ONTARIO ENERGY BOARD
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EB-2018-0165

ONTARIO ENERGY BOARD

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

AND IN THE MATTER OF an Application by Toronto Hydro-Electric System Limited ("Toronto Hydro") for an Order or Orders approving or fixing just and reasonable distribution rates and other charges, effective January 1, 2020 to December 31, 2024.

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COMPENDIUM OF THE SCHOOL ENERGY COALITION
(Panel 4 – UMS)

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TORONTO HYDRO-ELECTRIC SYSTEM LIMITED (“THESL”)

UNIT COSTS BENCHMARKING STUDY

SECTION I - INTRODUCTION

Torys LLP ("Torys"), acting on behalf of Toronto Hydro-Electric System Limited ("THESL" or "the Company"), engaged UMS Group to conduct a third party independent review of the Company's methodology for deriving unit costs and perform benchmarking comparisons of a pre-selected set of asset categories and maintenance programs; namely:

Asset Categories

- Wood Pole Replacement
- UG Cable (XLPE)
- OH Switches (Manual and Remote / Motor Operated)
- Pole Top Transformer Replacement
- Padmount / UG Transformer Replacement
- Network Transformer / Protector Replacement
- Breaker Replacement (SF6, Oil and Vacuum)

Maintenance Programs

- Vegetation Management
- Pole Test and Treat
- Overhead Line Patrol
- Vault Inspection

Establishing Context

In establishing context for the analyses and conclusions contained within this report, UMS Group:

- Reviewed relevant reports, procedures and system performance data provided by the Company, (***see Appendix A***);
- Was provided complete access to the Company's technical and management staff in the form of conference calls and on-site workshops (e.g.; Design and Construction, Planning and Standards, Enterprise Project Management and Development, Engineering and Regulatory and Finance); and
- Formed a Peer Group Panel, comprised of 17 electric utilities with system and customer demographics like those of THESL, each dealing with the unique cost drivers that are prevalent in large urban settings (***see Appendix B***).

Comparative Analysis

The actual Peer Group comparisons of unit costs accounted for the fact that though there are similarities among the electric utilities selected, there are also differences to be reconciled, including:

- Regional costs,
- Practices in reporting costs,
- System demographics (i.e.; population density and underground utility congestion), and
- Other external factors (i.e.; mandates and constraints regarding performance of work, weather, and vegetation).

Thus, we developed normalization factors (***see Appendix C***), assuring the completeness and relevance of our benchmarks. In addition, with respect to our assessment of the Company's unit costing practices, we adopted an industry-wide perspective (*i.e.;* not constrained by those of the Peer Group Panel).

UMS Group Qualifications

UMS Group, headquartered at 300 Interpace Parkway, Parsippany, NJ, 07054, was retained as an independent expert. With over 28 years of experience conducting comparative performance assessments for the global utilities industry, UMS Group has supported multiple assessments and global benchmarking programs on six continents working with state and province public utility commissions as well as more than 300 electric, gas and water utilities. UMS Group has augmented its analytical capabilities with a team of industry experts who are knowledgeable in best productivity and service-level performance practices to (1) ascertain an electric utility's efficiency and effectiveness in comparison to a qualified peer group, and (2) collaboratively develop aggressive, yet achievable performance improvement plans. Among other qualifications, UMS Group leads several Global Learning and Benchmarking consortia, which together with our portfolio of ongoing client engagements facilitates our ability to maintain "real-time" proprietary cost and operational performance data, correlated to industry "best practices," all supported by an analytical framework built on the premise that industry "best performers" can be both efficient and effective. Appendix D provides additional details regarding UMS Group's qualifications and those of the individuals assigned to this effort.

The UMS Group-assigned expert for this effort, Mr. Jeffrey W. Cummings, fully acknowledges his duties as an expert in accordance with Rule 13 and Form A of the Ontario Energy Board's ("OEB" or "Board") Rules of Practice and Procedure. In so doing, he acknowledges that it is his duty to provide evidence in relation to this report as follows:

- To provide opinion evidence that is fair, objective and non-partisan;
- To provide opinion evidence that related only to matters that are within his area of expertise; and

- To provide such additional assistance that the Board may reasonably require, to determine a matter in issue.

He acknowledges that the duty referred to above prevails over any obligation, which he may owe either Torys or THESL.

Structure of the Report

The ensuing discussion is divided into three sections:

- Section II – Executive Summary: A summarization of our conclusions on the Company's methodology for deriving unit costs and the benchmarking comparisons with the Peer Group Panel,
- Section III – Project Approach: A description of and rationale for the approaches, methodologies, criteria and frameworks adopted to accomplish THESL's stated objectives, and
- Section IV – Summary of Results: An expanded discussion of findings, conclusions and recommendations around the topic of unit costs.

We have provided additional appendices to supplement the information provided in Sections II through IV in the form of comparative charts, graphs and tables, as well as more in-depth explanations of the bases for our evaluations and supporting analytics.

SECTION II – EXECUTIVE SUMMARY

Overview of THESL's Unit Cost Initiative

UMS Group was retained to conduct a review of THESL's methodology for determining the unit costs underlying its distribution system capital and maintenance programs and perform a utility benchmarking study to compare THESL's unit costs with those of a Peer Group Panel. In accomplishing these objectives, UMS Group:

- Conducted a series of workshops / interviews with several THESL stakeholder organizations (e.g.; Design and Construction, Planning and Standards, Enterprise Project Management and Development, Engineering, and Regulatory and Finance),
- Reviewed a myriad of requested reports, procedures and system performance data (***see Appendix A***).
- Established a Peer Group Panel of 17 electric utilities, largely based on demographics (customer density, vegetation, and weather / climate), and factors that add complexity to field execution (e.g.; technical, legislative, regulatory and Bargaining Unit constraints / mandates),
- Designed and administered a survey, seeking fully-loaded unit cost comparators and key accounting and local factors to conduct full-scale normalization (i.e.; accounting for elements beyond currency conversion rates and regional cost adjustments), and
- Analyzed the results of the survey, resulting in the benchmark of seven asset categories and four maintenance programs and a comparison of THESL's unit cost methodology with that of representative sampling of industry peers.

The results of this effort summarized below and expanded upon in Section IV, "Summary of Results," yielded insights from both industry and THESL – specific perspectives.

Industry Perspective Regarding Unit Cost Methodology

Unit costing is a simple concept to grasp. However, the reporting of unit costs for productivity measurement or benchmarking across electric utilities is complex:

- *Asset Categories*: Most utilities map burdened labor (i.e.; vacations, holidays and training less corporate A&G), and material and equipment costs to asset classes based on some form of work order time sheets, and then allocate design, engineering, permitting, warehousing and AFUDC to arrive at a total cost. One can then infer a unit cost by dividing this "fully-loaded" cost by the number of units installed within the same year. Though seemingly straight forward, electric utilities need to account for the (1) carryover of costs from the previous fiscal year, (2) lagging costs applied to uninstalled assets, and (3) different reporting regimens for work performed in-house vs. by a third party.
- *Maintenance Programs*: The industry is consistent in not applying overheads to maintenance costs (only salary burdened by statutory costs and benefits). However, there

are inconsistencies regarding the extent to which maintenance activities are actually "unitized" (often they are managed as "buckets" with budgets based on historical spending patterns with little, if any visibility on units inspected, tested or maintained). Therefore, the fact that 50 percent of the utilities responding to the survey could not provide unit costs for three of the four maintenance programs was not a surprise.

In spite of the industry shortfalls described above, electric utilities have typically used unit costs to provide order-of-magnitude estimates, define staffing levels, create resource-loaded schedules, and/or support financial reporting requirements. Therefore, the above-described methodology has proven adequate. However, as the focus shifts to measuring and comparing performance, inconsistencies in the burdening of capital labor costs, challenges in disaggregating the components of unit costs to arrive at a direct labor unit cost, and lack of transparency into the number of units installed will:

- Preclude effective Performance Management (e.g.; use of fully-loaded unit costs potentially masks productivity improvement or degradation, the inability to unitize maintenance programs limits the monitoring of productivity to budget management, and inconsistencies in the burdening of capital labor costs results in the need for more rigorous "normalization" routines when comparing unit costs across electric utilities),
- Adversely affect management's ability to assess the effectiveness of material procurement policies, and
- Limit insights regarding the trade-offs in using in-house vs. hiring outside contractor resources.

As we surveyed the industry, THESL was among a small percentage of electric utilities that are addressing these issues.

THESL – Specific Perspective Regarding Unit Cost Methodology

THESL has taken some initial steps to bridge the gap between unit cost and performance management by implementing a new "Asset Assembly Unit Structure" ("AAU") for tracking unit costs for in-house capital projects as a complement to "Unit Pricing Contract Management System" ("UPCMS") used for work performed by outside contractors. This change allows for the (1) collection of labor and material cost information at the asset level (in contrast to the project or work order level), (2) comparison of actual and budgeted unit costs on an on-going basis, and (3) disaggregation of the components of unit cost to expand THESL's view of performance. In other words, THESL is disaggregating the components of unit cost to expand its view of performance by separating labor from material, and removing financial loaders on labor to establish a direct labor unit cost.

With respect to the four Maintenance Programs that comprised the scope of this effort, THESL derived cost and unitized information from the vendor invoices, thus reflecting an accurate depiction of unit cost. For maintenance work performed by THESL in-house staff, THESL comports to the industry standard of not applying overheads to maintenance costs (only salary burdened by statutory costs and benefits).

Unit Cost Benchmarks

In reviewing the actual benchmarks, relative to a Peer Group Panel of 17 electric utilities spanning the North American continent (***see Section III and Appendix B***), fully "normalized" comparisons place THESL in the second quartile in all but one asset category. Even without "normalizing" for differences in regional costs, accounting practices, and a myriad of difficulty factors - ***see Section III and Appendix C*** - THESL's position is still fairly strong: Two Asset Categories: Wood Pole and Breaker, and One Maintenance Program: Pole Test and Treat slip slightly into the 3rd quartile.

Table II-1: Fully Normalized Benchmark Comparisons

		Quartile			
Category / Program	**THESL Unit Cost 3-YR Weighted Average**	**Top**	**2nd**	**3rd**	**Bottom**
Wood Pole	$7,434		X		
UG Cable (XLPE)	$96		X		
OH Switches (Manual and Remote / Motor-Operated	$21,062		X		
Pole Top Transformer	$11,761			X	
Padmount / UG Transformer	$21,454		X		
Network Transformer / Protector	$88,943		X		
Breaker (SF6, Oil, and Vacuum)	$85,242		X		
Vegetation Management	$2,111		X		
Pole Test and Treat	$18		X		
Overhead Line Patrol	$44		X		
Vault Inspection	$253		X		

The seven asset categories represent approximately 60 percent of the maintenance capital budget over the 2014 through 2016 period, and THESL spends approximately 50 percent of all preventative and predictive maintenance costs on the four maintenance programs that comprised this study.

Summary

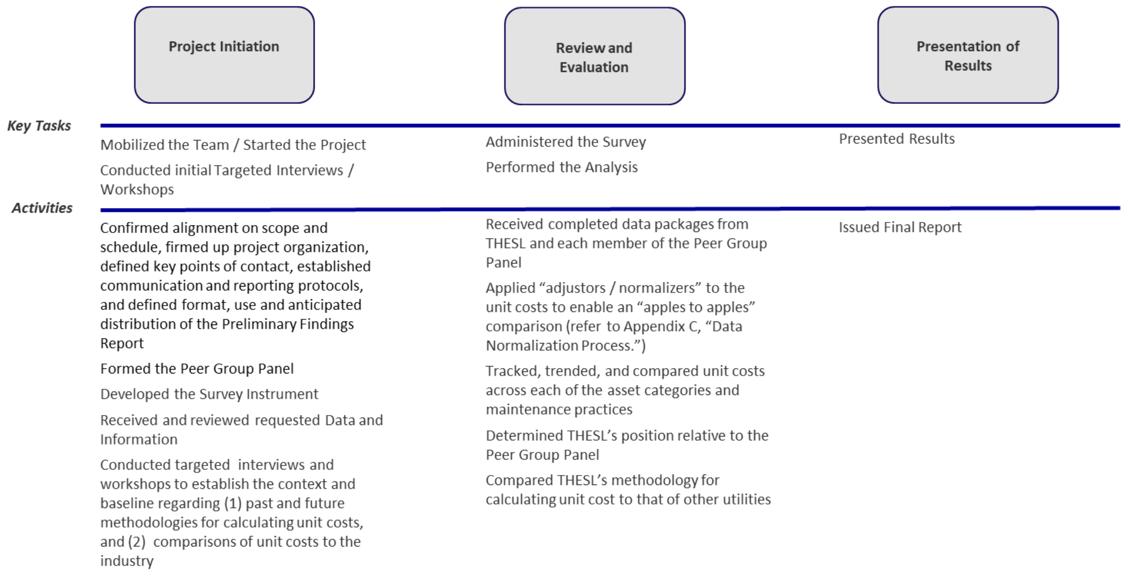
THESL is operating from a position of strength with respect to Unit Costs:

- Fully normalized benchmark comparisons place THESL in a strong position (2nd quartile in all but one of the asset categories / maintenance programs reviewed as part of this project),
- Recent changes in the structures used by THESL to collect and maintain capital unit cost information (i.e.; AAU) opens the door for improving the quality of estimates and the managing of productivity, and
- Methods currently in place to report and manage unit costs related to maintenance programs comport to industry standards.

SECTION III – PROJECT APPROACH

In order to assess the Company's methodology for deriving unit costs and perform benchmarking comparisons of a pre-selected set of asset categories and maintenance programs, UMS Group developed and executed the following work plan:

Figure III-1: Unit Cost Performance Assessment Overview



From Project Initiation to the Presentation of Results, UMS Group applied several elements of its proprietary and time-tested benchmarking and practices assessment methodology to independently assess THESL's approach in deriving unit costs; and benchmark the fully loaded unit costs of a representative cross-section of asset categories and maintenance programs. The following discussion will expound on those aspects of our approach that contributed to our achieving the level of objectivity and relevance committed to in our original proposal.

Peer Group Panel

The Peer Group Panel used for this study consisted of 17 electric utilities; namely:

- AES-IPL (Indianapolis, IN)
- AES-DPL (Dayton, OH)
- Ameren UE (St. Louis, MO)
- Baltimore Gas and Electric (Baltimore, MD)
- Detroit Edison (Detroit, MI)
- Dominion – VP (Richmond, VA)
- ENMAX (Edmonton, AB)
- FirstEnergy CEI (Cleveland, OH)
- Lansing Board of Water and Light (Lansing, MI)

- Pacific Gas and Electric (San Francisco, CA)
- Portland General Electric (Portland, OR)
- Philadelphia Electric Company (Philadelphia, PA)
- SMUD (Sacramento, CA)
- SaskPower (Regina, Saskatchewan)
- Seattle City Light (Seattle, WA)
- Southern California Edison (Southern California including Los Angeles suburbs)
- Xcel Energy – MN (Minneapolis, MN)

In selecting the utilities that comprise this group, our goal was to provide comparisons that would be relevant to an electric utility of THESL's size and complexity (and where there were inconsistencies, apply industry-accepted normalization processes). Table III-1 illustrates THESL's relative position across the myriad of factors considered in conducting like-for-like unit cost comparisons. Though no two electric distribution systems / organizations are identical, THESL is among the highest percentages within this Peer Group Panel in four of five factors that can influence comparisons of fully loaded unit costs.

Table III-1: Distribution of Peer Group Panel across Difficulty Factors (including THESL)

Vegetation		
Low	Medium	High
9	7	2
UG Utility Congestion		
Low	Medium	High
1	6	11
Population Density (Customers per Square KM)		
Low (<25)	Medium (25 to 100)	High (>100)
2	4	12
External Factors		
Low	Medium	High
2	7	9
Weather / Climate		
Mild	Moderate	Harsh
4	11	3

NOTES: The area shaded in red reflects the categorization of THESL in each category.

There are several instances where a utility has a large urban center and even larger rural areas (e.g.; Xcel Energy, Ameren UE, and SaskPower). In these cases, we were able to collect data on those districts that serve the larger population centers (i.e.; more closely approximating THESL's demographics).

In considering other Province of Ontario electric distribution systems / organizations, notwithstanding the recently formed Alectra Utilities,[1] THESL stands unique. Toronto city ordinances, a higher cost of living, the amount of underground construction, greater volatility in customer movements, amount of electric distribution assets, and population density, taken in totality, suggested a more appropriate peer group for comparing unit costs, one that consists of electric utilities operating in other regulatory environments / under other jurisdictions.

See Appendix B for more detail regarding the categorization of utilities in Table III-1.

Asset Categories and Maintenance Programs

As stated in Section I – Introduction, the study addressed unit costs for replacing seven categories of assets and conducting four maintenance programs, based initially on a list prepared by THESL, and then modified based on the availability of relevant unit cost information from the Peer Group Panel:

Asset Categories

- Wood Pole Replacement
- UG Cable (XLPE)
- OH Switches (Manual and Remote / Motor Operated)
- Pole Top Transformer Replacement
- Padmount / UG Transformer Replacement
- Network Transformer / Protector Replacement
- Breaker Replacement (SF6, Oil and Vacuum)

Maintenance Programs

- Vegetation Management
- Pole Test and Treat
- Overhead Line Patrol
- Vault Inspection

In assessing the viability of these asset categories / maintenance programs to serve as a proxy for THESL's effectiveness and efficiency in performing work, UMS Group considered two perspectives:

- *Contribution to Capital Expenditures and Maintenance Spending*: The seven asset categories represent approximately 60 percent of the maintenance capital budget over the 2014 through 2016 period; and THESL spends approximately 50 percent of all preventative and predictive maintenance costs in each year on the four maintenance programs that comprised this study.

[1] It may be appropriate to invite Alectra Utilities to join the Peer Group Panel in future benchmark studies, but only after the organizations around which this organization has formed fully integrate their business practices and accounting processes. Given that the merger was not compete until January 31st, 2017, the time frame for this study (2014-2016), and our view that a 3 to 5-year time frame to complete these types of transformations is reasonable, we felt it appropriate to hold off on including Alectra Utilities in this effort.

- *Impact on Reliability*: UMS Group has conducted several reliability-related assessments over the past 10 years (ranging from reviewing system performance to adjudging response during major storm events, ***see Appendix E***). In conducting these assessments, the primary areas of concern include vegetation management, equipment failures, underground facilities, and the overall conduct of inspection, test and maintenance programs, all of which the seven asset categories and four maintenance programs that comprised this study are covered.

It is therefore our view that any conclusions around performance resulting from benchmarking or trending the unit costs of these seven asset categories and four maintenance programs are reflective of THESL's operating performance.

Survey Instrument

UMS Group originally identified 20 electric utilities for inclusion in the Peer Group Panel, requiring 12 to assure a valid sample size on which to make meaningful comparisons. We were successful in soliciting the participation of 17, thus enhancing the veracity of the results. The Survey Instrument itself (***see Appendix F***) consisted of three tabs:

- *Unit Costs* for years 2014 through 2016, requesting the fully loaded installation, test, and inspection costs and number of assets installed / test and inspections conducted for each asset category and maintenance program. We averaged the responses were across the three-year period (weighted by number of replacements, inspections and / or tests each year) to "smooth out" the year-to-year fluctuations that are likely to occur in the course of executing an annual capital investment and the maintenance-spending portfolio.
- *Accounting*, requesting (1) brief descriptions of each electric utility's method for determining unit costs, (2) listings of costs (in addition to direct labor and material) that were included in the reporting of costs (in-house work), (3) listings of costs included for contracted work, and (4) the bases for the accounting of these costs (i.e.; GAAP or IFRS). This information was then used to inform the "Pre-Analysis Adjustors" phase of the normalization process (i.e.; account for the different methods used to apply indirect and overhead costs to capital projects), briefly described below and further expanded upon in ***Appendix C***.
- *Local Factors*, providing a listing of any technical, legislative, regulatory and bargaining unit constraints / mandates (referred to as "external factors") that dictate specific practices to be employed in performing work that could have cost ramifications. This information informed the "Full-Scale" phase of the normalization process briefly described below and further expanded upon in ***Appendix C***.

THESL first reviewed and tested the survey instrument, after which UMS Group issued it to each of the electric utilities that agreed to participate in this study. As the completed surveys were returned, UMS Group reviewed the responses and reached out to the respondents as necessary to resolve any apparent outliers and/or address areas where there appeared to be confusion.

Practices Assessment

UMS Group met with several organizations within THESL (e.g.; Design and Construction, Planning and Standards, Enterprise Project Management and Development, Engineering, and Regulatory and Finance) to gain insights and perspective regarding its practices (past, current and future state) to derive unit costs. We used a variety of sources to compare this input with practices in use across the industry (summarized in Section IV-Summary of Results); namely:

- Insights gleaned from the Peer Group responses in the Accounting Tab of the Survey Instrument, augmented by follow up conversations to clarify / lend context to expressed points-of-view,
- Feedback from electric utilities that are part of our Global Learning Consortia (the focus of which includes benchmarking and the sharing of practices to improve performance and reduce costs), most notably the International Distribution Asset Management Study (IDAMS), International Transmission Operations and Maintenance Study (ITOMS), and International Distribution Benchmark Consortium (IDBC), and
- UMS Group knowledge gleaned from routinely working with over 40 to 50 electric utility organizations on an annual basis.

Benchmarking

UMS Group applied its methodology and a tailored work plan to meet THESL's specific objective to benchmark unit costs across seven asset categories and four maintenance programs. Data provided by the previously described Peer Group Panel (***see Appendix B***) established THESL's position with respect to efficiency (cost); and we conducted practices interviews to lend context to these comparisons. In so doing, we were able to ascertain THESL's position relative to the Peer Group Panel, and further inform our views regarding THESL's methodology to calculate unit costs.

The benchmarking process itself consisted of three steps:

- Data Collection and Analysis: As each electric utility indicated its willingness to participate in the Peer Group Panel for this effort, UMS Group transmitted the survey instrument, configured to ensure consistent responses (i.e.; the questions were tightly structured) and support the "normalization" process (allow for valid comparison of fully-loaded unit costs). In concert with sending the survey instrument, UMS Group provided "real time" instruction, and over time, conducted follow-up sessions to track progress, provide clarification and address any questions that might arise. THESL was the initial recipient of the Survey Tool, enabling the identification and remediation of any unanticipated areas of confusion / ambiguity / difficulty in completing the data package; and thus, increasing the likelihood of a valid comparison with the Peer Group Panel. As the surveys were completed, UMS Group performed a validation check for data quality, thus increasing the overall credence of the results. As UMS Group detected instances of potential misinformation, omissions, or anomalies it contacted the respondent and resolved any underlying issues.

- Assure an "Apples-to-Apples" Comparison: The initial formation of a Peer Group Panel represents the first step in assuring valid unit cost comparisons. Table III-1 provides a view of this group relative to five areas that can affect performance (i.e.; Vegetation, UG Utility Congestion, Population Density, External Factors and Weather Climate). There was not a perfect fit for the 17 electric utilities across all five areas, though each member of the peer group panel was "compatible" with THESL in several of these areas (but, none in all of them). UMS Group developed data normalization routines to account for any remaining gaps, enabling valid comparisons of fully loaded unit costs (acknowledging that directional accuracy rather than precision is the acceptable standard in conducting such comparisons). Unique to this project was the use of a phased approach to data normalization. We started with raw comparisons (accounting for the conversion from imperial to metric units and US to Canadian dollars), then applied pre-analysis adjustors (accounting for regional cost factors and the different methods used by electric utilities in burdening unit costs with indirect and overhead costs), and ended with full scale normalization (adjusting for the difficulty factors presented in Table III-1). Addressed in more detail in ***Appendix C***, this staged approach provides transparency to the process of data normalization, deemed appropriate given the wide range of factors that can affect these comparisons.
- Present the Results: UMS Group presented THESL's position relative to the Peer Group Panel median at each of the three phases of normalization (refer to Table IV-1). Recognizing that some might prefer more delineation in the ranking, we also provided a more expansive presentation of THESL's position relative to each member of the Peer Group Panel for the fully normalized scenario in ***Appendix G***.

SECTION IV – SUMMARY OF RESULTS

The following discussion summarizes the results of an approach that

- Utilized UMS Group's proprietary and time-tested benchmarking and practices assessment methodology,
- Drew upon our extensive cost and service level database and best practices library,
- Analyzed input from a survey instrument administered to the Peer Group Panel, and
- Captured insights and perspectives from key management staff within the THESL organization.

Assessment of THESL's Unit Cost Methodology

As a precursor to assessing THESL's Unit Cost Methodology it is important to reemphasize that though a simple concept to grasp, there is enough evidence to suggest that the reporting of unit costs for benchmarking across electric utilities is complex:

- Past applications of unit costs have not necessarily been part of a performance management / improvement process; rather used to provide order-of-magnitude estimates (with no feedback loop to actual execution), and/or support some form of financial reporting (not necessarily linked to managing worker productivity or project / program execution). Further, current data collection processes for cost are heavily biased towards supporting basic finance and accounting functions, and are generally not conducive to providing the necessary granularity (from an operations perspective) to manage costs at the project or program level. The results of the Peer Group Panel Survey validated this point, as only half of the respondents were able to differentiate among the different types of UG cable and breakers, or separate UG network transformers from network protectors (some utilities even encountered challenges in integrating units installed with dollars spent).
- Practices regarding the burdening of capital labor costs are inconsistent across the industry (e.g.; the industry treats training, meetings, conferences, and A&G, and AFUDC / CWIP costs differently), rendering use of publicly available information to conduct such comparisons, marginally useful.
- Maintenance program costs are not always unitized or traceable back to actual installations. Rather, electric utilities often manage them as programs with budgets based on historical spending patterns with little, if any visibility on units inspected, tested or maintained.

Therefore, any industry comparisons of unit costs across electric utilities will require some degree of normalization. However, internal trending through application of a consistent methodology can be an integral part of any electric utility's internal performance management program by tracking changes in performance related to project / program execution.

In assessing THESL's approach to unit costing, it is our view that THESL is in line with the industry, noting the following as the bases for this statement:

- *Asset Categories*: THESL is transitioning from an approach that mirrors (in concept) that which is in effect across the industry to one that will provide even more granularity and transparency in measuring performance. In responding to the survey that drove this effort, THESL aggregated fully loaded unit costs for each asset class within a project (referred to as a "data point"). It then removed outliers (i.e.; those data points that fell within the lower decile and upper decile of the full range of data points), and calculated the average value of all remaining data points (reflecting a combination of in-house and outside contractor costs). This approach was necessary for the following reasons:
    - The structure used to track and maintain unit cost estimates (referred to as the "LU / MU" structure where "LU" signifies "Labor Units" and "MU" signifies "Material Units") lacks sufficient granularity to facilitate traceability of actual costs charged against specific types of assets and repetitive activities during project execution. THESL has since implemented a revised work breakdown structure complete with an "Asset Assembly Unit" structure ("AAU") to capture average costs incurred on repetitive activities. This effort will include specific type of assets that, for internally executed planned capital work, will (1) facilitate an improved feedback loop between budgeted and actual costs for estimated units, and (2) isolate the wrench time component in an activity to better analyze the controllable drivers of field productivity.
    - The "Unit Pricing Contractor Management System" ("UPCMS") used to estimate, track and invoice work performed by outside contractors does not facilitate a view of the actual direct labor costs for completed units of work. .
- *Maintenance Programs*: For work performed by external contractors, THESL extracted unit costs directly from the vendor invoices. Consistent with established industry practices, any in-house labor costs assigned to maintenance programs are not burdened by overheads (i.e.; only statutory costs and benefits are applied).

Benchmarking of THESL's Unit Costs

In accordance with the approach outlined in the previous section, UMS Group benchmarked THESL's Unit Costs at each of the pre-established checkpoints:

- Raw Comparisons ("Median" in Table IV-1), reflecting the conversions from imperial to metric units and US to Canadian dollars, and a few adjustments to the original asset categories / maintenance programs to facilitate Peer Group comparisons (e.g.; combining Network Transformers with Network Protectors),
- Pre-Analysis Adjustors ("Median 1" in Table IV-1), adjusting for regional cost variances and accounting for the different methods used by electric utilities in applying indirect and overhead costs to unit costs, and

- Full-Scaled Normalization ("Median 2" in Table IV-1), incorporating commonly incurred "difficulty factors" (e.g.; Population Density, UG Utility Congestion, External Factors, Weather/Climate, and Vegetation) to further refine the benchmarking process.

Table IV-1 provides an encapsulated summary of THESL's unit costs (reflecting a three-year average through 2016), as compared to the Peer Group median at each of these checkpoints. The red shading reflects the one asset category with unit costs significantly higher than the Peer Group Median, and the yellow shading highlights two asset classes (Wood Pole Replacement and Breaker Replacement) and one maintenance program (Pole Test and Treat) where THESL's unit costs are marginally higher (within 10 percent) than that of the Peer Group Median. So, on balance, THESL compares favorably with the Peer Group Panel.

Table IV-1: THESL and Peer Group Panel Comparisons

	Units	THESL	Median	Median 1	Median 2
	Asset Categories				
Wood Pole Replacement	Each	$ 7,434	$ 7,372	$ 7,438	$ 7,665
UG Cable Replacement-XLPE	per Meter	$ 96	$ 96	$ 96	$ 98
OH Switches Replacement	Each	$ 21,062	$ 21,590	$ 22,269	$ 23,451
Pole Top Transformer Replacement	Each	$ 11,761	$ 8,652	$ 9,301	$ 10,514
Padmount / UG Transformer Replacement	Each	$ 21,454	$ 21,491	$ 21,645	$ 23,479
Network Transformer / Protector Replacement	Each	$ 88,943	$ 89,254	$ 87,991	$ 95,369
Breaker Replacement	Each	$ 85,242	$ 85,228	$ 85,128	$ 92,938
Switchgear Replacement	Each	$ 1,529,625	Note 1	Note 1	Note 1
	Maintenance Practices				
Vegetation Management	per Line KM	$ 2,111	$ 3,739	$ 3,792	$ 3,965
Pole Test and Treat	Each	$ 18	$ 17	$ 19	$ 19
Overhead Line Patrol	per Line KM	$ 44	$ 44	$ 47	$ 47
Vault Inspection	Each	$ 253	$ 253	$ 261	$ 272

We provide a more detailed presentation of these results in ***Appendix G***.

Implications of the Study

In reviewing our assessment of THESL's Unit Cost methodology, the subsequent benchmarking across seven asset categories and four maintenance programs, and taking stock of industry practices, additional assertions apply:

- The asset categories and maintenance programs selected by THESL represent a valid proxy for trending its performance.
- Within these asset categories and maintenance programs, continued refinement is called for in the reporting, collecting and synthesizing of cost and installation data, particularly as the industry drives to adopt unit costing as a means for trending and comparing performance.

- The industry (particularly in North America and certainly in the US) has not matured to the point where (1) common methodologies exist in deriving unit rates, or (2) managing unit rates is a conscious part of any performance improvement programs.
- Benchmarking is directionally accurate in identifying opportunities for improvement and/or validating current cost and service levels. In applying this methodology to unit costs, absent detailed specifications regarding their calculation (which were developed for this study but not practical when conducting less rigorous comparisons of publicly available data), there are a wide array of variables to consider such an effort difficult.

Appendix A – Supporting Material

UMS Group used the following THESL provided information and data to support the study:

- Unit Cost Survey – THESL September 5, 2017 (THESL Response to Unit Cost and Accounting Tabs on the Survey Form)
- 2-AMPCO-3 Table of Costs
- 2015-2019 Programs to Asset Category Mapping_V2_20170801 (Capital Program Tracker)
- Capital UC Methodology (Capital Unit Cost Methodology-Power Point Presentation)
- Interrogatory Response-AMPCO (1-AMPCO-3 filed May 27, 2016)
- Maintenance Practice
- SAIFI SAIDI 2012-2016 (2012-2016 SAIFI SAIDI by Cause Code with and without MED for Lines and Stations)
- SAP Asset Class Mapping Extract 08082017)Master Spreadsheet of Distribution Assets)
- THESL-Reply Argument (EB-2014-0116 pages 66 through 68 13398-2009 19208026.4)
- THESL LTR Affidavit of A. Rouse 20150116 (THESL Custom Incentive Rate Application (EB-2014-0116 dated January 16, 2015)
- THESL Response AMPCO Motion Settlement 20170121 (THESL Custom Incentive Rate Application (EB-2014-0116 dated January 21, 2015)
- THESL SUB AMPCO Affidavit of M. Walker dated January 13, 2015 (THESL Responses to motions filed by Energy Probe and AMPCO on December 22nd and 31st, 2014)
- UMS Info Request Response 2017-09-15 (Estimated Labor % per Unit by Asset Class – Capital / Regulated Safety Training, and Employee Fringes)
- Unit Cost Local Factors (THESL Response to Local Factors Tab on the Survey Form)
- Unit Costs for Benchmarking Study – Maintenance (VM, Pole Testing, OH Line Patrol and IR Screening, OH Switch Maintenance, and UG Vault Inspection 2014 through 2019)
- Whitepaper Adoption of IAS16 PPE Engineering and Admin Reclassification 2010-04-03 (“EAR” Version V5.7-Final dated July 30, 2010)

Appendix B – Peer Group

The Peer Group Panel used for this study consisted of 17 electric utilities; namely:

- AES-IPL (Indianapolis, IN)
- AES-DPL (Dayton, OH)
- Ameren UE (St. Louis, MO)
- Baltimore Gas and Electric (Baltimore, MD)
- Detroit Edison (Detroit, MI)
- Dominion – VP (Richmond, VA)
- ENMAX (Edmonton, AB)
- FirstEnergy CEI (Cleveland, OH)
- Lansing Board of Water and Light (Lansing, MI)
- Pacific Gas and Electric (San Francisco, CA)
- Portland General Electric (Portland, OR)
- Philadelphia Electric Company (Philadelphia, PA)
- SMUD (Sacramento, CA)
- SaskPower (Regina, Saskatchewan)
- Seattle City Light (Seattle, WA)
- Southern California Edison (Southern California including Los Angeles suburbs)
- Xcel Energy – MN (Minneapolis, MN)

In selecting the utilities that comprise this group, we strove to provide results based on comparisons that would be relevant to an electric utility of THESL's size and complexity (and where there are inconsistencies, apply industry-accepted normalization processes – ***see*** Appendix C). Table B-1 illustrates THESL's relative position across the myriad factors that need to be considered in conducting like-for-like unit cost comparisons of Electric Distribution Companies; and though no two Electric Distribution Systems / Organizations are identical, THESL is among the highest percentages within this peer group for four of five factors that can influence comparisons to unit costs.

Table B-1: Distribution of Peer Group Panel across Difficulty Factors (including THESL)

Vegetation		
Low	Medium	High
9	7	2
UG Utility Congestion		
Low	Medium	High
1	6	11
Population Density (Customers per Square KM)		
Low (<25)	Medium (25 to 100)	High (>100)
2	4	12
External Factors		
Low	Medium	High
2	7	9
Weather / Climate		
Mild	Moderate	Harsh
4	11	3

NOTE: The area shaded in red reflects the categorization of THESL in each category.

The following extracts were used to categorize the Peer Group utilities in terms of **Vegetation**:

Figure B-1: US Vegetation Density

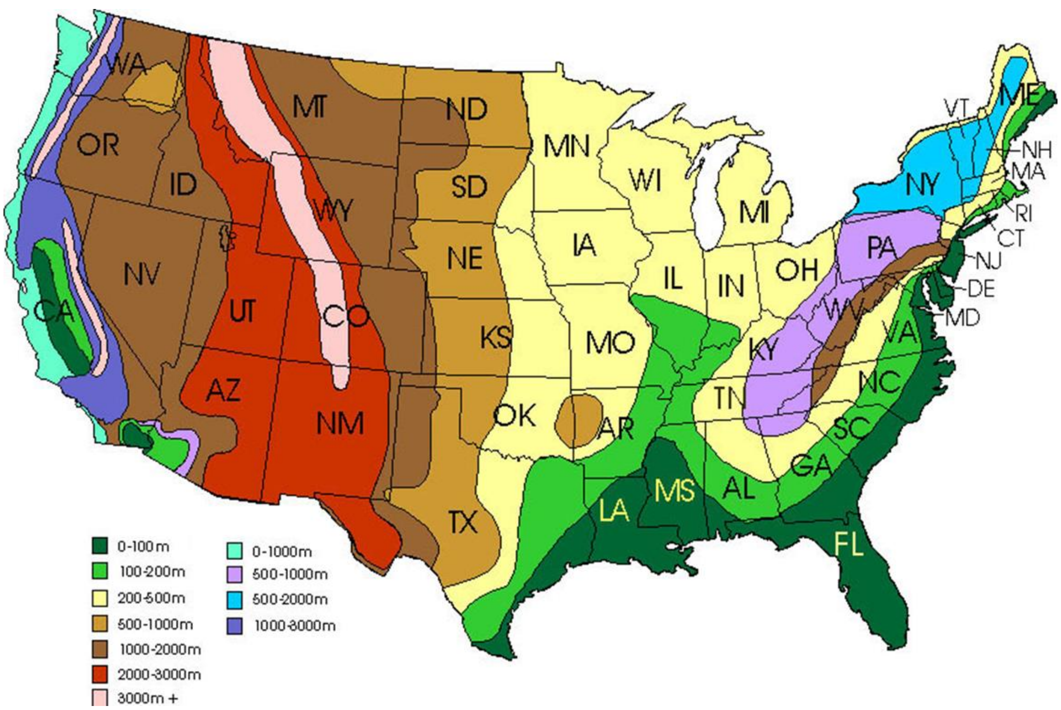
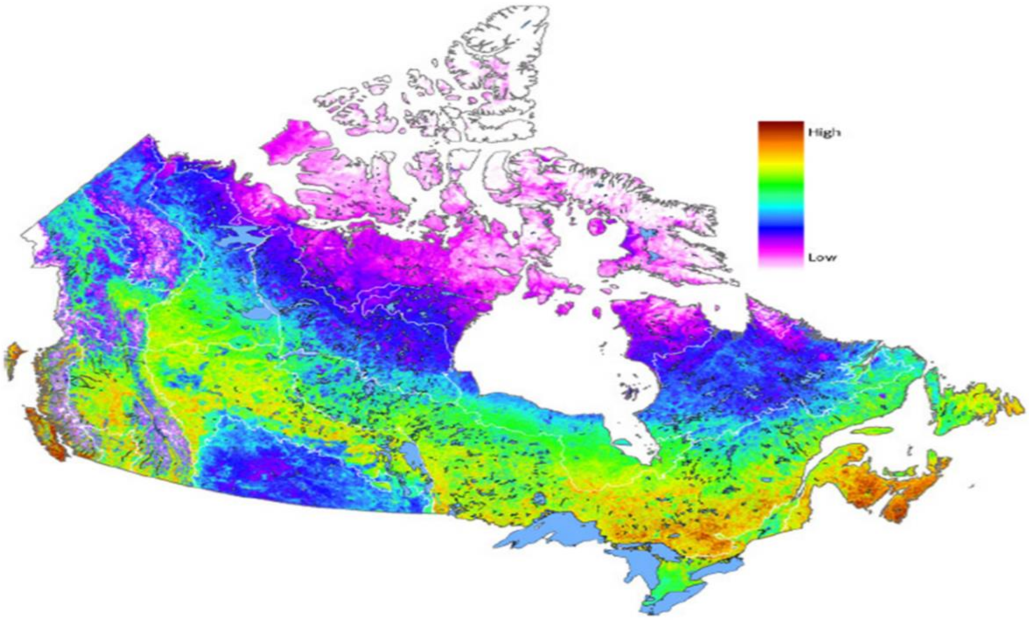
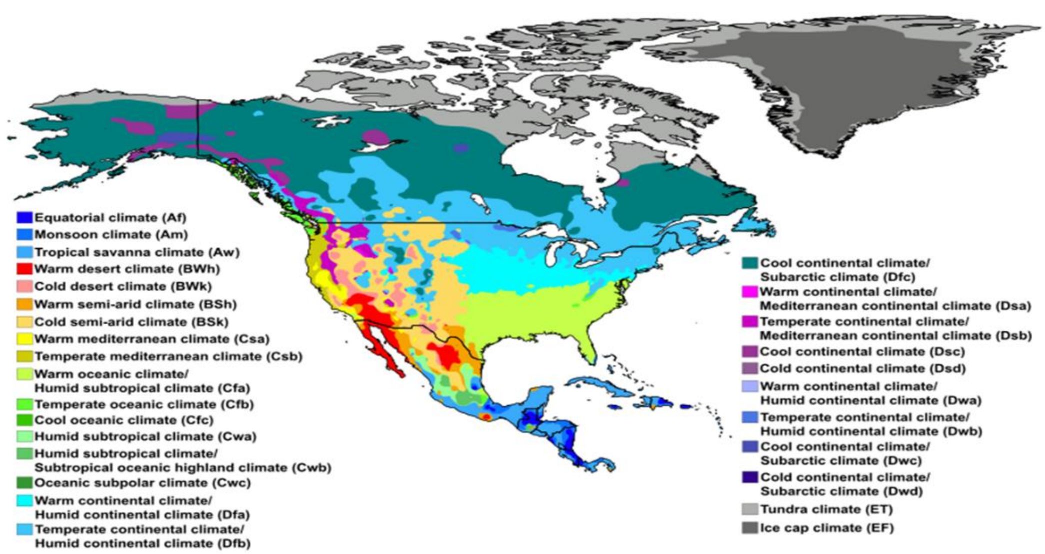


Figure B-2: Canadian Vegetation Density



In addition, with respect to **Weather / Climate**:

Figure B-3: North American Climate Map



The **External Factors** rating reflected responses to our queries regarding applicability of an array of factors that have an adverse effect on field productivity. Based on the responses, an assessment of the level of difficulty confronting each utility was made (high, medium or low).

Table B-2: Summary of External Factors Ratings

Cost Impact Category	THESL	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q
Excessive Travel Time	X		X	X	X	X	X	X			X	X	X	X	X	X	X	X
Road restrictions which limit working hours	X	X	X	X	X	X	X	X		X	X	X		X	X	X	X	X
High water table	X	X					X	X		X		X		X	X			
Working next to energized lines (requiring dedicated observer, gloves, etc.)	X	X	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X
Requirements to perform work off hours (i.e., night/weekend)	X		X	X	X	X	X	X		X	X	X	X	X	X	X	X	X
Changed standards requiring rebuilds rather than like-for-like (i.e., clearances)	X	X	X	X		X		X	X			X	X	X				
Excessive switching requirements (i.e., to isolate on dual radial construction)	X	X	X	X				X	X	X			X		X			
Shoring requirements for UG work	X											X		X		X	X	X
Limitations on tree trimming (e.g.; unusually tight clearances)	X	X				X	X			X	X	X		X	X	X	X	X
Prior use of lead cables	X	X							X				X				X	
High fault currents (impacting equipment sourcing)	X	X								X	X	X	X	X	X	X	X	X
Paid duty for police presence on public roads	X	X	X	X	X	X	X			X		X	X	X	X	X	X	X
Extensive use of submersible transformers	X	X						X										X
Environmental regulations	X	X				X	X	X		X		X		X	X	X		X
Insufficient IT Enablement									X								X	
Union Work Rules										X		X		X				
City consent requirements (i.e., customer notification, restoration, progressive clean-up, etc.)	X	X	X	X	X	X	X		X	X	X	X	X	X	X	X	X	X
Level of Difficulty	High	High	Medium	Medium	Low	Medium	Medium	Medium	Low	High	Medium	High	Medium	High	High	High	High	High

NOTE: The "alpha" designations are applied to mask the identity of any specific utility in the Peer Group Panel (a commitment that must be adhered to throughout the process, as guarantees of confidentiality were required to garner their participation in the study).

In addition, the following table substantiates the groupings (High, Medium and Low) of the Peer Group Panel based on **Population Density**.

Table B-3: Peer Group Panel Population Density

Peer Group Panel	Number of Customers	Service Territory (Sq. KM)	Population Density
AES-IPL	480,000	1,368	**351.0**
AES-DPL	520,000	6,000	**86.7**
Ameren UE	1,200,000	113,183	**10.6**
Baltimore Gas and Electric	1,250,000	5,957	**209.8**
Detroit Edison	2,200,000	20,000	**110.0**
Dominion VP	2,600,000	77,700	**33.5**
ENMAX	850,000	1,087	**782.0**
FirstEnergy CEI	700,000	4,403	**159.0**
Lansing Board of Water and Light	100,000	130	**769.2**
Pacific Gas and Electric	16,000,000	181,300	**88.3**
Portland General Electric	862,000	10,360	**83.2**
Philadelphia Electric Company	1,600,000	5,439	**294.2**
Sacramento Municipal Utility District	625,000	1,431	**436.8**
SaskPower	522,000	651,000	**0.8**
Seattle City Light	425,000	342	**1,243.1**
Southern California Edison	15000000	130000	**115.4**
Toronto Hydro	761,000	630	**1,207.9**
Xcel Energy	2,500,000	17,066	**146.5**

NOTE: Though the normalization process is designed to account for differences in key variables (of which Population Density is one), a review of Table B-3 identifies three utilities whose population density is excessively low (SaskPower, Ameren UE and Dominion VP) in comparison to the Peer Group Panel. Removing them from the sample does not change Toronto Hydro's position within the respective quartiles.

The categorization of **UG Utility Congestion** (High, Medium and Low) was based on each utility's response to a direct inquiry from UMS Group.

Other Utilities Serving the Province of Ontario

In establishing the Peer Group Panel, there is rationale for defining a peer group outside of the other utilities that serve the Province of Ontario (as the peer group determines the comparative position with respect to unit costs). First, from purely a demographic perspective, the City of Toronto ranks among the more urban in North America, and as with all predominantly urban electric utilities, they deal with several unique cost drivers, including:

- City ordinances that impact the conduct of work (e.g., restrictions on work hours and additional police/traffic control), logistics that limit access of vehicles and work teams to the work site (e.g.; traffic flow considerations and congestion), and system design (e.g. fully enclosed substations with due regard to external appearances and limits on use of overhead construction)

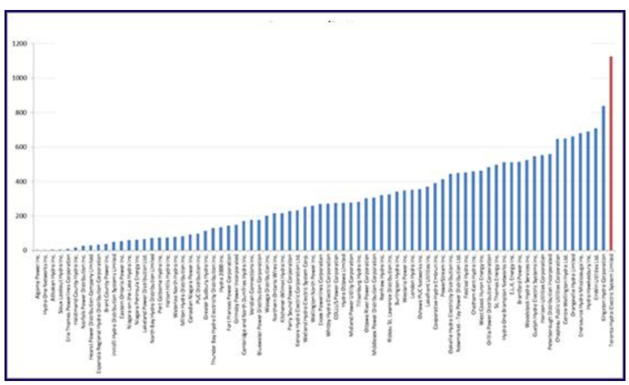
- Higher cost of living which leads to higher wage structures and a noted increase in overheads (offices and other facilities)
- Complex underground construction related to secondary networks (e.g.; limited access, possible interference with other underground utilities, underground cable through concrete duct banks, increased number of feeder ties and back-feed capability, and increased need for technology to provide more automation).
- More volatility in customer movements causing a higher number of turn-on/turn-offs.

Consistent with these factors, notwithstanding the recently formed Alectra Utilities, THESL stands unique among the other Ontario LDCs. The following charts illustrate THESL's relative standing to other Ontario utilities, looking at customer density, amount of installed assets, and comparison to other predominantly urban electric distribution companies.

Population Density

At a customer density of 1,208 customers per square kilometer (as compared to the Ontario utility average of 293), THESL's unit costs are impacted by the requirements for larger and more complex service points, and the sheer volume of traffic and congestion related to high density areas.

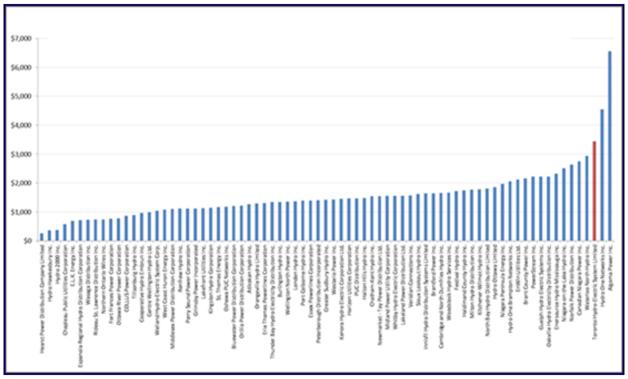
Figure B-4: Customer per KM^2 (Comparison with other Ontario LDCs)



Installed Distribution Assets

As THESL serves a significantly larger number of customers (10 times that of the Provincial average), they are among the top 3 in terms of fixed assets per customer (i.e.; more assets to maintain and ultimately replace on a per customer basis).

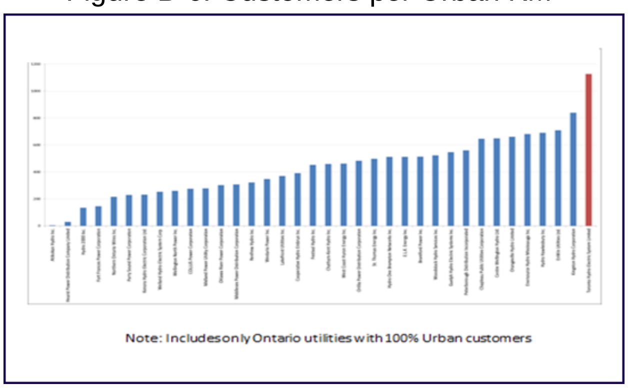
Figure B-5: Installed Distribution Assets (Comparison with Ontario LDCs)



Urban Population Density

Narrowing the view to Electric Distribution Companies serving only urban customers, THESL is at the far end of the scale; and is the second largest in total number of customers.

Figure B-6: Customers per Urban KM^2



The uniqueness among LDCs is always an issue when conducting comparative analyses (i.e.; the need for normalizing the inputs). However, in this instance, the sheer magnitude and scope of the differences in customer density, system configuration, and number of installed assets, combined with the external factors that are typically intensified in large urban areas, presents THESL as an outlier relative to all the other Ontario LDCs. Therefore, we have established a peer group that presents a more compatible view of these differentiating factors, thus facilitating a more valid comparison of unit costs.

Appendix C – Unit Cost Benchmarking Normalization

Prior to conducting comparative analyses with the Panel Group Panel (***see*** Appendix B), it was necessary to "normalize" the unit cost performance across all participating electric utilities. The selection of the panel accounted for key criteria to facilitate proper comparisons (*e.g.;* mix of urban and rural centers, cross-section of public and investor-owned utilities, with minor exceptions climate and number of customer served, existence of an underground network, and externally imposed mandates / constraints that affect productivity). Yet no two electric utilities or the specific factors that affect their costs are ever identical - thus, the need to "normalize."

Defining the "Normalizing" Variables

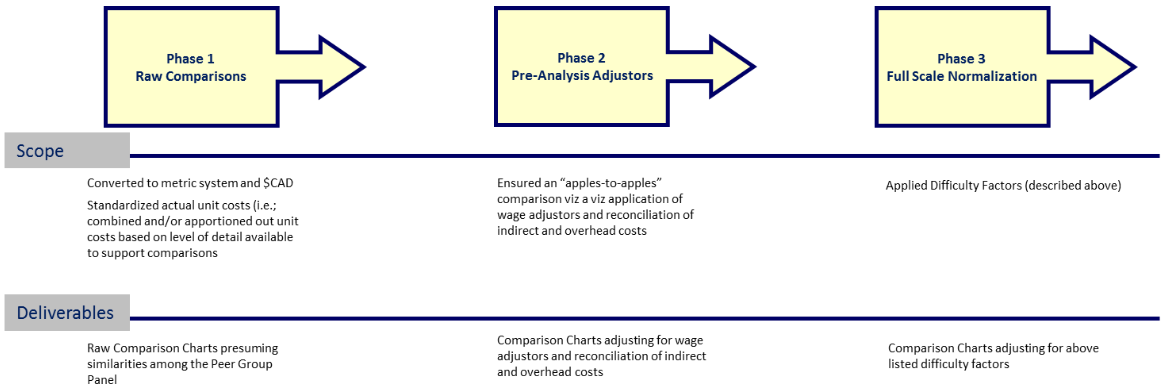
For this study, we established two categories of variables:

- Cost-Related Variables:
  - *Regional Cost Differences* (applying regional cost adjustors based on average wages in each of the major cities that comprise the Peer Group Panel)
  - *Accounting Practices* (relating to the handling of indirect costs and overhead allocations viz a viz unit costs for asset replacements and / or the conduct of maintenance practices.
- Difficulty Factors, acknowledging that system and city-specific demographics play a role in worker productivity:
  - *Population Density* (potentially impacts accessibility, increases awareness of public safety, and creates added distractions during the performance of work),
  - *Underground Utility Congestion* (increases the propensity for third-party damage and accounts for the impact of tight spaces, both factors that can contribute to the slowdown of work),
  - *External Factors* (accounts for varying degrees of technical, legislative, regulatory and bargaining unit constraints / mandates that dictate the specific practices to be employed in performing work, many of which inhibit the flow of work),
  - *Weather*, (accounts for the differences between harsh and temperate climates and their impact on productivity), and
  - *Vegetation* (besides the direct correlation to one of the maintenance programs being benchmarked, accounts for the challenges that increased vegetation might pose in gaining access to critical assets).

Applying the "Normalizing" Variables

In applying these variables, we instituted a three-phased approach, thereby availing the reader total transparency to the comparisons at three major junctures of the process.

Figure C-1: Three-Phased Data Normalization Process



- **Raw Comparisons (Phase 1)** involved, where appropriate, the conversion from imperial to metric units and US to Canadian dollars. As we opted to adopt a three-year average (2014 through 2016), the conversion rate of $US to $CDN at the end of each year was applied (accounting for the ever-changing conversion rate over the three-year period).

- **Pre-Analysis Adjustors (Phase 2)** involved the application of regional cost adjustors and accounting for the different methods used by electric utilities to apply indirect and overhead costs to unit costs.

  Table C-1 illustrates the derivation of regional cost adjustors, sources for which include the Board of US Labor Statistics and, for Canada, individual governmental provincial websites. Using "average wage" as a proxy, we decreased the unit costs at electric utilities with regional costs higher than THESL (i.e.; ENMAX, Pacific Gas and Electric and Southern California Edison) and increased all others (except Seattle City Light, which is on a par with THESL), these changes all proportionate to their variance from the average wage for Toronto.

Table C-1: Regional Cost Adjustors

Peer Group Panel	Average Wage	Factor	Adjustment
AES-IPL	$ 58,082	0.74	1.35
AES-DPL	$ 58,627	0.75	1.34
Ameren UE	$ 59,818	0.76	1.31
Baltimore Gas and Electric	$ 68,101	0.87	1.15
Detroit Edison	$ 63,860	0.82	1.23
Dominion VP	$ 60,896	0.78	1.29
ENMAX	$ 104,410	1.33	0.75
FirstEnergy CEI	$ 59,830	0.76	1.31
Lansing Board of Water and Light	$ 58,962	0.75	1.33
Pacific Gas and Electric	$ 94,438	1.21	0.83
Portland General Electric	$ 66,910	0.85	1.17
Philadelphia Electric Company	$ 66,452	0.85	1.18
Sacramento Municipal Utility District	$ 67,816	0.87	1.15
SaskPower	$ 89,431	1.14	0.88
Seattle City Light	$ 78,492	1.00	1.00
Southern California Edison	$ 102,400	1.31	0.76
Toronto Hydro	**$ 78,280**	**1.00**	**1.00**
Xcel Energy	$ 68,212	0.87	1.15
		Average Adjustment	**1.13**

NOTE: We made adjustment indicated in Table C-1 to the labor component of Unit Cost, assuming the following split between labor and non-labor costs

Table C-2 Labor and Non-Labor Cost Split

Asset Category / Maintenance Program	Labor Costs	Non-Labor Costs
Wood Pole Replacement	60%	40%
UG Cable Replacement	50%	50%
OH Switches Replacement	40%	60%
Pole Top Transformer Replacement	50%	50%
Padmount / UG Transformer Replacement	50%	50%
Network Transformer / Protector Replacement	40%	60%
Breaker Replacement	40%	60%
Vegetation Management	70%	30%
Pole Test and Treat	70%	30%
Overhead Line Patrol	70%	30%
Vault Inspection	70$	30%

In further adjusting for the differences in Accounting Practices, we queried each of the electric utilities as to what non-direct labor and material were and were not included in the unit costs, distinguishing between utility and outside contractor-performed work. Table C-3 illustrates the differences across the Peer Group Panel.

Table C-3: Composition of Unit Costs
(In addition to Direct Labor and Material)

Category	THESL	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q
Design and Permitting Costs	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Project Management / Supervisory Costs	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Other Project-Related Costs (e.g.; Fleet and Warehousing)	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Other Labor-Related Costs (e.g.; Training, Meetings and Conferences)	X	X	X	X	X	X	X	X	X	X	X	X		X	X	X	X	
Employee-Related Costs (Benefits, Pensions and Bonuses)	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Divisional Administrative and General Costs			X	X				X	X	X		X			X	X		X
AFUDC / CWIP	X		X	X	X			X	X	X			X	X	X	X		X
Adjustment Factor	1.0	1.02	0.95	0.95	1.0	1.02	1.02	0.95	0.95	0.95	1.02	1.0	1.02	1.0	0.95	0.95	1.02	1.0

The adjustment factors, ranging between 0.95 and 1.02, reflect comparisons with THESL (i.e.; those with more categories in their Unit Costs calculation than THESL were reduced by five percent; and those with fewer categories in their Unit Costs calculation than THESL were increased by two percent). There was no noted difference in applying loaders to work performed by outside contractors.

- **Full-Scale Normalization (Phase 3)** applied the above described difficulty factors in further normalizing unit costs across all 18 participating electric utilities. Table C-4 provides the bases for these adjustments.

Table C-4: Full Scale Normalization

Utility	Population Density	UG Utility Congestion	External Factors	Weather / Climate	Vegetation
Impact	High / Medium/ Low	High / Moderate / Low	High / Medium / Low	Mild / Moderate / Harsh	High / Medium / Low
Source of Impact Assessment	Table B-3	Peer Group Survey	Table B-2	Figure B-3	Figures B-1 and B-2
AES-IPL	High	High	Medium	Moderate	Low
AES-DPL	Medium	Low	Medium	Moderate	Low
Ameren UE	Low	Moderate	Low	Moderate	Low
Baltimore Gas and Electric	High	High	High	Moderate	Medium
Detroit Edison	High	Moderate	Medium	Moderate	Low
Dominion-VP	Medium	Moderate	Medium	Mild	High
ENMAX	High	Moderate	Medium	Harsh	Low
FirstEnergy-CEI	High	High	High	Moderate	Medium
Lansing Board of Water and Light	High	Moderate	Low	Moderate	Low
Pacific Gas and Electric	High	High	High	Mild	Medium
Portland General Electric	Medium	High	High	Moderate	Medium
Philadelphia Electric Company	High	High	Medium	Moderate	High
Sacramento Municipal Utility District	High	High	High	Mild	Medium
SaskPower	Low	Moderate	Medium	Harsh	Low
Seattle City Light	High	High	High	Moderate	Medium
Southern California Edison	High	High	High	Mild	Low
Toronto Hydro	High	High	High	Moderate	Medium
Xcel Energy	High	High	High	Harsh	Low

In addition, Table C-5 outlines the framework used in applying these normalizing factors.

Table C-5: Difficulty Factor Scoring Criteria

Domain	Weighting	Metric	Source	Ordinal Ranking Assignment
Population Density	20%	Customers per KM^2 translated to High / Medium Low	Table B-3	High: 6 Medium: 5 Low: 4
UG Utility Congestion	20%	High / Moderate / Low	Peer Group Survey	High: 6 Medium: 5 Low: 4
External Factors	20%	High / Medium /Low	Table B-2	High: 6 Medium: 5 Low: 4
Weather / Climate	20%	Harsh / Moderate / Mild	Figure B-3	High: 6 Medium: 5 Low: 4
Vegetation	20%	High / Medium / Low	Figures B-1 and B-2	High: 6 Medium: 5 Low: 4

In applying the domain rankings to specific Asset Categories and Maintenance Programs, it is important to note that depending on the operating environment for each category / program, not all the domains in Table C-5 applied. Tables C-6 and C-7 account for this further refinement to the normalization process.

Table C-6: Domain Applicability Matrix by Asset Category / Maintenance Program

Operating Environment	Asset Category / Maintenance Program	Domain				
		Population Density	UG Utility Congestion	External Factors	Weather / Climate	Vegetation
Overhead (OH)	Wood Pole OH Switch Pole Top Transformers Breaker Pole Test and Treat OH Line Patrol	**X**		**X**	**X**	**X**
Underground (UG)	UG Cable Padmount / UG Transformer Network Transformer / Protector Vault Inspection	**X**	**X**	**X**	**X**	
Vegetation Management	Vegetation Management			**X**	**X**	**X**

Table C-7: Full-Scale Normalization Factors (by Domain and Operating Environment)

Peer Group Panel	Population Density	UG Utility Congestion	External Factors	Weather / Climate	Vegetation	OH Adjustment		UG Adjustment		VM Adjustment	
						Score	Factor	Score	Factor	Score	Factor
AES-IPL	6	6	5	5	4	20	**1.09**	22	**1.04**	14	**1.13**
AES-DPL	5	5	5	5	4	19	**1.14**	20	**1.13**	14	**1.13**
Ameren UE	4	5	4	5	4	17	**1.23**	18	**1.22**	13	**1.19**
Baltimore Gas and Electric	6	6	6	5	5	22	**1.00**	23	**1.00**	16	**1.00**
Detroit Edison	6	5	5	5	4	20	**1.09**	21	**1.09**	14	**1.13**
Dominion VP	5	5	5	4	6	20	**1.09**	19	**1.17**	15	**1.06**
ENMAX	6	5	5	6	4	21	**1.05**	22	**1.04**	15	**1.06**
FirstEnergy CEI	6	6	6	5	5	22	**1.00**	23	**1.00**	16	**1.00**
Lansing Board of Water and Light	6	5	4	5	4	19	**1.14**	20	**1.13**	13	**1.19**
Pacific Gas and Electric	6	6	6	4	5	21	**1.05**	22	**1.04**	15	**1.06**
Portland General Electric	5	6	6	5	5	21	**1.05**	22	**1.04**	16	**1.00**
Philadelphia Electric Company	6	6	5	5	6	22	**1.00**	22	**1.04**	16	**1.00**
Sacramento Municipal Utility District	6	6	6	4	5	21	**1.05**	22	**1.04**	15	**1.06**
SaskPower	4	5	5	6	4	19	**1.14**	20	**1.13**	15	**1.06**
Seattle City Light	6	6	6	5	5	22	**1.00**	23	**1.00**	16	**1.00**
Southern California Edison	6	6	6	4	4	20	**1.09**	22	**1.04**	14	**1.13**
Toronto Hydro	6	6	6	5	5	22	**1.00**	23	**1.00**	16	**1.00**
Xcel Energy	6	6	6	6	4	22	**1.00**	24	**0.96**	16	**1.00**
					Average Adjustment		**1.07**		**1.07**		**1.07**

Tables C-8 through C-10 present the outputs of the three-phased approach to normalization across the seven asset categories and four maintenance programs, noting that the Peer Group Panel is intentionally masked to comply with our commitment regarding the confidential handling of this information.

Table C-8: Raw Comparisons – Phase 1
(Metric and Canadian Dollar Conversion)

Asset Category	Unit	THESL	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	Median
Wood Pole Replacement	Each	**$ 7,434**	$ 6,190	$ 5,552	$ 5,957	$ 5,229	$ 4,801	$ 7,567	$ 7,533	$ 5,174	$ 7,452	$ 7,233	$ 7,286	$ 7,964	$ 7,848	$ 7,457	$ 7,762	$ 7,310	$ 7,548	**$ 7,372**
UG Cable Replacement (XLPE)	Meter	**$ 96**	$ 72	$ 79	$ 84	$ 77	$ 99	$ 92	$ 96	$ 95	$ 101	$ 93	$ 90	$ 99	$ 96	$ 98	$ 97	$ 88	$ 100	**$ 96**
OH Switch Replacement	Each	**$ 21,062**	$ 27,456	$ 21,086	$ 19,095	$ 18,282	$ 21,574	$ 21,786	$ 23,278	$ 21,605	$ 16,813	$ 17,762	$ 20,755	$ 23,795	$ 26,310	$ 22,300	$ 22,433	$ 18,929	$ 24,154	**$ 21,590**
Pole Top Transformer Replacement	Each	**$ 11,761**	$ 7,006	$ 8,090	$ 7,412	$ 8,093	$ 8,157	$ 9,300	$ 12,576	$ 7,491	$ 10,166	$ 12,043	$ 7,285	$ 12,435	$ 13,683	$ 8,527	$ 8,326	$ 10,358	$ 8,777	**$ 8,652**
Padmount / UG Transformer Replacement	Each	**$ 21,454**	$ 19,684	$ 18,239	$ 18,938	$ 18,612	$ 19,475	$ 19,309	$ 22,375	$ 18,689	$ 21,691	$ 21,855	$ 21,738	$ 23,025	$ 24,610	$ 21,670	$ 17,452	$ 21,529	$ 21,910	**$ 21,491**
Network Transformer / Protector Replacement	Each	**$ 88,943**	$ 81,811	$ 80,099	$ 79,766	$ 72,128	$ 81,871	$ 73,024	$ 92,465	$ 72,905	$ 91,423	$ 86,034	$ 89,565	$ 90,700	$ 94,052	$ 94,811	$ 92,043	$ 91,030	$ 90,472	**$ 89,254**
Breaker Replacement	Each	**$ 85,242**	$ 74,373	$ 78,582	$ 74,057	$ 71,214	$ 81,570	$ 79,773	$ 89,565	$ 78,571	$ 88,328	$ 85,214	$ 86,356	$ 87,765	$ 88,240	$ 88,316	$ 82,809	$ 88,139	$ 87,093	**$ 85,228**
Maintenance Practice																				
Vegetation Management	Line KM	**$ 2,111**	$ 4,071	$ 2,403	$ 2,697	$ 3,786	$ 3,713	$ 3,683	$ 3,436	$ 4,369	$ 3,312	$ 4,264	$ 4,030	$ 3,765	$ 3,600	$ 4,134	$ 4,564	$ 3,115	$ 4,534	**$ 3,739**
Pole Test and Treat	Each	**$ 18**	$ 15	$ 16	$ 17		$ 17		$ 19			$ 15				$ 15		$ 18		**$ 17**
Overhead Line Patrol	Line KM	**$ 44**	$ 40	$ 44	$ 45		$ 46		$ 46			$ 41				$ 44		$ 42		**$ 44**
Vault Inspection	Each	**$ 253**	$ 214	$ 221	$ 215		$ 229		$ 275			$ 257				$ 283		$ 256		**$ 253**

Table C-9: Pre-Analysis Adjustors - Phase 2
(Regional Cost Adjustments and Accounting Practices)

Asset Category	Unit	THESL	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	Median 1
Wood Pole Replacement	Each	**$ 7,434**	$ 7,481	$ 6,375	$ 6,798	$ 6,197	$ 5,560	$ 9,040	$ 6,082	$ 5,882	$ 7,802	$ 8,166	$ 7,960	$ 7,442	$ 7,835	$ 6,083	$ 8,027	$ 8,124	$ 6,773	**$ 7,438**
UG Cable Replacement (XLPE)	Meter	**$ 96**	$ 85	$ 88	$ 93	$ 89	$ 112	$ 108	$ 80	$ 105	$ 104	$ 104	$ 96	$ 94	$ 96	$ 82	$ 99	$ 96	$ 91	**$ 96**
OH Switch Replacement	Each	**$ 21,062**	$ 31,460	$ 22,818	$ 20,573	$ 20,539	$ 23,993	$ 24,759	$ 19,900	$ 23,214	$ 17,058	$ 19,407	$ 22,036	$ 22,834	$ 26,281	$ 19,189	$ 22,570	$ 20,461	$ 22,501	**$ 22,269**
Pole Top Transformer Replacement	Each	**$ 11,761**	$ 8,248	$ 9,022	$ 8,222	$ 9,342	$ 9,260	$ 10,840	$ 10,452	$ 8,283	$ 10,478	$ 13,377	$ 7,847	$ 11,776	$ 13,664	$ 7,146	$ 8,493	$ 11,355	$ 8,026	**$ 9,301**
Padmount / UG Transformer Replacement	Each	**$ 21,454**	$ 23,173	$ 20,340	$ 21,007	$ 21,485	$ 22,108	$ 22,506	$ 18,596	$ 20,663	$ 22,358	$ 24,276	$ 23,415	$ 21,805	$ 24,576	$ 18,162	$ 17,803	$ 23,600	$ 20,035	**$ 21,645**
Network Transformer / Protector Replacement	Each	**$ 88,943**	$ 93,741	$ 86,679	$ 85,938	$ 81,032	$ 91,052	$ 82,989	$ 79,048	$ 78,336	$ 92,755	$ 94,003	$ 95,093	$ 87,038	$ 93,951	$ 81,584	$ 92,603	$ 98,403	$ 84,280	**$ 87,991**
Breaker Replacement	Each	**$ 85,242**	$ 85,218	$ 85,037	$ 79,788	$ 80,006	$ 90,717	$ 90,660	$ 76,569	$ 84,425	$ 89,615	$ 93,107	$ 91,686	$ 84,222	$ 88,145	$ 75,995	$ 83,312	$ 95,277	$ 81,133	**$ 85,128**
Maintenance Practice																				
Vegetation Management	Line KM	**$ 2,111**	$ 5,049	$ 2,838	$ 3,164	$ 4,604	$ 4,386	$ 4,507	$ 2,692	$ 5,102	$ 3,521	$ 4,891	$ 4,465	$ 3,471	$ 3,593	$ 3,280	$ 4,784	$ 3,510	$ 3,991	**$ 3,792**
Pole Test and Treat	Each	**$ 18**	$ 19	$ 19	$ 20		$ 20		$ 15			$ 17				$ 12		$ 20		**$ 19**
Overhead Line Patrol	Line KM	**$ 44**	$ 50	$ 52	$ 53		$ 54		$ 36			$ 47				$ 35		$ 47		**$ 47**
Vault Inspection	Each	**$ 253**	$ 266	$ 261	$ 252		$ 270		$ 215			$ 295				$ 224		$ 289		**$ 261**

Table C-10 Full-Scale Normalization – Phase 3
(Difficulty Factors)

Asset Category	Unit	THESL	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	Median 2
Wood Pole Replacement	Each	$ 7,434	$ 7,481	$ 6,955	$ 7,724	$ 7,605	$ 6,066	$ 9,862	$ 6,358	$ 6,684	$ 8,156	$ 8,166	$ 8,322	$ 8,457	$ 7,835	$ 6,636	$ 8,027	$ 8,124	$ 7,081	$ 7,665
UG Cable Replacement (XLPE)	Meter	$ 96	$ 85	$ 92	$ 105	$ 108	$ 122	$ 126	$ 83	$ 119	$ 109	$ 108	$ 101	$ 106	$ 96	$ 86	$ 95	$ 96	$ 95	$ 98
OH Switch Replacement	Each	$ 21,062	$ 31,460	$ 24,892	$ 23,378	$ 25,207	$ 26,175	$ 27,010	$ 20,805	$ 26,380	$ 17,834	$ 19,407	$ 23,038	$ 25,948	$ 26,281	$ 20,933	$ 22,570	$ 20,461	$ 23,524	$ 23,451
Pole Top Transformer Replacement	Each	$ 11,761	$ 8,248	$ 9,843	$ 9,343	$ 11,466	$ 10,101	$ 11,825	$ 10,927	$ 9,412	$ 10,954	$ 13,377	$ 8,203	$ 13,382	$ 13,664	$ 7,796	$ 8,493	$ 11,355	$ 8,391	$ 10,514
Padmount / UG Transformer Replacement	Each	$ 21,454	$ 23,173	$ 21,224	$ 23,747	$ 26,155	$ 24,030	$ 26,420	$ 19,405	$ 23,358	$ 23,330	$ 25,332	$ 24,433	$ 24,650	$ 24,576	$ 18,951	$ 17,029	$ 23,600	$ 20,906	$ 23,479
Network Transformer / Protector Replacement	Each	$ 88,943	$ 93,741	$ 90,448	$ 97,147	$ 98,648	$ 98,969	$ 97,422	$ 82,485	$ 88,554	$ 96,788	$ 98,090	$ 99,227	$ 98,391	$ 93,951	$ 85,132	$ 88,577	$ 98,403	$ 87,945	$ 95,369
Breaker Replacement	Each	$ 85,242	$ 85,218	$ 92,768	$ 90,668	$ 98,189	$ 98,964	$ 98,902	$ 80,050	$ 95,938	$ 93,688	$ 93,107	$ 95,854	$ 95,706	$ 88,145	$ 82,904	$ 83,312	$ 95,277	$ 84,821	$ 92,938
Maintenance Practice																				
Vegetation Management	Line KM	$ 2,111	$ 5,049	$ 3,193	$ 3,559	$ 5,467	$ 4,935	$ 4,789	$ 2,861	$ 6,059	$ 3,521	$ 4,891	$ 4,744	$ 3,688	$ 3,593	$ 3,690	$ 4,784	$ 3,510	$ 4,241	$ 3,965
Pole Test and Treat	Each	$ 18	$ 19	$ 21	$ 23		$ 22		$ 16			$ 17				$ 13		$ 20		$ 19
Overhead Line Patrol	Line KM	$ 44	$ 50	$ 56	$ 60		$ 59		$ 38			$ 47				$ 38		$ 47		$ 47
Vault Inspection	Each	$ 253	$ 266	$ 272	$ 285		$ 293		$ 225			$ 308				$ 234		$ 289		$ 272

3-Year Avg. Converted to CDN + Cost Component Adjustment																				
Asset Category	**Unit**	**THESL**	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**	**J**	**K**	**L**	**M**	**N**	**O**	**P**	**Q**	**Median**
Wood Pole Replacement	Each	**$ 7,434**	$ 6,313	$ 5,275	$ 5,659	$ 5,229	$ 4,897	$ 7,718	$ 7,156	$ 4,916	$ 7,080	$ 7,378	$ 7,286	$ 8,044	$ 7,848	$ 7,084	$ 7,374	$ 7,456	$ 7,548	**$ 7,221**
UG Cable Replacement (XLPE)	Meter	**$ 96**	$ 74	$ 75	$ 80	$ 77	$ 101	$ 94	$ 91	$ 90	$ 96	$ 95	$ 90	$ 100	$ 96	$ 93	$ 92	$ 89	$ 100	**$ 93**
OH Switches Replacement	Each	**$ 21,062**	$ 28,005	$ 20,031	$ 18,140	$ 18,282	$ 22,006	$ 22,221	$ 22,114	$ 20,525	$ 15,973	$ 18,117	$ 20,755	$ 24,033	$ 26,310	$ 21,185	$ 21,312	$ 19,307	$ 24,154	**$ 21,124**
Pole Top Transformer Replacement	Each	**$ 11,761**	$ 7,146	$ 7,686	$ 7,042	$ 8,093	$ 8,320	$ 9,486	$ 11,947	$ 7,117	$ 9,657	$ 12,284	$ 7,285	$ 12,559	$ 13,683	$ 8,100	$ 7,909	$ 10,565	$ 8,777	**$ 8,549**
Padmount / UG Transformer Replacement	Each	**$ 21,454**	$ 20,077	$ 17,327	$ 17,991	$ 18,612	$ 19,865	$ 19,695	$ 21,256	$ 17,754	$ 20,607	$ 22,292	$ 21,738	$ 23,255	$ 24,610	$ 20,586	$ 16,580	$ 21,959	$ 21,910	**$ 20,596**
Network Transformer / Protector Replacement	Each	**$ 88,943**	$ 83,448	$ 76,094	$ 75,777	$ 72,128	$ 83,509	$ 74,484	$ 87,842	$ 69,260	$ 86,852	$ 87,755	$ 89,565	$ 91,607	$ 94,052	$ 90,071	$ 87,441	$ 92,851	$ 90,472	**$ 87,598**
Breaker Replacement	Each	**$ 85,242**	$ 75,861	$ 74,653	$ 70,354	$ 71,214	$ 83,202	$ 81,369	$ 85,087	$ 74,643	$ 83,911	$ 86,919	$ 86,356	$ 88,643	$ 88,240	$ 83,900	$ 78,668	$ 89,902	$ 87,093	**$ 83,906**
Maintenance Practice																				
Vegetation Management	Line KM	**$ 2,111**	$ 4,153	$ 2,283	$ 2,562	$ 3,786	$ 3,788	$ 3,757	$ 3,264	$ 4,150	$ 3,147	$ 4,349	$ 4,030	$ 3,803	$ 3,600	$ 3,928	$ 4,336	$ 3,178	$ 4,534	**$ 3,787**
Pole Test and Treat	Each	**$ 18**	$ 16	$ 15	$ 16		$ 17		$ 18			$ 16				$ 14		$ 18		**$ 16**
Overhead Line Patrol	Line KM	**$ 44**	$ 41	$ 42	$ 43		$ 47		$ 44			$ 42				$ 42		$ 43		**$ 43**
Vault Inspection	Each	**$ 253**	$ 219	$ 210	$ 204		$ 233		$ 261			$ 262				$ 269		$ 261		**$ 253**

Data from: 1B-SEC-15, Appendix A

RESPONSES TO OEB STAFF INTERROGATORIES

INTERROGATORY 12:

Reference(s): Exhibit 1B, Tab 2, Schedule 1, Appendix B, p. 27-33

a) UMS Group normalization for regional cost differences seems to include only wages (Exhibit 1B / Tab 2 / Schedule 1 / Appendix B / p. 27). Please confirm whether this is correct and explain why other regional costs differences (e.g. input costs) were not considered for normalization purposes.

b) Please advise to what degree UMS Group applied the same unit cost benchmarking normalization methodology described in Appendix C in previous studies (Exhibit 1B / Tab 2 / Schedule 1 / Appendix B / pp. 27-33). If applicable, please explain how the normalization approach applied in the Toronto Hydro study differs from other studies completed by UMS Group.

c) Beyond those described in Appendix C, please advise whether other normalization factors exist that UMS Group considered but were not included in the study (Exhibit 1B / Tab 2 / Schedule 1 / Appendix B / pp. 27-33). If applicable, please provide these factors and explain why they were the not included in the study.

d) Please advise whether UMS group believes that the normalization process would have benefited from Ontario LDC data (Exhibit 1B / Tab 2 / Schedule 1 / Appendix B / pp. 27-33).

e) Please identify the source(s) of the data used to populate Table B-2 (Exhibit 1B / Tab 2 / Schedule 1 / Appendix B / p. 23) and Tables C-1 to C-10 (Exhibit 1B / Tab 2 / Schedule 1 / Appendix B / pp. 29-33).

RESPONSE (PREPARED BY UMS):

a) In applying its normalization routines, UMS Group always starts with wages, as it constitutes the most basic differentiator when comparing costs across regions and other jurisdictional boundaries. The other grouping of normalizers (referred to in the study as "Difficulty Factors") include other cost-related, regionally driven variables (particularly within those items categorized as "External Factors"), which include the following, but not limited to:
   - Excessive Travel Time
   - Road Restrictions
   - Requirements to Work during Off Hours
   - Limitations on Tree Trimming
   - Environmental Regulations
   - Union Work Rules
   - City Consent Requirements

b) Conceptually, the normalization methodology adopted for this study coincides with that used in other studies, tailored to assure proper adjustments to those elements that affect unit cost comparisons. The following discussion summarizes this point:
   - **Regional Cost Differences**: UMS Group used the same methodology as in the majority of its benchmarking efforts.
   - **Accounting Practices**: Applied to efforts where UMS Group compares unit costs. Depending on the scope, higher level benchmarking studies (which

comprise the majority of our work) may look only at differences in policies around capitalizing vs. expensing costs.

- **Population Density**: Also factored in studies that assess service restoration during major storm events.
- **Underground Utility Congestion**: Considered when assessing the cost and performance levels at the asset level.
- **External Factors**: The level of detail for this study was commensurate with the task of looking at individual asset classes and specific maintenance programs. Higher-level studies may apply a "correction factor," usually focused on the influence of the bargaining unit in driving overtime and work rules and the existence of unusual city ordinances.
- **Weather**: Applicability determined by the composition of the peer group (i.e.; the extent to which they experience similar weather), and the scope of the study.
- **Vegetation**: Particularly relevant when comparing overall O&M spending levels and programs where accessibility to the assets may be an issue.

The framework remains constant, but depending on the level of detail called for in a study and the specifics regarding the benchmarked utility, the level of rigor applied within these categories will vary.

Due to the scope and focus of the study, the uniqueness of an "Investor Owned Utility sized" municipality in a heavily populated area, and the composition of the peer group, UMS Group did not consciously omit any normalizing factors, and applied a level of detail beyond that of more typical UMS Group's studies.

c) Please refer to UMS Group's response to 1B-SEC-15 (c ii) for rationale in excluding Ontario utilities from the peer group. With respect to the question at hand, our criteria in selecting the peer group (outlined in UMS Group's response to interrogatory 1B-SEC-15 (c i)) did not include benefiting the normalizing process. UMS Group apply normalizers to increase the likelihood of an "apples-to-apples" comparison when assessing dissimilar utilities (which is always the case). That said, had we selected an Ontario utility, there are a few factors that would have been the same (i.e.; regional costs, weather and vegetation), but nearly 30 percent of the utilities that comprised the peer group were evenly matched in weather and vegetation.

d) The completed survey forms formed the bases for the majority of data contained in Exhibit 1B, Tables B-2 and C-3 through C-10. Specific to each table:

- **Table B-2:** UMS Group assigned a level of difficulty (high, medium, or low) based on the number of external factors indicated as relevant by each utility.
- **Table C-1**: UMS Group applied regional cost adjustors based on a comparison of regional average wages provided by the Board of US Labor Statistics for the US utilities and municipalities and individual governmental provincial websites in Canada.
- **Table C-2**: UMS Group based the split between labor and non-labor costs on information contained within the UMS Group proprietary data bases used to store cost and service level performance data for our Global Learning Consortia.
- **Table C-3**: UMS Group assigned an adjustment factor based on the number of categories included in the unit cost calculation.
- **Table C-4:** The source for each column is included in the table in red font.

- **Table C-5:** UMS Group applied the weightings and ranking scales based on similar approaches used in our Global Learning Consortia.
- **Table C-6**: UMS Group assessed the applicability of asset categories and maintenance programs of the five factors that defined the level of difficulty in performing work.
- **Table C-7:** Reflects an accumulation of the factors in preparation for our three-phased approach to normalization across the seven asset categories and four maintenance programs.
- **Tables C-8 through C-10**: The unit cost information reflects that provided by each of the utilities via the survey form. Each table reflects the incremental application of normalization starting with Phase 1 (Raw Comparisons: Metric and Dollar Conversion), continuing with Phase 2 (Applying Regional Cost and Accounting Adjustments), and ending with Phase 3 (Applying Full-Scale Normalization).

Please refer to the actual worksheets in UMS Group's response to interrogatory 1B-SEC-15 (f).

TORONTO HYDRO-ELECTRIC SYSTEM LIMITED (“THESL”)

Distribution System Plan Asset Management Review

SECTION I - INTRODUCTION

The Ontario Energy Board's ("OEB" or "the Board") Filing Requirements for Electricity Transmission and Distribution Applications, Chapter 5, Consolidated Distribution System Plan Filing Requirements state an expectation that "the DS Plan optimizes investments and reflects regional and smart grid considerations; serves present and future customers; places a greater focus on delivering value for money; aligns the interests of the distributor with those of customers; and supports the achievement of public policy objectives."

Furthermore, the Board wants to ensure that its established performance outcomes for electricity distributors are being achieved. Specifically, these outcomes include:

- Customer Focus: services are provided in a manner that responds to identified customer preferences;
- Operational Effectiveness: continuous improvement in productivity and cost performance is achieved; and utilities deliver on system reliability and quality objectives;
- Public Policy Responsiveness: utilities deliver on obligations mandated by government (e.g., in legislation and in regulatory requirements imposed further to Ministerial directives to the Board); and
- Financial Performance: financial viability is maintained; and savings from operational effectiveness are sustainable.

A specific requirement of the Board for the Distribution System Plan ("DSP") is for the Electricity Distributor to explain its asset management process in order to provide the Board and stakeholders with an understanding of not only the processes themselves but how they create and drive the expenditure decisions in the DSP. The objective is to allow the Board to assess whether and how a distributor's DSP delivers value to customers, including controlling costs through optimization, prioritization and pacing of capital-related expenditures based on the condition of the assets and their ability to meet the specified performance outcomes.

Implicit in the Board's requirements is that the filing utility's DSP be based on sound asset management principles. To that end Torys LLP ("Torys"), acting on behalf of Toronto Hydro-Electric System Limited ("THESL" or "the Company"), engaged UMS Group to evaluate its asset management practices as they relate to the formation and execution of its DSP.

Overview

UMS Group completed personnel interviews and reviewed the relevant sections of THESL's 2020-2024 DSP Filing in order to evaluate the asset management practices that THESL used to develop its Distribution System Plan (DSP).

The purpose of these interviews and the document review was to gain an understanding, from an asset management perspective, of how the DSP was constructed. The objective was to gather information that UMS could use to evaluate whether the aspects of the asset management system relevant to the construction of the DSP are in alignment with industry standard practices per ISO 55001. ISO 55001 is the global industry standard which specifies the requirements for the establishment, implementation, maintenance and improvement of a management system for asset management of physical assets. It was used as a basis of comparison to provide a level of objectivity to the evaluation of THESL's Asset Management practices.

From the interviews and the review of DSP documents, UMS qualitatively evaluated where it believes Toronto Hydro's maturity level currently is across the relevant domains within the standard. In order to provide some external context to its evaluation, UMS scored THESL's asset management maturity using the ISO 55001 maturity scale and compared it to a group of 14 North American electric utility business units for which UMS Group has previously performed asset management assessments.

The bases for UMS's findings include insights formed in working with other electric utilities worldwide in developing and implementing asset management capabilities, along with its formal expertise as an IAM Endorsed Assessor for ISO 55001 certification.

UMS Group Qualifications

UMS Group, headquartered at 300 Interpace Parkway, Parsippany, NJ, 07054, has been a leading provider of utility asset management services for over 25 years. UMS published its first report on this topic – the ISAM Report ("International Strategic Asset Management") in 1992 after conducting a worldwide search for best practices in utility asset management.

In the decades since, UMS Group has performed over 200 utility projects covering the full gamut of asset management. These include asset management gap assessments, multi-year large scale company-wide asset management transformations, development and implementation of asset management Operating Models, development of guiding documents/strategies (i.e., AM Policies, Strategic Asset Management Plans, Asset Management Plans, etc.), definition and implementation of asset management processes, and development and implementation of asset management tools (i.e., economic models, portfolio optimization tools, risk management tools, etc.)

UMS has developed and continually adapted its assessment methodologies to align them with emerging industry standards. In August 2010, UMS Group, as one of the first 11 firms so named, was appointed an Endorsed Assessor for the PAS 55 standard by the Institute of Asset Management (IAM), the professional body of those involved in the acquisition, operation and care of physical assets – particularly critical infrastructure. The Endorsed Assessor designation followed a rigorous IAM review of the expertise, practices, tools and techniques which UMS Group applies to asset management compliance assessments. UMS Group has since been appointed an Endorsed Assessor and Endorsed Trainer for the ISO 55000/1/2 standard by the IAM. **Appendix A** provides additional details regarding UMS Group's qualifications and those of the individual assigned to this effort.

The UMS Group-assigned expert for this effort, Mr. Steven Morris, fully acknowledges his duties as an expert in accordance with Rule 13 and Form A of the Ontario Energy Board's ("OEB" or

"Board") Rules of Practice and Procedure. In so doing, he acknowledges that it is his duty to provide evidence in relation to this report as follows:

- To provide opinion evidence that is fair, objective and non-partisan;
- To provide opinion evidence that related only to matters that are within his area of expertise; and
- To provide such additional assistance that the Board may reasonably require, to determine a matter in issue.

He acknowledges that the duty referred to above prevails over any obligation, which he may owe either Torys or THESL.

Structure of the Report

The ensuing discussion is divided into three sections:

- Section II – Executive Summary: A summarization of UMS's conclusions on the maturity of THESL's asset management practices used to develop its 2020-2024 Distribution System Plan (DSP),
- Section III – Project Approach: A description of and rationale for the approaches, methodologies, criteria and frameworks used to evaluate THESL's asset management maturity relative to development of the DSP
- Section IV – Summary of Results: An expanded discussion of findings, conclusions and recommendations around the topic of asset management.

SECTION II – EXECUTIVE SUMMARY

Overview of DSP Asset Management Review

UMS Group was retained to evaluate THESL's asset management practices as they relate to the formation and execution of its DSP. In accomplishing these objectives, UMS Group:

- Conducted a series of interviews with several THESL stakeholder organizations (e.g.; Planning Integration, Investment Planning, System Planning, Standards and Technical Studies, Program Management, Engineering Services, Fleet, Facilities, IT, etc.),
- Reviewed the relevant sections of the 2020-2024 Distribution System Plan filing,
- Evaluated THESL's asset management capabilities per the ISO 55001 domains relevant to the DSP,
- Compared THESL to a group of 14 electric utility business units on their asset management maturity per the ISO 55001 standard,
- Analyzed the results of the interviews, DSP review, and asset management assessment.

Evaluation of THESL's Asset Management Capabilities as Applicable to the DSP

Toronto Hydro has been developing its asset management capabilities for a number of years and exceeds the North America average level of maturity in all relevant areas, even reaching into "Best Practice" for North American utilities for some domains. In general, North American utilities are not as advanced in the discipline of asset management as global leaders in Northern Europe, Australia, and New Zealand, although there is a large degree of variance in the maturity of specific utilities.

Furthermore, THESL has clearly adopted the principle of continuous improvement such that it strives to 1) use asset data to optimize the decisions is makes about its assets, and 2) identify opportunities to improve operational effectiveness.

In UMS's numerous assessments of asset management maturity, one of the areas in which UMS has found that utilities have the most difficulty is in translating Strategic Objectives into Actions at the asset level. There is often a disconnect between what outcomes Leadership wants to achieve and what work is actually performed. However, this does not seem to be an issue for THESL. Senior Leadership has defined clear strategic objectives which are directly addressed in decisions made around Programs for the DSP. In addition, the Strategic Objectives have been directly linked to the Performance Outcomes enumerated in the Board's Chapter 5 filing requirements – Customer Focus, Operational Effectiveness, Public Policy Responsiveness, and Financial Performance. This link helps ensure that asset-based decisions in the DSP meet both Utility and Stakeholder interests.

To ensure that the decisions made are delivering on the objectives, THESL continues to improve its performance management framework to track performance of its annual investment program. For this DSP filing, THESL is developing capabilities to measure performance in terms of outcomes in order to be able to demonstrate the link between the plan and programs, and the outcomes, as well as to measure the efficiency in achieving the outcomes.

THESL's asset lifecycle processes used to identify projects to be included in the DSP programs is at a higher than average level of maturity and is moving towards best practice. Lifecycle planning, risk assessment, maintenance optimization, and asset condition assessment are all key asset management processes which THESL uses to identify and evaluate projects to be included in the DSP. Economic analysis, stakeholder outcomes, and operational effectiveness are all considered in prioritizing projects for inclusion in Programs.

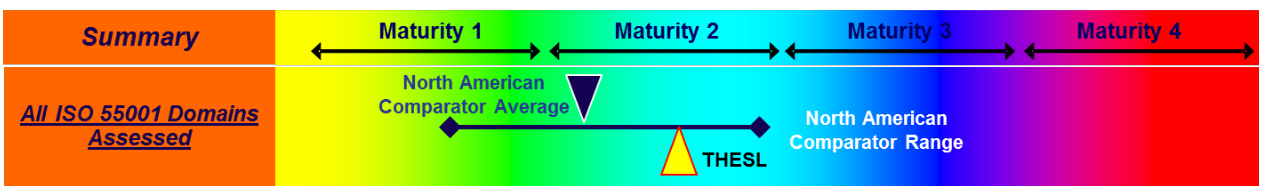
THESL's asset management processes include a variety of quantitative and qualitative analyses including the analysis of Customer Interruption Costs and the direct costs of responding to a failure, as well as ranges of customer outcomes related to reliability, safety, the environment, and financial impacts. While quantitative methods are used to identify projects, the methodology used for prioritizing individual projects is largely qualitative, as the desire to address a variety of stakeholder-driven outcomes precludes the use of a single (i.e., economic) measure. This demonstrates a level of maturity in translating customer needs and expectations into decision-making that exceeds most North American utilities. THESL also has a well-defined process for decision-making and the prioritization of projects as input to DSP Programs. This process ensures that needs and risks are assessed as required by industry standards. In alignment with ISO 55001 requirements, roles and responsibilities for the creation and execution of the DSP are clearly defined.

Asset management is a data-driven discipline and a higher level of maturity means incorporating quantitative analysis into decision-making using data – asset data, work data, customer data, cost data, system data, etc. While, UMS did not directly examine THESL's data, through information gathered in the interviews it appears that THESL's data for major asset classes is generally thought to be good. As with the industry as a whole, the quality of THESL's data varies among different asset classes. However, for the major asset classes, THESL's data appears to be sufficient for supporting its asset management decision-making processes. In addition, THESL strives to continuously improve the quality of data. For example, Mobile Data Terminals are being used to collect inspection data, and during the inspection, existing data is validated and the condition of the asset is noted. Where other data gaps in the asset register exist (e.g., asset age), predictive algorithms are being used to estimate data values.

From an Enabling Technology perspective, THESL is generally more mature than the typical utility with good modeling and Business Intelligence tools for performing lifecycle analysis, as well as forecasting failures and their impacts. UMS considers the Feeder Investment Model and Reliability Projection Methodology as examples of best practice asset management analytical techniques. In addition, Asset Condition Assessment has moved from a relatively simplistic model to a more sophisticated one which would be considered to use best practice techniques.

While THESL's asset management practices used to develop the DSP are above average, there are still some opportunities for improvement to achieve best practice levels. First, while the asset management system is well-defined, the level of documentation could be improved to ensure sustainability over the long-term. Second, while THESL does a good job addressing risk at both the corporate and DSP level, the methodology THESL uses for assessing and tracking the risk of deferred investment is not a highly standardized process. In addition, asset class level risk registers and an associated asset risk assessment process would assist THESL in being more proactive in ensuring risks beyond reliability are kept within tolerances. Finally, THESL's current portfolio optimization approach is manual, while the industry is moving to using tools which can provide a more comprehensive, programmatic optimization analysis that provides greater transparency into trade-offs.

In order to provide context to its qualitative evaluation of the extent to which THESL's asset management system aligns with the standard for good asset management, UMS also scored THESL's asset management maturity on the ISO 55001 scale and compared it to a database of 14 transmission and/or distribution utility business units for which it had previously conducted asset management maturity assessments. Across the ISO 55001 domains assessed, THESL's average maturity level is a 2.1, while the North American Comparator Average is a 1.6. The range of average maturity levels for the individual comparators ranges from 1.1 to 2.4. The result from the comparison of THESL's maturity scores versus the comparator group confirms and is in alignment with UMS's qualitative assessment of its relevant asset management practices, most of which exceed the industry standard and some of which are in alignment with best practices.

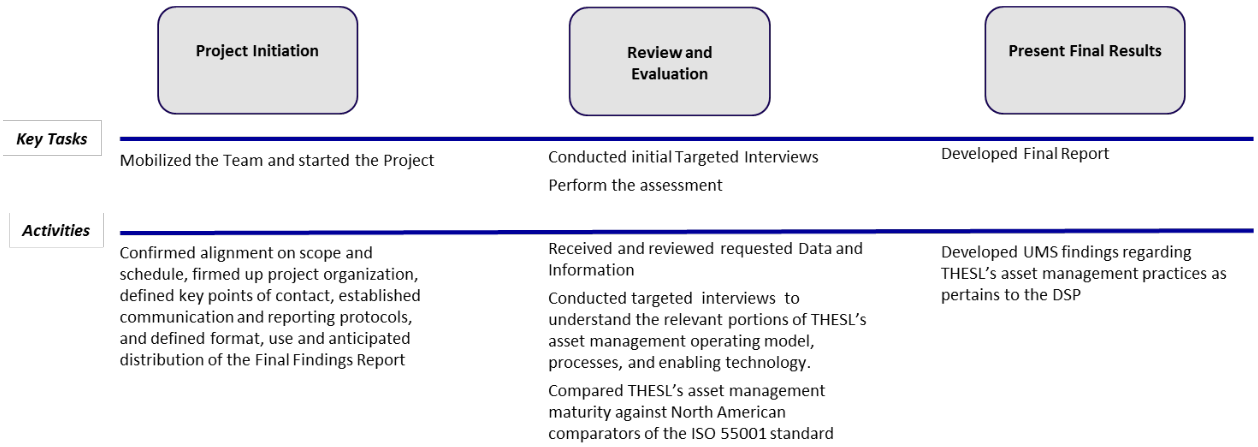


It should be noted that this finding is only against the 11 ISO 55001 domains assessed, not the full 24 domains within ISO 55001. The reason for this subset is that not all aspects of asset management are directly involved in the development of the DSP, and THESL desired a focus evaluation, rather than a more general one. These 11 domains represent the asset management domains that a utility should be using to create a capital plan like the DSP. That being said, and given that UMS did not specifically assess the other 13 ISO 55001 domains, UMS's view, based on the interviews and documentation review performed, is that THESL would likely exceed the industry average across most, if not all, 24 domains as well. However, that assessment is not specifically supported by this review.

SECTION III – PROJECT APPROACH

UMS Group implemented the following Project Work Plan (Figure III-1) to review THESL's asset management practices as relevant to the DSP and evaluate them against the ISO 55001 standard to provide an independent opinion on their competence:

Figure III-1: DSP Asset Management Review Overview



From Project Initiation to the Presentation of Results, UMS Group applied several elements of its endorsed and time-tested asset management assessment methodology to independently evaluate THESL's asset management maturity for those domains relevant to the DSP. The following discussion will expound on those aspects of UMS's approach that contributed to UMS achieving the level of objectivity and relevance needed to provide an independent review.

Practices Assessment

UMS Group met with a number of organizations within THESL (e.g.; Planning Integration, Investment Planning, System Planning, Standards and Technical Studies, Program Management, Engineering Services, Fleet, Facilities, IT, etc.) to gain insights and perspective regarding the asset management practices it uses to develop the DSP. UMS also received demonstrations of some of the key tools used to perform analyses to support decision-making around the DSP. A standard practice of most of UMS's assessment engagement is to perform interviews and review documentation to understand what and how a utility practices asset management. UMS has well established frameworks and interview guides to determine the relative maturity of practices versus the ISO 55001 standard.

DSP Domains

In order to evaluate the application of asset management principles to the development and execution of the DSP, UMS Group identified a number of asset management domains (Table III-1) which are relevant to the efforts undertaken. These domains formed the basis of UMS's evaluation of asset management maturity, as each was assessed individually against both the relevant ISO 55001 standard and UMS's experience gained from working with numerous North American electric utilities.

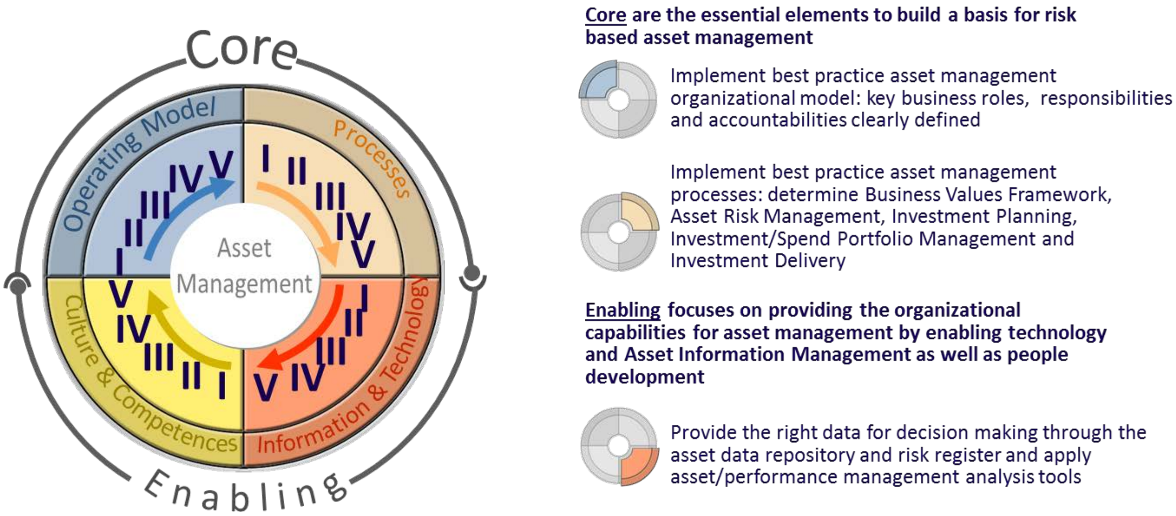
Table III-1: DSP Review Domains

Alignment of Strategy, Objectives, and Initiatives	Line-of-Sight Performance Objectives
Asset Management Systems and Tools	Performance Management
Application of Asset Management Processes	Resource Strategy and Plan to Execute the DSP
Application of Risk to Decision-making	Risk Tolerance
Business Value Framework	Role Clarity in Developing the DSP
Data Collection and Management	Scope of the AM System
DSP Feasibility	Stakeholder Management
DSP Formulation	Strategic Objectives

Strategic Asset Management Model

As an organizing framework, UMS Group used its proprietary Strategic Asset Management (SAM) Model (Figure III-3) which aggregates individual ISO 55001 domains into a holistic, risk based management model for asset-intensive businesses. The model embodies a well-defined organization structure, set of management processes, performance framework, and supporting information systems. The model also aligns with ISO 55001 and puts the key elements of ISO 55001 into a framework that more easily enables understanding of gaps and application of recommendations to improve the asset management system.

Figure III-3: Strategic Asset Management (SAM) Model



Evaluation Model

In defining the framework used to perform the review, UMS linked the DSP domains evaluated to the Strategic Asset Management Model domains. Similarly, the corresponding ISO 55001 Standard domains were linked to the corresponding Strategic Asset Management Model domains. This framework provides a holistic way to directly tie the DSP review to ISO 55001 in a more holistic and understandable format (Table III-3).

Table III-2: Relationship between ISO 55001, SAM Model, and DSP Domains

DSP Domain	Strategic Asset Management Model Domain	ISO 55001 Domain
Strategic Objectives, Business Value Framework, Stakeholder Management	Operating Model	4.2 Understanding the Needs and Expectations of Stakeholders
Scope of the AM System		4.3 Determining the scope of the AM system
Risk Tolerance		5.1 Leadership and Commitment
Role Clarity in Developing the DSP		5.3 Organizational Roles and Responsibilities
Performance Management		10.3 Improvement
DSP Formulation, Application of AM Processes	Processes	6.2 Asset Management Objectives and Planning
Resource Strategy and Plan to Execute the DSP		7.1 Resources
Application of Risk to Decision-making		6.1 Actions to Address Risks and Opportunities
DSP Feasibility (i.e.; Portfolio Execution)		8.1 Operational Planning and Control
Alignment of Strategy, Objectives, and Initiatives. Line-of-Sight Performance Objectives		9.1 Monitoring, Measurement, Analysis and Evaluation
Data Collection and Management, AM Systems and Tools	Enabling Technology	7.5 Information Requirements

ISO 55001 Maturity Scoring

To perform the comparative evaluation against the utility comparators, UMS Group used the ISO 55001 Maturity scale (Figure III-2) as the standard to assess asset management practices as they relate specifically to the Distribution System Plan (DSP). This scale was used for both THESL and the other assessed comparator utilities.

Figure III-2: ISO 55001 Maturity Scale

Maturity Level 0	Maturity Level 1	Maturity Level 2	Maturity Level 3	Maturity Level 4
The organization has not recognized the need for this requirement and/or there is no evidence of commitment to put it in place.	The organization has identified the need for this requirement, and there is evidence of intent to progress it.	The organization has identified the means of systematically and consistently achieving the requirements, and can demonstrate that these are being progressed with credible and resourced plans in place	The organization can demonstrate that it systematically and consistently achieves relevant requirements set out in ISO 55001.	The organization's processes and approaches go beyond the requirements of ISO 55001.

In order to be certified as ISO 55001 compliant, a company must be at Maturity Level 3 in all of the ISO 55001 domains. It should be noted that to date, UMS Group knows of only one North American utility business unit which has been ISO 55001 certified – PG&E Gas Operations. Therefore, UMS's intent was not to compare THESL against the certification level of maturity, but rather against the North American utility industry. To do so in a quantitative manner, UMS Group compared THESL against a comparator group made up of 14 North American electric utility business units for which it has performed asset management assessments (Table III-3). While these utilities were not specifically selected to represent the industry as a whole, as a consultancy who has performed scores of such assessments, UMS believes that the results are consistent with its qualitative view of asset management maturity across the North American utility industry.

Table III-3: North American Electric Utility AM Maturity Assessment Comparator Group

Avista Utilities – Distribution	Nova Scotia Power – T&D
Avista Utilities – Transmission	PowerStream – Distribution
EPCOR – Distribution	PSEG LI - Distribution
Lansing Board of Water & Light – T&D	PSE&G - Distribution
Manitoba Hydro – Distribution	Sask Power – T&D
Manitoba Hydro – Transmission	Southern California Edison - Substations
NB Power – T&D	Tennessee Valley Authority - Transmission

SECTION IV – SUMMARY OF RESULTS

The following discussion summarizes the results of an approach that:

- Utilized UMS Group's endorsed and time-tested asset management assessment methodology,
- Drew upon UMS's extensive experience performing asset management assessments and helping develop and implement asset management competencies and tools for utilities, and
- Captured insights and perspectives from key management and staff within the THESL organization.

Review of THESL's Use of Asset Management in the DSP

This section provides UMS's evaluation of the asset management maturity of the key domains which it believes are relevant to development and execution of THESL's 2020-2024 DSP Plan. These domains have been grouped into three areas of the UMS SAM Model – Operating Model, Processes, and Enabling Technology.

OPERATING MODEL

Clarity of Roles and Responsibilities

THESL has clearly defined the roles and responsibilities around asset management and has defined accountability for creation and execution of the DSP. This helps ensure that all necessary process steps to develop the DSP are performed and that decisions are made at the appropriate level. There is a designated responsible person for each of the DSP programs who is responsible for key decisions and actions around each Program. This provides THESL with greater accountability than much of the industry which typically relies on a committee-based approach for decision-making. While committees are good for achieving consensus, they do not provide accountability for decisions or actions which is a requirement for good asset management. In defining programs, alternatives are identified and analyzed to determine how they can help meet objectives. In addition, the decision-making criteria that is applied to this analysis is appropriate for the importance and complexity of the decisions being made. The use of alternative analysis and appropriate decision-making criteria provide both more consistency and transparency in DSP development.

Scope of the Asset Management System

THESL has identified the key assets to be covered by the asset management system, taking into account relevant internal and external issues, and addressing the needs and expectations of stakeholders. The scope of the asset management system is driven by the importance and level of risk around the assets and ensures that asset management processes are applied to the Program assets (i.e., Distribution Infrastructure, IT, Facilities, and Fleet) in the DSP. Similarly, the level of analysis used to develop programs is increased for the major assets which drive outcomes and are a larger portion of the capital spend. While THESL's asset management system is fairly well defined, the level of documentation around some parts of it could be improved to ensure sustainability.

Incorporation of Strategy and Business Value Framework

THESL has a good understanding of stakeholder needs and expectations and includes them in its decision-making criteria. The process used to develop Programs for the DSP is directly and clearly linked by line-of-sight to the strategic objectives which are based on an assessment of Stakeholder needs and expectations. The outcomes-based framework is based on stakeholder input and directly aligned with the four performance outcomes the Board has established for electricity distributors. Not only does the link between Programs and the outcomes-based framework provide confidence that the DSP addresses the Board's performance requirements, but THESL's process for defining strategic objectives, aligning them with stakeholder needs, and formalizing them into a framework to support asset-related decisions (such as development the DSP) is one of the most thorough and comprehensive that UMS has seen in the North American utility industry.

Application of Risk Tolerance Framework

A corporate risk matrix and tolerance levels have been established and needs and risks are assessed qualitatively as part of project prioritization. In addition, risk is used to identify projects and build programs, as well as to assess feasibility and manage implementation of the DSP. The process around risk management provides assurance that risk is being addressed in constructing the DSP. And while many utilities have a corporate risk matrix and established tolerance levels like THESL, not as many use risk as extensively to drive asset management decisions, nor have many "monetized" risk to be able to calculate a dollar-based risk reduction value as THESL has. At the same time, while risk is used to identify projects and build programs, assessment and monitoring of the risk of deferred investments beyond reliability impacts is not performed using optimization techniques that would align with best practice.

Line-of-sight Performance Management

THESL's asset management process ensures that objectives flow down throughout the organization to individual goals to ensure Line-of-Sight alignment. In addition, a process exists to ensure that performance aligns with the objectives and Management has a monthly review of the asset management system to ensure that it is performing acceptably. Finally, a new initiative will improve tracking of costs and link outcomes to projects to enable continuous improvement. This Performance Management framework around the DSP demonstrates that THESL is striving to identify opportunities to achieve continuous improvement.

Stakeholder Management / Benefit Capture Framework

THESL undertakes both formal and informal efforts to identify stakeholder needs and expectations. Stakeholders have been identified – Customers, Regulator, City, Province, Employees – and their requirements and expectations have been defined through multiple avenues, both formal and informal. Stakeholder needs are reflected in the decision-making framework ("outcomes framework") and are well communicated to the personnel who make the decisions so that they are kept informed on stakeholder needs. The process used to engage stakeholders, identify their needs, and translate them into outcomes helps ensure that the DSP aligns the interests of the Distributor with those of customers and public policy. In addition, THESL's benefits capture framework exceeds what is typically seen in the industry in terms of formally translating these needs and expectations into desired outcomes which are linked to DSP Program development. To achieve best practice, THESL would need to measure the results of its efforts against the desired outcomes and use deviations to drive performance improvement initiatives. This is an action which THESL has said it plans to undertake for the 2020-2024 period.

PROCESSES

<u>Distribution System Plan Formulation</u>

THESL has a well-defined process for creating the DSP that takes into account needs and risks as part of its prioritization process and links decisions to its objectives. asset management is integrated with Financial and Business Planning to achieve the strategic objectives. The Programs take into account requirements from outside the asset management system such as financial constraints, resource constraints, and legal/regulatory constraints. Individual projects are identified through a variety of qualitative and quantitative analyses, and comparing individual projects puts a strong reliance on subject matter experts to make the right choice.

For Distribution, condition assessment is a key driver for plan development, with the level of condition assessment used to drive DSP programs varying for different asset classes. For Fleet, lifecycle replacement timing drives development of the plan based on current vehicle mix and age. For IT, equipment is replaced on a fixed lifecycle schedule. Applications are prioritized based on business case analysis of alternatives incorporating risk. For Facilities, the program is driven by poor condition assets, age, and criticality. Overall, the processes used to formulate the DSP provide confidence that it was created using sound asset management techniques.

THESL uses an optimization, rather than prioritization approach to its Program portfolios which exceeds what is typical in the industry. However, THESL's current optimization approach is manual, while the industry is moving to using tools which can provide a more comprehensive, programmatic optimization analysis. THESL has recognized this improvement potential and has said it is exploring opportunities to move to a more automated methodology to ensure that it is selecting the projects and overall portfolio which will deliver the most value against the desired outcomes.

<u>Distribution System Plan Feasibility</u>

THESL's practices for assessing the feasibility of the DSP are in alignment with or exceed industry standard practice. Senior Leadership sets objectives and selects the level of funding for Programs. Outcomes are modeled to determine if Programs meet objectives and if not, the Program goes back to Designated Responsible Person with a request to assess changes to Programs or alternatives. The evaluation of Programs to determine if they can deliver on the objectives despite constraints, as well as the costing out of the Programs using high-level average costs is consistent with the approach used by most of the industry.

THESL's practices around ensuring delivery of the DSP border on best practice in terms of having a cross-functional Project Development Group to develop cost estimates, conduct constructability reviews, develop execution strategies, and gain stakeholder agreement. This is also true for the Program Management group which matches projects to the resource pool, uses resource availability to schedule projects, and makes decisions whether to use internal or external resources.

THESL treats and monitors risks identified through a risk assessment of each project. Risks are also assessed at the program level where a mitigation strategy is developed and monthly reporting performed. This use of individual project risk assessments, program risk assessments, and avoidance of contingencies built into budgets is a more sophisticated way of managing implementation risk than used at most utilities. Overall, the process used to assess and manage DSP feasibility provides a high degree of confidence that the DSP will be achieved.

Performance Management

THESL has a process which provides line-of-sight to corporate objectives and ensures that the assets and the asset management system are performing as expected and achieving targeted stakeholder outcomes. The performance of both capital and maintenance work is also tracked to ensure compliance with asset management strategies and programs, as well as to drive continuous improvement in execution efficiency and effectiveness. In addition, for the 2020-2024 DSP, THESL will link projects to outcomes to track that they deliver cost-effective benefits to customers. This performance management framework of THESL's is in alignment with best practice asset management in terms of linking strategy to actions and measuring the results. The performance management framework also helps ensure THESL is meeting the objectives established in the DSP. While most utilities measure performance, many find it difficult to link the actions directly to the utility's strategic objectives. In addition, many utilities do not have a good performance feedback loop to ensure that non-conformities and opportunities for improvement are identified and addressed. THESL has both parts of the process and is continually increasing the use of performance results to drive improvement.

Application of Asset Management Processes

THESL has a number of key asset management processes which are used in developing the DSP. Asset risk management is performed as part of lifecycle optimization, as well as in response to specific incidents, and critical assets have a more targeted risk assessment focused on them. Lifecycle planning is performed across all the divisions to understand the trade-offs between alternatives and optimize on cost, performance, and risk. Maintenance strategies are developed through RCM and lifecycle analysis, where appropriate, and adjusted as necessary. Asset Condition Assessment has transitioned from a relatively simplistic model which is consistent with industry standard practice to a more sophisticated one which uses best practice techniques. Failures are forecast and reliability projections are used to understand medium- and long-term threats from asset failure which is then used to guide Program development. Assets are not just assessed individually, groups of assets are assessed to identify opportunities to replace assets in a more cost efficient manner (i.e., area replacement). Monetized risk models exist and are used to identify risk and develop the economic business case for decisions. As a whole, the asset management processes provide confidence that the DSP delivers value to stakeholders by optimizing decisions from an asset lifecycle perspective and balancing risk with cost and performance.

The use of lifecycle planning to understand the trade-offs between alternatives and optimize on cost, performance, and risk; the use of failure forecasting to develop reliability projections; and the use of monetized risk models to assess the financial cost/benefit of projects are all examples of practices that exceed what is typically found in utility asset management programs. The new asset condition assessment model (based on CNAIM) is in alignment with best practice techniques. Outside of the Distribution System assets, Fleet's asset management processes are consistent with the level of maturity typically found in the utility industry in this domain. IT's performance of risk assessments, lifecycle analysis, and business cases exceeds industry standard practices for this domain. Facilities' use of lifecycle analysis, failure-based maintenance strategies, asset condition assessments, and criticality and risk assessment place it above the average utility Facilities organization in asset management competence.

ENABLING TECHNOLOGY

Data Collection and Management

THESL has identified the data needed to support its asset management activities and has implemented technology to assist in collecting and managing that data. Data quality is reported to vary by asset class, but is generally thought to be good for major assets. While, UMS did not directly examine data, through its interviews, UMS determined that the quality of data THESL uses to supports its asset management decisions and practices, including formulation of the DSP, is consistent with the industry as a whole. As is common in most utilities, data quality varies by asset class, but is generally good for major assets, particularly asset classes with small numbers of expensive assets. Having sufficient and reasonable quality data helps assure the accuracy of the decisions that the DSP is built upon. To continue moving towards best practice in data collection and management, THESL continues to develop data quality measures and address deficient data needed to improve decision-making.

Asset Management Systems and Tools

THESL has the necessary tools and models to perform best practice asset management analyses. In some cases, THESL exceeds industry standards with its tools and models, such as those used to support key asset management analyses such as asset health indexing, lifecycle costing, risk costing, economic analysis, and reliability analysis. THESL is also using best practice Business Intelligence tools to develop Programs that are more efficient. THESL has an asset register to capture asset data for each asset type (e.g., Distribution, Fleet, Facilities, IT, etc.) and a risk register exists at the corporate level. While this use of an asset register and a corporate risk register to support asset management are in alignment with typical industry practices, best practice would be to have an asset risk register to track risks for individual asset classes. Overall, the application of systems and tools to perform needed asset management analyses provides confidence that the DSP is data-driven and based on appropriate asset lifecycle analysis.

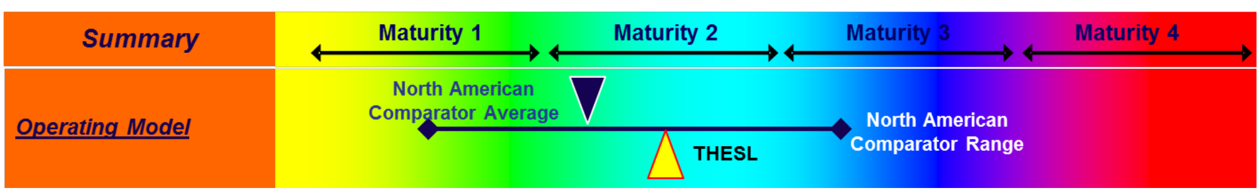
Comparison of THESL to Comparator Group

In addition to the evaluation of THESL's application of asset management to the development and execution of the DSP, UMS assessed the maturity of THESL's asset management capabilities against the international standard, ISO 55001. For reference purposes, UMS used a group of 14 North American utilities ("comparators") for which it had previously performed asset management maturity assessments. While these utilities were not specifically chosen as a representative sample of the electric utility industry, based on UMS's experience performing utility asset management assessments, as well as assisting utilities in building their asset management capabilities, it believes the results are a reaonably accurate representation of the North American industry.

In order to make the results more meaningful from a holistic perspective, UMS aggregated the scores across the domains in the Strategic Asset Management (SAM) Model.

The Operating Model domain assesses the extent to which the asset management system aligns with ISO 55001 standards for good asset management in terms of the definition and distinction between roles, responsibilities, and accountabilities. It also evaluates the consistency between overall strategy, the underlying philosophy in managing the assets, and the deployment of personnel in capturing the value of installed assets. Finally, it assesses the degree to which stakeholder needs and expectations are captured and used to drive business decisions.

Across the sub-domains which make up this domain (see Table III-3), UMS scored THESL as an average 2.0 maturity, while the comparator group average was 1.6. The maturity level of individual comparators (averaged across the sub-domains) ranged from 1.0 to 2.7.



THESL's scores in the five ISO 55001 domains which make up this aggregated score range from 1.8 to 2.5. As Table IV-1 below demonstrates, THESL's asset management maturity exceeds the comparator group average maturity in all the sub-domain areas that make up the Operating Model domain.

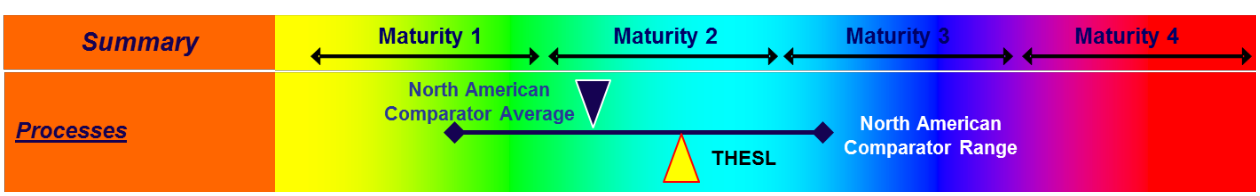
Table IV-1: Comparison of THESL against Comparators (Operating Model)

ISO 55001 Domain (SAM Domain)	Maturity Level 3 per Standard	UMS Assessment of THESL	THESL Maturity	Comparator Avg. Maturity
4.2 Understanding the Needs and Expectations of Stakeholders (Operating Model)	The organization identifies stakeholders that are relevant to the AM system, and captures their requirements and expectations. The organization determines criteria for AM decision making which includes where appropriate consultation with relevant stakeholders. Relevant stakeholder requirements are determined for recording of	Multiple formal and informal efforts are undertaken to understand stakeholder needs and expectations which are reflected in the decision-making framework.	2.5	1.9

ISO 55001 Domain (SAM Domain)	Maturity Level 3 per Standard	UMS Assessment of THESL	THESL Maturity	Comparator Avg. Maturity
	information relevant for AM, and for their reporting internally and externally.			
4.3 Determining the scope of the AM system (Operating Model)	The scope of the asset management system is clearly documented in terms of its boundaries, applicability, interfaces with other management systems and the asset portfolio covered. It is also aligned with AM Policy and Strategy (SAMP).	The scope of THESL AM system and its outputs enable the delivery of the organizational objectives. Overall AM system documentation could be improved.	1.8	1.6
5.1 Leadership and Commitment (Operating Model)	Top management ensures that the AM Policy, SAMP, and Objectives are in place and consistent with organizational objectives. The AM system is fully integrated with the organization's business processes. The approach used for managing AM related risk is aligned with the organization's risk management approach.	Asset management is integrated with the DSP planning process. A corporate risk matrix and tolerance levels have been established to provide a consistent basis for managing risk.	2.0	1.6
5.3 Organizational Roles and Responsibilities (Operating Model)	Top management has assigned responsibility and authority for: i) establishment and update of the SAMP, AM objectives and AM plans; ii) ensuring the adequacy, suitability and effectiveness of the AM system in delivering the strategy and conforming to ISO 55001; and iii) reporting on the performance of the AM system.	Roles and responsibilities for asset management (and the DSP) have been clearly defined.	2.0	1.4
10.3 Improvement (Operating Model)	The organization can demonstrate that the suitability, adequacy and effectiveness of its AM system is being continually improved through its processes for monitoring and evaluation, reviews by top management, and the existence of AM objectives and actions designed to improve the system.	Performance of the DSP in terms of results are tracked to both ensure conformity with AM strategies and programs and identify opportunities for improving execution efficiency and effectiveness.	2.0	1.7

The Processes domain assesses the extent to which the asset management system aligns with ISO 55001 standards for good asset management in terms of the consistency of risk analysis methodology and investment planning, and linking it to asset management policy and corporate/business area strategy. It also assesses the extent to which investments are identified, prioritized and optimized based on overall value, resources, and risk; as well as how asset management plans, processes and procedures are factored into the planning and execution of capital projects and O&M programs. Finally, it assesses how strategy is aligned with action through use on line-of-sight measures.

Across the sub-domains which make up this domain, UMS scored THESL as an average 2.1 maturity, while the comparator group average was 1.6. The maturity level of individual comparators (averaged across the sub-domains) ranged from 1.1 to 2.6.



THESL's scores in the five ISO 55001 domains which make up this aggregated score range from 2.0 to 2.2.

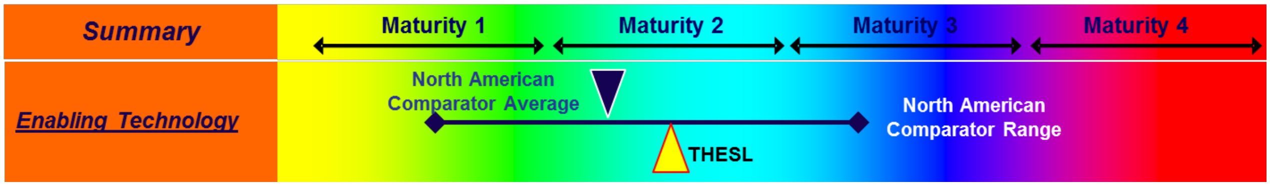
As Table IV-2 below demonstrates, THESL's asset management maturity exceeds the comparator group average maturity in all the sub-domain areas that make up the Processes domain.

Table IV-2: Comparison of THESL against Comparators (Processes)

ISO 55001 Domain (SAM Domain)	Maturity Level 3 per Standard	UMS Assessment of THESL	THESL Maturity	Comparator Avg. Maturity
6.1 Actions to Address Risks and Opportunities (Processes)	Processes and measures are in place to assure that the desired outcomes of the AM system are achieved and undesired effects are mitigated. Internal and external context and stakeholder requirements are considered in determining the risks and opportunities. The organization monitors the effectiveness of actions and processes for addressing the risks and opportunities, and can demonstrate how continual improvement is achieved through risk and opportunity management.	Risk assessment is carried out across multiple dimensions and at multiple points in asset lifecycle analysis. Opportunities are identified both internally and externally through communication with stakeholders. Risk and performance are monitored.	2.2	1.8
6.2 Asset Management Objectives and Planning (Processes)	The organization has documented AM objectives to align with and enable achievement of organizational objectives and AM policy. It considers stakeholder and other requirements in establishing AM objectives. It effectively communicates its AM objectives with those responsible for achieving them. The AM objectives are measurable, monitored, reviewed and updated. It has established and documented its planning processes, methods and decision criteria to achieve objectives.	There is a clear link between asset management objectives and the DSP programs. AM processes are in alignment with industry standard practice and in many cases exceed them.	2.0	1.7
7.1 Resources (Processes)	The organization can demonstrate that it has evaluated and provided adequate resources to establish, maintain and improve the asset management system.	A defined process and responsible group exist to determine the resources needed, including the division of work and use of external resources.	2.2	1.7
8.1 Operational Planning and Control (Processes)	Operational planning and delivery processes are being controlled in accordance with the specified criteria. Documented evidence provides assurance that processes have been carried out as planned. Risks associated with delivery activities are being managed.	Program Management oversees planning and control processes to ensure execution of the DSP, including risk management.	2.0	1.5
9.1 Monitoring, Measurement, Analysis and Evaluation (Processes)	The organization can demonstrate that it has established what needs to be monitored / measured so it can determine whether it achieves the intended outcomes of its AM system.	A performance management framework exists which links directly to strategic objectives and outcomes are compared to targets. A formal process exists for monitoring the asset management system to ensure it is meeting objectives.	2.2	1.3

The Enabling Technology domain assesses the extent to which the asset management system aligns with ISO 55001 standards for good asset management in terms of whether the asset management information management architecture and processes (for systems and data) in place are adequate to support asset-related decisions.

In this domain, UMS scored THESL as a 2.0 maturity, while the comparator group average was 1.7. The maturity level of individual comparators ranged from 1.0 to 2.8.



As Table IV-3 below demonstrates, THESL's asset management maturity exceeds the comparator group average maturity in the one sub-domain area that makes up the Enabling Technology domain.

Table IV-3: Comparison of THESL against Comparators (Enabling Technology

ISO 55001 Domain (SAM Domain)	Maturity Level 3 per Standard	UMS Assessment of THESL	THESL Maturity	Comparator Avg. Maturity
7.5 Information Requirements (Enabling Technology)	All information identified as required for asset management purposes is defined, along with the sources, quality assurance requirements and processes to manage the information. The information is traceable and consistent, including between financial and non-financial information.	THESL has identified the information needed to support development of the DSP and has implemented appropriate technology to use data to support decision-making	2.0	1.7

Asset Management Program Assessment

(PAS 55)

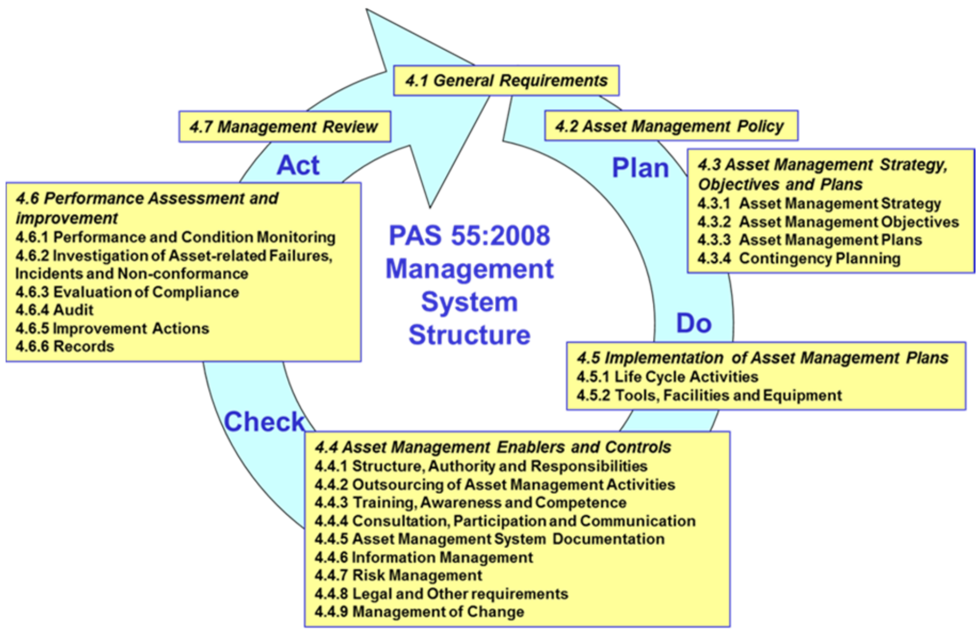
Prepared by: UMS Group

February 6, 2013

Executive Summary

UMS Group conducted a “soft assessment” of PowerStream’s Asset Management program in comparison to the operating model defined in the 2008 revision to the Publicly Available Specification (PAS 55). In so doing, we reviewed documentation and conducted 39 targeted interviews (refer to Appendix A for listing of those interviewed) across the entire enterprise and evaluated PowerStream’s alignment to basic Asset Management principles / practices across 7 domains and 24 areas.

Figure 1 – PAS 55 Evaluation Framework

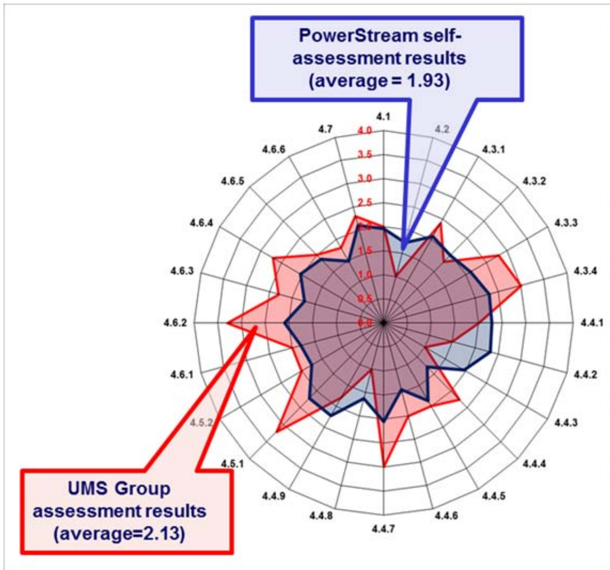


Applying our analytical methodology, we identified 6 areas where PowerStream is adjudged nearing or at the “competence level” (scoring “3.0” or above) specified in PAS 55 (highlighted Figure 2 in Green Font), noting that PowerStream has already implemented a number of tactical initiatives that comprise an effective Asset Management Program (referred to as “no regrets” moves); and with the formulation of an effective strategy and a comprehensive communication / training plan, and continued focus on collecting / consolidating critical asset related data and information, PowerStream is well-positioned to close any remaining relevant gaps within a 2 to 3 year time period.

Summary of PAS 55 Assessment

The following figure illustrates both a UMS Group and PowerStream self-assessment. Since the PowerStream evaluations are in fact averages across the entire range of possible scores (“0.0” to “4.0”), we viewed the UMS Group scores as more representative of PowerStream’s position across each of these areas of competence. Furthermore, we attribute the wide range of scores within the PowerStream participants as indicative of a lack of familiarity with sound Asset Management principles, rather than a representation of different informed views.

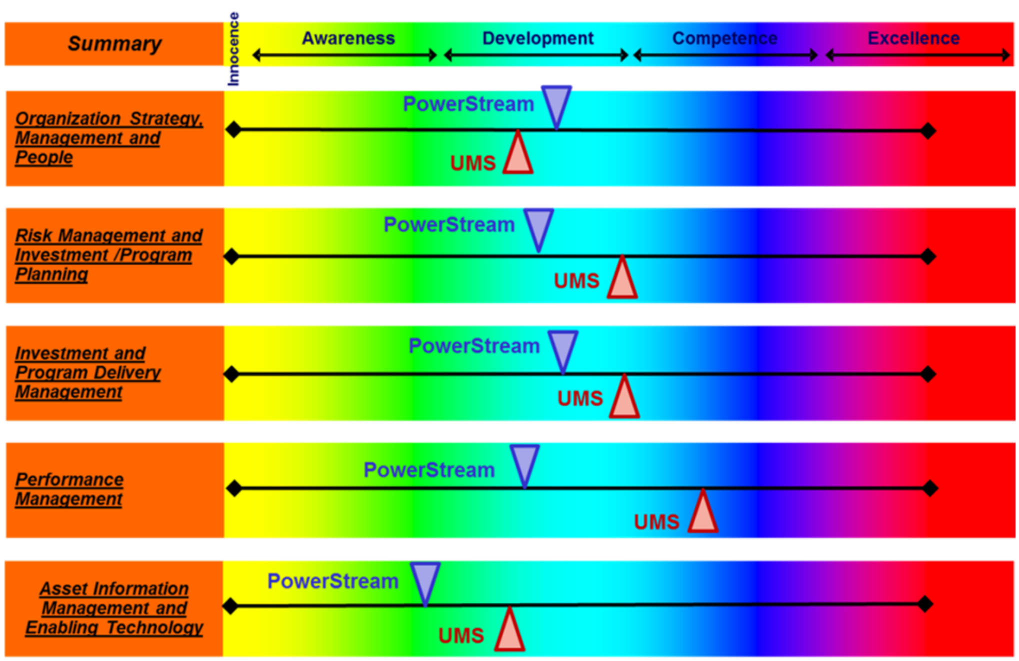
Figure 2 – Summarized Results of Gap Analysis



4.1	General requirements
4.2	Asset Management Policy
4.3.1	Asset Management Strategy
4.3.2	Asset Management Objectives
4.3.3	Asset Management Plans
4.3.4	Contingency Planning
4.4.1	Structure, Authority and Responsibilities
4.4.2	Outsourcing of Asset Management Activities
4.4.3	Training, Awareness and Competence
4.4.4	Consultation, Participation and Communication
4.4.5	Asset Management System Documentation
4.4.6	Information Management
4.4.7	Risk Management
4.4.8	Legal and Other Requirements
4.4.9	Management of Change
4.5.1	Life Cycle Activities
4.5.2	Tools, Facilities and Equipment
4.6.1	Performance and Condition Monitoring
4.6.2	Investigation of Asset-related Failures, Incidents and Non-conformance
4.6.3	Evaluation of Compliance
4.6.4	Audit
4.6.5	Improvement Actions
4.6.6	Records
4.7	Management Review

Translating these 24 areas of Asset Management competencies into 5 categories (Organization Strategy, Management and People, Risk Management and Investment / Program Planning, Investment and Program Delivery Management, Performance Management, and Asset Information Management and Enabling Technology), PowerStream is predominantly in the "Development" stage of Asset Management Program implementation (i.e., the organization has a good understanding of Asset Management, has decided how the elements of Asset Management will be applied, and has made progress in implementation).

Figure 3 – Overall Assessment



Findings and Recommendations

During the course of the evaluation, UMS Group was favorably impressed with many facets of PowerStream's approach to Asset Management. Recognizing that most successful transformation plans leverage existing strengths, we deem it appropriate to first highlight the areas where PowerStream has already instituted, or is well on the way to instituting, effective Asset Management practices and approaches, and then highlight highly leverageable opportunities to maintain momentum towards establishing excellence:

- PowerStream has effectively applied the Asset Condition Assessment (ACA) methodology developed by Kinectrics Inc. and BIS Consulting, LLC across 11 major asset classes (TS Transformer, MS Transformer, Circuit Breaker, 230kV Switch, MS Primary Switch, Station Capacitor, Station Reactor, Distribution Transformer, Distrbution Switchgear, Wood Pole and Distribution UG Primary Cable), establishing optimum asset replacement cycles as an input to its capital investment budgeting process. The approach presented in performing asset evaluations and developing overall programs is in line with industry leading practices. We would recommend continued emphasis in the following areas for achieving alignment among all of the key elements of an effective asset lifecycle plan for PowerStream's most critical assets:
  - Information management practices (including the collection, maintenance and accuracy of asset condition data / information to assist in developing health indices, probabilistic failure rates, criticality of components, asset risks, and correlation of projected asset failures and required replacement capital);
  - Establishing the necessary IT platforms to manage the data and information required to perform asset evaluations;
  - Tightening up the connection between the ACAs and the current capital investment portfolio optimization process; and,
  - Extending this philosophy to inspection and maintenance program optimization (reflecting cost-benefit trade-offs between interval-based, condition-based, and reliability centered maintenance (RCM) with "run-to-failure" as an asset-specific, proactive strategy rather than an outcome of broader funding decisions).
- PowerStream has a core knowledge base with the experience, competencies and skills necessary to effect and sustain this transformation. The challenge involves properly leveraging this capability across the organization in a way that captures / integrates the embedded subject matter expertise as effectively and efficiently as possible. This will require a number of actions:
  - Development / communication of a comprehensive Asset Management Strategy and Plan that ties many of the ongoing intiatives into a total package and clearly illustrates how this strategy is an enabler to other corporate initiatives (e.g. "Journey to Excellence").
  - Continued clarity around the roles of Asset Owner, Asset Manager and Service Provider, particularly regarding: the establishment of, and management to, asset risk tolerance thresholds; distinguishing between maintenance program development and the actual conduct of maintenance work (similarly the establishment of design and construction standards vs. actual performance of capital projects); and the integration of asset-by-asset criticality, condition and risk information into the investment and program funding process.

- Key elements of Financial and Project / Program Planning and Execution appear to be in place. Possible enhancements to consider include:
  - Consistent with the statements regarding asset condition and performance based data / information, standardize Project and Program monitoring and reporting across PowerStream. Also, consider extending beyond standard progress and budget performance monitoring to validate the capture of value or elimination of risk presented in the various business cases.
  - With respect to performance monitoring, challenge existing KPIs regarding line-of-sight linkage between individual performance, investment and program delivery, and corporate strategy, ensuring full transparency across the business.
  - It appears that PowerStream applies a holistic approach in evaluating lifecycle cost when making asset procurement decisions. As asset lifecycle optimization practices undergo continued refinement, there may be a need to adjust various purchasing evaluation factors.
  - In light of the dynamics between O&M spending and Capital investment dollars, PowerStream may find opportunity to properly recategorize future spending / investment decisions (e.g. Extension of ROW clearance, Danger Tree removal, linkage of inspection activity to ultimate replacement and definition of units of property).
  - Consistent with the recommendation to extend the philosophy and approach used for developing ACAs for critical assets, the current Capital Portfolio Optimization tool could be applied to O&M programs (which will require a more comprehensive programmatic approach to O&M spending and linkage to anticipated value capture and risk mitigation).

Prospects for Success

UMS Group maintains a highly optimistic view of PowerStream's potential to achieve industry leading status in its Asset Management implementation:

- We encountered no resistance to the notion of value to be derived from this program, particularly once it was presented in the context of PowerStream's Journey to Excellence as an enabler and as a more "routinized" approach to common sense practices for optimizing the performance and investment / spending levels on assets.
- PowerStream's leaders understand the differences inherent to the amalgamation of a number of utilities and remain focused on gaining philosophical and programmatic alignment, rather than tactical compliance (e.g. Differing approaches between North and South in implementing cyclic circuit inspection programs).
- As is usually the case, the Stations and Protection / Controls areas appear to have progressed further than Lines in implementing effective Asset Management processes. This assessment seems to be driven primarily by the implementation of CASCADE (combined with the noted shortcomings of the accuracy and effectiveness of GIS for Lines) and the inherent advantage of less-distributive assets. That said, the applicable activity level related to Lines is consistent with the challenge of getting a better handle on data / information management and integrating asset health and condition information into the various investment and program planning processes.

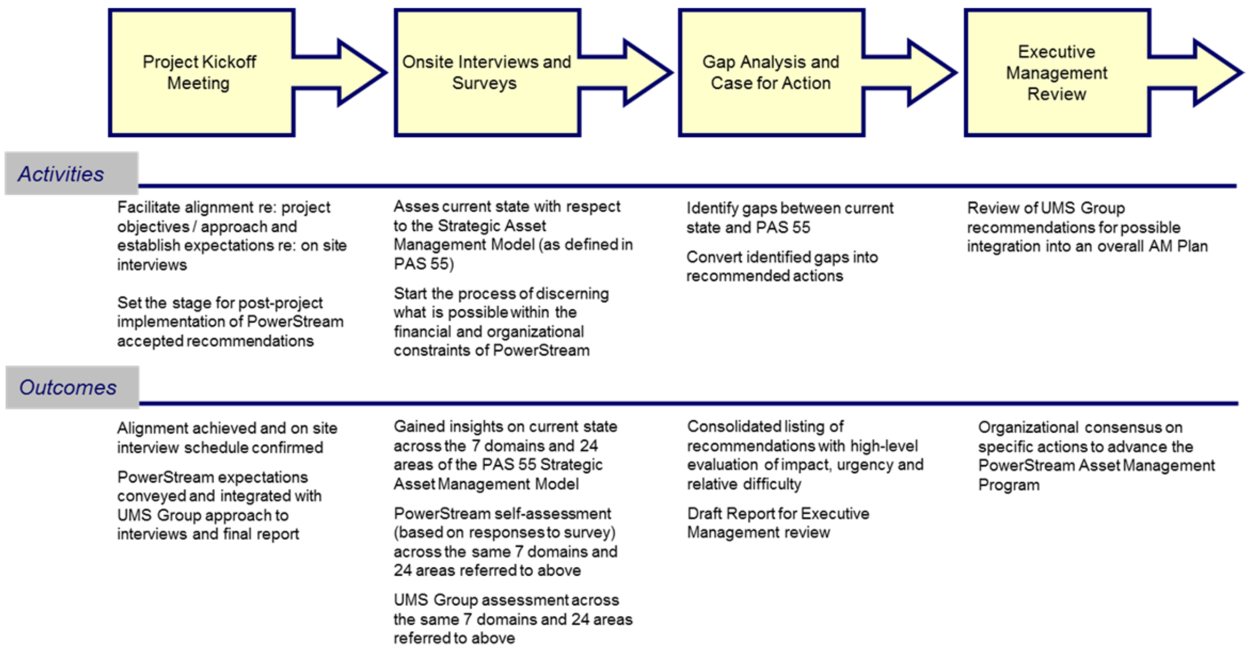
- Those charged with implementing this transformation understand the importance of coordinating their requirements with the Corporate IT Strategy, and are implementing measures to facilitate the proper integration of their requirements into this plan.

The following discussion more explicitly outlines our approach, specific aspects of the evaluation, and 17 initiatives proposed for consideration in PowerStream's Asset Management Transformation Plan.

Project Approach

Consistent with Figure 4 (below), UMS Group viewed this effort in 4 distinct phases: initially confirming alignment around the process and expectations related to the effort, then conducting on site interviews and surveys across the entire enterprise to discern current state and any practical constraints to continuous improvement, performing a gap analysis to the practices established in PAS 55, and ultimately submitting our findings for Executive Management review and subsequent integration with PowerStream's Operational Plan.

Figure 4 – Overall Approach



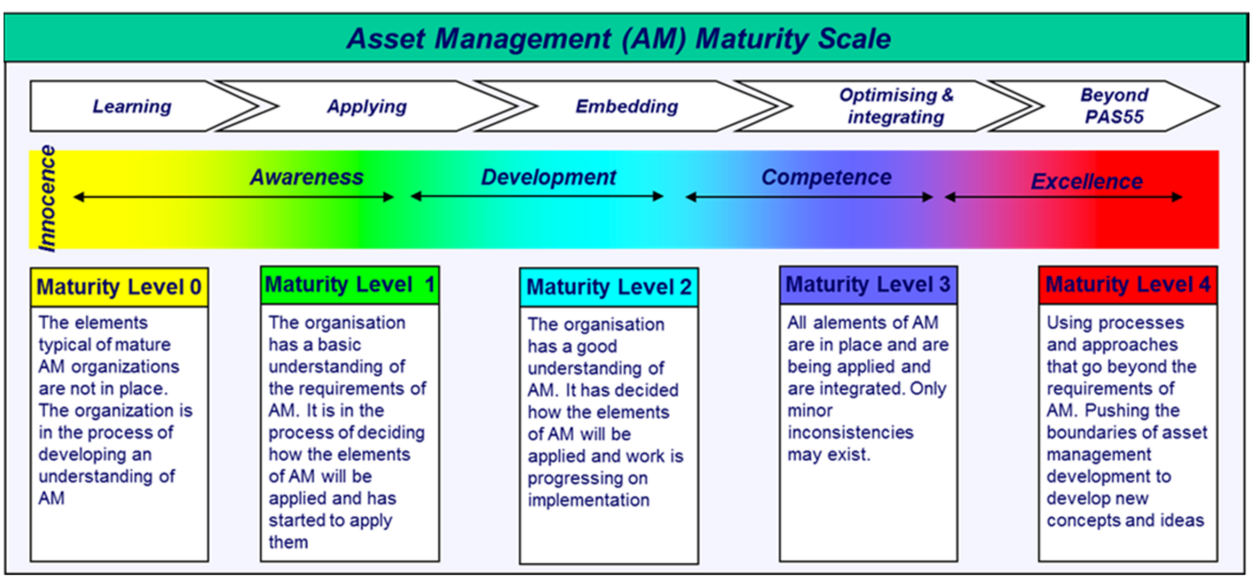
Upon review of relevant PowerStream Asset Management related documentation and 39 targeted group and / or individual interviews (refer to Appendix A for a listing of interviews / meetings conducted over a 2-week period), we facilitated a self-evaluation and conducted our own evaluation of PowerStream's standing across 7 domains and 24 areas of competence (illustrated in Figure 2), and then translated these areas of competence into the UMS Group evaluation framework (Figure 5):

Figure 5 – UMS Group Analytical Framework

PAS 55 Areas of Competence		UMS Group Evaluation Framework	Definition
4.1 4.2 4.3.1 4.3.2 4.4.1 4.4.3 4.4.4	General Requirements Asset Management Policy Asset Management Strategy Asset Management Objectives Structure, Authority and Responsibilities Training, Awareness and Competence Consultation, Participation and Communication	**Organization Strategy, Management and People**	Extent to which the Asset Management (AM) system aligns with PAS-55 standard requirements. Specifically, we reviewed the definition and distinction between the Asset Owner, Asset Manager and Service Provider functions and evaluated consistency between overall strategies, the underlying philosophy in managing the assets, and the deployment of personnel in capturing value of installed assets.
4.3.3 4.3.4 4.4.7 4.4.8	Asset Management Plans Contingency Planning Risk Management Legal and Other Requirements	**Risk Management and Investment / Program Planning**	Consistency of risk analysis methodology and investment/program planning with AM policy and corporate / business area strategy; Determined the extent to which investments/programs are identified, prioritized and optimized based on overall value, resources, and risk; and AM plans, processes and procedures are factored into the planning and execution of capital projects and O&M programs.
4.5.1 4.5.2 4.4.2	Life Cycle Activities Tools, Facilities and Equipment Outsourcing of Asset Management Activities	**Investment / Program Delivery Management**	Methods and processes that reflect the alignment of life cycle activities with the overall asset strategy. This area also includes project and resource management and performance assessment / auditing/ condition monitoring.
4.4.9 4.6.1 4.6.2 4.6.3 4.6.4 4.6.5 4.7	Management of Change Performance and Conditioning Monitoring Investigation of Asset-Related Failures, Incidents and Non-Conformance Evaluation of Compliance Audit Improvement Actions Management Review	**Performance Management**	Extent to which the organization has embedded the skills and competencies necessary to successfully effect an Asset Management transformation. It includes evaluating if a performance management framework is in place so that the organization's strategy, objectives, and KPI's / measures are aligned, ensuring that the expected performance of both assets and resources (internal and external) support those stated strategies and objectives.
4.4.5 4.4.6 4.6.6	Asset Management System Documentation Information Management Records	**Asset Information Management and Enabling Technologies**	Extent to which the installed AM Information Management architecture and processes are adequate to ensure availability of accurate asset performance information in support of asset-related decisions.

The individual scores were evaluated, applying the following Asset Management Maturity Scale, differentiating between PowerStream's self-evaluation and that performed by UMS Group.

Figure 6 – Asset Management Maturity Scale



Asset Management Gap Assessment

Report of Findings to Manitoba Hydro

Conducted by

UMS Group Inc.
Morris Corporate Center 1
300 Interpace Parkway, Suite C380
Parsippany, NJ 07054

December 15, 2016

Available in accessible formats upon request

INTRODUCTION

Overview of Project

UMS Group was engaged by Manitoba Hydro (Hydro) in September 2016 to conduct a Gap Assessment of its Asset Management capabilities. The scope of this assessment was to evaluate the organization's current asset management capabilities and practices and make recommendations for implementing a best practice Asset Management System.

The project comprised a review of Hydro's existing corporate and business unit level Asset Management practices and comparison to industry best practices, as well as to international standards for Asset Management (PAS 55 and ISO 55000). From this review, UMS developed a detailed and prioritized listing of the gaps between Hydro's current Asset Management practices and industry best practices and identified necessary steps to bridge the gaps.

To perform the assessment, UMS collected and reviewed asset management-related process and practice documentation, as well as current plans to monitor and maintain asset performance, asset condition and risk levels. Additionally, interviews were held with the Executive team to understand their views on asset management, objectives for the assessment, and perceived issues/gaps. Following those interviews, individual interviews were held with personnel involved with asset management from across the Hydro Generation Operations, Transmission, and Customer Service and Distribution business units. The focus of these interviews was to understand current and planned asset management roles and responsibilities, practices, processes, and tools.

Finally, individual workshops were held with each of the Generation Operations, Transmission, and Customer Service and Distribution business units to discuss asset management standards and best practices and walkthrough a self-assessment of the Business Unit maturity compared to industry standards – International Organization for Standardization (ISO) 55000 and Publicly Available Specification (PAS) 55 – and best practice. Individual workshops were also held with each of the Business Units to review the Asset Lifecycle and Risk Strategy Process and gain a better understanding of how Hydro addresses the steps in the process and where gaps exist.

The Gap Assessment Methodology is described in Appendix A. Manitoba Hydro personnel who were interviewed and/or participated in workshops are listed in Appendix B.

As a definitional note, there are several terms used in the report which might not be familiar to readers. There are defined below:

- Management System – The set of interrelated or interacting elements of an organization (i.e., policies, processes and procedures) used to ensure that it can fulfill all the tasks required to achieve its objectives.

- Model – A high level representation of a system made up of concepts which communicate basic facts about the system
- Framework – A high level guide which identifies the key elements of a structure.

What is Asset Management?

Asset Management is a system that uses data-driven decision-making to ensure the right work is being undertaken to achieve the desired performance outcomes in the most efficient way. Its overall objective is to ensure that short term decisions meet the long term needs of stakeholders in the optimal manner.

Good Asset Management means spending limited resources in the most effective way to meet business objectives. It does so by proactively investing in the asset in a way that meets the strategic objectives of the company, rather than merely reacting to asset deficiencies as they occur. This investment is based on economic modeling of benefits versus its costs, rather than historical spend or “pet” projects. By providing the focus and accountability for the best use of its resources, Asset Management optimizes the total expenditure needed to achieve the desired business and asset performance outcomes.

Strategic Value of Asset Management

Improving its Asset Management capabilities has the potential to provide significant strategic benefit to Manitoba Hydro by ensuring that it is optimizing its capital and operating expenditures, managing risk within a set tolerance level, and delivering long-term value to customers by reliably and safely providing service in a cost-effective manner.

Specific benefits that can be achieved by Hydro through the maturation of its asset management system include:

- Improved asset productivity through life extension and reduction in failures
- Increased efficiency in asset maintenance through better targeting of needed work and elimination of non-valued added work
- Reduced uncertainty through better forecasting of failures and understanding of risk
- Ability to compare investments across asset classes through consistent approach and monetization of benefits
- Improved effectiveness of expenditure dollars through focus on performance management and continuous improvement
- Optimizes use of human resources by matching the workforce – in terms of size and composition – to the work required, rather than creating work to keep the workforce busy
- Greater transparency for internal and external stakeholders through use of data-driven decision-making and quantitative analysis

In 10 previous utility asset management transformations we have performed, we have found that utilities see significant improvements in productivity and overall cost savings of 20-30% over 5 years with the application of an asset management system.

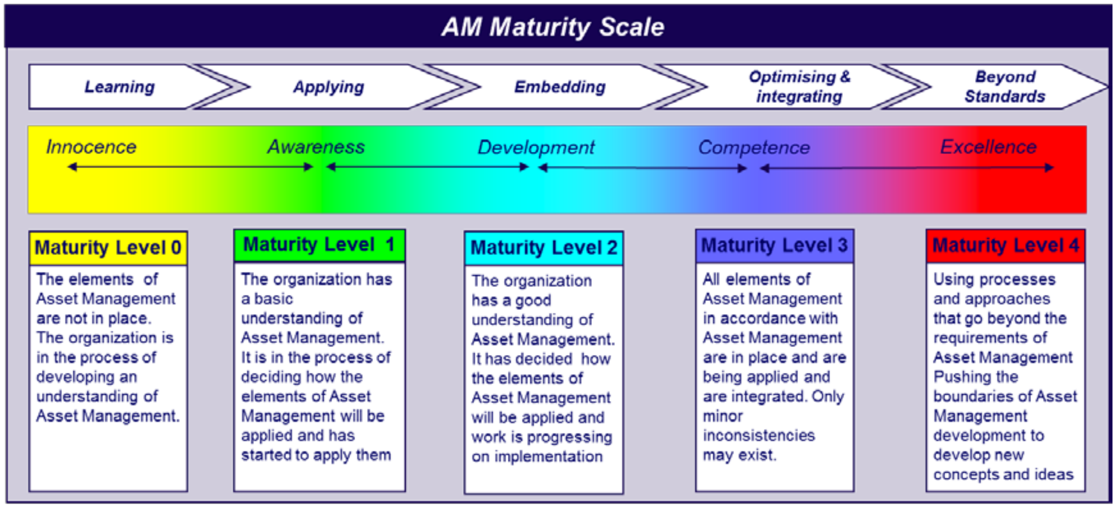
Achieving these benefits means adopting a process model whereby the responsibilities and accountabilities for the different Asset Management roles are clearly defined and understood by personnel. The three key roles in an Asset Management process model are the Asset Owner, Asset Manager, and the Service Provider.

The Asset Owner identifies needs and requirements of stakeholders and sets the business values and risk tolerance levels for the Asset Manager. The Asset Manager then determines what has to be done, when, and where to realize the objectives set by the Asset Owner and agrees on a service level for performing work with the Service Provider(s). In turn, the Service Provider determines how the work is performed while keeping costs to a minimum for the specified levels of work and quality as agreed to with the Asset Manager.

The three roles operate in a chain and need each other to work closely together based on formalized agreements.

EXECUTIVE SUMMARY

Using the methodology described in the *Introduction* above, UMS Group assessed Hydro against ISO 55000 and best practice Asset Management on the following scale:



Notes on the use of the maturity scale:

1 As indicated by the colour transitions, the boundaries of the maturity scale are not hard values
2 Compliance with the AM Standard is at Competence maturity level 3
3 There is no upper limit to excellence as defined by the red colored zone

Overall, Hydro scored a 1.5 with the individual Business Unit Scores as follows: Generation Operations (GO) = 1.7, Transmission = 1.6, and Customer Service & Distribution (CS&D) = 1.3. While these scores may seem low compared to a competence standard of 3, it is important to realize that many North American utilities would rate a 0 (unaware of major Asset Management System requirements) or a 1 (aware of, but not yet developing). In addition, the individual components which make up these average scores ranged from 0.5 to 3.0 corresponding to the fact that while Hydro is fully Competent in some areas, there are others where it is just starting to develop its capabilities.

Against the industry, Manitoba Hydro compares favorably versus North American utilities in terms of its Asset Management maturity level. However, North America lags global Asset Management best practice as embodied by utilities overseas who have been developing their capabilities for more than two decades.

Hydro has followed a typical path along the Asset Management maturity curve by starting with grassroots-led tactical solutions to solve specific problems. As with many utilities, the initial role Leadership played at Hydro with regard to Asset Management has been providing approval and direction when requested. If Hydro seeks to become an asset management-focused company, Leadership will want to place a greater emphasis on the strategic value of asset management, challenge progress within the Business Units, demand accountability for results, and commit the resources needed to achieve its objectives.

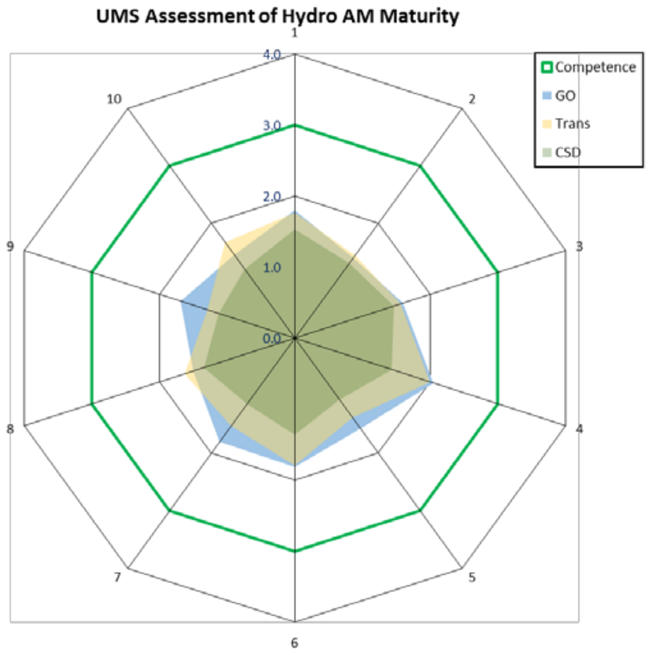
Between the three Business Units, Hydro has developed a number of the key components of best practice asset management such as:

ASSESSMENT

Overall Assessment

UMS Group assessed Hydro against ISO 55000 and best practice asset management using a 0 to 4 scale where 0 = Innocence, 3 = Competence (in compliance with the standard) and 4 = Best Practice.

1	Context of the Organization
2	Leadership
3	Planning
4	Support
5	Operation
6	Improvement
7	Asset Life-Cycle & Risk Strategy
8	Investment Delivery Assurance
9	Performance Management
10	Data Management



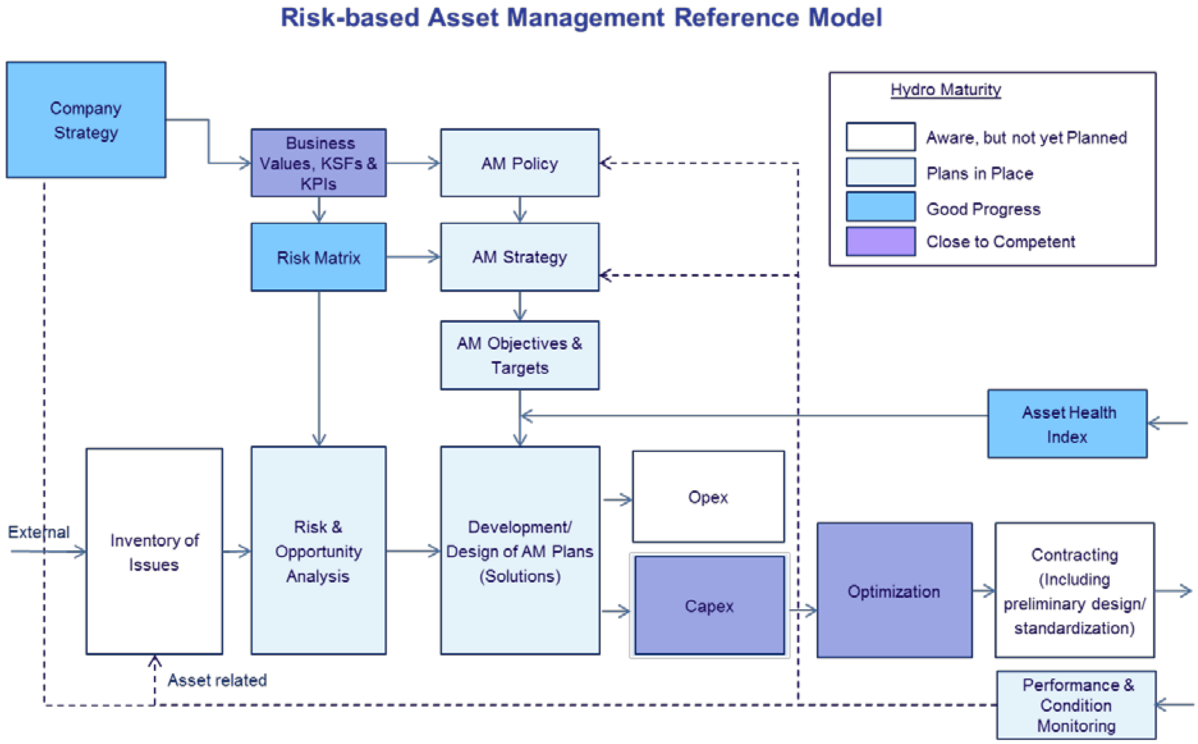
Overall, Hydro scored a 1.5 with the individual Business Unit Scores as follows: Generation Operations (GO) = 1.7, Transmission = 1.6, and Customer Service & Distribution (CS&D) = 1.3.

Each of the 10 domains evaluated has multiple components in which individual scores are averaged. These individual scores ranged from 0.5 to 3, so the averages reflect the fact that while Hydro is Competent in some areas (further described below), it also is missing some key components.

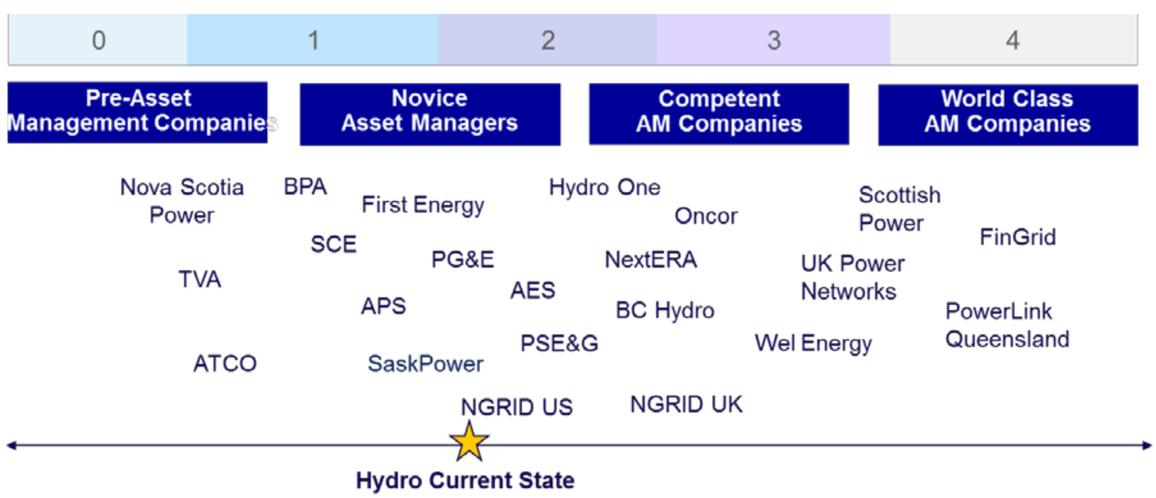
The recommendations provided in this assessment are those that are required to take Hydro to a 3 in every area, which would signify Competence with the ISO 55000 standard. Companies which reach this level, typically push forward towards Excellence (4.0) in a strategic manner where specific areas are targeted for improvement.

The specific level of competence to which Hydro should aspire is a matter for the Corporate Asset Management Executive Council (CAM EC) to determine. While, some of the benefits of Asset Management can be realized with a piecemeal approach, significant improvement only occurs when the entire Asset Management System is functioning at a high level.

The Chart below shows UMS Group's Reference Model for Asset Management. The colored boxes provide an indication of the level of maturity of specific



While its score may seem low compared to a competence standard of 3, it is important to realize that many North American utilities would rate a 0 (unaware of major Asset Management System requirements) or a 1 (aware of, but not yet developing). Overall, Manitoba Hydro compares favorably against North American utilities in terms of its Asset Management maturity level, largely as a result of recent progress made (e.g., Capital Investment Optimization-C55, CVF, Asset Health Indices (AHI), Reliability Centered Maintenance (RCM), Failure Curves, etc.).



Note: The above positions reflect UMS' opinion of the relative AM maturity of each company based on a range of source information.

RESPONSES TO SCHOOL ENERGY COALITION INTERROGATORIES

INTERROGATORY 43:

Reference(s): **Exhibit 2B, Section D, Appendix A**

With respect to the 'Distribution System Plan Asset Management Review':

a) Please provide the retainer agreement and any instructions UMS was given regarding its work.

b) Please provide a copy of the ISO 55001 document that UMS is using to compare Toronto Hydro against.

c) [p.7, 11] Please provide both, the median and average score for each of i) distributor only utilities, ii) transmission only utilities, iii) both, on the 11 ISO 55001 domains that UMS thought were relevant.

d) [p.8] Please provide a list of domains that the UMS did not believe were relevant.

e) [p.11] The Report states: "While these utilities were not specifically selected to represent the industry as a whole, as a consultancy who has performed scores of such assessments, UMS believes that the results are consistent with its qualitative view of asset management maturity across the North American utility industry." What is the basis for this belief?

f) [p.18-21] For each of the domains that Toronto Hydro has been scored against, please provide UMS' assessment of what Toronto Hydro would need to do to achieve level 3 maturity.

RESPONSE (PREPARED BY TORONTO HYDRO):

a) Please refer to Toronto Hydro's response to interrogatory 1B-CCC-8.

RESPONSE (PREPARED BY UMS)

b) The ISO 55001:2014 standard was the basis for the comparison of Toronto Hydro. As this standard is copyrighted by the International Standards Organization (ISO), UMS Group cannot provide a copy. However, the document is publicly available for purchase from the ISO, the American National Standards Institute, and a number of other sellers.

c) There are 3 categories of Asset Management maturity assessment scores which UMS Group used in the Benchmark: Transmission-only, Distribution-only, and T&D-combined (e.g., utilities for which the asset management function is performed for both T&D). The median and average scores for each, as well as for all 14 utilities are included in Table 1 below.

Table 1: Breakdown of Asset Management Maturity Benchmark by Type of Business Unit

	Transmission- only		Distribution - only		T&D - combined		All	
	Median	Average	Median	Average	Median	Average	Median	Average
4.2 Understanding the needs and expectations of stakeholders	2.0	2.0	2.0	2.1	1.6	1.7	1.9	1.9

4.3 Determining the scope of the asset management system	1.5	1.4	1.8	2.0	1.0	1.1	1.5	1.6
5.1 Leadership and commitment	1.3	1.2	1.8	1.7	1.8	1.8	1.5	1.6
5.3 Organizational roles, responsibilities and authorities	1.2	1.2	1.8	1.9	1.3	1.3	1.3	1.4
6.1 Actions to Address Risks and Opportunities	1.7	1.6	2.0	2.1	1.6	1.6	1.8	1.8
6.2 Asset Management Objectives and Planning	1.6	1.5	1.8	1.8	1.9	1.8	1.7	1.7
7.1 Resources	1.8	1.8	1.8	1.8	1.6	1.7	1.6	1.7
7.5 Information Requirements	2.3	2.1	1.9	1.8	1.4	1.3	1.9	1.7
8.1 Operational Planning and Control	1.2	1.1	1.6	1.7	1.4	1.4	1.4	1.5
9.1 Monitoring, Measurement, Analysis and Evaluation	1.5	1.5	1.3	1.4	1.0	1.0	1.3	1.3
10.3 Improvement	2.0	1.8	1.8	1.7	1.4	1.4	1.8	1.7

d) The following domains are those of the ISO 55001 standard which were <u>not</u> assessed: 4.1 Understanding the organization and its context, 4.4 Asset management system, 5.2 Policy, 7.2 Competence, 7.3 Awareness, 7.4 Communication, 8.2 Management of Change, 8.3 Outsourcing, 9.2 Internal Audit, 9.3 Management Review, 10.1 Nonconformity and Corrective Action, 10.2 Preventive Action.

e) The basis for UMS Group's belief that the results from the sample of 14 utilities are consistent with and representative of the asset management maturity of the North American utility industry is our interaction and work with scores of these utilities. While not all of our engagements encompass a comparative assessment of asset management maturity, and therefore were not included in the benchmark, many of them include targeted work in asset management. We also interact with scores of other utilities, who may not be our clients, on a professional level at various conferences and forums. Both these targeted engagement and non-engagement interactions provide us with insight into the maturity level of specific domains for a broad swath of North American utilities, which informs our qualitative view of asset management maturity.

f) The ISO 55001 Standard requires Competence (a maturity level of 3 in all domains) to be both demonstrated and documented, and the determination of Competence requires a complex, detailed assessment of a number of interrelated factors. This makes it difficult to provide a list of recommendations, which if made, would guarantee achievement of a maturity level of 3. However, in the interest of being responsive to the question, Table 2 below provides a high-level recommendation of what Toronto Hydro needs to be able to achieve level 3 maturity in the 11 assessed domains. In most cases, Toronto Hydro has in place, or in development, most of the capabilities required for achieving Level 3 maturity. However, validation of this maturity requires that a ***documented*** process be available for the assessor to evaluate. Therefore, the biggest gap is for Toronto Hydro to document its Asset Management objectives, strategies, and processes as required by the ISO 55001 standard.

Table 2: Achieving Level 3 Maturity

ISO 55001 Section	Actions to Achieve Level 3 Maturity
4.2 Understanding the Needs and Expectations of Stakeholders	Formally document the process for managing stakeholders in a Strategic Asset Management Plan (SAMP) along with the stakeholder analysis and signed approval of the decision-making criteria
4.3 Determining the scope of the AM system	Formally document, as part of or linked to the SAMP, the criteria and rationale for determining which assets are part of the AM system; the AM Policy, and AM Objectives, the asset portfolio covered by the asset management system; and the boundaries/interfaces between the AM system and the other management systems used by Toronto Hydro.
5.1 Leadership and Commitment	Develop a formal SAMP, AM Objectives, and AM Performance Measures, so Leadership can confirm they are compatible with the organizational objectives, as well as that AM system supports delivery

	of the SAMP. Develop a formal plan for communicating the asset management objectives and the importance of the AM system to stakeholders.
5.3 Organizational Roles and Responsibilities	Formally document roles and responsibilities for ensuring 1) creation and update of the SAMP, delivery of the SAMP; 2) the asset management system conforms to ISO 55001, and 3) creation and update of AM Plans.
6.1 Actions to Address Risks and Opportunities	Develop a formal AM Policy and ensure adherence to that Policy in Planning. In assessing risk, consider risks to the AM system in addition to risks to the assets or asset performance.
6.2 Asset Management Objectives and Planning	Create a SAMP which 1) identifies the process for designing, implementing and reviewing asset management objectives, and linking asset management objectives to organisational guidance and objectives; 2) documents the relationship between corporate guidance and directives to actions; and 3) describes how the AM objectives are monitored and the metrics to ensure performance against the objectives.
7.1 Resources	Document in the SAMP the resources required to implement and maintain the asset management system; the competencies required to implement and maintain the asset management system; and the roles and responsibilities to implement and maintain the asset management system. Establish a process to measure performance against the SAMP and track compliance
7.5 Information Requirements	Create formal data governance and data management processes to ensure that the information requirements of the AM system have been adequately identified and that information is being adequately managed
8.1 Operational Planning and Control	Develop and document a formal process for ensuring that the asset management system is being operated per the criteria established in the SAMP.
9.1 Monitoring, Measurement, Analysis and Evaluation	Document in the SAMP the process for setting quantitative and qualitative performance metrics including leading and lagging indicators; identifying patterns and behaviours that enable improvement activities; and ensuring alignment between performance indicators. Metrics should be established for asset management performance and asset management system performance.
10.3 Improvement	Establish, implement and maintain a formal process for determining opportunities and assessing, prioritizing and implementing actions to achieve continual improvement and reviewing their subsequent effectiveness.