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June 1, 2018

Robert Laking, Chair
Yukon Utilities Board
Box 31728
Whitehorse, YT Y1A 6L3

Dear Mr. Laking:

Re: Yukon Energy Corporation 2107/18 General Rate Application – Rebuttal Evidence

Pursuant to the process and schedule set out in Order 2018-03, please find attached Yukon Energy's rebuttal evidence regarding the intervenor evidence filed by City of Whitehorse on April 20, 2018.

Yours truly,

Ed Mollard
Chief Financial Officer

Attachments

YUKON ENERGY REBUTTAL EVIDENCE

1.0 INTRODUCTION

On April 20, 2018 the City of Whitehorse (CW) filed Intervenor Evidence by Mr. Russ Bell (the "CW Evidence") with the Yukon Utilities Board (YUB or the Board).

Yukon Energy Corporation (YEC or Yukon Energy) is submitting this rebuttal evidence in response to the CW Evidence and the CW responses to interrogatories on Mr. Bell's evidence.

The CW Evidence focuses mainly on assertions that the Yukon Energy 2016 Resource Plan did not appropriately consider the effects that the introduction of what the CW Evidence calls "disruptive technology" could have in the future, noting that the GRA appears to have been prepared "with the assumption that there will only be technological changes that it will implement on its Grid and not changes that the end use customer may implement." [1]

In summary, this rebuttal covers the following issues that are addressed in the CW Evidence:

- The Yukon Energy Capital Program & Disruptive Technology;
- Yukon Energy Grid Load Forecast;
- Vegetation Management Policy;
- Diesel Contingency Fund; and
- Total Labour and Cost per FTE.

2.0 YUKON ENERGY CAPITAL PROGRAM & DISRUPTIVE TECHNOLOGY

2.1 CW EVIDENCE

The CW Evidence notes that the majority of the GRA test year cost increases relate to increased capital and amortization of deferred charges, and indicates concern (page 4) that "investment in utility assets commits the utility and its customers to increasing rates almost in perpetuity".

Further, the CW Evidence notes concern (page 5) that "If there is a major disruptive technology, there is the distinct possibility that there will be stranded assets that will be unrecovered".

The CW Evidence states (page 6) that the Resource Plan Section 8 portfolio analysis does not appear to consider potential for extensive use of micro generation, micro storage and micro grids, and subsequently (page 9) states: "What is missing [from the 2016 Resource Plan] is an analysis of the impact on YEC decisions and on customer rates if there is a significant switch to new technology by end use customers, resulting in significantly reduced loads and demands."

The CW Evidence concludes on this matter (page 9) that without this missing analysis, the 2016 Resource Plan "is not a reliable assessment of future needs for capital" and "[a]ccordingly, the costs of the study should be excluded from rates."

[1] CW Evidence, page 1-2.

2.2 YEC REBUTTAL

2.2.1 GRA Capital Plan

YEC's August 3, 2017 "Summary and Overview of Application" presentation (at workshop review of the Application) highlighted (slides 24 to 28) the importance of rate base growth as a driver for cost changes in this GRA.

In summary, capital related cost increases in this GRA are required for sustaining capital, projects constructed and in service, capacity planning requirements (to ensure dependable capacity as required by recommended capacity planning criteria), or deferred costs related to prior planning and/or Board directions following the last GRA.

The following are noted in this regard (see Attachment B for added information):

- Capital project PP&E spending of $35 million was for two capacity-related projects (LNG Plant and Whistle Bend Supply/Takhini Upgrade) completed in 2015;
- A further $25 million was for eight sustaining capital projects completed from 2015 to 2018 to sustain existing plant and equipment.
- Deferred charges included an increase of $9.8 million for DSM[2], the 2016 Resource Plan Update and the Gladstone Diversion Project[3] (each related to planning for future generation and transmission requirements); a further $8.3 million was added to rate base in 2017 and 2018 from other deferred projects, plus $6.3 million for deferred overhauls and about $6.6 million of other deferred costs.

2.2.2 2016 Resource Plan & Disruptive Technology

The CW Evidence focuses on the spectre of what Mr. Bell calls "disruptive technology" but provides no guidance regarding how Yukon Energy or the Board should reasonably respond to this stated dilemma[4].

- In response to YUB-CW-2, disruptive technology is defined by CW, and in that regard the potential impacts of micro generation and micro grid technology are specifically highlighted with regard to electric utility risks.
- However, in response to YUB-CW-4, Mr. Bell says it is not possible for him to make specific recommendations at this time, beyond suggesting "it would seem prudent to consider the potential for disruptive technology, even in a scenario where total load and peak load is reduced by factors such as 10%, 20%, or more later in the term of the resource plan." Further, in response to UCG-CW-5(a), Mr. Bell states that he cannot calculate the impact of any potential change.
- In response to YUB-CW-5, Mr. Bell does not agree that there is a trade-off when balancing the need for utility infrastructure versus minimizing risks of stranded assets due to the potential for new

[2] Directed to be retained in WIP in Order 2013-01 following the 2012/13 GRA. Para 367 notes "Until the plan is filed, the Board directs that: a) YEC create a deferral account wherein DSM O&M related costs are to be held, and b) all DSM-related capital costs be held in WIP."

[3] Directed to be retained in WIP in Order 2013-01 following the 2012/13 GRA. Para 344 notes "The Board finds that Gladstone hydro enhancement project has potential to be a viable project and directs that all project expenditures be held in WIP until the project is completed. Moreover, YEC is to cease work on this project if and when YEC concludes that there is no net economic benefit of the project to ratepayers".

[4] In the response to UCG-CW-4(b), Mr. Bell admits that he does not have any ways to ensure that there will be no stranded assets.

technology – Mr. Bell states (without further explanation) "there is an obligation for utility management to think differently when assessing investments in long lived assets." Mr. Bell asserts that the possibility of stranded assets increases if there is no recognition of possible changes – and then he also states: "At this point, it is not possible to predict disruptive technology" and "[i]t is not possible to predict the timeframes for any disruptive technology."

- In addressing the 2016 Resource Plan, the CW Evidence acknowledges that the 2016 Resource Plan references (at Part 2, pdf page 122) uncertainty over distributed electrical generation technologies and the related risk of increased rates caused by reduced load. The concern expressed by the CW Evidence is the absence of any specific portfolio analysis in the Resource Plan to address this specific risk, yet the CW Evidence cannot provide any guidance as to any clear scenario that merited attention in this regard.
- In contrast, the 2016 Resource Plan did consider electric cars as a technology that had future potential to impact Yukon grid load and energy requirements (see Appendix 4.5 of the 2016 Resource Plan [Electric Vehicle Investigation] and "EV Sales" were considered in the 2016 Resource Plan forecasts (highlighting the extent to which this factor would develop slowly over the 20-year forecast period).

Accordingly, based on present circumstances and reasonably foreseeable trends, longer term risks related to "disruptive technology" are not sufficiently defined at this time to merit changes to any of YEC's capital plans for the GRA test years or for the coming five year period or to modify the 2016 Resource Plan portfolio options and assessments (beyond noting, as the Resource Plan notes, that such risks, if materialized, would result in lower energy loads and higher rates in the future than would otherwise occur)[5].

As a result, there is no basis for dismissing the 2016 Resource Plan – or disallowing any of its costs - based on its treatment at this time of so-called "disruptive technology" risks[6].

Finally, in addressing the GRA, the CW Evidence acknowledges in response to UCG-CW-3 that the utility "is entitled to a reasonable opportunity to recover prudently incurred costs" and that "there is an increasing cost to maintaining grid connected customers." The CW Evidence offers no guidance on which capital costs (incurred or planned) would not be considered prudent in light of concerns about potential disruptive technology.

[5] Each "resource plan" is a living document - resource plan forecasts are continuously reviewed and updated and the overall plan is subject to update on a 5-year planning cycle. This iterative process allows for load and other risks to be considered and addressed on a timely basis as they arise.

[6] If overall Yukon grid load is at some time in the future materially impacted by customers pursuing self-generation it is likely that customers that choose to self-generate will still require the Yukon grid to provide stable back up generation and capacity, i.e., there will be an ongoing requirement to maintain a reliable and dependable grid, with related dependable generation, transmission and distribution facilities able to supply peak grid requirements. Further, the most likely impact would be to reduce (on an intermittent basis) energy generation requirements below what would otherwise be required, particularly during summer or other periods outside the winter peak load period. If this were to occur mitigation of this risk would presumably include restricting new utility investment in capital-intensive renewable generation assets in favour of investment in new generation assets that could be effectively shut off when there is no requirement for generation [but that would be available to provide backup or capacity as required], i.e., thermal generation.

3.0 GRID LOAD FORECAST

3.1 CW EVIDENCE

The CW Evidence raises the following concerns regarding YEC grid load forecasts in resource plans and the GRA (beyond concerns noted above relating to the absence of any load forecasts based on disruptive technology impacts):

- A pattern of load divergence between both versions of the 2011 Resource Plan and actual load, and between the 2016 Resource Plan and the GRA, cast doubt on the veracity of the sales forecast in the Resource Plan (Q13, pages 7 and 8).
- There is a disconnect between wholesale consumption forecasts for AEY and YEC (Q18, page 10); there appears to be only a cursory understanding by YEC of the customer (AEY) and its needs and expected sales (Q20, page 11); Mr. Bell recommends that the latest approved wholesale sales forecast be included in the YEC application (unless YEC has more recent information to support its forecast), and that it is incumbent on YEC to work closely with AEY in developing wholesale sales forecast (Q21, page 12; also UCG-YEC-1-7(a) and YUB-CW-1-6).

3.2 YEC REBUTTAL

3.2.1 Resource Plan Load Forecast [Long Term vs. GRA Forecast]

The CW Evidence regarding divergences between resource plan forecasts and actuals and/or GRA forecasts ignores the practice that YEC uses with regard to these forecasts.

YEC's load forecasts provided in each resource plan reflect changes in response to new information since the previous resource plan, particularly as regards industrial loads.

In contrast, GRA forecasts are prepared separately from resource plan forecasts, and are based on the best information available at the time that the GRA is prepared. It is important to emphasize that YEC in preparing a GRA bears the risks related to its load forecast which are not typically updated during a GRA proceeding.

Attachment A, Section 1 provides a more detailed review of 2011 and 2016 resource plan forecasts, as well as actuals where relevant, and the current GRA forecasts as referenced by the CW Evidence. In summary, the impact of industrial load changes has been material – and will continue to be highly relevant in Yukon, underlining the need for ongoing updates to reflect the best available information for each GRA and/or resource planning decision.

3.2.2 Wholesale Load Forecast [AEY vs YEC Forecasts]

Variances in wholesale forecasts between YEC and AEY in the companies' two GRA processes reflect variances in forecast approach (re: determination of weather normalized loads) as well as changes due to YUB direction (as provided in Order 2017-01 regarding the AEY GRA).

It is important to emphasize that Yukon Energy and AEY do communicate regarding wholesale forecast assumptions – however, as noted below, additional communication with AEY would not have led to more accurate YEC wholesale forecasts for this GRA (i.e., AEY approved forecasts were materially affected by Board direction in Order 2017-01 and overall actual results were materially impacted by weather).

In any event, in response to YUB-YEC-1-3, YEC provided an adjusted 2017 and 2018 wholesale forecast that was consistent with the adjusted 2017 AEY purchase power forecast included in the approved AEY Compliance Filing [approved by Order 2017-03].

Attachment A, Section 3 reviews recent history regarding YEC and AEY forecasts for firm wholesale consumption on the grid, including outcomes of Board decisions. The following key points are noted regarding the 2017 forecast included in YEC's 2017/18 GRA:

- The AEY 300.3 GW.h 2017 wholesale forecast 2017 included in its 2016/17 GRA was based on a modified method for weather normalization using a short term approach with 3 years of data that reflected recent warm weather[7].
- YEC developed its 2017 wholesale GRA forecast at 309.0 GW.h, reflecting a longer-term weather normalization approach and review of the AEY GRA filings (see Attachment A, Section 3).
- In AEY's GRA the Board directed AEY to change its forecast to reflect a longer weather data period. This direction resulted in AEY final approved Compliance Filing forecast of 314.2 GW.h for 2017[8]. Approval of this filing was subsequent to the filing of YEC's 2017/18 GRA.
- After AEY's Compliance filing - in response to YUB-YEC-1-3 - YEC filed an adjusted 2017 and 2018 wholesale forecast to ensure that its 2017 wholesale forecast is consistent with the YUB's approved AEY purchase power forecast for 2017 (314.2 GW.h). YEC noted in its response that YEC did not have the information AEY used to prepare AEY's Compliance Filing forecast (including the 2017 forecast by month) and therefore its response was subject to refinement in YEC's Compliance Filing at the end of the YEC GRA process.

It is also worth noting that actual AEY wholesales for 2017 were higher (at 328.4 GW.h)[9] than any of the above forecasts, including the forecast approved for the AEY Compliance Filing. Available evidence suggests that weather was a key factor in explaining actual results that were well above forecast in four winter months.

4.0 VEGETATION MANAGEMENT POLICY

4.1 CW EVIDENCE

The CW Evidence states the following regarding vegetation management (Q17, pages 9 and 10):

- Vegetation management is the largest increase in YEC operating costs;
- YEC appears to have developed the YEC Vegetation Management policy with minimal input from other utilities, and Mr. Bell would have expected that other utility policies and practices should have been used to develop YEC policy. (In response to YUB-CW-1-1, Mr. Bell states concern that

[7] See Order 2017-01 para 22. AEY proposed in its application to update the timeframes used to determine the weather-normalized UPC. The existing methodology [from 2013-15 GRA] used longer time period [15 years of regression data for UPC and 20 year average for "normal" HDD]; the proposed methodology for 2017/18 used only the last three years of data.
[8] At para 40 the Board directed AEY in its compliance filing, to refile its sales and revenue forecast, incorporating its prior methodology [used in the 2013-15 GRA] using a 10-year timeframe for UPC regression and normalizing HDD.
[9] See response to CW-YEC-2-1, and UCG-YEC-2-28(a).

YEC's vegetation management policy was developed without adequate research into other utility policies and practices, and that YEC "should have canvassed other similar utilities in an assessment of its policy" and "from the YEC evidence, it appears that YEC did not undertake such due diligence."); and

- Mr. Bell recommends that YEC be directed to compare its vegetation management policy to other utilities and provide a report in the Compliance Filing; if the report proves that YEC's policy drives costs that are higher than required, Mr. Bell recommends that the budget for vegetation management should be reduced.

4.2 YEC Rebuttal

Mr. Bell's assessment ignores relevant history on this matter and his conclusion that YEC has not undertaken due diligence with regard to the vegetation management policy is not correct[10]. Further, it is not appropriate to recommend a process for filing a report in a compliance filing that would then be used to modify the allowed revenue requirement for the test years.

A more thorough review of history regarding this matter is provided below.

In Order 2008-09 Yukon Energy was directed by the Board to develop a comprehensive brushing policy. Yukon Energy undertook an independent study of current brushing practices in order to identify opportunities to enhance the program management, reliability and cost effectiveness. Relevant studies were undertaken in 2010[11].

At the time of the 2012/13 GRA filing Yukon Energy was in the process of field testing the recommendations arising from the study in order to assess which recommendations worked best, with testing expected to be completed in 2012 and development of a formal brushing policy expected in 2013.

This was reviewed in detail in Tab 6 and Appendix 12.1 and 12.2 of the 2012/13 GRA [provided as Attachment C to this Rebuttal Evidence]. Specifically, Yukon Energy participated in a jointly-funding multi-utility survey of best practices in brushing conducted by CEATI International Inc.[12]; and retained Environmental Consultants Inc. (ECI) to complete a survey of its transmission / sub-transmission rights of way and a review of the vegetation management program. The ECI study also provided recommendations for Yukon Energy to consider implementing to enhance the quality of the vegetation management program based on industry best practices.

The Board also recognized the work undertaken by YEC in advance of the 2012/13 GRA filing in Order 2013-01 noting as follows at para 96 and 97 of the Order [footnotes omitted]:

> YEC stated in the Application that in compliance with Board Order 2009-8, YEC undertook a brushing survey of North American utilities on industry best practices and commissioned a quantitative audit and assessment of their vegetation control practices with the objective of

[10] The evidence references the response to CW-YEC-1-29. This response focused on the final stage of development of the policy document, but did not detail the extensive process and studies undertaken by YEC leading up to the development of the brushing policy, but noted "In addition, the policy reflects a review of brushing practices which was reviewed in the 2012/13 Application".

[11] See 2012/13 GRA, Tab 6, page 6-8 and 6-9 as well as Tab 3, page 3-8 and 3-9. Tab 3, page 3-8 and 3-9 notes "YEC undertook a brushing survey of North American utilities on industry best practice. As well, the company commissioned a quantitative audit and assessment of our vegetation control practices with the objective of developing a cyclical brushing strategy which met YEC's goals of cost effectiveness, safety and security of energy transmission."

[12] Shortly after filing the 2012/13 GRA it was noted that the CEATI International Inc. study was considered confidential and could not be provided on the record of the GRA proceeding.

developing a cyclical brushing strategy. The survey which was conducted by the Centre for Energy Advancement through Technological Innovation (CEATI) International cost $0.025 million. The audit and assessment work done by Environmental Consultants, Inc. (ECI) cost $0.105 million with an additional $0.027 million in helicopter fees for aerial surveys. The two studies were attached to the Application as Appendix 12.1 and Appendix 12.2.

YEC submitted that the estimate for the 2012 brushing costs was based on testing the recommendations in the ECI study and that the results of this work would form part of the brushing policy to be developed in 2013.

In summary, the overall process leading to the current Vegetation Management policy displayed ample and appropriate due diligence, including adequate research into other utility policies and practices with involvement of jointly funded external expertise. There is no need for any further reporting or review to compare YEC's vegetation management policy to other utilities.

5.0 DIESEL CONTINGENCY FUND

5.1 CW EVIDENCE

The CW Evidence states (Q22, page 12) that the use of the Diesel Contingency Fund (DCF) appears to be loosely defined, with YEC ability to use the DCF to offset management decisions and with "the impact of significantly reducing the risks facing YEC". Mr. Bell concludes that this should result in a reduction in any requested return on equity premium, or "the permitted reasons for use of the DCF should be restricted to things that cause the use of diesel generation that are beyond the control of management."

YUB-CW-7 provides the following additional CW evidence on the DCF:

- **Deferral Accounts Reducing YEC Risk and ROE (sub "a-c")**
  - "In saying that inclusion of the DCF as currently structured should result in a lower risk and lower ROE, Mr. Bell is recognizing that the pervasive nature of the DCF results in lower risk to YEC. Mr. Bell suggests that the previously approved ROE of 8.25% would be adequate."
  - Mr. Bell separately states that YEC's risk premium "must be reduced" to the extent that YEC has more costs (as a percentage of revenue requirement) subject to deferral treatment than the utilities considered in the BCUC cost of capital proceeding - and Mr. Bell lists several YEC items that he views as deferral accounts (including DFPVA, deferred LNG price variance, DCF, RFID, Vegetation Management Deferral Account, ERA, and Regulatory Hearing Deferral Account).
- **Limits on DCF (sub "d-h")**
  - "Mr. Bell does not agree that YEC should have a deferral account that covers all variances in the hydro generation forecast due to variances in water levels".
  - The CW response states that a deferral account must be structured in a manner that is consistent with the way that the GRA costs are developed, not provide an opportunity for the utility to earn additional returns, address costs that are material with little or no

ability for management to forecast or to control, and the structure of the deferral account must be as simple and straight forward as possible.

- Mr. Bell understands that current GRA rates are set using LTA hydro generation, but notes evidence regarding DCF cap and Rider E impacts that end up sending a form of short-term price signal "making it difficult to choose between a deferral account based on short term forecasts of hydro generation and water levels, or one based on long term averages."
- Mr. Bell supports a simplified deferral account for variances in the hydro generation forecast due to variances in water levels similar to the diesel deferral account proposed by AEY in the YEC-YECL DCF-ERA proceeding that led to the decision in Board Order 2015-01; however, aside from referencing the benefits of a simple approach where possible, Mr. Bell does not explain this support.

5.2 YEC REBUTTAL

Mr. Bell addresses separately DCF issues related to YEC risks and ROE, versus DCF issues related to the deferral account mechanism. These two sets of issues are addressed separately below in YEC's rebuttal.

5.2.1 DCF Impacts on Risk & ROE

Mr. Bell's broad assertion that DCF risk mitigation for YEC justifies a lower ROE, let alone a ROE of 8.25%, does not consider past Board decisions on YEC's ROE.

From the late 1980s, it has been understood by all stakeholders, and more specifically the Board, that the risk of low water conditions (as regards added costs for thermal generation) is to be borne by the customers of the utility. A reserve or deferral account mechanism to implement this risk assignment has been in place since that time[13]. Further, the existence of such a reserve has never been suggested by any stakeholder as a basis to justify a lower ROE nor has the Board ever considered it as a basis for a lower ROE.

Based on normal principles established in Canada for regulation of hydro utilities, there is simply no basis for Mr. Bell to suggest that risk of low water conditions should be borne by YEC - or that YEC's ROE should be reduced when a deferral account assigns this risk to ratepayers[14].

Mr. Bell's simple reference to the prior approved ROE of 8.25% for YEC's 2012/13 GRA does not support a lower ROE for YEC due to the DCF. As reviewed in Section 8.1 of YEC's GRA Application, the Board in Order 2013-01 determined a fair return for YEC based on the AUC benchmark ROE of 8.75% less the 0.5% as directed by OIC 1995/90.

Board decisions on ROE for AEY and YEC are typically based on BCUC benchmark ROE plus a risk premium and without any reference to a reduction due to the DCF (see recent Order 2017-01 for AEY GRA, as well as prior Board Orders regarding YEC's GRA applications for 1998 rate revision [the DCF was first approved in 1997 GRA], 2005[15], and 2008/2009[16]).

[13] See response to YUB-YEC-2-2(c).
[14] See response to YUB-YEC-2-9(e).
[15] Order 2005-12.
[16] Order 2009-8.

Mr. Bell is also not accurate in his review of YEC deferral accounts in response to YUB-CW-7 (c). Except for the Vegetation Management Deferral Account (directed in Order 2013-01) and the Regulatory Hearing Deferral Account (which CW recommended be established during the 2012/13 GRA) actual YEC deferral accounts have been in existence for many years, and there is no basis for now suggesting any ROE reduction for YEC related to YEC's actual deferral accounts.

Specific comment on each of the accounts noted by Mr. Bell is provided below:

- **The Diesel Fuel Price Variance Account** (DFPVA) - Historically, a fuel adjustment mechanism has been in place in Yukon to provide for stability relative to swings in fuel prices since before the NCPC transfer in 1987. Fuel adjustment provisions in use today (as set out in OIC 1995/90) have continued to be included in Yukon rate policy since the transfer of NCPC assets to Yukon. The authorization for these provisions has been granted via successive Orders in Council in place since 1988 (OIC 1988/150, OIC 1991/62 and current rate policy OIC 1995/90). Historically, both Companies have established and used a Deferral Fuel Price Variance Account (DFPVA) for tracking transactions relative to operations and accounting for deferred fuel price variance has no effect on the net earnings of the utility. Ratepayers pay final rates that reflect the actual fuel costs per litre incurred by the Companies, regardless of GRA forecast prices.
- **Deferred LNG Price Variances in Amounts Collected (or Refunded) to Customers -** With the introduction of LNG to the Yukon Grid the DFPVA needs to be updated to include changes in LNG thermal generation cost changes. Adjustments to account for LNG fuel price changes along with diesel fuel prices changes have not yet been approved by the Board.
- **Diesel Contingency Fund –** As reviewed earlier in this rebuttal, the DCF as established in the 1997/98 GRA recognizes that thermal generation cost impacts from water availability changes are to be borne by ratepayers - and that the DCF in combination with LTA hydro forecasts for GRA test years is designed to smooth out rate impacts over the long-term related to annual water availability variances. Prior to the DCF, other reserve account mechanisms also assigned this cost risk to ratepayers. Yukon Energy retains thermal generation cost risks related to load growth.
- **Reserve for Injuries and Damages** – The Reserve for Injuries and Damages (RFID) is an account maintained as approved by the Board, in order to address uninsured and uninsurable losses as well as the deductible portion of insured losses. This long-standing reserve serves two purposes: (1) it allows for a balance to be struck between purchasing additional insurance vs. using a self-insurance type approach via the RFID; and (2) it allows the costs of unforeseen events to be smoothed out over a number of years to avoid rate instability for ratepayers.
- **Vegetation Management Deferral Account –** Order 2013-01 directed "for the period beyond the test years (future years)" ... to create a transmission vegetation management deferral account. In future years, distribution and transmission vegetation management-related costs greater than 2011 actual brushing costs are to be held in the newly created vegetation management deferral account." YEC created and deferred costs to this account for the period beyond the 2012/13 test years and prior to the 2017/18 test years. YEC in this GRA is seeking to have these costs approved [and YEC is still subject to risks related to the Board not approving these costs as part of this GRA], but is not seeking ongoing approval of the vegetation management deferral account. Consequently, risks related to vegetation management are not being transferred to ratepayers.

- **Energy Reconciliation Adjustment (ERA) –** The ERA is not a deferral account. It is part of the wholesale rate charged to AEY. It does not transfer forecast risk to Yukon retail or industrial ratepayers. The Board must review and approve any ERA charges to YECL – to the extent that such charges are not approved YEC is at risk.
- **Regulatory Hearing Deferral Account** - Yukon Energy established a Hearing Cost Reserve Account in accordance with the direction provided in Board Order 2013-03 and based on concerns raised by CW regarding the prior approach to forecasting and amortizing hearing expenses as part of the GRA test years. The account in effect ensures that YEC must assign an expense each year for payment to this account (versus prior practice of only amortizing actual expenses over a prescribed period). This account does not mitigate YEC risk but ensures that only hearing costs as approved by the Board are included in rates [YEC retains risk related to hearing costs that it incurs that are not approved by the Board and these risks are not passed to ratepayers].

5.2.2 DCF Deferral Account Mechanism

Mr. Bell does not recognize that the DCF deferral account is in fact structured in a manner that is consistent with the criteria that he sets out in response to YUB-CW-7(d and f), more particularly:

- It is structured in a manner consistent with the way that the GRA costs are developed (i.e., using LTA hydro generation);
- It does not provide an opportunity for the utility to earn additional returns;
- It addresses costs that are material with little or no ability for management to forecast or to control; and
- The structure of the deferral account is as simple and straight forward as possible in the current circumstances and given the objective to smooth out over the long term water variability impacts on rates.

Mr. Bell notes only two specific concerns regarding the DCF mechanism, each of which is addressed below:

1. **YEC management's ability to use the DCF to offset management decisions (including the decision to enhance winter storage and alter system operations):**

   YEC has addressed the question of potential management decision impacts on DCF determinations in response to AEY-YEC-2-1 (2017/18 GRA Proceeding) and YUB-YEC-1-5 (ERA Part 1 Proceeding), confirming that the DCF is addressing water variance impacts outside management control in as simple and straight forward a structure as possible.

   Summary points on this issue include:

   a. The DCF provides a consistent and reasonable basis to separate thermal generation cost variance due to water and wind availability (to be borne by ratepayers) from thermal generation cost variance due to changes in total grid load (to be borne by the utilities).

   b. The DCF also addresses where feasible all potential operational risks that could affect thermal generation risks, removing specific non-water-related thermal operation risks, e.g., risks related to RFID events, capital projects, thermal unit fuel efficiencies, and (as proposed for the first time in the current Application) thermal generation maintenance and run-up requirements.

c. YEC is not aware of any consistent and reasonable way to isolate operation risks related to use of water for hydro generation to the extent that these may impact thermal generation costs. Such isolation has not been attempted in either the Low Water Reserve Fund (LWRF) or the DCF[17].

d. Further, as noted in the response to YUB-YEC-1-6(b) (ERA Part 1 Application), YEC has well established systems to monitor its use of available water, and is not aware of any material impacts on the effectiveness of LWRF or DCF determinations related to the water management element of its systems' operation.

2. **DCF cap impacts can make it difficult for DCF rate impacts to reflect LTA forecasts**:

   In response to this CW concern, YEC notes that the issue if the DCF cap is separate from the overall DCF structure and its charges or rebates to YEC, i.e., the DCF cap simply affects when funds are paid out from the fund to ratepayers and/or ratepayers are charged extra amounts to replenish the fund.

   Further, as reviewed in Appendix 3.4 of the Application (Attachment 3.4.4), concerns related to the DCF cap impacts can be addressed by simple changes to the existing caps.

In contrast to the above, there is no apparent basis for Mr. Bell's support of a simplified deferral account for variances in the hydro generation forecast due to variances in water levels similar to the diesel deferral account proposed by AEY in the YEC-YECL DCF-ERA proceeding that led to the decision in Board Order 2015-01.

Not only was AEY's proposal in that earlier proceeding not approved by the Board, it is not consistent with certain of Mr. Bell's criteria:

- The "simplified deferral account" as proposed by AEY accounted for all differences between forecast and actual diesel generation costs, regardless of the cause. As such, it did not attempt to separate out any cost impacts related to management forecast of grid loads or operation of the system - and therefore would not be compliant with Mr. Bell's stated criteria or concerns.
- The Board in Order 2015-01 (section 2.3.1.4 of Appendix A) was clear that the utilities alone should bear the risk for thermal cost variances due to variances from forecast total generation requirements (noting thermal zone communities as one example where this applies and hydro generation does not exist), while also noting that all parties agree that hydro generation risks related to water lie with the ratepayer. The Board's concerns regarding the simplified deferral account as proposed by AEY included:
  - No party opposed a fund related to water level variances, and this causal factor is not directly addressed in the simplified deferral account, i.e., the proposal merely accounts for changes from forecast to actual for diesel volumes, regardless of cause.
  - The simplified proposal shifts forecast risk for diesel volume from the utility to ratepayers.

[17] See responses (ERA) to YUB-YEC-1-6(b) and YUB-YEC-1-5(b).

  - It is not clear that the simplified proposal is limited to the hydro grid. If the proposal extends beyond the hydro grid, "then the shifting of risk from the utility to the ratepayer is even more unreasonable."

- In contrast to the simplified deferral account as proposed by AEY, the DCF and prior contingency funds approved by the Board retained YEC responsibility for forecast thermal generation fuel cost variance due to total generation load variance from GRA forecast.

6.0 TOTAL LABOUR AND COST PER FTE

6.1 CW EVIDENCE

The CW Evidence states (Q23, page 13) that there is no place in a YEC Application to see total labour and cost per FTE. CW provided a table example from Alberta minimum filing requirements, and suggested that YEC file a similar table in future applications.

6.2 YEC REBUTTAL

YEC's Application provides the following information on total labour and cost per FTE:

- Table 3.3 shows total labour cost for each year (including history), and Table 3.4 shows employee complement (FTE) by year (including history). The text related to the tables reviews the overall changes for labour and FTE cost requirements, including head count, labour rates, and capital/ maintenance allocation of labour and changes by department.
- Tables 3.5 to 3.9 show labor cost separately for production, transmission, distribution, general operating and maintenance, and administration.

YEC has ability to report on added breakouts of labour as regards labour, fringe, contract and other costs. However, YEC does not use the other categories suggested (Direct, Isolated, General) and the evidence filed does not adequately explain the nature of these categories sufficient to allow YEC to determine if existing systems and practices can accommodate this structure. It is similarly unclear how these categories will assist the Board in assessing the adequacy of the evidence beyond what is already provided.

Attachment A

ATTACHMENT A

This attachment provides details of the basis for the Yukon Energy Grid Load Forecast.

The CW Evidence focuses on load forecast related issues exploring the following concerns:

- Pattern of divergence in load in the previous Resource Plan.
- 2016 Resource Plan has no scenario with significant penetration of what it calls "disruptive technology", which it says could result in significant reductions in annual load and peak demand.
- Differences between AEY purchased power and YEC wholesale forecast forecasts.

Further evidence on each of these concerns is provided in the sections that follow.

A1: 2006 AND 2011 RESOURCE PLAN LOAD FORECAST VS ACTUALS

The CW evidence indicates that there is a pattern of load divergence between the 2011 Resource Plan load forecasts [including the July 2012 forecast and November 2012 update] and actual load.

CW evidence provides the 2006 Resource Plan load forecast in its comparison table.

Table A-1: Comparison Table Included in CW Evidence

Forecast Years	Base Case with DSM - Total Load (GW.h)			Actual	Actual vs 2006 Plan		Actual vs 2011 RP - July 2012		Actual vs 2011 RP - Nov 2012	
	2006 RP - 1.85%/yr Case	2011 RP - July 2012 Version	2011 RP - Nov 2012 Version		GW.h	%	GW.h	%	GW.h	%
2006	302.0			302.0	0.0	0.00%				
2007	307.6			307.7	0.1	0.03%				
2008	313.3			315.7	2.4	0.77%				
2009	319.1			345.6	26.5	8.30%				
2010	325.0			351.5	26.5	8.15%				
2011	331.0			368.7	37.7	11.39%				
2012	337.1	416.0	406.0	392.1	55.0	16.32%	-23.9	-5.75%	-13.9	-3.42%
2013	343.3	430.0	412.0	388.5	45.2	13.17%	-41.5	-9.65%	-23.5	-5.70%
2014	349.7	443.0	437.0	373.9	24.2	6.92%	-69.1	-15.60%	-63.1	-14.44%
2015	356.2	449.0	449.0	380.7	24.5	6.88%	-68.3	-15.21%	-68.3	-15.21%
2016	362.8	455.0	461.0	386.0	23.2	6.39%	-69.0	-15.16%	-75.0	-16.27%

The following is noted in response to the CW Evidence regarding the "pattern of load divergence".

1. **CW evidence compares generation forecasts and sales forecasts:**

   CW uses an **"**apples to oranges" approach when comparing Resource Plan load forecasts to actual results in its tables. The Resource Plan load forecasts included in CW's evidence are generation forecasts that include firm sales plus applicable losses, but do not include secondary sales.

   The actual column in the CW Evidence are energy sales numbers which include secondary sales, but does not include losses].

Table A-2 below compares the relevant 2011 Resource Plan forecasts for firm load to actuals at the generation level (i.e., including losses). This also separates out industrial and non-industrial load.

Table A-2: Comparison of Industrial and Firm Non-Industrial Loads [including losses]

Forecast Years	2011 RP - July 2012 Version, Base Case [GW.h]			Actuals, firm load [GW.h]			Actual vs 2011 RP - July 2012 [%]		
	Non-Industrial Load	Industrial Load	Total Load	Non-Industrial Load	Industrial Load	Total Load	Non-Industrial Load	Industrial Load	Total Load
2012	359.0	56.9	415.9	376.6	47.9	424.5	4.9%	-15.8%	2.1%
2013	362.6	67.8	430.4	375.0	44.2	419.2	3.4%	-34.9%	-2.6%
2014	365.5	77.8	443.3	357.4	39.1	396.5	-2.2%	-49.8%	-10.6%
2015	371.3	77.8	449.1	369.5	40.8	410.3	-0.5%	-47.5%	-8.6%
2016	377.2	77.8	455.0	368.2	44.6	412.8	-2.4%	-42.7%	-9.3%

Forecast Years	2011 RP - November 2012 Update, Base Case [GW.h]			Actuals, firm load [GW.h]			Actual vs 2011 RP - November 2012 [%]		
	Non-Industrial Load	Industrial Load	Total Load	Non-Industrial Load	Industrial Load	Total Load	Non-Industrial Load	Industrial Load	Total Load
2012	359.0	46.5	405.5	376.6	47.9	424.5	4.9%	3.1%	4.7%
2013	362.6	49.3	411.9	375.0	44.2	419.2	3.4%	-10.4%	1.8%
2014	368.3	68.3	436.6	357.4	39.1	396.5	-2.9%	-42.8%	-9.2%
2015	374.1	74.5	448.6	369.5	40.8	410.3	-1.2%	-45.2%	-8.5%
2016	380.6	80.4	461.0	368.2	44.6	412.8	-3.3%	-44.5%	-10.5%

2. **CW Evidence does not consider the impact that changes in industrial loads can have on actual sales on Yukon's isolated grid:**

The CW Evidence did not assess whether changes in load were attributable to a particular rate class. However, as Table A-2 shows, differences between the Resource Plan Forecast and actuals are attributable largely to changes in industrial loads. The timing for connection of new mines, as well as their ongoing operation, can be highly uncertain and may depend on factors such as regulatory processes and changes in world markets.

During the preparation of the 2011 Resource Plan YEC relied on the best information then available on status of existing and expected new mines.

- The 2011 Resource Plan forecast for Alexco was 14.2 GW.h for 2012, 15.8 GW.h for 2013, 20.9 GW.h for 2014 and increasing to approximately 33 GW.h in 2016. However, in late 2013 the mine suspended its mine operation due to unfavourable market conditions[1].
- The 2011 Resource Plan as well as the 2012/13 YEC GRA and the 2013-15 AEY GRA also included assumed Whitehorse Copper Tailings (WHCT) generation load at 9.3

[1] https://www.alexcoresource.com/news/2014/alexco-reports-year-end-and-fourth-quarter-2013-results/ [accessed on May 22, 2018].

GW.h/year for 2014-2018. However, this mine has not to date commenced operation.

Industrial mine load will continue to be a major source of variance in the Yukon grid forecasts[2]. Consequently, Yukon Energy updates the Yukon Grid load forecast on ongoing basis to reflect the most recent information regarding industrial loads and other changes on the system. This is what it did when preparing the latest Resource Plan.

3. **CW Evidence does not consider the impact a particular rate class can have on changes in assets:**

Mr. Bell in response to YUB-CW-3 (b) also notes "The fact that any one particular rate class may have caused the variance will have less impact on the resulting changes in assets constructed. This is particularly true as the YEC system is an interconnected system."

YEC new asset requirements can be affected by load changes in specific rate classes:

- **Capacity Planning Criteria Requirements:**

  The CW Evidence ignores Yukon grid realities, including the fact that due to current grid loads YEC capacity planning requirements to date have been based on the N-1 criterion [which does not include consideration of industrial loads, and focuses only on non-industrial load requirements].

  The following are specifically noted:

  - The 2006 Resource Plan, page 3-24 notes that as long as "the WAF system with the current Aishihik line (i.e., no twinning of this line) can meet the wholesale/retail peak under the N-1 criteria, up to 6-7 MW of major industrial loads can be served without driving new generation investment for capacity reasons."
  - The 2011 Resource Plan Overview [page 25, footnote 14] also indicates that with the currently connected mine loads the "N-1 requirement (currently loss of the Whitehorse transmission connection to the Aishihik hydro plant) based on non-industrial loads is expected to determine new default diesel capacity requirements."
  - The 2017/18 GRA [page 2-15] indicates that with the current forecast industrial load "the LOLE criterion is satisfied in each test year so long as the single contingency [N-1] criterion is met".

- **Bulk Generation and Transmission Planning:**

  Overall, industrial load changes in Yukon tend to have a greater impact on overall grid energy load requirements (in percentage terms) than would be typical for most

[2] The Yukon Economic Outlook for 2017 notes that in many jurisdictions "gains in real GDP are closely tied to gains in other variables such as employment, population, and retail sales. In Yukon, correlation between GDP changes and other indicators is often not as strong." It also notes that mining related activities "have been a key driver of Yukon's economic performance with annual gains and contractions, particularly of GDP, often explained by what is happening in the mining sector." See http://www.finance.gov.yk.ca/pdf/budget/201718Economic_outlook.pdf [accessed on May 22, 2018]. [accessed on May 22, 2018].

southern utilities. The CW Evidence in this regard ignores Yukon history regarding development of major new infrastructure.

Specifically, the addition of major new long-term industrial loads have historically led to the development of bulk generation and transmission assets on the Yukon grid. Assets for hydro and transmission in Yukon were historically developed in response to the UKHM and Faro mine loads. The Minto mine load played a key role in stimulating the Carmacks-Stewart Transmission Project's development and the potential development of the Carmacks Copper mine load played a key role in justifying investment in the Mayo B hydro expansion.

4. The CW Evidence separately (page 8) references the following table as provided originally in response to CW-YEC-1-4 (d) (CW added the last row on "variance"), showing the 2016 GRA amount being lower than the 2016 Resource Plan (Very Low Industrial Activity Scenario) but with this being reversed for 2017 and 2018 with the divergence growing in 2018:

	2016	**2017**	**2018**
GRA	412,812	420,398	382,966
Resource Plan	414,300	417,800	377,000
Variance	-1,488	2,598	5,966

The Resource Plan forecast and the GRA forecasts have two separate focuses. The GRA is based on best available information for the two test years at the time the GRA is filed; and the Resource Plan is a long term planning forecast. The above data from YEC's CW-YEC-1-4 response shows firm generation load forecasts (i.e., generation for all loads other than secondary) for 2016 and 2017 in the 2016 Resource Plan scenario, versus actual 2016 firm generation and 2017 forecast in the GRA. As noted in CW-YEC-1-4(d), the 2018 loads shown in this table are only for non-industrial customer classes. The following is noted:

- The Resource Plan forecast ("Very Low Industrial Activity Scenario") assumed no industrial customers on the system in 2018.
- In error, the GRA number of 382,966 MW.h for 2018 in YEC's response only deducted the 38,219 MW.h forecast Minto sales – after deducting related losses at 8.8%, the corrected number of 379,602 MW.h indicates a lower variance of 2,602 MW.h.
- The Resource Plan "Low Industrial Activity Scenario" at 423,000 MW.h in 2018 with Minto mine is 1,815 MW.h higher than the GRA forecast at 421,185 MW.h with this mine.

A2: "DISRUPTIVE TECHNOLOGY" IMPACTS

The CW Evidence focuses on what it terms as possible "disruptive technology" impacts on the Yukon grid resulting in loss of grid load due to improvements in micro generation and micro grid technology.

YEC notes the following factors with regard to the "disruptive technology" issues noted in the CW Evidence:

1. The 2017/18 GRA includes 2017 and 2018 load forecasts and assumes no material impact from micro generation or micro grid technology energy generation sources (i.e., there is no current evidence of material impact from such generation sources in the test years).

2. The Yukon Grid is an isolated grid. There is no economic opportunity to 'overbuild' and sell to another market; and there is no opportunity to buy power from another market when needed. Careful planning is required to ensure adequate capacity and energy is available on the grid to serve all customers and ensure continued safe and reliable service.

3. North American Electric Reliability Corporation (NERC) notes that with the emerging energy resources there remains a "need to ensure reliability of the bulk power system during both normal operation and in response to disturbances."[3]

   Emerging generation sources may reduce energy requirements on the grid; however, the customers that choose to self-generate will still require the Yukon grid to provide stable back up generation and capacity. YEC notes the following in this regard:

   - YEC will still need to provide enough electricity to meet the entire needs of its service territory. The NARUC Manual on Distributed Energy Resources Rate Design and Compensation[4] notes the following:

     - Distributed Energy Resources can also cause increased costs, including distribution system upgrades and additional generation to back up intermittent resources, particularly at high adoption levels, whether system-wide or at the feeder level.

     - The customer is still tied into the grid and the utility is still responsible for delivery.

     - The customer may still be grid reliant during peak times.

   - Accordingly, if YEC faced specific distributed energy resource risks the manner in which these risks would likely be mitigated would be to only invest in non-capital intensive grid generation assets that could be effectively shut off when there is no requirement for generation [but that would be available to provide backup or capacity as required], i.e., thermal generation. This effectively would mean that going forward the utility would only be investing in thermal generation assets and not renewable assets.

4. The US Federal Energy Regulatory Commission (FERC) notes[5] some reliability issues with emerging technologies. Concerns include lack of data and the resulting implications for system operation. It also notes that "several potential reliability issues such as impacts to operations and planning including modeling, ramping and load forecasting". There is no reliable data for YEC on such emerging technologies that could be considered to be included as part of its resource plan.

[3] Distributed Energy Resources Task Force Report, February 2017. https://www.nerc.com/comm/other/essntlrlbltysrvcstskfrcdl/distributed_energy_resources_report.pdf [accessed on May 23, 2018].
[4] https://pubs.naruc.org/pub/19FDF48B-AA57-5160-DBA1-BE2E9C2F7EA0 [accessed on May 23, 2018].
[5] https://www.ferc.gov/legal/staff-reports/2018/der-report.pdf [accessed on May 23, 2018]

5. The resource plan is a living document - resource plan forecasts are continuously reviewed and updated annually and the overall plan is subject to updates on a 5-year planning cycle. This iterative process allows for load and other risks to be considered and addressed on a timely basis as they arise.

A3: WHOLESALE LOAD FORECAST FOR 2017 AND 2018

The CW evidence notes the following regarding the wholesale sales forecast for the 2017 and 2018 test years:

- There appears to be "a disconnect between forecasts of wholesale consumption for ATCO Electric Yukon (AEY) and YEC" and "from the responses to information requests, there appears to be only a cursory understanding of the customer and its needs and expected sales".
- CW also recommends that the "latest approved" wholesale forecast should be included in application, and
- "It is incumbent on YEC to work closely with AEY in developing wholesale sales forecasts"; "YEC should start with AEY then provide an assessment of AEY forecast"; and if YEC disagrees with AEY's forecast it should provide detailed reasons for not using it.

This issue was raised in previous hearings.

During the review of YEC 2012/13 GRA, CW argued that AEY serves retail customers and is in a better position to forecast retail customer loads. YEC argued at the time that it updated its wholesale forecasts for 2012 and 2013 using the best available information related to AEY's forecast.

In the end the Board supported YEC's wholesale sales forecast [YUB Order 2013-01 Appendix A: Reasons for Decision, paragraph 34]:

> In making its decision on the wholesale sales forecast, the Board considered YEC's submission that it's "...updated wholesale forecasts for 2012 and 2013 using the best available information... [and] ...adopting YECL's forecast ... would result in a less accurate forecast ... than that provided by YEC in the Application." Moreover, the Board is not convinced by the evidence of the interveners that YEC's wholesale sales should not be adopted. The Board finds YEC's wholesale forecast reasonable.

The Board also noted that AEY may have better information on Fish Lake generation and directed YEC to update its Fish Lake generation assumption.

A similar argument was raised during the review of AEY 2013-15 GRA where the Board in Order 2014-06 approved a different power purchase number for AEY compared to YEC's approved wholesale forecast in the 2012/13 GRA.

In the AEY 2016/17 GRA AEY had argued [page 5 of AEY reply argument] that:

> YEC's calculations, in part, are based on its approved 2012-2013 GRA forecasts. Given YEC's GRA was filed on April 27, 2012, it is reasonable to conclude information used to determine its sales forecast is well over 18 months old. This is clearly not the latest and best information available for forecasting Yukon Electrical's sales at this point in time.

As indicated in Tab 2, page 2-4 of YEC's 2017-18 GRA, as part of preparation for the GRA application, YEC also reviewed AEY's forecasts provided in AEY's 2016-2017 GRA filings. Subsequent to finalizing YEC's forecasts for this Application, Board Order 2017-01 was issued on the AEY GRA and AEY filed its Compliance Filing response for review by the Board and interveners.

For its forecast YEC used multi-variate regression assessments of monthly wholesales change from January 2013 through September 2016, excluding Fish Lake hydro generation impacts, that highlighted a strong correlation (R2>90%) over this period between AEY's monthly load on the grid and Whitehorse Heating Degree Days (HDD) below 13ºC. Whitehorse temperatures during 2014 to 2016 were warmer than normal (with the variance from normal widening over this period), indicating that AEY wholesales were progressively reduced during this period by above normal temperatures. Based on AEY evidence, the magnitude of the above normal temperature impact likely reduced AEY wholesales by about 6.4 GW.h in 2015, and by a higher amount in 2016.

Based on the above assessment of wholesale changes since 2013, YEC concluded that the 2016 actual was at least 2 to 3 GW.h below what could be expected based on normal temperatures, i.e., a minimum firm wholesales at normal weather of about 304 GW.h. Yukon Energy's 2016 Resource Plan forecasts based on normalized weather for non-industrial loads indicated AEY firm wholesales at about 302 GW.h for 2016, 305 GW.h for 2017, and 309 GW.h for 2018. In contrast, initial runs of the YEC regression model for AEY's monthly load on the grid based on 20 years of data resulted in firm wholesale forecasts for the test years well beyond what appeared to be acceptable estimates (i.e., approximately 320 GWh).

Based on all of these comparisons, YEC determined the 2017 firm wholesales forecast of 309 GW.h to be reasonable. Table A-3 provides comparison of 2016 actual wholesales, 2017 forecast from AEY 2016/17 GRA filing as well as YEC's 2017/18 GRA.

Table A-3: Firm Wholesale Sales Forecast for 2017, MW.h

	2016 Actuals	AEY 2016/17 GRA Forecast for 2017		YEC 2017/18 GRA Forecast for 2017	Difference from Original Filing	Difference from Compliance Filing
		Original Filing	Compliance Filing			
	A	B	C	D	E=D-B	F=D-C
Firm Wholesale Sales	301,207	300,325	314,234	309,000	8,675	-5,234

As indicated in response to CW-YEC-1-11, YEC communicated with AEY regarding the power purchase forecast at the time YEC prepared its application. No communication was required after the Board Order on AEY 2016/17 GRA as the impact of the Board Order was already reflected in AEY's Compliance Filing and increased the power purchase forecast by about 4.7%, or 14 GW.h, as illustrated in Table A-3.

In response to YUB-YEC-1-3 YEC provided a wholesale forecast that reflected the impact of using AEY's 2016/17 GRA Compliance Filing forecast for 2017 and adjusted 2018 accordingly. Based on annual forecast number included in AEY's Compliance Filing the net impact is a reduction in the required increase of Revenue Requirement $0.027 million for 2017 and $0.014 million for 2018.

Attachment B

ATTACHMENT B

This attachment provides the details of the basis for the capital cost impacts in the Yukon Energy 2017/18 GRA.

The CW evidence states the following:

- "The issue I have is that investment in utility assets commits the utility and its customers to increasing rates almost in perpetuity. As utility asset lives are in the 40 to 50 year range, any investment today will result in costs to customers for the life of the assets."
- "YEC spent deferred costs of $5.993 million in 2016 and forecasts deferred costs of $5.570 million in 2017 and 17.631 million in 2018. Combined this results in expenditures over the test period of over $52 million."
- "In the initial Application, it is clear that the majority of increases in costs relate to increased capital and to the amortization of Deferred Charges."

B1: CAPITAL INVESTMENTS

Sustaining of existing infrastructure is very important in providing reliable energy to Yukoners. Further, the capital spending in the GRA also includes investments to ensure sufficient dependable capacity for the integrated grid, and continued planning expenditures to meet other potential future generation and transmission requirements.

The major projects undertaken since the last GRA include a number of enhancements, repairs or improvements to existing infrastructure including the Aishihik Redundancy Project, Mayo Hydro Substation Enhancements, Mayo Head Gate Repairs and the Whitehorse Spillway Improvements. Some of the major projects were undertaken to address capacity planning requirements such as reinforce the 25 km line L172 between Takhini and Whitehorse and the Whitehorse Diesel-Natural Gas Conversion Project.

The CW Evidence notes that Mr. Bell "was involved in the Northwest Territories Power Corporation (NTPC) rate hearing in July 2017. At that hearing customers lined up to express their concern about increased energy costs."

It should be noted that as part of its 2012/14 GRA NTPC was granted a 7% rate increase effective May 1, 2012, a 7% rate increase effective April 1, 2013, a 5.6% rate increase effective April 1, 2014 and a 6.2% effective April 1, 2015. The NWT PUB also approved a rate increase of 4.8% effective August 1, 2016 and interim rate increase of 4.0% effective April 1, 2017 as part of NTPC's 2016/19 GRA.

Further, NTPC's 2016/19 GRA Phase II compliance filing proposed rate design corresponding to a 2% average revenue requirement increase effective April 1, 2018. The NWT PUB decision with respect to the 2018/19 test year has not yet been issued.

Table B-1 below provides a comparison of capital investments as percentage of total plant in service for YEC, AEY and NTPC. The table shows that YEC investments are mainly impacted by major projects, however, they are still lower compared to the level of investment by AEY and NTPC as percentage of total plant in service.

Table B-1: Comparison of Capital Expenditures

Description	Actual 2013	Actual 2014	Actual 2015	Actual 2016	Forecast 2017	Forecast 2018
Yukon Energy						
Major Projects	15,755	28,508	16,162	5,512	9,852	8,700
Ongoing Capital						
Transmission	2,178	1,372	1,496	1,010	1,615	1,625
Distribution	537	873	1,115	753	500	715
Generation	2,259	3,159	2,024	1,817	1,065	1,094
General Plant & Equipment	1,738	2,083	2,172	2,493	1,574	2,499
Overhaul	2,903	1,669	122	888	0	0
Subtotal Ongoing Capital	9,614	9,156	6,928	6,962	4,753	5,933
Total Expenditures	25,370	37,664	23,090	12,474	14,605	14,633
Total Plant In-Service	496,269	501,659	564,536	570,769	599,521	610,236
Total Expenditures as % of total plant in-service	5.1%	7.5%	4.1%	2.2%	2.4%	2.4%

AEY 2016/17 GRA Compliance Filing	Actual 2013	Actual 2014	Actual 2015	Forecast 2016	Forecast 2017
Total Plant In-Service	179,002	195,537	204,749	217,952	229,270
Total Expenditures	15,358	16,837	10,694	14,998	12,471
Total Expenditures as % of total plant in-service	8.6%	8.6%	5.2%	6.9%	5.4%

NTPC 2016/19 GRA	Actual 2013/14	Actual 2014/15	Actual 2015/16	Forecast 2016/17	Forecast 2017/18	Forecast 2018/19
Total Plant In-Service	448,726	468,267	488,364	520,790	538,757	561,510
Total Expenditures	30,021	19,996	31,632	23,621	19,955	23,640
Total Expenditures as % of total plant in-service	6.7%	4.3%	6.5%	4.5%	3.7%	4.2%

B2: DEFERRED COSTS

The CW evidence notes the following regarding the deferred costs:

- "YEC spent deferred costs of $5.993 million in 2016 and forecasts deferred costs of $5.570 million in 2017 and 17.631 million in 2018."

The majority of the deferred costs indicated in CW's evidence are for nine major projects listed below. The details for those projects are provided in Section 5.3. of the 2017/18 GRA. It should be noted that from the approximately $29 million spending on deferred costs that CW noted for 2016 through 2018, approximately $11 million remains in WIP with no impact on rates.[1]

- **Spending on Sustaining Capital**:

  No net rate base impact in test years. Net deferred costs in WIP by end of 2018 of approximately $2.899 million:

[1] The change in WIP from 2015 year end at $19.069 million [Table 5.5] to $29.858 million [Table 5.8].

- **Stewart Keno City Transmission Project**

  $2.807 million in rate base by end of 2016 for planning and permitting, with these costs fully offset by contributions.

- **Aishihik Relicensing**

  Forecast WIP cost of approximately $2.899 million by end of 2018 - project planned for completion in 2019).

- **Spending to address Capacity Planning Requirements:**

  No net rate base impact in test years. Net deferred costs in WIP by end of 2018 of approximately $13.067 million:

  - **Battery Project** – (forecast WIP cost of approximately $8.856 million by end of 2018 for planning, engineering, permitting, long-lead equipment procurement, civil work - project planned for completion in 2019).

  - **Thermal Plant Project** – (forecast WIP cost of approximately $4.211 million by end of 2018 planning, engineering, permitting, long-lead equipment procurement - project planned for completion in 2020).

- **Spending on planning to meet other potential Future Generation and Transmission Requirements:**

  Net rate base impact increase of approximately $9.845 million by the end of 2018, excluding reductions due to amortization in the test years. Net deferred costs in WIP by end of 2018 of approximately $11.512 million:

  - **Demand Side Management (DSM)** – ($3.319 million net increase in rate base costs by end of 2018, excluding reductions due to amortization).

  - **Resource Plan Update 2016** – ($2.004 million net increase in rate base costs by end of 2017, excluding reductions due to amortization).

  - **Gladstone Diversion Project** – ($4.521 million net increase in rate base costs by start of 2017).

  - **Marsh Lake Storage Enhancement Project** – (forecast WIP cost of approximately $8.156 million by end of 2018 - project subject to ongoing review, potential in-service by 2022).

  - **Mayo Lake Storage Enhancement Project** – (forecast WIP cost of approximately $3.356 million by end of 2018 - project subject to ongoing review, potential in-service by 2022).

B3: IMPACT TO REVENUE REQUIREMENTS

The CW evidence notes the following:

- "In the initial Application, it is clear that the majority of increases in costs relate to increased capital and to the amortization of Deferred Charges."

Mr. Bell in his evidence compares the forecast for 2017 and 2018 test years to the 2016 actuals. Table 3.14 of the 2017/18 GRA shows that the increase in depreciation and amortization expense in 2017 forecast over 2016 is $2.998 million [$10.814 million in 2017 compared to $7.816 million in 2016] and about 77% or $2.301 million of this increase relates to the increase in deferred cost amortization.

In its Order 2013-01 during the review of YEC's 2012/13 GRA, the Board directed that "for project expenditures incurred in the test years and beyond, the Board directs that these expenditures be held in WIP until such time the costs are brought before the Board for a prudence review and have been approved." Therefore, YEC proposed the deferred costs held in WIP to be closed and amortized. This increased the amortization expense for the test years compared to the actuals.

Attachment C

TAB 12
TECHNICAL REPORTS FILED IN RESPONSE TO BOARD DIRECTIVES

APPENDIX 12.1
CEATI TECHNOLOGY REVIEW ON BEST PRACTICES FOR A RISK-BASED APPROACH TO VEGETATION MANAGEMENT

APPENDIX 12.2
YUKON ENERGY CORPORATION TRANSMISSION VEGETATION CONDITION ASSESSMENT

ENVIRONMENTAL CONSULTANTS, INC.

Yukon Energy Corporation
Transmission Vegetation
Condition Assessment

Prepared for
Yukon Energy Corp.
Whitehorse, Yukon, Canada

Prepared by
ECI
520 Business Park Circle
Stoughton, WI 53589

December 27, 2010

Table of Contents

Executive Summary

Environmental Consultants, Inc. (ECI) has completed a survey of Yukon Energy Corporations (YEC) transmission/sub-transmission rights-of-way and a review of the vegetation management program. The primary goal of the evaluation was to assess the vegetation conditions on the YEC overhead transmission and sub-transmission system and note areas of immediate concern recommend a long term maintenance schedule and develop associated budgets to support this schedule. A secondary goal was to conduct a high-level assessment of the vegetation management program and identify general opportunities to enhance program management, reliability and cost effectiveness.

The survey consisted of an aerial inspection and follow-up ground inspection/survey.

ECI's program assessment consisted of a review of available program documentation provided by YEC and interviews with key YEC personnel involved with the program. The survey and program review was a cooperative effort between YEC and ECI.

On the basis of ECI's review, program strengths and opportunities for improvement were identified. Recommendations, based on the results of the review, ECI's experience, and industry best practices, have been developed to provide YEC with a general plan for program improvement.

A recommended long-term maintenance schedule and budget was developed as well as a priority list of locations requiring vegetation maintenance prior to the 2011 growing season.

General Assessment

STRENGTHS

Key strengths of the current Yukon Energy vegetation maintenance program include the following:

- Yukon Energy management is supportive of program improvements.
- The program is focused on reliability.
- A centralized management structure is in place.
- Right-of-way (ROW) conditions are inspected on an annual basis.
- Budget has been increasing as kilometers of line increased.

Summary of Key Recommendations

ECI recommends that Yukon Energy consider implementing the following recommendations to enhance the quality of the vegetation management program:

1. Evaluate different contracting strategies to identify which is the most cost effective.
2. Establish 'Action Threshold Clearances' to help ensure that minimum acceptable clearances are not encroached upon, thus providing increased margin of safety regarding reliability.
3. Develop a formal Vegetation Management Policy and Specification to endure compliance by contractors and to assist YEC inspectors in determining vegetation maintenance needs. This will be a necessity if other contracting strategies are to be considered.
4. Ensure that vegetation maintenance crews exhibit reasonable production levels by implementing a work reporting/ measurement system and utilize the records to evaluate crews and compare contractor performance.
5. Provide information on the YEC website explaining the R/W vegetation maintenance program to the general public.
6. Formally investigate and document, with trained personnel, tree-caused outages to determine if changes in maintenance practices could have prevented the outages.
7. Implement an Integrated Vegetation Management (IVM) program that includes the use of herbicides as one of the tools available to control vegetation re-growth on YEC ROW's Herbicide utilization is a cost effective and environmentally sound method to control brush on the ROW and reduce future maintenance costs.
8. Consider increasing vegetation management oversight through one of the following methods: 1) add a Utility Arborist position to YEC staff; 2) provide additional training in vegetation management to existing staff to empower staff to make sound decisions regarding vegetation management; 3) contract vegetation management to a third party; incorporate vegetation management oversight as a part of the mowing/ tree contractors work scope.

Introduction

Yukon Energy Corporation (YEC) contracted with ECI to evaluate vegetation conditions on the YEC overhead transmission and sub-transmission system. ECI conducted an aerial survey of the entire 138 kV and 69 kV system as well as select 66 kV and 25 kV lines between September 23 and September 30, 2010 (a complete list of the inspected lines can be found in Appendix A). In addition, ECI inspected sample ROW locations from the ground. Ground sample points were distributed to provide representative samples for the specific lines and voltages based on their total overhead miles. All data was collected on a span-by-span basis. Aerial data collection included: vegetation management priority code (based on the recommended next year of maintenance), brush maintenance recommendations (mow, hand cut, foliar spray), accessibility, and notations on hazard[1] and danger[2] trees adjacent to the ROW corridor (dead, dying, severe lean toward line, etc.). Ground data collection included: species and number of stems on sample plots, tallest brush height on sample plot, danger/hazard trees at edge of ROW, measurement of re-growth and any other notes on general ROW condition or adjacent land use, access, etc. This report includes the following areas of evaluation:

1. Identification of locations on the transmission system where vegetation has grown to a height to represent a current threat to system reliability and function.
2. Evaluation of edge vegetation to note danger/hazard trees that represent a threat to the reliability of the system.
3. Evaluation of field conditions designed to quantify the extent of maintenance required and recommended maintenance practices.
4. Evaluation of vegetation management practices and effectiveness compared to industry best practice methods.
5. Develop a minimum 10 year maintenance plan with associated vegetation maintenance budget.

Through phone interview and via email questionnaires, the current operation procedures and vegetation management practices were discussed with YEC staff.

[1] Hazard tree: any tree that could contact the conductor if it fell.
[2] Danger tree: tree predisposed to failure due to disease, structure, dead or in decline, lean or soil conditions.

Current Operating Practices

YEC has a centralized staff that manages vegetation on the system. They are a part of the T&D organization. The overall transmission vegetation management program goals are based on safety, reliability, cost effectiveness, fire safety and utilizing industry best management practices. At present, YEC does not have a comprehensive vegetation management plan or clearance specifications. The major concerns for YEC are: hazard and danger trees – risk of fall-in from off ROW trees (especially on L 173 and L 171 with a large population of dead trees adjacent to the ROW).

Currently, vegetation maintenance is performed by one vendor under a T&M sole source contract. This arrangement was built out of necessity due to limited YEC staff for vegetation maintenance and limited availability of qualified contractors to perform the required work. YEC found and developed a local vendor to perform vegetation maintenance. This working relationship requires minimal supervision/ oversight.

Vegetation maintenance work is performed primarily in the fall – late winter or mid-summer as better access is afforded in wet areas. Minimal work is scheduled for the spring due to the spring-thaw (mud) season. Maintenance is 95 percent mowing with a hydro-axe and approximately 5 percent manual brushing where terrain is too steep or rough to mow. There is virtually no side pruning performed (due to wide ROW's).

The majority of transmission and higher voltage outages are due to off-ROW trees falling into the ROW. YEC has very few "grow-in" outages on the 25kV and higher voltage lines. YEC ROW vegetation maintenance is based on lines/line segments requiring work based on YEC inspections (hot spots). Cyclic maintenance by line on the transmission/sub-transmission system is not followed as there is not adequate funding to do so.

Vegetation maintenance needs are determined by YEC patrolmen via an annual inspection performed in the fall or spring. Typical patrol is via helicopter. YEC utilizes experienced staff for the vegetation patrol, however, these patrollers do not receive specific training on recognizing vegetation maintenance priorities or conditions and there are no established standard clearance specifications. YEC provides notification to abutting land owners regarding maintenance activities. Special notification and access permission to ROW is provided on First Nation locations.

YEC follows the Alberta Electric Utility Code for "tree energized electrical equipment" limits of approach (see Appendix L). If these limits are breached by tree(s), lines are de-energized to perform vegetation maintenance. YEC does not currently have guidelines to determine immediate maintenance requirements (emergency or high priority due to vegetation proximity) vs. scheduled maintenance. YEC is not subject to North American Electric Reliability Corporation (NERC) reliability standards (currently a stand-alone system) but, must practice due diligence in avoiding interruptions. Highest maintenance priority is with the 138 kV system, in particular the L 171 and L 170 lines. YEC belongs to the Western Electric Coordinating Council, as do most utilities in NW Canada

The vegetation maintenance budget is presented to YEC senior management on an annual basis for approval. Budget has been based on historical levels, not specifically to address cyclic maintenance requirements. The annual budget has been increasing over the past 10 years to keep pace with increasing kilometers of transmission lines. YEC falls under the local Utility board for rate and maintenance programs but must be cost-justified to be accepted into the rate base.

YEC does not perform in-depth post-outage investigations of vegetation caused outage investigations. Outages are listed only as "tree contacts", the specific reason is not listed (growth from on-ROW, growth form off-ROW, falling live tree from off-ROW, falling hazard or danger tree from off-ROW, etc. are not noted). As they are found, off-ROW danger trees are removed by YEC servicemen (for specific targeted locations). These associated costs are not recorded under line vegetation maintenance but are rolled into general "line maintenance" costs. The brushing contractor removes danger and hazard trees only in an area which are planned for brushing.

YEC does not have an electronic record keeping system that tracks contractor production, cost, or work location (line work history: last maintenance date, work type, cost, etc.). YEC has not established metrics to track the efficiency of the vegetation maintenance program (i.e., cost per hectare, cost per kilometer, mowing cost, brushing cost, etc.).

YEC is doing an admirable job in managing transmission vegetation with a limited budget. The size of the annual budget has necessitated a "just-in-time" approach to vegetation maintenance. The current maintenance practice of "just in time" or "hot spot" mowing and brushing has resulted in a system that is a patch work of various vegetation conditions (brush height and density) on the ROW's. Vegetation conditions on any given line range from clear (just maintained) to very tall brush (+ 6 M) requiring immediate attention. This results in excessive "jumping" from location to location by the contractor, thus incurring excessive travel time. The lack of accurate records regarding maintenance cost preclude developing a line maintenance history, determining the efficiency of the vendor and over-all lack of data to forecast future work effort and cost. Through ECI's aerial and ground survey, the vegetation workload has been quantified and utilizing historic maintenance cost, a maintenance budget has been established. Because maintenance has been on a "hot spot" basis, conversion to a more efficient and cost effective cyclic maintenance schedule will require several years to implement. During this implementation phase, "hot spot" maintenance will be required to maintain system reliability until cycles can be established. In addition, the early years of the conversion to cyclic maintenance may require a significantly higher budget. Future cycle vegetation maintenance costs are expected to be maintained at levels at or slightly higher than current annual expenditures (Figure 1) through the implementation of ECI's recommendations. Converting to a cyclic maintenance schedule will reduce unit production cost (lower density and shorter height brush), provide for reduce planning effort each year and provide for a sound basis to consider other contracting strategies, including the use of herbicides.

Vegetation Maintenance Expenditures

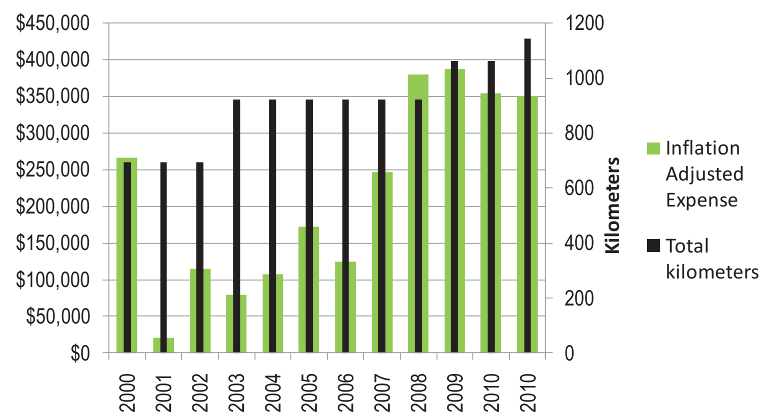


Figure 1. YEC Historic Transmission Vegetation Maintenance Expenditures[3] and Total Kilometers of ROW.

Production and Cost

YEC does not track production or cost on a per Hectare or per Kilometer bases. YEC only tracks total annual expenditures on vegetation maintenance by contract labor. YEC provided contractor records from the fall of 2009 and spring of 2010. From these detailed diary records, ECI calculated the total expenditure based on the contractor crew complement and the number of spans (hectares completed) during this time frame. The records represent a four-man crew that included 2 hydro-axes, 2 hydro-axe operators, 2 ground men (brushing), and off road transportation (snow master or 2-ATV's depending on ROW conditions) and the associated travel allowance (mobilization/de-mobilization) each day worked. A 38-day period was utilized for the calculations and the work included

[3] CPI adjusted to 2009 Dollars.

brushing and hydro-axe mowing. YEC contractor daily cost was approximately $6,400 per day or $4,000 per hectare completed ($1,620 per acre). The average production for the 4-person crew was 2 hectares per day (4.9 acre) for the 2-brushers and 2-hydro-axes combined. A good average production in the lower 48 states is 1.42 hectares (3.5 acres) per day per hydro-axe crew (with no manual clearing). Figure 2 provides a cost comparison of various transmission ROW vegetation maintenance practices for a NW Canadian utility and YEC[4]. Figure 3 provides a cost comparison of numerous US and Canadian utilities, a 22 utility bench-mark average and YEC mechanical mowing + brushing cost.

TREATMENT	UTILITY	COST PER UNIT
		HECTARE
Ground Foliar Herbicide	NW Canadian utility	$680 - $1,200
Basal Herbicide	NW Canadian utility	$880 - $1,500
Cut Stump Herbicide	NW Canadian utility	$5,900 - $8,800
Aerial herbicide	NW Canadian utility	$700 - $1,200
High-volume herbicide	Alberta	$2,500 - $3,000
Low-volume herbicide (1st cycle)	Alberta	$1,500 - $2,000
Low-volume herbicide (2nd cycle)	Alberta	$800 - $1,200
Shearing	NW Canadian utility	$370 - $780
Hand Brushing	NW Canadian utility	$3,700 - $5,100
Mowing	NW Canadian utility	$800 - $1,000
Mowing (hydro-axe)	**Yukon**	**$4,000**

Figure 2. Cost per Hectare for Various ROW Maintenance Types[5].

[4] YEC mechanical mowing cost is based on a 4 person crew: 2 brush cutters, 2 hydro-axes and 2 operators.
[5] Canadian dollars, 2009.

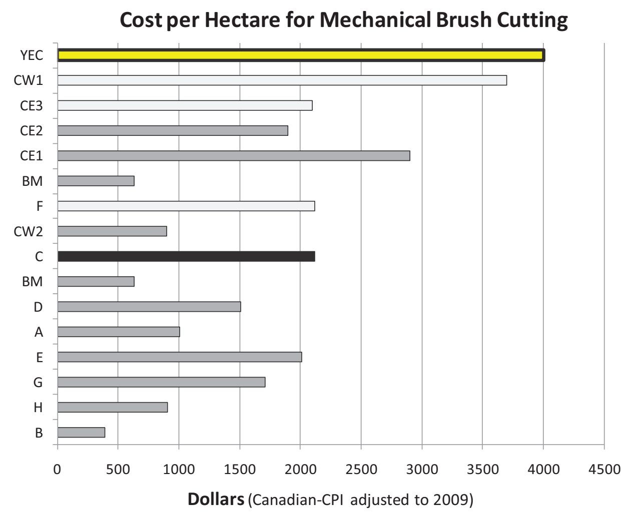


Figure 3. Cost per Hectare for Mechanical Brush Cutting.[6]

YEC provided their annual expenditures from 2000 to 2009 as well as budget for 2010 and 2011. In Table 1 the annual hectares maintained per year was calculated by dividing the annual expenditure (all annual cost adjusted by 2009 CPI) by the calculated 2009-2010 YEC production cost ($4,000/HA.). The annual work accomplishment was converted to a percent complete of total estimated system hectares that may require maintenance (approximately 80-percent of total ROW hectares). Figure 4 indicates the annual work completed against the 10-year cycle goal (1/10th of the hectares per year over ten years). This provides an indication on the potential work that is not being addressed under the current "just in time" maintenance scenario. These unmanaged hectares contain trees and brush that continue to grow, thus increasing future work effort (more and taller stems per hectare) as well as increasing the risk of vegetation grow-in outages. This risk increases each year and annual ROW patrols will require increased diligence to ensure the worst areas are identified and address prior to the start of the growing season to avoid interruptions from on ROW trees and brush.

[6] CE1, CE2, CE3= Eastern Canada Utilities; CW1, CW2= Western Canada Utilities; BM= 22 utility Avg. Canadian dollars, CPI adjusted to 2009 dollars.

Year	Actual Expense	Expenses (CPI adjusted to 2009 dollars)	TOTAL SYSTEM KM	Width KM	Total Sq KM	TOTAL Hectares (est.)	TOTAL Hectares to Maintain * (80% 0f total)	2010 Maint. Cost / Hectare**	Hectares maintained (based on $ expended)	Percent of Total System Hectares Worked	Equivalent Cycle (years)
2000	$216,000.00	$266,450.00	693	0.03	20.79	2079	1663.20	$4,000	54.00	3.2%	12
2001	$17,000.00	$20,640.00	693	0.03	20.79	2079	1663.20	$4,000	4.00	0.2%	173
2002	$97,000.00	$115,000.00	693	0.03	20.79	2079	1663.20	$4,000	24.00	1.4%	28
2003	$68,000.00	$79,123.00	923	0.03	27.69	2769	2215.20	$4,000	17.00	0.8%	54
2004	$95,000.00	$107,000.00	923	0.03	27.69	2769	2215.20	$4,000	23.00	1.0%	40
2005	$158,000.00	$172,119.00	923	0.03	27.69	2769	2215.20	$4,000	39.00	1.8%	23
2006	$117,000.00	$124,347.00	923	0.03	27.69	2769	2215.20	$4,000	29.00	1.3%	31
2007	$239,000.00	$247,090.00	923	0.03	27.69	2769	2215.20	$4,000	59.00	2.7%	15
2008	$382,000.00	$380,472.00	923	0.03	27.69	2769	2215.20	$4,000	95.00	4.3%	9
2009	$387,000.00	$387,000.00	1062	0.03	31.86	3186	2548.80	$4,000	96.00	3.8%	11
2010	$354,000***	$354,000.00	1062	0.03	31.86	3186	2548.80	$4,000	88.00	3.5%	12
2011	$350,000****	$350,000.00	1142	0.03	34.26	3426	2740.80	$4,000	87.00	3.2%	13
									615.00	23.7%	
										10-YR Total	

Notes:
* Total System Hectares = width (M) X length (KM) X .8 (80% requires work)
** Cost- based on YEC 2009-2010 actual form contractor logs)
*** Anticipated year-end actual
**** Budget as of Dec 2010

Table 1. Hectares Maintained per Year and Total System Hectares to be Maintained

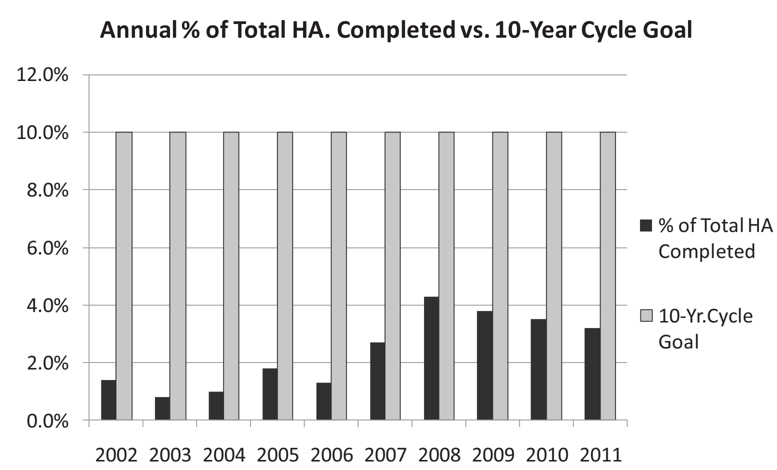


Figure 4. YEC Total Hectare Completed vs. 10-Year cycle Goal.[7]

[7] Based on ten year actual expenditures and YEC's 2009-2010 cost of $4,000 per hectare mowed/brushed.

Evaluation of Field Conditions

The evaluation of field conditions was a two part process: 1) aerial survey of the system; 2) follow-up on the ground survey plots to verify or "validate" the aerial data.

Aerial Survey

The aerial survey was designed to assess the adequacy of past ROW maintenance practices and the current state of vegetation on the system. Between September 23 and September 30, 2010 approximately 1,132 KM (703 miles) of the YEC transmission/sub-transmission system was flown with two experienced ECI utility foresters (1 surveyor and 1 data recorder). A complete list of the inspected lines can be found in Appendix A. Lines requiring immediate attention and listed as *Critical* are found in Appendix B and *Priority* lines that require mowing/brushing prior to the next growing season (spring 2011) are listed in Appendix C. Figures 5-8 contain photographs showing ROW conditions from an aerial perspective. Table 2 presents the number of spans falling into each priority level.

Based on brush density, height, and ground conditions formed the basis for recommendations regarding future maintenance practices and the year (from date of survey) maintenance should be performed. Through this rating system, a schedule was developed to guide YEC to a cyclic maintenance program. How quickly YEC achieves cyclic maintenance depends on how quickly maintenance practice efficiency can be achieved and what the annual budget should allotment.

ECI's aerial observations observed confirmed the "hot spot" approach to maintenance efforts that have been the historic vegetation management practice. The results are lines in a patchwork of varying brush conditions.

The most commonly observed condition relating to off-ROW fall-in outages were the presence of danger trees (dead or dying trees) immediately adjacent to the ROW. These trees pose a significant risk to system reliability and every effort should be made to remove them. The number of trees varied by line surveyed.

Brush control, where recently completed, was usually quite good. The use of herbicide treatment would assure that these brush-free conditions are extended for many years without requiring follow-up maintenance. The use of herbicides results in lower brush density thus lower future maintenance costs. Experience has shown that herbicide use results in declining future maintenance costs. As brush density decreases, cycle length (and cost) decreases. Perpetual mowing results in higher stem densities each mowing cycle and presents some environmental challenges that will be covered in a later section within this report.

Figure 5. Typical aerial view of ROW showing ground and edge conditions, no work required (Line L 170 A).

Figure 6. Aerial view of ROW showing ground and edge conditions, note tall brush on ROW requiring mowing (Line L 174).

Figure 7. Aerial view of high priority "*critical*" area, note tall brush on ROW requiring mowing prior to the next growing season (Line L 170B).

Figure 8. Typical aerial view of ROW showing ground and edge conditions, (Line L 173A).

Table 2. Priority of required work observed during aerial survey.

2010 - 2011 Priority Work

Priority Order	Line Number	Voltage	Priority Work Type: MPC "0" Critical (spans)	MPC "1" Priority (spans)	Hazard Tree Spans	Hazard Trees	Notes:
1	L 170B	138 KV	39	142	1	± 2	areas of 50% brush cover
2	L 250	69 KV	15	32	1	± 2	
3	L 174	66 KV	12	81	1	± 2	
4	L 355	25 KV	0	37	13	± 40	Schedule entire line for 2012 - as many as 50% of trees on edge dead or in decline: NUMEROUS DEAD TREES AT EDGE OF ROW
5	L 356	25 KV	0	16	0	0	
6	L 172	138 KV	0	3	0	0	Includes residential area
7	L 173B	138 KV	0	0	42	± 75	Excessive amount of dead/declining trees
8	S253-25F2	25 KV	0	0	9	± 11	
9	L 173A	138 KV	0	0	8	± 15	
10	L 170A	138 KV	0	0	1	± 1	
11	L 171	138 KV	0	0	1	± 3	
12	L 169	138 KV	0	0	0	0	Mostly deciduous tree cover
13	L 453	25 KV	0	0	0	0	Includes residential area - Mayo
Total Priority Work			66 Spans	311 Spans	77 spans	151 Trees	

Priority Color Code:

- ROW vegetation category 0 - Critical (as soon as possible)
- ROW vegetation category 1 - Priority (before spring 2011)
- Hazard Trees present - edge of ROW (dead, declining, leaning, etc.)

Ground Validation

ECI performed a ground validation of the aerial survey data. Ground truthing confirmed aerial observations with respect to both vegetation conditions and clearances relative to the conductors. At each plot, data was gathered on all of the primary species (tall-growing) on the sample plot and re-growth measurements for a 6-year period were taken on these species. In addition, data was collected on: brush density[8], brush height[9], presence or absence of danger and hazard trees, notes on site accessibility, and notes on edge tree maintenance. The photographs in figures 9 and 10 depict typical ground plot conditions. In addition to quantifying vegetation during the ground phase, future work was also prioritized. Three areas were considered in the prioritization process: tree-conductor clearance, potential off-ROW tree fall hazard, and brush that is too tall for herbicide application. Consistent with other findings, there were few spans in *critical* condition. The maintenance priority code (MPC)[10] was assigned to each plot as well. Data was collected on the species mix (Figure 11) and species growth rates (Figure 12) for each plot. Notations were made regarding recommended maintenance type (mow, hand-cut, herbicides).

Figure 9. Typical ground view of ROW showing ground and edge conditions, no maintenance required at this time (Line L 170A).

[8] H=>10,000 stems / acre, less than .6M apart (70-100% cover); M=5,000 to 10,000 stems/acre, .6-1.2 M apart; L=< 5,000 stems /acre, 1.2 M or more apart; S= sporadic brush.
[9] Critical= over 5.5m; H-High= 3.7 to 5.5 m; M-Medium=1.8 – 3.7m; L-Low= up to 1.8 m.
[10] MPC-Maintenance Priority Code: 0=Critical (do ASAP); 1=by 2011(priority before 2011 growing season); 2=by 2012; 3= by 2013; 3= by 2014.

Figure 10. Typical ground view of ROW showing ground and edge conditions, maintenance required within 1 year (Line L 169). Note multiple stems re-sprouting from previously cut stump in lower right corner of photo.

Species Composition

The ecological characteristics common to the YEC system limit diversity in ROW tree species composition. ECI recorded 5 primary species of tall-growing trees on the system ROW's. Figure 11 shows a comparative view of species mix as a percent of the total tree population.

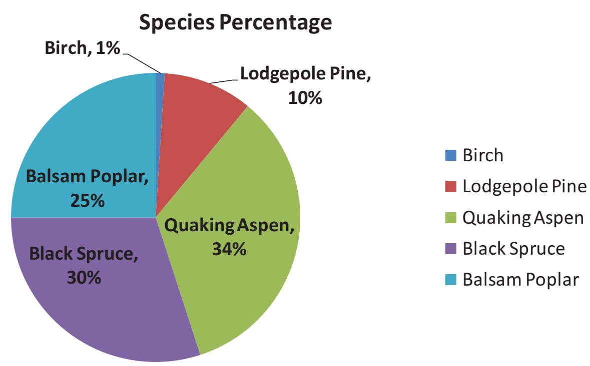


Figure 11. YEC Tree Species Distribution.

Deciduous species make up 60 - percent of the trees on the YEC system. This is made up of 3 primary deciduous species: quaking aspen (Populus tremuloides), balsam poplar (Populus balsamifera) and birch (Betula spp.). It should be noted that the vast majority of these species appear on the ROW as sprouts from previously mowed or cut stumps, not from seed.

Coniferous trees (pines and spruce) are also found on the YEC system. They comprise about 40 - percent of the total tree workload. The two major species encountered are black spruce (Picea mariana) and lodgepole pine (Pinus contorta). These species occur on the ROW from seeds of adjacent trees off-ROW. These species do not re-sprout after being mowed or cut.

Figure 12 shows the re-growth rates (cm) by species. These measurements were taken at each ground sample point and are a composite of all lines/locations surveyed. As expected, the spruce and pine have the slowest re-growth rates. This is due to: 1) these species were established on the ROW by seed (not root suckers or stump re-sprouting) thus take longer to develop a root system that prompts more rapid growth; and 2) these are not particularly fast growing species, especially when compared to the deciduous species. The three deciduous species exhibited similar re-growth rates and can be considered together when determining vegetation management strategies and cycle lengths.

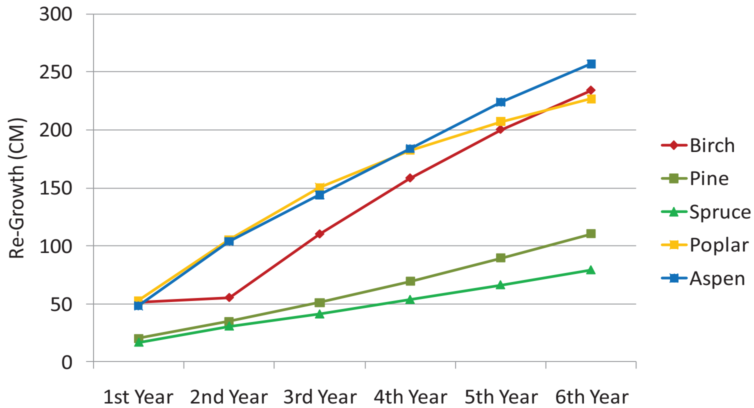


Figure 12. Re-Growth by Species.

Identification of Vegetation Problem Locations

Problem locations were broken into *critical* (need attention as soon as possible) and *priority* (require maintenance prior to the 2011 growing season). In addition, both potential danger and hazard trees were noted. These locations represent areas where vegetation represents a current threat to system reliability. ECI designated 63 locations (spans) on 3 lines as having a maintenance priority of "*Critical*" or needing immediate attention (Appendix B). Due to the absence of structure numbers visible from the air, ECI recorded GPS coordinates for the *critical* locations and reported them to YEC as they were observed. These locations, including a brief description of the vegetation that prompted the classification, are listed in Table 2. In addition to the *critical* locations, ECI found 272 "*priority*" locations (spans) on 8 lines that require vegetation work prior to the 2011 growing season. The approximate span location for these "priority" locations is found in Appendix C. *Critical* and *Priority* locations represent approximately 5 percent of the 7,000+ spans surveyed from the air.

Observations regarding problem locations were made as accurately as possible through aerial inspection. The ECI survey team was instructed to err on the side of caution due to the consequences of an interruption.

Overall Effectiveness of YEC's Current Vegetation Management

During the assessment, ECI observed vegetation conditions and management practices that varied within a ROW and among ROWs. In many cases, we found well-maintained corridors that reflected effective past and current practices. The lines that were in the worst condition were typically the lines that have gone the longest since last maintenance. These lines were also generally more inaccessible and had more adverse terrain, thus making mechanical maintenance difficult or impossible to accomplish.

This wide variation in ROW conditions is due to the historic nature of maintenance practices, i.e. "hot spotting". As previously discussed, YEC performs an annual survey to determine system conditions. Based on available budget, the "worst" (tallest/thickest brush) locations are selected for maintenance. This is basically a ROW reclamation or could be describe as a "just in time" maintenance program. While this concept has worked for utilities on distribution voltages, the risk is much higher on higher voltages and the consequences much worse if there is a vegetation cause interruption. In addition, by only performing vegetation maintenance on the areas with the highest brush density and size, maintenance costs are much higher than utilities experience where cyclic transmission maintenance is performed.

Some utilities have recently experienced problems when aerial inspection has failed to identify problem locations that subsequently resulted in grounding of a transmission line through a tree. System failure can have significant consequences. For this reason, a significant "margin for error" should be built into the transmission right-of-way vegetation management program to allow for some level of process failure without resultant operational failure of the transmission system.

"Margin for error" is sometimes too small – some trees are allowed to grow too close to conductors before scheduled maintenance

A small number of close clearance locations were observed by ECI on the YEC system. While as much as 10 feet of clearance may have existed at these locations at the time of YEC's routine inspection, some locations were observed by ECI with less than 10 feet of clearance (Figure 13). While it is likely that between ECI's and YEC's aerial patrol, most such locations have been identified, some utilities have found exclusive reliance on such patrols - especially at high flight speeds - to result in failure to record all problem locations.

Figure 13. Less than 3 meters clearance, L 250 spans 105-106.

Reliance on annual inspections to determine where maintenance should be performed next carries with it a measure of risk that is avoidable through a systematic vegetation management strategy. Figure 14 (L 169), is a location that is in need of maintenance. Situations like this illustrate how an overlooked span of brush could cause an outage. While line L 169 is not recommended for cyclic maintenance until 2013, the section in Figure 10 was listed as a "priority" location where maintenance should take place prior to the 2011 growing season. If maintenance is completed early in the season, before additional growth and periods of maximum line sag, situations such as this are typically uneventful. However, should weather or operational problems preclude completion of maintenance work as scheduled, risk of a transmission trip increases.

Figure 14. Line L 169, listed as priority location for maintenance within the next 6 months. Brush is 2.4M (8ft.) to 4.5 M (15ft.) in height. Last maintenance was via hot spot mowing in this location.

Maintenance Cycle Recommendations and Budget

Utilizing the information gathered in the aerial and ground survey and supplemented with line maintenance history provided by YEC, ECI developed a recommended cyclic maintenance schedule. The majority of YEC's vegetation effort in late 2010 and 2011 is being devoted to address the *Critical* and *Priority* locations identified. Starting in 2012, ECI's recommended cyclic schedule is based on the following considerations: voltage; maintenance priority code (MPC) from the survey; brush height and density as identified in the survey and budget considerations. In Appendix D ECI has developed several maintenance schedules based on various cycle lengths (7-year, 8-year and 10-year cycles). The first page of Appendix D is a 7-year schedule based on the ECI survey data utilizing the MPC to prioritize the lines from a cyclic standpoint. All cycle scenarios are based on a combination of incorporating IVM practices (i.e. herbicides), modifying contract strategy and maintaining fewer hectares of *priority* and *critical* brush (at the higher cost per hectare now being expended).

Budget and cycle assumptions:

- *Critical* and *Priority* work to be completed in 2010 and 2011: based on current YEC cost. (Approximately $4,000 per hectare).

- Moving to cyclic work in 2012-2013: production/cost was calculated on increasing contractor production as the height and density of brush will be significantly less. The assumption is that this will translate to a 30 percent decrease in cost from current $4,000/ hectare to approximately $2,800 / hectare. As the density and height of brush is reduced, mowing (where needed) can be performed with smaller, more cost efficient machines than the current hydro-axes. Also, lower density brush (fewer stems per hectare) requires less herbicide and more hectares can be treated for the same or lower cost.

- Cost/production for 2012 and beyond is based on higher production and maintenance of approximately 80 - percent of total ROW. This is based on the assumption that the remaining 20-percent does not require maintenance.
- Utilization of IVM principals and the inclusion of herbicides into the vegetation management program will further decrease future work (fewer stems per hectare) thus requiring far less effort when IVM is fully implemented on the YEC system. With the implementation of IVM there should be minimal mowing required in future cycles.
- A change in contracting methodology may also increase productivity and reduce cost.
- Second Cycle: Cost should be reduced by 18 to 29 - percent due to: 1) lower brush density; 2) less expense and effort on *Critical* and *Priority* locations; 3) herbicides use is a major component of the VM program; and 4) change in contracting strategy (refer to Net Present Value discussion and Appendix O).

Under YEC current maintenance strategy and practice (mowing and brushing crew), moving to a 10-year cyclic program may be cost prohibitive at $1,096,000[11] compared to the current expenditure of approximately $350,000 per year. Of the three ECI proposed maintenance cycles (7-year, 8-year and 10-year cycle), ECI recommends the 10-year cycle as the best fit for YEC. If YEC shifts to an IVM maintenance strategy and modifies contracting methodology, the maximum YEC should expect to spend approximately $500,000 - $672,000 per year with the 10-year cycle option. A vegetation management program that utilizes IVM as a key maintenance strategy will realize significant cost savings in the future as well as reducing the risk of vegetation caused grow-in interruptions to the high voltage system.

Recommended Industry Best Practices Strategies

Transmission owners need to develop practices that fulfill the requirements of the vegetation standard in a cost effective manner. These practices or strategies must be documented and consistently implemented. Over time, certain practices have been shown to be successful in preventing outages due to vegetation. Many of these practices were

[11] 2011 total hectares divided by 10 (a 10-yr. cycle) X current maintenance cost of $4,000/Ha.

incorporated into the NERC Standard FAC-003-1 since the group that developed and approved the standard included experienced transmission vegetation managers. The American National Standards Institute (ANSI) has established standards for vegetation maintenance on transmission ROW[12]. In addition, the international society of Arboriculture (ISA) has issued a companion publication to ANSI A300 Part 7, Best management practices, Integrated Vegetation Management.[13]

Work Management

WORK MANAGEMENT RECOMMENDATIONS

- **Develop and keep current a vegetation management plan.** Even though YEC is not subject to NERC standards, a transmission vegetation management plan (TVMP) is an extremely valuable tool to plan and implement both short-term and long-term vegetation management goals. A TVMP is the "road map" for vegetation management and provided direction and overview of system goals. It details how the work will be determined, planned and executed and provides a framework on how vegetation management will be implemented to ensure the reliability of the system. Annual plans are a subset of multi-year long-range plans. A plan will aid in developing budgets and tracking the work performed on individual lines. ECI has developed a draft TVMP for consideration by YEC.
- **Develop and keep a current work schedule.** The TVMP will detail systems and procedures for documenting and tracking the planned work. Plans are in need of constant update as work progresses. Updating will track work in progress and allow notice for any necessary adjustments.
- **Implement a system of inspecting planned work.** Documenting the inspection of completed work is also necessary to properly approve payment and ensure work reported as complete by the contractor meets YEC's expectations. Spot checks of completed work are commonly used with inspections of additional completed work when deficiencies are found. It is important to identify work that does not meet the standard early so that corrections can be made before more deficient work is completed. This will save time for both YEC and the contractor performing the work. Formal documentation of the work inspection is recommended.

[12] ANSI. 2006. The American National Standard for Tree Care Operations - *Tree, Shrub, and Other Woody Plant Maintenance- Standard practices (Integrated Vegetation Management a. Electric Utility Rights-of-way).* A 300 Part 7. American National Standards Institute, NY.

[13] Miller, R.H. 2007. Best Management Practices- Integrated Vegetation Management. International Society of Arboriculture, Champaign, Il.

- **Provide for consistent budgeting.** A consistent plan needs consistent funding. Budget reductions mid-year can cause workforce disruptions that increase future costs. Any changes to the established annual plan require documentation.
- **Establish and enforce work specifications.** The personnel performing the work must know exactly what is expected of them. The work inspector must know the specifications to properly enforce them. If future contract strategies are being considered, a clear, concise specification is required to communicate YEC vegetation maintenance goals to perspective contractors. The clearer the contract specification, the better the pricing from a perspective new contractor.
- **Develop action thresholds.** Develop a "clearance at time of maintenance" (clearance 1) distance and establish a minimum clearance threshold (clearance 2) that vegetation should never exceed. This threshold clearance will provide an additional margin of error to allow for vegetation growth, line sag and variations in maintenance cycles. Best practice utilities have developed an action threshold clearance value between Clearance 1 and Clearance 2 in order have a intermediate point to take appropriate action to avoid violating the vegetation standard. Another type of action threshold relates to the maximum height that brush[14] is allowed to attain to provide efficient and cost effective foliar application of herbicides. Since herbicide application is frequently less costly than mechanical clearing, it is important that brush is not allowed to grow taller than the maximum height 2.4 - 3.7 meters (8-12 feet) for effective herbicide use.
- **Develop a mitigation plan for exceptions/non-standard maintenance.** Keeping a record of locations where exceptions to standard practices exist is important to prevent outages or violations of YEC minimum acceptable clearance (between vegetation and conductors). An example would be where pruning is the only vegetation maintenance option allowed by the easement. The record should be specific as to the nature of the situation and regular inspection should be scheduled. Use of an automatic reminder system is recommended. Renegotiating or acquiring easements to eliminate clearance restrictions, payment for tree removal or replacing tall growing trees with compatible vegetation should be considered to eliminate the situation.
- **Develop standardized processes.** A uniform vegetation management plan for the entire YEC system is recommended.

[14] Brush is normally defined as immature (less than 10.2 cm or 4 inches in diameter), tall-growing tree species that would grow tall enough to interfere with conductors

- **Implement an integrated vegetation management program (IVM).** IVM is the art of controlling plant populations based on scientific principles from such fields as ecology, zoology and biology. Vegetation is managed to produce desired conditions (plant community density, structure and composition) and associated values consistent with stakeholder objectives on a sustainable basis. Stakeholders include both easement or fee holders, and all stakeholders and interested parties who may be influenced by IVM activities.
- **Manage the ROW by zones.** Managing the ROW in the zone immediately beneath the conductors differently from the rest of the ROW, known as the wire zone-border zone concept, is a successful approach to prevent outages in a cost effective manner (Figure 16), where sufficient ROW width is present. Different management techniques can be applied to these two zones and result in the many economic, operational and environmental benefits associated with the use of IVM techniques.

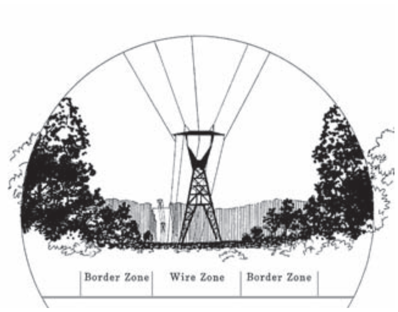


Figure 16. Wire Zone / Border Zone Vegetation Management.

- **Maintain the ROW edge**. Side trimming consists of trimming trees on the edge of the ROW. This work can be accomplished through the use of truck-mounted aerial lift equipment (bucket trucks), by manual climbing, or through the use of mechanical trimming equipment, such as a Jar raff or similar products.
- **Coordinate transmission work with related distribution work**. Occasionally distribution lines are found on the same ROW and even the same structures as a transmission line. Managing the vegetation simultaneously on both facilities can be cost effective. Problems can arise when different departments within the same company manage facilities with varying cycles, maintenance methods and budgets. The transmission maintenance organization should take the lead in coordinating and ensuring that the work is completed because a transmission outage has greater consequences than a distribution outage.

Integrated Vegetation Management

In Integrated Vegetation Management (IVM), the selection of control options is based on effectiveness, site characteristics, environmental impacts, safety, and economics. Good vegetation management is based on an understanding of plants and their environment. A holistic approach considers the inter-relationship of plants, site, and species composition and growth rates.

IVM is recognized as an industry best practice, and it is therefore recommended that YEC adopt this strategy for the maintenance of undesirable brush on its transmission and sub-transmission system. In general, this would be a combination of brushing, mechanical clearing (hydro-axe), and the use of herbicides to manage trees and bush on the YEC system.

Cutting deciduous brush without applying a follow-up herbicide application to the stump surface will permit the vegetation to re-sprout, thus requiring future maintenance. Trimming brush and/or allowing it to mature results in its becoming a more expensive and often permanent part of the workload. Trimming brush and the failure to use herbicides on cut stumps are not cost effective long term brush management techniques.

ECI recommends that YEC continue to fell trees and treat the deciduous cut-stumps of trees and brush with appropriate herbicides whenever possible. YEC should set minimum tree felling requirements as well as aggressively enforce the existing specifications for tree-felling and stump treatment. This will prevent future expansion of the system vegetation workload and future line clearance cost increases.

On most of the YEC ROW system, there appears to be an opportunity to treat standing brush less than 2.4 – 3.7 metres tall with either foliar or basal herbicide applications, avoiding hand cutting. Taller standing dead brush can become a source of complaints, and taller brush can be difficult to control with foliar applications without risking exposure to off-target plants. This use of a basal bark-applied herbicide would be a particularly valuable tool in the removal of tall-growing tree species growing in sensitive areas or where there is concern for off-target damage.

Use of herbicides is essential if YEC is to maximize the benefits of mechanical clearing and brushing. Herbicide use is an important component of an IVM strategy. YEC should develop specifications that require use of herbicides to treat stumps.

The effectiveness of selective herbicide applications has been well documented through long-term studies on utility rights-of-way in the central and northeastern United States. Results from treatment simulation models developed through these studies project that sites dominated by deciduous species would nearly double in stem density by the end of two cycles if simply cut without a follow-up herbicide application (Figure 17). These same sites would be expected to exhibit about a 50 percent reduction in stem density over the same time period if treated with a selective herbicide application.

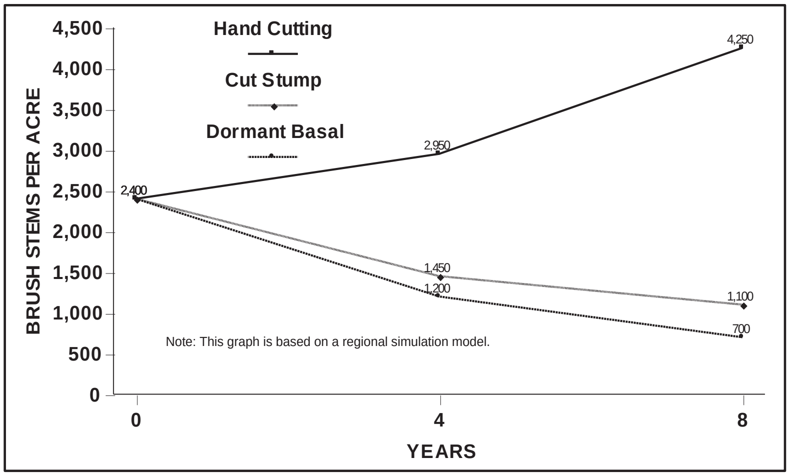


Figure 17. Effectiveness of Herbicides for Control of Brush Over Time. Results of long term study of brush management on utility rights-of-way in the northeast United States.

Currently, herbicides are not used in the control of ROW vegetation. This should be considered as it is an integral part of IVM program. An important consideration is that an herbicide program must be environmentally safe and professionally supervised to maintain public acceptance. Line clearance crews performing herbicide applications should receive proper training in species identification and herbicide application methods that are approved in Canada, (and Yukon) and deemed acceptable by the public and land owners.

It is recommended that YEC pursue the selective use of herbicides (e.g., foliar and basal) for the management of communities of deciduous brush species as a part of YEC IVM program. For a first step, it is suggested that YEC implement a study to look at design, cost-benefits and implementation of a comprehensive herbicide use program. This should include research into available products in Canada, other Canadian utilities experiences with herbicide program, and other Canadian private or public entities utilizing herbicides as a part of a comprehensive IVM program. The successful transition from no herbicide program to the use of herbicides as a part of YEC IVM will require professional supervision / oversight to ensure safe, effective application on appropriate species and sites. In addition, utilizing contractors trained and experienced in the use of herbicides in NW Canada will ensure a successful implementation of herbicides as a part of the YEC vegetation management program.

At a minimum, YEC should immediately implement the treatment of stumps with an appropriate, registered herbicide whenever possible, following removal of deciduous trees and brush. This should be monitored through a formal QA program to ensure this part of the specification is being followed. This would be a good first step in integrating herbicides into the YEC vegetation maintenance program. Figure 18 provides a comparison of herbicide spray application cost per hectare for various utilities in the Unites States and Canada as well as a bench-mark group of utilities. In 2010, YEC was spending approximately $4,000 per hectare to maintain ROW via mowing/manual cutting. In comparison, the use of herbicides as the primary Row maintenance tool is approximately $1,300 per hectare (22 utility average).

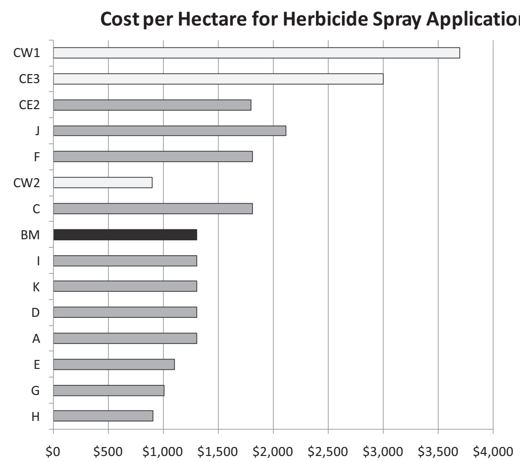


Figure 18. Cost per Hectare for Herbicide Spray Application.[15]

Herbicide Safety and Risk Assessments

Today's herbicides control tree/brush re-sprouting by blocking chemicals needed by plants to convert water, sunlight and nutrients into food for growth. Since these same chemicals are not present in animals and humans, the herbicides are very low in toxicity to people or animals. Without any food, the treated weed trees on the right-of-way wither and decompose. Treated stumps dry out and don't re-sprout.

[15] CE2, CE3=Eastern Canada utilities; CW1, CW2= Western Canada Utilities; BM= Avg. of 22 utilities, Canadian dollars, CPI adjusted to 2009 Dollars.

Safety for humans and the environment includes not causing adverse effects that are unacceptable. In this context, risk assessment is the process by which the likelihood of unacceptable adverse effects from the use of various methods of vegetation management can be determined.

An extensive report prepared by ECI provided the technical basis for and a summary of the risk to human health, wildlife and the environment from the use of 10 herbicides by a utility owner in the US. These herbicide uses included broadcast foliar, selective foliar, basal bark and cut stump applications. This assessment concluded that the margins of safety for herbicide use by the utility that commissioned the assessment were "adequate to assure protection of human health of workers and the general public."

ECI also completed an environmental impact statement resulting in the authorization of herbicides to control right-of-way vegetation in the Allegheny National Forest in Pennsylvania (US). Subsequent evaluation of herbicide use in the National Forest confirmed safe and effective use of foliar herbicides to control brush on utility right-of-way.

The human health risk assessment methodology used in these reports was the one generally recognized by the scientific community as necessary to characterize the potential adverse human health effects of chemicals in the environment. It is the same process used in judging the human health risk from cosmetics, food additives, pharmaceuticals, various household chemicals, and many other materials.

Herbicide Acceptance by Wildlife Groups in the United States

In the US, stump control herbicides are used not only by electric utilities, but also by numerous private and governmental wildlife habitat improvement organizations. Examples include:

- The Nature Conservancy on projects designed to limit the spread of invasive and non-native trees and shrubs. This would be similar to the efforts in the UK to eradicate the invasive plants Japanese Knotweed and Himalayan Balsam.
- Under the banner of an organization called Project Habitat®, groups such as the National Wild Turkey Federation, Buckmasters, Butterfly Lovers International and Quail Unlimited have joined together to encourage utilities to implement an "Integrated Vegetation Management" (IVM) approach to maintaining utility easements that appropriately utilizes herbicides as a component in the control of right-of-way vegetation. They have recognized that environmental benefits of herbicides, when properly used, outweigh any adverse risk and are

far more desirable than the alternatives to herbicide use, such as frequent mowing or hand cutting of undesirable trees.

Significant research has been undertaken over the past 30 years in the United States to document the impact of right-of-way herbicide use on the environment, wildlife and management costs. Much of this research has been conducted by ECI and its university research associates. Stems per hectare decrease over time through the use of herbicides, as does associated maintenance costs.

Brush control through the use of herbicides is an extremely cost effective maintenance tool. Figure 14 illustrates the successful use of herbicides by providing cost effective, environmentally acceptable and long-term brush control. Figures 19 - 21 provide examples of locations and line conditions on the YEC system where the use of herbicides would be an excellent maintenance prescription.

Figure 19. Example of good brush control through the use of herbicides (Wisconsin, U.S.).

Figure 20. L 356 – Perfect candidate for low volume herbicide application in the future.

Figure 21. L 250 – Excellent brush conditions (height and density) location for low-volume herbicide application within 1 - 2 growing seasons.

Utility Herbicide Use in Canada

There are numerous herbicides registered in Canada for use in vegetation control. "Tank mixing" of herbicides is possible to control a wider variety of unwanted vegetation than using only one herbicide (where and when permitted). In Canada, Integrated Pest Management (IMP) includes IVM. Herbicides use should be based on an IPM/IVM program includes scouting (for specific vegetation species, height, density and location), sensitive geographic features (streams, wetlands, etc.) as well as historical information on past maintenance practices. Scouting should also determine best application method and timing.

Herbicides are used in NW Canada successfully by utilities, railroads, gas line companies to name a few. There are numerous professional vegetation management associations in Canada that provide support and education opportunities in the environmentally safe use of herbicides in NW Canada. While mowing plays a role in vegetation control, mowing alone is not enough. Cutting off the plant tops promotes rapid re-sprouting and results in increased stem density. Mowing can be very hard on wildlife and can be dangerous to equipment operators as well. The selective use of herbicides controls the unwanted vegetation by targeting only the problem species. From registration of a new molecule to product registration takes approximately 4 years of testing and data collection. The Pest management Regulatory Agency (PMRA) oversees the process, balancing risks (human, environmental, operator) with the real need to providing applicators the products needed to safely manage unwanted vegetation on ROW's.
One of the numerous users of herbicides in NW Canada is AltaLink in Alberta[16]. AltaLink historically managed vegetation on a "just-in-time" approach via mowing. However, each year AltaLink had more hectares to maintain and the cost was constantly increasing. It was to the point that there were more areas requiring maintenance than available funds could support. Through a successful general tariff application (GTA), AltaLink received an initial budget increase from the regulator. Returning with more compelling evidence, AltaLink received a major funding increase in subsequent years. AltaLink had several tough years of increased budgets to re-claim the ROW, however, once the ROW was reclaimed, the maintenance costs were reduced. One of the tools used by AltaLink to more effectively and economically manage ROW vegetation was the use of herbicides. Once reclamation was completed via mowing, a follow-up application of herbicides ensured that there would be minimal re-sprouting of the undesirable vegetation. A combination of Garlon and Tordon[17] has AltaLink extend their cycle with a high degree of confidence that they would not have vegetation grow into the lines.

Environmental Considerations

The uses of herbicides on ROW's are a part of industry recognized best management practices. ECI understands the concern YEC has in implementing a herbicide program. ECI has contacted Mr. Travis Ritchie, Manager – Environment, Assessment and Licensing regarding concerns with implementing such a program. Issues that must be addressed and included in the implementation of a herbicide specification and policy include: Species At Risk Act (SARA); Migratory Birds Convention Act

[16] Transmission and Distribution World. Supplement to Transmission and Distribution magazine. June, 2010.
[17] Garlon and Tordon are registered products of Dow AgroSciences, both registered for use in Canada.

(Canada); Department of Fisheries & Oceans (DFO) – specifically issues related to Isolated Ponds, and maintenance of Riparian Vegetation in Existing ROW's; land owner notifications; buy-in from First Nation groups. As YEC ROW's have numerous stream crossing, wetlands, bogs and other wet areas of concern, much care should be taken in developing specifications for the use of herbicides in such areas.

While this seems like a huge effort, YEC will find the benefit in significantly reduced vegetation maintenance cost and improved system reliability (and peace of mind) to be well worth the effort. The current "just-in-time" management strategy has an associated high risk of potential grow-in vegetation outages. ECI suggests a team approach on this issue including potential members as Canadian herbicide contractors, other Canadian utilities utilizing herbicides, DFO representatives in addition to the appropriate YEC staff. ECI has been successful in leading such teams in the past at utilities that have not been utilizing herbicides.

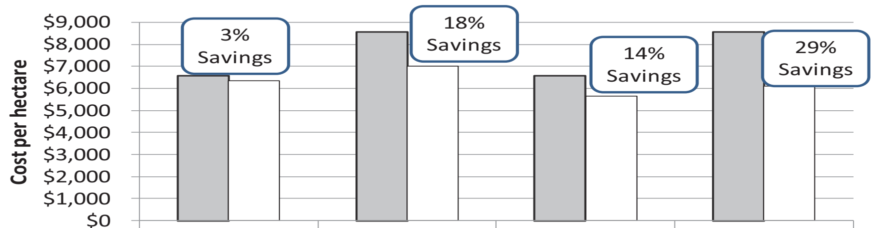
Mowing vs. IVM: Cost per Hectare Using Net Present Value Calculations

Beyond the environmental considerations of mowing vs. herbicide usage, the cost of each vegetation management practice should be considered both now and in the future. Using net present values calculations, the present cost of different management strategies with different maintenance cash flows over time can be compared, providing management with cost justifications for choosing one method over another.

ECI built a Net Present Value Table for a 20-year look at the cost of mowing vs. IVM (Appendix N). The table was based on YEC's current cost (mowing + brushing) at approximately $4,000 / hectare and herbicide cost (contractor experience in Alberta) for both high-volume (initial spray cycle @ high brush density) and low-volume (subsequent treatments @ lower brush density) applications using the high-cost range and the low-cost range for herbicide application. The IVM (herbicide) calculations include the initial cost of mowing and subsequent herbicide application cost (herbicide application two years after mowing then follow-up herbicide application on a 7-year cycle) over the 20-year period.

Table 3 presents a summary of the present value analysis that suggest that even when using high-cost estimates for herbicide application, IVM is less costly than mowing over both 10-year and 20-year time horizons.[18] [19]

[18] 2.13 % CPI source: CBO 10-year inflation forecast.
[19] 5.42 % Interest source: YEC cost of debt from 2011 business plan.



	PV (10yr) - High	PV (20yr) - High	PV (10yr) - Low	PV (20yr) - Low
Mowing	$6,558	$8,570	$6,558	$8,570
IVM	$6,357	$7,021	$5,645	$6,088

Mowing IVM

Table 3. Present Value of Mowing vs. IVM, for both high and low estimates of herbicide application costs.

Recommendations

ECI recommends the following:

1. Remove trees under the conductors in locations designated as *Critical* as soon as possible.
2. Remove trees under the conductors in locations designated as *Priority* before the next growing season (June 2011).
3. Remove all trees designated as Hazard over the next two years.
4. Establish a schedule of cyclic maintenance by right-of-way including separate schedules for *Critical*, *Priority* and Hazard tree locations.
5. Budget funds to address *Critical* locations as they are identified. This will be reduced each subsequent year of the maintenance cycle.
6. Establish a list or database of danger and hazard tree locations and develop a priority program to determine which trees should be removed first.
7. Develop vegetation maintenance clearance specifications for transmission and sub-transmission voltages and policy and standards specific to YEC needs and conditions. ECI has developed a draft TVMP for YEC's consideration.
8. Consider contracting alternatives to reduce maintenance cost as well as developing additional qualified vendors to perform vegetation maintenance on the YEC system (including herbicide application).
9. Implement Integrated Vegetation Management (IVM) as the guiding maintenance principle on the YEC system.
10. Establish an herbicide test plot area. Develop specification and guidelines on the use of herbicides on the YEC system. After an initial test period of various products and application methods and upon development of specification / procedures for herbicide use, (2012-2013), integrate the use of herbicides as a major component of the YEC vegetation maintenance program.

APPENDIX

Appendix A – List of Lines Inspected During Aerial Survey

YEC Line Survey

Line Number	Location-line name	Voltage	Kilometers	Number of Structures	Year Constructed	Construction Style
L 170	Takhini Substation-Faro	138 KV	365	1556	1968	wood H frame
L 169	Macintyre Tap to Whitehorse	138 KV	7	30	1980	wood H frame
L 175	Pelly Crossing - Stewart Crossing	138 KV	70	370	2010	wood H frame
L 173	Carmacks - Pelly Crossing	138 KV	110	552	2008	wood H frame
L 172	Takhini Switch Yard (Whitehorse) - Riverside Sub.	138 KV	25	112	1968	wood H frame
L 171	Takhini(Whitehorse)- Aishihik Riverside Sub - Takhini Switchyard (In Whitehorse)	138 KV	131	606	1976	wood H frame
L 250	Mayo - Keno City	69 KV	52	527	1982	wood H frame
L 174	Mayo - Dawson City (via Stewart Crossing)	66 KV	230	1688	2002	single pole
L 355	Aishihik - Haines Junction	25 KV	20KM Parallel to L171 34km Along highway to Haines Junction.	476	1976	single pole
L 356	Faro - Ross River	25 KV	60 KM	501	1978	wood H frame
S253-25F2	Minto Spur (Minto Landing west - Minto Mine) between Carmacks and Pelly Crossing	25 KV	29	337	2008	single pole
L 453	Mayo Town Feeder	25 KV	8	57	1963	single wood pole

Appendix B – List of Lines Classified as *Critical*

Line Number	Location-line name	Voltage	Construction Type	Priority 0 = Critical; before 2011
L 170B	Carmacks-Faro	138 KV	Wood H frame	37
L 250	Mayo-Keno City	69 KV	Wood H frame	15
	Mayo-Dawson City	66 KV	single wood pole	11
Total Spans of				**63**

Priority Color Code for Line Tabs

ROW vegetation category 0 (critical-before spring 2011)

Appendix C – List of Lines Classified as Priority

Line Number	Location-line Name	Voltage	Priority 1 = 2011
L 170A	Whitehorse-Carmacks	138 KV	23
L 170B	Carmacks-Faro	138 KV	45
L 169	MacIntyre-tap to Whitehorse	138 KV	24
L 172	Takhini-Riverside	138 KV	4
L 171	Takhini (Whitehorse)-Aishihik Riverside Sub- Takhini Switchyard (Whitehorse)	138 KV	4
L 250	Mayo-Keno City	69 KV	34
L 174	Mayo-Dawson	66 KV	84
L 355	Aishihik-Haines Junction	25 KV	38
L 356	Faro-Ross river	25 KV	16
Total Spans of Work			272

Priority Color Code for Line Tabs

ROW vegetation category 1 (2011)

Appendix D – Proposed Work Priority and Recommended Cycle Options and Estimated Cost

Work Priority Recommendation

Proposed 2012 Forward Work Schedule- 1st Cycle

(based on 2010 ECI Aerial/Ground survey)

Cycle Year	Recommended Maintenance Year	Line Number	Voltage	Width Meters (KM)	Span Length (KM)	Square KM per span	Line Length (KM)	SPANS (#)	Total Square KM	Total Hectares	Total Hectares Requiring Work
0	2010-2011	*Critical* work from ECI Survey		0.03	0.23	0.007		63	0.4347	43.47	43.47
0	2010-2011	*Priority* work from ECI Survey		0.03	0.23	0.007		272	1.8768	187.68	187.68
	TOTAL	2010 - 2011									
1A	2011-2012	L 356	25 KV	0.015	0.12	0.002	60	501	0.1080	10.8	8.64
1A	2011-2012	L 355	25 KV	0.015	0.12	0.002	55	310	0.5580	55.8	44.64
1A	2011-2012	L 171	138 KV	0.03	0.23	0.007	86	400	2.7600	276	220.80
	TOTAL	2011-2012									
2A	2012-2013	L 171	138 KV	0.03	0.23	0.007	45	206	1.4214	142.14	113.71
2A	2012-2013	L 169	138 KV	0.03	0.23	0.007	7	31	0.2139	21.39	17.11
2A	2012-2013	L 172	138 KV	0.03	0.23	0.007	25	116	0.8004	80.04	64.03
2A	2012-2013	L 250	69 KV	0.02	0.01	2E-04	52	531	0.1062	10.62	8.50
2A	2012-2013	L 453	25 KV	0.015	0.14	0.002	8	57	0.1197	11.97	9.58
	TOTAL	2012-2013									
3A	2013-2014	L 170A	138 KV	0.03	0.23	0.007	120	522	3.6018	360.18	288.14
	TOTAL	2013-2014									
4A	2014-2015	L 170A	138 KV	0.03	0.23	0.007	46	200	1.3800	138	110.40
4A	2014-2015	L 170B	138 KV	0.03	0.23	0.007	92	400	2.7600	276	220.80
	TOTAL	2014-2015									
5A	2015-2016	L 170B	138 KV	0.03	0.23	0.007	99	434	2.9946	299.46	239.57
5A	2015-2016	L 174	66 KV	0.02	0.14	0.003	230	500	1.4000	140	112.00
	TOTAL	2015-2016									
6A	2016-2017	L 174	66 KV	0.02	0.14	0.003	230	1230	3.4440	344.4	275.52
	TOTAL	2016-2017									
7A	2017-2018	L 173A	138 KV	0.03	0.2	0.006	110	552	3.3120	331.2	264.96
7A	2017-2018	S253-25F2	25 KV	0.015	0.09	0.001	29	336	0.4536	45.36	36.29
	TOTAL	2017-2018									

7-Year Cycle Option and Estimated Cost

7 Year Cycle- BY LINE BASED ON WORK PRIORITY 2013 Forward Work Schedule- 1st Cycle (COST IN 2010 DOLLARS- APPROXIMATELY 323 ha/yr)

Cycle Year	Recommended Maintenance Year	Line Number	Voltage	Width Meters (KM)	Span Length (KM)	Square KM per span	Line Length (KM)	SPANS (#)	Total Square KM	Total Hectres	Total Hectres Requiring Work	163 HA / YR Cost Estimate: Priority & Critical=$4,000/HA	COMMENTS
0	2010-2011	*Critical* work from ECI Survey 2010		0.03	0.23	0.0069		Critical 66	0.4554	45.54	45.00	**$180,000**	* **PRODUCTION:** Priority & Critical = 2 hectres / day (current rate of production); Scheduled $/H = 4 hectres / day **WORK SCOPE**- asume 80% of total spans require work
				0.03	0.23	0.0069		Priority 150	1.0350	103.5	104.00	**$416,000**	**66 total critical spans - from ECI survey 2010** **311 total priority spans - from ECI survey 2010**
		TOTAL 2010 - 2011						216			**149.00**	**$596,000**	
0	2011-2012	*Priority* work from ECI Survey 2010		0.03	0.23	0.0069		Priority 211	1.4559	145.59	146.00	**$584,000**	* **COST**: Critical & Priority: $4,000/H-based on current actual; Scheduled: $2,800/H - based on 30% production improvement (reduced work scope + use of herbicides + change in contract type)
		TOTAL 2011-2012						211			**146.00**	**$584,000**	**66 total critical spans - from ECI survey 2010** **311 total priority spans - from ECI survey 2010**
CYCLE # 1 12:00 AM	2012 - 2013	L 356	25 KV	0.015	0.12	0.0018	60	501	0.1080	10.8	8.64	**$24,192**	* COST: Scheduled: $2,800/H - based on 30% production improvement (reduced work scope + use of herbicides + change in contract type)
1	2012 - 2013	L 355	25 KV	0.015	0.12	0.0018	55	310	0.5580	55.8	44.64	**$124,992**	
1	2012 - 2013	L 171	138 KV	0.03	0.23	0.0069	109	500	3.4500	345	276.00	**$772,800**	L 171: Total KM=131, Total spans= 606
	TOTAL	**CYCLE1-YR 1**									**329.28**	**$921,984**	
CYCLE # 1 2	2013 - 2014	L 171	138 KV	0.03	0.23	0.0069	22	106	0.7314	73.14	58.51	**$163,834**	L 171: Total KM=131, Total spans= 606
2	2013 - 2014	L 169	138 KV	0.03	0.23	0.0069	7	31	0.2139	21.39	17.11	**$47,914**	
2	2013 - 2014	L 172	138 KV	0.03	0.23	0.0069	25	116	0.8004	80.04	64.03	**$179,290**	* COST: Scheduled: $2,800/H - based on 30% production improvement (reduced work scope + use of herbicides + change in contract type)
2	2013 - 2014	L 250	69 KV	0.02	0.01	0.0002	52	531	0.1062	10.62	8.50	**$23,789**	
2	2013 - 2014	L 453	25 KV	0.015	0.14	0.0021	8	57	0.1197	11.97	9.58	**$26,813**	
2	2013 - 2014	L 170A	138 KV	0.03	0.23	0.0069	70	300	2.0700	207	165.60	**$463,680**	
	TOTAL	**CYCLE 1-YR 2**									**323.33**	**$905,318**	
CYCLE # 1 3	2014-2015	L 170A	138 KV	0.03	0.23	0.0069	93	400	2.7600	276	220.80	**$618,240**	L 170A: Total KM=166; Total spans= 722
3	2014-2015	L 170B	138 KV	0.03	0.23	0.0069	41	180	1.2420	124.2	99.36	**$278,208**	
	TOTAL	**CYCLE 1-YR 3**									**320.16**	**$896,448**	* COST: Scheduled: $2,800/H - based on 30% production improvement (reduced work scope + use of herbicides + change in contract type)
CYCLE # 1 4	2015-2016	L 170B	138 KV	0.03	0.23	0.0069	149	654	4.5126	451.26	361.01	**$1,010,822**	L 170A: Total KM=166; Total spans= 722 L 170B: Total KM= 191; Total Spans= 834
	TOTAL	**CYCLE 1-YR 4**									**361.01**	**$1,010,822**	
CYCLE # 1 5	2016 - 2017	L 174	66 KV	0.02	0.14	0.0028	67	500	1.4000	140	112.00	**$313,600**	L 170B: Total KM= 191; Total Spans= 834 L 174: Total KM= 484;n Total Spans= 1730
5	2016 - 2017	L 174	66 KV	0.02	0.14	0.0028	135	1000	2.8000	280	224.00	**$627,200**	* COST: Scheduled: $2,800/H - based on 30% production improvement (reduced work scope + use of herbicides + change in contract type)
	TOTAL	**CYCLE 1-YR 5**									**336.00**	**$940,800**	
CYCLE # 1 6	2017-2018	L 174	66 KV	0.02	0.14	0.0028	31	230	0.6440	64.4	51.52	**$144,256**	L 174: Total KM= 484;n Total Spans= 1730
6	2017 - 2018	L 173A	138 KV	0.03	0.2	0.006	55	276	1.6560	165.6	132.48	**$370,944**	
	TOTAL	**CYCLE 1-YR 6**									**184.00**	**$515,200**	* COST: Scheduled: $2,800/H - based on 30% production improvement (reduced work scope + use of herbicides + change in contract type)
CYCLE # 1 7	2018 - 2019	L 173A	138 KV	0.03	0.2	0.006	55	276	1.6560	165.6	132.48	**$370,944**	
7	2018-2019	S253-25F2	25 KV	0.015	0.09	0.0014	29	336	0.4536	45.36	36.29	**$101,606**	* COST: Scheduled: $2,800/H - based on 30% production improvement (reduced work scope + use of herbicides + change in contract type)
	TOTAL	**CYCLE 1 YR 7**									**168.77**	**$472,550**	

CYCLE # 2	**7-year Cycle**			
Year of	**Cycle year**	***First Cycle Cost**	****Cost Estimate**	**Cost Assumptions**
1B	2019-2020	$921,984	$737,587	* **Assumption First Cycle**: scheduled cost=$2,800 / HA based on 30% production improvement + use of herbicides + change in contract type.
2B	2020-2021	$905,318	$678,989	
3B	2021-2022	$896,448	$672,336	****Assumptions Second Cycle**: reduced scope of work (lower brush height and stems per acre and fewer critical & priority locations) + incorporating the use of herbicides as a major part of VM program + change in contracting streategy = cost reduction of 20% over cycle 1.
4B	2022-2023	$1,010,822	$758,117	
5B	2023-2024	$940,800	$705,600	
6B	2024-2025	$515,200	$386,400	
7B	2025-2026	$472,550	$354,413	

8-Year Cycle Option and Estimated Cost

8 Year Cycle- BY LINE BASED ON WORK PRIORITY 2013 Forward Work Schedule- 1st Cycle (COST IN 2010 DOLLARS- APPROXIMATELY 283 ha/yr)

Cycle Year	Recommended Maintenance Year	Line Number	Voltage	Width Meters (KM)	Span Length (KM)	Square KM per span	Line Length (KM)	SPANS (#)	Total Square KM	Total Hectres	Total Hectres Requiring Work	163 HA / YR Cost Estimate: Priority & Critical=$4,000/HA	COMMENTS
0	2010-2011	*Critical* work from ECI Survey 2010		0.03	0.23	0.0069		Critical 66	0.4554	45.54	45.00	**$180,000**	* **PRODUCTION:** Priority & Critical = 2 hectres / day (current rate of production); Scheduled $/H = 4 hectres / day **WORK SCOPE**- asume 80% of total spans require work
				0.03	0.23	0.0069		Priority 150	1.0350	103.5	104.00	**$416,000**	**66 total critical spans - from ECI survey 2010** **311 total priority spans - from ECI survey 2010**
		TOTAL 2010 - 2011						216			**149.00**	**$596,000**	
0	2011-2012	*Priority* work from ECI Survey 2010		0.03	0.23	0.0069		Priority 211	1.4559	145.59	146.00	**$584,000**	* **COST**: Critical & Priority: $4,000/H-based on current actual; Scheduled: $2,800/H - based on 30% production improvement (reduced work scope + use of herbicides + change in contract type)
		TOTAL 2011-2012						211			**146.00**	**$584,000**	**66 total critical spans - from ECI survey 2010** **311 total priority spans - from ECI survey 2010**
CYCLE # 1 1A	2012 - 2013	L 356	25 KV	0.015	0.12	0.0018	60	501	0.1080	10.8	8.64	**$24,192**	* COST: Scheduled: $2,800/H - based on 30% production improvement (reduced work scope + use of herbicides + change in contract type)
1A	2012 - 2013	L 355	25 KV	0.015	0.12	0.0018	55	310	0.5580	55.8	44.64	**$124,992**	
1A	2012 - 2013	L 171	138 KV	0.03	0.23	0.0069	70	320	2.2080	220.8	176.64	**$494,592**	L 171: Total KM=131, Total spans= 606
	TOTAL	**CYCLE1-YR 1**									**229.92**	**$643,776**	
CYCLE # 1 2A	2013 - 2014	L 171	138 KV	0.03	0.23	0.0069	62	286	1.9734	197.34	157.87	**$442,042**	L 171: Total KM=131, Total spans= 606
2A	2013 - 2014	L 169	138 KV	0.03	0.23	0.0069	7	31	0.2139	21.39	17.11	**$47,914**	
2A	2013 - 2014	L 172	138 KV	0.03	0.23	0.0069	25	116	0.8004	80.04	64.03	**$179,290**	* COST: Scheduled: $2,800/H - based on 30% production improvement (reduced work scope + use of herbicides + change in contract type)
2A	2013 - 2014	L 250	69 KV	0.02	0.01	0.0002	52	531	0.1062	10.62	8.50	**$23,789**	
2A	2013 - 2014	L 453	25 KV	0.015	0.14	0.0021	8	57	0.1197	11.97	9.58	**$26,813**	
	TOTAL	**CYCLE 1-YR 2**									**257.09**	**$719,846**	
CYCLE # 1 3A	2014-2015	L 170A	138 KV	0.03	0.23	0.0069	93	400	2.7600	276	220.80	**$618,240**	L 170A: Total KM=166; Total spans= 722
	TOTAL	**CYCLE 1-YR 3**									**220.80**	**$618,240**	* COST: Scheduled: $2,800/H - based on 30% production improvement (reduced work scope + use of herbicides + change in contract type)
CYCLE # 1 4A	2015-2016	L 170 A	138 KV	0.03	0.23	0.0069	75	322	2.2218	222.18	177.74	**$497,683**	L 170A: Total KM=166; Total spans= 722 L 170B: Total KM= 191; Total Spans= 834
4A	2015-2016	L 170B	138 KV	0.03	0.23	0.0069	23	100	0.6900	69	55.20	**$154,560**	* COST: Scheduled: $2,800/H - based on 30% production improvement (reduced work scope + use of herbicides + change in contract type)
	TOTAL	**CYCLE 1-YR 4**									**232.94**	**$652,243**	
CYCLE # 1 5A	2016 - 2017	L 170B	138 KV	0.03	0.23	0.0069	85	375	2.5875	258.75	207.00	**$579,600**	L 170B: Total KM= 191; Total Spans= 834
	TOTAL	**CYCLE 1-YR 5**									**207.00**	**$579,600**	
6A	2016 - 2017	L 170B	138 KV	0.03	0.23	0.0069	82	359	2.4771	247.71	198.17	**$554,870**	
	TOTAL	**CYCLE 1-YR 6**									**198.17**	**$554,870**	
CYCLE # 1 7A	2017 - 2018	L 174	66 KV	0.02	0.14	0.0028	101	750	2.1000	210	168.00	**$470,400**	* COST: Scheduled: $2,800/H - based on 30% production improvement (reduced work scope + use of herbicides + change in contract type)
7A	2017 - 2018	L 173A	138 KV	0.03	0.2	0.006	20	100	0.6000	60	48.00	**$134,400**	
	TOTAL	**CYCLE 1-YR 7**									**216.00**	**$604,800**	
CYCLE # 1 8A	2018 - 2019	L 173A	138 KV	0.03	0.2	0.006	90	452	2.7120	271.2	216.96	**$607,488**	
8A		S253-25F2	25 KV	0.015	0.09	0.0014	29	336	0.4536	45.36	36.29	**$101,606**	
	TOTAL	**CYCLE 1 YR 8**									**253.25**	**$709,094**	

CYCLE # 2 **8-year Cycle**

Year of cycle	Cycle year	*First Cycle Cost Estimate	**Cost Estimate Second Cycle	Cost Assumptions
1B	2020 - 2021	$643,776	$515,021	* **Assumption First Cycle**: scheduled cost=$2,800 / HA based on 30% production improvement + use of herbicides + change in contract type. ****Assumptions Second Cycle**: reduced scope of w ork (low er brush height and stems per acre and few er critical & priority locations) + incorporating the use of herbicides as a major part of VM program + change in contracting streategy = cost reduction of 20% over cycle 1.
2B	2021 - 2022	$719,846	$539,885	
3B	2022 - 2023	$618,240	$463,680	
4B	2023 - 2024	$652,243	$489,182	
5B	2024 - 2025	$554,870	$416,153	
6B	2025 - 2026	$604,800	$453,600	
7B	2026 - 2027	$604,800	$453,600	
8B	2027 - 2028	$709,094	$531,821	

10-Year Cycle Option and Estimated Cost

10 Year Cycle- BY LINE BASED ON WORK PRIORITY 2013 Forward Work Schedule- 1st Cycle (COST IN 2010 DOLLARS- APPROXIMATELY 283 ha/yr)

Cycle Year	Recommended Maintenance Year	Line Number	Voltage	Width Meters (KM)	Span Length (KM)	Square KM per span	Line Length (KM)	SPANS (#)	Total Square KM	Total Hectres	Total Hectres Requiring Work	163 HA / YR Cost Estimate: Priority & Critical=$4,000/HA	COMMENTS
0	2010-2011	*Critical* work from ECI Survey 2010		0.03	0.23	0.0069		Critical 66	0.4554	45.54	45.00	**$180,000**	* **PRODUCTION:** Priority & Critical = 2 hectres / day (current rate of production); Scheduled $/H = 4 hectres / day **WORK SCOPE**- asume 80% of total spans require work
				0.03	0.23	0.0069		Priority 150	1.0350	103.5	104.00	**$416,000**	**66 total critical spans - from ECI survey 2010** **311 total priority spans - from ECI survey 2010**
		TOTAL 2010 - 2011						216			**149.00**	**$596,000**	
0	2011-2012	*Priority* work from ECI Survey 2010		0.03	0.23	0.0069		Priority 211	1.4559	145.59	146.00	**$584,000**	* **COST**: Critical & Priority: $4,000/H-based on current actual; Scheduled: $2,800/H - based on 30% production improvement (reduced work scope + use of herbicides + change in contract type)
		TOTAL 2011-2012						211			**146.00**	**$584,000**	**66 total critical spans - from ECI survey 2010** **311 total priority spans - from ECI survey 2010**
CYCLE # 1 1A	2012 - 2013	L 356	25 KV	0.015	0.12	0.0018	60	501	0.1080	10.8	8.64	**$24,192**	* COST: Scheduled: $2,800/H - based on 30% production improvement (reduced work scope + use of herbicides + change in contract type)
1A	2012 - 2013	L 355	25 KV	0.015	0.12	0.0018	55	310	0.5580	55.8	44.64	**$124,992**	
1A	2012 - 2013	L 171	138 KV	0.03	0.23	0.0069	50	230	1.5870	158.7	126.96	**$355,488**	L 171: Total KM=131, Total spans= 606
	TOTAL	**CYCLE1-YR 1**									**180.24**	**$504,672**	
CYCLE # 1 2A	2013 - 2014	L 171	138 KV	0.03	0.23	0.0069	82	376	2.5944	259.44	207.55	**$581,146**	L 171: Total KM=131, Total spans= 606
	TOTAL	**CYCLE 1-YR 2**									**207.55**	**$581,146**	
3A	2014-2015	L 169	138 KV	0.03	0.23	0.0069	7	31	0.2139	21.39	17.11	**$47,914**	
3A	2014-2015	L 172	138 KV	0.03	0.23	0.0069	25	116	0.8004	80.04	64.03	**$179,290**	
3A	2014-2015	L 250	69 KV	0.02	0.01	0.0002	52	531	0.1062	10.62	8.50	**$23,789**	
3A	2014-2015	L 453	25 KV	0.015	0.14	0.0021	8	57	0.1197	11.97	9.58	**$26,813**	* COST: Scheduled: $2,800/H - based on 30% production improvement (reduced work scope + use of herbicides + change in contract type)
3A	2014-2015	L 170A	138 KV	0.03	0.23	0.0069	35	150	1.0350	103.5	82.80	**$231,840**	
	TOTAL	**CYCLE 1-YR 3**									**182.02**	**$509,645**	
CYCLE # 1 4A	2015-2016	L 170A	138 KV	0.03	0.23	0.0069	76	325	2.2425	224.25	179.40	**$502,320**	
	TOTAL	**CYCLE 1-YR 4**									**179.40**	**$502,320**	
CYCLE # 1 5A	2016-2017	L 170 A	138 KV	0.03	0.23	0.0069	57	247	1.7043	170.43	136.34	**$381,763**	L 170A: Total KM=166; Total spans= 722
	2016-2017	L 170B	138 KV	0.03	0.23	0.0069	18	80	0.5520	55.2	44.16	**$123,648**	L 170B: Total KM= 191; Total Spans= 834
	TOTAL	**CYCLE 1-YR 5**									**180.50**	**$505,411**	
CYCLE # 1 6A	2017-2018	L 170B	138 KV	0.03	0.23	0.0069	80	350	2.4150	241.5	193.20	**$540,960**	L 170B: Total KM= 191; Total Spans= 834
	TOTAL	**CYCLE 1-YR 6**									**193.20**	**$540,960**	
7A	2018 - 2019	L 170B	138 KV	0.03	0.23	0.0069	92	404	2.7876	278.76	223.01	**$624,422**	* COST: Scheduled: $2,800/H - based on 30% production improvement (reduced work scope + use of herbicides + change in contract type)
	TOTAL	**CYCLE 1-YR 7**									**223.01**	**$624,422**	
CYCLE # 1 8A	2019 - 2020	L 174	66 KV	0.02	0.14	0.0028	101	750	2.1000	210	168.00	**$470,400**	* COST: Scheduled: $2,800/H - based on 30% production improvement (reduced work scope + use of herbicides + change in contract type)
8A	2019 - 2020	L 173A	138 KV	0.03	0.2	0.006	30	150	0.9000	90	72.00	**$201,600**	
	TOTAL	**CYCLE 1-YR 8**								**181**	**240.00**	**$672,000**	
CYCLE # 1 9A	2020 - 2021	L 173A	138 KV	0.03	0.2	0.006	80	402	2.4120	241.2	192.96	**$540,288**	* COST: Scheduled: $2,800/H - based on 30% production improvement (reduced work scope + use of herbicides + change in contract type)
	TOTAL	**CYCLE 1 YR 9**								**181**	**192.96**	**$540,288**	
CYCLE # 1		L 355	25 KV	0.015	0.09	0.00135	55	1976	2.6676	266.76	133.38	**$293,436**	SECOND TIME IN 10 YEAR- $2,200 / Ha and 50% w ork.
10A		S253-25F2	25 KV	0.015	0.09	0.00135	29	336	0.4536	45.36	36.29	**$101,606**	
	TOTAL	**CYCLE 1 YR 10**								**181**	**169.67**	**$395,042**	

CYCLE # 2	**10-year Cycle**			
Year of cycle	**Cycle year**	***First Cycle Cost Estimate**	****Cost Estimate Second Cycle**	**Cost Assumptions**
1B	2022 - 2023	$504,672	$403,738	* **Assumption First Cycle**: scheduled cost=$2,800 / HA based on 30% production improvement + use of herbicides + change in contract type. ****Assumptions Second Cycle**: reduced scope of w ork (low er brush height and stems per acre and few er critical & priority locations) + incorporating the use of herbicides as a major part of VM program + change in contracting streategy = cost reduction of 20% over cycle 1.
2B	2023 - 2024	$581,146	$464,916	
3B	2024 - 2025	$509,645	$407,716	
4B	2025 - 2026	$502,320	$401,856	
5B	2026 - 2027	$505,411	$404,329	
6B	2027 - 2028	$540,960	$432,768	
7B	2028 - 2029	$624,422	$499,538	
8B	2029 - 2030	$672,000	$537,600	
9B	2030 - 2031	$540,288	$432,230	
10B	2031 - 2032	$395,042	$316,034	

Appendix E – Industry Transmission VM Benchmark Comparisons[20]

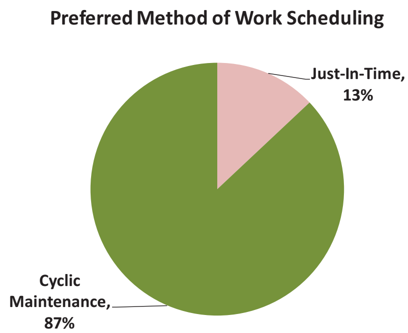


Figure M-1. Preferred Method of Vegetation Maintenance: Cyclic vs. Just-in-Time Based on Industry Benchmarking Study.

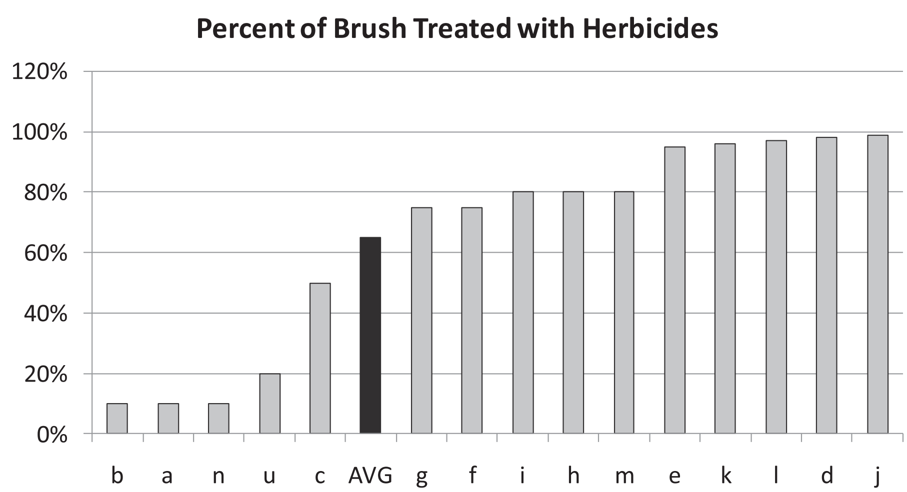


Figure M-2. Utility Comparison of Percentage of Total ROW Vegetation Maintenance Utilizing Herbicides (Acres treated).

[20] 22 Utility Benchmark Study in North America: transmission Results

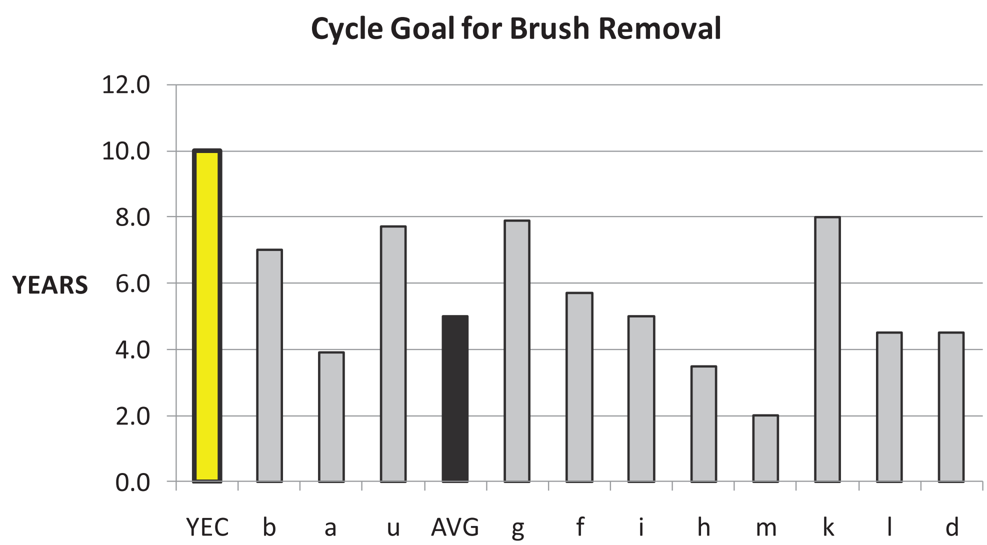


Figure M-3. Transmission ROW Vegetation Maintenance Cycle Goals for Various Utilities.

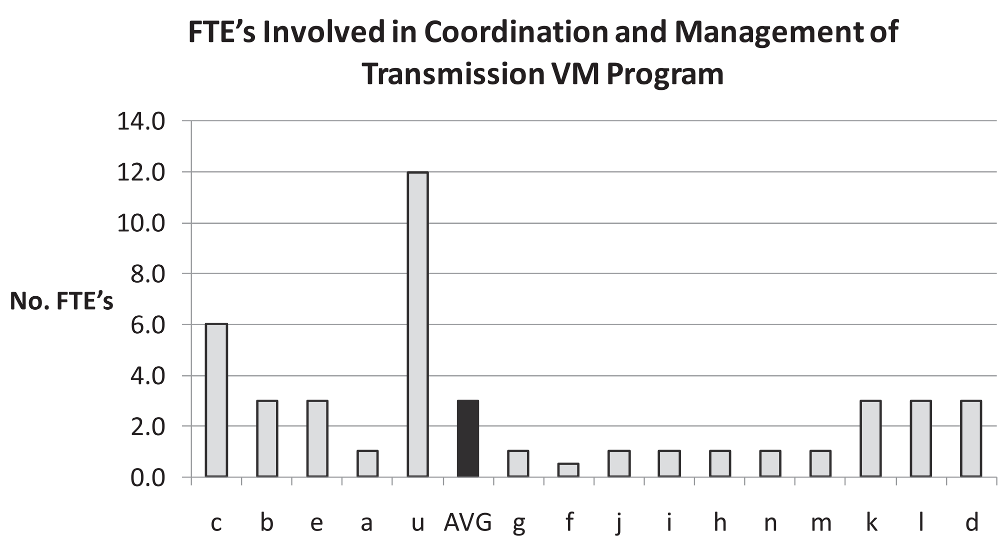


Figure M-4. Full-time Equivalents' Involved in the Coordination and Management of Transmission Vegetation Management for Various Utilities.

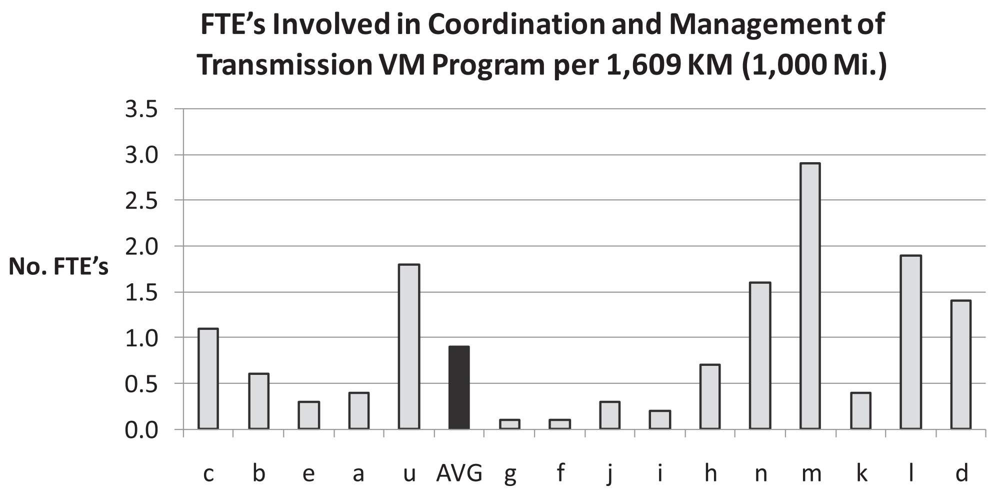


Figure M-5. Full-time Equivalents' Involved in the Coordination and Management of Transmission VM per 1,609 KM of ROW for Various Utilities.