Responses to Interrogatories

EB-2016-0105

ER-Staff-79

Ref: p. 3

At the above reference, it is stated that:

It is important to note that the final System Renewal budget for 2017 was not directly and exclusively derived from the Health Index distribution in the ACA report (the relationship is described in detail in the body of this report). Furthermore, although condition based needs represent an important input in developing System Investment capital requirements, there are other factors that are taken into account when deciding on appropriate System Renewal level, such as physical obsolescence, functional obsolescence, compliance with standards, municipal initiatives, and corporate considerations, e.g. financial constraints, input from customers, safety and environmental concerns, etc.

a) Please define each of the above referenced other factors and provide an example of how each has been incorporated into the Thunder Bay Hydro renewal capital expenditures planned for the test year.

b) Please discuss how physical obsolescence and functional obsolescence, as used in the above statement, should be differentiated from the ACA Health Index distribution.

c) In Mr. Tsimberg's opinion, did Thunder Bay Hydro sufficiently take both physical and functional obsolescence of assets into account when "deciding on appropriate System Renewal level" as filed in the application?

THUNDER BAY HYDRO RESPONSE

a) Kinectrics was unable to respond to part (a) without input from Thunder Bay Hydro. This response has been divided between the facts that are being provided by Thunder Bay Hydro, and the responses supplied by Kinectrics, so parties and the OEB can clearly understand where each response is coming from. This approach has been used in other IRRs below where a similar issue arose. The below chart defines each of the referenced 'other factors' and

provides an example of how each was incorporated into the decision making regarding capital expenditures planned for the test year.

Other Factor	**Definition**	**Example of Incorporation**
Physical Obsolescence	Occurs when an asset is deteriorated to a point of being at risk of failure.	Proactive asset replacements for wood poles
Functional Obsolescence	Occurs when an asset cannot perform as needed due to system requirements	Voltage conversion projects where replacement of transformers is required to complete the conversion to ultimately decommission the station.
Compliance with Standards	Standards set out by organizations such as CSA, ESA, Measurement Canada, and Environment Canada.	Meter testing program PCB Transformer Replacement program
Municipal Initiatives	City of Thunder Bay capital projects (road widening, infrastructure replacement) and beautification initiatives.	Co-ordinating renewal projects with city projects to avoid costs
Financial Constraints	Limit on the available capital expenditures.	Strategic reduction of the budget to meet the required envelope
Input from Customers	Feedback and comments from customer surveys provided to TBHEDI regarding system planning.	Residential Customers preference for cost minimization reduced the overall budget envelope Commercial Customers

		preference for reliability resulted in modifying the grid modernization plan
Safety Concerns	Reports from staff and the public which affect the health and safety of both internal and external parties.	Increased budget in Lines Safety Reports to handle the backlog of assets identified as safety concerns.
Environmental Concerns	Concerns with equipment negatively impacting the environment	Budget for Transformers and Lines Safety Reports impacted due to remediation costs.

KINECTRICS RESPONSE

b) ACA Health Index distribution only identifies units that are in bad condition. Units that are physically or functionally obsolete are not necessarily in a bad condition and, thus, sometimes are removed when NOT close to their physical end of life

c) I have no opinion on this question. The ACA was focused exclusively on condition based needs. I did not examine the system renewal spending from this perspective.

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-SEC-57

[Tsimberg p. 3] Please determine how the expert quantified "undesired significant increase", and what the amounts of such an increase would be, for each customer class if there are differences. Please explain whether the expert identified just an increase associated with System Renewal expenditures, just capital expenditures, or all changes in revenue requirement and forecasts that affect rates and customer bills.

KINECTRICS RESPONSE

TBH is addressing the backlog of units identified in the FFAP in a manner that strikes a balance between increased expenditure in System Renewal and the impact on rates. This avoids a more substantial increase in System Renewal if the full backlog were to be addressed starting in year 1. Kinectrics ACA study scope did not include pricing and analysis of resultant revenue requirements and rate impact of different investment scenarios.

ER-VECC-1

Ref: IA Report pg. 3

At page 3 of the report it states:
"*It is important to note that the final System Renewal budget for 2017 was not directly and exclusively derived from the Health Index distribution in the ACA report (the relationship is described in detail in the body of this report).*"

However at Exhibit 2, page 40 it also states:

"*Thunder Bay Hydro expects a cost increase in System Renewal capital expenditures from 2016 to 2017 of $1,215,053. The increase in expenditures is a direct result of the Asset Condition Assessment which was performed in 2016 by Kinectrics and provided a Health Index ("HI") of the entire asset base. The Health Index distribution provided Thunder Bay Hydro a comprehensive view into the condition of assets, and resulted in a suggested level of annual asset renewal in the form of a "Flagged for Action Plan"*.

a) Is the author suggesting that TBH increase in capital spending is not a direct consequence of the findings of the Kinectrics' ACA study?
b) Does the TBH proposed capital expenditures for the 2017 to 2021 period reflect "flagged for action plan" presented in the Kinectrics 2015 ACA?
c) If not, for each asset category how does it differ?

THUNDER BAY HYDRO RESPONSE

b) TBH proposed capital expenditures for 2017 to 2021 are lower than the presented "flagged for action plan" presented in the 2016 ACA.

c) The below chart indicates the differences between the Kinectrics levelized replacement targets verses the TBH planned replacements targeted for 2017 through to 2021.

	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
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
2018 Kinectrics Levelized Replacement Target (Yr1)	0	0	0	177	375	44	171	8	3	0	15	5	2	1	1	5
2018 TBH Replacement Target	0	0	0	197	330	53	171	9	18	1	15	7	2	1	1	3.2
2019 Kinectrics Levelized Replacement Target (Yr2)	0	0	0	176	381	44	171	9	3	0	15	5	3	1	1	6
2019 TBH Replacement Target	0	0	0	183	380	44	170	3	6	0	8	6	0	1	1	5.2
2020 Kinectrics Levelized Replacement Target (Yr3)	1	0	14	176	387	44	171	9	3	0	15	5	2	1	1	6
2020 TBH Replacement Target	0	0	0	195	380	44	170	9	6	0	6	1	6	1	1	5.6
2021 Kinectrics Levelized Replacement Target (Yr4)	0	0	0	176	394	44	171	10	4	1	15	5	2	1	1	6
2021 TBH Replacement Target	0	0	0	222	395	44	171	3	1	0	0	1	0	1	1	5.2

KINECTRICS RESPONSE

a) See response to ER-Staff-79 regarding factors other than the findings of the Kinectrics' ACA study which influenced the capital spending envelope. The System Renewal budget was based on the FFAP presented in the ACA. The relationship between the ACA and the budget is explained in the report, as the ACA is not exclusively used to determine capital spending.

2.0-SEC-58

[Tsimberg, p. 4] Please confirm that the expert is being qualified as an expert in OEB regulatory requirements. If confirmed, please provide the basis for that qualification. If not confirmed, please explain the evidentiary effect claimed of the "opinion" with respect to compliance with OED requirements.

THUNDER BAY HYDRO RESPONSE

Thunder Bay Hydro management did ask Mr. Tsimberg to express his views on compliance with the Ch. 5 Filing Requirements. It is always beneficial to obtain the views of an experienced third party in this regard. However, Thunder Bay Hydro does not intend to qualify Mr. Tsimberg as an expert in regulatory requirements.

In Thunder Bay Hydro's view, Mr. Tsimberg's expertise is in asset management and distribution system planning.

2.0-SEC-59

[Tsimberg, p. 5] Please confirm that Kinectrics is an offshoot of Hydro One, and before that Ontario Hydro. Please provide details of the role the expert Mr. Tsimberg played, if any, in the bankruptcy/insolvency of Ontario Hydro due to its overspending on capital.

KINECTRICS RESPONSE

Kinectrics is not an offshoot of Hydro One.

Kinectrics started as Research Division of Ontario Hydro and after Ontario Hydro was split up became a part of Ontario Power Generation (OPG). OPG then sold Kinectrics to private owners.

Yury Tsimberg is not aware of any bankruptcy/insolvency of Ontario Hydro.

2.0-SEC-60

[Tsimberg, p. 5] Please provide details of the extent, if any, to which the expert Mr. Tsimberg personally reviewed or assessed the distribution system assets of the Applicant. Please include details of all trips the expert made to Thunder Bay to review the assets, and the time spent in each such trip in that type of review. If the expert did not engage personally in a review of the assets, please provide all reports from other people, whether employees of Kinectrics or otherwise, on which Mr. Tsimberg is relying in giving his opinion.

KINECTRICS RESPONSE

Mr. Tsimberg together with his Kinectrics team reviewed TBH's asset categories and available condition data.

Mr. Tsimberg visited TBH on 3 occasions, the first visit for half a day and the last two visits for full day each as follows:

Visit one – November 6, 2015

Reviewed Kinectrics ACA methodology and discuss asset categories to be evaluated

Visit two – January 7, 2016

Kick-off meeting to finalize data categories to be evaluated and assess available data

Visit three – July 13, 2016

ACA results presentation and review by asset category

2.0-SEC-61

[Tsimberg, p. 6] Please provide details of how the HI formulae for the Applicant differs from the HI formulae for other distributors for whom Kinectrics has done the same type of consulting work. For each difference in the formulae, please explain the rationale for the difference, the extent, if any, to which the difference depends on management or engineering judgment by the local LDC personnel, and the impact of the difference on the comparability of results between LDCs.

KINECTRICS RESPONSE

Kinectrics is using the same general formula for all its LDC clients. The differences have to do with available condition data and asset degradation curves. The former is data driven while the latter depends on the engineering judgement by the local LDC personnel, both LDC-specific.

2.0-SEC-62

[Tsimberg, p. 6] Please provide the full HI calculation for the Applicant's assets, as determined by Kinectrics for the purposes of the ACA. Please provide the result in live Excel format, with all formulae live as in the original calculation. Where the calculations draw on source data, please provide the source data, also in live Excel format. Please ensure that the data provided includes the Data Availability Indicator for each asset or group of assets assessed.

KINECTRICS RESPONSE

Kinectrics formulae in "live" format represent Kinectrics developed proprietary IP and, as such, cannot be shared with other parties as this will severely undermine Kinectrics' commercial position. Complete results of the ACA, including DAI are presented in Exhibit 2, Attachment 2-I, Appendix C.

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.

ER-AMPCO-27

Ref: Page 6

a) Please provide and further explain each of the TBHEDI-specific Kinectrics formulas used by the expert to quantitatively express asset conditions in terms of HI.

KINECTRICS RESPONSE

Health Indexing quantifies equipment condition based on condition parameters that are related to the degradation factors that cumulatively lead to an asset's end of life. Condition parameters are the asset characteristics or properties that are used to derive the Health Index. In formulating a Health Index, condition parameters are ranked, through the assignment of weights, based on their contribution to asset degradation. The TBHEDI Health Index formulas were based on parameters that are related to asset degradation mechanisms. The weights were customized based on the data that TBHEDI had available. The asset Health Index formula for each asset is shown in detail in the ACA report (Section 1.1, 2.1, 3.1, 4.1, 5.1, 6.1, 7.1, 8.1 and 9.1 for each Asset's respective Health Index Formula)

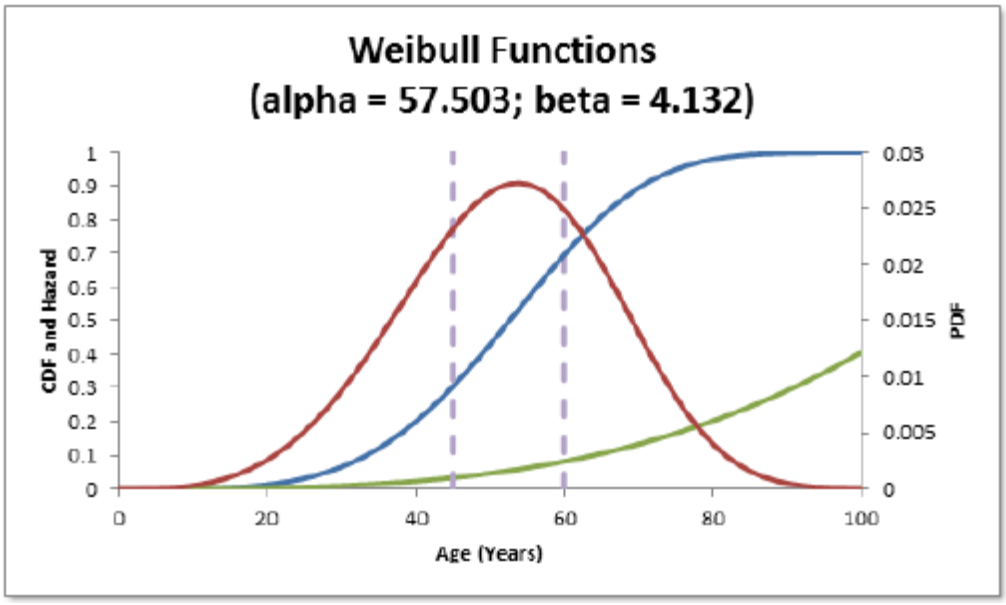
ER-Staff-81

Ref: p. 7

At the above reference, it is stated that:

The Figure 2 below shows Weibull curves used extensively in electrical utilities business to estimate relationship between HI score of individual assets and the corresponding Rate of Failure.

Figure 2 - Weibull Probability of Failure Curves



Failure density curve (the red curve) is first generated using removal statistics and then the rate of failure curve (the green curve) and probability of failure curve (the blue curve) are derived from the failure density curve. TBHEDI, like most other utilities, did not have sufficient removal statistics records required to generate the curves, so instead assumptions based on the experience of the TBHEDI's staff regarding typical useful life and extreme useful life of various assets were used to generate these curves. This is common practice amongst utilities who do not currently have removal statistics available. It is expected that going forward TBHEDI will start collecting removal information so that the risk assessment phase of the ACA process will improve in the future.

a) Please quantify the ratio of the missing Thunder Bay Hydro removal data as a percentage of a complete data set, where 100% indicates that all required removal data is available, and 0% indicates that none of the required data is available.

b) How important is removal data when calculating utility-specific Health Index ("HI") values?

c) To what extent does depending upon the opinions of experienced staff in the absence of complete actual removal data impact the confidence intervals associated with HI values? Please quantify.

d) Are removal data typically categorized by driver, e.g.: does removal data separately track storm-induced failures, electrical failures, tree-fall failures, vehicle accident failures and premature retirements due to customer requests (such as road widening or business closures)?

KINECTRICS RESPONSE

a) Removal data was not used in the HI calculation.

b) It is needed for linking HI with the corresponding probability of failure

c) The opinion of experienced staff is important in establishing Typical Useful Life for assets, whereas demographics are used to determine Extreme or Maximum Useful Life. It is impossible to quantify the impact of this approach verses using actual removals statistics.

d) Ideally, removal data is required to identify removals driven by condition only and they include actual failures and removal of assets in poor condition before they fail, for economic reasons.

AMPCO-28

Ref: Page 7

Preamble: The report indicates TBHEDI, like most other utilities, did not have sufficient removal statistics records required to generate the curves.

a) Please describe what "sufficient removal statistics records" consists of

b) Please summarize the removal information records that TBHEDI has.

c) Please describe the specific data that needs to be collected if TBHEDI is to start to collect this information.

THUNDER BAY HYDRO RESPONSE

a) Thunder Bay Hydro has removal vintage data for all assets, but the reason for removal including additional nameplate data is only collected for distribution transformers, substation transformers and circuit breakers.

b) Thunder Bay Hydro will begin collecting more comprehensive removal data on the remaining categories of assets, however the completeness of this data will depend on the nameplate data being visible, and historical records (ie. Initial purchase / in-service) being available.

KINECTRICS RESPONSE

a) There is no standard for "sufficient removal statistics records." This depends on the asset groups' quality of removal data (the distribution pattern of removal age). There is no absolute threshold in terms of percentage or number of years. The criteria for justifying an asset group's developed curve is the correlation coefficient. Normally if it is greater than 0.9 then there is confidence that the degradation follows Weibull distribution.

e) Data to be collected should include: time of removal, reason for removal, and asset nameplate information (e.g. manufacture date, years in service, make, model, etc.)

ER-Staff-82

Ref: p.7 and 8

At the above reference, it is stated that:

> Rather than using the term "Replacement Plan", FFAP was used because replacement is NOT the only option available when asset is found to be in a poor condition. For example some assets that are typically replaced proactively or before they fail are station transformers, circuit breakers and wood poles. Rather than replacement there are a number of actions that could be taken, such as refurbishment, more frequent inspections, specific operating procedures, increased spare equipment inventory, etc.

Please further discuss the options other than replacement that are listed as available, including what would determine when they were used in place of replacement and to what extent each of these options would represent an expenditure of capital, OM&A or other dollars.

KINECTRICS RESPONSE

The options other than replacement include but are not limited to the following:

- Refurbishment/repairs
- Operating procedure
- More frequent inspections
- Modified spares strategy
- Real time monitoring
- "do nothing". i.e. accepting higher risk

Assets that have non-replacement options available typically are proactively replaced (before they fail). Depending on option selected, they wold represent capital or O&M expenditure. For example, more frequent inspections would be an O&M expenditure whereas major refurbishment could be either capital or O&M depending on the LDC's accounting practices.

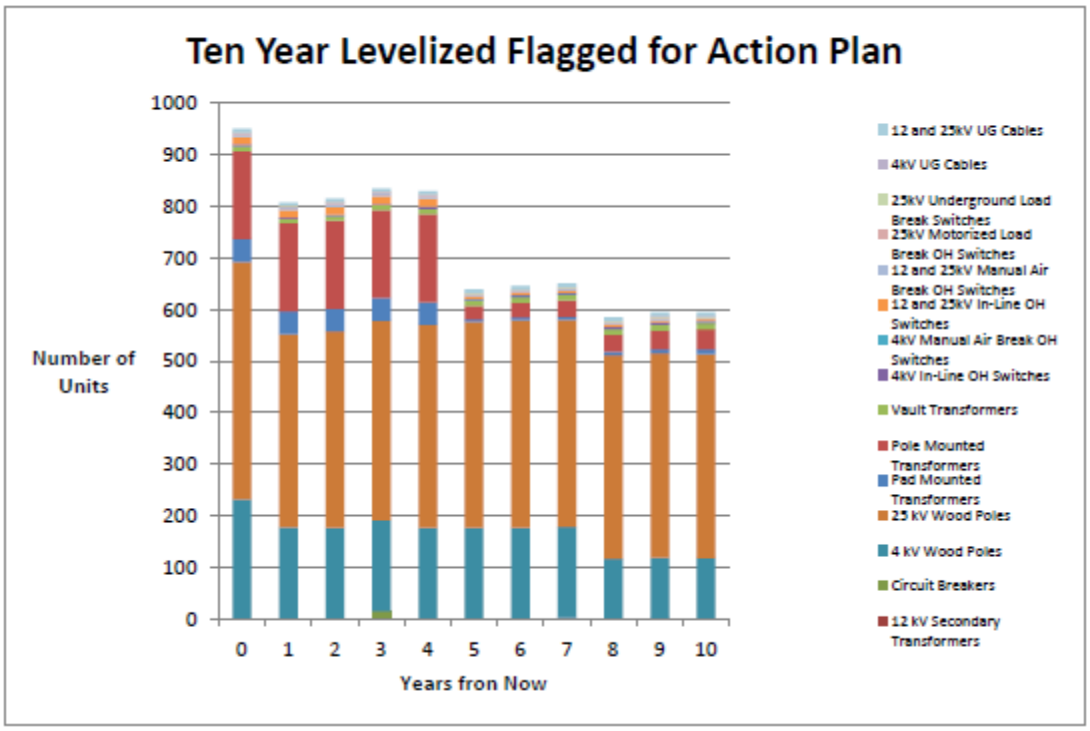
The decision of which is the most appropriate option is made on a case-by-case basis using economic considerations.

ER-Staff-83

Ref: p.8

At the above reference, the figure below is shown:

Figure 3 – TBHEDI's 10-Year FFAP



a) Please explain the reasons for the significantly higher number of units flagged for action during the first five years (year 0 to 4) shown in Figure 3, and particularly the number of units in year 0. Please quantify the explanation, to the extent possible.

b) Does the Flagged-for-Action Plan (FFAP) shown in Figure 3 incorporate the asset replacements forecast in the present filing? If not, please provide an updated version of Figure 3 that does incorporate the forecast replacements.

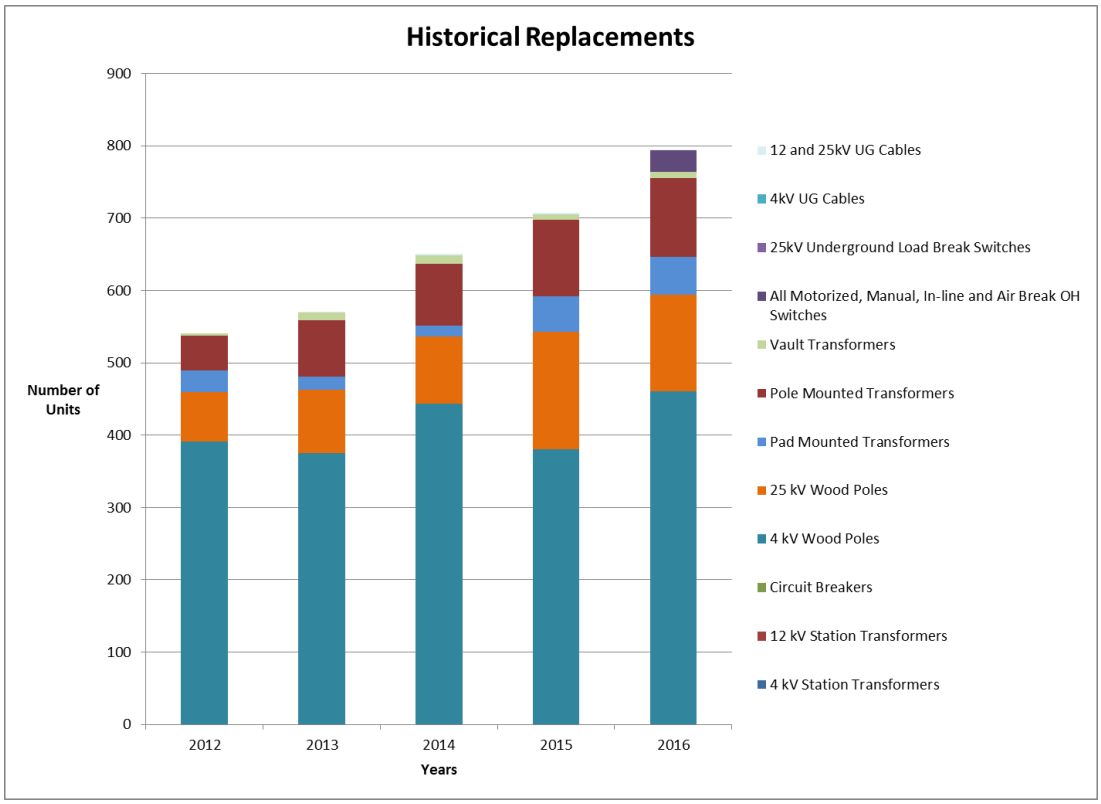
c) What would be the anticipated reliability impacts of implementing a replacement program that was more evenly paced over the planning horizon shown in Figure 3?

d) Please compare the FFAP with historical replacements for the 5 year period immediately prior to year 0 in Figure 3.

e) Please explain the reasons for any significant (>10%) inter-annual unit flagged for action counts over the historical and planned horizons, by asset class.

THUNDER BAY HYDRO RESPONSE

d) Please see below the historical replacements for the 5 year period immediately prior to year 0.



KINECTRICS RESPONSE

a) The number of units flagged for action is derived from HI and generated failure curves as described in the Kinectrics ACA report included in Exhibit 2, Attachment 2-I, Appendix C. For those that are proactively addressed, specific units are flagged for action once their POF exceeds 0.8.The units with only age data available have a number of units expected to fail each year estimated

without identifying specific units. Once this analysis was done, a five-year averaging was done or criticality considered in levelizing the FFAP.

The reason there are higher quantities flagged in the first 5 years is because it was found that there is a backlog of units that need to be addressed. i.e. larger quantities in very poor/poor condition that will translate to larger quantities to be addressed in the near future.

b) The asset replacement forecast in the present rate filing incorporates FFAP is an input in representing condition driven replacement needs along with other drivers (see response to ER-Staff-79 a)) and not the other way around.

c) Please see our response to ER-Staff-80 b)

e) FFAP was developed for the first time in 2016 and represents condition based only replacement requirements. Historical replacements represent not only condition based replacements but also replacements for other reasons and, thus, should not be compared to the FFAP in the ACA.

2.0-SEC-64

[Tsimberg, p. 8] Please provide complete lists of

a) All assets or asset classes that the expert believes the Applicant normally operates on a run to failure basis.

b) All assets or asset classes that, as the expert understands, are typically replaced before they fail by the Applicant, and in each case the basis for such replacement.

KINECTRICS RESPONSE

a) In Exhibit 2, Attachment 2-I, Appendix C, Asset Condition Assessment Report, page 16 and 17 indicate the asset classes that are normally operated on a reactive replacement strategy. In Exhibit 2, Attachment 2-I, Appendix C, Asset Condition Assessment Report, page 16 and 17 indicate the asset classes that are normally operated on a proactive replacement strategy basis.

2.0-SEC-65

[Tsimberg, p. 8] Please provide a table showing the FFAP list, and the determinations by the Application "on a case-by-case basis" as to what action the Applicant will take with respect to each item on the FFAP list.

KINECTRICS RESPONSE

FFAP list is included in the ACA report in Exhibit 2, Attachment 2-I, Appendix C, Asset Condition Assessment Report, page 16 and 17. This table also indicates each asset class replacement strategy.

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-AMPCO-31

Ref: Page 8

a) Has the expert done any analysis to compare the quantities and costs of the proposed FFAP to an FFAP based on using age or historical replacement rates?

KINECTRICS RESPONSE

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

ER-AMPCO-32

Ref: Page 8

a) Please provide the “other drivers” specific to TBHEDI that contribute to TBHEDI’s System Renewal Requirements.

THUNDER BAY HYDRO RESPONSE

a) Please refer to the response in ER-Staff-79 a).

2.0-SEC-66

[Tsimberg, p. 10] Please confirm that generally SAIFI is a reflection of asset condition and environmental impacts, while SAIDI reflects those items, plus a utility's responsiveness to outages.

KINECTRICS RESPONSE

Yes, however SAIDI also depends on 1) system ability to quickly identify fault location and isolate it from the rest of the system and 2) system capabilities to supply load from different supply point(s).

2.0-SEC-67

[Tsimberg, p. 10] Please explain the selection of the three "peers" used for benchmarking purposes. If this peer group has been mandated by the OEB, please provide a reference to the OEB document that so determines.

KINECTRICS RESPONSE

The selection of "peers" used for benchmarking purposes is from the report released by the Ontario Energy Board in 2013 titled "Third Generation Incentive Regulation Stretch Factor Updates for 2012 (EB-2011-0387)" specifically Table 5: Peer Group Divisions.

2.0-SEC-68

[Tsimberg, p. 10] Please confirm the following:

a) The Applicant's 2015 Gross SAIFI was 2.89, compared to the unweighted average for all LDCs of 1.83, and that the Applicant's Gross SAIFI was better than 12 of the other LDCs out of 59.

b) The Applicant's 2015 Gross SAIDI was 2.23, compared to the unweighted average for all LDCs of 3.54, and that the Applicant's Gross SAIFI was better than 26 other LDCs out of 59.

c) The Applicant's 2015 SAIFI (net of loss of supply) was 2.39, compared to the unweighted average for all LDCs of 1.08, and that the Applicant's Gross SAIFI was better than 3 other LDCs out of 59.

d) The Applicant's 2015 SAIDI (net of loss of supply) was 2.02, compared to the unweighted average for all LDCs of 1.60, and that the Applicant's Gross SAIFI was better than 19 other LDCs out of 59.

Please explain how these all-Ontario comparisons factored into the analysis by the expert.

KINECTRICS RESPONSE

a) The benchmarking in the report only involved the peer group of LDCs

b) The benchmarking in the report only involved the peer group pf LDCs

c) The benchmarking in the report only involved the peer group of LDCs

d) The benchmarking in the report only involved the peer group of LDCs

2.0-SEC-69

[Tsimberg, p. 10] Please confirm that the expert did not benchmark the capital spending plans of the Applicant relative to its Asset Condition Assessment to the capital spending plans of other LDCs who have filed ACAs and capital plans. By way of example, to what extent, if any, did the expert assess the FFAP responses of the Applicant relative to similar responses by other LDCs who have also relied on Kinectrics ACA work.

KINECTRICS RESPONSE

Confirmed.

2.0-SEC-70

[Tsimberg, p. 10] Please explain why the expert did not comment on whether a percentage of depreciation is a helpful benchmark, as requested by counsel in the revised instructions letter.

KINECTRICS RESPONSE

The "percentage of depreciation" approach is a high level general approach in the absence of more precise methodology to be used in determining System Renewal requirements, i.e. ACA for a specific utility. TBH's System Renewal capital requirements were based on specific findings from Kinectrics ACA plus considerations for other functional requirements. This eliminates the need for the "percentage of depreciation" approach.

ER-Staff-84

Ref: p. 11 and p. 13

At the first reference above, the following statement is made:

> Since most of the equipment caused outages are due to line components failures and TBHEDI spends the least amount per line km and close to the lowest cost per customer among the peer LDCs while experiencing by far the highest number of outage frequency rate and second highest outage duration rate, it could be concluded based on this benchmarking that TBHEDI is underspending on its line assets.

At the second reference above, the following statement is made:

> In addition to the outages caused by equipment failures due to equipment at the end-of-life, there are also random equipment failures involving assets recently installed or at mid-life. In such cases equipment is replaced or repairs are made and equipment stays in service, yet such outages also contribute to unreliability and cannot be addressed proactively.
>
> Finally, there are many factors that impact reliability performance, such as weather induced stresses, electrical faults, external causes (e.g. animals and drivers).

a) Please compare the frequency of equipment-caused outages to outages caused by weather events, tree contacts vehicle accidents and other external causes.

b) Are asset failures due to deteriorated asset condition a primary cause of Thunder Bay Hydro outages?

c) Will increasing the level of System Renewal expenditures noticeably reduce the outage frequency caused by weather events, tree contacts or vehicle accidents? Please quantify.

THUNDER BAY HYDRO RESPONSE

a) Page 44 of the DSP, included as Exhibit 2, Attachment 2-I, shows a compilation of the root causes of outages for the period 2012-2015. Thunder Bay Hydro follows the Ontario Energy Board Regulatory Reporting Requirement framework and attributes each outage to one of the 10 defined categories.

b) Asset failures due to deteriorated asset condition (OEB defined category "Equipment Failure") accounted for 24% of outages for the period 2012-2015.

KINECTRICS RESPONSE

c) Outages caused by tree contacts and vehicle accidents for the most part are not related to equipment condition. System Renewal expenditures, particularly in wood poles, are expected to reduce weather related outage frequency because poles in better condition can withstand stronger winds then poles in poor condition.

ER-Staff-85

Ref: p. 11

At the above reference, the following statement is made:

Table 1 below provides a comparison of Typical Useful Life (TUL) and Maximum useful Life (Max UL) used in the Kinectrics ACA study with the values provided as a guideline in the OEB's publication "Asset Deprecation Study for the Ontario Energy Board" issued on July 8, 2010.

Table 1 – Comparison of TBHEDI's Useful Lives with OEB Guideline Values

Asset Category	TBHEDI		OEB	
	TUL	Max UL	TUL	Max UL
Station Transformers	60	70	45	60
Circuit Breakers	60	70	45	65
Wood Poles	60	75	45	75
Painted Wood Poles	45	60	N/A	N/A
Pad Mounted Transformers	35	45	40	45
Pole Mounted Transformers	50	65	40	60
Vault Transformers	40	55	35	45
Overhead Switches	45	60	45	55
Non-TR Underground Cables	35	55	25	30
TR Underground Cables	40	60	40	55

It is seen from this comparison that in the Kinectrics ACA study TBHEDI's assets were assumed to last longer than the OEB's guideline values and, thus, the results of the ACA report were derived using conservative assumptions regarding assets useful lives. This means that if TBHEDI's TULs were assumed to be shorter, e.g. in line with the OEB guideline, than the ACA study would have identified more units for the inclusion in the FFAP thus resulting in higher System Renewal requirements.

Please correlate the TUL and Max UL values shown in Table 1 with the FFAP counts shown in Figure 3, i.e.: show how the year 0 replacement count for each asset class is related to the Table 1 TUL and Max UL values.?

KINECTRICS RESPONSE

TUL and Max TUL TBH-specific values were used to generate POF curves and these curves were used to relate HI with the corresponding POF. FFAP counts were then derived as explained in response to ER-Staff-83 a).

2.0-SEC-71

[Tsimberg, p. 11] Please confirm that spending per km. of line is primarily a function of customer density, and should be lower when customer density is lower. If this is not the case, please explain why.

KINECTRICS RESPONSE

Not confirmed. The spending per km line is primarily a function of lines length and condition of the lines components.

2.0-SEC-72

[Tsimberg, p. 12] Please provide details on what data was used by Kinectrics to determine that the Applicant's assets would last longer than the OEB's guideline values.

KINECTRICS RESPONSE

Interviews with Thunder Bay Hydro engineering and field staff were performed and analysis of records indicating in-service asset ages.

2.0-SEC-73

[Tsimberg, p. 13] Please provide details, included quantification, on how the improved reliability arising from the wood poles program and the underground cable replacement program have been reflected in the Application for the test year and subsequent years.

KINECTRICS RESPONSE

Please see the response to ER-Staff-80 a) and b)

2.0-SEC-74

[Tsimberg, p. 13] Please provide details on the extent to which replacement of an asset that has failed will produce less reliability benefit than replacement of an asset proactively because it is expected to fail soon. Please confirm that, on a portfolio basis, the latter is likely to have a similar impact on reliability as the former.

KINECTRICS RESPONSE

Please see the response to ER-Staff-80 a) and b)

ER-AMPCO-33

Ref: Page 13

a) Does TBHEDI track the age of each asset at the time of failure?

b) How did the expert use this data in determining the proposed FFAP?

THUNDER BAY HYDRO RESPONSE

a) TBH tracks the age (or decade) of each asset at the time of removal, but it does not track the age of each asset at the time of failure, this is only collected for distribution transformers.

KINECTRICS RESPONSE

b) TBHEDI, like most other utilities, did not have sufficient removal/failure statistics records required to generate life curves. Instead assumptions based on the experience of the TBHEDI's staff regarding typical useful life and extreme useful life of various assets was used to generate life curves. This is common practice amongst utilities who do not currently have comprehensive removal statistics available.

2.0-SEC-75

[Tsimberg, p. 14] Please provide details, including quantification, on how the reduction in corrective O&M has been reflected in the Application for the test year and subsequent years.

KINECTRICS RESPONSE

This is an empirical process and the impact on corrective O&M from the increase in System Renewal investments in linear assets could be estimated by trending the associated corrective O&M annual costs over a period of several years.

ER-AMPCO-34

Ref: Page 17

a) What is the expert's opinion on an alternative approach that paces the shift in expenditures over a five-year period or longer timeframe?

THUNDER BAY HYDRO RESPONSE

Thunder Bay Hydro's pacing approach to pacing the shift in expenditures is to begin in 2017 with the anticipation of becoming aligned with the "Flagged for Action" plan suggested by Kinectrics by 2019. Thunder Bay Hydro has purposely taken a conservative approach and pace the shift in expenditures over a 3 year period to minimize cost impact on the customer and to complete work in progress. Specifically 4kV conversion projects, where there are only one or two project areas remaining to be completed prior to decommissioning of a sub-station. In addition, this change is a fundamental shift 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.

KINECTRICS RESPONSE

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

2.0-SEC-76

[Tsimberg, p. 18] Please provide the factual basis on which the expert observed the paragraph commencing "In putting together capital plans…"

KINECTRICS RESPONSE

Contained in DSP included in Exhibit 2, Attachment 2-I.

2.0-SEC-77

[Tsimberg, p. 18] Please provide the factual basis on which the expert observed "Decision making follows the Asset Management Framework".

KINECTRICS RESPONSE

Through the review of Exhibit 2, Attachment 2-I, DSP Section 5.3 Asset Management

Process.

2.0-SEC-78

[Tsimberg, p. 18] Please provide the factual basis on which the expert observed "Existing capital planning process includes prioritization".

KINECTRICS RESPONSE

Through the review of Exhibit 2, Attachment 2-I, DSP, Section 5.4.2.3 "Project Prioritization Tools and Methods".

ER-AMPCO-35

Ref: Page 18

a) Does the expert have an opinion on the quality or accuracy of TBHEDI's response to the Chapter 5 requirements?

KINECTRICS RESPONSE

Please see section 7 of the report.

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.

ER-VECC-3

Ref: ACA Report/pg.10

a) The IA Report provides a comparison of TBH with selected LDCs. Why did the author choose these utilities to compare with TBH?

b) Did the IA author review the distribution system plans and most recent asset condition assessments for the comparator group of utilities?

c) What study did the author make of the reliability statistics so as to differentiate between weather related outages and outages due to equipment failure? If no such study why is not reasonable to conclude that the variance in reliability statistics is due to variances in weather or other factors beyond the control of the utilities management?

d) In the absence of knowledge as to the comparator group's asset condition why is it meaningful to compare total cost per customer or their reliability statistics?

KINECTRICS RESPONSE

a) The selection of "utilities" used for benchmarking purposes was from the report released by the Ontario Energy Board in 2013 titled "Third Generation Incentive Regulation Stretch Factor Updates for 2012 (EB-2011-0387)" specifically Table 5: Peer Group Divisions.

b) No

c) Peer group was selected to include LDC's of similar size and weather exposure.

d) These are the measures prescribed by the OEB for benchmarking of LDCs performance.

ER-VECC-4

Ref: E4/Attachment 4-O / IA pgs. 11-12 Table 1

a) Appendix 2-BB shown at the above reference appears to show that TBH is not proposing any asset category TUL's outside of the Board approved ranges with the exception of transportation equipment and computer hardware and software. Table 1 of IA Report suggests otherwise. Please explain this apparent inconsistency.

b) Please provide the reference to where in the ACA Report Kinectrics proposes new TULs for the assets categories shown in Table 1.

KINECTRICS RESPONSE

a) Historically physical lives of assets were longer than the corresponding depreciating periods, in fact the gap has narrowed after the introduction of IFRS. There is a good reason why the gap should remain as depreciation timeline takes into account replacements other than conditions based, i.e. road widening, which involves removal of newer assets way before the end of their physical life, whereas ACA results were based on estimated physical lives.

b) Kinectrics is not proposing new TULs for asset categories in Table 1 of the IA report, as Table 1 summarizes TUL and TUL max used in the ACA study based on the input from TBH Subject Matter Experts. In absence of actual removal statistics, this was the only option available for generating POF curves.

ER -VECC -5

Ref: IA Report pg. 14

a) What study has Kinectrics done which would show the veracity of the statement "…*planned replacements represent a much more efficient use of capital funds since planned replacement unit cost is always lower than forced replacement unit cost*"?

KINECTRICS RESPONSE

This is well accepted industry-wide assertion and, in fact, many utilities not only in North America but indeed across the world measure relative consequence of failure based on the ratio between forced and planned replacements, i.e. the higher the ratio the more critical the asset.

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.

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.

ER-AMPCO-30

Ref: Page 7
Ref: Exhibit 2, Attachment 2B, Appendix C, Page 3

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 ≤ Health Index < 50%
Fair	50 ≤ Health Index <70%
Good	70 ≤ Health Index <85%
Very Good	Health Index ≥ 85%

a) Does Kinectrics have general guidelines for each of the above five Health Index categories in terms of recommended asset replacement timing?

b) Do the timing recommendations for each category differ by asset type?

c) Do the timing recommendations for each category differ by LDC?

KINECTRICS RESPONSE

a) The timing for flagging for action is based on a probabilistic assessment. It considers the fact that in a given year, a younger asset may fail but that an asset in poor condition may not fail. Because of the probabilistic nature, the timing for action is not exact (Section II.2 of the ACA report). That said, typically assets found in very poor condition would generally be flagged for action within 5 years.

b) Timing will differ by asset type. Each asset group has a different useful life range. If the typical useful life is 60 years, a “very good” asset may not be flagged for 60 years. If the typical life is 30 years, a “very good” may not be flagged for 30

years. Flagged for action can even vary by unit within an asset class. For example, say transformers A and B right now both have a health index of 55% (i.e. exactly the same condition). However, A is in an environment where it is more heavily stress (say continuously loaded at 85%), whereas B is loaded at 45%. Even though both transformers currently have the same condition, A's likelihood of failure, given its more stressful environment, will be higher, and it will in effect be flagged for action sooner than B.

c) Yes. See b).