EB-2012-0064

Ontario Energy Board

IN THE MATTER OF the *Ontario Energy Board Act, 1998*, S.O. 1998, c. 15, (Schedule B);

AND IN THE MATTER OF an application by **TORONTO HYDRO ELECTRIC SYSTEM LIMITED** for an order approving just and reasonable rates and other charges for electricity distribution to be effective June 1, 2012, May 1, 2013 and May 1, 2014.

ENERGY PROBE RESEARCH FOUNDATION
(“ENERGY PROBE”)
CROSS-EXAMINATION COMPENDIUM

PANEL 1A

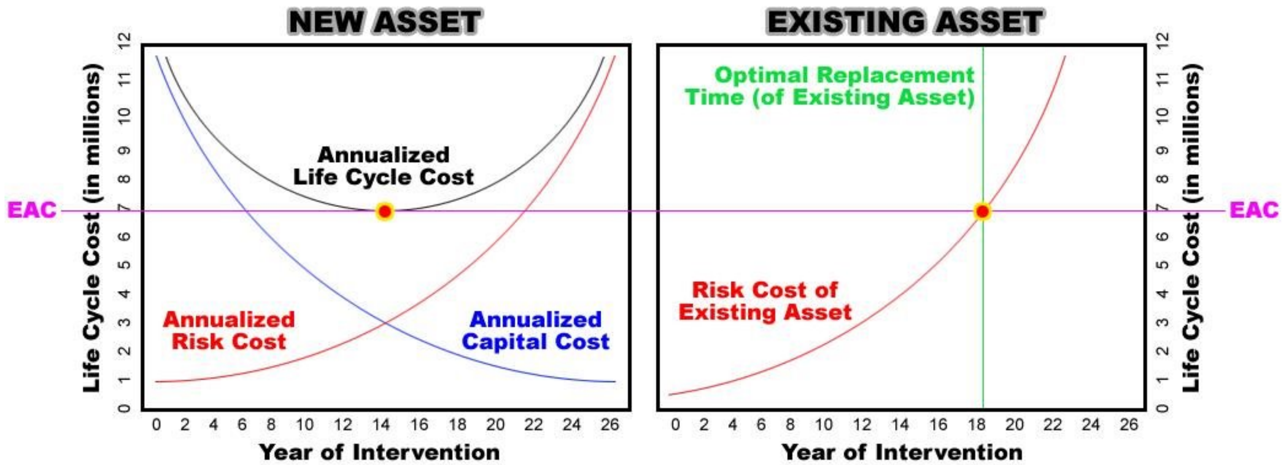

Figure 2: Illustrative Example of Optimal Intervention Time (Existing Assets)

At a more detailed level, the FIM approach compares the costs that THESL and its customers will experience if an existing asset fails weighted by the probability of failure[1] (Risk Cost) against the annualized cost of replacing that asset with a new one. These asset-related failure costs include both the cost of replacing the failed asset and the costs that customers will incur as a result of the failure. The cost of replacing the failed asset includes the cost of acquiring and installing the new asset and any additional costs necessitated by the fact it failed in operation and must be replaced on a reactive basis.

The cost of failure to customers is based on the consequences of failure for each asset. Consequence costs depend on the magnitude and duration of customer interruptions associated with a particular asset. The FIM bases the magnitude of an outage on the peak load interrupted, which is calculated based on the location of the asset and the configuration of the distribution system at its location. This is good proxy for the magnitude of customer impacts because it accounts for the combined load of different customer classes that are served by the asset and the fact that more outages occur during peak periods when assets are heavily loaded. The duration of the outage is estimated based on the following parameters for each asset class:

[1] The probability of an asset's failure at any point in time is based on its age and condition. This information is derived as described in the Asset Condition Assessment. Age-and-condition parameters are translated into a probability of failure using a Hazard Rate Distribution Function, which represents the conditional probability of failure for any given asset in the population that has survived to that time.

(i) The type of failed asset.
(ii) The type of asset failure mode.
(iii) The manner in which the asset is configured within the distribution system.
(iv) The process by which the system is restored to its former (pre-outage) state (e.g., repair or replacement of asset)

The risk costs also include non-asset related failure costs. These are the costs of failures that derive from causes other than the asset itself. These causes include weather, vegetation, animal interference and human interference.

The FIM can be used to evaluate either replacement of a single asset or replacement of asset combinations involving various asset types present on a feeder. This latter "job-based" approach allows engineering staff to evaluate the grouping of assets within a job, in terms of the comparative benefits of replacement. When several assets are replaced together in a job, there are additional costs and savings.

The additional costs derive from the fact that not every asset being replaced will be at its optimal replacement time. Assets may be before, at, or beyond their optimal replacement time. Thus some assets will have sacrificed economic life because they are replaced before their optimal replacement time, while others will have incurred excess risk cost because they are replaced after their optimal replacement time. The cumulative sacrificed life and excess risk of the assets included in the job becomes a cost against the project.

The benefits from replacing assets together derive from the savings realized from concurrent replacement. These "concurrent intervention" benefits are the savings from replacing multiple assets in a single job. They include factors such as improved equipment utilization, reduced set-up time, improved transportation of crew and material, and reduced road blockage costs. These benefits must be weighed against the total costs (cumulative asset excess risk and sacrificed life values) in order to produce an overall project net cost calculation.

The cumulative sacrificed life and excess risk of the assets being replaced shown by the red curve in Figure 3. The concurrent intervention benefits are illustrated by the green curve in used to estimate the total U/G concrete-encased TR-XLPE cable to be installed as part of the future state.

The existing assets' age and condition data, along with the installed load within their respective protected regions' were utilized as part of the existing asset risk calculation. These same loading parameters were then applied to the new front lot underground infrastructure as part of the new asset risk calculation.

In addition to those risks related to an asset's age and condition, by knowing the length and loading of each protected region, the non-asset risks (NAR) of the current and future states can also be calculated and utilized as part of the cost of ownership determination.

5.2 Non Asset Risk - Procedure

Non-Asset Risks (NAR) are risks incurred due to any factor that may lead to an outage on the system that is not directly tied to the assets' age and condition, including animal contact, lightning, adverse weather, and human elements.

These risks are based upon historical failures that were identified to be caused by factors that are considered to be non-asset related. The information regarding the historical failures is attained from ten years worth of historical outage data.

Information regarding the number of outages, customer interruptions (CI) and customer hours interrupted (CHI) are captured at the feeder level from this historical outage data. This information is then normalized over the total length of the feeder, such that this historical non-asset-related information is calculated on a per meter basis for that given feeder. This normalized value is multiplied by the length of the area of study in order to project this historical non-asset risk information to the area of study.

This information can then be translated into a quantified NAR by accounting for the customer interruption costs, as well as the installed load within the area of study, measured in kVA, which will be impacted should any of these non-asset-related events take place.

These costs are used as part of a net present value calculation to produce the final quantified NAR associated with the area of study. Therefore, it is assumed that these non-asset risks will continue to exist over the entire life cycle of each asset.

The overhead system and the underground system have varying non-asset outage causes associated with them because the non-asset factors that affect an overhead system are different from those that affect the underground system. The NAR sources that impact the overhead distribution system include storms, tree contacts, adverse environments (e.g., salt spray), animal/bird contacts, human elements, extreme temperature, and vehicles. In contrast, the underground distribution system is only affected by dig-ins, and then only for underground direct buried cables, because the underground system is sheltered from the majority of risks that face the overhead system. As a result, underground cables located in concrete-encased conduits do not face non-asset risks because the concrete encasement of the cables protects them from dig-ins.

5.3 Project Net Benefit (NPV) Calculation - Procedure

As previously described, the cost of ownership represents the net present value of the various costs associated with the respective existing assets across their life cycles (100-year period). Both asset-related and non-asset-related risk costs are considered as part of this cost of ownership calculation.

Also as previously mentioned, asset-related risks include the direct and indirect costs associated with asset replacement and resulting outage impacts to customers, while non-asset risks include the indirect costs associated with outage impacts due to weather, animal and human-related events.

The cost of ownership was calculated for each "state" of the assets – the existing overhead rear lot assets as well as the new underground front lot assets. The individual cost of ownership values for each asset are summed up to represent these respective states.

In addition, this business case evaluation also considers other alternatives, such as rebuilding the existing rear lot overhead assets to front lot overhead assets, or rebuilding the existing rear lot assets like-for-like as new rear lot assets. Cost of ownership was calculated using the formulas provided below:

- Cost of Ownership for Existing Assets (COO_E) = (NPV1 + NAR1)
- Cost of Ownership for New Assets (COO_N) = (NPV2 + NAR2)

Where:

- NPV1 represents cost of ownership of the existing overhead rear-lot assets to be replaced, including the assets' probability of failure multiplied with their impacts of failure which include direct and indirect cost attributes associated with in-service asset failures, costs of customer interruptions, emergency repairs and replacement.
- NAR1 represents the NPV calculation of non-asset risks associated with the existing overhead rear-lot plant, including animal-related, weather-related and human-related impacts taking place over the life cycle of this infrastructure. Further explanation of the Non-Asset Risk calculation is provided in Section 5.2.
- NPV2 represents cost of ownership of the new assets to be installed, including the assets' probability of failure multiplied with their impacts of failure which include direct and indirect cost attributes associated with in-service asset failures, costs of customer interruptions, emergency repairs and replacement.
- NAR2 represents the NPV calculation of non-asset risks associated with the new state. For underground front-lot plant, this would be attributed to dig-in impacts taking place over the life cycle of this infrastructure. Further explanation of the Non-Asset Risk calculation is provided in Section 5.2.

The overall project net present value is calculated using the following formula shown below:

- Project NPV = (COO_E – COO_N) – Project Cost

Thus, the segment NPV value reflects the difference in the cost of ownership between the existing construction and new construction, after the total cost of the project has been subtracted.

5.4 Project Net Benefit (NPV) Calculation – Numerical Calculation

The following options have been considered as part of the business case evaluation:

- Option 1: Status Quo (Do not replace existing rear lot construction, plus remediation on an as-needed basis)
- Option 2: Like-for-Like Replacement of Existing O/H Rear Lot with New O/H Rear Lot
- Option 3: Replacement of Existing O/H Rear Lot with New O/H Front Lot
- Option 4: Replacement of Existing O/H Rear Lot with New U/G Front Lot

Options 1, 2 and 4 were further analyzed as per the quantitative Project NPV calculation, in order to determine the most optimal option for execution. Option 3 – Replacement of existing rear lot infrastructure with overhead front lot infrastructure – was not considered as part of this analysis, as it was determined not to be a feasible solution. This is due to the historically strong opposition to front lot overhead conversion that has been experienced in the past, including customer opposition as well as difficulties in securing permits from the City of Toronto. A specific example of this instance is the Whitebirch rear lot conversion job, in which the planned approach was to convert the existing rear lot infrastructure to an overhead front lot design. This approach was met with extreme opposition from city councillors, and was ultimately rejected by the councillors and residents. Tables A1 through to A3 highlight the results of the evaluation options.

1 **Table A1: Status Quo (Remediation on an as-needed basis)**

Business Case Element	**Estimated Cost ($, millions)**
OPTION 1 – Status Quo (Remediation on an as-needed basis)	
Cost of Ownership of Existing Rear Lot Construction (COO_E)	
Projected risk cost of existing rear lot (NPV)	$7.95
Projected non-asset risk cost of existing rear lot (NPV)	$102.48
Maintenance cost of existing rear lot	$0.68
TOTAL (COO_E)	**$111.11**

/C

2 **Table A2: Like-for-Like Replacement of Existing O/H Rear Lot with New O/H Rear Lot**

Business Case Element	**Estimated Cost ($, millions)**
OPTION 2 – Like-for-Like Replacement of Existing O/H Rear Lot with New O/H Rear Lot	
Cost of Ownership of New Standardized Rear Lot Construction (COO_N)	
Projected risk cost of new overhead rear lot (NPV)	$2.37
Projected non-asset risk cost of new overhead rear lot (NPV)	$102.48
Maintenance cost of new overhead rear lot	$0.68
TOTAL (COO_N)	**$105.53**
Option 2 Project Net Benefit	
TOTAL (COO_E)	**$111.11**
TOTAL (COO_N)	**$105.53**
PROJECT COST	**$7.36**
PROJECT NPV: ((COO_E – COO_N) – PROJECT COST)	**-$1.78**

/C

/C

Table A3: Replacement of Existing O/H Rear Lot with New U/G Front Lot

Business Case Element	**Estimated Cost ($, millions)**
OPTION 4 – Replacement of Existing O/H Rear Lot with New U/G Front Lot	
Cost of Ownership of New Standardized Underground Front Lot Construction (COO_N)	
Projected risk cost of underground front lot (NPV)	$11.55
Projected non-asset risk cost of underground front lot (NPV)	$0
Maintenance cost of underground front lot	$0.43
TOTAL (COO_N)	**$11.98**
Option 4 Project Net Benefit	
TOTAL (COO_E)	**$111.11**
TOTAL (COO_N)	**$11.98**
PROJECT COST	**$66.14**
PROJECT NPV: ((COO_E – COO_N) – PROJECT COST)	**$32.99**

/c
/c

To further illustrate the relationship between Non-Asset Risk and Asset Risk, a comparison was made against historically tracked CHI over the last ten-year period due to asset and non-asset causes for the rear lot feeders.

Table A4: NPV and CHI ratios of Non-Asset to Asset Risk for Existing Rear Lot

	NPV ($ in Millions)	**CHI (hrs)**
Asset Risk	7.95	784.45
Non-Asset Risk (NAR)	102.48	6193.21
Ratio (NAR/Asset Risk)	12.89	7.90

/c

The difference between the two ratios is attributed to the increasing trend of non-asset related outages. The graph includes outages from tree contacts, animal contacts, lightning, and adverse weather. Over the last five years, there has been an increasing trend in the amount of non-asset related failures. This is further illustrated in Figure A4. The 12.89 ratio represents a value that /c will be held constant over the next three years, even though the expected number of non-asset will be held constant over the next three years, even though the expected number of non-asset outage duration is forecasted to rise. It also reflects a run-to-fail approach of the assets, while the historical CHI data represents assets that have had planned work performed on them.

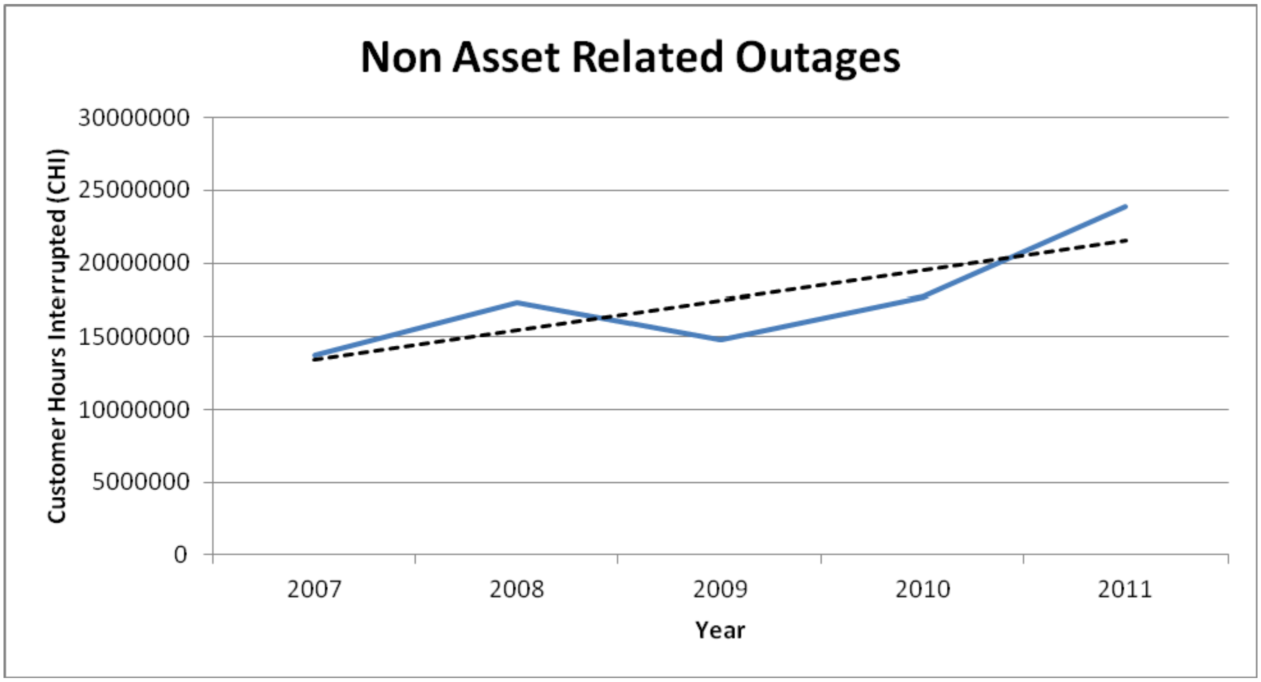

Figure A4: Growth of CHI due to increasing non-asset outages system-wide

Table 4: Customer Connections Capital Summary ($ M)

	2012	**2013**	~~**2014**~~
Customer Connections Capital (Gross)	42.08	49.25	~~62.00~~
Customer Contributions	(17.10)	(11.86)	~~(32.00)~~
Customer Connections Capital (Net)	24.98	37.39	~~30.00~~

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4. Reactive Capital

Reactive Capital is comprised of capital expenditures necessary to repair defective and failed equipment. This work is non-discretionary in nature and required to restore power to customers in the case of outages, to mitigate potential safety risks to the public, to maintain system integrity, to maintain accurate billing, to perform corrective work to address failed and defective equipment and/or to address other unexpected events that require immediate action. Such work and the related capital expenditures are unplanned, but THESL allocates funds for reactive work based on historical system performance, analyses of failure trends, and the trends of the number of work requests for reactive capital work over the past five years. Table 5 below presents the projected spending for Reactive Capital.

Table 5: Reactive Capital Summary ($ M)

	2012	2013	~~2014~~
Underground Assets	16.10	17.80	~~18.70~~
Overhead Assets	7.80	9.60	~~12.20~~
Stations and	0.70	1.10	~~1.00~~
Metering Assets	0.80	0.80	~~0.80~~
Total	25.40	29.30	~~32.70~~

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GTA REALTORS® Release Monthly Resale Housing Figures

TORONTO, December 5, 2012 -- Greater Toronto Area REALTORS® reported 5,793 sales in November 2012 – down by 16 per cent compared to November 2011.

"Transactions have been down on a year-over-year basis since June, after being up substantially in the last half of 2011 and the first half of 2012. Some buyers pulled forward their decision to purchase, which has impacted sales levels in the second half of 2012," said Toronto Real Estate Board (TREB) President Ann Hannah.

"Stricter mortgage lending guidelines, including a reduced maximum amortization period and a purchase price ceiling of one-million dollars for government insured mortgages, have prompted some buyers to move to the sidelines. This situation has been exacerbated in the City of Toronto because the additional upfront Land Transfer Tax takes money away from buyers that otherwise could be used for a larger down payment," continued Ms. Hannah.

The average selling price was up by 1.6 per cent annually to $485,328. The MLS® Home Price Index (MLS® HPI) Composite Benchmark was up by 4.6 per cent compared to last year.

"The moderate annual rate of price growth compared to previous months was largely due to a different mix in detached home sales this year compared to last, particularly in the City of Toronto. The share of detached homes that sold for over one-million dollars was down substantially, which influenced the overall average price," said Jason Mercer, TREB's Senior Manager of Market Analysis.

"The MLS® HPI detached benchmark price, which tracks the price for a home with the same attributes over time, was up by almost six per cent in Toronto, suggesting that market conditions for low-rise homes remain quite tight despite a changing mix of sales," added Mercer.

Summary of TorontoMLS Sales and Average Price

November 1 - 30

	2012			2011		
	Sales	Average Price	New Listings	Sales	Average Price	New Listings
City of Toronto ("416")	2,308	$517,866	4,056	2,952	$520,664	4,200
Rest of GTA ("905")	3,485	$463,779	5,782	3,956	$445,434	5,507
GTA	5,793	$485,328	9,838	6,908	$477,582	9,707

TorontoMLS Sales & Average Price By Home Type

November 1 - 30, 2012

	Sales			Average Price		
	416	905	Total	416	905	Total
Detached	764	1,954	2,718	741,480	556,745	608,672
Yr./Yr. % Change	-18.5%	-10.6%	-13.0%	-3.8%	3.5%	0.1%

Semi-Detached	280	397	677	583,117	392,067	471,083
Yr./Yr. % Change	-12.5%	-9.4%	-10.7%	3.8%	5.8%	4.4%
Townhouse	248	657	905	440,930	347,461	373,074
Yr./Yr. % Change	-28.1%	-6.4%	-13.6%	5.3%	1.3%	1.4%
Condo Apartment	987	392	1,379	350,540	279,483	330,341
Yr./Yr. % Change	-25.1%	-26.5%	-25.5%	-3.9%	2.5%	-2.3%

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GTA Commercial REALTORS® Release MonthlyCommercial Market Figures

TORONTO, December 5, 2012 -- Toronto Real Estate Board (TREB) Commercial Division Members reported 486,656 leased square feet of industrial, commercial/retail and office space through the TorontoMLS system in November 2012. This result was down by 27 per cent in comparison to November 2011.

Industrial properties accounted for 85 per cent of space leased, or 413,886 square feet – down by 21 per cent compared to last year. While the amount of industrial space leased was down year-over-year, the average lease rate for transactions undertaken on a per square foot net basis was up by four per cent to $5.14.

"A key theme in any discussion regarding the Canadian economy this year has been uncertainty. While economic growth in Canada continues to be driven by domestic consumer and business spending, growth in the export sector, which is so important to industrial concerns in the GTA, has continued to be anemic. Recession in Europe and slow growth in the United States and Asia have been at the root of this problem. This economic uncertainty has translated into less industrial space leased compared to a year ago, as some firms have put their real estate investment decisions on hold," said TREB Commercial Division Chair Cynthia Lai.

There were 50 sales of industrial, commercial/retail and office properties in November 2012 – down by 19 per cent in comparison to November 2011. Sales were more evenly distributed by market segment, in comparison to the leasing market, with 36 per cent of transactions accounted for by industrial properties, 42 per cent accounted for by commercial/retail properties and 22 per cent accounted for by office properties.

The average selling price per square foot for transactions where pricing was disclosed was up on a year-over-year basis for industrial and commercial/retail properties, while the price was down for office properties.

"The year-over-year change in the average selling prices was likely due to a combination of a change in market conditions in some parts of the GTA compared to last year and a change in the mix of properties sold this year compared to last," added Lai.

November 2012: Per Square Foot Net Commercial Leasing Summary

Lease Transactions Completed on a *Per Square Foot Net Basis with Pricing Disclosed* on TorontoMLS

Leased Sq. Ft. (Price Disclosed, Per Sq.Ft. Net)

	Nov. 2012	Nov. 2011	% Change
Industrial	413,886	525,743	-21.3%
Commercial	47,087	81,597	-42.3%
Office	25,683	58,197	-55.9%
Total	486,656	665,537	-26.9%

Source: TREB Commercial Division

Avg. Lease Rate (Price Disclosed, Per Sq.Ft. Net)

	Nov. 2012	Nov. 2011	% Change
Industrial	$5.14	$4.94	4.1%
Commercial	$19.11	$18.77	1.8%
Office	$14.10	$12.40	13.7%

November 2012: Commercial Sales Completed with Pricing Disclosed on TorontoMLS

Sales (Price Disclosed)

	Nov. 2012	Nov. 2011	% Change
Industrial	18	24	-25.0%
Commercial	21	25	-16.0%
Office	11	13	-15.4%
Total	50	62	-19.4%

Avg. Sale Price Per Sq. Ft. (Pricing Disclosed)

	Nov. 2012	Nov. 2011	% Change
Industrial	$84.55	$73.67	14.8%
Commercial	$251.46	$194.42	29.3%
Office	$157.34	$233.45	-32.6%

As a whole, THESL's underground plant has been improving in reliability over the last few years due to increasing capital investment and replacement of assets which are at or beyond end of useful life. Despite this improvement, however, the remaining cables, as they continue to age, will continue to have more faults resulting in the need for more reactive capital funds to address the cable faults. A reduction in the planned spending on reactive capital can only exacerbate the current situation.

The need for expenditures on Overhead assets is projected to remain stable.

With respect to meters, THESL is responsible for maintaining the accuracy of all customers' billing and metering. It must address defective meters to be compliant with the Minister of Energy's directive on smart meter installation and the metering requirements set out by Measurement Canada in the Electricity and Gas Act. As part of this program, defective meters are replaced on a reactive basis. THESL forecasts a steady level of spending for these meter replacements.

5. Continuing Projects and Emerging Issues Portfolio

The Continuing Projects and Emerging Issues Portfolio consists of projects from 2011 which are being completed in 2012, and emerging projects which arise from issues that are difficult or impossible to anticipate and are likely to require attention within a year. The emerging projects are typically in response to reliability and/or safety issues and projects that have emerged on short notice such as externally- initiated relocations. The projects in the portfolio are non-discretionary and are classified into the following groups:

- Continuing projects from 2011 into 2012
- Emerging projects for 2012
- Emerging projects for 2013 ~~and 2014~~

The continuing projects consist of: a) projects that were initiated in 2011 and scheduled to be completed in 2012 and b) projects that were deferred from 2011 to 2012 due to the emergence of higher priority projects. These continuing projects address crucial reliability and/or safety issues, and support the infrastructure-related initiatives of external stakeholders such as the City of Toronto, the TTC, and GO Transit in their infrastructure-related initiatives. The deferral of 2012 continuing projects could result in the further deterioration of THESL's service reliability and THESL breaking its contractual commitment to external stakeholders, which may result in THESL facing cancellation penalties from vendors or external entities.

Emerging projects for 2012 consist of programs which include direct buried cables replacements, overhead rebuilds, and external plant relocations. Emerging projects aim to address pressing issues that require intervention within a year but not immediate attention, in contrast with those that are part of the Reactive Capital portfolio which deals with failed assets and assets that require immediate attention. These projects address many reliability issues (related to both the number of customer outages and the duration of outages) and replace and upgrade old and failing equipment. These projects include those for which THESL has entered into contracts with 3rd parties. The deferral or cancellation of any of these projects may add to the persistence of reliability and safety issues that have emerged in the recent. Work on emerging capital projects has already begun on selected projects to prevent further degradation of reliability of the system, potential safety risks, and uphold THESL's commitment to customer satisfaction.

The emerging projects for 2013~~-2014~~, consist of capital projects that are anticipated to require attention and capital investment within a year of being identified. Based on issues requiring short-term intervention that have surfaced in the past**,** THESL anticipates that the emerging projects for 2013~~-2014~~ will be related to reliability, safety, external plant relocation requests, XLPE (cross-linked polyethylene) cable in duct, underground residential distribution (URD) system, egress cable civil infrastructure, and/or cable chambers. The deferment or cancellation of these projects would likely prevent THESL from addressing the reliability and safety issues that are anticipated to emerge during 2013~~-2014~~ and hinder work done by external stakeholders, such as the City of Toronto, TTC, and Go Transit. Table 6 below summarizes the 2012-~~2014~~ projected spending in the portfolio.

Table 6: Capital Investment Proposed for the Continuing Projects and Emerging Issues ($M)

	2012	**2013**	**~~2014~~**
Continuing Projects from 2011 into 2012	16.85	-	
Emerging Projects for 2012	38.88	-	
Emerging Projects for 2013 ~~and 2014~~	-	40.00	~~24.90~~
Total	**55.73**	**40.00**	**~~24.90~~**

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stakeholders, such as the City of Toronto, TTC, and Go Transit. Table 6 below summarizes the 2012-2014 projected spending in the portfolio.

Table 6: Capital Investment Proposed for the Continuing Projects and Emerging Issues ($M)

	2012	**2013**	**2014**
Continuing Projects from 2011 into 2012	19.50	-	-
Emerging Projects for 2012	33.10		
Emerging Projects for 2013 and 2014	-	25.70	24.90
Total	**52.60**	**25.70**	**24.90**