EB-2016-0105

# Thunder Bay Hydro Electricity Distribution Inc.
# Application for electricity distribution rates beginning May 1, 2017

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VULNERABLE ENERGY CONSUMERS COALITION

(“VECC”)

CAPITAL EXPENDITURE PANEL

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June 29, 2017

# TAB 1

## 2-Staff-34

Ref: App. 2 – DSP – S 5.2.3.2: Summary of Performance over the Historical Period, Summary of Operational Effectiveness Measures – IV. System Reliability Indicators, p. 42

At the above reference, the following table is shown:

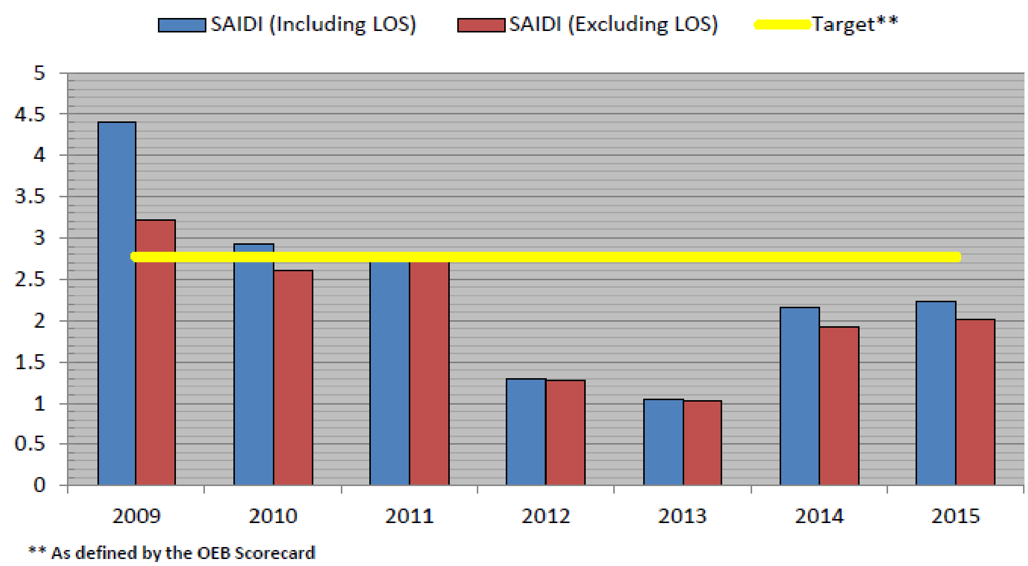



**Figure 5.2.3-2 Historical SAIDI Performance**

a) Please explain the reasons for the comparatively high SAIDI in 2009.
b) Please explain the reasons for the step improvement in SAIDI from 2011 to 2012.
c) Please explain the reasons for the increase in SAIDI from 2012 & 2013 to 2014 & 2015.

### Thunder Bay Hydro Response:

a) High SAIDI in 2009 was attributable to a windstorm we had on September 28 and a significant Loss of Supply event at Hydro One's FWTS in October.

b) 2011 to 2012 had less significantly sized outages due to fewer weather related outage events.

c) 2012 and 2013 had less significantly sized outages due to fewer weather related outage events.

2014 and 2015 could be considered a more “normal” year with regard to the number of significant weather related outage events.

i) The percentage of unknown outage causes (25%) is typical among Thunder Bay Hydro's peers. (Guelph Hydro from 2010-2014 recorded 31%, Waterloo in 2014 recorded 47%, North Bay Hydro from 2011-2013 recorded 33%)

ii) The likely drivers for the unidentified causes are; tree contacts and foreign interference on the line that burn off prior to a patrol.

b) Thunder Bay Hydro has recently invested in Smart Fault Indicators to place on feeders with a large amount of unknown outages. These indicators provide on-site and remote monitoring for accurate aid in determining status of the system and location of faults. They will provide real time event based reports: fault detection, momentary vs. permanent fault detection, fault current magnitude and duration, time stamp, loss of current.

## 2-Staff-35

Ref: App. 2 – DSP – S 5.2.3.2: Summary of Performance over the Historical Period, Summary of Operational Effectiveness Measures – IV. System Reliability Indicators, p. 44

At the above reference, the following table is shown:

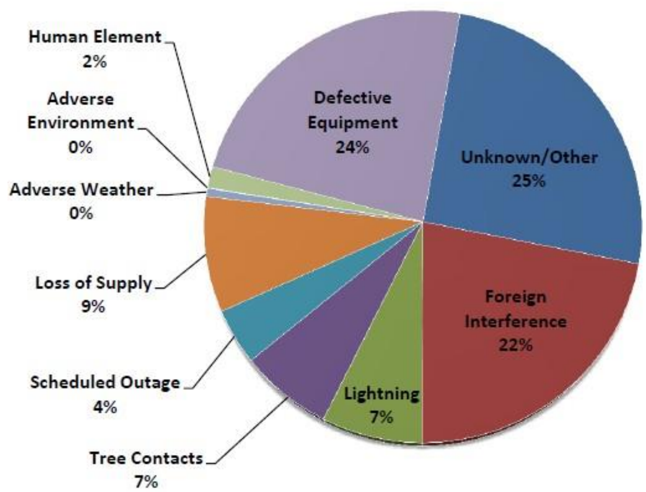



Figure 5.2.3-5 Outage Causes by Duration 2012-2015

a) Please explain why 25% of outages between 2012-2015 have unknown causes.
   i. Would a 25% proportion of unknown outage causes be typical among Thunder Bay Hydro's peers?
   ii. Does Thunder Bay Hydro have any insights as to the likely drivers for the unidentified cause outages?

b) What steps, if any, is Thunder Bay Hydro taking to identify the causes of such outages going forward?

**Thunder Bay Hydro Response:**

a) Unknown causes are those outages that typically resolve themselves without being able to determine the exact cause.

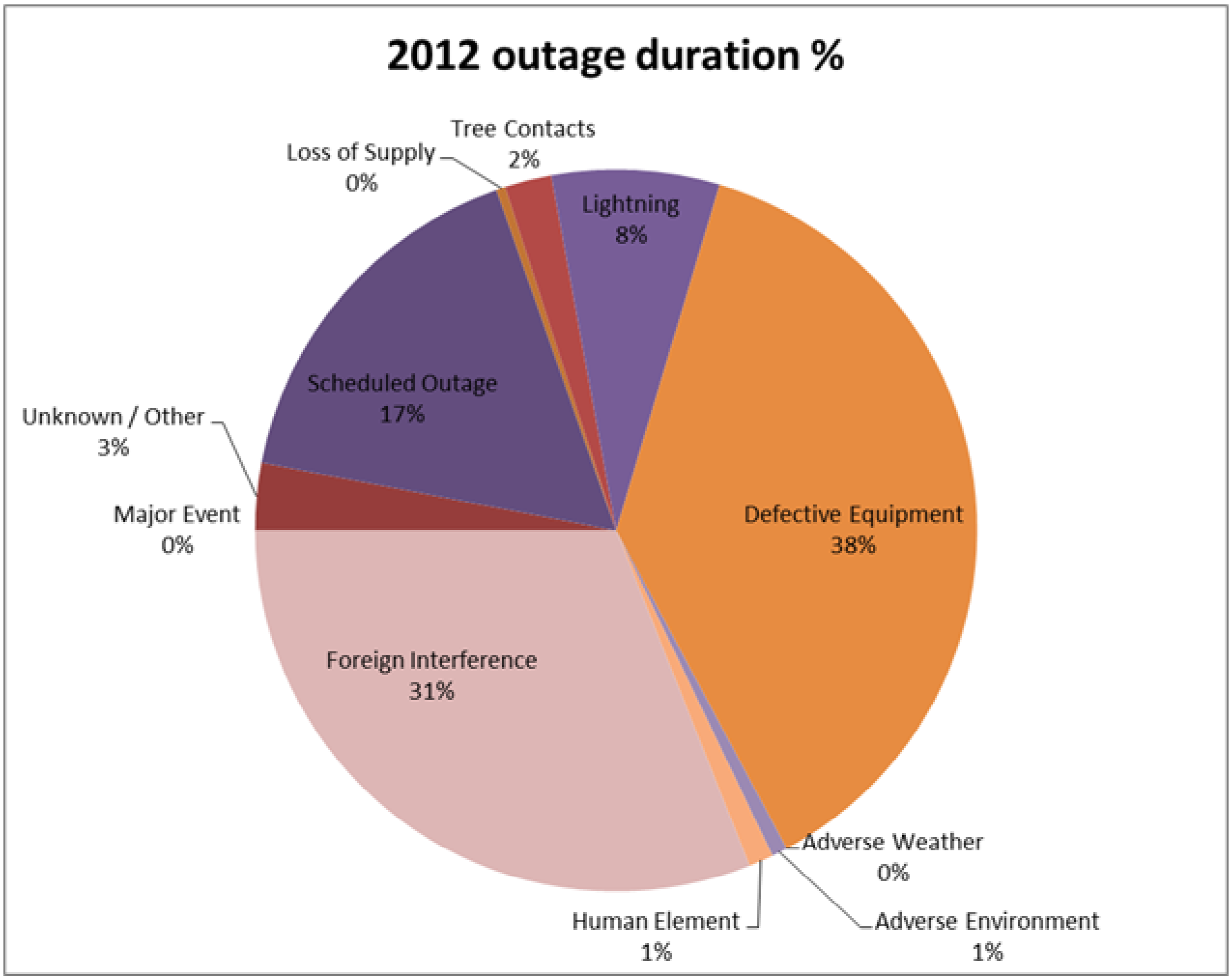
## 2-AMPCO-6

Ref: Appendix 2-B DSP Page 44

a) Figure 5.2.3-5 Outage Causes by Duration: Please provide Figure 5.2.3-5 separately for each of the following years: 2012, 2013, 2014, and 2015.

b) Please provide a Figure that shows the Outage Causes by Duration for 2016.

### Thunder Bay Hydro Response:



## 2-Staff-23

Ref: E2/p. 58

At the above reference, SAIDI and SAIFI statistics are shown for the years 2011 to 2015. Both of these indicators appear to be significantly lower for 2014 than the other four years.

Please explain why this was the case.

### Thunder Bay Hydro Response:

**Service Reliability**

| Index | Including outages caused by loss of supply | | | | | Excluding outages caused by loss of supply | | | | | Excluding Major Events | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2011 | 2012 | 2013 | 2014 | 2015 | 2011 | 2012 | 2013 | 2014 | 2015 | 2011 | 2012 | 2013 | 2014 | 2015 |
| SAIDI | 2.797 | 1.290 | 1.038 | 2.156 | 2.228 | 2.783 | 1.285 | 1.031 | 1.922 | 2.021 | | | | | |
| SAIFI | 3.805 | 3.126 | 2.137 | 2.944 | 2.887 | 3.659 | 3.124 | 2.018 | 2.684 | 2.390 | | | | | |

**5 Year Historical Average**

| Index | | | | | |
|---|---|---|---|---|---|
| SAIDI | | 1.902 | | 1.808 | | |
| SAIFI | | 2.980 | | 2.775 | | |

The top chart on this page shows the correct data for the correct year

All of the Yearly data detailed within the original Exhibits 2's Page 58 Service Reliability Chart was erroneously shifted to the next year. (i.e. the 2014 data was in the 2015 column in the COS report). It is presumed that the question posed to Thunder Bay Hydro Electricity Distribution Inc would have been. ***"SAIDI and SAIFI are significantly lower in 2013 than the other 4 years. Explain why"?***

**Answer:**

**Thunder Bay Hydro Electricity Distribution Inc was fortunate and enjoyed a couple of years (2012 and 2013) with fewer significant outages or weather related outage events.**

## ER-Staff-80

Ref: p. 3

At the above reference, it is stated that:

Although increase in System Renewal investments is expected to result in improved reliability it is not possible to quantify such an improvement due to many unknown factors that contribute to supply interruptions to customers.

a) Please provide the basis for the claim that an "increase in System Renewal investments is expected to result in improved reliability", given that Thunder Bay Hydro's SAIDI and SAIFI performance has historically been driven by significant weather events, as described in EB 2016-0105 Ex. 1, p. 21, lines 20 – 27. Please explain in detail.

b) If accurate quantification of the anticipated reliability improvement is not possible, is it possible to provide an order of magnitude or qualitative discussion of anticipated performance improvement?

c) In Mr. Tsimberg's opinion, is the Thunder Bay Hydro system presently providing acceptable performance based on SAIDI and SAIFI values, if Hydro One Networks loss of supply events are excluded?

### KINECTRICS RESPONSE

a) SAIDI and SAIFI are not exclusively driven by significant weather events but also by equipment failures. In fact, assets in bad condition will fail under less stressful conditions than assets in good condition: for example, whilst major storms could knock over poles in any condition, medium or even minor storms could knock over poles in poor condition but not poles in good condition.

b) The reliability will in fact get worse if insufficient investments are made in existing assets (harvesting), or will stay about the same if adequate investments are made (sustainment) and improve if investments are increased (improving). The corresponding level of investment could only be determine by tracking equipment failures contribution from SAIDI and SAIFI over a period of several years against renewal investments made, i.e. using an empirical process.

c) No. Based on the comparison of TBH's $/km vs SAIDI and SAIFI for the peer group the renewal investment level in lines assets seem to be inadequate.

## 2.0 – VECC 5

Reference: E1/pg.21 & Appendix 2-B DSP/pg.44

a) Thunder Bay Hydro notes that nearly one quarter of all outages can be attributed to defective equipment. What specific capital and maintenance projects are proposed during the rate period with an objective of lowering outages due to this cause?
b) Please provide the breakdown of outages by duration by cause for each of the years 2012 through 2016.

**Thunder Bay Hydro Response:**

a) The following capital projects are proposed during the rate period with an objective of lowering outages due to defective equipment on 10M series of feeders;

Removal of Hardisty Substation (2019)
Cumming-Brodie
Finlayson-Brodie
Cameron-Vickers
Northern-Vickers
Ford-Walnut
Ford-Ridgeway
Donald-Edward
McPherson-Christie
Removal of Mountdale Substation (2018)
Donald-Mountdale
25kV Pole sets
Transformer and Switch Replacements

In addition, the porcelain insulator program which replaces porcelain with polymer insulators is proposed as a maintenance project to reduce outages due to this type of defective equipment.

b)

As per all OEB calculations, only customer interruptions of duration 1 minute or longer are used to determine the statistics in this report.

| OEB Cause | 2012 | | | | 2013 | | | | 2014 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | outage events | customer interruptions | customer hours of interruption | duration % | outage events | Customer interruptions | Customer hours of interruption | duration % | outage events | Customer interruptions | Customer hours of interruption | duration % |
| Unknown / Other | 34 | 1452 | 1904 | 3.0 | 23 | 14387 | 1013 | 1.6 | 33 | 19504 | 2016 | 1.9 |
| Scheduled Outage | 349 | 9508 | 10709 | 16.6 | 349 | 11709 | 12354 | 20.0 | 293 | 5236 | 5452 | 5.1 |
| Loss of Supply | 5 | 89 | 238 | 0.4 | 4 | 5970 | 334 | 0.5 | 5 | 13032 | 11738 | 10.9 |
| Tree Contacts | 21 | 2221 | 1369 | 2.1 | 30 | 9337 | 10386 | 16.8 | 82 | 18840 | 51700 | 48.0 |
| Lightning | 29 | 19105 | 4836 | 7.5 | 4 | 511 | 996 | 1.6 | 18 | 12049 | 2095 | 1.9 |
| Defective Equipment | 163 | 71750 | 24180 | 37.5 | 193 | 53028 | 28080 | 45.4 | 129 | 39174 | 12968 | 12.1 |
| Adverse Weather | - | - | - | 0.0 | 7 | 2552 | 758 | 1.2 | - | - | - | 0.0 |
| Adverse Environment | 3 | 711 | 476 | 0.7 | 1 | 4 | 8 | 0.0 | - | - | - | 0.0 |
| Human Element | 8 | 10904 | 733 | 1.1 | 5 | 2323 | 255 | 0.4 | 6 | 5497 | 2298 | 2.1 |
| Foreign Interference | 162 | 40013 | 20010 | 31.0 | 154 | 14539 | 7638 | 12.4 | 181 | 34155 | 19350 | 18.0 |
| Major Event* | n/a | n/a | n/a | 0.0 | n/a | n/a | n/a | 0.0 | n/a | n/a | n/a | 0.0 |

| OEB Cause | 2015 | | | | 2016** | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | outage events | Customer interruptions | Customer hours of interruption | duration % | outage events | Customer interruptions | Customer hours of interruption | duration % | outage events | Customer interruptions | Customer hours of interruption | duration % |
| Unknown / Other | 21 | 4666 | 375 | 0.3 | 63 | 41700 | 7401 | 8.2 | | | | |
| Scheduled Outage | 233 | 9554 | 7470 | 6.7 | 280 | 6435 | 6762 | 7.5 | | | | |
| Loss of Supply | 7 | 25058 | 10437 | 9.3 | 4 | 12560 | 4818 | 5.3 | | | | |
| Tree Contacts | 66 | 14577 | 53345 | 47.5 | 88 | 15368 | 31399 | 34.8 | | | | |
| Lightning | 19 | 4357 | 1677 | 1.5 | 8 | 422 | 442 | 0.5 | | | | |
| Defective Equipment | 169 | 62468 | 31040 | 27.6 | 175 | 30465 | 21315 | 23.7 | | | | |
| Adverse Weather | 1 | 6 | 33 | 0.0 | 8 | 1690 | 878 | 1.0 | | | | |
| Adverse Environment | 2 | 38 | 101 | 0.1 | 4 | 433 | 231 | 0.3 | | | | |
| Human Element | 4 | 2678 | 158 | 0.1 | 4 | 4115 | 703 | 0.8 | | | | |
| Foreign Interference | 193 | 22044 | 7674 | 6.8 | 181 | 36183 | 16175 | 17.9 | | | | |
| Major Event* | n/a | n/a | n/a | 0.0 | 0 | 0 | 0 | 0 | | | | |

***Major Event cause was not a reporting requirement prior to 2016. ** 2016 values are a close approximation. Q4 outage record validations were incomplete prior to creating this report.**

## 2 –VECC-11

Reference: E2/Appendix 2-B/ DSP/

a) What metrics are proposed by Thunder Bay Hydro to assess whether the capital budget plan in each year is executed (that is projects planned are projects completed)?
b) What metrics does Thunder Bay Hydro use to understand the efficiency of its capital budgeting (e.g. engineering and planning costs as a proportion of asset in-service etc.).
c) If outages due to defective equipment are noted as a significant driver for capital replacement why is there no metric in Thunder Bay Hydro's proposal which measures the impact of the DSP on outages caused by defective equipment?

**Thunder Bay Hydro Response:**

a) Thunder Bay Hydro proposes to assess DSP performance (as per section 5.2.3.2 for the DSP) with the following method.
    a) Financial performance measured as plan vs actual expenditures percentage, where over expenditure >100% and under expenditure <100%

    b) Scope Management measured as plan vs actual quantities of assets

    renewed percentage, where larger than planned quantities renewed >100%, and less than planned quantities renewed <100%

    c) These two will factor together for a reported "On-Schedule", "Ahead of-Schedule" or "Behind-Schedule" performance measure.

b) Thunder Bay Hydro does not currently have a specific metric it is tracking for performance in terms of "efficiency of capital budgeting". However the capital budgeting process is continually reviewed following the completion of each capital project and actual costs are compared to budget costs. As a measure of performance, Thunder Bay Hydro calculates the average age of poles in the system on an annual basis and reviews progress in its reducing this measure. Pole age is used as a proxy for all overhead assets in the distribution system.

c) Thunder Bay Hydro plans to use the OEB reported outage statistics as a metric to determine the duration and number of outages caused by defective equipment. Thunder Bay Hydro plans to review these statistics on an annual basis to determine the impact of the DSP on outages caused by defective equipment.

## 2-Staff-29

Ref: App. 2 – DSP – S 5.2.3.1: Metrics to Monitor DSP Process Performance, p. 30

At the above reference, it is stated that:

> There is one measure expected by the Chapter 5 filing requirements, but Thunder Bay Hydro has not yet developed a mechanism for measuring or tracking. This measure is;
>
> - Cost-Efficiency and Effectiveness with respect to planning quality

a) Has Thunder Bay Hydro consulted with other LDCs that have already developed a Cost-Efficiency and Effectiveness metric? If yes, please provide details.

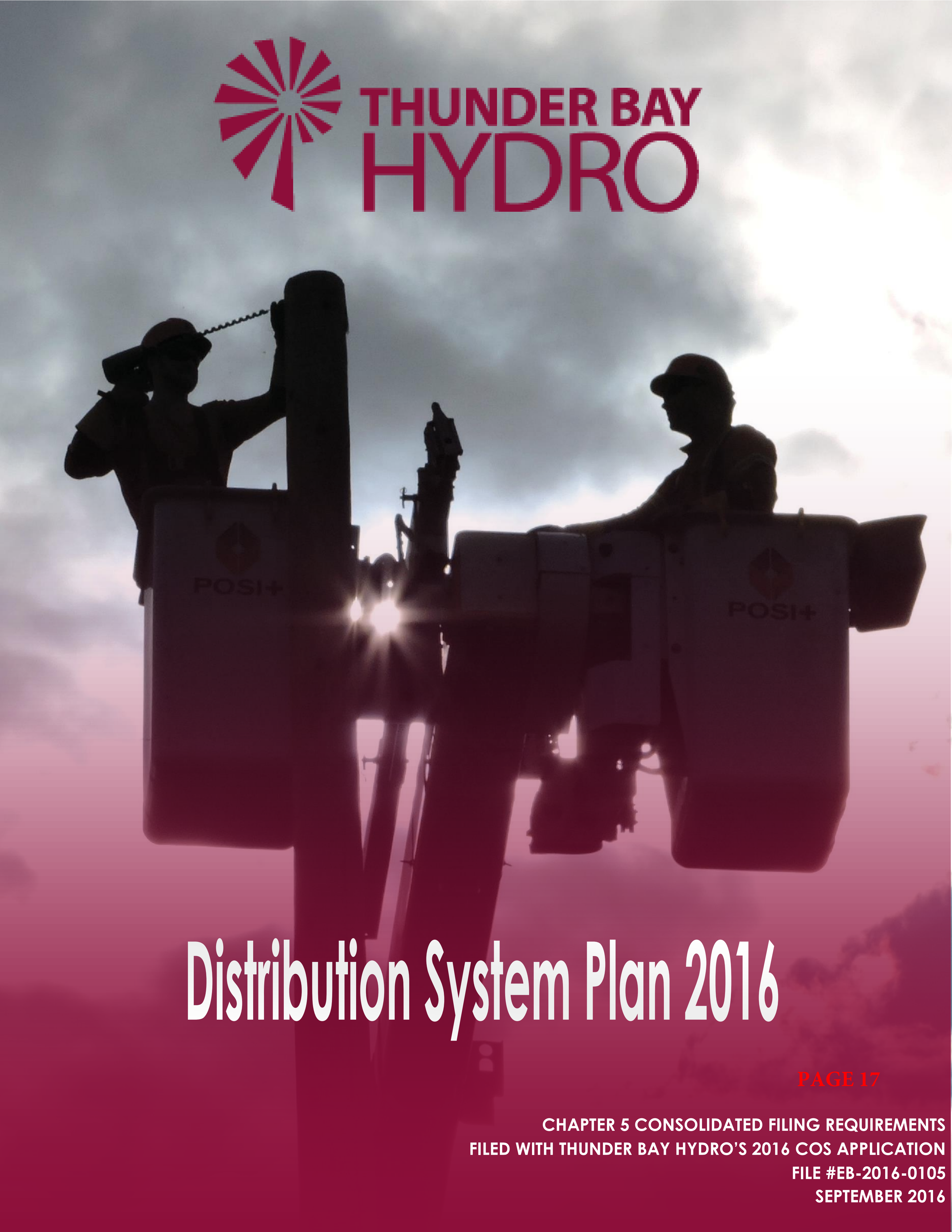
b) Is Thunder Bay Hydro missing any information or processes that would be required to develop such a metric?

**Thunder Bay Hydro Response:**

a) No, Thunder Bay Hydro has not consulted with other LDC's that have already developed a cost-efficiency and effectiveness metric.

b) At this time it is not known whether any information or processes are missing in order to develop a metric. Thunder Bay Hydro is planning on consulting with other LDC's to determine the best practices and at that time will be better able to determine whether any information or processes are missing in order to develop this metric, and these would be implemented at that time.

# TAB 2

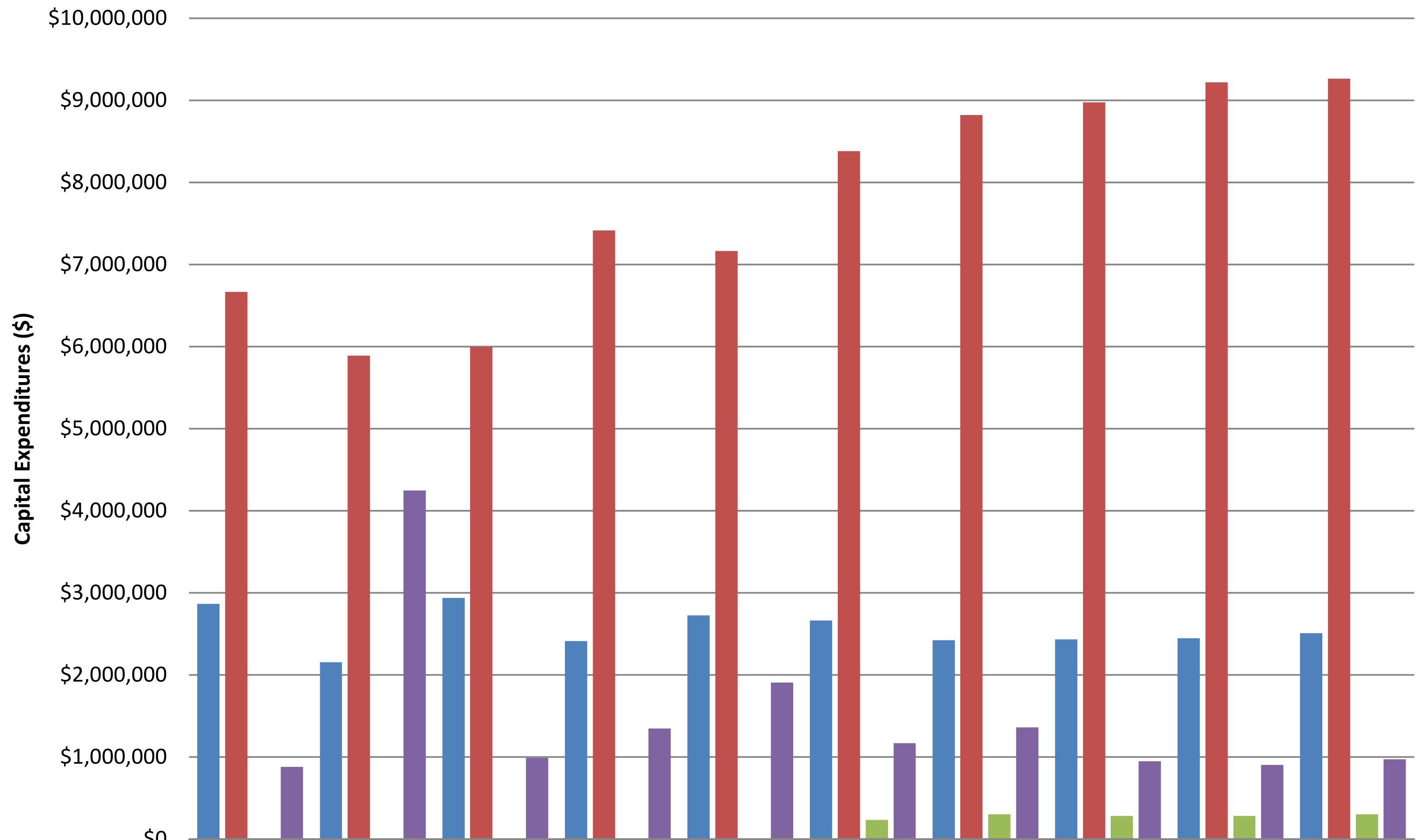



THUNDER BAY HYDRO

# Distribution System Plan 2016



CHAPTER 5 CONSOLIDATED FILING REQUIREMENTS
FILED WITH THUNDER BAY HYDRO'S 2016 COS APPLICATION
FILE #EB-2016-0105
SEPTEMBER 2016




| | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 |
|---|---|---|---|---|---|---|---|---|---|---|
| System Access | $2,863,931 | $2,153,655 | $2,936,881 | $2,412,277 | $2,722,077 | $2,662,432 | $2,422,273 | $2,432,053 | $2,444,765 | $2,505,497 |
| System Renewal | $6,664,243 | $5,887,628 | $5,994,452 | $7,413,468 | $7,164,703 | $8,379,758 | $8,818,369 | $8,975,721 | $9,216,828 | $9,261,478 |
| System Service | $0 | $0 | $0 | $0 | $0 | $230,375 | $300,000 | $280,000 | $280,000 | $300,000 |
| General Plant | $876,685 | $4,245,878 | $988,614 | $1,344,970 | $1,905,805 | $1,167,500 | $1,359,760 | $946,131 | $900,514 | $969,308 |

**Figure 5.4.4-1 Investment by Category for 2012 to 2021**

## 2-VECC-7

Reference: E2/pg.25 & Appendix 2-AA (Excel) / Table 2-20

a) Please update Appendix 2-AA (Table 2-20) to show 2016 actuals.

**Thunder Bay Hydro Response:**

## Appendix 2-AA
## Capital Projects Table

| Projects | 2012 | 2013 | 2014 | 2015 | 2016 Bridge Year | 2017 Test Year |
|---|---|---|---|---|---|---|
| **Reporting Basis** | | | | | | |
| | Actuals | Actuals | Actuals | Actuals | Actuals | Forecast |
| **SYSTEM ACCESS** | | | | | | |
| **PCB Transformer Replacements (A 01)** | 143,287 | 120,061 | 217,974 | | 113,711 | 118,655 |
| **Customer Recoverable System Modifications (A 02)** | | 221,636 | 509,842 | 859,513 | 755,267 | 281,092 |
| **Customer Driven System Expansions (A 11)** | | 197,649 | | 181,267 | 127,256 | 209,034 |
| **Residential Service Connections (A 12)** | 459,350 | 296,842 | 302,465 | 282,378 | 345,931 | 445,213 |
| **General Service Connections (A 13)** | 627,181 | 578,080 | 580,813 | 461,209 | 332,213 | 926,898 |
| New courthouse - Miles @ Brodie (WF0376329) | 323,741 | 391,726 | | | | |
| **Expansions for Residential Subdivisions (A 14)** | | | 335,496 | 118,498 | | 230,530 |
| **System Relocations (A 15)** | 447,447 | | 428,303 | 176,094 | 465,012 | 164,881 |
| Golf Links Road Widening Stage 2 (WF0482298) | | | 285,169 | | | |
| **Meter Installations (A 21)** | | 189,544 | 175,260 | 192,854 | 201,262 | 286,129 |
| **Generator Driven Expansions (A 32)** | 666,826 | | | | | |
| **Miscellaneous** | **196,098** | **158,117** | **101,558** | **140,464** | **57,745** | **-** |
| **Sub-Total System Access** | **$ 2,863,931** | **$ 2,153,655** | **$ 2,936,881** | **$ 2,412,277** | **$ 2,398,398** | **$ 2,662,432** |
| **SYSTEM SERVICE** | | | | | | |
| **Grid Modernization (A 35)** | | | | | | 230,375 |
| **Miscellaneous** | **-** | **-** | **-** | **-** | **887** | **-** |
| **Sub-Total System Service** | **$ -** | **$ -** | **$ -** | **$ -** | **$ 887** | **$ 230,375** |
| **SYSTEM RENEWAL** | | | | | | |
| **Line Voltage Conversions (B 12)** | | | | | | |
| Brock-Ford Rebuild | 1,476,051 | | | | | |
| Georgina-Francis Conversion | 940,824 | | | | | |
| Brown-Isabella Rebuild | 1,637,599 | | | | | |
| Churchill-Edward 25kV Area Rebuild | | 223,674 | 247,555 | | | |
| Ogden-McMurray Area Rebuild | 1,075,188 | 1,624,654 | | | | |
| McKenzie-Dease Area Design | | | 171,815 | 204,139 | | |
| Clayte-Burriss Design | | | 1,979,501 | | | |
| Huron-Otto Rebuild | | 196,143 | 1,327,820 | | | |
| Dawson-Rockwood Area Rebuild | | | | 1,239,672 | | |
| Redmond-Egan Area Rebuild | | | | | | |
| Balsam-Minot Area Rebuild | | | 619,344 | 1,225,645 | | |
| Eliott-Leslie Area Rebuild | | 664,836 | | | | |
| Durban-Brodie Area Conversion | | 593,882 | | | | |
| Mary-Heath Area Conversion/Rebuild | | 1,032,388 | | | | |
| Black Bay-Dewe Rebuild | | | | | 619,148 | 1,174,110 |
| Dewe-Rita Rebuild | | | | | 643,613 | 1,489,302 |
| Donald-Mountdale | | | | | | 310,256 |
| Dacre-Leslie | | | | 586,778 | 1,225,286 | |
| Bruswick-Legion | | | | 411,866 | | |
| Isabella-James | | | | 362,893 | 857,844 | |
| McPherson-Christie | | | | | | |
| Court-VanHorne | | | | | | |
| MacDougall-Court | | | | | | 789,716 |
| Victoria /James | | | | | 1,764,925 | |
| FW TS Exit Cable Replacement | | | | | | 376,868 |
| Finlayson - Brodie Conversion | | | | | | 893,725 |
| Cumming - Brodie Street | | | | | | 580,677 |
| 25kV Pole Replacements | | | | | | 584,384 |
| **System Improvements (B 13)** | | | | | | |
| 10M8 Reconfiguration | | | | 372,317 | | |
| **U/G Installations/Replacements (B 14)** | 213,160 | | | | | |
| Industrial Park - U/G Express Reinforcement | | | | 280,312 | | |
| Main St Connection 10M3 to 17M1 | | | 116,412 | | | |
| **Small Pole Replacements (A 16)** | 160,400 | | | 130,406 | 557,464 | 342,512 |
| Northwood - 10M9 Pole Line (WF0469253) | | 236,494 | | | | |
| 2M5 Pole Line Rebuild (WF0484290) | | | 159,795 | 126,926 | | |
| Main St and Hammond (WF0508762) | | | 116,798 | 198,919 | | |
| Lane South of Arthur between Edward and Ford Rebuild (WF0517942) | | | | 138,764 | | |
| Edward between Aurthur and Mary Rebuild (WF052223) | | | | 171,493 | | |
| Edward and Churchill Rebuild (WF0525234) | | | | 261,792 | | |
| **Lines Safety Reports (A 17)** | 468,445 | 625,723 | 567,743 | 495,879 | 571,492 | 761,834 |
| **Transformer/Switch/Switchgear Replacements (A 18)** | 123,691 | 345,416 | 215,210 | 932,264 | 886,511 | 756,484 |
| Hector Dougall Way (WF 0474031) | | | 119,529 | | | |
| Waverly Park Towers Transformer Replacement (WF0484290) | | | 209,732 | | | |
| **Miscellaneous** | **568,886** | **344,417** | **143,199** | **273,402** | **261,771** | **319,888** |
| **Sub-Total System Renewal** | **$ 6,664,243** | **$ 5,887,628** | **$ 5,994,452** | **$ 7,413,468** | **$ 7,388,053** | **$ 8,379,756** |
| **GENERAL PLANT** | | | | | | |
| 2012 Terex Digger Derrick | | 220,340 | | | | |
| 2013 Material Handler | | 291,262 | | | | |
| 2014 Freight liner Double Bucket | | | 364,664 | | | |
| 2015 Feight Liner Double Bucket | | | | 282,464 | | |
| 2016 Digger Derrick | | | | | 255,160 | |
| 2016 Double Bucket | | | | | | 410,670 |
| 2016 Single Bucket | | | | | 190,016 | |
| 2017 Mini Bucket | | | | | 128,522 | |
| 2017 Double Bucket | | | | | | 125,000 |
| **Fleet Garage** | | 3,277,070 | | | | |
| **Building Improvements** | | | | | | |
| **IT (Software and Hardware)** | 231,506 | | 136,189 | 194,052 | 138,457 | 211,000 |
| **Power Operated Equipment** | | | | 196,682 | | |
| **Equipment - Tools, Shop, Testing, Power and Communications** | | | 160,587 | 158,841 | 124,602 | 206,500 |
| **Fleet - Rolling Stock** | 437,900 | 249,002 | 257,949 | 202,974 | 278,384 | 160,000 |
| **SCADA** | | | | | 437,540 | |
| **Miscellaneous** | **207,279** | **208,204** | **69,225** | **309,957** | **170,363** | **140,000** |
| **Sub-Total General Plant** | **$ 876,685** | **$ 4,245,878** | **$ 988,614** | **$ 1,344,970** | **$ 1,811,475** | **$ 1,253,170** |
| **Total** | **10,404,860** | **12,287,160** | **9,919,947** | **11,170,715** | **11,598,812** | **12,525,733** |
| **Less Renewable Generation Facility Assets and Other Non-Rate-Regulated Utility Assets** ***(input as negative)*** | | | | | | |
| **Total** | **10,404,860** | **12,287,160** | **9,919,947** | **11,170,715** | **11,598,812** | **12,525,733** |

THUNDER BAY HYDRO


# Distribution System Plan 2016



CHAPTER 5 CONSOLIDATED FILING REQUIREMENTS
FILED WITH THUNDER BAY HYDRO'S 2016 COS APPLICATION
FILE #EB-2016-0105
SEPTEMBER 2016

The development of the Asset Condition Assessment (“ACA”) (see the DSP found in Appendix 2-B of this Exhibit, under Section Appendix 5.2.1.1) provided Thunder Bay Hydro staff the opportunity to work with an external firm with considerable experience in the field of asset management. This experience has informed Thunder Bay Hydro’s staff on the methodologies of assessing condition of equipment, evaluating the associated risk of failure and developing replacement /refurbishment plans. The results have also provided Thunder Bay Hydro better knowledge of the condition of assets within the distribution territory and better informed the Asset Management Process.

This approach of condition based rather than age based asset management has been incorporated into the DSP and resulted in a shift in infrastructure investment. With previous Asset Management Plans, the focus of Thunder Bay Hydro’s investment was the decommissioning of 4kV substations and the renewal of associated distribution assets. The analysis by Kinectrics resulted in an extension of power transformer typical useful life based on winter peaking, low loading levels, and technical analysis of oil results. As a result, Thunder Bay Hydro has determined that a shift away from a Voltage Conversion towards a better-rounded System Renewal plan is necessary. Thunder Bay Hydro defines a better-rounded system renewal plan, as one which accounts for renewal of assets on 4kV as well as 12kV and 25kV voltage levels, as well as a mix of overhead and underground projects. In order to meet the asset renewal quantities suggested by Kinectrics an increase from historical levels of investment will occur in underground infrastructure and 25kV pole replacements.

The shift in expenditures from historical levels of replacement will begin in 2017 and Thunder Bay Hydro anticipates becoming aligned with the “Flagged for Action” plan suggested from Kinectrics by 2019. Thunder Bay Hydro has purposely taken a conservative approach and paced the shift in expenditures over a 3 year period to minimize cost impact to the customer and to complete work in progress; specifically on 4kV conversion projects, where there are only one or two project areas prior to decommissioning of a station. In addition, this change is a fundamental shift in philosophies and requires changes in construction practices, scheduling and labor allocations. Allowing 3 years to become aligned will allow Thunder Bay Hydro the chance to implement these changes in the most cost effective manner.

### System Service

For the 2017 Forecast period, Thunder Bay Hydro expects expenditures in System Service to increase by $230,375. This increase is to implement automation improvements on selected feeders as an initiative of the ‘Grid Modernization Plan’ attached as Appendix 2-B, Appendix D.

### General Plant

For the 2017 Forecast period, Thunder Bay Hydro expects expenditures in General Plant to reduce by $647,478. This decrease in spending is primarily due to the SCADA system expenditure being completed in 2016.

### 2018-2021 Forecast Capital Expenditure Variance Analysis

Overall trending for the forecast period of 2018 to 2021 between categories is consistent in the System Access, System Renewal and System Service categories. Inflationary increases are expected to account for minor year over year increases of approximately 2%, as their variance falls below the materiality threshold. A decrease in expenditures in the General Plant category accounts for an overall decrease in expenditures over the forecast period.

**TABLE 2-18: FUTURE CAPITAL EXPENDITURE AVERAGE VARIANCES**

| Category | Forecast Period | | | |
|---|---|---|---|---|
| | 2018 | 2019 | 2020 | 2021 |
| System Access | $2,422,273 | $2,432,053 | $2,444,765 | $2,505,497 |
| System Renewal | $8,818,369 | $8,975,721 | $9,216,828 | $9,261,478 |
| System Service | $300,000 | $280,000 | $280,000 | $300,000 |
| General Plant | $1,359,760 | $946,131 | $900,514 | $969,308 |
| Total Expenditure | $12,900,402 | $12,633,905 | $12,842,107 | $13,036,284 |

### System Access

Year over year average variance and trending for the forecast period of 2018 to 2021 are very consistent with historical values with an inflationary increase of 2%.

### System Renewal

Over the 2018 to 2021 forecast period, Thunder Bay Hydro expects to see only minimal increases of approximately 1.2% in the System Renewal category to reach sustainment levels of asset renewal. Thunder Bay Hydro recognizes the importance of renewing all asset categories and anticipates alignment with suggested levels in the Kinectrics report (Appendix 2-B Section, Appendix C) by 2019.

Thunder Bay Hydro has been investing in System Renewal since 2008 and has continued to increase the replacement of wood poles, distribution transformers and overhead switches through to 2017. Expenditures in these accounts have not increased at the same rate as quantities have increased and this is in large part due to the cost-efficiencies employed by the utility. In order to implement a balanced

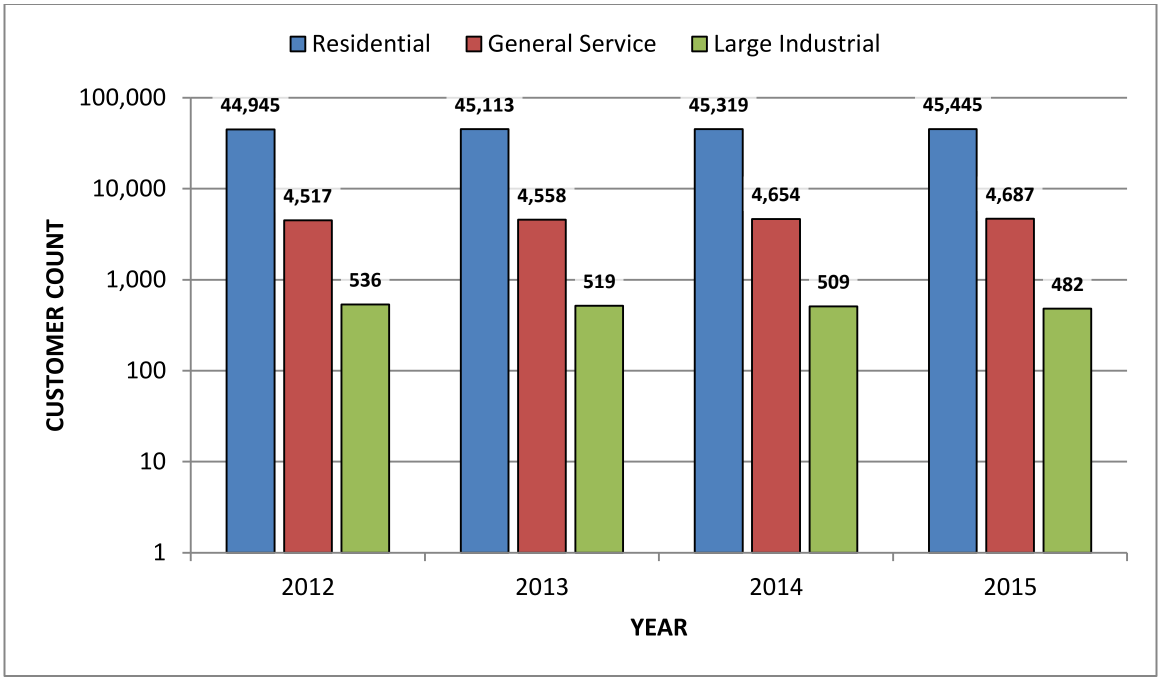



**Figure 5.1.1-2 Customer Mix by Class**

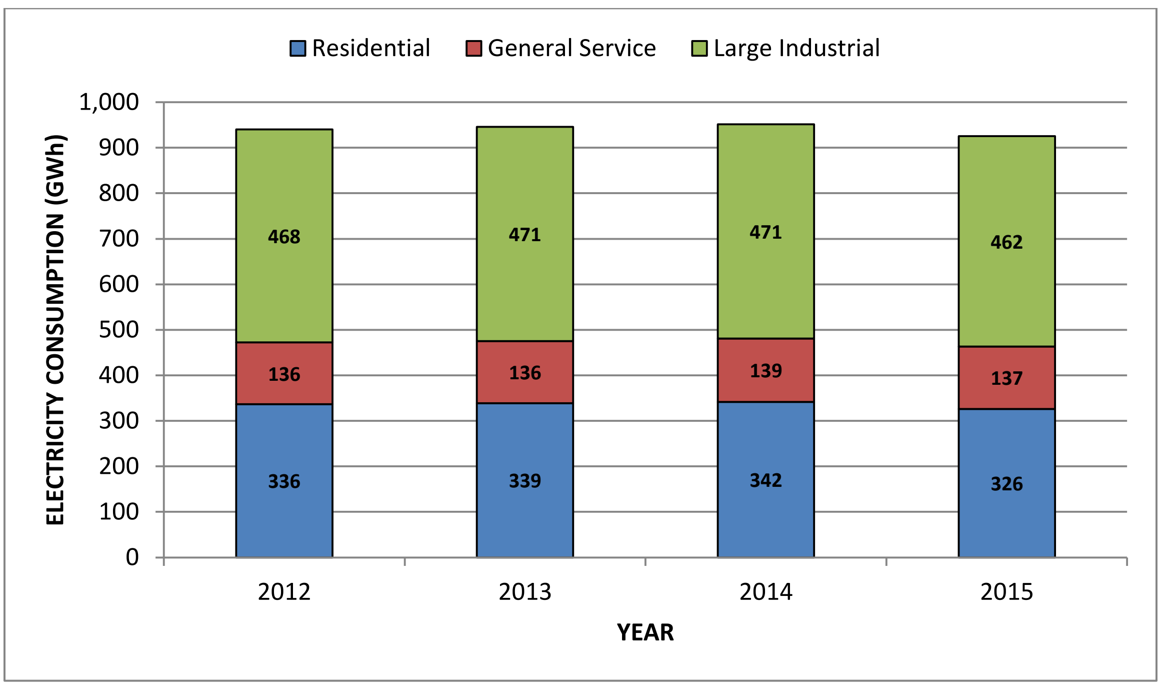



**Figure 5.1.1-3 - Electricity Consumption by Customer Class**

# TAB 3

THUNDER BAY HYDRO


# Distribution System Plan 2016



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*primary process steps and information flows used by the distributor to identify, select, prioritize and/or pace investments; i.e.:*

- *asset register;*
- *asset condition assessment;*
- *asset capacity utilization/constraint assessment;*
- *historical period data on customer interruptions caused by equipment failure;*
- *reliability based 'worst performing feeder' information and analysis;*
- *reliability risk/consequence of failure analyses.*

*Use of a flowchart illustration accompanied by explanatory text is recommended.*

### 5.3.1.3 Asset Management Strategy (OEB Filing Req. 5.3.1b)

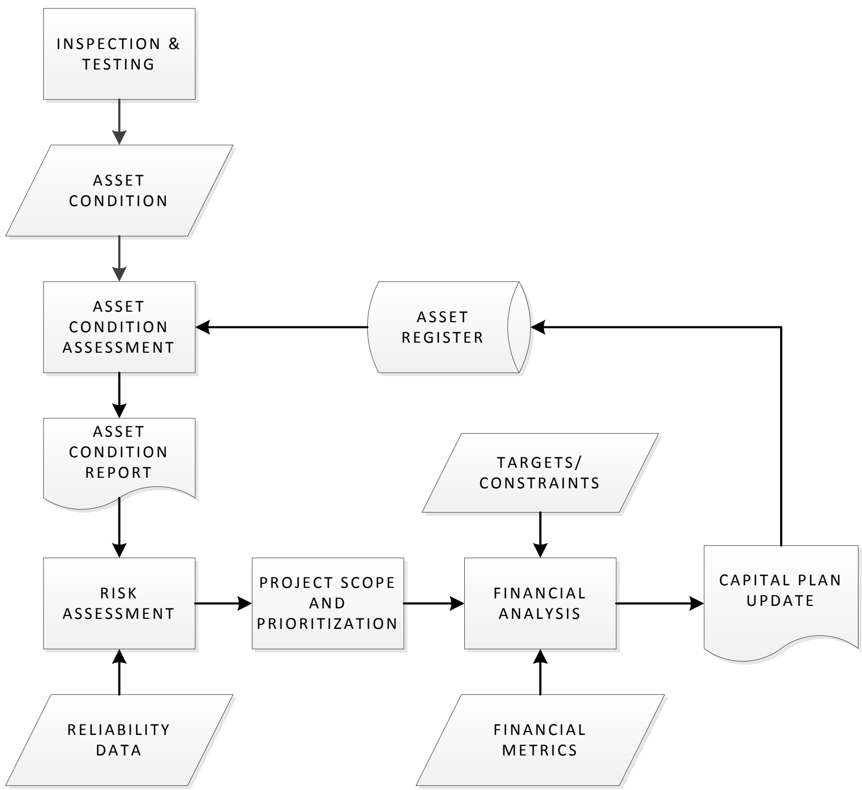



**Figure 5.3.1-1 - Thunder Bay Hydro Asset Management Framework**

A. Asset Management Framework Summary

Figure 5.3.1-1 above details the strategy Thunder Bay Hydro utilizes to appropriately select and prioritize asset investments. The process begins with the inspection and testing phase. Thunder Bay Hydro has a mature and comprehensive inspection and testing regime that provide details on asset condition. These programs have been refined over time and incorporate information on industry best practice, historical findings and regulatory requirements.

An asset condition report is formed based on detailed analysis of the contents of the asset register in conjunction with the inspection and testing programs. The output of this forms the basis of the pace at which assets in the system require action to be taken. Assets identified as part of this process are then evaluated based on the risk they pose to the system. Considerations during this process include consequence of failure, redundancy, availability of temporary measures and historical reliability data.

The output of this process defines the project scope. Financial analysis of projects is then executed utilizing historical metrics driven from previously executed projects. Considerations during this process are financial targets or constraints from internal performance measures and corporate strategic initiatives. This process is further discussed in Section 5.4.2.

The final output of this process is used to inform and update the capital expenditure plan.

B. Data Sets

i. Asset Register

The asset register is made up of data from various databases and is generally available through Thunder Bay Hydro's GIS interface. The data comprises all the information that allows each asset to be uniquely identified such as serial number, nameplate data, and Thunder Bay Hydro assigned identifiers. It also contains data regarding the physical characteristics such as age and configuration of the asset as well as installation and removal data and location. The register is routinely updated as assets are installed, removed or refurbished as requirements dictate.

As part of its commitment to continuous improvement, Thunder Bay Hydro is currently contemplating implementing a formal pole testing regimen as part of its inspection process. This would provide quantitative data on the condition of the specified poles within this system and would inform the ACA with objective information. The data collected would improve the quality of the ACA analysis as well; assist in determining the condition of poles suspected to be in poor health.

ii. Asset Condition Report

An ACA study has been completed and a report has been prepared by Kinectrics to determine the current health of Thunder Bay Hydro's distribution system assets. The resulting report describes the methodology used to analyze the major assets within the distribution system and identifies data gaps where they exist. The report contains information relating to Thunder Bay Hydro's efforts to date and provides insight into opportunities for improvement in the inspection process. The report also provides a levelized asset replacement schedule which helps to inform the renewal portion of the capital expenditure plan.

iii. Historical Period Data on Customer Interruptions caused by Equipment Failure

## 2-VECC-15

Reference: E2/Appendix 2-B/Appendix C: Kinectrics ACA/ Table III-4/pg.22

a) The "data gap" shown in this table for wood poles and underground cables is medium to high. Kinectrics notes in their summary of data assessment results: "*even if an asset group has a high DAI, this does not mean information for this asset group is complete. i.e. if there are numerous data gaps, the degree of confidence that the Health Index reflects true condition may still be low*" (pg.21). Please explain the level of confidence in the health index that is being purported for wood pole and underground cables in this study.
b) Specifically explain what percentage of the pole population was subject to hammer test and rocking test.
c) For poles that are subject to visual inspection does Thunder Bay Hydro have a of database indicating general condition (e.g. noting soil condition, shell rot or decay, holes etc.)?
d) Please explain how pole age is determined by Thunder Bay Hydro. Specifically does Thunder Bay Hydro have an asset data base showing all pole ages?

**Thunder Bay Hydro Response:**

a) The health index was calculated using age and an "overall risk" determined from visual inspections. Since the health index was based mostly on an inspection data point and not only age (i.e. "overall risk" has a higher weight than age), there is a fair level of confidence in the results.

For underground cables the health index was based solely on cable age. The age profile of an asset population can give broad insight to the health profile of the asset class, particularly if the failure statistics of the broad population is known. However, since there is no conditional data available for the underground cable asset class, the level of confidence in the results for this asset group is less than that of wood poles.

b) No poles were subject to a rocking test. A sample size of poles were subject to hammer testing however Thunder Bay Hydro found the results to be very subjective and could not quantify the results in a meaningful way.

c) Thunder Bay Hydro maintains a database indicating the general conditions of its poles.

d) Pole age has been determined through locating and recording the dating information on the pole provided by the manufacturer. Where this data is unobtainable as a result of deterioration or other, then the age is estimated by subject matter experts while performing field inspections.

Thunder Bay Hydro performs regular inspections of all major components of its distribution system. The asset inspection information becomes a subset of data associated to the asset. The information is used as an input to the asset condition assessment. Table 5.3.1-2 below details the frequency and inspection method for each asset category.

| ASSET | INSPECTION FREQUENCY | INSPECTION METHOD |
|---|---|---|
| Substations | Monthly | Visual |
| Substation Transformers | Annual | DGA |
| Pole Mounted Transformers | Triannual | Visual |
| Pad Mounted Transformers | Triannual | Visual |
| Pad Mounted Transformers | 9 Years | Detailed |
| Vault Transformers | Triannual | Detailed |
| Switches | Triannual | Detailed |
| Reclosers | Triannual | Visual |
| Poles | Triannual | Visual |

**Table 5.3.1-2 Thunder Bay Hydro Asset Inspection Frequency**

Inspections are performed throughout the year and their execution and inspection content vary by asset class. The data that is collected is validated and analyzed and then linked back to the asset register. During the inspection cycle any major defects that are noted, that may potentially impact safety, are immediately reported for corrective action. An example of this may be low hanging conductor or a transformer that has shifted on its foundation. Both of these pose a safety hazard and defects such as these would be corrected immediately.

Outputs:

- Inspection Data – data is returned from the field in the form of spreadsheets, hard copies and digital records and are recorded in the asset register for further analysis and input to other processes.

ii. <u>Asset Condition Assessment</u>

Inputs:

- Inspection Data – data from current and past field inspections becomes part of the criteria assessed in the ACA.
- Asset Register – provides the details that are characteristic of each asset class for the various condition criteria assessed in the ACA.

<u>Process:</u>

Traditionally, Thunder Bay Hydro has utilized the average age of its assets as an indicator of health of its assets; and more broadly, average age of its wood poles as a proxy for overall system health. Utilizing a TUL of 50 years for its wood poles, Thunder Bay Hydro targeted an average age of 25 years for this asset population. Through detailed analysis, Thunder Bay Hydro determined that 700 poles are required to be replaced annually to obtain a half-year reduction in age over the same period. This 700 pole replacement target accounts for approximately 70% of Thunder Bay Hydro's system renewal budget annually.

Through the inspection process, Thunder Bay Hydro has identified the fact that a significant portion of its underground assets are reaching the end of their useful life as well. Increased investment in underground renewal would then also be required to reduce the backlog of assets that have reached, or will reach the end of their useful lives in the near term.

Understanding that determining the appropriate replacement levels for all of its distribution assets is a complex problem, Thunder Bay Hydro sought to engage a third party to assist with this process.

As a result, and in order to better refine its asset condition assessment, Thunder Bay Hydro engaged Kinectrics to complete an ACA of key distribution assets. The results of which are summarized in Figure 5.3.1-2 below. The full ACA report is available for review in Appendix C.

## 2-VECC-12

Reference: E2/Appendix 2-B/ DSP/pg.60

a) Please provide an explanation as what constitutes each of the inspection methods used for assets (i.e. Visual, DGA, Detailed).
b) Specifically, please explain how poles and underground plant are inspected and their health index determined.

**Thunder Bay Hydro Response:**

(a) The following provides an explanation as to what constitutes each of the inspection methods used for assets;

- Visual inspection constitutes using the skills of experienced personnel to examine assets in the field without the use of specialized testing equipment.
- Detailed inspection constitutes using the skills of experienced personnel in conjunction with testing equipment and other tools to more closely examine assets.
- DGA or Dissolved Gas Analysis is used to check for the existence of gasses formed during periods of faults or overloads in oil insulated equipment.

(b) Poles and underground plant are initially inspected using a visual inspection method. If a defect is noted during visual inspection, follow-up action is taken. The follow-up action can consist of a detailed inspection, corrective action at the time of inspection or submission of a maintenance request. The inspection completes with each asset being assigned a condition rating. The condition rating information becomes one of several input parameters into the Health Index calculation. Health Indexing quantifies equipment condition based on numerous condition parameters that are related to the long-term degradation factors that cumulatively lead to an asset's end of life.

The Health Index is an indicator of the asset's overall health and is typically given in terms of percentage, with 100% representing an asset in brand new condition. Health Indexing provides a measure of long-term degradation and thus differs from defect management, whose objective is finding defects and deficiencies that need correction or remediation in order to keep an asset operating prior to reaching its end of life.

In formulating a Health Index, condition parameters are ranked, through the assignment of weights, based on their contribution to asset degradation. The condition parameter score for a particular parameter is a numeric evaluation of an asset with respect to that parameter.

iv. Pole Mounted Transformers Inspection and Maintenance

The inspection of these units coincides with the requirements set forth in the DSC in so far as they are inspected on a three year cycle. The inspection process checks for leaks and general tank condition; condition of the bushings; and oil discolouration which indicates flashover. Pole mount transformers have relatively few failures as a population and as such require little in the way of regular maintenance to ensure these units reach their typical useful lives. However, if a transformer is found to be in such poor condition by trained inspectors, it will be replaced proactively to avoid reactive replacement in the near term.

v. Distribution Pole Inspection and Testing

The inspection of these assets coincides with the requirements set forth in the DSC in so far as they are inspected on a three year cycle. Thunder Bay Hydro conducts a visual inspection of all the poles it owns within its service territory. The inspection considers overall pole condition and condition of pole attachments. Poles that have been identified, through visual inspection, as being in poor condition are further inspected in detail. Through non-destructive testing (hammer testing) inspectors attempt to ascertain the extent to which the asset has deteriorated. Poles identified as being a hazard or in imminent risk of failure are replaced immediately; other poles are prioritized based on their health as part of the asset management and capital planning process.

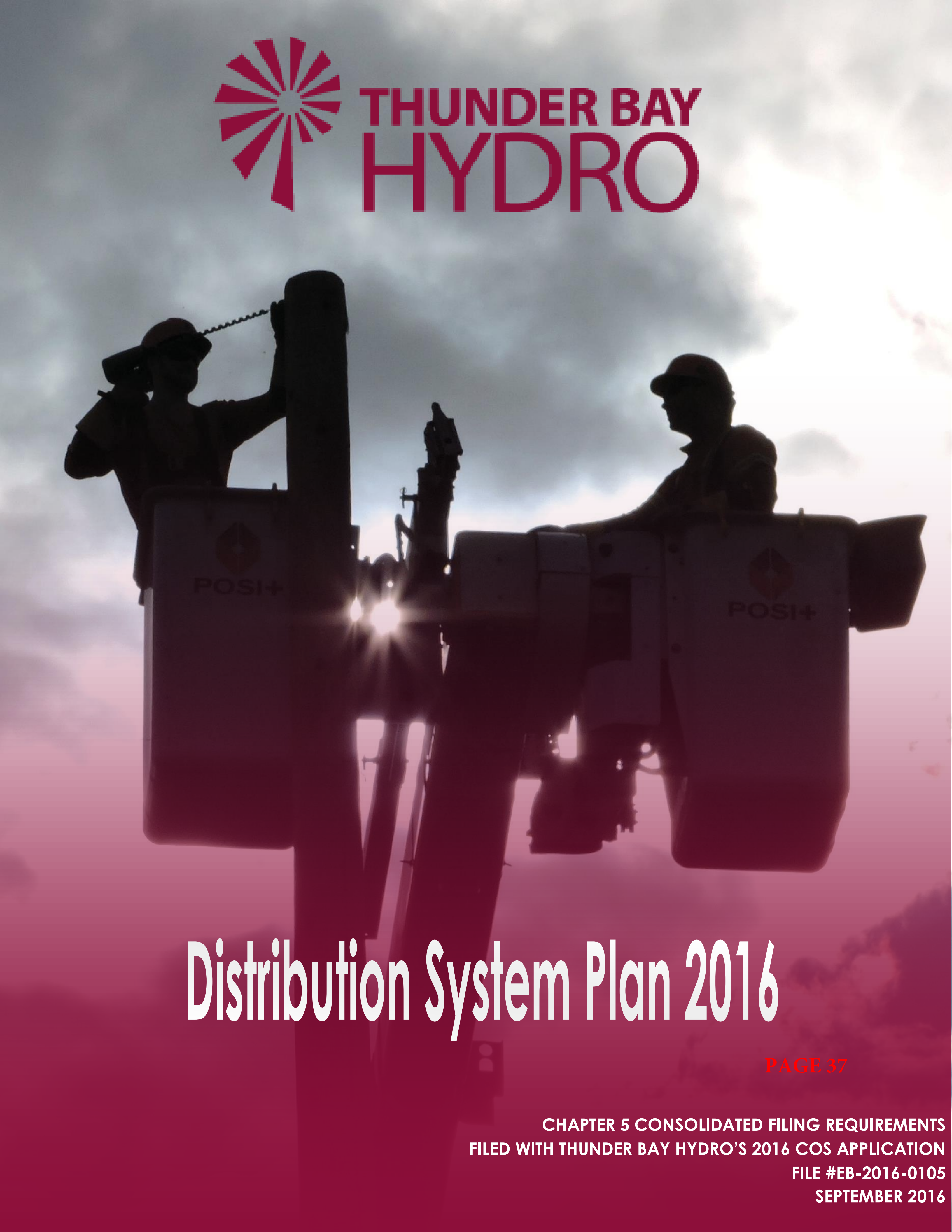
vi. Overhead Switch Inspection and Maintenance

The inspection of these assets coincides with the requirements set forth in the DSC in so far as they are inspected on a three year cycle. The intention is to ensure that every switch is at least visually inspected every three years. Visual inspection of the in-line, air-break, load-break, and recloser population is captured under this initiative. Switch maintenance activities are conducted in parallel with switch inspection activities. Where the inspection determines that maintenance of the switch is required, the inspection crew may conduct the maintenance immediately and note this on the inspection form. Where the crew is unable to immediately perform the maintenance, a deficiency is noted on the inspection form. The completed detailed inspection form is submitted for prioritization based on available resources and details of the annual inspection are then logged into the inspection database.

vii. Tree Trimming Maintenance and Inspection

Thunder Bay Hydro performs vegetation management in a reactive and proactive manner throughout its service territory. Thunder Bay Hydro receives numerous 3rd party requests annually to manage vegetation that has been identified as posing a potential threat to Thunder Bay Hydro's overhead infrastructure. These are generally safety concerns and are remediated in a reactive nature. Thunder Bay Hydro also proactively manages vegetation in areas of planned capital investment prior to executing work in these areas.

# TAB 4



THUNDER BAY HYDRO

# Distribution System Plan 2016

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a leader in providing life cycle management solutions for the electricity industry, to complete an Asset Condition Assessment for its major asset categories. The process included an in-depth review and analysis of the data available for these major assets, as well as a detailed report outlining the health of Thunder Bay Hydro's system (via a health index). The output of this process yields levelized renewal targets for each asset category.

The engagement of Kinectrics and subsequent report complete with health index has greatly impacted the development of this DSP. Thunder Bay Hydro has revised its previous capital plan to harmonize with results of the Kinectrics report. In doing so, Thunder Bay Hydro considered; the impact this shift would have on projects currently under execution; the impacts to the current planning cycle; and the impacts to customers, the municipality and 3rd party attachers. For these reasons, Thunder Bay Hydro has chosen a conservative approach to implementing the shift over a 3 year period.

Thunder Bay Hydro will continue seek improvements where it can, in particular in its data collection efforts, to help close any data gaps and in doing so increase the integrity of the analysis. This will further aid in informing on the asset renewal process and the decisions that influence the capital investment plan.

**Cost Control**

Thunder Bay Hydro continues to work diligently to reduce costs and be more efficient. For this planning cycle, Thunder Bay Hydro expects to further improve operational efficiencies through implementation of operations technology and SCADA. Over the historical period Thunder Bay Hydro has deployed several devices that assist in the timely and effective operation of the system (i.e. remotely operated switches with telemetry, fault indicators, etc.). For this planning period Thunder Bay Hydro is proposing expenditures in these areas in anticipation of further improvements in efficiencies.

**Public Policy Responsiveness**

Based on the current results, the metrics in this category are not directly influencing operational imperatives. However, Thunder Bay Hydro will continue to support conservation programs and other initiatives aimed at reducing consumption.

Renewable connections are expected to remain static or to continue decreasing for the forecast period. In addition to this assumption, Thunder Bay Hydro has consulted with local development groups, and anticipates minimal new Micro Generation connections due to reduced return on investment for installations, and continued constraints in the rural areas. For these reasons these metrics are not directly influencing capital expenditures during this planning cycle.

**Financial Ratios**

Thunder Bay Hydro has currently met or exceeded all of the internally defined metrics for financial ratios. For this reason these metrics are not directly influencing capital expenditures during this planning cycle. As Thunder Bay Hydro is committed to the satisfaction of its customers it expects to continue to achieve similar results through the forecast period.

KINECTRICS

# THUNDER BAY HYDRO
# 2015 ASSET CONDITION ASSESSMENT

**August 11, 2016**


Kinectrics Inc.
800 Kipling Avenue
Toronto, ON
M8Z 6C4 Canada
www.kinectrics.com

# SUMMARY

In 2015 Thunder Bay Hydro Electricity Distribution Inc. (TBH) determined a need to perform a condition assessment of its key distribution assets. This would result in a quantifiable evaluation of asset condition, aid in prioritizing and allocating sustainment resources, and facilitate the development of a Distribution System Plan.

The asset groups included in the 2015 asset condition assessment (ACA) were as follows: substation transformers, breakers, wood poles, distribution transformers, overhead line switches, underground switches, and underground cables. For each asset category, the Health Index distribution was determined and a condition-based Flagged for Action plan was developed.

In terms of quantities of assets that need to be addressed, 25 kV wood poles require the most attention. Although only 3% of the population needs to be looked at this year, this amounts to over 450 poles. Approximately 9% of 4 kV wood poles were also flagged for action this year. Because of the considerably smaller population, however, this equates to just over 230 poles. Approximately 19% of pole mounted transformers were classified under the very poor category. As such, 170 transformers need to be addressed.

Many asset groups (i.e. distribution transformers, overhead switches, and underground cables) had only age data available. Data gaps for these and all other asset categories were identified. It is recommended that TBH begin collecting information to fill these data gaps and to use such information for future assessments.

It is important to note that the flagged for action plan presented in this study is based solely on asset condition and that there are numerous other considerations that may influence TBH's Distribution System Plan.

### I.2 Deliverables

The deliverable in this study is a Report that includes the following information:

- Description of the Asset Condition Assessment methodology
- For each asset category the following are included:
    - Health Index formula
    - Age distribution
    - Health Index distribution
    - Condition-based Flagged For Action Plan
    - Assessment of data availability by means of a Data Availability Indicator (DAI) and a Data Gap analysis.

# II ASSET CONDITION ASSESSMENT METHODOLOGY

Health Indexing quantifies equipment condition based on numerous condition parameters that are related to the long-term degradation factors that cumulatively lead to an asset's end of life. The Health Index is an indicator of the asset's overall health and is typically given in terms of percentage, with 100% representing an asset in brand new condition. Health Indexing provides a measure of long-term degradation and thus differs from defect management, whose objective is finding defects and deficiencies that need correction or remediation in order to keep an asset operating prior to reaching its end of life.

*Condition parameters* are the asset characteristics or properties that are used to derive the Health Index. A condition parameter may be comprised of several sub-condition parameters. For example, a parameter called "Oil Quality" may be a composite of parameters such as "Moisture", "Acid", "Interfacial Tension", "Dielectric Strength" and "Color".

In formulating a Health Index, condition parameters are ranked, through the assignment of *weights*, based on their contribution to asset degradation. The *condition parameter score* for a particular parameter is a numeric evaluation of an asset with respect to that parameter.

Health Index (HI), which is a function of scores and weights, is therefore given by:

$$HI = \frac{\sum_{m=1}^{\forall m} \alpha_m (CPS_m \times WCP_m)}{\sum_{m=1}^{\forall m} \alpha_m (CPS_{m.\max} \times WCP_m)} \times DR$$

**Equation 1**

where

$$CPS_m = \frac{\sum_{n=1}^{\forall n} \beta_n (SCPS_n \times WSCP_n) \times DR_n}{\sum_{n=1}^{\forall n} \beta_n (WSCP_n)} \times DR_m$$

**Equation 2**

| | |
|---|---|
| CPS | Condition Parameter (CP) Score, 0-4 |
| WCP | Weight of Condition Parameter |
| $\alpha_m / \beta_n$ | Data availability coefficient for condition parameter<br>(1 if input data available; 0 if not available) |
| SCPS | Sub-Condition Parameter (SCP) Score, 0-4 |
| WSCP | Weight of Sub-Condition Parameter |
| DR | De-Rating Multiplier |

The scale that is used to determine an asset's score for a particular parameter is called the *condition criteria*. In the Kinectrics methodology, a condition criteria scoring system of 0 through 4 is used. A score of 0 is the "worst" possible score; a score of 4 is the "best" score. I.e. $CPS_{max} = SCPS_{max} = 4$.

Note: From the formula, it can be seen that each parameter (condition or sub-condition) will have the following properties:

1. Weight
2. Availability coefficient (1 if asset has data for such parameter available; 0 otherwise)
3. Score (real value from 0 through 4)
4. Multiplier (real value)

### *II.1.1 Health Index Results*

As stated previously, an asset's Health Index is given as a percentage, with 100% representing "as new" condition. The Health Index is calculated only if there is sufficient condition data. The subset of the population with sufficient data is called the *sample size*. Results are generally presented in terms of number of units and as a percentage of the sample size. If the sample size is sufficiently large and the units within the sample size are sufficiently random, the results may be extrapolated for the entire population.

The Health Index distribution given for each asset group illustrates the overall condition of the asset group. Further, the results are aggregated into five categories and the categorized distribution for each asset group is given. The Health Index categories are as follows:

| | |
|---|---|
| Very Poor | Health Index < 25% |
| Poor | 25 $\leq$ Health Index < 50% |
| Fair | 50 $\leq$ Health Index <70% |
| Good | 70 $\leq$ Health Index <85% |
| Very Good | Health Index $\geq$ 85% |

Note that for critical asset groups, such as Power Transformers, the Health Index of each individual unit is given.

| Condition Parameter | | Condition Parameter Weight (WCP) | Sub-Condition Parameter | | Sub-Condition Parameter Weight (WCF) | Data Available? (β = 1 if available; 0 if not) |
|---|---|---|---|---|---|---|
| m | Name | | n | Name | | |
| 1 | A | 1 | 1 | A_1 | 1 | 1 |
| 2 | B | 2 | 1 | B_1 | 2 | 1 |
| | | | 2 | B_2 | 4 | 1 |
| | | | 3 | B_3 | 5 | 0 |
| 3 | C | 3 | 1 | C_1 | 1 | 0 |

The Data Availability Indicator is calculated as follows:

$$DAI_{CP1} = (1*1) / (1) = 1$$
$$DAI_{CP2} = (1*2 + 1*4 + 0*5) / (2 + 4 + 5) = 0.545$$
$$DAI_{CP3} = (0*1) / (1) = 0$$

$$DAI = (DAI_{CP1}*WCP_1 + DAI_{CP2}*WCP_2 + DAI_{CP3}*WCP_3) / (WCP_1 + WCP_2 + WCP_3)$$
$$= (1*1 + 0.545*2 + 0*3) / (1 + 2 + 3)$$
$$= 35\%$$

An asset with all condition parameter data represented will, by definition, have a DAI value of 100%. In this case, an asset will have a DAI of 100% regardless of its Health Index score. Provided that the condition parameters used in the Health Index formula are of good quality and there are little data gaps, there will be a high degree of confidence that the Health Index score accurately reflects the asset's condition.

### *II.3.2 Data Gap*

The Health Index formulations developed and used in this study are based only on TBH's available data. There are additional parameters or tests that TBH may not collect but that are important indicators of the deterioration and degradation of assets. The set of unavailable data are referred to as data gaps. I.e. A data gap is the case where none of the units in an asset group has data for a particular item. The situation where data is provided for only a sub-set of the population is not considered as a data gap.

As part of this study, the data gaps of each asset category are identified. In addition, the data items are ranked in terms of importance. There are three priority levels, the highest being most indicative of asset degradation.

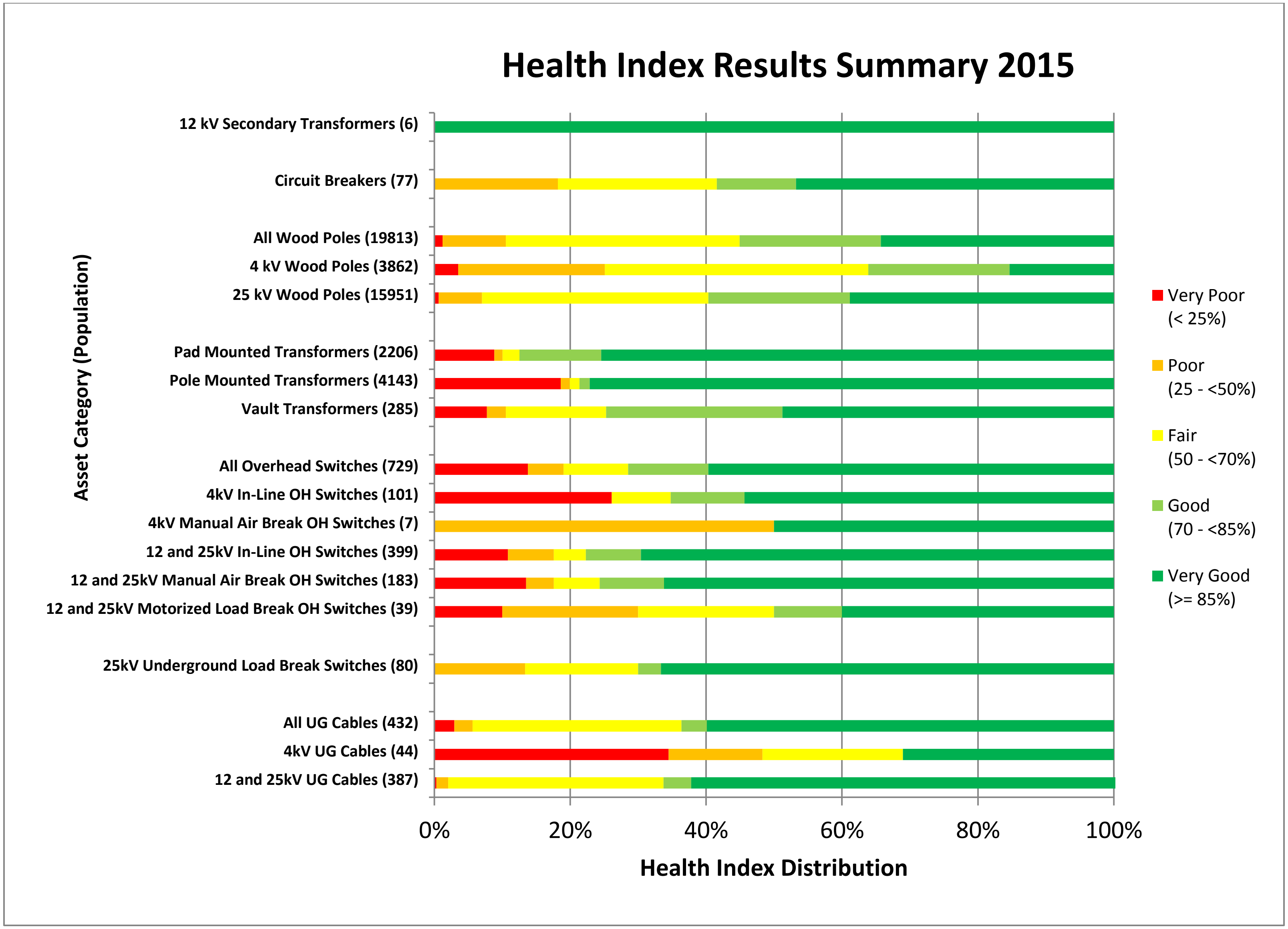


**Figure 5.3.1-2 Health Index Results Summary 2015**

# TAB 5

## 2.0-SEC-63

[Tsimberg, p. 6] Please provide a list of all "data gaps" (as Kinectrics defines that term) identified by the expert in the course of his analysis, and the impact of each on the expert's opinion.

### KINECTRICS RESPONSE

All "data gaps:" are provided in the ACA report contained in Exhibit 2, Attachment 2-I, Appendix C, with the importance denoted.

Specific data gaps are listed in detail for each asset category in the report. The extent of "data gaps" are qualified as low to high, where "high" (low meaning not much more condition data needs to be incorporated; high meaning important condition parameters have yet to be incorporated. Assets with "high" data gaps are typically age-based assessments; assets with "medium-high" typically have aged and some simplified inspection records. There is a higher level of confidence in HI results for an asset group with low data gaps and high DAI.

Delta). Such information will provide good, objective condition data as input into the Health Index.

**Table III-4 Data Assessment**

| Asset Category | | Average DAI | Data Gap |
|---|---|---|---|
| **Station Transformers** | All | 93% | Low-Medium |
| | 4 kV | 92% | |
| | 12 kV | 93% | |
| **Breakers** | Breakers | 61% | Low-Medium |
| **Wood Poles** | All | 100% | Medium-High |
| | 4 kV | 100% | |
| | 25 kV | 100% | |
| **Distribution Transformers** | Pad Mounted Transformers | 85% | Low-Medium |
| | Pole Mounted Transformers | 100% | Medium-High |
| | Vault Transformers | 100% | Medium-High |
| **OH Switches** | All | 42% | High |
| | 4kV In-Line | 46% | |
| | 4kV Manual Air Break | 29% | |
| | 12 and 25kV In-Line | 37% | |
| | 12 and 25kV Manual Air Break | 40% | |
| | 12 and 25kV Motorized Load Break | 26% | |
| **Underground Switches** | 25kV Underground Load Break Switches | 38% | High |
| **Underground Cables** | All | 48% | High |
| | 4kV | 65% | |
| | 12 and 25kV | 47% | |

## ER –VECC -7

Ref: ACA pg.20

a) Please provide the assessment as to how TBH's distribution system plan address the data gasp summarized in Table III-4.
b) Please explain the implications to the ACA of the large number of assets with Medium -High or High data gaps.

### Thunder Bay Hydro Response

The Ontario Energy Board stated in Procedural Order No. 5 that (**emphasis added**):

> "Intervenors shall request any relevant information and documentation from Thunder Bay Hydro on **the new expert report only**, by written interrogatories filed with the OEB and served on all parties by June 2, 2017."

VECC does not cite the new expert report in this interrogatory. Rather VECC's questions relate solely to the ACA. The ACA has been on the evidentiary record, and all parties including VECC have had ample opportunity to ask questions about it. It is Thunder Bay Hydro submits that this interrogatory is in breach of the procedural directions of the Board in Procedural Order No. 5.

Despite this, to the extent additional information may be of assistance to the Ontario Energy Board in its decision making on this case, and to avoid further procedural delays, Thunder Bay Hydro has asked that Kinectrics provide a response to this interrogatory.

a) Thunder Bay Hydro plans to address the data gaps identified as Medium-High or High as summarized in Table III-4 in the following manner;

- Wood Poles – objective pole testing to be incorporated into risk assessments
- OH and UG Switches – operations and inspection/corrective maintenance records are to be developed and collected
- Underground cables – evaluation of cost/benefit of diagnostic testing

## KINECTRICS RESPONSE

b) Assets with “high” data gaps are typically age-based assessments; assets with “medium-high” typically have aged and some simplified inspection records. There is a higher level of confidence in HI results for an asset group with low data gaps and high DAI.

# TAB 6

## AMPCO-29

Ref: Page 8

a) Please summarize the asset failure information collected by TBHEDI

b) Did the expert review TBHEDI's actual failure data by asset type?

c) How was actual failure data by asset used to determine the HI scores by asset?

d) Did the expert review TBHEDI's historical replacement rates? If yes, how was the information used?

### THUNDER BAY HYDRO RESPONSE

a) Asset failure information collected by TBHEDI includes distribution transformers and primary underground cable.

### KINECTRICS RESPONSE

b) Yes, for failure information that was provided.

c) Actual failure information was not used. Typical useful life ranges, estimated by TBH subject matter experts, were used to develop the life curves. These curves are used in scoring criteria for the "age" parameter (defined in the report as each asset class's age criteria).

d) The ACA is a condition-based assessment. Since historical replacement rates are not necessarily based on condition, they were not considered.

# ER-VECC-2

Ref: ACA Report

a) Please explain the role of Ms. Katrina Lotho in preparing the ACA report and the role of Mr. Tsimberg in reviewing the report.
b) The ACA methodology requires assessment of condition parameters or asset characteristics. Which author carried or verified the TBH's asset condition testing?
c) Specifically, which author verified the sample size (shown in Table III-1) and made the "data gap" assessment shown in Table III-4.
d) Which author inspected the assets characteristics for the assets listed in Table III-1?

## THUNDER BAY HYDRO RESPONSE

The Ontario Energy Board stated in Procedural Order No. 5 that (**emphasis added**):

> "Intervenors shall request any relevant information and documentation from Thunder Bay Hydro on **the new expert report only**, by written interrogatories filed with the OEB and served on all parties by June 2, 2017."

VECC does not cite the new expert report in this interrogatory. Rather VECC's questions relate solely to the ACA. The ACA has been on the evidentiary record, and all parties including VECC have had ample opportunity to ask questions about it. Thunder Bay Hydro submits that this interrogatory is in breach of the procedural directions of the Board in Procedural Order No. 5.

Despite this, to the extent additional information may be of assistance to the Ontario Energy Board in its decision making on this case, and to avoid further procedural delays, Thunder Bay Hydro has asked that Kinectrics provide a response to this interrogatory.

**KINECTRICS RESPONSE**

a) Katrina Lotho calculated Health Indices of assets using asset data provided by TBH. From the calculated health, the flagged for action plan was found. Katrina Lotho then prepared the ACA report that details the findings. Yury Tsimberg reviewed and approved the methodology (e.g. algorithms, assumptions) and the findings from the study, he was ultimately responsible for the contents of the report and had final sign-off authority.

b) Katrina Lotho and Yury Tsimberg reviewed the available asset data provided by TBH. The actual methodologies or test procedures used by TBH to gather this provided data was not within the scope of the ACA.

c) Katrina Lotho determined the sample size. Katrina Lotho made the data gap assessment, and Yury Tsimberg was ultimately responsible for the contents of the report and had final sign-off authority.

d) Asset Data was provided by Thunder Bay Hydro, Katrina Lotho calculated the Health Index Results contained in Table III-1. Health Index results were based on health index calculations also performed by Katrina Lotho. The input data provided by TBH was not validated or verified by Kinectrics.

# TAB 7

## ER -VECC -6

Ref: ACA/pg. 16 Table III-2

a) For each asset category please provide a comparison of Table III-2 10 year levelized Flagged for Action Plan in the ACA with TBH's capital expenditure proposals for 2017 through 2021.

b) Given the ACA is based on 2015 data please explain how 2016 actual capital expenditures are being considered in the response to a).

c) For each asset category please provide both the quantity of assets TBH has or proposes to replace in 2016 and 2017 and provide a comparison to the first year amount flagged in the ACA action plan. Please comment on any differences.

d) Please provide the change in reliability risk if TBH were to replace the number of assets recommended but equally over 10 years.

e) Table III-2 generally shows a larger quantity of asset replacements in year 1 then would be the case if assets were replaced on as an equal amount over the ten years. Please explain why and what difference would occur if TBH replaced a greater number of assets in 2 or 3, rather than year one of its capital plan. That is how does altering the pace of asset replacement affect reliability?

### THUNDER BAY HYDRO RESPONSE

The Ontario Energy Board stated in Procedural Order No. 5 that (**emphasis added**):

> "Intervenors shall request any relevant information and documentation from Thunder Bay Hydro on **the new expert report only**, by written interrogatories filed with the OEB and served on all parties by June 2, 2017."

VECC does not cite the new expert report in this interrogatory. Rather VECC's questions relate solely to the ACA. The ACA has been on the evidentiary record, and all parties including VECC have had ample opportunity to ask questions about it. It is

Thunder Bay Hydro submits that this interrogatory is in breach of the procedural directions of the Board in Procedural Order No. 5.

Despite this, to the extent additional information may be of assistance to the Ontario Energy Board in its decision making on this case, and to avoid further procedural delays, Thunder Bay Hydro has asked that Kinectrics provide a response to this interrogatory.

a) While preparing the response to this interrogatory TBH discovered an error in Table III-2. Specifically, the spreadsheet used to calculate the 10 year FFAP included an incorrect cell reference. Attached below are the corrections provided by Kinectrics to fix for that error.

   TBH believes that its DSP is not affected based on the results of this table as the error only affected the last two years of the 10 year levelized quantities and the DSP only encompasses the first 5 years of levelized planning. Therefore there are no further revisions to be made as a result of the error in this table.

   The below amended Table III-2 from the Kinectrics ACA contains both Kinectrics proposed levelized plan and Thunder Bay Hydro's proposed plans in response to this IR.

| Asset Category | | 10 Year LEVELIZED Flagged for Action Total | | | | TBH Proposed First Year (2017) Quantity | TBH Proposed 10 Year (2017-2027) Quantity |
|---|---|---|---|---|---|---|---|
| | | First Year | | 10 Year | | | |
| | | Quantity | Percentage | Quantity | Percentage | | |
| **Substation Transformers** | 4 kV Secondary Transformers | 0 | 0% | 4 | 24% | 0 | 0 |

| Asset Category | | 10 Year LEVELIZED Flagged for Action Total | | | | TBH Proposed First Year (2017) Quantity | TBH Proposed 10 Year (2017-2027) Quantity |
|---|---|---|---|---|---|---|---|
| | | First Year | | 10 Year | | | |
| | | Quantity | Percentage | Quantity | Percentage | | |
| | 12 kV Secondary Transformers | 0 | 0% | 0 | 0% | 0 | 0 |
| **Circuit Breakers** | Circuit Breakers | 0 | 0% | 14 | 18% | 0 | 0 |
| **Wood Poles** | 4 kV Wood Poles | 232 | 6% | 1815 | 48% | 385 | 1849 |
| | 25 kV Wood Poles | 460 | 3% | 4390 | 30% | 193 | 4242 |
| **Distribution Transformers** | Pad Mounted Transformers | 44 | 2% | 262 | 12% | 75 | 302 |
| | Pole Mounted Transformers | 171 | 4% | 1048 | 25% | 171 | 1046 |
| | Vault Transformers | 10 | 4% | 110 | 39% | 3 | 91 |
| **Overhead Switches** | 4kV In-Line OH Switches | 3 | 3% | 37 | 37% | 20 | 72 |
| | 4kV Manual Air Break OH Switches | 0 | 0% | 7 | 100% | 10 | 17 |
| | 12 and 25kV In-Line OH Switches | 15 | 4% | 99 | 25% | 5 | 59 |
| | 12 and 25kV Manual Air Break OH Switches | 5 | 3% | 39 | 21% | 5 | 37 |
| | 12 and 25kV Motorized Load Break OH Switches | 2 | 5% | 22 | 56% | 0 | 19 |
| **Underground Switches** | 25kV Underground Load Break Switches | 1 | 1% | 17 | 21% | 0 | 16 |
| **Underground Cables*** | 4kV UG Cables | 1 | 2% | 11 | 25% | 1 | 11 |
| | 12 and 25kV UG Cables | 6 | 2% | 71 | 18% | 1.4 | 62.6 |

c) The below table provides a 2016 Thunder Bay Hydro actual replacements and 2017 proposed replacements as well as a comparison of the Kinectrics Levelized Replacement Target for year 0. There are differences in the split between 4kV and 25kV wood poles due to the completion of several 4kV conversion projects work-in-progress prior to alignment in 2019. In addition there are differences in the number of pad mounted distribution transformers and overhead switches planned for replacement or removal due to their functional obsolescence in 4kV projects.

| | 4 kV | 12 kV | Breakers | 4 kV | 25 kV | Pad Mounted Transformers | Pole Mounted Transformers | Vault Transformers | 4kV In-Line | 4kV Manual Air Break | 12 and 25kV In-Line | 12 and 25kV Manual Air Break | 25kV Motorized Load Break | 25kV Underground Load Break Switches | 4kV | 12 and 25kV |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2016 TBH Actual Replacements | 0 | 0 | 0 | 461 | 133 | 52 | 109 | 9 | 12 | 0 | 12 | 6 | 0 | 0 | 0 | 0.96 |
| 2017 Kinectrics Levelized Replacement Target (Yr0) | 0 | 0 | 0 | 232 | 460 | 44 | 171 | 10 | 3 | 0 | 15 | 5 | 2 | 1 | 1 | 6 |
| 2017 TBH Replacement Target | 0 | 0 | 0 | 385 | 193 | 75 | 171 | 3 | 7 | 2 | 5 | 5 | 0 | 0 | 1 | 1.4 |

## KINECTRICS RESPONSE

a) Below is the corrected Table III-2 Total Year 1 and 10-Year Total Flagged for Action Plan.

| Asset Category | | 10 Year Flagged for Action Total | | | | 10 Year LEVELIZED Flagged for Action Total | | | | Replacement Strategy |
|---|---|---|---|---|---|---|---|---|---|---|
| | | First Year | | 10 Year | | First Year | | 10 Year | | |
| | | Quantity | Percentage | Quantity | Percentage | Quantity | Percentage | Quantity | Percentage | |
| Substation Transformers | 4 kV Secondary Transformers | 0 | 0% | 4 | 24% | 0 | 0% | 4 | 24% | proactive |
| | 12 kV Secondary Transformers | 0 | 0% | 0 | 0% | 0 | 0% | 0 | 0% | proactive |
| Circuit Breakers | Circuit Breakers | 0 | 0% | 14 | 18% | 0 | 0% | 14 | 18% | proactive |
| Wood Poles | 4 kV Wood | 364 | 9% | 1865 | 48% | 232 | 6% | 1815 | 47% | proactive |

| Asset Category | | 10 Year Flagged for Action Total | | | | 10 Year LEVELIZED Flagged for Action Total | | | | Replacement Strategy |
|---|---|---|---|---|---|---|---|---|---|---|
| | | First Year | | 10 Year | | First Year | | 10 Year | | |
| | | Quantity | Percentage | Quantity | Percentage | Quantity | Percentage | Quantity | Percentage | |
| | Poles | | | | | | | | | |
| | 25 kV Wood Poles | 544 | 3% | 4807 | 30% | 460 | 3% | 4390 | 28% | proactive |
| **Distribution Transformers** | Pad Mounted Transformers | 204 | 9% | 254 | 12% | 44 | 2% | 262 | 12% | proactive |
| | Pole Mounted Transformers | 625 | 15% | 1049 | 25% | 171 | 4% | 1048 | 25% | reactive |
| | Vault Transformers | 14 | 5% | 116 | 41% | 10 | 4% | 110 | 39% | reactive |
| **Overhead Switches** | 4kV In-Line OH Switches | 3 | 3% | 41 | 41% | 3 | 3% | 37 | 37% | reactive |
| | 4kV Manual Air Break OH Switches | 0 | 0% | 4 | 57% | 0 | 0% | 7 | 100% | reactive |
| | 12 and 25kV In-Line OH Switches | 30 | 8% | 95 | 24% | 15 | 4% | 99 | 25% | reactive |
| | 12 and 25kV Manual Air Break OH Switches | 20 | 11% | 41 | 22% | 5 | 3% | 39 | 21% | reactive |
| | 12 and 25kV Motorized Load Break OH Switches | 0 | 0% | 16 | 41% | 2 | 5% | 22 | 56% | reactive |
| **Underground Switches** | 25kV Underground Load Break Switches | 0 | 0% | 15 | 19% | 1 | 1% | 17 | 21% | reactive |
| **Underground Cables** | 4kV UG Cables | 2 | 5% | 5 | 11% | 1 | 2% | 11 | 25% | reactive |
| | 12 and 25kV UG Cables | 4 | 1% | 75 | 19% | 6 | 2% | 71 | 18% | reactive |

b) ACA was based on the input data/information as of the end of 2015 and is a snap shot in time aimed at assisting with the annual budgeting process. 2016 replacement were not considered in the ACA study.

c) This strikes a balance between dealing with a backlog of assets in the FFAP while mitigating impact on rates.

d) and e) Refer to the Kinectrics response in ER-Staff-80 a) and b) regarding reliability. In addition it is not possible to quantify the reliability change if replacements are not done per FFA. The FFA is a probabilistic assessment, which means that for nearly all assets (with the exception of station transformers and breakers) the specific asset flagged for action is not determined, i.e. only estimated quantities are determined. As such, the reliability impact can't be quantified. It can only be said that, from a qualitative standpoint, that risk increases because the likelihood of failure of assets will increase as they continue to remain in service.

# TAB 8

### 2.6.2 Analysis of Capital Expenditures

Table 2-11 below provides a summary of capital expenditures for the historical years, 2013 through 2015 as well as the 2016 Bridge Year. This table can be found in Attachment 2-C and is consistent with Board Appendix 2-AB.

**Table 2-11: Historical Capital Expenditures Summary**

| CATEGORY | Historical Period (previous plan[1] & actual) | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2012 | | | 2013 | | | 2014 | | | 2015 | | | 2016 | | |
| | Plan | Actual | Var | Plan | Actual | Var | Plan | Actual | Var | Plan | Actual | Var | Plan | Actual[2] | Var |
| | $ '000 | | % | $ '000 | | % | $ '000 | | % | $ '000 | | % | $ '000 | | % |
| System Access | 2,032 | $2,864 | 40.9% | 1,963 | $2,154 | 9.7% | 3,556 | $2,937 | -17.4% | 3,812 | $2,412 | -36.7% | 2,795 | $2,722 | -2.6% |
| System Renewal | 7,118 | $6,664 | -6.4% | 6,596 | $5,888 | -10.7% | 6,402 | $5,994 | -6.4% | 6,770 | $7,413 | 9.5% | 7,090 | $7,165 | 1.1% |
| System Service | - | $0 | -- | - | $0 | -- | - | $0 | -- | - | $0 | -- | - | $0 | -- |
| General Plant | 1,097 | $877 | -20.0% | 4,443 | $4,246 | -4.4% | 1,199 | $989 | -17.5% | 1,357 | $1,345 | -0.9% | 2,059 | $1,906 | -7.4% |
| TOTAL EXPENDITURE | $ 10,247 | $10,405 | 1.5% | $ 13,003 | $12,287 | -5.5% | $ 11,157 | $9,920 | -11.1% | $ 11,938 | $11,171 | -6.4% | $ 11,944 | $11,793 | -1.3% |
| System O&M | 6,594 | 6,998 | 6.1% | $ 7,064 | $6,803 | -3.7% | $ 6,959 | $7,316 | 5.1% | $ 7,229 | $7,441 | 2.9% | $ 7,675 | $8,034 | 4.7% |

**Planned vs. Actual Variances**

The 2012 planned to actual variance for capital was a result of an increase in customer requests. A large volume of the General Services requests were recovered through capital contributions. In addition the implementation of Renewable Enabling Improvements significantly impacted the capital expenditures. As a result of sub-contracting out the bill print process, Thunder Bay Hydro did not purchase a budgeted mail machine in 2012. The 2012 planned to actual variance for operation and maintenance (O&M) was the result of life to date Smart Metering Expenses presented in the 2012 actuals, as directed by the Board.

In 2013 Thunder Bay Hydro saw a consistent demand increase from customers General Services and an increase in demand for customer driven expansion. Thunder Bay Hydro also experienced a decrease in System Renewal variance which was due to variations in costs across several projects executed during the year as well the deferral of certain capital investment projects to 2014 & 2015. The General Plant variance decrease was due to a change in costs for the construction of the new fleet garage as well as cost savings for office furniture, equipment and tools. 2013 Operations & Maintenance decrease in variance were the result of a decrease in benefit costs as a result of the actuarial valuation update which resulted in an actuarial gain which was amortized over 12 years. In addition salary, wage and overtime were less than budget due to less storm related activity.

In 2014, Thunder Bay Hydro had budgeted based on previous trends in the demand for General Services in 2012 and 2013. However, the trend experienced in those years did not continue into 2014. In addition an Ontario Power Authority approved renewable wind project was cancelled. Additionally a system renewal project originally designed as an overhead project was revised to an underground design as a result of customer consultation. As a result the project was delayed due to the procurement of the required materials. The General Plant decrease in variance was due to the timing and receipt of large vehicles that were ordered during the year. O&M variances were the result of Fleet Department

# 2-AMPCO-11

Ref: Appendix 2-B DSP Page 121 Appendix 2-AB Table 2 - Capital Expenditure Summary

a) Please recast the table to include Thunder Bay Hydro Electricity Distribution Inc's internal approved capital budget for the years 2012 to 2016.

## Thunder Bay Hydro Response:

**Appendix 2-AB**
**Table 2 - Capital Expenditure Summary from Chapter 5 Consolidated Distribution System Plan Filing Requirements**

**First year of Forecast Period:** *2017*

| CATEGORY | Historical Period (previous plan[1] & actual) | | | | | | | | | | | | | | | Forecast Period (planned) | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2012 | | | 2013 | | | 2014 | | | 2015 | | | 2016 (Bridge Year) | | | 2017 | 2018 | 2019 | 2020 | 2021 |
| | Plan | Actual | Var | Plan | Actual | Var | Plan | Actual | Var | Plan | Actual | Var | Plan | Actual [(2)] | Var | | | | | |
| | *$ '000* | | % | *$ '000* | | % | *$ '000* | | % | *$ '000* | | % | *$ '000* | | % | *$ '000* | | | | |
| **System Access** | 2,032 | 2,864 | 40.9% | 1,963 | 2,154 | 9.7% | 3,556 | 2,937 | -17.4% | 3,812 | 2,412 | -36.7% | 2,795 | 2,722 | -2.6% | 2,662 | 2,422 | 2,432 | 2,445 | 2,505 |
| **System Renewal** | 7,118 | 6,664 | -6.4% | 6,596 | 5,888 | -10.7% | 6,402 | 5,994 | -6.4% | 6,770 | 7,413 | 9.5% | 7,090 | 7,165 | 1.1% | 8,380 | 8,818 | 8,976 | 9,217 | 9,261 |
| **System Service** | - | - | -- | - | - | -- | - | - | -- | - | - | -- | - | - | -- | 230 | 300 | 280 | 280 | 300 |
| **General Plant** | 1,097 | 877 | -20.0% | 4,443 | 4,246 | -4.4% | 1,199 | 989 | -17.5% | 1,357 | 1,345 | -0.9% | 2,059 | 1,906 | -7.4% | 1,168 | 1,360 | 946 | 901 | 969 |
| **TOTAL EXPENDITURE** | 10,247 | 10,405 | 1.5% | 13,003 | 12,287 | -5.5% | 11,157 | 9,920 | -11.1% | 11,938 | 11,171 | -6.4% | 11,944 | 11,793 | -1.3% | 12,440 | 12,900 | 12,634 | 12,842 | 13,036 |
| **System O&M** | 6,594 | 6,998 | 6.1% | 7,064 | 6,803 | -4% | 6,959 | 7,316 | 5% | 7,229 | 7,441 | 3% | 7,675 | 8,034 | 5% | 8,026 | 8,187 | 8,350 | 8,592 | 8,842 |

## 2-Staff-39

Ref: App. 2 – DSP – S 5.3.1.3: Asset Management Strategy, C. Process– ii. Asset Condition Assessment, pp. 60-61

At the above reference, it is stated that:

> Traditionally, Thunder Bay Hydro has utilized the average age of its assets as an indicator of health of its assets; and more broadly, average age of its wood poles as a proxy for overall system health. Utilizing a TUL of 50 years for its wood poles, Thunder Bay Hydro targeted an average age of 25 years for this asset population. Through detailed analysis, Thunder Bay Hydro determined that 700 poles are required to be replaced annually to obtain a half-year reduction in age over the same period. This 700 pole replacement target accounts for approximately 70% of Thunder Bay Hydro's system renewal budget annually.

a) Please provide the justification for Thunder Bay Hydro to pursue the proposed accelerated pole replacement program in terms of expected improvement in system performance indices (SAIDI, SAIFI, CAIDI).
b) Please provide detailed calculations showing the need for 700 poles to be replaced annually to obtain a half-year reduction in age over the same period.

**Thunder Bay Hydro Response:**

(a) Thunder Bay Hydro cannot justify the accelerated pole replacement program in terms of SAIDI, SAIFI, and CAIDI as these are not the primary drivers for the accelerated replacement program.

(b) The example that follows details how 700 poles yields a half year reduction in age annually.

| 2016 | | Average Age (years) | | Qty |
|---|---|---|---|---|
| Start of Year (All Poles) | | 29 | x | 19,919 |
| Projected Age of Poles Replaced | − | 48 | x | 700 |
| Average Age of New Poles Installed (Year End) | + | 0.5 | x | 700 |
| Increase in Age of Remaining Poles (Year End) | + | 1 | x | 19,219 |
| | | | = | 566,122 |
| | | | ÷ | 19,919 |
| Average Age at Year End | | | = | 28.42 |