/07/2013	MN0041307	CL&P Post Inspection of Existing Lake Connections Attachments	Resource & Pwr Delivery Planning & Design	Line Design
04/11/2013	MN0041308	CL&P Lake County Phase 2B Pre-Attachment Assessment	Resource & Pwr Delivery Planning & Design	Line Design
04/11/2013	MN0041309	CL&P Lake County Phase 2B Post-Attachment Assessment	Resource & Pwr Delivery Planning & Design	Line Design
07/02/2013	MN0071307	Minnesota Power Pole Attachment Survey	Resource & Pwr Delivery Planning & Design	Line Design
14/02/2013	MN0071309	Minnesota Power 2013 Line Design & Staking Training	Resource & Pwr Delivery Planning & Design	Line Design
13/05/2013	MN0071310	Minnesota Power Tek Star Browerville Application	Resource & Pwr Delivery Planning & Design	Line Design
28/05/2013	MN0071311	Minnesota Power Lake Connections Phase 2A Application	Resource & Pwr Delivery Planning & Design	Line Design
18/06/2013	MN0071313	Minnesota Power CenturyLink Duluth Area Application	Resource & Pwr Delivery Planning & Design	Line Design
25/07/2013	MN0071314	Minnesota Power Lake Connections Phase 2C Application	Resource & Pwr Delivery Planning & Design	Line Design
15/10/2013	MN0071315	Minnesota Power Conductor Sag and Tension Table Development	Resource & Pwr Delivery Planning & Design	Line Design
13/11/2013	MN0071316	Minnesota Power Charter Superior 27 Application	Resource & Pwr Delivery Planning & Design	Line Design
17/03/2014	MN0071406	Minnesota Power Tekstar Browerville 18 Application	Resource & Pwr Delivery Planning & Design	Line Design
22/04/2014	MN0071407	Minnesota Power Lake Connections Hoyt Lakes 190	Resource & Pwr Delivery Planning & Design	Line Design
05/05/2014	MN0071408	Minnesota Power Lake Connections Aurora 230	Resource & Pwr Delivery Planning & Design	Line Design
05/05/2014	MN0071409	Minnesota Power Lake Connections Babbitt 287	Resource & Pwr Delivery Planning & Design	Line Design
20/05/2014	MN0071410	Minnesota Power Charter Superior 29	Resource & Pwr Delivery Planning & Design	Line Design

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10/06/2014	MN0071411	Minnesota Power MediaCom Hermantown - Arrowhead Rd	Resource & Pwr Delivery Planning & Design	Line Design
16/06/2014	MN0071412	Minnesota Power Lake Connections Silver Bay	Resource & Pwr Delivery Planning & Design	Line Design
16/07/2014	MN0071413	Minnesota Power Lake Connections Winton 27	Resource & Pwr Delivery Planning & Design	Line Design
19/08/2014	MN0071414	Minnesota Power NESC Biwabik 42	Resource & Pwr Delivery Planning & Design	Line Design
03/09/2014	MN0071415	Minnesota Power CI Little Falls	Resource & Pwr Delivery Planning & Design	Line Design
26/09/2014	MN0071416	Minnesota Power NESC Jay Cooke 11	Resource & Pwr Delivery Planning & Design	Line Design
31/10/2014	MN0071417	Minnesota Power Lake Connections French River A	Resource & Pwr Delivery Planning & Design	Line Design
31/10/2014	MN0071418	Minnesota Power Lake Connections French River B	Resource & Pwr Delivery Planning & Design	Line Design
31/10/2014	MN0071419	Minnesota Power NESC French River Hatchery	Resource & Pwr Delivery Planning & Design	Line Design
24/11/2014	MN0071420	Minnesota Power CI Hibbard	Resource & Pwr Delivery Planning & Design	Line Design
19/02/2013	MN0171306	MREA Line Design & Staking - Module I-3	Resource & Pwr Delivery Planning & Design	Line Design
29/01/2014	MN0171406	MREA 2014 Line Design & Staking Training	Resource & Pwr Delivery Planning & Design	Line Design
22/03/2013	MN0331306	Anoka Dist. UB Design - GRE 115kV line	Resource & Pwr Delivery Planning & Design	Line Design
16/09/2013	MN0331307	Anoka Underground Bid Documents	Resource & Pwr Delivery Planning & Design	Line Design
31/12/2012	MN0591210	2013 Peoples Annexation Line Valuation	Resource & Pwr Delivery Planning & Design	Line Design
13/11/2013	MN0591306	People's 2013 RPU Annexation	Resource & Pwr Delivery Planning & Design	Line Design
03/07/2012	MN0721206	Renville WP Projects CAS-338,339	Resource & Pwr Delivery Planning & Design	Line Design
14/01/2013	MN0721306	Renville Line Design - FEMA Projects	Resource & Pwr Delivery Planning & Design	Line Design
14/01/2013	MN0721406	Renville Line Design - FEMA Projects	Resource & Pwr Delivery Planning & Design	Line Design
04/03/2013	MN0951306	North Star 2013 Construction Contract	Resource & Pwr Delivery Planning & Design	Line Design
10/03/2014	MN0951406	North Star 2014 Construction Contract	Resource & Pwr Delivery Planning & Design	Line Design
11/12/2014	MN0951410	North Star Line Design Workshop	Resource & Pwr Delivery Planning & Design	Line Design
06/12/2012	MN1231208	Geronimo Wind Energy Line Design Support for Paynesville Transmission	Resource & Pwr Delivery Planning & Design	Line Design
17/03/2014	MN1831406	LHB Enbridge Superior Terminal Electrical Line Upgrade	Resource & Pwr Delivery Planning & Design	Line Design
08/12/2014	MN1831412	LHB Enbridge Clearbrook Station OH Line	Resource & Pwr Delivery Planning & Design	Line Design
20/03/2012	NH0041206	NHEC Engineering Services for Conway Line Reroute	Resource & Pwr Delivery Planning & Design	Line Design
10/12/2013	OH0011306	Pioneer Prologis Warehouse Line Extension and Upgrade	Resource & Pwr Delivery Planning & Design	Line Design
04/11/2013	OH0651307	SCP Idaho to Ware Rd Sub 69kv line design	Resource & Pwr Delivery Planning & Design	Line Design
02/05/2014	OH0651409	South Central Roundbottom 12kV Line Design	Resource & Pwr Delivery Planning & Design	Line Design

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07/07/2014	OH0651410	South Central Logan Elm to Kinderhook Transmission Design	Resource & Pwr Delivery Planning & Design	Line Design
29/09/2014	OH0651412	South Central Biers Run to Andersonville Substation CWP Transmission Design	Resource & Pwr Delivery Planning & Design	Line Design
29/09/2014	OH0651413	South Central Lockbourne to Ashville Substation CWP Transmission Design	Resource & Pwr Delivery Planning & Design	Line Design
29/09/2014	OH0651414	South Central Ashville to Bell Siding Substation CWP Transmission Design	Resource & Pwr Delivery Planning & Design	Line Design
29/09/2014	OH0651415	South Central SR 104 to Andersonville Substation CWP Transmission Design	Resource & Pwr Delivery Planning & Design	Line Design
29/09/2014	OH0651416	South Central Laurelville Substation to Logan Elm Tap CWP Transmission Design	Resource & Pwr Delivery Planning & Design	Line Design
10/07/2012	OH0961206	Piqua Redesign of damaged 69kV Line	Resource & Pwr Delivery Planning & Design	Line Design
08/08/2012	OH0961207	Piqua Assessment and Redesign of sub #4 to Sub #5 Line	Resource & Pwr Delivery Planning & Design	Line Design
19/02/2013	OH0961306	City of Piqua Construction Documents and Staking	Resource & Pwr Delivery Planning & Design	Line Design
28/03/2013	OH0961307	City of Piqua Sub #4 to Sub #3 Engineering Analysis	Resource & Pwr Delivery Planning & Design	Line Design
21/04/2014	OH0961406	City of Piqua Water Plant Line - Underbuild Analysis	Resource & Pwr Delivery Planning & Design	Line Design
07/05/2014	OH0961407	City of Piqua Pole Replacement Support	Resource & Pwr Delivery Planning & Design	Line Design
03/04/2012	OR0221206	Stantec Geronimo Paynesville Line - 30% Design	Resource & Pwr Delivery Planning & Design	Line Design
03/04/2012	OR0221207	Stantec Geronimo Black Oak Line - 30% Design	Resource & Pwr Delivery Planning & Design	Line Design
15/12/2014	PSE011416	2015 Distribution Line Design Course	Resource & Pwr Delivery Planning & Design	Line Design
06/02/2012	SD0381206	Moreau Contract Work 2012 FEMA OH Projs	Resource & Pwr Delivery Planning & Design	Line Design
06/02/2012	SD0381207	Moreau Contract Work 2012 FEMA UG Projs	Resource & Pwr Delivery Planning & Design	Line Design
06/02/2012	SD0381208	Moreau LD & Staking for FEMA PW 142 - Parade Line	Resource & Pwr Delivery Planning & Design	Line Design
06/02/2012	SD0381209	Moreau LD & Staking for FEMA PW161- US Hwy 63	Resource & Pwr Delivery Planning & Design	Line Design
06/02/2012	SD0381210	Moreau LD & Staking for FEMA PW 189 - Airport Road	Resource & Pwr Delivery Planning & Design	Line Design
06/02/2012	SD0381211	Moreau LD & Staking for FEMA PW 193 - N. Sioux/McGill	Resource & Pwr Delivery Planning & Design	Line Design
06/02/2012	SD0381212	Moreau LD & Staking for FEMA PW 202 - Curtis/Cemetery	Resource & Pwr Delivery Planning & Design	Line Design
06/02/2012	SD0381213	Moreau LD & Staking for FEMA PW 203 - Ridgeview	Resource & Pwr Delivery Planning & Design	Line Design
06/02/2012	SD0381215	Moreau Contract Work 2012 FEMA UG Projs	Resource & Pwr Delivery Planning & Design	Line Design
09/11/2012	SD0381218	MGEC WO 12-277 FEMA 404 & 406 Out of Scope LD & Staking	Resource & Pwr Delivery Planning & Design	Line Design
09/11/2012	SD0381219	MGEC WO 12-276 FEMA 404 Projects 11, 13, 14 and 17 LD & Staking	Resource & Pwr Delivery Planning & Design	Line Design

Project Start	Project #	Project Name	Dept Name	Project Type
04/12/2013	SD0381307	Moreau Oct. 2013 Storm FEMA Project Estimates	Resource & Pwr Delivery Planning & Design	Line Design
24/03/2014	SD0381406	MGEC WO#14-117 Dietterle Line Design	Resource & Pwr Delivery Planning & Design	Line Design
24/03/2014	SD0381407	MGEC WO#14-118 Shambo Line Design	Resource & Pwr Delivery Planning & Design	Line Design
24/03/2014	SD0381408	MGEC WO#14-119 Gebhart Line Design	Resource & Pwr Delivery Planning & Design	Line Design
24/03/2014	SD0381409	MGEC WO#14-120 Walters Line Design	Resource & Pwr Delivery Planning & Design	Line Design
24/03/2014	SD0381410	MGEC WO#14-122 Grand River Line Design	Resource & Pwr Delivery Planning & Design	Line Design
24/03/2014	SD0381411	MGEC WO#14-123 Petik Line Design	Resource & Pwr Delivery Planning & Design	Line Design
24/03/2014	SD0381412	MGEC WO#14-124 Charlie Clark Line Design	Resource & Pwr Delivery Planning & Design	Line Design
24/03/2014	SD0381413	MGEC WO#14-125 Keldron S. Line Design	Resource & Pwr Delivery Planning & Design	Line Design
24/03/2014	SD0381414	MGEC WO#14-127 Roger Dix Line Design	Resource & Pwr Delivery Planning & Design	Line Design
24/03/2014	SD0381415	MGEC WO#14-129 Kvale Line Design	Resource & Pwr Delivery Planning & Design	Line Design
24/03/2014	SD0381416	MGEC WO#14-130 Mike Beer Line Design	Resource & Pwr Delivery Planning & Design	Line Design
24/03/2014	SD0381417	MGEC WO#14-131 Tomac Line Design	Resource & Pwr Delivery Planning & Design	Line Design
24/03/2014	SD0381418	MGEC WO#14-132 Jeff Meier Line Design	Resource & Pwr Delivery Planning & Design	Line Design
24/03/2014	SD0381419	MGEC WO#14-133 Glad Valley Line Design	Resource & Pwr Delivery Planning & Design	Line Design
24/03/2014	SD0381420	MGEC WO#14-134 Cook Line Design	Resource & Pwr Delivery Planning & Design	Line Design
24/03/2014	SD0381421	MGEC WO#14-135 '14 FEMA 406 OOS LD	Resource & Pwr Delivery Planning & Design	Line Design
24/03/2014	SD0381422	MGEC WO#14-136 FEMA 404 13-A LD	Resource & Pwr Delivery Planning & Design	Line Design
24/03/2014	SD0381423	MGEC WO#14-137 FEMA 404 13-B1 LD	Resource & Pwr Delivery Planning & Design	Line Design
24/03/2014	SD0381424	MGEC WO#14-138 FEMA 404 13-B2 LD	Resource & Pwr Delivery Planning & Design	Line Design
24/03/2014	SD0381425	MGEC WO#14-139 FEMA 404 14 LD	Resource & Pwr Delivery Planning & Design	Line Design
24/03/2014	SD0381426	MGEC WO#14-140 '14 FEMA 404 OOS LD	Resource & Pwr Delivery Planning & Design	Line Design
24/03/2014	SD0381427	MGEC WO#14-141 Bullhead Line Design	Resource & Pwr Delivery Planning & Design	Line Design
24/03/2014	SD0381428	MGEC WO#14-142 Isabel Line Design	Resource & Pwr Delivery Planning & Design	Line Design
03/12/2014	SD0381429	Moreau Grand FEMA Work	Resource & Pwr Delivery Planning & Design	Line Design
07/06/2012	SD0431206	E. River Beresford to Tea Line	Resource & Pwr Delivery Planning & Design	Line Design
25/02/2013	SD0431306	E. River Mount Vernon to Plankinton Line	Resource & Pwr Delivery Planning & Design	Line Design
09/09/2013	SD0431308	E. River Mitchell Reroute	Resource & Pwr Delivery Planning & Design	Line Design
06/11/2012	VA0281207	Northern Neck Mattox Creek Crossing	Resource & Pwr Delivery Planning & Design	Line Design

Project Start	Project #	Project Name	Dept Name	Project Type
06/11/2012	VA0281208	Northern Neck Horners Mill Pond Crossing	Resource & Pwr Delivery Planning & Design	Line Design
19/11/2013	VA0281306	Northern Neck Garner Line - Wood vs Steel Pole Analysis	Resource & Pwr Delivery Planning & Design	Line Design
11/12/2014	VA0281407	Northern Neck Avalon Transmission Line	Resource & Pwr Delivery Planning & Design	Line Design
10/04/2014	WI0011406	Kaukauna Material and Construction Standards Assessment	Resource & Pwr Delivery Planning & Design	Line Design
09/02/2012	WI0141206	Oconto FF Line 477 LD	Resource & Pwr Delivery Planning & Design	Line Design
30/04/2013	WI0141306	Oconto Q Line to Little Suamico Sub	Resource & Pwr Delivery Planning & Design	Line Design
25/11/2014	WI0141406	Oconto TLB Rebuild	Resource & Pwr Delivery Planning & Design	Line Design
10/03/2014	WI0181406	Menasha Fox River Crossing	Resource & Pwr Delivery Planning & Design	Line Design
17/01/2012	WI0321207	Pierce 2012 CTH "D" Line Rebuild	Resource & Pwr Delivery Planning & Design	Line Design
17/01/2012	WI0321208	Pierce 2012 CTH "V" Line Rebuild	Resource & Pwr Delivery Planning & Design	Line Design
10/12/2012	WI0321212	Pierce ESA-07 WO# 13009C Line Design	Resource & Pwr Delivery Planning & Design	Line Design
10/12/2012	WI0321213	Pierce ESA-05 WO# 13011C Line Design	Resource & Pwr Delivery Planning & Design	Line Design
21/04/2014	WI0321406	Pierce-Pepin GLS-01 Line Design and Staking Assistance	Resource & Pwr Delivery Planning & Design	Line Design
07/02/2014	WI0381406	Rock Energy HWY 75 3ph Design	Resource & Pwr Delivery Planning & Design	Line Design
16/05/2014	WI0381407	Rock Energy South Bluff Street Line Rebuild	Resource & Pwr Delivery Planning & Design	Line Design
01/01/2014	WI0431403	Scenic Work Order Inspections	Resource & Pwr Delivery Planning & Design	Line Design
02/10/2012	WI0471206	Jackson HUC3 608.08 Line Design	Resource & Pwr Delivery Planning & Design	Line Design
19/09/2013	WI0471307	Jackson HUC3 608.07 Line Design	Resource & Pwr Delivery Planning & Design	Line Design
11/08/2014	WI0511403	St. Croix Work Order Inspections	Resource & Pwr Delivery Planning & Design	Line Design
15/07/2014	WI0631403	Bayfield '14 Work Order Inspection	Resource & Pwr Delivery Planning & Design	Line Design
22/01/2014	WI0641406	Dairyland Staking Seminar	Resource & Pwr Delivery Planning & Design	Line Design
23/04/2012	WI1471206	Georgia Brander Project - Dist Line & Substation	Resource & Pwr Delivery Planning & Design	Line Design
12/11/2013	WI1521306	Sauk City Industrial Park Distribution System Design	Resource & Pwr Delivery Planning & Design	Line Design
31/10/2014	WI1521406	Sauk City Hwy 12/60 Distribution Line Relocation	Resource & Pwr Delivery Planning & Design	Line Design
02/01/2014	WV0101406	Harrison Project 308 Line Design	Resource & Pwr Delivery Planning & Design	Line Design
17/07/2012	OH0061202	Buckeye Misc Engineering & Ops	Resource & Pwr Delivery Planning & Design	Power System Studies
21/05/2014	AR0021406	Carroll Transmission Ownership Study	Resource & Pwr Delivery Planning & Design	Power System Studies
21/05/2014	AR0031406	Ozarks Transmission Ownership Study	Resource & Pwr Delivery Planning & Design	Power System Studies
04/08/2014	IN1131406	Utilities District of Western Indiana Owensburg/Guthrie CVR/Sectionalizing	Resource & Pwr Delivery Planning & Design	Power System Studies

Project Start	Project #	Project Name	Dept Name	Project Type
04/08/2014	IN1131407	Utilities District of Western Indiana PV System Impact Study 2014	Resource & Pwr Delivery Planning & Design	Power System Studies
15/09/2014	MN1601406	Allete Buena Vista Thermal Analysis & LMP History	Resource & Pwr Delivery Planning & Design	Power System Studies
31/03/2014	OH0651408	South Central 69kV Loop Protection and ATS Study	Resource & Pwr Delivery Planning & Design	Power System Studies
17/02/2014	OH0751406	NWEC Environmental Report - 69 kV line	Resource & Pwr Delivery Planning & Design	Power System Studies
17/07/2012	SD0431208	E. River Sioux Falls Area System Analysis	Resource & Pwr Delivery Planning & Design	Power System Studies

RESPONSES TO BUILDING OWNERS AND MANAGERS ASSOCIATION, GREATER TORONTO INTERROGATORIES

INTERROGATORY 62:

Reference(s): **Exhibit 1B, Tab 2, Schedule 5, Appendix (8) to Appendix B, page 1-2**

Please provide evidence to the infrastructure cost per type of area shown in Figure 1-1.

RESPONSE:

Please refer to Sections 4 and 5 in the Appendix of the PSE Report, dated September 19, 2014.

RESPONSES TO BUILDING OWNERS AND MANAGERS ASSOCIATION, GREATER TORONTO INTERROGATORIES

INTERROGATORY 63:

Reference(s): **Exhibit 1B, Tab 2, Schedule 5, Appendix (8) to Appendix B, page 2-1**

Which skyscrapers were built in Toronto in the "early 1900s"? Please explain fully.

RESPONSE:

According to the Canadian Encyclopaedia[1], October 2013 edition, the following are some examples of skyscrapers that were built in Toronto in the early 1900s:

- the six-storey, 33-metre Robert Simpson department store at the corner of Yonge and Queen Streets, 1895;
- the 15-storey Traders Bank of Canada on Yonge Street, 1905; and
- the 20-storey, 91-metre Royal Bank Building located on the corner of Yonge and King streets, 1915.

[1] http://www.thecanadianencyclopedia.ca/en/article/skyscrapers/

RESPONSES TO BUILDING OWNERS AND MANAGERS ASSOCIATION, GREATER TORONTO INTERROGATORIES

INTERROGATORY 64:

Reference(s): **Exhibit 1B, Tab 2, Schedule 5, Appendix (8) to Appendix B, page 2-5**

"A unique and dated downtown system, which features a network of secondary voltage cables"

Please provide a full discussion of the "unique and dated" characteristics of the downtown system of Toronto Hydro.

RESPONSE:

Toronto Hydro's secondary network system is discussed in detail at Exhibit 2B, Section 6.12.2.1. A brief summary of the more significant "unique and dated" characteristics of Toronto Hydro's secondary network follows.

The secondary network system is not commonly used by utilities. It is unique in that it is the only secondary distribution system that supplies customers simultaneously from multiple sources. Should any of these sources fail, the remaining sources will continue to supply all customer loads without interruption. All other secondary distribution systems supply customers from one source at a time. As a result, should this source of supply fail, all customers connected to it are interrupted until customers can be switched to an alternate supply or repairs are completed. Secondary network distribution therefore requires unique equipment, maintenance and operating practices. It is uniquely reliable among secondary distribution systems.

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Toronto Hydro's secondary network distribution system was designed in an era of low-rise development. The available network secondary distribution grid voltage of 216Y/125V is only suitable for buildings up to approximately 25 storeys in height. Since most new developments are considerably higher, they now commonly use 347Y/600V distribution voltage. As a result, Toronto Hydro's secondary network system is dated to the extent that it no longer matches the needs of new customers.

Also, in the past, Toronto Hydro did not mix radial and network loads on the same primary feeders, as is the present practice. In addition, maintenance and operating practices have evolved over the years. The secondary network distribution system requires modifications to reflect this new environment.

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INTERROGATORY 65:

Reference(s): **Exhibit 1B, Tab 2, Schedule 5, Appendix (8) to Appendix B, General**

Please provide the evidence in support of each coincident factor used to calculate the coincident peaks for each building type in this analysis and for each of the six areas. Provide rationale for each coincident factor together with studies and surveys or forecasts that provide authoritative bases for these choices (for example, commercial office space at 0.52 and education at 1.00).

RESPONSE (PREPARED BY PSE):

The coincident factor ("CF") used in the analysis is derived from an industry-accepted empirical formula, which is a function of the number of services within a corresponding customer type grouping. Per the given examples: 1) Commercial office space comprised of a quantity of 49 services, which results in a CF of 0.52 per the empirical formula; and 2) Education comprised of a quantity of 1 service which results in a CF of 1.00. The empirical formula applied was $CF = ½(1+5/(2n+3))$; where "n" is the number of services within a corresponding customer type grouping.

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INTERROGATORY 66:

Reference(s): **Exhibit 1B, Tab 2, Schedule 5, Appendix (8) to Appendix B, page 4-4**

Please justify the use of a 90% power factor in the comparison between the coincident peak for the Urban Residential Area (Area 4) as calculated by PSE and Toronto Hydro.

RESPONSE (PREPARED BY PSE):

The study was based on summer peak load which comprises of both resistive (e.g., lighting) and reactive components (e.g., air conditioning). It is the author's experience that the power factor for this load mix generally ranges between 85% and 95%. A 90% power factor was referenced simply due to the law of averages, while also recognizing that the sensitivity of applying the outer ranges (i.e., 85% and 95%) would not significantly affect the results of the study.

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INTERROGATORY 67:

Reference(s): **Exhibit 1B, Tab 2, Schedule 5, Appendix (8) to Appendix B, page 4-5**

Please justify the use of the 90% power factor generally.

RESPONSE:

Please see the response to Interrogatory 1B-BOMA-66.

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INTERROGATORY 68:

Reference(s): **Exhibit 1B, Tab 2, Schedule 5, Appendix (8) to Appendix B, General**

Please explain the relationship between service and unit for each building type used in the analysis. For example, in a 100 suite condominium, or an apartment building, with a master meter, and residential suite meters for each suite plus one suite, is there one service (to the master meter) or 101 services? What is the difference if individual suite energy consumption is not metered but allocated by the Condominium Board, or apartment owner?

RESPONSE:

The number of services estimated within Area 4, correlates to the quantity of individual living units. Per the given hypothetical example, a 100-unit apartment with a master meter would correlate to an estimated 100 services.

Energy consumption not metered, but allocated by a Condominium Board or apartment owner, had no impact on the methodology used in the study.

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INTERROGATORY 69:

Reference(s): **Exhibit 1B, Tab 2, Schedule 5, Appendix (8) to Appendix B, page 5-1**

What were the developed "electrical design plans by PSE" based on, aside from the actual installations by Toronto Hydro? What else were they based on? Please discuss fully.

RESPONSE (PREPARED BY PSE):

The electrical design plans for Areas 1, 2, and 3 were developed by a PSE senior designer who specializes in designing distribution systems. The design was based on the location and type of customer services within the defined area, as well as the electric system topology required to distribute power to those services. Distribution plant assets in the design included poles, switches, risers, overhead conductor, underground cable, transformers, and secondary conductor. Areas 4, 5, and 6 were based on actual distribution plant assets installed with each corresponding area as provided by Toronto Hydro.

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INTERROGATORY 70:

Reference(s): **Exhibit 1B, Tab 2, Schedule 5, Appendix (8) to Appendix B, page 5-1**

For the replacement cost exercise:

a) Please explain how the assumption made as to how the infrastructure for the six areas were developed. Were they designed ab initio, in other words, creating an "optimal" infrastructure, assuming there is no existing plant, are they based on replacing like with like, or are they based on replacing retiring assets with what the authors consider to be the best infrastructure to meet the needs of the area, taking into account the basic structure of the existing infrastructure, for example, the fact that almost all the transformer stations are owned and operated by Hydro One Transmission? Please discuss fully.

b) Please provide the answers for all six areas, identifying any differences in methodology among areas.

c) Please provide the geographic boundaries of each of the six areas, and the municipality in which they are located, and the justification for selecting those boundaries. Please describe any alternative areas that were considered and rejected. Did Toronto Hydro provide the six areas to PSE, or did PSE select the areas from lists provided by Toronto Hydro, or through their own analysis?

RESPONSE (PREPARED BY PSE):

a) Replacement costs for Areas 1, 2, and 3 were based on replacing "like with like" distribution plant assets identified in the design developed by PSE. In other words,

RESPONSES TO BUILDING OWNERS AND MANAGERS ASSOCIATION, GREATER TORONTO INTERROGATORIES

the methodology assumed that the exact same distribution plant assets designed by PSE would be replaced. Areas 4, 5, and 6 were based on replacing actual distribution plant assets as provided by Toronto Hydro. Substation assets were not applied in the methodology for any of the six areas.

b) Please refer to response in part a).

c) Please refer to Exhibit I of the report. The geographical boundaries are further defined per the below zoomed in images.

Area 1

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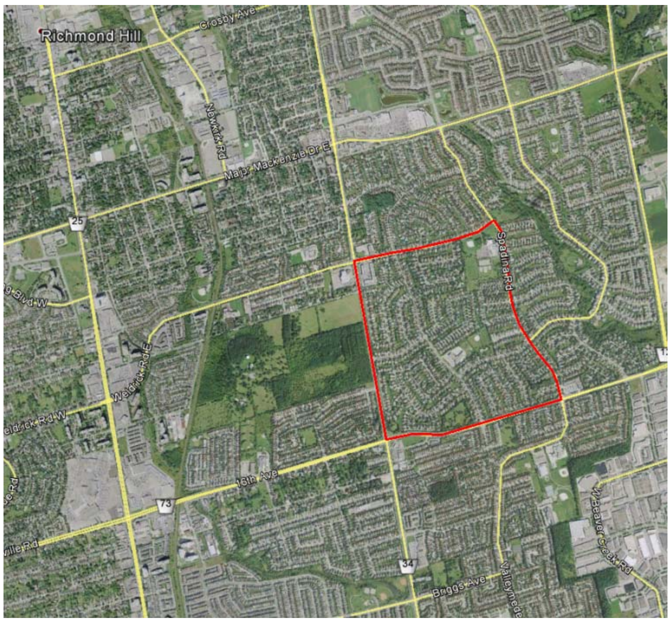
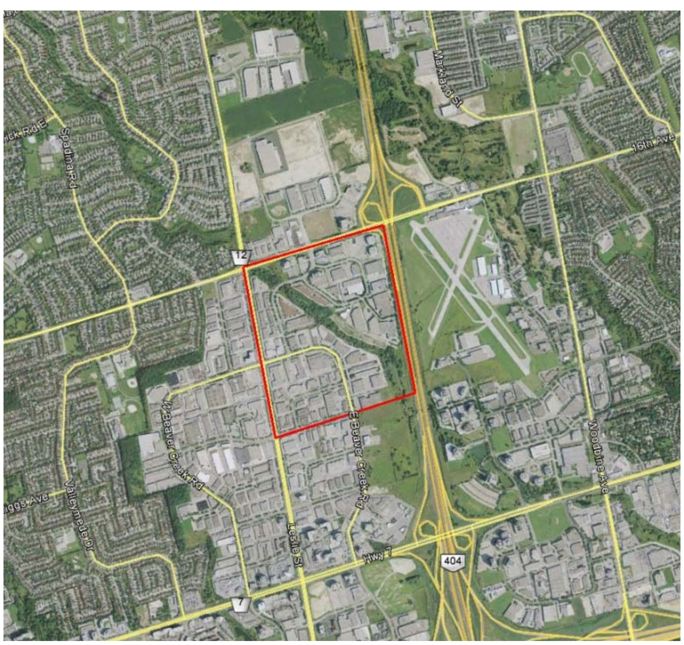
Area 2



Area 3



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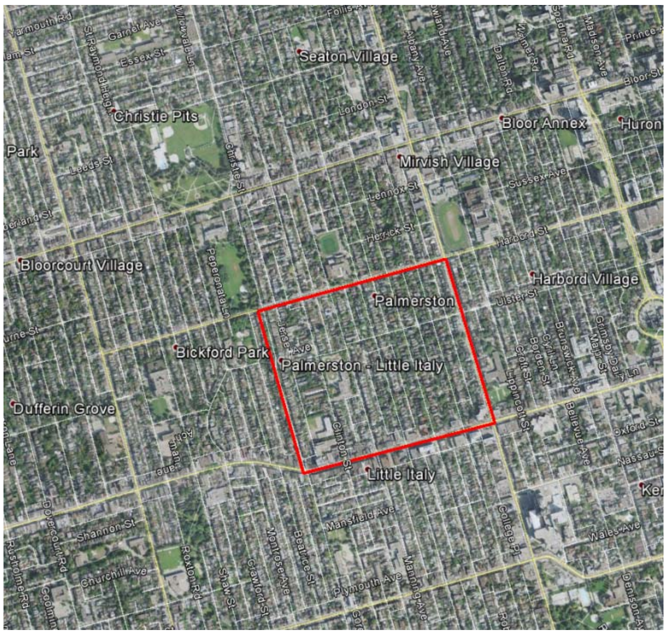
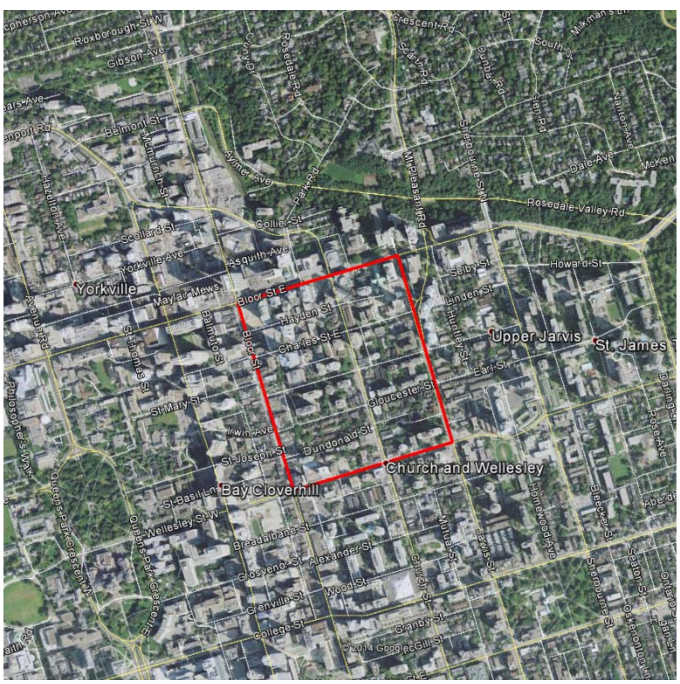
Area 4



Area 5



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<u>Area 6</u>

The six areas were selected by PSE within each environment type, with the intent to represent environments that could be defined as Rural, Suburban Residential, Suburban Commercial, Urban Residential, Urban Commercial, and Core City. Because Toronto Hydro's service territory is composed of environments defined in the study as Urban Residential, Urban Commercial, and Core City, corresponding areas for these environments (Areas 4, 5, and 6) were selected by PSE within the city limits of Toronto. Areas 1, 2, and 3 were selected based on their relative close proximity to the City of Toronto, while still fitting the study's description of Rural, Suburban Residential, and Suburban Commercial. No alternative areas were reviewed or rejected. Toronto Hydro was not involved in the process of selection, nor did it influence PSE's selection.

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INTERROGATORY 70:

Reference(s): **Exhibit 1B, Tab 2, Schedule 5, Appendix (8) to Appendix B, page 5-1**

Please confirm that the same conclusion can be drawn for a utility(ies) serving predominantly in rural areas.

RESPONSE (PREPARED BY PSE):

The study conclusion is independent of the service area environment of a specific utility(ies).

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INTERROGATORY 72:

Reference(s): **Exhibit 1B, Tab 2, Schedule 5, Appendix (8) to Appendix B, page 6-4 (general)**

Please indicate how many sq km of Toronto are classified in each of the six area types defined in the study. Please provide a detailed rationale for the classification. Provide the same information for each of Ottawa Hydro, Horizon Utilities, London Utilities, and Enersource.

RESPONSE: **/C**

Toronto Hydro performed the analysis on the number of square kilometres for each of the area types presented in the study within the City of Toronto, using its own interpretation of each area type and a number of simplifying assumptions. Given the mixed nature of load in most neighbourhoods across Toronto, as distinct from the generally uniform areas assessed in the PSE study, the results of Toronto Hydro's area assignment are based on a significant over-simplification of Toronto's actual load mix, made in an effort to comply with the request in the Interrogatory. Toronto Hydro notes that it would be inappropriate to use the results of this assessment for the purposes of drawing any conclusions regarding Toronto Hydro's capital program. Toronto Hydro would like to emphasize that the load density cost study undertaken by PSE was primarily advanced as empirical support for the conclusion that higher load density in urban environments leads to higher capital costs beyond a certain threshold, which was in turn presented as additional support for the use of the Urban Core variable in PSE's total cost benchmarking study.

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To facilitate the request, Toronto Hydro divided the service territory into 100 square-metre lots, with each part being assigned either to Urban Residential or Urban Commercial type. Residential or Commercial type classification was based on the predominant customer type in a specific lot using customer information for each supply point stored in GEAR. The Metro / Core area was specified as per the following territories:

- Downtown Core: Bloor Street on the North, Lake Ontario on the South, Don Valley Parkway on the East, and Bathurst Street on the West.
- Park Lawn: Gardiner Expressway to the North, Lake Shore Blvd. to the South and Park Lawn Road to the West.
- Yonge/Eglinton: Lawrence Avenue to the North and Davisville Avenue to the South, Mt. Pleasant Road to the East, and Duplex Avenue to the West.
- Yonge/Sheppard: Yonge Street between Sheppard Avenue and Finch Avenue.

The results are illustrated graphically in the map below, along with total amount and percentages of sq. km within each area:

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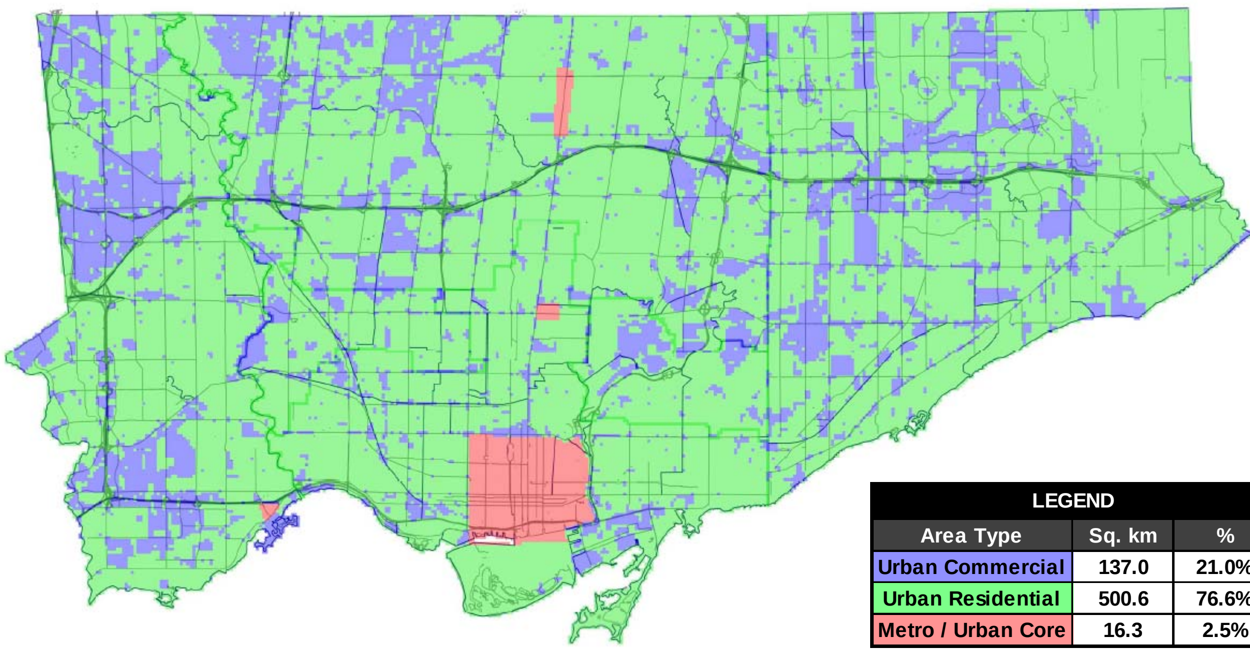

LEGEND		
Area Type	Sq. km	%
Urban Commercial	137.0	21.0%
Urban Residential	500.6	76.6%
Metro / Urban Core	16.3	2.5%

Toronto Hydro is not in a position to undertake the analysis requested for other LDCs due to lack of knowledge of their service territories and the substantial amount of time and effort that would be required if Google Maps were to be used for this analysis.

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INTERROGATORY 73:

Reference(s): **Exhibit 1B, Tab 2, Schedule 5, Appendix (8) to Appendix B, Appendix B (continued), page 6**

"The same reasons that necessitate a combined US and Ontario sample when performing total cost benchmarking for Toronto Hydro also apply to benchmarking its reliability"

a) Please explain fully why that should be the case.
b) Please provide evidence for that conclusion.
c) Please explain the factors that support this proposition. Please consider, in descending order of importance, each variable, e.g., number of customers, demand, etc. that influences distribution costs, and for each variable, describe why it should also impact SAIFI and SAIDI and SAIFI/customer in the same manner. Provide the same for each.
d) Please provide the SAIFI and SAIDI per customer results and the SAIFI and SAIDI per kW demand results for Toronto Hydro relative to the Ontario utilities, and the combined sample.
e) Please provide the historical and projected costs on a per customer basis between historical and projected costs for the company and the Ontario and combined samples.

RESPONSE (PREPARED BY PSE):

a) The vast differences in size and operating environments between the Ontario sample and Toronto Hydro necessitate including U.S. utilities into the benchmarking

RESPONSES TO BUILDING OWNERS AND MANAGERS ASSOCIATION, GREATER TORONTO INTERROGATORIES

framework. In the cases of both cost and reliability, a proper evaluation that includes a data set comprising utilities with similar size and operating environments is necessary; otherwise Toronto Hydro is an outlier.

b) Please see Chapter 6 in PSE's Report, titled "Importance of U.S. Data for Benchmarking Toronto Hydro."

c) The different factors such as number of customers, demand, etc. will not impact distribution costs and reliability in the "same manner". PSE's statement referenced in the interrogatory was not meant to imply that each factor will impact both costs and reliability in the same manner. The reasons in the referenced statement (that a benchmarking study should contain similar utilities to the studied utility) apply for either a cost or a reliability benchmarking study.

d) PSE is unsure what is meant by "SAIFI and SAIDI per customer results" or per kW in this question. It may be helpful to mention that SAIFI and SAIDI are already divided by the number of customers within their definition such that if these measures were again divided by the number of customers or kW demand it would be a meaningless statistic. This is not a metric commonly used in the industry.

e) Please see the response to Interrogatory 1B-BOMA-90 for the historical costs of Toronto Hydro, Ontario sample, and U.S. sample. Only for Toronto Hydro were projected costs used. The projected cost per customer numbers for Toronto Hydro are provided in the table below.

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Year	Total Cost per Customer
2013	909
2014	991
2015	1,101
2016	1,165
2017	1,228
2018	1,280
2019	1,341

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INTERROGATORY 74:

Reference(s): **Exhibit 1B, Tab 2, Schedule 5, Appendix (8) to Appendix B, page 16**

Please provide a copy of the most recent FERC Form 1 filings for each of the US companies in the combined data set, and a 2013 copy of the Platt's UDI Directory of Electric Power Suppliers and Distributors.

RESPONSE (PREPARED BY PSE):

PSE does not have a copy of the FERC Form 1 filings for each U.S. company. PSE used SNL Energy's data download service to only download the specific data used in the study. FERC Form 1 filings are publically available and instructions for download can be found at the following link: http://www.ferc.gov/docs-filing/forms/form-1/viewer-instruct.asp

PSE purchased the 2013 Platt's UDI Directory of Electric Power Suppliers and Distributors. The directory is copyrighted and cannot be reproduced. Please see the following link where the directory can be found:
http://www.platts.com/products/electric-power-producer-directory

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INTERROGATORY 75:

Reference(s): **Exhibit 1B, Tab 2, Schedule 5, Appendix (8) to Appendix B, page 16**

a) Please explain why, in determining Canadian distributor wage costs, you did not use the filings of the Ontario utilities.

b) Please explain why you used BLS estimate of job occupation weight in the US Power Industry to assess such weights in Ontario, which could be more directly determined by looking at Ontario data.

RESPONSE (PREPARED BY PSE):

a) An econometric benchmarking study uses input prices and variables which are external to the utility in fashioning the appropriate benchmark. Wages paid by each distributor are not external but rather at the discretion of each utility, at least partially, and would not be candidate variables.

b) PSE used the same BLS weights to remain consistent for both the U.S. and Ontario observations. PSE used the BLS occupation weights when constructing the wage levels for each utility. These wage levels are calculated as weighted averages of a mix of occupational wages based on the BLS weightings in the U.S. Power Industry.

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INTERROGATORY 76:

Reference(s): **Exhibit 1B, Tab 2, Schedule 5, Appendix (8) to Appendix B, page 17**

Please list the US utilities that qualified as having above one million customers. Did these utilities typically serve more than one municipality? Please provide details for each utility.

RESPONSE (PREPARED BY PSE):

Please see Table 1 in the PSE Report. Twenty-two U.S. utilities had more than 1,000,000 customers. The urban core variable was set at "one" for the following U.S. utilities: Arizona Public Service, Commonwealth Edison, Consolidated Edison, and San Diego Gas & Electric. None of these utilities serves more than one municipality greater than one million customers.

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INTERROGATORY 77:

Reference(s): **Exhibit 1B, Tab 2, Schedule 5, Appendix (8) to Appendix B, page 18**

Please show the percentage of forestation available from Toronto Hydro and each of the Ontario utilities that had such data available.

RESPONSE (PREPARED BY PSE):

Please refer to Appendix A to this response.

Company	Forestation Variable
HEARST POWER DISTRIBUTION COMPANY LIMITED	0.08824
WELLAND HYDRO-ELECTRIC SYSTEM CORP.	0.10078
ENERSOURCE HYDRO MISSISSAUGA INC.	0.10366
MILTON HYDRO DISTRIBUTION INC.	0.13793
LONDON HYDRO INC.	0.18062
BRANTFORD POWER INC.	0.18124
THESL	**0.18262**
ORANGEVILLE HYDRO LIMITED	0.19718
GUELPH HYDRO ELECTRIC SYSTEMS INC.	0.20458
TILLSONBURG HYDRO INC.	0.22051
KITCHENER-WILMOT HYDRO INC.	0.22493
OSHAWA PUC NETWORKS INC.	0.24157
ST. THOMAS ENERGY INC.	0.27184
HALTON HILLS HYDRO INC.	0.35088
NEWMARKET-TAY POWER DISTRIBUTION LTD.	0.37
HORIZON UTILITIES CORPORATION	0.37324
WASAGA DISTRIBUTION INC.	0.38462
ORILLIA POWER DISTRIBUTION CORPORATION	0.39179
SIOUX LOOKOUT HYDRO INC.	0.40541
HALDIMAND COUNTY HYDRO INC.	0.41667
WELLINGTON NORTH POWER INC.	0.46753
LAKEFRONT UTILITIES INC.	0.50403
PETERBOROUGH DISTRIBUTION INCORPORATED	0.50932
RENFREW HYDRO INC.	0.55556
ESPANOLA REGIONAL HYDRO DISTRIBUTION CORPORATION	0.58182
THUNDER BAY HYDRO ELECTRICITY DISTRIBUTION INC.	0.6001
HYDRO OTTAWA LIMITED	0.603
CHAPLEAU PUBLIC UTILITIES CORPORATION	0.63057
KINGSTON HYDRO CORPORATION	0.65434
ATIKOKAN HYDRO INC.	0.65625
KENORA HYDRO ELECTRIC CORPORATION LTD.	0.70769
HYDRO ONE NETWORKS INC.	0.80833
MIDLAND POWER UTILITY CORPORATION	0.82927
HYDRO HAWKESBURY INC.	0.87069
OAKVILLE HYDRO ELECTRICITY DISTRIBUTION INC.	0.875
NORTH BAY HYDRO DISTRIBUTION LIMITED	0.91729
PARRY SOUND POWER CORPORATION	0.98413
ALGOMA POWER INC.	0.99074

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INTERROGATORY 78:

Reference(s): **Exhibit 1B, Tab 2, Schedule 5, Appendix (8) to Appendix B, page 19**

a) Why did PSE not use km of underground line as a proxy for plant in service overhead, and underground? Please explain fully.

b) Why did PSE not extract data on plant in service overhead and plant in service underground from Ontario utility filings, including responses to IRs of recent cases?

c) How many of the US utilities listed are located in more than one regulatory jurisdiction? Please indicate which ones, and which regulators when the information available in the FERC filings.

RESPONSE (PREPARED BY PSE):

a) Km of underground line is not available for all U.S. utilities. Using km of underground line would make a poor proxy for plant in service, since the costs of undergrounding plant vary considerably based on location (even within a single utility, underground costs can vary considerably based on terrain and other factors), and underground lines tend to be considerably more costly than overhead lines.

b) PSE did consider this and PSE asked Toronto Hydro to start a preliminary attempt at extracting that data. Toronto Hydro began with the largest distributors and was finding in some cases that no recent data on plant in service was readily available on a consistent basis. Based on this sampling and the large amount of time it was taking, it

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was not the best use of resources to continue with collecting the Ontario plant in service data.

c) There are a number of U.S. utilities which serve multiple states. Please see PSE's response to Interrogatory 1B-BOMA-74 for the link to all of the publicly available FERC Form 1 filings.

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INTERROGATORY 79:

Reference(s): **Exhibit 1B, Tab 2, Schedule 5, Appendix (8) to Appendix B, page 23**

Does PSE use the allowed return on capital as the opportunity cost of capital? Please explain fully what PSE means by the "opportunity cost of capital".

RESPONSE (PREPARED BY PSE):

Yes, PSE uses the allowed return on capital based on the Board's historical calculated returns as the opportunity cost of capital. By the "opportunity cost of capital", PSE means the expected return of capital if invested in some other investment alternative, assuming the same amount of risk associated with utilities. For simplicity and consistency, PSE used the Board's calculated historical allowed return on capital for all utilities in the sample.

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INTERROGATORY 80:

Reference(s): **Exhibit 1B, Tab 2, Schedule 5, Appendix (8) to Appendix B, page 24**

Why is the US sample not confined to utilities that are distribution utilities only? How many of the utilities listed at page 20 are distribution only? How many are distribution and transmission only? Please provide the cost analysis done in PSE on a "cost per customer basis". What conclusion can be drawn from that analysis, in PSE's view?

RESPONSE (PREPARED BY PSE):

Please see the variable denoted as "pctdst1" in the data contained in the response to interrogatory 1B-OEBStaff-14. All U.S. utilities have some plant in service that is classified as something other than distribution plant. For this reason, PSE included the "pctdst1" variable in the models to adjust for this characteristic. Furthermore, PSE allocated Administrative and General expenses based on the proportion of each utility's distribution functions. Please see the FERC Form 1 filings discussed in response to interrogatory 1B-BOMA-74. PSE did not conduct a "cost per customer basis" analysis, and it is unclear what is meant by that analysis. If the question means what would the results of PSE's cost analysis be if the actual and benchmark data was divided by the number of customers, then the exact same conclusions would be drawn, as the percent difference between these two metrics would be equivalent to the percent different of actual and benchmark costs.

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INTERROGATORY 81:

Reference(s): **Exhibit 1B, Tab 2, Schedule 5, Appendix (8) to Appendix B, page 24, Figure 8**

What independent variables did PSE consider adding but ultimately reject in its regression analysis, and why? Please discuss fully.

Please indicate why the following independent variables were:

a) considered but ultimately not used to construct the model;
b) not considered:
    i) nature of the subsurface condition, eg. rock, sand, clay, etc.
    ii) temperature
    iii) composite age of the utility infrastructure, in particular, age of the central core, date the utility was founded, dates of major expansions
    iv) legislative requirements for third parties to share capital costs due to work done in response to government/agency directives
    v) presence and percentage of distributed generation on the distribution system, relative to total utility purchased or produced power
    vi) capital structure and allowed returns, in each year of the period studied
    vii) regularity of rate cases
    viii) stringency of environmental legislation
    ix) zoning legislation.

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RESPONSE (PREPARED BY PSE):

PSE considered variables such as kWh, customer density, wind, and terrain for certain models. They were not included because they either did not come in with the expected sign and/or were not statistically significant.

i) Not considered: data not readily available.

ii) Not considered: no theory on why temperature would impact distribution total costs

iii) Not considered: infrastructure age is a long-run utility decision that may be addressed throughout the Custom IR period. This information is also not readily available for many utilities.

iv) Not considered: data not readily available.

v) Not considered: data not readily available.

vi) Not considered: financial performance is not part of the benchmarking study. The study focused on the reasonableness of spending levels.

vii) Not considered: data not readily available.

viii) Not considered: data not readily available.

ix) Not considered: data not readily available.

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INTERROGATORY 82:

Reference(s): **Exhibit 1B, Tab 2, Schedule 5, Appendix (8) to Appendix B, page 26**

"A cost benchmark reflects the performance of an average utility facing the business conditions of the utility whose values are used to generate the benchmark"

How is the average utility determined in this case? How many of the sample companies were relied upon to create the average utility? Which utilities were they? Please provide Annual Reports, SEDAR filings, for each of the utilities (or leaves to obtain such). How were the costs assembled and developed? Please discuss fully. Which business conditions were considered?

RESPONSE (PREPARED BY PSE):

The "average utility" being referenced in the statement is a hypothetical average-performing utility with the business conditions of those of Toronto Hydro. This hypothetical utility is determined by the econometric model using the parameters and specific variable values of Toronto Hydro. The entire sample is used to generate the model parameters; a link to the data has been provided in the response to 1B-BOMA-74. The PSE report provides a description of the variables considered in the model (in particular, see Chapter 2 for further details).

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INTERROGATORY 83:

Reference(s): **Exhibit 1B, Tab 2, Schedule 5, Appendix (8) to Appendix B, page 26**

Please explain in readable form, the composition of the equations in 2.3.2.2, explaining fully what each symbol denotes, and how it is used to describe the determinants of cost (c), and how the equation relates to the simplified cost function equation at the middle of page 26.

RESPONSE (PREPARED BY PSE):

The simplified cost equation in the middle of page 25 captures the idea that cost (C) is a dependent variable whose outcome is determined by independent variables that generally fall into output (Y) and input price (P) categories. It is a general form used simply to relate this idea. The equation on page 26, on the other hand, is the cost function that takes a particular form known as the translog cost function. It is one that the Board has indicated is the preferred representation of cost in statistical models. It still relates cost to independent variables that take the form of outputs (denoted by Y), input prices (denoted by W instead of P here) and other business condition variables (denoted by Z). Here is the detailed listing of what each term means:

α_o is an intercept term

$\sum_i \alpha_i lnY_i$ is the sum of the log of output i times its associated parameter α_i

$\sum_j \beta_j lnW_j$ is the sum of the log of input price j times its associated parameter β_j

$\sum_h \beta_h lnZ_h$ is the sum of the log of business condition variable h times its associated parameter γ_h

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The terms in the bracket are the sums of interaction terms among logs of outputs and input prices; they include squared terms of logs of outputs and input prices as well as interactions between logs of different Y's (output $i's$ and $k's$) and W's (input prices $j's$ and $n's$). The ½ in front of the term is a feature of the translog functional form having to do with symmetry of terms.

$\sum_i \sum_j \alpha_{ij} lnY_i lnW_j$ is the sum of the interaction of the log of output i and input price j times their parameters designated by α_{ij}

$\alpha_t t$ is trend (t) times its parameter α_t

Finally, ε captures the error term of the model.

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INTERROGATORY 84:

Reference(s): **Exhibit 1B, Tab 2, Schedule 5, Appendix (8) to Appendix B, page 26**

Could the same variables, or some of the same variables, e.g., number of customers, demand, be used to benchmark Toronto Hydro on a cost per customer basis. Please discuss fully. Would such analysis have different implications for benchmarking exercise?

RESPONSE (PREPARED BY PSE):

PSE is unclear as to what is meant by “benchmark Toronto Hydro on a cost per customer basis”. If this is meant to indicate that the dependent variable in the model (i.e., the metric being benchmarked) could be “cost per customer,” then PSE agrees that a similar approach could be undertaken. PSE, however, used the translog cost function, because this was the Board’s preferred model specification. An analysis using “cost per customer” instead could theoretically have different results, although in the present case PSE would expect the implications of such a study would be consistent with those found in PSE’s report, assuming a U.S. sample is included and the study is conducted using acceptable benchmarking principles.

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INTERROGATORY 85:

Reference(s): **Exhibit 1B, Tab 2, Schedule 5, Appendix (8) to Appendix B, page 24**

Please rank the eight independent variables in Figure 8, on a descending percentage basis, on their relative influence in determining utility costs in the PSE Model. Please show the relative percentage contribution for each variable.

RESPONSE (PREPARED BY PSE):

The impact of the independent variables and relevant percentage contribution depends on the data of each utility. At the sample mean, the effect on cost of the eight independent variables is as follows: for every one percent increase in each variable (and in the case of the dummy variable, for those serving an urban core with 1 million or more customers), we expect cost to change as detailed below (variables listed by magnitude of % change).

Independent Variable	Percent change in cost
Retail customers	0.967%
Serving a large urban core	0.749%
Regional input prices	0.539%
Customer density per line mile	-0.149%
Peak demand	0.114%
Percentage of electric to total customers	0.104%
Percentage of plant distribution	0.066%
Percent residential volume	0.016%

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The effect of these comes from the translog cost model estimates, where the parameter estimates of the model are interpreted as elasticities, which capture the percent change in cost for every one percent change in each respective independent variable. The percent effect of the dummy variable (urban core dummy) in the model is obtained by the following formula for those utilities serving an urban core with a million customers or more: 100*(exp(UD estimate)-1). Since the parameter estimate of the urban core dummy variable is 0.00749, the percent effect on cost of serving such an urban core is 100*(exp(0.00749)-1), which equals 0.749%. As the table indicates, percent residential volume has the smallest effect and the number of customers the largest effect on cost at the sample mean.

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INTERROGATORY 86:

Reference(s): **Exhibit 1B, Tab 2, Schedule 5, Appendix (8) to Appendix B, page 28**

In the simplified equation on that page, please explain fully why the incremental number of customers is multiplied by ten.

RESPONSE (PREPARED BY PSE):

This is purely a hypothetical and illustrative example. The paragraph above the equation states this, along with footnote 26. The number ten was not meant to have any significance beyond showing the mechanics of the equation.

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INTERROGATORY 87:

Reference(s): Exhibit 1B, Tab 2, Schedule 5, Appendix (8) to Appendix B, page 28

"Absent robust forecast costs from a large sample of US utilities, PSE is of the opinion that…"

a) Please confirm that the validity of benchmarking future costs, against other utilities' future costs, or against the same utility's historical costs is dependent on the integrity and accuracy of the forecasts. Please discuss fully. Has PSE included in its analysis the accuracy of Toronto Hydro's forecasts of the relevant variables, capital costs, capital price, depreciation, OM&A costs over the period 2002-2012? Please explain fully, and provide the results of the forecasts relative to actuals for each variable for each historical year including 2013 and 2014 to date.

b) Has PSE done studies for other utilities which utilize the approach utilized in the study, including comparison of a hypothetical composite average utility facing the same business conditions as the utility to be benchmarked (in this case, Toronto Hydro), and/or the use of historical benchmarking results to determine the reasonableness of forecast future results. Please provide copies of all such studies.

RESPONSE (PREPARED BY PSE):

a) The forecasted variables in the benchmark evaluation will have an impact on the future year benchmarks. The historical cost benchmarks will not be dependent on the forecasted variables. PSE received the forecasts from Toronto Hydro and is assuming

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they are accurate in the benchmark study. No analyses were conducted by PSE to test the accuracy of the forecasts. The question above referenced capital costs and OM&A costs; these forecasts will not impact PSE's benchmark total costs, as the benchmark total costs are calculated independently of the forecasted capital costs and OM&A costs. The study is showing the reasonableness of the forecasted capital and OM&A costs by how they relate to the benchmark costs.

b) PSE has conducted over twenty benchmarking studies for utilities in the past five years that utilize the econometric benchmarking approach used in the PSE study. In addition to working with utilities, PSE has estimated econometric benchmarking models for the Board in the 3rd Generation IR updates, and we have conducted similar types of research for consumer advocates in the U.S. Many of these studies have been created solely for internal management purposes and cannot be shared. The publicly available reports are contained in a folder named "Publicly Available Econometric Benchmarking Reports" in the file 1B-BOMA-87.zip provided separately along with other large-volume files requested of PSE (1B-OEBStaff-10.zip and 1B-OEBStaff-14.zip).

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INTERROGATORY 88:

Reference(s): **Exhibit 1B, Tab 2, Schedule 5, Appendix (8) to Appendix B, page 37**

a) (i) Does the US sample utilities contain all major US utilities, including the major nuclear utilities, such as Exelon, Southern Company? (ii) Why are the numbers not provided for the corporations that own several US utilities, such as Exelon, Southern, AEP, First Energy, Natural Grid, etc.? How many of the large multi-utility corporations are not in the US sample and what would be the results of including them?

b) Some of the relative importance of the variables as between the US sample and the Combined Sample appear to be very different (see comparison of Table 4, page 31 with Table 7, page 37). The correlation with costs to customer numbers is lower in US sample, the correlation with demand is twice as large, .220 vs .114, the urban core deeming variable is much larger in the US. In effect, the relative contribution of different variables is very different in the US sample compared to the combined sample. Please discuss in detail the extent to which this affects the integrity of the comparison. Please provide the same explanation for the reliability indexing, pages 46-47 (Tables 11, 12, 13, 14).

RESPONSE (PREPARED BY PSE):

a) The sample used data is at the operating company level, rather than data at the holding company level. So for those corporations that own multiple utilities, PSE included the individual utilities rather than the aggregated larger holding company.

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Many of the utilities owned by the corporations mentioned in the question are included in the sample. For example, the question asks why Southern Company is not included in the sample. The Southern Company owns the operating utilities of Alabama Power, Georgia Power, Gulf Power, and Mississippi Power. All four of these utilities are included in the PSE sample. FERC Form 1 cost data is provided on the operating utility level, rather than the holding company level, making a cost benchmark analysis containing only holding company data more difficult. Using holding company level data would also limit the number of observations and explanatory variables. The accuracy of the benchmarking exercise would decrease, in PSE's opinion, if data for the multi-utility corporations were included, rather than the individual operating utility data.

b) In PSE's assessment, the "integrity of the comparison" between models is not a concern. PSE estimated separate models with separate data sets and "let the data speak". The fact that separate models with different data sets show similar results regarding the reasonableness of Toronto Hydro's costs provides more, not less, evidence for PSE's conclusions. The same is true for reliability. PSE chose to provide more information to the Board in the form of multiple models for cost and reliability using different data sets. All models led to the same overall conclusions: that Toronto Hydro's costs are below benchmark values, Toronto Hydro's SAIFI is higher than benchmark values, and its SAIDI is lower than benchmark values. Forecasted spending should result in convergence of Toronto Hydro's results towards the benchmark in both total costs and SAIFI. These same results hold for both data sets.

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INTERROGATORY 89:

Reference(s): **Exhibit 1B, Tab 2, Schedule 5, Appendix (8) to Appendix B, page 43**

Why were only some of the samples of U.S. utilities used in the total cost benchmarking used for the reliability benchmarking? For each of the utilities not used, please provide the explanation.

RESPONSE (PREPARED BY PSE):

The reason a U.S. utility was not included in the reliability benchmarking, but was included in the total cost benchmarking, is that PSE could not locate reliability data or other explanatory variable data for those utilities. All investor-owned utilities in the U.S. must file FERC Form 1s, which include the cost data necessary for the total cost benchmarking. For this reason, the total cost benchmarking sample can include a large number of utilities. However, reliability data is not reported on the FERC Form 1 and must be gathered for each individual utility, typically from Commission filings. Unfortunately, not all regulators in the U.S. mandate their utilities to file reliability data. For this reason, the reliability benchmarking sample is smaller than the total cost benchmarking sample.

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INTERROGATORY 90:

Reference(s): **Exhibit 1B, Tab 2, Schedule 5, Appendix (8) to Appendix B, pages 55-61**

Please provide the data in Figures 23, 24, and 25 as a total cost per customer basis, and peak demand per customer basis.

RESPONSE (PREPARED BY PSE):

The requested data is provided in Appendix A to this response.

Ontario Data

Firm ID	Name	Cost/customer	kW/customer
500	ALGOMA POWER INC.	1,742	3.448
501	ATIKOKAN HYDRO INC.	925	2.705
502	BLUEWATER POWER DISTRIBUTION CORPORATION	557	5.208
503	BRANT COUNTY POWER INC.	787	5.556
504	BRANTFORD POWER INC.	485	5.042
505	BURLINGTON HYDRO INC.	533	5.761
506	CAMBRIDGE and NORTH DUMFRIES HYDRO INC.	546	5.867
507	CANADIAN NIAGARA POWER INC.	718	3.933
508	CENTRE WELLINGTON HYDRO LTD.	554	4.310
509	CHAPLEAU PUBLIC UTILITIES CORPORATION	618	5.051
510	COLLUS POWER CORPORATION	455	3.671
511	COOPERATIVE HYDRO EMBRUN INC.	523	3.445
512	E.L.K. ENERGY INC.	394	5.606
513	ENERSOURCE HYDRO MISSISSAUGA INC.	672	8.029
514	Entegrus Powerlines	540	4.753
515	ENWIN UTILITIES LTD.	712	6.201
516	ERIE THAMES POWERLINES CORPORATION	597	5.102
517	ESPANOLA REGIONAL HYDRO DISTRIBUTION CORPORATION	588	4.012
518	ESSEX POWERLINES CORPORATION	442	4.634
519	FESTIVAL HYDRO INC.	578	5.296
520	FORT FRANCES POWER CORPORATION	632	4.519
521	GREATER SUDBURY HYDRO INC.	525	4.157
522	GRIMSBY POWER INCORPORATED	465	4.691
523	GUELPH HYDRO ELECTRIC SYSTEMS INC.	613	5.750
524	HALDIMAND COUNTY HYDRO INC.	634	4.680
525	HALTON HILLS HYDRO INC.	641	6.861
526	HEARST POWER DISTRIBUTION COMPANY LIMITED	429	5.773
527	HORIZON UTILITIES CORPORATION	432	4.629
528	HYDRO 2000 INC.	475	5.060
529	HYDRO HAWKESBURY INC.	262	3.747
530	HYDRO ONE BRAMPTON NETWORKS INC.	483	5.887
531	HYDRO ONE NETWORKS INC.	1,187	3.252
532	HYDRO OTTAWA LIMITED	493	4.892
533	KENORA HYDRO ELECTRIC CORPORATION LTD.	560	3.726
534	KINGSTON HYDRO CORPORATION	480	4.772
535	KITCHENER-WILMOT HYDRO INC.	444	4.264
536	LAKEFRONT UTILITIES INC.	414	4.599
537	LAKELAND POWER DISTRIBUTION LTD.	599	4.170
538	LONDON HYDRO INC.	431	4.714
539	MIDLAND POWER UTILITY CORPORATION	633	5.600
540	MILTON HYDRO DISTRIBUTION INC.	513	5.171
541	NEWMARKET-TAY POWER DISTRIBUTION LTD.	469	4.650
542	NIAGARA PENINSULA ENERGY INC.	646	5.178
543	NIAGARA-ON-THE-LAKE HYDRO INC.	700	5.502
544	NORFOLK POWER DISTRIBUTION INC.	650	4.471
545	NORTH BAY HYDRO DISTRIBUTION LIMITED	546	4.594
546	NORTHERN ONTARIO WIRES INC.	577	3.828
547	OAKVILLE HYDRO ELECTRICITY DISTRIBUTION INC.	646	5.764
548	ORANGEVILLE HYDRO LIMITED	534	4.223
549	ORILLIA POWER DISTRIBUTION CORPORATION	591	4.456
550	OSHAWA PUC NETWORKS INC.	427	4.311
551	OTTAWA RIVER POWER CORPORATION	465	3.369
552	PARRY SOUND POWER CORPORATION	687	5.309
553	PETERBOROUGH DISTRIBUTION INCORPORATED	516	4.341
554	POWERSTREAM INC.	565	5.804

US Data

Firm ID	Name	Cost/customer	kW/customer
2	Alabama Power Co	785	8.083
8	AmerenUE	748	7.070
9	Appalachian Power Company	577	7.546
10	Arizona Public Service Co	806	6.304
11	Atlantic City Electric Co	716	5.104
12	Avista Corp	644	4.604
13	Baltimore Gas & Electric Co	748	5.691
15	Black Hills Power Inc	851	6.347
20	Carolina Power & Light Co	636	8.143
21	Central Hudson Gas & Electric Corp (CHGE)	962	4.451
23	Central Maine Power Co	504	2.621
27	Cincinnati Gas & Electric Co (Duke Energy OH)	589	5.753
29	Cleco Corp	756	8.010
30	Cleveland Electric Illuminating Co (First Energy)	477	5.976
32	Commonwealth Edison Co	687	6.050
36	Connecticut Light & Power Co	882	4.441
40	Consolidated Edison Co of new York Inc (CONED)	1,072	3.302
43	Consumers Energy Company	617	4.534
44	Dayton Power & Light Co	554	5.712
45	Delmarva Power & Light Co	768	8.253
46	Detroit Edison	698	5.184
47	Duke Energy Corp	651	7.042
48	Duquesne Light Co	732	5.078
51	El Paso Electric Co	448	4.416
53	Empire District Electric Co (MO)	876	7.050
54	Entergy Arkansas Inc	681	9.745
57	Entergy Mississippi Inc	676	7.663
58	Entergy New Orleans Inc	635	6.372
62	Florida Power & Light Co	462	4.940
63	Florida Power Corp	574	6.136
64	Georgia Power Co	718	7.127
67	Green Mountain Power Corp	737	4.215
68	Gulf Power Co	580	5.736
73	Idaho Power Co	721	6.171
76	Indiana Michigan Power Co	504	8.026
78	Indianapolis Power & Light Co	498	6.510
87	Jersey Central Power & Light Co	799	5.838
89	Kansas City Power & Light Co (MO)	694	7.116
91	Kentucky Power Co (AEP)	805	8.661
92	Kentucky Utilities Co	550	7.974
98	Louisville Gas and Electric Co	519	7.003
99	Madison Gas and Electric Co	746	5.322
105	Metropolitan Edison Co	790	5.490
110	Mississippi Power Co	961	14.452
111	Monongahela Power Co	634	5.012
113	MDU Resources Group, Inc.	403	4.257
119	Nevada Power Co	672	6.710
124	new York State Electric & Gas Corp (NYSEG)	728	3.442
126	Niagara Mohawk Power Corp (National Grid)	1,068	4.991
130	Northern Indiana Public Service Co	625	6.915
131	Northern States Power Co (XCEL)	517	5.585
135	Ohio Edison Co (First Energy)	353	5.739
136	Ohio Power Co (AEP)	600	6.901
138	Oklahoma Gas and Electric Co	700	8.760
140	Orange and Rockland Utilities Inc (O&R)	987	6.766

Combined Data

Firm ID	Name	Cost/customer	kW/customer
2	Alabama Power Co	785	8.083
8	AmerenUE	748	7.070
9	Appalachian Power Company	577	7.546
10	Arizona Public Service Co	806	6.304
11	Atlantic City Electric Co	716	5.104
12	Avista Corp	644	4.604
13	Baltimore Gas & Electric Co	748	5.691
15	Black Hills Power Inc	851	6.347
20	Carolina Power & Light Co	636	8.143
21	Central Hudson Gas & Electric Corp (CHGE)	962	4.451
23	Central Maine Power Co	504	2.621
27	Cincinnati Gas & Electric Co (Duke Energy OH)	589	5.753
29	Cleco Corp	756	8.010
30	Cleveland Electric Illuminating Co (First Energy)	477	5.976
32	Commonwealth Edison Co	687	6.050
36	Connecticut Light & Power Co	882	4.441
40	Consolidated Edison Co of new York Inc (CONED)	1,072	3.302
43	Consumers Energy Company	617	4.534
44	Dayton Power & Light Co	554	5.712
45	Delmarva Power & Light Co	768	8.253
46	Detroit Edison	698	5.184
47	Duke Energy Corp	651	7.042
48	Duquesne Light Co	732	5.078
51	El Paso Electric Co	448	4.416
53	Empire District Electric Co (MO)	876	7.050
54	Entergy Arkansas Inc	681	9.745
57	Entergy Mississippi Inc	676	7.663
58	Entergy New Orleans Inc	635	6.372
62	Florida Power & Light Co	462	4.940
63	Florida Power Corp	574	6.136
64	Georgia Power Co	718	7.127
67	Green Mountain Power Corp	737	4.215
68	Gulf Power Co	580	5.736
73	Idaho Power Co	721	6.171
76	Indiana Michigan Power Co	504	8.026
78	Indianapolis Power & Light Co	498	6.510
87	Jersey Central Power & Light Co	799	5.838
89	Kansas City Power & Light Co (MO)	694	7.116
91	Kentucky Power Co (AEP)	805	8.661
92	Kentucky Utilities Co	550	7.974
98	Louisville Gas and Electric Co	519	7.003
99	Madison Gas and Electric Co	746	5.322
105	Metropolitan Edison Co	790	5.490
110	Mississippi Power Co	961	14.452
111	Monongahela Power Co	634	5.012
113	MDU Resources Group, Inc.	403	4.257
119	Nevada Power Co	672	6.710
124	new York State Electric & Gas Corp (NYSEG)	728	3.442
126	Niagara Mohawk Power Corp (National Grid)	1,068	4.991
130	Northern Indiana Public Service Co	625	6.915
131	Northern States Power Co (XCEL)	517	5.585
135	Ohio Edison Co (First Energy)	353	5.739
136	Ohio Power Co (AEP)	600	6.901
138	Oklahoma Gas and Electric Co	700	8.760
140	Orange and Rockland Utilities Inc (O&R)	987	6.766

Ontario Data

Firm ID	Name	Cost/customer	kW/customer
555	PUC DISTRIBUTION INC.	550	4.278
556	RENFREW HYDRO INC.	559	4.281
557	RIDEAU ST. LAWRENCE DISTRIBUTION INC.	451	5.580
558	SIOUX LOOKOUT HYDRO INC.	778	6.610
559	ST. THOMAS ENERGY INC.	452	3.858
560	THUNDER BAY HYDRO ELECTRICITY DISTRIBUTION INC.	536	3.458
561	TILLSONBURG HYDRO INC.	610	5.690
562	TORONTO HYDRO-ELECTRIC SYSTEM LIMITED	852	6.829
563	VERIDIAN CONNECTIONS INC.	477	4.590
564	WASAGA DISTRIBUTION INC.	349	2.379
565	WATERLOO NORTH HYDRO INC.	657	5.472
566	WELLAND HYDRO-ELECTRIC SYSTEM CORP.	436	2.983
567	WELLINGTON NORTH POWER INC.	719	4.796
568	WEST COAST HURON ENERGY INC.	615	7.001
569	WESTARIO POWER INC.	483	3.890
570	WHITBY HYDRO ELECTRIC CORPORATION	542	4.990

US Data

Firm ID	Name	Cost/customer	kW/customer
142	Pacific Gas and Electric Co	851	3.650
145	Pennsylvania Electric Co	913	5.091
146	Pennsylvania Power Co	615	6.890
148	Portland General Electric Co	671	4.344
149	Potomac Edison Co	540	7.575
150	Potomac Electric Power Co	1,150	8.594
151	PP&L Inc	705	5.204
152	PSI Energy Inc (Duke Energy IN)	640	7.720
153	Public Service Co of Colorado	551	4.931
154	Public Service Co of new Hampshire	660	3.375
155	Public Service Co of new Mexico (PNM)	424	3.988
156	Public Service Co of Oklahoma	696	8.125
158	Puget Sound Energy	658	4.060
159	Rochester Gas and Electric Corp	777	4.584
163	San Diego Gas & Electric Co	822	3.286
165	Sierra Pacific Power Co	745	4.733
167	South Carolina Electric & Gas Co	724	7.223
169	Southern California Edison Co	821	4.490
171	Southern Indiana Gas and Electric Co (Vectern)	689	9.004
172	Southwestern Electric Power Co (AEP)	658	10.289
174	Southwestern Public Service (Xcel)	554	13.767
178	Tampa Electric Co	601	5.772
183	Tucson Electric Power Co	539	6.921
186	United Illuminating Co	952	4.210
195	Virginia Electric and Power Co	609	6.994
196	West Penn Power Co (Allegheny Power)	503	5.494
198	Western Massachusetts Electric Co (Northeast Utilities)	875	3.847
201	Wisconsin Electric Power Co (WEPCO)	560	5.515
202	Wisconsin Power and Light Co	673	6.016
203	Wisconsion Public Service Co	563	5.295
562	TORONTO HYDRO-ELECTRIC SYSTEM LIMITED	852	6.829

Combined Data

Firm ID	Name	Cost/customer	kW/customer
142	Pacific Gas and Electric Co	851	3.650
145	Pennsylvania Electric Co	913	5.091
146	Pennsylvania Power Co	615	6.890
148	Portland General Electric Co	671	4.344
149	Potomac Edison Co	540	7.575
150	Potomac Electric Power Co	1,150	8.594
151	PP&L Inc	705	5.204
152	PSI Energy Inc (Duke Energy IN)	640	7.720
153	Public Service Co of Colorado	551	4.931
154	Public Service Co of new Hampshire	660	3.375
155	Public Service Co of new Mexico (PNM)	424	3.988
156	Public Service Co of Oklahoma	696	8.125
158	Puget Sound Energy	658	4.060
159	Rochester Gas and Electric Corp	777	4.584
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167	South Carolina Electric & Gas Co	724	7.223
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171	Southern Indiana Gas and Electric Co (Vectern)	689	9.004
172	Southwestern Electric Power Co (AEP)	658	10.289
174	Southwestern Public Service (Xcel)	554	13.767
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195	Virginia Electric and Power Co	609	6.994
196	West Penn Power Co (Allegheny Power)	503	5.494
198	Western Massachusetts Electric Co (Northeast Utilities)	875	3.847
201	Wisconsin Electric Power Co (WEPCO)	560	5.515
202	Wisconsin Power and Light Co	673	6.016
203	Wisconsion Public Service Co	563	5.295
500	ALGOMA POWER INC.	1,742	3.448
501	ATIKOKAN HYDRO INC.	925	2.705
502	BLUEWATER POWER DISTRIBUTION CORPORATION	557	5.208
503	BRANT COUNTY POWER INC.	787	5.556
504	BRANTFORD POWER INC.	485	5.042
505	BURLINGTON HYDRO INC.	533	5.761
506	CAMBRIDGE and NORTH DUMFRIES HYDRO INC.	546	5.867
507	CANADIAN NIAGARA POWER INC.	718	3.933
508	CENTRE WELLINGTON HYDRO LTD.	554	4.310
509	CHAPLEAU PUBLIC UTILITIES CORPORATION	618	5.051
510	COLLUS POWER CORPORATION	455	3.671
511	COOPERATIVE HYDRO EMBRUN INC.	523	3.445
512	E.L.K. ENERGY INC.	394	5.606
513	ENERSOURCE HYDRO MISSISSAUGA INC.	672	8.029
514	Entegrus Powerlines	540	4.753
515	ENWIN UTILITIES LTD.	712	6.201
516	ERIE THAMES POWERLINES CORPORATION	597	5.102
517	ESPANOLA REGIONAL HYDRO DISTRIBUTION CORPORATION	588	4.012
518	ESSEX POWERLINES CORPORATION	442	4.634
519	FESTIVAL HYDRO INC.	578	5.296
520	FORT FRANCES POWER CORPORATION	632	4.519
521	GREATER SUDBURY HYDRO INC.	525	4.157
522	GRIMSBY POWER INCORPORATED	465	4.691
523	GUELPH HYDRO ELECTRIC SYSTEMS INC.	613	5.750
524	HALDIMAND COUNTY HYDRO INC.	634	4.680

Ontario Data

Firm ID	Name	Cost/customer	kW/customer

US Data

Firm ID	Name	Cost/customer	kW/customer

Combined Data

Firm ID	Name	Cost/customer	kW/customer
525	HALTON HILLS HYDRO INC.	641	6.861
526	HEARST POWER DISTRIBUTION COMPANY LIMITED	429	5.773
527	HORIZON UTILITIES CORPORATION	432	4.629
528	HYDRO 2000 INC.	475	5.060
529	HYDRO HAWKESBURY INC.	262	3.747
530	HYDRO ONE BRAMPTON NETWORKS INC.	483	5.887
531	HYDRO ONE NETWORKS INC.	1,187	3.252
532	HYDRO OTTAWA LIMITED	493	4.892
533	KENORA HYDRO ELECTRIC CORPORATION LTD.	560	3.726
534	KINGSTON HYDRO CORPORATION	480	4.772
535	KITCHENER-WILMOT HYDRO INC.	444	4.264
536	LAKEFRONT UTILITIES INC.	414	4.599
537	LAKELAND POWER DISTRIBUTION LTD.	599	4.170
538	LONDON HYDRO INC.	431	4.714
539	MIDLAND POWER UTILITY CORPORATION	633	5.600
540	MILTON HYDRO DISTRIBUTION INC.	513	5.171
541	NEWMARKET-TAY POWER DISTRIBUTION LTD.	469	4.650
542	NIAGARA PENINSULA ENERGY INC.	646	5.178
543	NIAGARA-ON-THE-LAKE HYDRO INC.	700	5.502
544	NORFOLK POWER DISTRIBUTION INC.	650	4.471
545	NORTH BAY HYDRO DISTRIBUTION LIMITED	546	4.594
546	NORTHERN ONTARIO WIRES INC.	577	3.828
547	OAKVILLE HYDRO ELECTRICITY DISTRIBUTION INC.	646	5.764
548	ORANGEVILLE HYDRO LIMITED	534	4.223
549	ORILLIA POWER DISTRIBUTION CORPORATION	591	4.456
550	OSHAWA PUC NETWORKS INC.	427	4.311
551	OTTAWA RIVER POWER CORPORATION	465	3.369
552	PARRY SOUND POWER CORPORATION	687	5.309
553	PETERBOROUGH DISTRIBUTION INCORPORATED	516	4.341
554	POWERSTREAM INC.	565	5.804
555	PUC DISTRIBUTION INC.	550	4.278
556	RENFREW HYDRO INC.	559	4.281
557	RIDEAU ST. LAWRENCE DISTRIBUTION INC.	451	5.580
558	SIOUX LOOKOUT HYDRO INC.	778	6.610
559	ST. THOMAS ENERGY INC.	452	3.858
560	THUNDER BAY HYDRO ELECTRICITY DISTRIBUTION INC.	536	3.458
561	TILLSONBURG HYDRO INC.	610	5.690
562	TORONTO HYDRO-ELECTRIC SYSTEM LIMITED	852	6.829
563	VERIDIAN CONNECTIONS INC.	477	4.590
564	WASAGA DISTRIBUTION INC.	349	2.379
565	WATERLOO NORTH HYDRO INC.	657	5.472
566	WELLAND HYDRO-ELECTRIC SYSTEM CORP.	436	2.983
567	WELLINGTON NORTH POWER INC.	719	4.796
568	WEST COAST HURON ENERGY INC.	615	7.001
569	WESTARIO POWER INC.	483	3.890
570	WHITBY HYDRO ELECTRIC CORPORATION	542	4.990

RESPONSES TO BUILDING OWNERS AND MANAGERS ASSOCIATION, GREATER TORONTO INTERROGATORIES

INTERROGATORY 91:

Reference(s): **Exhibit 1B**

Please provide a detailed explanation of the "dummy" variable for the urban core in the PSE analysis. What does its coefficient signify?

RESPONSE (PREPARED BY PSE):

Please see the urban core variable description contained on page 17 of the PSE Report. The coefficient signifies the model's estimation of how much expected costs increase if the utility serves a large urban core, as defined in the study.