

**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**





## **Yukon Energy Corporation Transmission Vegetation Condition Assessment**

Prepared for  
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## **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.

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### ***General Assessment***

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#### ***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.



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**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.



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## 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<sup>1</sup> and danger<sup>2</sup> 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.

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<sup>1</sup> Hazard tree: any tree that could contact the conductor if it fell.

<sup>2</sup> Danger tree: tree predisposed to failure due to disease, structure, dead or in decline, lean or soil conditions.



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## 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



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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 from 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.).

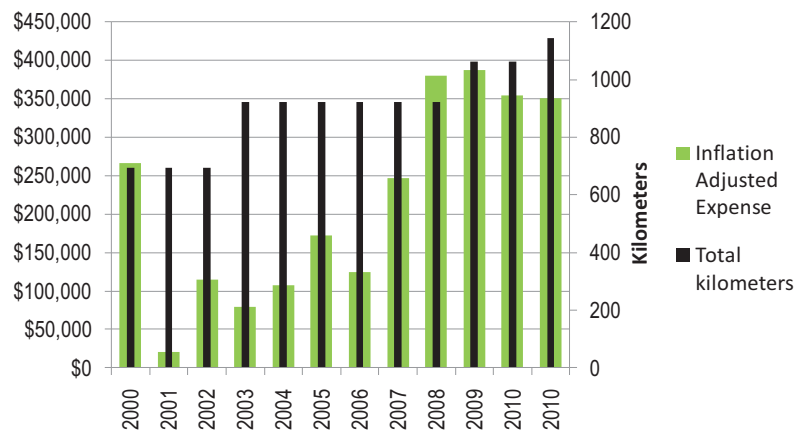
YEC is doing an admirable job in managing transmission vegetation with a limited budget. The size of the annual budget has necessitated a “just-in-time” approach to vegetation maintenance. The current maintenance practice of “just in time” or “hot spot” mowing and brushing has resulted in a system that 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,



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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<sup>3</sup> 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

<sup>3</sup> CPI adjusted to 2009 Dollars.



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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<sup>4</sup>. Figure 3 provides a cost comparison of numerous US and Canadian utilities, a 22 utility benchmark average and YEC mechanical mowing + brushing cost.

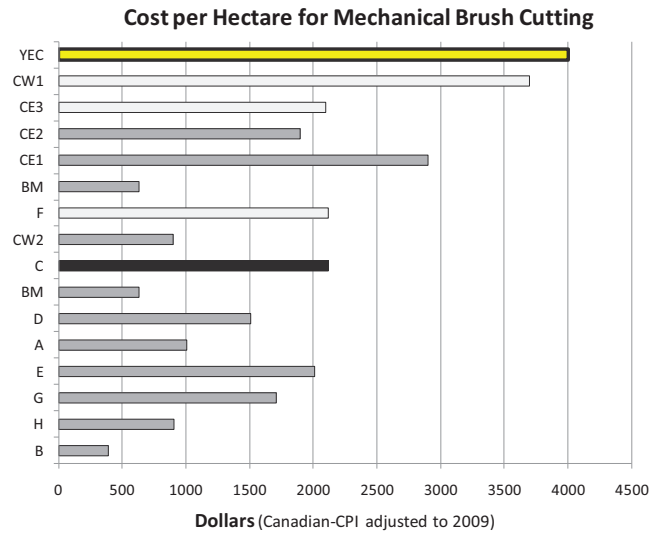
TREATMENT	UTILITY	COST PER UNIT
		HECTARE
Ground Foliar Herbicide	NW Canadian utility	\$680 - \$1,200
Basal Herbicide	NW Canadian utility	\$880 - \$1,500
Cut Stump Herbicide	NW Canadian utility	\$5,900 - \$8,800
Aerial herbicide	NW Canadian utility	\$700 - \$1,200
High-volume herbicide	Alberta	\$2,500 - \$3,000
Low-volume herbicide (1 <sup>st</sup> cycle)	Alberta	\$1,500 - \$2,000
Low-volume herbicide (2 <sup>nd</sup> 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
<b>Mowing (hydro-axe)</b>	<b>Yukon</b>	<b>\$4,000</b>

Figure 2. Cost per Hectare for Various ROW Maintenance Types<sup>5</sup>.

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



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**Figure 3. Cost per Hectare for Mechanical Brush Cutting.<sup>6</sup>**

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 (1/10<sup>th</sup> 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.

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

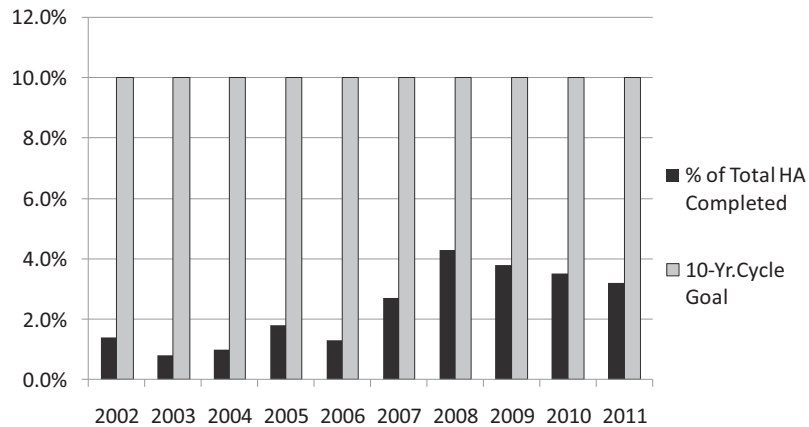


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Year	Actual Expense	Expenses (CPI adjusted to 2009 dollars)	TOTAL SYSTEM KM	Width KM	Total Sq KM	TOTAL Hectares (est.)	TOTAL Hectares to Maintain * (80% of total)	2010 Maint. Cost / Hectare**	Hectares maintained (based on \$ expended)	Percent of Total 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
<b>Notes:</b> * 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**

**Annual % of Total HA. Completed vs. 10-Year Cycle Goal**



**Figure 4. YEC Total Hectare Completed vs. 10-Year cycle Goal.<sup>7</sup>**

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



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## 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.

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### 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



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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).**



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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).





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

Priority Order	Line Number	Voltage	Priority Work Type			Hazard Trees	Notes:
			MPC "0" Critical (spans)	MPC "1" Priority (spans)	Hazard Tree Spans		
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: <b>NUMEROUS DEAD TREES AT EDGE OF ROW</b>
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.)



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**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<sup>8</sup>, brush height<sup>9</sup>, 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)<sup>10</sup> 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).**

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<sup>8</sup> 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.

<sup>9</sup> 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.

<sup>10</sup> 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.



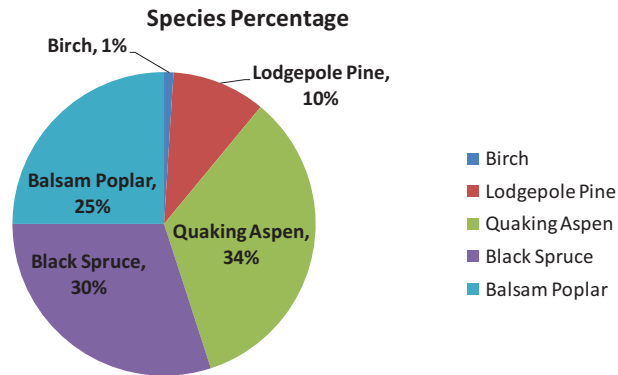
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**Figure 10. Typical ground view of ROW showing ground and edge conditions, maintenance required within 1 year (Line L 169). Note multiple stems re-sprouting from previously cut stump in lower right corner of photo.**

### 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



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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.

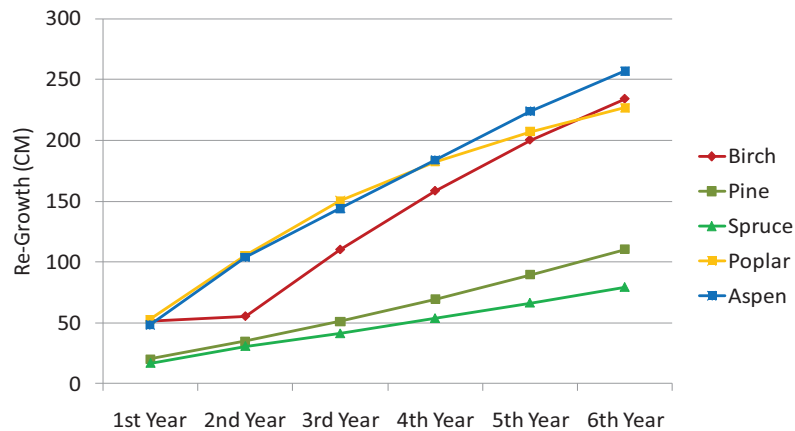


Figure 12. Re-Growth by Species.

### 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



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“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.



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“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.



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**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



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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<sup>11</sup> 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

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



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**Work  
Management**

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<sup>12</sup>. In addition, the international society of Arboriculture (ISA) has issued a companion publication to ANSI A300 Part 7, Best management practices, Integrated Vegetation Management.<sup>13</sup>

### **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.

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<sup>12</sup> 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.

<sup>13</sup> Miller, R.H. 2007. *Best Management Practices- Integrated Vegetation Management*. International Society of Arboriculture, Champaign, IL.



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- **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 to have an intermediate point to take appropriate action to avoid violating the vegetation standard. Another type of action threshold relates to the maximum height that brush<sup>14</sup> 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.

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<sup>14</sup> 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



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- **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.

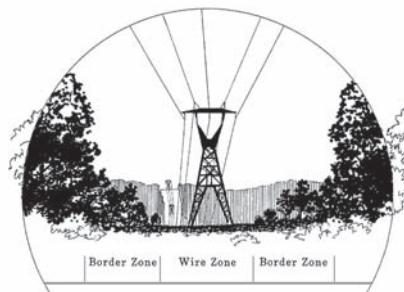


Figure 16. Wire Zone / Border Zone Vegetation Management.

- **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.



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**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.

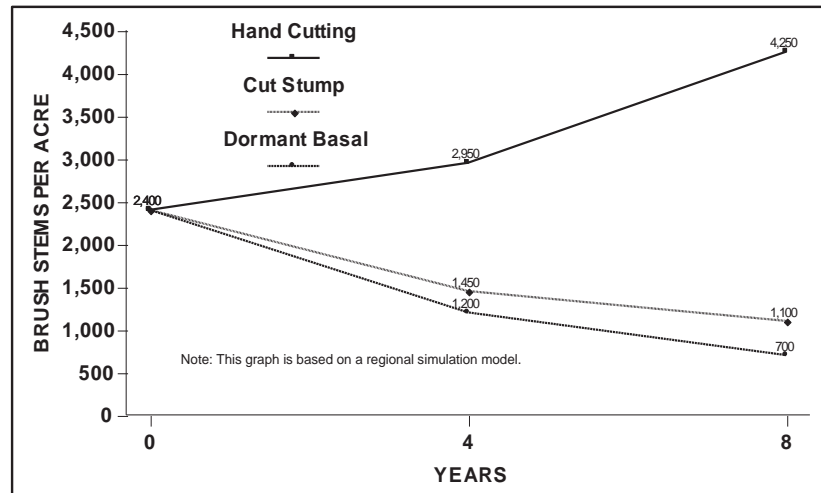
Use of herbicides is essential if YEC is to maximize the benefits of mechanical clearing and brushing. Herbicide use is an important component of an IVM strategy. YEC should develop specifications that require use of herbicides to treat stumps.

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



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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



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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 United 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).

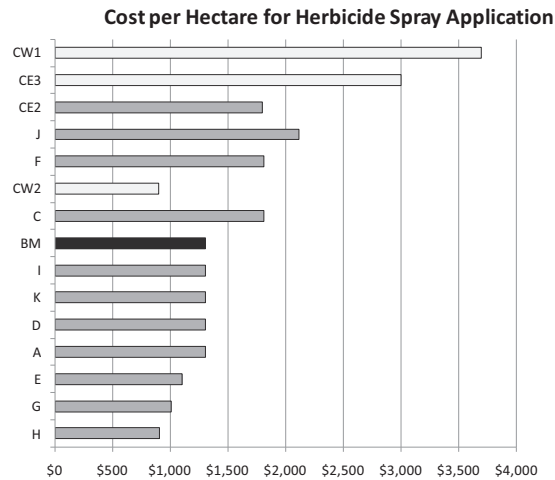


Figure 18. Cost per Hectare for Herbicide Spray Application.<sup>15</sup>

**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.

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



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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.

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**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



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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.).**



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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.

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**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 (IPM) 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



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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<sup>16</sup>. 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<sup>17</sup> has AltaLink extend their cycle with a high degree of confidence that they would not have vegetation grow into the lines.

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**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

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<sup>16</sup> Transmission and Distribution World. Supplement to Transmission and Distribution magazine. June, 2010.

<sup>17</sup> Garlon and Tordon are registered products of Dow AgroSciences, both registered for use in Canada.



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(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.

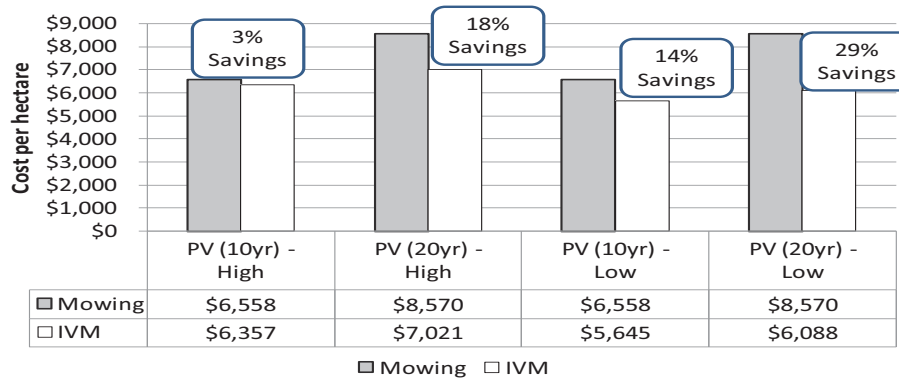
Table 3 presents a summary of the present value analysis that suggest that even when using high-cost estimates for herbicide application, IVM is less costly than mowing over both 10-year and 20-year time horizons.<sup>18 19</sup>

<sup>18</sup> 2.13 % CPI source: CBO 10-year inflation forecast.

<sup>19</sup> 5.42 % Interest source: YEC cost of debt from 2011 business plan.



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**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.



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## APPENDIX



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## 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



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**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
<b>Total Spans of</b>				<b>63</b>

**Priority Color Code for Line Tabs**

 ROW vegetation category 0 (critical-before spring 2011)



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**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)



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## 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
<b>TOTAL</b>		<b>2010 - 2011</b>									
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
<b>TOTAL</b>		<b>2011-2012</b>									
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
<b>TOTAL</b>		<b>2012-2013</b>									
3A	2013-2014	L 170A	138 KV	0.03	0.23	0.007	120	522	3.6018	360.18	288.14
<b>TOTAL</b>		<b>2013-2014</b>									
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
<b>TOTAL</b>		<b>2014-2015</b>									
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
<b>TOTAL</b>		<b>2015-2016</b>									
6A	2016-2017	L 174	66 KV	0.02	0.14	0.003	230	1230	3.4440	344.4	275.52
<b>TOTAL</b>		<b>2016-2017</b>									
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
<b>TOTAL</b>		<b>2017-2018</b>									



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**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		66	0.4554	45.54	45.00	\$180,000	* PRODUCTION: Priority & Critical = 2 hectres / day (current rate of production); Scheduled 5/H = 4 hectres / day WORK SCOPE- assume 80% of total spans require work
				0.03	0.23	0.0069		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
		<b>TOTAL 2010 - 2011</b>						<b>216</b>			<b>149.00</b>	<b>\$596,000</b>	
0	2011-2012	Priority work from ECI Survey 2010		0.03	0.23	0.0069		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)
		<b>TOTAL 2011-2012</b>						<b>211</b>			<b>146.00</b>	<b>\$584,000</b>	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
		<b>TOTAL CYCLE1-YR 1</b>									<b>329.28</b>	<b>\$921,984</b>	
CYCLE # 1	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	
		<b>TOTAL CYCLE 1-YR 2</b>									<b>323.33</b>	<b>\$905,318</b>	
CYCLE # 1	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	
		<b>TOTAL CYCLE 1-YR 3</b>									<b>320.16</b>	<b>\$896,448</b>	* COST: Scheduled: \$2,800/H - based on 30% production improvement (reduced work scope + use of herbicides + change in contract type)
CYCLE # 1	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
		<b>TOTAL CYCLE 1-YR 4</b>									<b>361.01</b>	<b>\$1,010,822</b>	
CYCLE # 1	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)
		<b>TOTAL CYCLE 1-YR 5</b>									<b>336.00</b>	<b>\$940,800</b>	
CYCLE # 1	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	
		<b>TOTAL CYCLE 1-YR 6</b>									<b>184.00</b>	<b>\$515,200</b>	* COST: Scheduled: \$2,800/H - based on 30% production improvement (reduced work scope + use of herbicides + change in contract type)
CYCLE # 1	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)
		<b>TOTAL CYCLE 1 YR 7</b>									<b>168.77</b>	<b>\$472,550</b>	

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	**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 strategy = cost reduction of 20% over cycle 1.
3B	2021-2022	\$896,448	\$672,336	
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	



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**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 hectares / day (current rate of production); Scheduled \$/H = 4 hectares / day WORK SCOPE: assume 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
		<b>TOTAL 2010 - 2011</b>						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)
		<b>TOTAL 2011-2012</b>						211			146.00	\$584,000	66 total critical spans - from ECI survey 2010 311 total priority spans - from ECI survey 2010
<b>CYCLE # 1</b>													
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
		<b>TOTAL CYCLE1-YR 1</b>									229.92	\$643,776	
<b>CYCLE # 1</b>													
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	
		<b>TOTAL CYCLE1-YR 2</b>									257.09	\$719,846	
<b>CYCLE # 1</b>													
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 * COST: Scheduled: \$2,800/H - based on 30% production improvement (reduced work scope + use of herbicides + change in contract type)
		<b>TOTAL CYCLE1-YR 3</b>									220.80	\$618,240	
<b>CYCLE # 1</b>													
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 * COST: Scheduled: \$2,800/H - based on 30% production improvement (reduced work scope + use of herbicides + change in contract type)
4A	2015-2016	L 170B	138 KV	0.03	0.23	0.0069	23	100	0.6900	69	55.20	\$154,560	
		<b>TOTAL CYCLE1-YR 4</b>									232.94	\$652,243	
<b>CYCLE # 1</b>													
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
		<b>TOTAL CYCLE1-YR 5</b>									207.00	\$579,600	
<b>CYCLE # 1</b>													
6A	2016 - 2017	L 170B	138 KV	0.03	0.23	0.0069	82	359	2.4771	247.71	198.17	\$554,870	
		<b>TOTAL CYCLE1-YR 6</b>									198.17	\$554,870	
<b>CYCLE # 1</b>													
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	
		<b>TOTAL CYCLE1-YR 7</b>									216.00	\$604,800	
<b>CYCLE # 1</b>													
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	
		<b>TOTAL CYCLE1 YR 8</b>									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	\$615,021	* 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 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 strategy = cost reduction of 20% over cycle 1.
2B	2021 - 2022	\$719,846	\$539,885	
3B	2022 - 2023	\$618,240	\$463,690	
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	



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**10-Year Cycle Option  
and Estimated Cost**

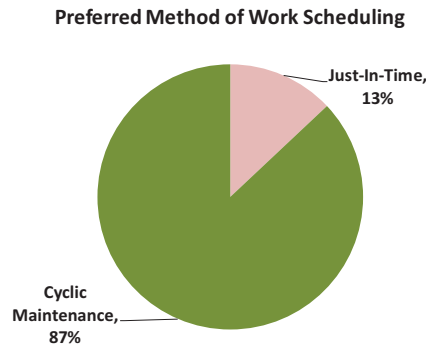
10 Year Cycle- BY LINE BASED ON WORK PRIORITY 2013 Forward Work Schedule- 1st Cycle (COST IN 2010 DOLLARS- APPROXIMATELY 283 h/yr)														
Cycle Year	Recommended Maintenance Year	Line Number	Voltage	Width Meters (KM)	Span Length (KM)	Square KM per span	Line Length (KM)	SPANS (#)	Total Square KM	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		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: assume 80% of total spans require work	
				0.03	0.23	0.0069		150	1.0350	103.5	104.00	\$416,000	66 total critical spans - from ECI survey 2010	
		<b>TOTAL 2010 - 2011</b>						<b>216</b>			<b>149.00</b>	<b>\$596,000</b>	311 total priority spans - from ECI survey 2010	
0	2011-2012	Priority work from ECI Survey 2010		0.03	0.23	0.0069		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)	
		<b>TOTAL 2011-2012</b>						<b>211</b>			<b>146.00</b>	<b>\$584,000</b>	66 total critical spans - from ECI survey 2010	
													311 total priority spans - from ECI survey 2010	
CYCLE # 1	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	
		<b>TOTAL CYCLE 1-YR 1</b>									<b>180.24</b>	<b>\$504,672</b>		
CYCLE # 1	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	
		<b>TOTAL CYCLE 1-YR 2</b>									<b>207.55</b>	<b>\$581,146</b>		
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		
		<b>TOTAL CYCLE 1-YR 3</b>									<b>182.02</b>	<b>\$509,645</b>		
CYCLE # 1	2015-2016	L 170A	138 KV	0.03	0.23	0.0069	76	325	2.2425	224.25	179.40	\$502,320		
		<b>TOTAL CYCLE 1-YR 4</b>									<b>179.40</b>	<b>\$502,320</b>		
CYCLE # 1	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	
		<b>TOTAL CYCLE 1-YR 5</b>									<b>180.50</b>	<b>\$505,411</b>		
CYCLE # 1	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	
		<b>TOTAL CYCLE 1-YR 6</b>									<b>193.20</b>	<b>\$540,960</b>		
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)	
		<b>TOTAL CYCLE 1-YR 7</b>									<b>223.01</b>	<b>\$624,422</b>		
CYCLE # 1	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		
		<b>TOTAL CYCLE 1-YR 8</b>									<b>181</b>	<b>240.00</b>	<b>\$672,000</b>	
CYCLE # 1	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)	
		<b>TOTAL CYCLE 1-YR 9</b>									<b>181</b>	<b>192.96</b>	<b>\$540,288</b>	
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% work.	
10A		S253-25F2	25 KV	0.015	0.09	0.00135	29	336	0.4536	45.36	36.29	\$101,606		
		<b>TOTAL CYCLE 1-YR 10</b>									<b>181</b>	<b>169.67</b>	<b>\$395,042</b>	

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 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 strategy = 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	\$640,288	\$432,230	
10B	2031 - 2032	\$395,042	\$316,034	

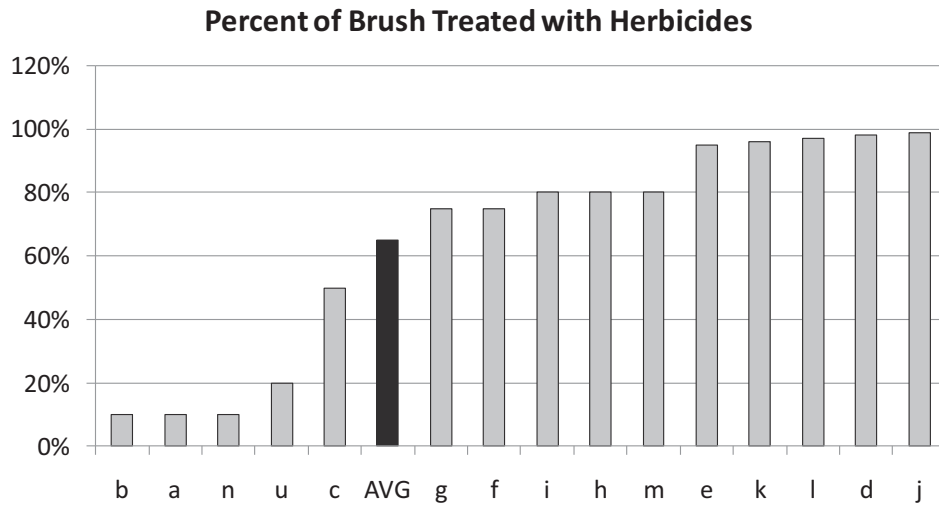


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## Appendix E – Industry Transmission VM Benchmark Comparisons<sup>20</sup>



**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).**

<sup>20</sup> 22 Utility Benchmark Study in North America: transmission Results



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### Cycle Goal for Brush Removal

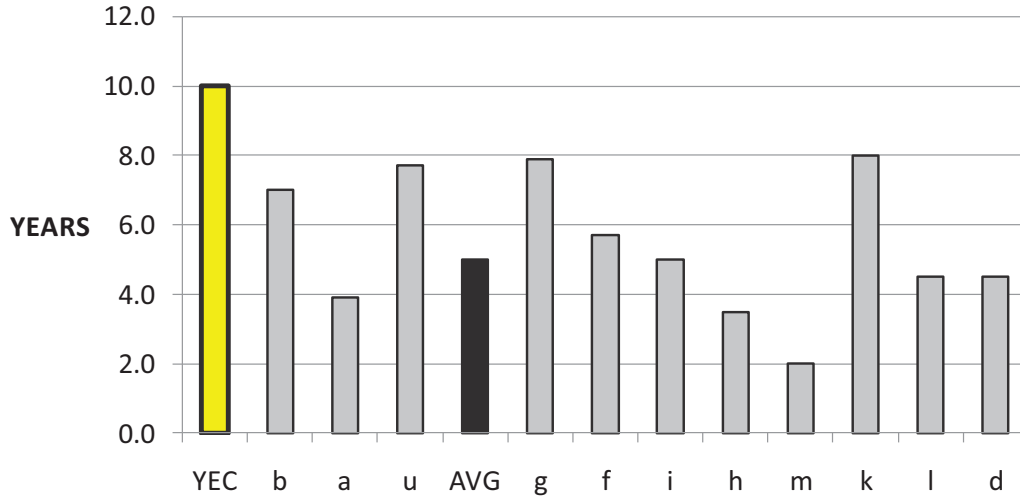


Figure M-3. Transmission ROW Vegetation Maintenance Cycle Goals for Various Utilities.

### FTE's Involved in Coordination and Management of Transmission VM Program

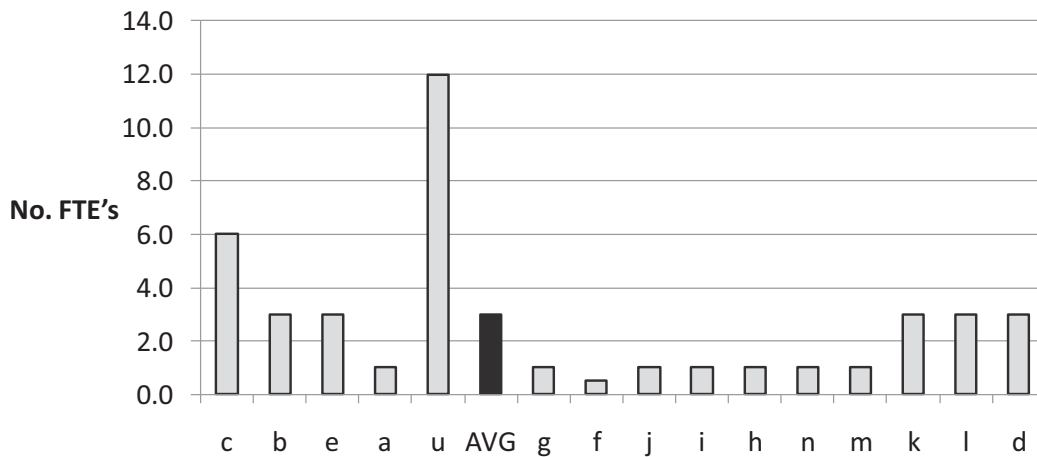


Figure M-4. Full-time Equivalents' Involved in the Coordination and Management of Transmission Vegetation Management for Various Utilities.



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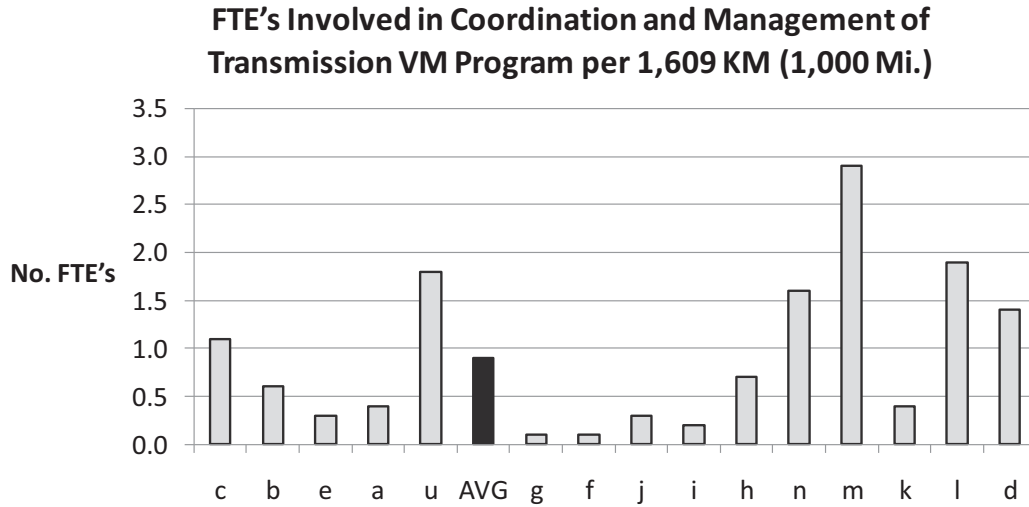


Figure M-5. Full-time Equivalents' Involved in the Coordination and Management of Transmission VM per 1,609 KM of ROW for Various Utilities.



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**APPENDIX 12.3**  
**POWER AND UTILITY SURVEY REPORT**





## Power and Utility Survey Results – Self Funding Vehicles

November 2010

*prepared by*

**Aon Reed Stenhouse Inc.**

## Introduction

As Canada's leading insurance brokerage and risk management firm, Aon Reed Stenhouse services commercial and personal lines clients through a network of offices from coast to coast. An organization with strong Canadian roots, our specialists have been meeting the insurance and risk management needs of Canadians for more than a century.

Aon Reed Stenhouse is committed to developing superior financial and insurance products as well as providing improved, more cost-effective ways of dealing with risk. Our determination to create new opportunities for our clients puts us at the leading edge of our business and sets new standards for our industry.

This report is based on survey data collected in 2010, capturing the perspectives of twelve (12 ) power and utility corporations across Canada. The purpose of the report is to understand each corporation's appetite for retaining risk, the maturity of their risk management processes and details on any self funding mechanisms they may have in place.

Having insight into one's peer group can help a corporation benchmark their own decisions. If a company is outside the norm, this could be the result of various circumstances. Some of these may include a company's structural characteristics, for example their size or type of organization (public versus government), their appetite for risk or their corporate culture.

If you have any questions or comments about the survey or these findings, please contact your local Aon account manager.

Best Regards,

Ed Anhalt  
Senior Vice President  
Aon Reed Stenhouse

## Executive Summary

Aon surveyed twelve (12) power and utility corporations through emails and telephone interviews. Of these twelve (12), there were ten (10) public utility companies and two (2) publicly traded companies. Within this group, 42% of these companies retained less than \$1 Million in property deductibles and 33% of those surveyed retained between \$250,000 - \$1,000,000 in liability deductibles.

We also learned that 75% of these companies had performed a risk assessment and over 83% had performed some type of Enterprise Risk Management.

In terms of pre or post loss funding mechanism, seven (7) of the twelve (12) had developed some type of contingent reserve fund. Most of the government companies had a post funding mechanism where they were able to recover losses from the public through a consumer rate adjustment. Interestingly over 83% of those surveyed had not conducted any formal study to determine the feasibility of a contingent reserve fund.

Of the 42% of respondents who had developed a pre loss self funding vehicle, it varied widely by company as to which department was assigned to administer the funds.

Companies who have either a pre loss or post loss contingency reserve have various ways of determining the level of funding. These include historical costs and statistical information, post loss reserves, loss adjusters and approval by the utility commission.

Another question we asked of companies was how frequently funds were being transferred into the reserve. Again, there were a variety of answers however annually generally tended to be the norm. The calculations of the amount to be transferred were also performed by a variety of departments including internal finance staff, loss adjusters, the treasury department, legal & finance or the utility commission.

A further question asked of those surveyed was the loss criteria required to access funds from the reserve. Once again the criteria varied widely from: only liability claims, to any insured losses within the deductible, to all uninsured losses. Of the losses that do qualify, the minimum threshold below which the loss is considered to be operational risk included: \$1000 based on a decision made by management, \$100,000 determined through historical loss records, anything under deductible as determined by an actuary and \$1 Million dollars.

Over 63% of the respondents continue to utilize some form of contingent reserve fund today.

For those companies who do not have a pre loss self funding vehicle, the reasons for not going forward were: currently expensing losses, the decision was based on the current asset mix and geographic locations of facilities, government guarantees allow companies to collect losses from the rate payers, and not allowed by the commission to have a pre loss funded vehicle.

Lastly, 67% of those surveyed had considered a captive but most for various reasons did not go through with it. Those reasons included: no tax savings for them, too expensive, never had problems obtaining good coverage.

## Appendix – Survey Results

### *Question 1: Are you?*

<b>Type of Company</b>	<b>Response %</b>
Public Utility Company	83.3%
Publically Traded Company	16.7%

### *Question 2: Is the deductible under your property insurance?*

<b>Deductible</b>	<b>Response %</b>
< \$1 Million	41.7%
\$1 Million to \$5 Million	16.7%
\$5 Million to \$25 Million	25.0%
> \$25 Million	16.7%

### *Question 3: Is the deductible under your liability insurance?*

<b>Liability Deductible</b>	<b>Response Percent</b>
<\$250,000	25.0%
\$250,000 - \$1 Million	33.3%
\$1 Million - \$5 Million	25.0%
Above \$5 Million	16.7%

### *Question 4: Has your company performed a company risk assessment?*

<b>Answer</b>	<b>Response Percent</b>
Yes	75.0%
No	16.7%
n/a	8.3%

### *Question 5: Has your company performed any Enterprise Risk Management work?*

<b>Answer</b>	<b>Response Percent</b>
Yes	83.3%
No	16.7%

**Question 6: Has your company ever considered developing a contingent reserve fund?**

<b>Answer</b>	<b>Response Percent</b>
Yes	58.3%
No	41.7%

**Comments**

- Post Basis
- Reserve for deductibles and uninsured losses.
- They have considered it, but do not have one.
- They have one pre and one post funded vehicle. They have a pre-funded vehicle for their CGL losses – have a budget allocated amount"
- Not at this point in time – maybe in the future. They can get losses back through the rate payers; guarantees come from the provincial government.
- They have a post-funded reserve; have not considered doing a pre-funded reserve. Regulators allow certain uninsured losses to go through the reserve. Reserve is paid by the rate base; get that money back through the customers. It covers deductibles and uninsured losses.
- They have a self insurance reserve fund through the Utilities commission (they had to apply through them). They want to maintain the SIRF. \$400,000 annually goes into the fund – the Utilities Commission had to approve it each year. They have a policy set up for the fund, and anything that falls within that policy gets paid by the fund – this is their way of funding their losses.
- No – they have a post-funding system. They are regulated by the Utility Commission. It does not like pre-funded reserve funds. Once a claim of an unplanned capital expenditure in excess of \$\$\$ is made, they have a recovery system. When a loss occurs, they fund the loss, and recover it via rate calculations. They use it as a recovery mechanism.

**Question 7: Was a formal study used to determine the feasibility of such a vehicle?**

<b>Answer</b>	<b>Response Percent</b>
Yes	16.7%
No	83.3%

**Comments**

- Regulatory decision – fund was approved. Regulator gives 100,000 per year.
- An internal study was done by the ERM department. It was decided it was not worth it.
- Actuarial was used
- Not sure. The fund has been around for while.

**Question 8: Have you ever developed a self funding vehicle? If so, who administers the fund?**

<b>Answer</b>	<b>Response Percent</b>
Yes	41.7%
No	58.3%

**Comments**

- Unfunded liability reserve
- CFO administers
- They have a self funding vehicle for liability. Risk Manager administers the fund.
- Administered internally out of head office. Local authorities up to \$2000

- Legal department administers

***Question 9: How is the level of funding determined?***

Comments

- Post loss reserves estimated
- Based on review of historical losses
- The level of funding is based on reserve estimates by loss adjusters.
- Part of the budgeting process – arbitrary amount
- Historical & Statistical information
- Post-loss
- Company recommends the level of funding, but the Utility Commission ultimately decides
- Post-cost recovery basis.

***Question 10: How often are funds transferred?***

Comments

- Quarterly
- Annually, roughly \$100,000
- Whenever required, depending on the reserve level.
- Annually – the pool of funds is budgeted for annually
- Deductibles and uninsured losses are tracked and include those into the rate base; will get it back on a post-loss basis through customers.
- Every time they have to go back for the General Tariff Application (GTA) – roughly yearly
- They have to file an application – every claim is a bit different.

***Question 11: Who does the calculations?***

Comments

- Finance staff
- Loss Adjuster.
- Treasury department
- Legal & Finance
- Company recommends but Utility Commission approves

***Question 12: Is there specific criteria for the type of losses that can be paid from the fund? In the absence of specific guidelines, who decides which requests get funded?***

Comments

- Liability claims
- Deductibles and uninsured losses. They have guidelines, but have been instructed by the regulator to draft up a more specific policy.
- All liability losses go into the fund.
- Anything covered by the CGL policy. They self-fund the first 10 million
- Yes – uninsured losses or self retained. In absence of specific guidelines, the legal & business unit decides
- Uninsurable losses – low frequency, high severity
- They have a SIRF policy in place. Things that fall into the policy get paid by the fund. Usually these are things that are excluded by other insurance policies.

- Yes – but these are loosely defined, and can always be challenged. They have to make an argument in the court of law, and the commission ultimately decides.

**Question 13: Does the fund have a minimum threshold below which the loss is consider operational risk? How was that level determined?**

Comments

- Below deductible all operational risk, current expensed
- \$1000 management decision – but regulator told them it is too low – they will increase it
- \$100,000 determined through historical loss records.
- No
- Anything under deductible – determined by actuary
- \$100,000. Not sure how it was determined.
- \$1 Million. It was a quick decision, and has not been challenged by the commission. Anything below \$1 Million is not significant to them.

**Question 14: Is it still utilized today?**

<b>Answer</b>	<b>Response Percent</b>
Yes	63.6%
No	36.4%

Comments

- On a post loss basis
- The post funded vehicle.

**Question 15: If you did not develop a self funding vehicle what was the reason for not going forward? Is this something you may revisit in the future?**

Comments

- Current expensed
- Yes may revisit in the future
- The decision was based on the current asset mix and geographic locations of facilities. Yes, they would consider revisiting the decision later.
- Guarantees come from the provincial government that they can collect losses through the rate payer. They have not had any major incidents so far that have been crippling to the organization. May reconsider in the future.
- No would not revisit
- It made no sense – there is no incentive as they get money back from the customer rates.
- Not allowed by commission to have prefunded vehicle.

*Question 16: Have you ever considered building a captive*

<b>Answer</b>	<b>Response Percent</b>
Yes	66.7%
No	25.0%
N/A	8.3%

Comments

- Considered but not acted on.
- They considered it briefly 7 years ago. They didn't see a benefit as a regulated company to have one. Willing to consider it again in the future.
- They have considered it and had one up until 3 years ago. There are no plans to bring it back in the future.
- No, and have no plans to consider it in the future.
- Yes, they looked at it 2 years ago. They did a study. There are no tax savings for them, too expensive
- No – they have never had problems obtaining good coverage.
- Study completed 4 years ago. This is an area the company will continue to investigate.
- Many years ago they had a captive – however it did not work very well. In the past 10 years they have looked at creating a captive 3-4 times
- They have a captive, but it just a flow through for accessing reinsurance at this stage.

**APPENDIX 12.4**  
**YUKON ENERGY GENERAL LIABILITY AND COMMERCIAL**  
**PROPERTY RETENTION ANALYSIS 2010**



**Aon Risk Solutions**  
Global Risk Consulting  
IAO Actuarial Consulting Services Inc.

## General Liability and Commercial Property Retention Analysis

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Prepared for

**Yukon Energy Corporation**

September 20, 2010

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Prepared by:

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Global Risk Consulting  
IAO Actuarial Consulting Services Inc.





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**Aon Risk Solutions**  
Global Risk Consulting  
IAO Actuarial Consulting Services Inc



## Objectives and Scope

This report and analysis has been prepared by IAO Actuarial Consulting Services Inc. – An Aon Company (“IAO”), at the request of Yukon Energy Corporation (“YEC”).

The purpose of this study was to explore the potential benefits that may arise by varying levels of retentions with respect to YEC’s General Liability and Property program. In establishing this, IAO has reviewed losses and exposures for the program. The study is designed to:

- Evaluate YEC’s current insurance program
- Estimate the Total Cost of Risk for the program
- Estimate expected retained losses at various retention levels
- Determine the effects of retaining risk via an alternate retention program
- Make recommendations

In our analysis forecasted losses and technical premiums are calculated for the September 1, 2010 to September 1, 2011 policy period for liability cover, and June 1, 2010 to June 1, 2011 policy period for property cover.

## Background of Analyst

Alex Xu is a Fellow of the Casualty Actuarial Society, a member of the American Academy of Actuaries, and meets the Qualification Standards of the Canadian Institute of Actuaries to render the actuarial report contained herein.

We performed this analysis using generally accepted actuarial principles and all relevant Actuarial Standards of Practice.

Please contact us if you have any questions regarding this report.

Respectfully submitted,

A handwritten signature in black ink, appearing to read 'Alex Xu', is positioned above a horizontal line.

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Global Risk Consulting  
IAO Actuarial Consulting Services Inc

1



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## Executive Summary

IAO is pleased to present YEC with the results of an analysis of their General Liability and Commercial Property program. The purpose of this study is to perform a risk retention analysis to evaluate the feasibility of several retention alternatives available in today's marketplace.

The key conclusions and recommendations from our analysis are:

### General Liability Program- Recommendation Based on Technical Premium for Forecasted Policy Period

In the table below we have summarized the estimated ultimate losses incurred by YEC, broken down to retained losses by the Reserve for Injury and Damages ("RFID"), and the excess losses ceded to the commercial insurers.

RFID Limit	Retained RFID Loss	Expected Excess Loss Ceded to Insurers
\$100,000	18,233	43,038
\$250,000	25,876	35,394
\$350,000	28,710	32,561

The table below summarizes the total cost of risk calculations for the RFID at different retention levels, the losses retained by the RFID, plus the technical premium for the commercially insured layer. The technical premium is the sum a prudent underwriter would require, all things being equal, to meet forecasted losses with a reasonable degree of confidence, plus direct and indirect expenses related to policy issuance and claims administration and an acceptable profit margin. The volatility statistics measures the potential for large annual loss at different retention levels.

RFID Limit	Retained RFID Loss	Technical Premium Insured Layer	Total Cost of Risk for RFID and Insured Layer	Volatility within RFID
\$100,000	18,233	66,212	84,445	110,420
\$250,000	25,876	54,453	80,329	233,281
\$350,000	28,710	50,093	78,803	322,708

Changing Retention Amount:	Change in Total Cost of Risk for RFID and Insured Layer	Change in Volatility for RFID
\$250,000 -> \$100,000	4,116	-122,861
\$250,000 -> \$350,000	-1,526	89,427

Increasing the retention does provide economic benefit for YEC, with the higher retention, the total cost of risk decreases; however, variability of claims, as measured by the volatility statistics, increases significantly. On the other hand, lowering the retention increases the total cost of risk, with a significant decrease in volatility.

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After having given consideration of cost and benefit, we do not recommend altering the retention structure for the General Liability program at this time.

**Property Program– Recommendation Based on Technical Premium for Forecasted Policy Period**

In the table below we have summarized the estimated ultimate losses incurred by agencies, broken down to losses retained by the Reserve for Injury and Damages (“RFID”), and the excess losses ceded to the commercial insurers.

RFID Limit	Retained RFID Loss	Expected Excess Loss Ceded to Insurers
\$100,000	129,102	415,568
\$250,000	186,060	358,610
\$500,000	241,822	302,848

The table below summarizes the total cost of risk calculations for the RFID at different retention levels; the retained losses by the RFID, plus the technical premium for the commercially insured layer. The technical premium is the sum a prudent underwriter would require, all things being equal, to meet forecasted losses with a reasonable degree of confidence, plus direct and indirect expenses related to policy issuance and claims administration and an acceptable profit margin. The volatility statistics measures the potential for large annual loss at different retention levels.

RFID Limit	Retained RFID Loss	Technical Premium Insured Layer (Excess Property)	Total Cost of Risk for RFID and Insured Layer	Volatility within RFID
\$100,000	129,102	692,614	821,716	244,447
\$250,000	186,060	597,684	783,744	515,163
\$500,000	241,822	505,747	746,569	866,789

Changing Retention Amount:	Change in Total Cost of Risk for RFID and Insured Layer	Change in Volatility for RFID
\$250,000 -> \$100,000	37,972	-270,716
\$250,000 -> \$500,000	-37,175	351,626

Based on YEC’s technical premium, we do not recommend altering the retention structure for the property line at this time. Increasing the retention does provide economic benefit for YEC, with the higher retention, the total cost of risk decreases; however, variability of claims, as measured by the volatility statistics, increases significantly. On the other hand, lowering the retention increases the total cost of risk, with a significant decrease in volatility.

We must remember that the technically optimized retention is a theoretical suggested point at which insurance policies attach. When market reaction is tested, it may well be that the short term reality of the insurance markets makes it advantageous to take deductibles at a lower or higher level. The choice of the optimal retention level is also based on budget considerations and the maximum level of risk that the organization will allow.

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## **Conditions and Limitations**

### **Inherent Uncertainty**

Calculations produce estimates of inherently uncertain future contingent events. We believe that the estimates provided represent reasonable provisions based on the appropriate application of techniques to the available data. However, there is no guarantee that actual future payments will not differ from estimates included herein.

### **Extraordinary Future Emergence**

Our projections make no provision for the extraordinary future emergence of losses or types of losses not sufficiently represented in the historical data or which are not yet quantifiable.

### **Data Reliance**

In conducting this analysis, we relied upon the provided data without audit or independent verification; however, we reviewed it for reasonableness and consistency. Any inaccuracies in quantitative data or qualitative representations can have a significant effect on the results of our review and analysis.

### **Use and Distribution**

Use of this report is limited to YEC for the specific purpose described in the Objectives and Scope section. Other uses are prohibited without a signed consent form from IAO.

Distribution by YEC is unrestricted. We request that IAO be notified of further distribution of this report. The report should only be distributed in its entirety including all supporting exhibits.



## General Liability

### Data

IAO was informed that, by December 31, 2009, there have been no liability claims reported.

IAO was provided with expiring and historical insurance information by Mr. Ed Mollar, Chief Finance officer of YEC, and his team. The data was not audited but we did conduct certain consistency checks. Any inaccuracies in quantitative data or qualitative representations can have a significant effect on the results of our review and analysis.

### Program Description

Under the current liability structure, claims with a loss amount below the deductible of \$250,000 are self insured by YEC, in the form of a RFID.

The current Commercial General Liability policy has limits of liability as follows:

Total Umbrella and Excess Limit	<b>50,000,000</b>
Occurrence Limit	<b>5,000,000</b>
Aggregate, Products and Completed Operations	<b>5,000,000</b>
Employee Benefits Liability	<b>5,000,000</b>
Tenant's Legal Liability	<b>5,000,000</b>
Non-owned Automobile	<b>5,000,000</b>
Employers' Liability	<b>5,000,000</b>
Advertising Liability	<b>5,000,000</b>
Fire Fighting Expense	<b>5,000,000</b>

### Deductibles

Self Insured Retention 250,000

### Forecasted Losses

Forecasted losses are the mean ultimate loss selections for future policy periods. The forecasted losses at different retention levels have been summarized in the table below along with the percentile distribution of each forecasted retention option for the 2010/2011 policy period.

The fundamental first step in deriving appropriate premium is to establish an estimate of the annual claims that the program would expect to pay out. This is essentially a two-step process. The first step is a statistical model of the number of claim being made during the future policy period, which we refer to as the frequency component of the model. The second step, the severity component, determines the benefits payable to the claimant. Usually, we would be fitting a curve to the YEC's CGL experience. As YEC did not have any CGL claims, we fit a curve to the industry experience based on the assumption that the CGL severity of YEC is line with that of industry. As for the frequency component, we scaled the 2008 industry claims counts down to the YEC's exposure level. Aggregation of these claims over a single given year determines the total annual claim amount payable.

We have constructed a simulation model, which stochastically produces a series of claims for a single year. Each claim simulated is selected so as to reflect reasonably possible claims, based on the

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historical information provided to us. The process is repeated 10,000 times (each time referred to as an iteration), allowing us to gauge the entire distribution of potential outcomes for the total annual claims (referred to as the aggregate losses).

<b>Forecasted Ultimate RETAINED Losses at Various Retention Levels (Policy Year 2010/2011)</b>				
	<b>Unlimited</b>	<b>Retained RFID Loss with \$100,000 limit</b>	<b>Retained RFID Loss with \$250,000 limit</b>	<b>Retained RFID Loss with \$350,000 limit</b>
<b>Forecast</b>	61,270	18,233	25,876	28,710
Percentile				
25%	0	0	0	0
30%	0	0	0	0
40%	0	0	0	0
50%	999	999	999	999
60%	4,198	4,198	4,198	4,198
75%	17,029	17,029	17,029	17,029
80%	27,345	27,345	27,345	27,345
85%	45,014	45,014	45,014	45,014
90%	78,677	78,677	78,677	78,677
95%	179,373	100,000	178,460	178,460
98%	440,236	109,747	250,000	350,000
99%	750,238	128,653	259,157	351,418

The table below represent the mean ultimate losses ceded to the commercial insurer, at different RFID limit options. At the current RFID limit of \$250,000, we expect that the insurers will pay \$35,294, once losses have developed over several periods to their ultimate amounts.

<b>Forecasted Ultimate INSURED Losses at Various RFID Levels (Policy Year 2010/2011)</b>			
	<b>Excess of RFID with \$100,000 limit</b>	<b>Excess of RFID with \$250,000 limit</b>	<b>Excess of RFID with \$350,000 limit</b>
<b>Forecast</b>	<b>43,038</b>	<b>35,394</b>	<b>32,561</b>

The full results of the loss forecast are documented in Exhibit II, Sheet 3 and 4 of this report.



**Total Cost of Risk – Forecasted Policy Period**

Once the loss forecast has been completed for the liability line, the last step in to evaluate the total cost of risk for the program. We define the Total Cost of Risk = Losses Retained by RFID + Technical Premium for Excess losses.

We evaluated alternate retention options for estimated market premium and ‘technical premium’ evaluation, which is defined as the amount a prudent insurer would charge based on the results of our analysis. An assumed 65% permissible loss ratio was used in calculating the premium for the insured layer.

To measure the variability of expected loss within a retention-option, we define the term “volatility” as the difference between the 99<sup>th</sup> percentile loss and the mean loss. Where the mean loss represents the likely scenario where a loss experience may occur once in two years, and the 99<sup>th</sup> percentile represents a loss experience that may occur once in a hundred years. The volatility shows the difference in loss experience between an ‘average year’ and a ‘catastrophic year’.

**Technical Premium**

In the following tables the premium used to determine the total cost of risk is based upon **technical premium**. The total cost of risk includes retained RFID loss and the technical premium for excess layers, covered by commercial insurers.

RFID Limit	Retained RFID Loss	Technical Premium Insured Layer (Umbrella/Excess)	Total Cost of Risk for RFID and Insured Layer	Volatility within RFID
\$100,000	18,233	66,212	84,445	110,420
\$250,000	25,876	54,453	80,329	233,281
\$350,000	28,710	50,093	78,803	322,708
Unlimited	61,270	None	61,270	688,968

The excess losses insured by the primary policy and loss ratios at alternate retentions are displayed below.

Retention	Excess Loss (Insured Layer)	Technical Premium Insured Layer	Loss Ratio
\$100,000	43,038	66,212	65%
\$250,000	35,394	54,453	65%
\$350,000	32,561	50,093	65%

As you can see in the table above, by increasing the retention, the total cost of risk decreases. However, a side effect of the decrease in total cost of risk is the increase in the variability of the claims, as measured by the volatility statistics. The increase in volatility is significantly higher than the decrease in the total cost of risk. We would not recommend altering the retention at this time.

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Below you will find a chart displaying the differences among different retention alternatives based upon technical premiums.

Changing Retention Amount:	Change in Total Cost of Risk	Change in Volatility
\$250,000 - \$100,000	4,116	-122,861
\$250,000 - \$350,000	-1,526	89,427
\$250,000 - Unlimited	-19,059	455,687

We must remember that the technically optimized retention is a theoretical suggested point at which insurance policies attach. When market reaction is tested, it may well be that the short term reality of the insurance markets makes it advantageous to take deductibles at a lower or higher level. The choice of the optimal retention level is also based on budget considerations and the maximum level of risk that the organization will allow.

#### Description of Exhibits - Liability

Exhibit I Sheet 1 to Sheet 4 displays our retention analysis result in detail for Commercial General Liability.

Exhibit III Sheet 1 to Sheet 2 displays our Severity and Frequency selection for our simulation model.



## Commercial Property

### Data

Individual claims data was provided by Mr. Ed Mollard, Chief Financial Officer of YEC, and his team for the period of 1993 to 2009. It is our understanding that all losses are reported on a ground-up basis.

The data was not audited but we did conduct certain consistency checks. Any inaccuracies in quantitative data or qualitative representations can have a significant effect on the results of our review and analysis.

### Program Description - Property

Under the current property structure, losses below the deductible of \$100,000 of the commercial property policy are retained by YEC, in the form of a RFID.

The following chart summarizes the expiring property insurance structure for YEC with current limits and deductibles for each layer.

#### Limits of Liability

Any one occurrence	250,000,000
Annual Aggregate Earthquake	350,000,000
Annual Aggregate Flood	350,000,000

#### Deductibles

\$ 100,000 any one occurrence or accident, except;

\$ 50,000 any one occurrence or accident in respect of property in transit

\$ 50,000 property under course of construction, erection, assembly or installation

\$ 250,000 any one accident or occurrence in respect of Accident to an object

### Forecasted Losses

Forecasted losses are the mean ultimate loss selections for future policy periods. The forecasted losses at different retention levels have been summarized in the table below, along with the percentile distribution of each forecasted retention option, for the 2010/2011 policy period.

To estimate forecasted losses, we used simulation by fitting a curve to YEC's experience. As YEC did not experience catastrophic losses during the evaluation period; therefore we judgmentally used one in 150 years as the return period and 100% of property statement of value as the catastrophe severity to estimate potential large losses.

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Forecasted Ultimate RETAINED Losses at Various Retention Levels Policy Year 2010/2011				
	Unlimited	Retained RFID Loss with \$100,000 limit	Retained RFID Loss with \$250,000 limit	Retained RFID Loss with \$500,000 limit
<b>Forecast</b>	544,670	129,102	186,060	241,822
Percentile				
25%	61,818	61,818	61,818	61,818
30%	71,762	71,762	71,762	71,762
40%	94,353	94,353	94,353	94,353
50%	121,975	116,142	121,975	121,975
60%	168,217	138,834	168,217	168,217
75%	367,386	178,398	295,069	367,386
80%	499,014	197,514	321,290	499,014
85%	832,028	220,816	351,508	554,490
90%	1,112,299	248,199	400,783	605,231
95%	1,871,532	290,731	522,628	738,110
98%	3,077,286	343,467	614,027	1,008,729
99%	3,905,723	373,549	701,223	1,108,611

The table below represent the mean ultimate losses ceded to the commercial insurer, at different RFID limit options. At the current RFID limit of \$100,000, we expect that the insurers will pay \$415,568 once losses have developed over several periods to their ultimate amounts.

Forecasted Ultimate INSURED Losses at Various RFID Levels (Policy Year 2010/2011)			
	Excess of RFID with \$100,000 limit	Excess of RFID with \$250,000 limit	Excess of RFID with \$500,000 limit
<b>Forecast</b>	<b>415,568</b>	<b>358,610</b>	<b>302,848</b>

This analysis requires that a probability distribution be mapped out for each proposed retention level. The expected loss under each retention is generally regarded to be the value that is found at or near the 50<sup>th</sup> percentile. This means that the expected value of losses has a probability of 1 in 2 of occurring, or once in every two years. A more prudent scenario would be to examine retention level (or levels) associated with the 90<sup>th</sup> percentile. This means that the expected losses forecasted have probability of 1 out of 10 of occurring.

The full results of the loss forecast are documented in Exhibit II of this report.

#### Total Cost of Risk – Forecasted Policy Period

Once the loss forecast has been completed for the liability line, the last step in to evaluate the total cost of risk for the program. We define the Total Cost of Risk = Losses Retained by RFID + Technical Premium for Excess losses.

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We evaluated alternate retention options for estimated market premium and ‘technical premium’ evaluation, which is defined as the amount a prudent insurer would charge based on the results of our analysis. An assumed 60% permissible loss ratio was used in calculating the premium for the insured layer. In addition a present value factor is applied since incurred losses will be paid over several policy periods. We used the technical premium to determine the discount in premium at different retention options.

To measure the variability of expected loss within a retention-option, we define the term “Volatility”, as the difference between the 99<sup>th</sup> percentile loss and the mean loss. Where the mean loss represents the likely scenario where a loss experience may occur once in two years, and the 99<sup>th</sup> percentile represents a loss experience that may occur once in a hundred years. The volatility shows the difference in loss experience between an ‘average year’ and a ‘catastrophic year’.

**Technical Premium**

In the following tables the premium used to determine the total cost of risk is based upon **technical premium**. The total cost of risk includes retained RFID loss and the technical premium for excess layers, covered by commercial insurers.

RFID Limit	Retained RFID Loss	Technical Premium Insured Layer (Excess Property)	Total Cost of Risk for RFID and Insured Layer	Volatility within RFID
\$100,000	129,102	692,614	821,716	244,447
\$250,000	186,060	597,684	783,744	515,163
\$500,000	241,822	505,747	746,569	866,789
Unlimited	544,670	None	544,670	3,361,053

The excess losses, insured by the primary policy and loss ratios at alternate retentions are displayed below.

Retention	Excess Loss (Insured Layer)	Technical Premium Insured Layer	Loss Ratio
\$100,000	415,568	692,614	60%
\$250,000	358,610	597,684	60%
\$500,000	302,848	505,747	60%

As you can see in the table above, if the premiums were based upon the technical premium, by increasing the retention the total cost of risk decreases. However, a side effect of the decrease in total cost of risk is the increase in the variability of the claims, as measured by the volatility statistics. The increase in volatility is significantly higher than the decrease in the total cost of risk. We would not recommend altering the RFID limit at this time.



Below you will find a chart displaying the differences among different retention alternatives based upon technical premiums.

Changing Retention Amount:	Change in Total Cost of Risk	Change in Volatility
\$250,000 - \$100,000	37,972	-270,716
\$250,000 - \$500,000	-37,175	351,626
\$250,000 - Unlimited	-239,074	2,845,890

We must remember that the technically optimized retention is a theoretical suggested point at which insurance policies attach. When market reaction is tested, it may well be that the short term reality of the insurance markets makes it advantageous to take deductibles at a lower or higher level. The choice of the optimal retention level is also based on budget considerations and the maximum level of risk that the organization will allow.

**Description of Exhibits - Property**

Exhibit II Sheet 1 to 4 displays the full result of Property retention analysis.

Exhibit III displays the Property claims severity and frequency selection.

Exhibit IV displays the YEC Property claims history data and development.

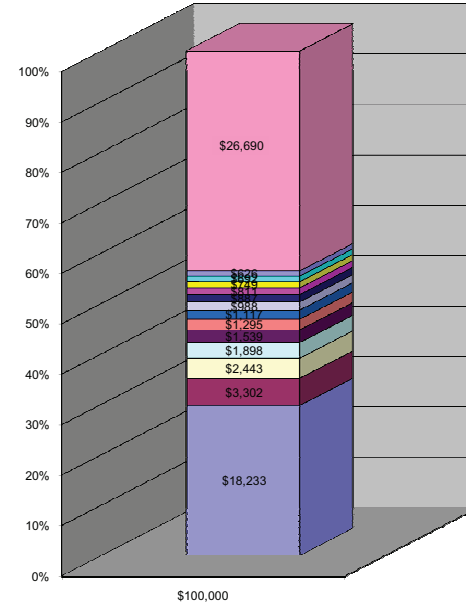
Yukon Energy Corporation  
IAO Actuarial Consulting Services - An Aon Company  
Retention Analysis for Yukon Energy Corporation

Exhibit I  
Sheet 1

CGL Loss Forecast - Summary

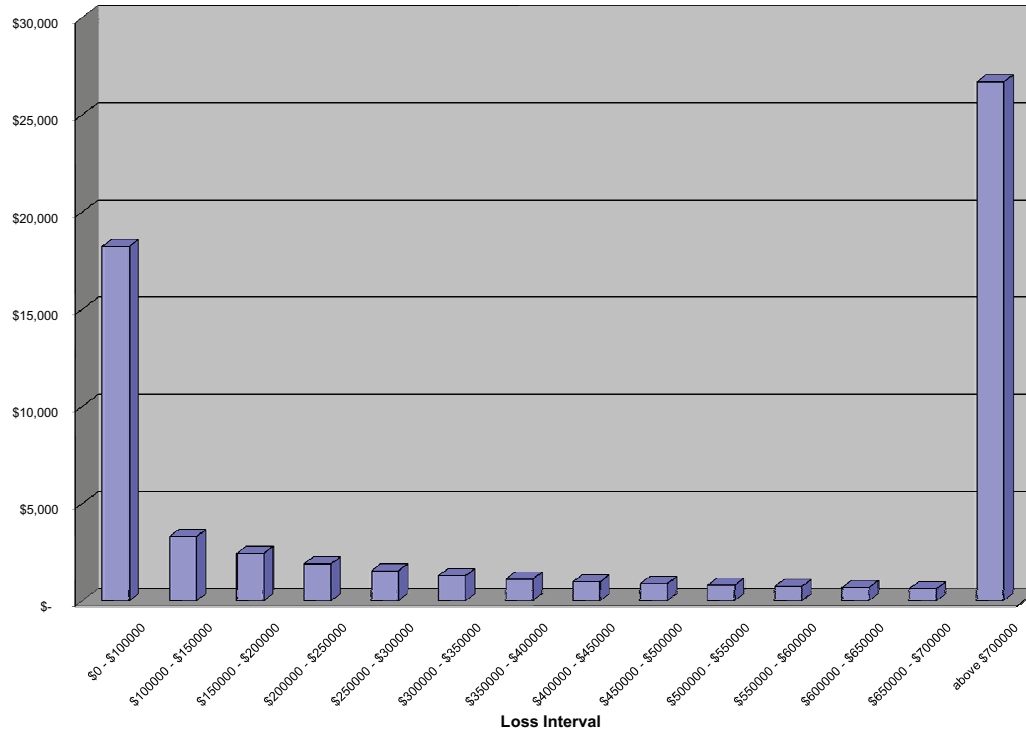
Loss Interval		Expected Loss in Each Layer
-	\$ 100,000	\$ 18,233
\$ 100,000	\$ 150,000	\$ 3,302
\$ 150,000	\$ 200,000	\$ 2,443
\$ 200,000	\$ 250,000	\$ 1,898
\$ 250,000	\$ 300,000	\$ 1,539
\$ 300,000	\$ 350,000	\$ 1,295
\$ 350,000	\$ 400,000	\$ 1,117
\$ 400,000	\$ 450,000	\$ 988
\$ 450,000	\$ 500,000	\$ 887
\$ 500,000	\$ 550,000	\$ 811
\$ 550,000	\$ 600,000	\$ 749
\$ 600,000	\$ 650,000	\$ 692
\$ 650,000	\$ 700,000	\$ 626
\$ 700,000		\$ 26,690
Unlimited Loss		\$ 61,270

If the Deductible is	Limited Expected Loss	Excess Loss above	Estimated Market Premium	Total Cost of Risk
[1]	[2]	[3]	[4]	[5]
\$ 100,000	\$ 18,233	\$ 43,038	\$ 66,212	84,445
\$ 150,000	\$ 21,535	\$ 39,735	\$ 61,131	82,666
\$ 200,000	\$ 23,978	\$ 37,292	\$ 57,373	81,351
\$ 250,000	\$ 25,876	\$ 35,394	\$ 54,453	80,329
\$ 300,000	\$ 27,415	\$ 33,855	\$ 52,085	79,500
\$ 350,000	\$ 28,710	\$ 32,561	\$ 50,093	78,803
\$ 400,000	\$ 29,827	\$ 31,444	\$ 48,375	78,202
\$ 450,000	\$ 30,815	\$ 30,456	\$ 46,855	77,670
\$ 500,000	\$ 31,702	\$ 29,569	\$ 45,490	77,192
\$ 550,000	\$ 32,513	\$ 28,757	\$ 44,242	76,755
\$ 600,000	\$ 33,262	\$ 28,008	\$ 43,090	76,352
\$ 650,000	\$ 33,954	\$ 27,316	\$ 42,025	75,979
\$ 700,000	\$ 34,580	\$ 26,690	\$ 41,062	75,642
NO INSURANCE	\$ 61,270	\$ -	\$ -	61,270



NOTES

CGL Loss Forecast - Expected Loss in Each Layer



Yukon Energy Corporation  
IAO Actuarial Consulting Services - An Aon Company  
Retention Analysis for Yukon Energy Corporation

Exhibit I  
Sheet 3

CGL Loss Forecast at Different Scenarios Part 1

	Return Period	Limited Expected Loss below \$100000	Limited Expected Loss below \$150000	Limited Expected Loss below \$200000	Limited Expected Loss below \$250000	Limited Expected Loss below \$300000	Limited Expected Loss below \$350000	Limited Expected Loss below \$400000	Limited Expected Loss below \$450000
Minimum		0	0	0	0	0	0	0	0
Maximum		300,000	446,135	546,135	646,135	745,437	795,437	845,437	898,741
Mean		18,233	21,535	23,978	25,876	27,415	28,710	29,827	30,815
Std Deviation		34,223	44,348	52,901	60,303	66,894	72,868	78,354	83,483
Variance		1,171,208,000	1,966,772,000	2,798,483,000	3,636,443,000	4,474,781,000	5,309,686,000	6,139,322,000	6,969,358,000
Skewness		2	3	3	3	4	4	4	4
Kurtosis		9	11	13	15	18	20	21	23
Errors Calculated		0	0	0	0	0	0	0	0
Mode		0	0	0	0	0	0	0	0
5% Perc	1	0	0	0	0	0	0	0	0
10% Perc	1	0	0	0	0	0	0	0	0
15% Perc	1	0	0	0	0	0	0	0	0
20% Perc	1	0	0	0	0	0	0	0	0
25% Perc	1	0	0	0	0	0	0	0	0
30% Perc	1	0	0	0	0	0	0	0	0
35% Perc	1	0	0	0	0	0	0	0	0
40% Perc	1	0	0	0	0	0	0	0	0
45% Perc	1	75	75	75	75	75	75	75	75
50% Perc	1	999	999	999	999	999	999	999	999
55% Perc	1	2,261	2,261	2,261	2,261	2,261	2,261	2,261	2,261
60% Perc	1	4,198	4,198	4,198	4,198	4,198	4,198	4,198	4,198
65% Perc	1	7,020	7,020	7,020	7,020	7,020	7,020	7,020	7,020
70% Perc	1	10,877	10,877	10,877	10,877	10,877	10,877	10,877	10,877
75% Perc	1	17,029	17,029	17,029	17,029	17,029	17,029	17,029	17,029
80% Perc	1	27,345	27,345	27,345	27,345	27,345	27,345	27,345	27,345
85% Perc	1	45,014	45,014	45,014	45,014	45,014	45,014	45,014	45,014
90% Perc	10	78,677	78,677	78,677	78,677	78,677	78,677	78,677	78,677
95% Perc	20	100,000	149,319	178,460	178,460	178,460	178,460	178,460	178,460
98% Perc	50	109,747	154,690	200,000	250,000	300,000	350,000	398,872	429,028
99% Perc	100	128,653	172,648	214,308	259,157	303,250	351,418	400,000	450,000
99.5% Perc	200	128,653	172,648	214,308	259,157	303,250	351,418	400,000	450,000
99.9% Perc	1,000	209,723	300,000	387,059	407,782	447,888	497,888	547,888	595,961

Yukon Energy Corporation  
IAO Actuarial Consulting Services - An Aon Company  
Retention Analysis for Yukon Energy Corporation

Exhibit I  
Sheet 4

CGL Loss Forecast at Different Scenarios Part 2

	Return Period	Limited Expected	Limited Expected	Limited Expected	Limited Expected	Limited Expected	Limited Expected	Unlimited Loss
		Loss below \$500000	Loss below \$550000	Loss below \$600000	Loss below \$650000	Loss below \$700000	Loss above \$700000	
Minimum		0	0	0	0	0	0	0
Maximum		954,397	1,004,397	1,054,397	1,104,397	1,154,397	181,585,100	182,285,100
Mean		31,702	32,513	33,262	33,954	34,580	32,853	61,270
Std Deviation		88,307	92,933	97,379	101,653	105,674	1,848,862	1,863,582
Variance		7,798,205,000	8,636,487,000	9,482,680,000	10,333,400,000	11,166,920,000	3,418,289,000,000	3,472,939,000,000
Skewness		4	5	5	5	5	95	94
Kurtosis		25	26	28	30	32	9,307	9,151
Errors Calculated		0	0	0	0	0	0	0
Mode		0	0	0	0	0	0	0
5% Perc	1	0	0	0	0	0	0	0
10% Perc	1	0	0	0	0	0	0	0
15% Perc	1	0	0	0	0	0	0	0
20% Perc	1	0	0	0	0	0	0	0
25% Perc	1	0	0	0	0	0	0	0
30% Perc	1	0	0	0	0	0	0	0
35% Perc	1	0	0	0	0	0	0	0
40% Perc	1	0	0	0	0	0	0	0
45% Perc	1	75	75	75	75	75	0	75
50% Perc	1	999	999	999	999	999	0	999
55% Perc	1	2,261	2,261	2,261	2,261	2,261	0	2,261
60% Perc	1	4,198	4,198	4,198	4,198	4,198	0	4,198
65% Perc	1	7,020	7,020	7,020	7,020	7,020	0	7,020
70% Perc	1	10,877	10,877	10,877	10,877	10,877	0	10,877
75% Perc	1	17,029	17,029	17,029	17,029	17,029	0	17,029
80% Perc	1	27,345	27,345	27,345	27,345	27,345	0	27,345
85% Perc	1	45,014	45,014	45,014	45,014	45,014	0	45,014
90% Perc	10	78,677	78,677	78,677	78,677	78,677	0	78,677
95% Perc	20	178,460	178,460	178,460	178,460	178,460	0	179,373
98% Perc	50	429,028	429,028	429,028	429,028	429,028	0	440,236
99% Perc	100	500,000	550,000	600,000	650,000	699,856	0	750,238
99.5% Perc	200	507,689	555,869	605,415	651,419	700,219	454,427	1,438,566
99.9% Perc	1,000	631,660	681,660	731,660	770,580	796,690	4,155,554	4,117,042

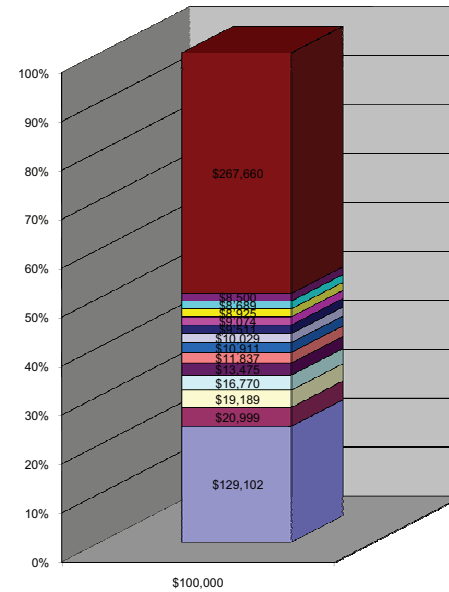
Yukon Energy Corporation  
IAO Actuarial Consulting Services - An Aon Company  
Retention Analysis for Yukon Energy Corporation

Exhibit II  
Sheet 1

Property Loss Forecast - Summary

Loss Interval		Expected Loss in Each Layer
-	\$ 100,000	\$ 129,102
\$ 100,000	\$ 150,000	\$ 20,999
\$ 150,000	\$ 200,000	\$ 19,189
\$ 200,000	\$ 250,000	\$ 16,770
\$ 250,000	\$ 300,000	\$ 13,475
\$ 300,000	\$ 350,000	\$ 11,837
\$ 350,000	\$ 400,000	\$ 10,911
\$ 400,000	\$ 450,000	\$ 10,029
\$ 450,000	\$ 500,000	\$ 9,511
\$ 500,000	\$ 550,000	\$ 9,074
\$ 550,000	\$ 600,000	\$ 8,925
\$ 600,000	\$ 650,000	\$ 8,689
\$ 650,000	\$ 700,000	\$ 8,500
\$ 700,000		\$ 267,660
Unlimited Loss		\$ 544,670

If the Deductible is [1]	Limited Expected Loss [2]	Excess Loss above [3]	Estimated Market Premium [4]	Total Cost of Risk [5]
\$ 100,000	\$ 129,102	\$ 415,568	\$ 692,614	821,716
\$ 150,000	\$ 150,101	\$ 394,569	\$ 657,615	807,716
\$ 200,000	\$ 169,290	\$ 375,380	\$ 625,634	794,924
\$ 250,000	\$ 186,060	\$ 358,610	\$ 597,684	783,744
\$ 300,000	\$ 199,535	\$ 345,135	\$ 575,225	774,760
\$ 350,000	\$ 211,372	\$ 333,298	\$ 555,497	766,869
\$ 400,000	\$ 222,283	\$ 322,388	\$ 537,313	759,595
\$ 450,000	\$ 232,311	\$ 312,359	\$ 520,598	752,909
\$ 500,000	\$ 241,822	\$ 302,848	\$ 504,747	746,569
\$ 550,000	\$ 250,897	\$ 293,774	\$ 489,623	740,519
\$ 600,000	\$ 259,822	\$ 284,848	\$ 474,747	734,569
\$ 650,000	\$ 268,511	\$ 276,159	\$ 460,266	728,776
\$ 700,000	\$ 277,010	\$ 267,660	\$ 446,100	723,110
NO INSURANCE	\$ 544,670	\$ -	\$ -	544,670

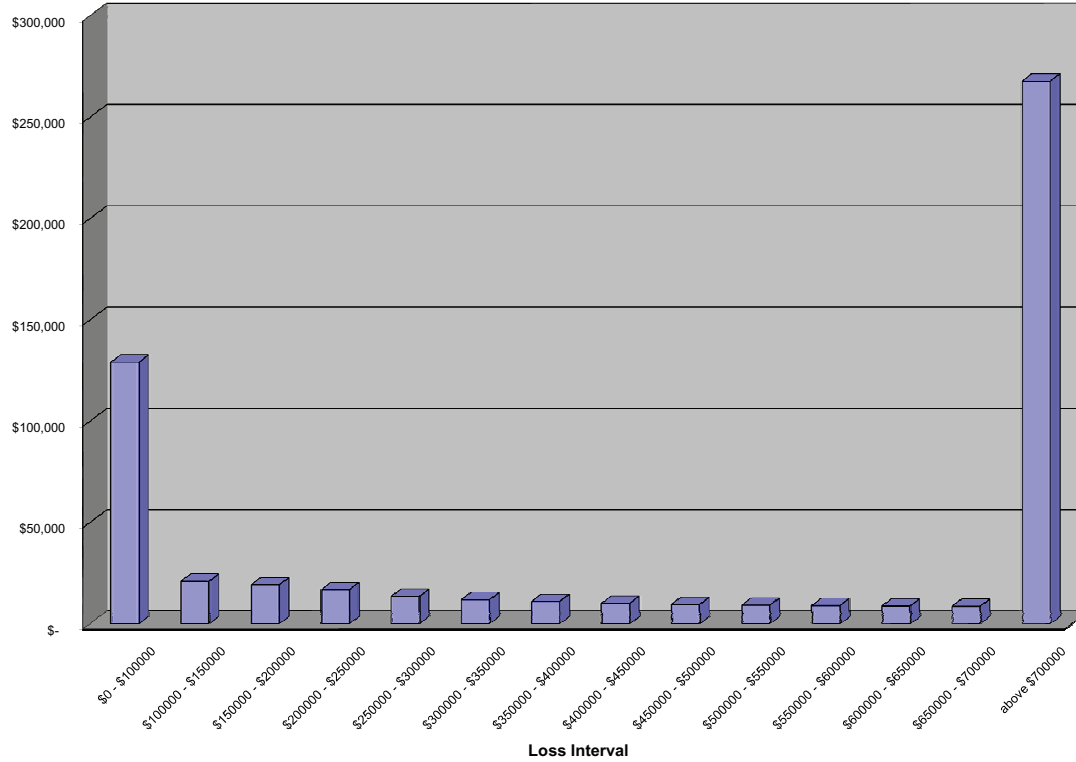


NOTES

Yukon Energy Corporation  
IAO Actuarial Consulting Services - An Aon Company  
Retention Analysis for Yukon Energy Corporation

Exhibit II  
Sheet 2

Property Loss Forecast - Expected Loss in Each Layer



Yukon Energy Corporation  
IAO Actuarial Consulting Services - An Aon Company  
Retention Analysis for Yukon Energy Corporation

Exhibit II  
Sheet 3

Property Loss Forecast at Different Scenarios Part 1

	Return Period	Limited Expected Loss	Limited Expected Loss	Limited Expected Loss	Limited Expected Loss	Limited Expected Loss	Limited Expected Loss	Limited Expected Loss
		below \$100000	below \$150000	below \$200000	below \$250000	below \$300000	below \$350000	below \$400000
Minimum		0	0	0	0	0	0	0
Maximum		544,514	744,514	944,514	1,144,514	1,299,110	1,399,110	1,499,110
Mean		129,102	150,101	169,290	186,060	199,535	211,372	222,283
Std Deviation		85,584	111,942	138,531	163,450	184,714	204,448	223,497
Variance		7,324,669,000	12,530,960,000	19,190,940,000	26,715,840,000	34,119,100,000	41,798,770,000	49,950,900,000
Skewness		1	1	1	1	1	1	2
Kurtosis		4	4	4	5	5	5	5
Errors Calculated		0	0	0	0	0	0	0
Mode		0	0	0	0	0	0	0
5% Perc	1	19,439	19,439	19,439	19,439	19,439	19,439	19,439
10% Perc	1	31,063	31,063	31,063	31,063	31,063	31,063	31,063
15% Perc	1	41,907	41,907	41,907	41,907	41,907	41,907	41,907
20% Perc	1	52,375	52,375	52,375	52,375	52,375	52,375	52,375
25% Perc	0	61,818	61,818	61,818	61,818	61,818	61,818	61,818
30% Perc	0	71,762	71,762	71,762	71,762	71,762	71,762	71,762
35% Perc	0	82,010	82,010	82,010	82,010	82,010	82,010	82,010
40% Perc	0	94,353	94,353	94,353	94,353	94,353	94,353	94,353
45% Perc	0	104,469	106,739	106,739	106,739	106,739	106,739	106,739
50% Perc	0	116,142	121,975	121,975	121,975	121,975	121,975	121,975
55% Perc	0	127,577	141,056	141,056	141,056	141,056	141,056	141,056
60% Perc	0	138,834	160,127	168,217	168,217	168,217	168,217	168,217
65% Perc	0	151,171	179,582	207,889	218,346	218,346	218,346	218,346
70% Perc	0	163,452	197,571	232,755	268,009	287,668	287,668	287,668
75% Perc	0	178,398	215,571	255,183	295,069	329,004	357,593	367,386
80% Perc	0	197,514	235,871	278,315	321,290	357,593	394,395	431,641
85% Perc	1	220,816	264,753	309,077	351,508	388,806	428,925	470,289
90% Perc	10	248,199	309,816	356,923	400,783	438,078	479,577	519,197
95% Perc	20	290,731	367,139	446,758	522,628	578,892	614,982	651,652
98% Perc	50	343,467	434,209	528,650	614,027	698,091	781,368	859,142
99% Perc	100	373,549	490,581	602,344	701,223	782,376	861,049	939,768
99.5% Perc	200	410,349	527,932	661,488	789,768	883,769	974,754	1,069,150
99.9% Perc	1,000	478,266	621,339	753,325	892,840	1,034,758	1,154,534	1,273,772

Yukon Energy Corporation  
IAO Actuarial Consulting Services - An Aon Company  
Retention Analysis for Yukon Energy Corporation

Exhibit II  
Sheet 4

Property Loss Forecast at Different Scenarios Part 2

	Return Period	Limited Expected Loss below \$500000	Limited Expected Loss below \$550000	Limited Expected Loss below \$600000	Limited Expected Loss below \$650000	Limited Expected Loss below \$700000	Limited Expected Loss above \$700000	Unlimited Loss
Minimum		0	0	0	0	0	0	0
Maximum		1,692,185	1,786,459	1,936,459	2,086,459	2,236,459	49,872,900	51,099,630
Mean		241,822	250,897	259,822	268,511	277,010	267,660	544,670
Std Deviation		259,623	277,266	295,124	312,911	330,645	2,306,395	2,406,445
Variance		67,404,040,000	76,876,190,000	87,097,960,000	97,913,370,000	109,326,400,000	5,319,460,000,000	5,790,976,000,000
Skewness		2	2	2	2	2	16	15
Kurtosis		6	6	6	6	6	296	266
Errors Calculated		0	0	0	0	0	0	0
Mode		0	0	0	0	0	0	0
5% Perc	1	19,439	19,439	19,439	19,439	19,439	0	19,439
10% Perc	1	31,063	31,063	31,063	31,063	31,063	0	31,063
15% Perc	1	41,907	41,907	41,907	41,907	41,907	0	41,907
20% Perc	1	52,375	52,375	52,375	52,375	52,375	0	52,375
25% Perc	0	61,818	61,818	61,818	61,818	61,818	0	61,818
30% Perc	0	71,762	71,762	71,762	71,762	71,762	0	71,762
35% Perc	0	82,010	82,010	82,010	82,010	82,010	0	82,010
40% Perc	0	94,353	94,353	94,353	94,353	94,353	0	94,353
45% Perc	0	106,739	106,739	106,739	106,739	106,739	0	106,739
50% Perc	0	121,975	121,975	121,975	121,975	121,975	0	121,975
55% Perc	0	141,056	141,056	141,056	141,056	141,056	0	141,056
60% Perc	0	168,217	168,217	168,217	168,217	168,217	0	168,217
65% Perc	0	218,346	218,346	218,346	218,346	218,346	0	218,346
70% Perc	0	287,668	287,668	287,668	287,668	287,668	0	287,668
75% Perc	0	367,386	367,386	367,386	367,386	367,386	0	367,386
80% Perc	0	499,014	499,014	499,014	499,014	499,014	0	499,014
85% Perc	1	554,490	596,470	640,643	683,574	729,582	34,225	832,028
90% Perc	10	605,231	648,031	692,439	738,231	784,006	241,890	1,112,299
95% Perc	20	738,110	779,320	815,663	856,989	904,132	823,375	1,871,532
98% Perc	50	1,008,729	1,067,138	1,114,106	1,156,814	1,193,444	2,037,115	3,077,286
99% Perc	100	1,108,611	1,192,548	1,283,691	1,376,079	1,469,227	2,787,069	3,905,723
99.5% Perc	200	1,247,643	1,333,168	1,427,255	1,519,896	1,606,405	11,488,575	13,043,237
99.9% Perc	1,000	1,538,637	1,680,504	1,797,878	1,897,878	1,997,878	45,697,900	46,520,508

Yukon Energy Corporation  
IAO Actuarial Consulting Services - An Aon Company  
Retention Analysis for Yukon Energy Corporation

**Exhibit III**  
**Sheet 1**

**Claims Frequency Selection**

**Property**

Acc Year	Claims Counts	Total SOV (\$000)	Frequency (Per \$000,000)
[1]	[2]	[3]	[4]
			[2]/[3]*1000
1993	1	596,037	0.0017
1994	1	596,037	0.0017
1995	0	596,037	-
1996	1	596,037	0.0017
1997	2	596,037	0.0034
1998	6	596,037	0.0101
1999	6	596,037	0.0101
2000	4	596,037	0.0067
2001	1	596,037	0.0017
2002	5	596,037	0.0084
2003	1	596,037	0.0017
2004	1	608,482	0.0016
2005	3	612,757	0.0049
2006	7	619,239	0.0113
2007	3	624,720	0.0048
2008	8	630,759	0.0127
2009	1	642,944	0.0016
Total	51		
		Max	0.0127
		Min	-
		Average	0.0049
		Avg exld Max & Min	0.0047
		Avg Last 5 Yr	0.0070
		Frequency Selected [5]	0.0060
		2010 SOV [6]	649,037
		2010 Predicted Claims Counts(Lambda) [7]=[5]*[6]	<b>4.00</b>

**CGL**

	Written Premium	Claim Counts	Claim Frequency
Industry	42,979,021	251	0.01
YEC	63,750	0.6	<b>0.01</b>
		Lambda Selected:	<b>1.00</b>

*Yukon Energy Corporation  
 IAO Actuarial Consulting Services - An Aon Company  
 Retention Analysis for Yukon Energy Corporation*

**Exhibit III  
 Sheet 2**

**Claims Severity  
 Property**

Historical Severity	Claim Counts	Prob	Severity Distribution	
			Prob	Severity
0% - 0.5%	34	72.34%	72.22%	0.25%
0.5% - 1%	6	12.77%	12.74%	0.75%
1% - 5%	3	6.38%	6.37%	3.00%
5% - 15%	2	4.26%	4.25%	10.00%
15% - 25%	1	2.13%	2.12%	20.00%
>25%	1	2.13%	2.12%	25.00%
		CAT	0.17%	100%
Total	47			

2010 Predicted Claims Counts(Lambda) 4  
 Catastrophe occurs 1 in 150 years  
 Catastrophe Prob: 0.17%

**CGL**

	YEC	Industry
Mean	43,129	43129.1
Std	646,937	165,789
CV	15.00	3.84

Selected Distribution RiskLognorm(44526, 646937, RiskShift(-1396.9))

Yukon Energy Corporation  
IAO Actuarial Consulting Services - An Aon Company  
Retention Analysis for Yukon Energy Corporation

Exhibit IV  
Sheet 1

**Claims Data**

Accident Year	Total Incurred	Description	Age	LDf	Trending Factor	Ultimate Losses	Count	SOV (\$000)	Severity Proportion
[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]	[10]
	[a]	[a]		[b]	[c]	[2]*[5]*[6]		[a]	[7]/[9]/1000
1993	118,578		204	1.000	1.189	141,016	1	-	-
1994	149,176		192	1.000	1.177	175,647	1	-	-
1995	-		180	1.000	1.166	-	0	-	-
1996	1,852		168	1.000	1.154	2,138	1	-	-
1997	100,000	Ins deductible-J00053 S150 T10 Failure	156	1.000	1.143	114,282	1	50,573	0.226%
1997	100,000	Ins deductible- Whse Fire J98007	156	1.000	1.143	114,282	1	50,573	0.226%
1998	369,624	98DCF adj see WDF DCF files je 911	144	1.000	1.132	418,232	1	50,573	0.827%
1998	20,796	98DCF adj see WDF DCF files je 1019	144	1.000	1.132	23,531	1	50,573	0.047%
1998	34,675	J00084 S150 T10 Failure 2nd Occurance to rvse	144	1.000	1.132	39,235	1	206	19.028%
1998	77,652	J98009 L170 Forest fire Faro	144	1.000	1.132	87,864	1	103,360	0.085%
1998	42,476	J98011 Forest fire Little Fox Lk	144	1.000	1.132	48,062	1	103,360	0.046%
1998	34,282	S/B post clsg adj 1998 Diesel burned during fire waiting period	144	1.000	1.132	38,790	1	50,573	0.077%
1999	46,450	TF J00053 S150 T10 Failure 1997 balance	132	1.000	1.120	52,038	1	206	25.237%
1999	16,704	TF J00084 S150 T10 Failure 2nd occurrence 1997 balance	132	1.000	1.120	18,714	1	206	9.076%
1999	32,806	TF M99021 Frazil Ice	132	1.000	1.120	36,753	1	50,573	0.073%
1999	5,882	TF M99017 - Wind Damage	132	1.000	1.120	6,590	1	103,360	0.006%
1999	27,360	TF M99018 - Wind Damage	132	1.000	1.120	30,651	1	103,360	0.030%
1999	41,625	TF M99019 - Wind Damage	132	1.000	1.120	46,632	1	103,360	0.045%
2000	36,533	Reallocate JE 1019(1998) O&M/Fuel-not reserve	120	1.000	1.109	40,523	1	50,573	0.080%
2000	2,761	Yukon Explosives-Replacement climbing equip	120	1.000	1.109	3,062	1	50,573	0.006%
2000	354	Fuel for generator at Fox Lake fire	120	1.000	1.109	392	1	103,360	0.000%
2000	83,159	TF J00105 Frazil Ice Nov 2000	120	1.000	1.109	92,241	1	50,573	0.182%
2001	25,000	Payment of Deductable to Kendall Adj for Fire Fighting cost	108	1.000	1.098	27,456	1	103,360	0.027%
2002	145	Olson Construction	96	1.000	1.087	158	1	160,648	0.000%
2002	2,160	Olson Construction	96	1.000	1.087	2,349	1	160,648	0.001%
2002	5,456	M02002	96	1.000	1.087	5,933	1	128	4.628%
2002	20,271	M02003	96	1.000	1.087	22,042	1	34,165	0.065%
2002	72,055	M02008	96	1.000	1.087	78,349	1	50,573	0.155%
2003	357,407	J03002 WH3 Turbine	84	1.000	1.077	384,780	1	50,573	0.761%
2004	150,298	WW2 Ring Gear Repair	72	1.000	1.066	160,207	1	2,689	5.958%
2005	3,974	Computer Stolen	60	1.000	1.055	4,194	1	4,263	0.098%
2005	5,726	TF J05001 Dwsn Hse H20 Dmge	60	1.000	1.055	6,043	1	128	4.713%
2005	1,773	Repair marsh lk dam	60	1.000	1.055	1,872	1	16,228	0.012%
2006	15,275	TF J05002 - Takhini Substation Break-In	48	1.000	1.045	15,961	1	7,309	0.218%
2006	32,347	TF J05006 - Kulan Break In	48	1.000	1.045	33,800	1	2,059	1.642%
2006	10,849	TF J05007 - L171 Lightning Arrestor Failure	48	1.000	1.045	11,336	1	103,360	0.011%
2006	35,348	R06001 - L171 Insulator Failure	48	1.000	1.045	36,936	1	103,360	0.036%
2006	35,620	R06002 - Whitehorse Hydrant Leak	48	1.000	1.045	37,221	1	160,648	0.023%
2006	302,098	J06002 - WH1 Hub and Blade Overhaul	48	1.000	1.045	315,671	1	50,573	0.624%

Yukon Energy Corporation  
IAO Actuarial Consulting Services - An Aon Company  
Retention Analysis for Yukon Energy Corporation

**Exhibit IV**  
**Sheet 1**

**Claims Data**

Accident Year	Total Incurred	Description	Age	LDF	Trending Factor	Ultimate Losses	Count	SOV (\$000)	Severity Proportion
[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]	[10]
	[a]	[a]		[b]	[c]	[2]*[5]*[6]		[a]	[7]/[9]/1000
2006	199,814	J06001 - Aishihik Cable Repair	48	1.000	1.045	208,792	1	30,640	0.681%
2007	39,073	R07001 - L174 Broken Pole	36	1.000	1.035	40,424	1	103,360	0.039%
2007	17,261	R07002 - Water Damage at MLCS	36	1.000	1.035	17,858	1	16,228	0.110%
2007	6,965	R07003 - Kulan Warehouse Water Damage	36	1.000	1.035	7,206	1	2,059	0.350%
2008	40,431	R08001-L172 Insulator Failure	24	1.025	1.024	42,450	1	103,360	0.041%
2008	11,244	R08002- Rock Creek Crossing	24	1.025	1.024	11,805	1	103,360	0.011%
2008	24,880	R08004-Outage Damages- Oct.2008	24	1.025	1.024	26,122	1	4,263	0.613%
2008	1,042	YEC Knocked over Street Light	24	1.025	1.024	1,094	1	160,648	0.001%
2008	15,063	Repair Flood Cost Damage	24	1.025	1.024	15,815	1	16,228	0.097%
2008	15,900	R06002 - Whitehorse Hydrant Leak	24	1.025	1.024	16,694	1	160,648	0.010%
2008	1,368	R08004-Outage Damages- Oct.2008	24	1.025	1.024	1,436	1	4,263	0.034%
2008	24,352	R08005-Aishihik Sub Cable Failure	24	1.025	1.024	25,568	1	3,628	0.705%
2009	118,000		12	1.179	1.014	141,067	1	-	-

Notes

- [a] From YEC
- [b] From Sheet 2
- [c] Annual Trend 1%

*Yukon Energy Corporation  
IAO Actuarial Consulting Services - An Aon Company  
Retention Analysis for Yukon Energy Corporation*

**Exhibit IV  
Sheet 2**

**Loss Development Factor**

Age	Property Incurred LDF
12	1.179
24	1.025
36	1.000
48	1.000
60	1.000
72	1.000
84	1.000
96	1.000
108	1.000
120	1.000
132	1.000
144	1.000
156	1.000
168	1.000
180	1.000
192	1.000
204	1.000
216	1.000
228	1.000
240	1.000
252	1.000
264	1.000
276	1.000
288	1.000
300	1.000
312	1.000



**APPENDIX 12.5**  
**YUKON ENERGY CORPORATION**  
**ACTUARIAL VALUATION AS AT DECEMBER 31, 2009**



**Aon Risk Solutions**  
Global Risk Consulting  
IAO Actuarial Consulting Services Inc.

**Yukon Energy Corporation**  
**Actuarial Valuation as at December 31, 2009**  
**September 27, 2010**

**Aon Risk Solutions**  
Global Risk Consulting  
IAO Actuarial Consulting Services Inc.



**Aon Risk Solutions**  
Global Risk Consulting  
IAO Actuarial Consulting Services Inc.

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## 1. Introduction

### 1.1 Purpose and Scope

This report and analysis has been prepared by IAO Actuarial Consulting Services Inc. – An Aon Company (“IAO”), at the request of Yukon Energy Corporation (“YEC”).

The purpose of this study was to prepare an actuarial valuation of YEC’s Reserve for Injury and Damages (RFID) as at December 31, 2009. In establishing this, IAO has reviewed historical losses and exposures for the program. The study is designed to:

- Evaluate YEC’s RFID
- Estimate the ultimate losses as at December 30, 2009
- Determine the annual provision for the reserve fund

In addition, this report includes background information such as historical commentary about the company, RFID and its operations. This information has been provided to add completeness and context to the report and to the best of our knowledge is accurate. However, we can make no warranty that this background information is accurate and any person wishing to confirm the accuracy should do so with company management.

### 1.2 Background of Analyst

Alex Xu is a Fellow of the Casualty Actuarial Society, a member of the American Academy of Actuaries, and meets the Qualification Standards of the Canadian Institute of Actuaries to render the actuarial report contained herein.

We performed this analysis using generally accepted actuarial principles and all relevant Actuarial Standards of Practice.

Please contact us if you have any questions regarding this report.

Respectfully submitted,

A handwritten signature in black ink, appearing to read 'Alex Xu', is written over a horizontal line.

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### **1.3 Data**

In developing this report and rendering the opinion, IAO has relied on data and information provided by company management. The data consisted of detailed actual loss information on an assumed basis, as well as exposure information.

After reviewing the information, we are satisfied that the information is reliable for the purpose of our work. However, our review in no way constitutes an audit of the data and we take no responsibility for its accuracy.

### **1.4 Distribution and Use**

This report contained herein is intended solely for the company internal use only. It is neither intended nor necessarily suitable for any other purpose. Further distribution is prohibited without the express written permission of IAO Actuarial Consulting Services Inc.

A condition of permission for distribution is that the entire report to be distributed rather than any part thereof. In addition, all recipients must be made aware that IAO remains available to answer any questions regarding the report, at the expense of YEC. Judgments about the conclusions drawn in this report should be made only after considering the entire report.



## **1.5 Limitations**

The calculation of ultimate losses and resulting annual provision shown in this report are point estimates. These values are subject to inherent variability as well as substantial measurement uncertainty, which can have a material impact in the near term. The possibility of this variability arises because all factors affecting the ultimate liability for loss and loss adjustment expense have not taken place and cannot be evaluated with absolute certainty. Such factors may include, but are not limited to, such as expected future inflationary trends.

Our projection of liabilities is based to the extent possible on the company's historical experience and we have anticipated no extraordinary changes to the various factors that might impact the future cost of claims. However, we have used methods that we believe produce reasonable results given the current information. No guarantee, either expressed or implied, should be inferred that our estimates will develop as shown in this report.

This report contains information that falls outside the scope of what is required for the valuation of the RFID of the company (i.e. historical background of the company and its operations). This information is conveyed for convenience only, and should not be relied upon unless reconfirmed by the company's management. IAO Actuarial Consulting Services Inc. does not warrant the accuracy of this information, as this information does not fall within the scope of the valuation opinion provided.



## 2. Executive Summary

We have estimated the claims liability for RFID as at December 31, 2009 as follows:

RFID Claims Liability	As at December 31, 2009
Undiscounted	\$194,767
Actuarial Present Value Claims liability	\$202,195

We have estimated the annual provision for RFID, based on information as at December 31, 2009 as \$195,048.



### **3. Commentary**

#### **3.1 Historical Background**

Established in 1987, Yukon Energy is a publicly owned electrical utility that operates as a business, at arms length from the Yukon government. YEC are the main generator and transmitter of electrical energy in the Yukon. YEC works with its parent company Yukon Development Corporation to provide Yukoners with a secure supply of clean, electrical energy by focusing on renewable sources of power and energy solutions that complement its legacy hydro assets.

Yukon Energy is incorporated under and regulated by the Business Corporations Act, the Public Utilities Act and the Yukon Waters Act. Its headquarters are located near the Whitehorse Rapids hydro plant in Whitehorse, with community operations in Mayo, Faro and Dawson City.

A Reserve for Injuries and Damages is maintained in order to address uninsured and uninsurable losses as well as the deductible portion of insured losses. YEC noted during the 2005 rate review process that it applies the following corporate accounting practice with respect to the Reserve for Injuries and Damages (RFID):

- It is a contingency reserve set up to address the cost of uninsured/uninsurable losses.
- Uninsured losses are defined as losses that could be covered by insurance but which Yukon Energy has chosen not to insure because the probability, frequency and/or dollar value of losses do not justify the premium.
- Uninsurable losses are those losses for which coverage is not available in the conventional insurance market.
- The RFID is also used to pay the insurance policy deductible in the event of a claimed loss.

The 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 reserve; and (2) it allows the costs of unforeseen events to be smoothed out over a number of years to avoid rate instability for ratepayers.

In 1995, YEC recommended an amount of \$1,135,000 as reasonable and prudent amount to set as a reserve for damages and uninsured losses. This recommended amount was made with reference to YEC's insurance coverage and the potential costs related to the loss of generating capacity. Of the \$1,135,000, \$1,035,000 was related to uninsured costs related to a waiting period incurred should YEC experience a loss of generating capacity with the balance (\$100,000) considered a reasonable amount to cover other uninsured losses. The YUB did not endorse this approach and instead ordered that a reserve be maintained at a minimal level to deal with uninsured losses as they occurred; the reserve would be replenished through charges to income in future periods that would be built directly into consumer rates. Under this approach the reserve functions as "an uninsured loss stabilization fund" with balances regularly fluctuating between

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surplus amounts and deficit amounts. The YUB has not identified specific surplus or deficit limits to the account.

While, prior to the 2005 review of rates, annual amounts of \$50,000 were appropriated to the account in order to replenish the reserve, auditors had expressed increased concern with regard to the growing balance in the account.

In 2005, YEC thus requested an increase in the annual appropriation to the reserve from \$50,000 to \$150,000 level. The Board agreed that the annual appropriation should be increased; however, \$150,000 was considered too high given the lack of information for 2005 actual losses. The Board ordered an increase in the annual appropriation of up to \$100,000 per year for each of 2005, 2006 and 2007.

## **3.2 Valuation of Claims Costs**

### **3.2.1 Data and Information**

The RFID historical claims data (by transaction) from 1993 to 2009 were provided by Mr. Ed Mollard and his team. We were informed that it contains all claims which charged into the fund including auto losses which were not covered by commercial property policy. And there were no claims falling into the general liability category. The claims record only contains the incurred losses which was not further split into paid loss and case reserve. Additionally, the loss payment has been expensed as pay and go basis. Therefore, we do not believe there is any material claim handling expense, and if not it has been change to normal operation expense.

Meanwhile, we were also provided the property Statement of Value (SOV) from 2003 to 2010 and the total uninsured property (transmission and power distribution line) for 2010.

### **3.2.2 Assumptions**

The historical claims data contains some claims for leased/rented vehicles. But we were not provided the vehicle exposure value. We assume that each year's vehicle exposure is equal to 5% of total Statement of Value (SOV).

Accordingly, we utilize the following methods to treat the auto losses in our analysis.

- A. Analyze the combined losses (including auto losses) and adjust the total exposure by 1.05
- B. Analyze the auto losses separately and add back to the property line.



### **3.2.3 Methodology**

We applied the following actuarial methodologies for the purpose of estimating the ultimate losses on an undiscounted basis:

- Incurred Loss Development
- Loss Rate
- Bornhuetter-Ferguson Using Exposures and Incurred Loss
- Frequency – Severity(FS) techniques

#### *Incurred Loss Development*

Using the incurred loss development technique, ultimate losses are estimated by calculating past incurred loss development factors and applying them to exposure periods with further expected incurred loss development.

Since incurred losses include payments and case loss reserves, changes in both of these amounts are incorporated in this method, providing a larger volume of data than just payments to estimate ultimate losses. Thus incurred loss patterns may be less erratic than paid loss patterns, especially for coverages that have a long payout pattern but for which claims are reported relatively early and case loss reserve estimates are established.

This method assumes that those who have been setting reserves have been following consistent practices over the historical period that is reviewed. Changes in claims handling procedures, large claims, or significant numbers of claims of an unusual nature may cause results to be erratic. Also, choosing an appropriate “tail factor” to determine the change in incurred loss from the latest development period to ultimate may require considerable judgment, especially for coverages which have long reporting patterns.

#### *Loss Rate*

The Loss per Exposure technique is useful when loss experience is correlated with an exposure base. The method multiplies the number of exposures for each period by the estimated ultimate loss per exposure to produce ultimate loss estimates. Since this method introduces information which is independent of the actual loss experience, it can be a valuable addition or alternative to other approaches.

In order to use the loss per exposure method, a good exposure base must be available and preferably already in use. Since the number of exposures recorded for a particular exposure period does not typically change over time, only loss per exposure estimates for each period need to be selected to use this method. Review of the Cumulative Paid Loss or Incurred Loss Per Exposure exhibits may provide some insight into any changes or trends which are occurring in loss per exposure over time.

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### *Bornhuetter-Ferguson Using Exposures and Incurred Loss*

This method is a combination of the Incurred Loss Development Method and the Loss Per Exposure method. The amount of losses yet to be incurred is based on expected loss per exposure estimates. These estimates are then modified to the extent incurred losses to date differ from what would have been expected based on the selected incurred loss development pattern.

The formula used to estimate reserves for unreported claims and for any additional development on existing case reserves is the product of expected ultimate losses (exposure x loss per exposure) and  $[1 - (1/CLDF)]$ , where CLDF is the appropriate cumulative incurred loss development factor. These reserves are added to cumulative incurred losses to produce the ultimate loss estimates.

This method avoids some of the distortion that could result if a large development factor were applied to a small base of incurred losses to calculate ultimate loss. This method will react slowly if actual loss per exposure develops differently because of major changes in retentions or deductibles, the forms and conditions of reinsurance coverage, the types of risks covered or a variety of other changes.

### *Frequency – Severity (FS) techniques*

This method is to multiply the estimated ultimate number of claims (i.e., frequency) by the estimated ultimate average value (i.e., severity). By analyzing claims experience by its frequency and severity components, actuaries are able to examine trends and patterns in the rates of claims emergence (i.e., reporting) and settlement (i.e., closure) as well as in the average values of claims.

This method can be particularly valuable when an organization is undergoing change in operations, philosophy, or management. Frequency-severity methods can also be important to validate or reject the findings from other actuarial projection techniques.

## **3.2.4 Analysis**

YEC has provided us the list of up to date claims. No claims have been reported from the general liability program. We found the data are quite volatile with maximum annual claims of \$633,000 in 2006 and minimum claim amount of \$13,000 in 2005 in recent years. We have utilized industry information while we have given the credibility to YEC's own experience.

To determine the ultimate losses as at December 31, 2009 and its annual provision to the RFID, we have utilized the triangular methods and tested with the Frequency and Severity method. We determined a selected provision by combining the information produced by all the methods.

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### 3.2.5 Actuarial Present Value Claims Liabilities

The Standards of Practice of the Canadian Institute of Actuaries stipulate that claims liabilities should be determined on an actuarial present value basis. A claims liability is a liability for future cash flow relating to claims charged to RFID up to December 31, 2009. The actuarial present value liabilities are taken to be the present value of these future cash flows as at December 31, 2009, discounted at an appropriate rate and inflated to include a provision for adverse deviations, which reflects the inherent uncertainty in the liability estimate. This is considered accepted actuarial practice, and our valuation is consistent with these principles.

#### 3.2.5.1 Assumptions

##### *Payment Patterns*

Since there is insufficient company data upon which to determine payout patterns, we have judgmentally selected the property claims payment pattern for RFID as follows:

Age	12	24	36
Payment Pattern	0.75	0.95	1.00

Also we have used the following industry CGL payment pattern for RFID's CGL claims payout pattern.

Age	12	24	36	48	60	72	84
Payment Pattern	0.090	0.384	0.803	0.923	0.977	0.998	1.000

##### *Discount Rate*

For YEC, we selected a discount rate of 3.00% for December 31, 2009.

##### *Provision for Adverse Deviations*

Accepted actuarial practice requires that policy liabilities be Actuarial Present Value to reflect the time value of money and to include a provision for adverse deviations (PfAD) to reflect uncertainty in the estimates made. For property and casualty insurers, there are three basic sources of uncertainty:

1. Development of the claims liabilities.
2. Amounts recoverable from reinsurers.
3. Future interest rates.

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For each of these sources, a provision for adverse deviations is established based on a selected percentage, called a margin for adverse deviation (MfAD). Consistent with the Standards of Practice of the Canadian Institute of Actuaries, our selections of the claims development MfADs were based on various considerations including those related to company practices, those related to the data underlying the unpaid claim estimates, and those related to the line of business for which the MfAD was selected. According to the Canadian Institute of Actuaries, the claim development MfADs selected must be in the range of 2.5% to 20.0% of the present value of the unpaid claims on both a gross and net basis. The following table presents our selection of claims development MfAD by line of business.

<b>Line of Business</b>	<b>Claims Development MfAD</b>
Commercial Property	5.0%
Commercial General Liability	10.0%

The reinsurance recovery PfAD takes into account the volume of business ceded to reinsurers/insurers, the nature of the company’s reinsurance contracts, and any potential problems with existing reinsurers. The Canadian Institute of Actuaries requires that the reinsurance recovery MfADs be in the range of 0% to 15.0% of the present value of ceded unpaid claims and operates as a reduction to the ceded claims liability. Based on RFID’s claims history, we believe that there is no recovery risk for RFID. Therefore, this MfAD is zero.

The interest rate PfAD considers the company’s current investment portfolio and ongoing investment philosophy, the economic investment climate, the method of valuing assets, and the matching of investments to claims payment patterns. The Canadian Institute of Actuaries has directed that this MfAD fall within a range of 25 to 200 basis points and be applied as a reduction to the discount rate used to bring unpaid claims to present value. Given the considerations described above, we have assumed an interest rate MfAD of 25 basis points.

### **3.2.6 Findings**

Our findings for claims liabilities of RFID as at December 31, 2009 are as follows:



Case Reserve	IBNR	Total undiscounted Claims Liabilities	Present Value of Total undiscounted Claims Liabilities	Total PfAD	ULAE	Total discounted Claims Liabilities
110,876	83,892	194,767	189,961	12,234	-	202,195

The following chart summarizes our annual provision analysis result.

Method	Auto claims treatment	
	Including Auto claims	Excluding Auto claims and adding back
Incurred Loss Development Loss Rate BF	198,713 (A)	195,248 (B)
Frequency * Severity	191,183 (C)	251,313 (D)

Selected by IAO: 195,048 (the average of A, B and C)



## 4. Exhibits

Exhibits in Appendix A of this report present the full annual claims cost analysis result while we included the auto losses in our analysis.

- Exhibit 1 : Analysis based on incurred Loss development, Loss Rate and BF method
- Exhibit 2 – 4: Analysis based on frequency - severity method

Exhibits in Appendix B of this report present the full annual claims cost analysis result while we analyzed auto losses separately.

- Exhibit 1 : Analysis based on incurred Loss development, Loss Rate and BF method
- Exhibit 2 – 4: Analysis based on frequency - severity method

Exhibits in Appendix C present the summary of discounted and undiscounted claims liabilities analysis.

# Appendix A

Yukon Energy Corporation  
IAO Actuarial Consulting Services - An Aon Company  
Actuarial Valuation for Reserve for Injury and Damages as at December 31, 2009

Exhibit 1  
Sheet 1

**Claims Analysis - Commercial Property ( including auto exposures)**

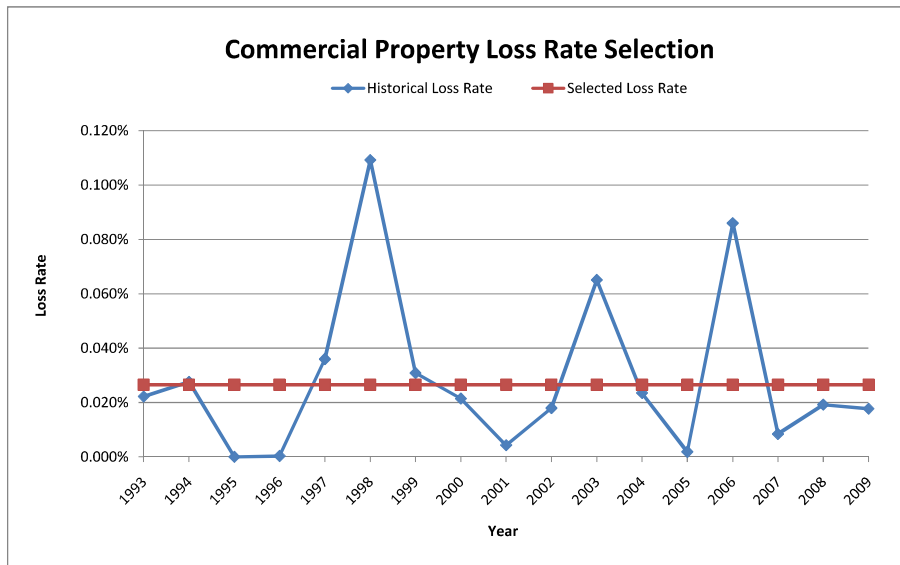
Acc Yr	Total SOV (\$000)	Vehicle Adjustment Factor	Total Exposure (\$000)	Total Incurred	Age	LDF	Trend Factor	Trended Ultimate-Loss Development Method	Loss Rate	Trended Ultimate-Loss Rate Method	Trended Ultimate-Loss BF Method	Trended Ultimate Loss Selected	Implied LDF
[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]	[10]	[11]	[12]	[13]	[14]
	[a]		[2]*[3]	[a]		[b]	[c]	[3]*[5]*[6]	[9]/[4]/1000	[4]*[15]*1000	[5]+[11]*(1-1/[7])		[13]/[8]/[5]
1993	596,037	1.05	625,839	118,578	204	1.000	1.173	139,042	0.022%	166,267	118,578	139,042	1.000
1994	596,037	1.05	625,839	149,176	192	1.000	1.161	173,189	0.028%	166,267	149,176	173,189	1.000
1995	596,037	1.05	625,839	-	180	1.000	1.149	-	0.000%	166,267	-	-	1.000
1996	596,037	1.05	625,839	1,852	168	1.000	1.138	2,108	0.000%	166,267	1,852	2,108	1.000
1997	596,037	1.05	625,839	200,000	156	1.000	1.127	225,365	0.036%	166,267	200,000	225,365	1.000
1998	596,037	1.05	625,839	612,760	144	1.000	1.116	683,636	0.109%	166,267	612,760	683,636	1.000
1999	596,037	1.05	625,839	175,048	132	1.000	1.105	193,361	0.031%	166,267	175,048	193,361	1.000
2000	596,037	1.05	625,839	122,807	120	1.000	1.094	134,312	0.021%	166,267	122,807	134,312	1.000
2001	596,037	1.05	625,839	25,000	108	1.000	1.083	27,071	0.004%	166,267	25,000	27,071	1.000
2002	596,037	1.05	625,839	105,105	96	1.000	1.072	112,686	0.018%	166,267	105,105	112,686	1.000
2003	596,037	1.05	625,839	383,777	84	1.000	1.062	407,387	0.065%	166,267	383,777	407,387	1.000
2004	711,843	1.05	747,435	167,202	72	1.000	1.051	175,731	0.024%	198,571	167,202	175,731	1.000
2005	716,118	1.05	751,924	13,642	60	1.000	1.041	14,196	0.002%	199,764	13,642	14,196	1.000
2006	722,599	1.05	758,729	633,092	48	1.000	1.030	652,275	0.086%	201,571	633,092	652,275	1.000
2007	728,080	1.05	764,484	63,299	36	1.000	1.020	64,572	0.008%	203,101	63,299	64,572	1.000
2008	734,119	1.05	770,825	143,093	24	1.025	1.010	148,137	0.019%	204,785	148,088	148,088	1.025
2009	746,304	1.05	783,619	118,000	12	1.179	1.000	139,093	0.018%	208,184	149,570	149,570	1.268
Total				3,032,430				3,292,162		3,044,908	3,068,994	3,302,590	
								Max Loss Rate:	0.109%				
								Min Loss Rate:	0.000%				
								Average:	0.029%				
								Average excluding Max & Min:	0.026%				
								Selected Loss Rate [15]	0.027%				
								Average Annual Claims Cost - Commercial Property(including auto exposures):				194,270	

**Notes**

- [a] From YEC
- [b] From Exhibit 5, Sheet 2
- [c] Annual trend 1%

Yukon Energy Corporation  
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Actuarial Valuation for Reserve for Injury and Damages as at December 31, 2009

Exhibit 1  
Sheet 2



Yukon Energy Corporation  
IAO Actuarial Consulting Services - An Aon Company  
Actuarial Valuation for Reserve for Injury and Damages as at December 31, 2009

Exhibit 1  
Sheet 3

**Claims Analysis - CGL**

Acc Yr	Total Exposure (Revenue \$000)	Total Incurred	Age	LDF	Trend Factor	Trended Ultimate-Loss Development Method	Loss Rate	Trended Ultimate-Loss Rate Method	Trended Ultimate-BF Method	Trended Ultimate Loss Selected
[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]	[10]	[11]
	[a]	[a]		[b]	[c]	[3]*[5]*[6]	[7]/[2]	[2]*[12]*1000	[3]+[9]*(1-1/[5])	
1999	23,377	0	132	1.000	1.629	-	0.250%	58,437	-	-
2000	23,479	0	120	1.000	1.551	-	0.250%	58,692	-	-
2001	24,595	0	108	1.000	1.477	-	0.250%	61,482	-	-
2002	24,595	0	96	1.000	1.407	-	0.250%	61,482	-	-
2003	24,839	0	84	1.000	1.340	-	0.250%	62,092	-	-
2004	25,782	0	72	1.000	1.276	-	0.250%	64,449	-	-
2005	26,889	0	60	0.998	1.216	-	0.250%	67,216	-	135
2006	28,061	0	48	0.893	1.158	-	0.250%	70,146	-	8,386
2007	28,386	0	36	0.905	1.103	-	0.250%	70,958	-	7,464
2008	29,047	0	24	1.182	1.050	-	0.250%	72,611	-	11,165
2009	32,413	0	12	1.871	1.000	-	0.250%	81,025	-	37,711
Total						-		1,079,213		48,875
						Selected Loss Rate [12][d]	0.250%			

Average Annual Claims Cost - CGL: **4,443**

Annual Claims Cost - Total: **198,713**

**Notes**

- [a] From YEC
- [b] From Exhibit 5, Sheet 2
- [c] Judgmentally selected annual trend 5%
- [d] Judgmentally selected

Yukon Energy Corporation  
 IAO Actuarial Consulting Services - An Aon Company  
 Actuarial Valuation for Reserve for Injury and Damages as at December 31, 2009

**Exhibit 2**  
**Sheet 1**

**Claims Frequency Analysis**

Acc Yr	Property (incl. auto)	Total	Frequency(Per Million)	CGL Claims Counts	Total Revenue(\$000)	Frequency
	Claims Counts	SOV(\$000)				
	[1]	[2]	[3]			
			[1]/[2]*1000			
1993	1	625,839	0.0016	0		
1994	1	625,839	0.0016	0		
1995	0	625,839	-	0		
1996	1	625,839	0.0016	0		
1997	2	625,839	0.0032	0		
1998	7	625,839	0.0112	0		
1999	7	625,839	0.0112	0	23,377	-
2000	4	625,839	0.0064	0	23,479	-
2001	1	625,839	0.0016	0	24,595	-
2002	9	625,839	0.0144	0	24,595	-
2003	9	625,839	0.0144	0	24,839	-
2004	2	747,435	0.0027	0	25,782	-
2005	5	751,924	0.0066	0	26,889	-
2006	8	758,729	0.0105	0	28,061	-
2007	3	764,484	0.0039	0	28,386	-
2008	9	770,825	0.0117	0	29,047	-
2009	1	783,619	0.0013	0	32,413	-
Total	70			0		
		Average	0.0061			
		Max	0.0144			
		Min	-			
		Average excluding Max & Min	0.0060			
		Latest 3 Yr Average	0.0056			
		Selected:	0.0058			
		2009 SOV(\$000):	783,619			
		Projected Claims Count:	5.00			

Yukon Energy Corporation  
 IAO Actuarial Consulting Services - An Aon Company  
 Actuarial Valuation for Reserve for Injury and Damages as at December 31, 2009

Exhibit 3  
 Sheet 1

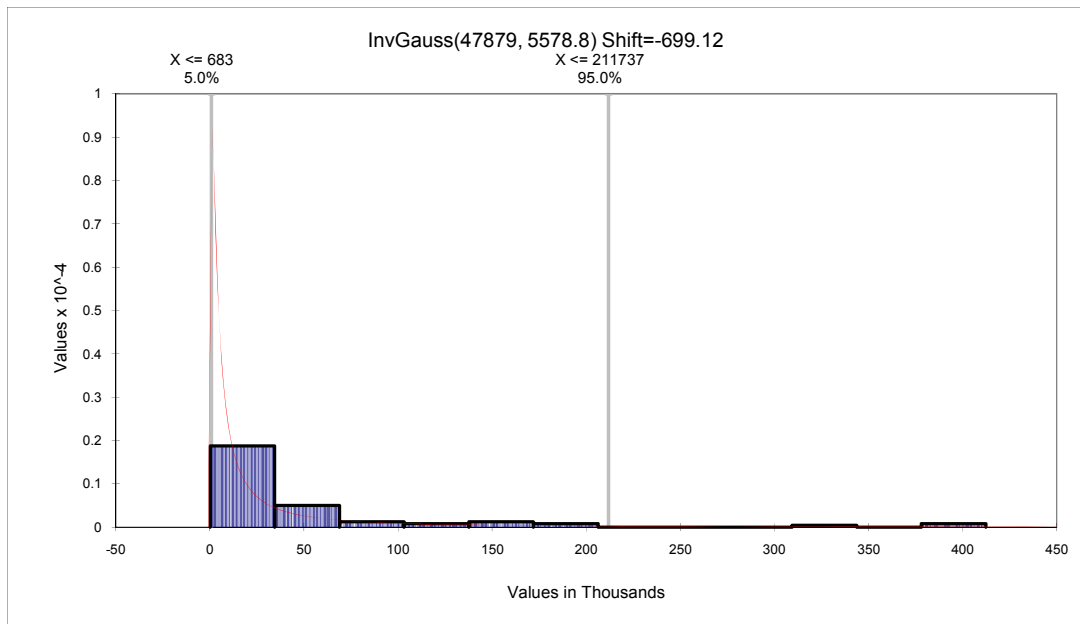
**Commercial Property Severity - Comparison of Fitted Distributions - Summary**

Fitting Distribution	Fitting Period	Statistics								Goodness of Fit	
		Parameters		Left X(5%)	Right X(95%)	P(X<=0)	Mean	Std. Dev.	Variance	RMS Error	Rank
Empirical	All			1,661	139,042	10.00%	47,180	82,460	6,702,473,080		
InvGauss	All	Shift m l	-699 47,879 5,579 5,579	2,382	104,549	10.00%	47,180	140,265	19,674,143,050	N/A	3 3 3 3
Weibull	All	Shift b	-7,397 1 48,979 48,979	939	123,717	10.00%	46,008	63,332	4,010,988,090	N/A	4 4 4 4
Expon	All	Shift m s	N/A 19,707 36,148 36,148	2,505	101,053	10.00%	40,572	46,361	2,149,374,290	N/A	5 5 5 5

	Rank	Root-mean square error	Shape Graph	Difference 10 <sup>-6</sup>	P(X<=0)	90% Range		Mean	Min	Max
						Left X	Right X			
Lognorm	1	N/A	ok		10.00%	2,344	140,867	77,556	106	99,999,999,999.0
Pearson5	2	N/A	ok		10.00%	2,293	190,326	N/A	-639	99,999,999,999.0
InvGauss	3	N/A	ok		10.00%	2,382	104,549	47,180	-699	99,999,999,999.0
Weibull	4	N/A	ok		10.00%	939	123,717	46,008	-7,397	99,999,999,999.0
Expon	5	N/A	ok		10.00%	2,505	101,053	40,572	-99,999,999,999	99,999,999,999.0
ExtValue	6	N/A	bad		10.00%	9,977	107,761	46,508	-516	99,999,999,999.0
Logistic	7	N/A	bad		10.00%	411	3,551,732	N/A	155	99,999,999,999.0
Normal	8	N/A	ok		10.00%	-15,620	101,554	29,709	-99,999,999,999	99,999,999,999.0
Pareto	9	N/A	very bad		10.00%	-22,220	152,856	47,180	-99,999,999,999	99,999,999,999.0
Empirical						1,661	139,042	47,180	155	412,378.0

**NOTES**  
 The row highlighted in yellow is the selected severity distribution

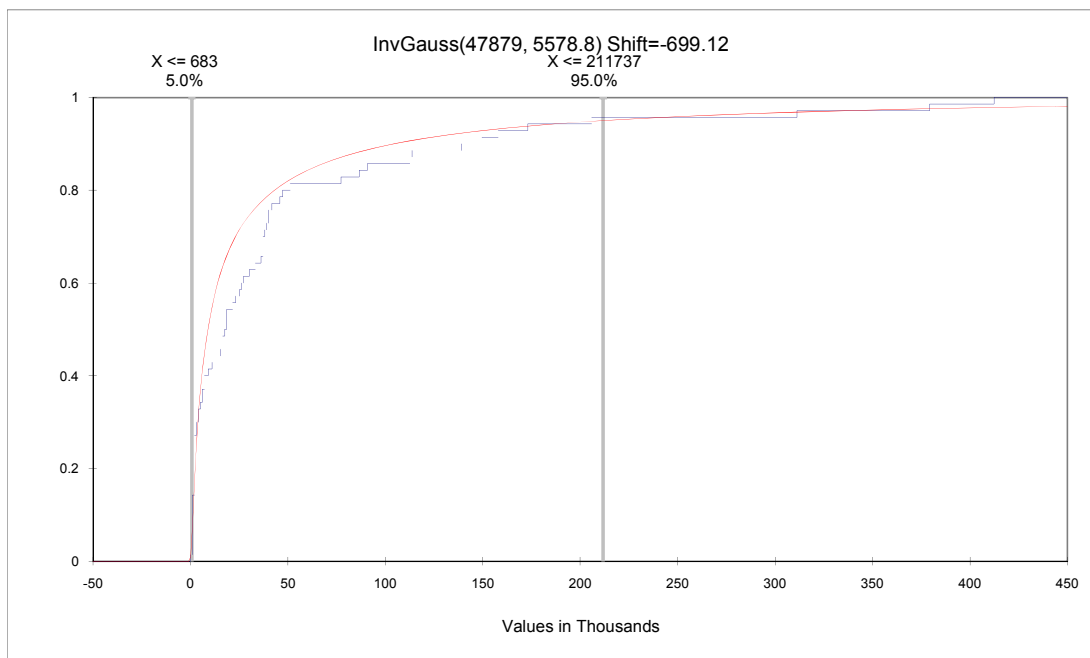
**Commercial Property Severity - Comparison of Fitted Distributions - Probability Density Function**



Yukon Energy Corporation  
IAO Actuarial Consulting Services - An Aon Company  
Actuarial Valuation for Reserve for Injury and Damages as at December 31, 2009

Exhibit 3  
Sheet 3

**Commercial Property Severity - Comparison of Fitted Distributions - Cumulative Distribution Function**



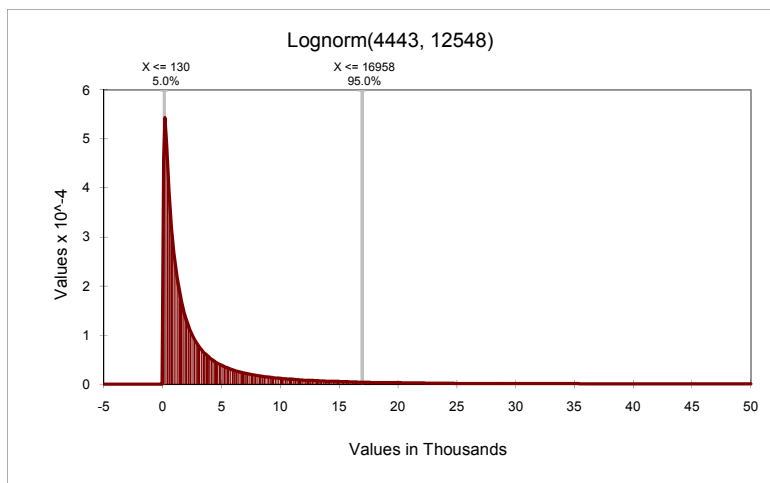
Yukon Energy Corporation  
IAO Actuarial Consulting Services - An Aon Company  
Actuarial Valuation for Reserve for Injury and Damages as at December 31, 2009

Exhibit 3  
Sheet 4

**CGL Annual Losses Distribution Selection**

Mean: 4,443  
Standard Deviation: 12,548

Distribution Selection: 4,443 RiskLognorm(4443, 12548)



*Yukon Energy Corporation*  
*IAO Actuarial Consulting Services - An Aon Company*  
*Actuarial Valuation for Reserve for Injury and Damages as at December 31, 2009*

**Exhibit 4**  
**Sheet 1**

**Annual Claims Cost Projection - Commercial Property**

Property Losses at Expected Level: 186,740

Property Losses distribution

Minimum	-
Maximum	4,962,188
Mean	186,740
Std Deviation	291,070
Variance	84,721,820,000
Skewness	4
Kurtosis	36
Errors Calculated	-
Mode	-
5% Perc	4,442
10% Perc	10,484
15% Perc	16,432
20% Perc	22,954
25% Perc	30,816
30% Perc	39,584
35% Perc	48,652
40% Perc	59,544
45% Perc	71,918
50% Perc	86,157
55% Perc	102,486
60% Perc	123,733
65% Perc	147,335
70% Perc	178,487
75% Perc	217,828
80% Perc	269,604
85% Perc	351,521
90% Perc	469,072
95% Perc	715,947

Yukon Energy Corporation  
 IAO Actuarial Consulting Services - An Aon Company  
 Actuarial Valuation for Reserve for Injury and Damages as at December 31, 2009

**Exhibit 4**  
**Sheet 2**

**Annual Claims Cost Projection - CGL**

CGL Losses at Expected Level: 4,443

CGL Losses distribution

Minimum	-
Maximum	250,000
Mean	4,443
Std Deviation	12,548
Variance	157,446,593
Skewness	-
Kurtosis	-
Errors Calculated	-
Mode	-
5% Perc	130
10% Perc	222
15% Perc	319
20% Perc	426
25% Perc	546
30% Perc	682
35% Perc	838
40% Perc	1,019
45% Perc	1,231
50% Perc	1,483
55% Perc	1,786
60% Perc	2,158
65% Perc	2,624
70% Perc	3,225
75% Perc	4,028
80% Perc	5,159
85% Perc	6,886
90% Perc	9,900
95% Perc	16,958

**Annual Claims Cost - Total: 191,183**

Yukon Energy Corporation  
IAO Actuarial Consulting Services - An Aon Company  
Actuarial Valuation for Reserve for Injury and Damages as at December 31, 2009

Exhibit 5  
Sheet 1

**Claims Data**

Calendar Year	Accident Year	Total Incurred	Description	Age	LDF	Trending Factor	Ultimate Losses	Claims Counts
[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]
		[a]	[a]		[b]	[c]	[3]*[6]*[7]	if [3]>0
1993	1993	118,578		204	1.000	1.173	139,042	1
1994	1994	149,176		192	1.000	1.161	173,189	1
1995	1995	-		180	1.000	1.149	-	0
1996	1996	1,852		168	1.000	1.138	2,108	1
1997	1997	100,000	Ins deductible-J00053 S150 T10 Failure	156	1.000	1.127	112,683	1
1997	1997	100,000	Ins deductible- Whse Fire J98007	156	1.000	1.127	112,683	1
1998	1998	369,624	98DCF adj see WDF DCF files je 911	144	1.000	1.116	412,378	1
1998	1998	20,796	98DCF adj see WDF DCF files je 1019	144	1.000	1.116	23,201	1
1998	1998	34,675	J00084 S150 T10 Failure 2nd Occurance to rvse	144	1.000	1.116	38,686	1
1998	1998	77,652	J98009 L170 Forest fire Faro	144	1.000	1.116	86,634	1
1998	1998	42,476	J98011 Forest fire Little Fox Lk	144	1.000	1.116	47,390	1
1998	1998	33,254	TF C0115 new truck replacement je 808	144	1.000	1.116	37,100	1
1998	1998	34,282	S/B post clsg adj 1998 Diesel burned during fire waiting period	144	1.000	1.116	38,247	1
1999	1999	4,221	Loss on vehicle #T 34 - Oct 98	132	1.000	1.105	4,662	1
1999	1999	46,450	TF J00053 S150 T10 Failure 1997 balance	132	1.000	1.105	51,309	1
1999	1999	16,704	TF J00084 S150 T10 Failure 2nd occurrence 1997 balance	132	1.000	1.105	18,452	1
1999	1999	32,806	TF M99021 Frazil Ice	132	1.000	1.105	36,238	1
1999	1999	5,882	TF M99017 - Wind Damage	132	1.000	1.105	6,498	1
1999	1999	27,360	TF M99018 - Wind Damage	132	1.000	1.105	30,222	1
1999	1999	41,625	TF M99019 - Wind Damage	132	1.000	1.105	45,979	1
2000	2000	36,533	Reallocate JE 1019(1998) O&M/Fuel-not reserve	120	1.000	1.094	39,956	1
2000	2000	2,761	Yukon Explosives-Replacement climbing equip	120	1.000	1.094	3,019	1
2000	2000	354	Fuel for generator at Fox Lake fire	120	1.000	1.094	387	1
2000	2000	83,159	TF J00105 Frazil Ice Nov 2000	120	1.000	1.094	90,950	1
2001	2001	25,000	Payment of Deductible to Kendall Adj for Fire Fighting cost	108	1.000	1.083	27,071	1
2002	2002	1,000	Royal & Sun Alliance-deductible re w/o unit 44	96	1.000	1.072	1,072	1
2002	2002	1,252	A1 Auto Body	96	1.000	1.072	1,342	1
2002	2002	905	Irving Collision	96	1.000	1.072	970	1
2002	2002	145	Olson Construction	96	1.000	1.072	155	1
2002	2002	2,160	Olson Construction	96	1.000	1.072	2,316	1
2002	2002	5,456	M02002	96	1.000	1.072	5,850	1
2002	2002	20,271	M02003	96	1.000	1.072	21,734	1
2002	2002	72,055	M02008	96	1.000	1.072	77,253	1
2002	2002	1,861	J02001	96	1.000	1.072	1,995	1
2003	2003	2,027	A1 Auto Body	84	1.000	1.062	2,152	1
2003	2003	1,033	Norcan Leasing	84	1.000	1.062	1,097	1
2003	2003	529	Norcan Leasing	84	1.000	1.062	562	1
2003	2003	1,565	Norcan Leasing	84	1.000	1.062	1,661	1
2003	2003	1,000	UAB Buzzeo Loss Adj--Bank Rec Item	84	1.000	1.062	1,062	1
2003	2003	475	Norcan Leasing	84	1.000	1.062	505	1
2003	2003	357,407	J03002 WH3 Turbine	84	1.000	1.062	379,394	1
2003	2003	15,996	J01006 Veh Vandalism	84	1.000	1.062	16,980	1
2003	2003	3,745	Norcan Leasing	84	1.000	1.062	3,975	1
2004	2004	16,904	Service Truck Fire Loss	72	1.000	1.051	17,766	1
2004	2004	150,298	WW2 Ring Gear Repair	72	1.000	1.051	157,964	1
2005	2005	3,974	Computer Stolen	60	1.000	1.041	4,135	1
2005	2005	1,000	Third Party Vehicle Damage - Mayo	60	1.000	1.041	1,041	1
2005	2005	1,169	Service Truck Fire Loss	60	1.000	1.041	1,217	1
2005	2005	5,726	TF J05001 Dwsn Hse H20 Dmge	60	1.000	1.041	5,958	1
2005	2005	1,773	Repair marsh lk dam	60	1.000	1.041	1,845	1
2006	2006	15,275	TF J05002 - Takhini Substation Break-In	48	1.000	1.030	15,738	1
2006	2006	32,347	TF J05006 - Kulan Break In	48	1.000	1.030	33,327	1
2006	2006	10,849	TF J05007 - L171 Lighning Arrestor Failure	48	1.000	1.030	11,178	1
2006	2006	35,348	R06001 - L171 Insulator Failure	48	1.000	1.030	36,419	1
2006	2006	35,620	R06002 - Whitehorse Hydrant Leak	48	1.000	1.030	36,700	1
2006	2006	1,740	R06003 - Unit 63 Vehicle Theft	48	1.000	1.030	1,792	1
2006	2006	302,098	J06002 - WH1 Hub and Blade Overhaul	48	1.000	1.030	311,252	1
2006	2006	199,814	J06001 - Aishihik Cable Repair	48	1.000	1.030	205,869	1
2007	2007	39,073	R07001 - L174 Broken Pole	36	1.000	1.020	39,859	1
2007	2007	17,261	R07002 - Water Damage at MLCS	36	1.000	1.020	17,608	1
2007	2007	6,965	R07003 - Kulan Warehouse Water Damage	36	1.000	1.020	7,105	1
2008	2008	40,431	R08001-L172 Insulator Failure	24	1.025	1.010	41,842	1
2008	2008	11,244	R08002- Rock Creek Crossing	24	1.025	1.010	11,636	1

YUKON ENERGY CORPORATION  
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APRIL 2012

2008	2008	8,814	R08003-Polaris Ranger & Trailer Rplcm	24	1.025	1.010	9,122	1
2008	2008	24,880	R08004-Outage Damages- Oct.2008	24	1.025	1.010	25,748	1
2008	2008	1,042	YEC Knocked over Street Light	24	1.025	1.010	1,078	1
2008	2008	15,063	Repair Flood Cost Damage	24	1.025	1.010	15,588	1
2008	2008	15,900	R06002 - Whitehorse Hydrant Leak	24	1.025	1.010	16,455	1
2008	2008	1,368	R08004-Outage Damages- Oct.2008	24	1.025	1.010	1,416	1
2008	2008	24,352	R08005-Aishihik Sub Cable Failure	24	1.025	1.010	25,202	1
2009	2009	118,000		12	1.268	1.000	149,570	1
Total		3,032,430					3,302,590	70

Notes

[a] From YEC

[b] Exhibit 1, Sheet 1, Column 14

[c] Judgmentally selected annual trend 1%

**Loss Development Factor**

Age [1]	Property Incurred LDF [2]	CGL Incurred LDF [3]
	[a]	[b]
12	1.179	1.871
24	1.025	1.182
36	1.000	0.905
48	1.000	0.893
60	1.000	0.998
72	1.000	1.000
84	1.000	1.000
96	1.000	1.000
108	1.000	1.000
120	1.000	1.000
132	1.000	1.000
144	1.000	1.000
156	1.000	1.000
168	1.000	1.000
180	1.000	1.000
192	1.000	1.000
204	1.000	1.000
216	1.000	1.000
228	1.000	1.000
240	1.000	1.000
252	1.000	1.000
264	1.000	1.000
276	1.000	1.000
288	1.000	1.000
300	1.000	1.000
312	1.000	1.000

Notes

[a] Ambest 2008

[b] IAO UMS

## Appendix B

Yukon Energy Corporation  
IAO Actuarial Consulting Services - An Aon Company  
Actuarial Valuation for Reserve for Injury and Damages as at December 31, 2009

Exhibit 1  
Sheet 1

**Claims Analysis - Commercial Property (Excluding Auto Exposures)**

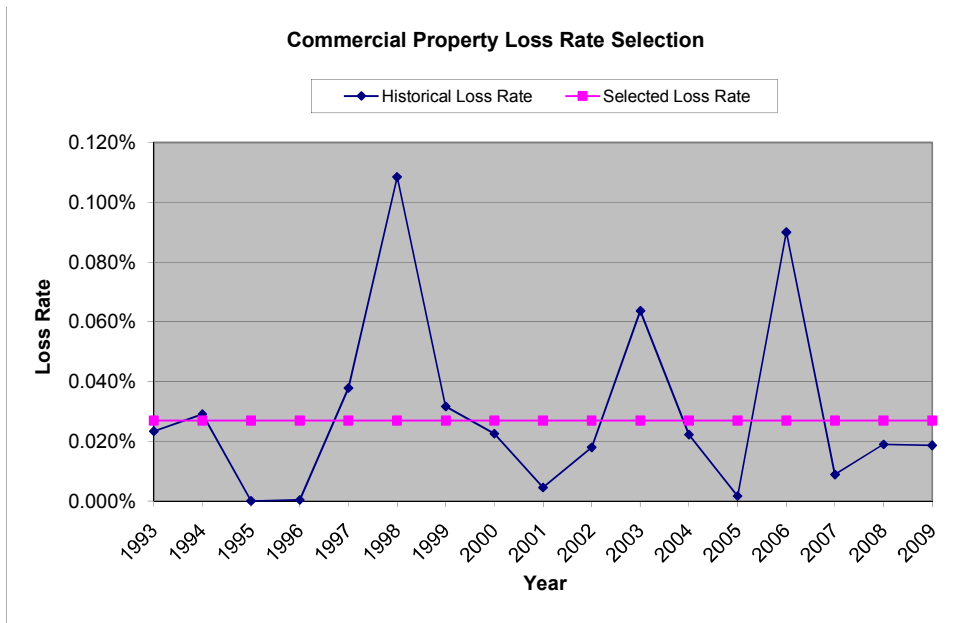
Acc Yr [1]	Total Exposure (SOV \$000) [2]	Total Incurred [3]	Age [4]	LDF [5]	Trend Factor [6]	Trended Ultimate-Loss Development Method [7]	Loss Rate [8]	Trended Ultimate-Loss Rate Method [9]	Trended Ultimate-BF Method [10]	Trended Ultimate Loss Selected [11]	Implied LDF [12]
	[a]	[a]		[b]	[c]	[3]*[5]/[6]	[7]/[2]/1000	[2]*[13]*1000	[3]+[9]*(1-1/[5])		[11]/[6]/[3]
1993	596,037	118,578	204	1.000	1.173	139,042	0.023%	160,365	118,578	139,042	1.000
1994	596,037	149,176	192	1.000	1.161	173,189	0.029%	160,365	149,176	173,189	1.000
1995	596,037	-	180	1.000	1.149	-	0.000%	160,365	-	-	1.000
1996	596,037	1,852	168	1.000	1.138	2,108	0.000%	160,365	1,852	2,108	1.000
1997	596,037	200,000	156	1.000	1.127	225,365	0.038%	160,365	200,000	225,365	1.000
1998	596,037	579,506	144	1.000	1.116	646,536	0.108%	160,365	579,506	646,536	1.000
1999	596,037	170,827	132	1.000	1.105	188,699	0.032%	160,365	170,827	188,699	1.000
2000	596,037	122,807	120	1.000	1.094	134,312	0.023%	160,365	122,807	134,312	1.000
2001	596,037	25,000	108	1.000	1.083	27,071	0.005%	160,365	25,000	27,071	1.000
2002	596,037	100,087	96	1.000	1.072	107,307	0.018%	160,365	100,087	107,307	1.000
2003	596,037	357,407	84	1.000	1.062	379,394	0.064%	160,365	357,407	379,394	1.000
2004	711,843	150,298	72	1.000	1.051	157,964	0.022%	191,523	150,298	157,964	1.000
2005	716,118	11,473	60	1.000	1.041	11,939	0.002%	192,673	11,473	11,939	1.000
2006	722,599	631,352	48	1.000	1.030	650,483	0.090%	194,417	631,352	650,483	1.000
2007	728,080	63,299	36	1.000	1.020	64,572	0.009%	195,892	63,299	64,572	1.000
2008	734,119	134,279	24	1.025	1.010	139,012	0.019%	197,516	139,096	139,096	1.026
2009	746,304	118,000	12	1.179	1.000	139,093	0.019%	200,795	148,449	148,449	1.258
Total		2,933,940				3,186,086		2,936,833	2,969,207	3,195,526	
						Max Loss Rate:	0.108%				
						Min Loss Rate:	0.000%				
						Average:	0.029%				
						Average excluding Max & Min:	0.026%				
						Selected Loss Rate [13]	0.027%				
						Average Annual Claims Cost - Commercial Property:				187,972.14	

**Notes**

- [a] From YEC
- [b] From Exhibit 5, Sheet 2
- [c] Annual trend 1%

Yukon Energy Corporation  
IAO Actuarial Consulting Services - An Aon Company  
Actuarial Valuation for Reserve for Injury and Damages as at December 31, 2009

Exhibit 1  
Sheet 2



Yukon Energy Corporation  
IAO Actuarial Consulting Services - An Aon Company  
Actuarial Valuation for Reserve for Injury and Damages as at December 31, 2009

Exhibit 1  
Sheet 3

**Claims Analysis - CGL**

Acc Yr	Total Exposure (Revenue \$000)	Total Incurred	Age	LDF	Trend Factor	Trended Ultimate-Loss Development Method	Loss Rate	Trended Ultimate-Loss Rate Method	Trended Ultimate-BF Method	Trended Ultimate Loss Selected
[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]	[10]	[11]
	[a]	[a]		[b]	[c]	[3]*[5]*[6]	[7]/[2]	[2]*[12]	[3]+[9]*(1-1/[5])	
1999	23,377	0	132	1.000	1.629	-	0.250%	58,437	-	-
2000	23,479	0	120	1.000	1.551	-	0.250%	58,692	-	-
2001	24,595	0	108	1.000	1.477	-	0.250%	61,482	-	-
2002	24,595	0	96	1.000	1.407	-	0.250%	61,482	-	-
2003	24,839	0	84	1.000	1.340	-	0.250%	62,092	-	-
2004	25,782	0	72	1.000	1.276	-	0.250%	64,449	-	-
2005	26,889	0	60	0.998	1.216	-	0.250%	67,216	- 135	-
2006	28,061	0	48	0.893	1.158	-	0.250%	70,146	- 8,386	-
2007	28,386	0	36	0.905	1.103	-	0.250%	70,958	- 7,464	-
2008	29,047	0	24	1.182	1.050	-	0.250%	72,611	11,165	11,165
2009	32,413	0	12	1.871	1.000	-	0.250%	81,025	37,711	37,711
Total						-	0.250%	1,079,213	32,890	48,875
							Selected Loss Rate [12][d]	0.250%		
										Average Annual Claims Cost - CGL: 4,443

**Notes**

[a] From YEC  
[b] From Exhibit 5, Sheet 2  
[c] Annual trend 5%  
[d] Judgmentally selected

Yukon Energy Corporation  
IAO Actuarial Consulting Services - An Aon Company  
Actuarial Valuation for Reserve for Injury and Damages as at December 31, 2009

Exhibit 1  
Sheet 4

**Claims Analysis - Auto Only**

Acc Yr	Total Exposure (SOV \$000)	Percentage of Auto Exposures	Total Auto Exposure (\$000)	Total Incurred	Age	LDF	Trend Factor	Trended Ultimate-Loss Development Method	Loss Rate	Trended Ultimate-Loss Rate Method	Trended Ultimate-Loss BF Method	Trended Ultimate Loss Selected
[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]	[10]	[11]	[12]	[13]
1993	596,037	5.00%	29,802	-	204	1.000	1.173	-	0.000%	5,901	-	-
1994	596,037	5.00%	29,802	-	192	1.000	1.161	-	0.000%	5,901	-	-
1995	596,037	5.00%	29,802	-	180	1.000	1.149	-	0.000%	5,901	-	-
1996	596,037	5.00%	29,802	-	168	1.000	1.138	-	0.000%	5,901	-	-
1997	596,037	5.00%	29,802	-	156	1.000	1.127	-	0.000%	5,901	-	-
1998	596,037	5.00%	29,802	33,254	144	1.000	1.116	37,100	0.124%	5,901	33,254	37,100
1999	596,037	5.00%	29,802	4,221	132	1.000	1.105	4,662	0.016%	5,901	4,221	4,662
2000	596,037	5.00%	29,802	-	120	1.000	1.094	-	0.000%	5,901	-	-
2001	596,037	5.00%	29,802	-	108	1.000	1.083	-	0.000%	5,901	-	-
2002	596,037	5.00%	29,802	5,017	96	1.000	1.072	5,379	0.018%	5,901	5,017	5,379
2003	596,037	5.00%	29,802	26,371	84	1.000	1.062	27,993	0.094%	5,901	26,371	27,993
2004	711,843	5.00%	35,592	16,904	72	1.000	1.051	17,766	0.050%	7,048	16,904	17,766
2005	716,118	5.00%	35,806	2,169	60	1.000	1.041	2,257	0.006%	7,090	2,169	2,257
2006	722,599	5.00%	36,130	1,740	48	1.000	1.030	1,792	0.005%	7,155	1,740	1,792
2007	728,080	5.00%	36,404	-	36	1.000	1.020	-	0.000%	7,209	-	-
2008	734,119	5.00%	36,706	8,814	24	1.025	1.010	9,125	0.025%	7,269	8,991	8,991
2009	746,304	5.00%	37,315	-	12	1.179	1.000	-	0.000%	7,389	1,121	1,121
<b>Total</b>			<b>545,774</b>	<b>98,490</b>				<b>106,076</b>		<b>108,075</b>	<b>99,788</b>	<b>107,063</b>
								Max Loss Rate:	0.124%			
								Min Loss Rate:	0.000%			
								Average:	0.020%			
								Average excluding Max & Min:	0.014%			
								Selected Loss Rate [15]	0.020%			
										Average Annual Claims Cost - Auto:		<b>2,832</b>
										<b>Average Annual Claims Cost - Total:</b>		<b>195,248</b>

Notes  
[a] From YEC  
[b] Judgmentally selected  
[c] From Exhibit 5, Sheet 2  
[d] Annual trend 1%

Yukon Energy Corporation  
IAO Actuarial Consulting Services - An Aon Company  
Actuarial Valuation for Reserve for Injury and Damages as at December 31, 2009

Exhibit 2  
Sheet 1

**Claims Frequency Analysis**

Acc Yr	Property		Frequency (Per Million)	Auto		Frequency (Per Million)	CGL		Total	
	Claims	CoI SOV(\$000)		Claims	CoI Total Expc		Claims	CoI Revenue(\$000)	Frequency	
1993	1	596,037	0.0017	0	29,802	-	0			
1994	1	596,037	0.0017	0	29,802	-	0			
1995	0	596,037	-	0	29,802	-	0			
1996	1	596,037	0.0017	0	29,802	-	0			
1997	2	596,037	0.0034	0	29,802	-	0			
1998	7	596,037	0.0117	0	29,802	-	0			
1999	7	596,037	0.0117	0	29,802	-	0	23,377	-	
2000	4	596,037	0.0067	0	29,802	-	0	23,479	-	
2001	1	596,037	0.0017	0	29,802	-	0	24,595	-	
2002	5	596,037	0.0084	4	29,802	0.134	0	24,595	-	
2003	1	596,037	0.0017	8	29,802	0.268	0	24,839	-	
2004	1	711,843	0.0014	1	35,592	0.028	0	25,782	-	
2005	3	716,118	0.0042	2	35,806	0.056	0	26,889	-	
2006	7	722,599	0.0097	1	36,130	0.028	0	28,061	-	
2007	3	728,080	0.0041	0	36,404	-	0	28,386	-	
2008	8	734,119	0.0109	1	36,706	0.027	0	29,047	-	
2009	1	746,304	0.0013	0	37,315	-	0	32,413	-	
Total	53			17			0			
		Average	0.0048			0.0319				
		Max	0.0117			0.2684				
		Min	-			-				
		Average excluding Max & Min	0.0047			0.0182				
		Latest 3 Yr Average	0.0055			0.0091				
		Selected	0.005			0.014				
		2009 SOV	746,304			37,315				
		Projected Claims Count	4.00			1.00				

Yukon Energy Corporation  
IAO Actuarial Consulting Services - An Aon Company  
Actuarial Valuation for Reserve for Injury and Damages as at December 31, 2009

Exhibit 3  
Sheet 1

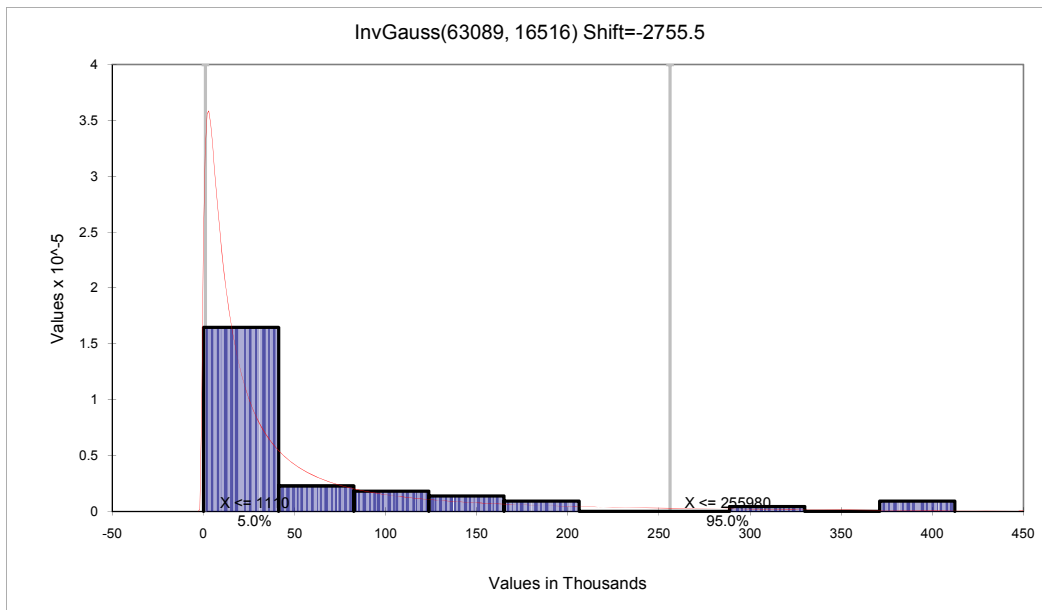
**Commercial Property Severity - Comparison of Fitted Distributions - Summary**

Fitting Distribution	Fitting Period	Statistics								Goodness of Fit	
		Parameters		Left X(5%)	Right X(95%)	P(X<=0)	Mean	Std. Dev.	Variance	RMS Error	Rank
Empirical	All			4,135	157,964	10.00%	60,334	90,895	8,106,084,230		
InvGauss	All	Shift m l	-2,756 63,089 16,516 16,516	5,436	150,227	10.00%	60,334	123,303	15,203,624,530	N/A	2 2 2 2
Lognorm	All	Shift b	-120 88,616 372,068 372,068	4,747	183,640	10.00%	88,495	372,068	138,434,936,800	N/A	3 3 3
Expon	All	Shift m s	-980 60,178 N/A N/A	12,448	137,585	10.00%	59,198	60,178	3,621,410,860	N/A	5 5 5

	Rank	Root-mean square error	Shape Graph	Difference 10^-6	P(X<=0)	90% Range		Mean	Min	Max
						Left X	Right X			
Pearson5	1	N/A	ok		10.00%	6,100	171,007	N/A		99,999,999,999.0
InvGauss	2	N/A	ok		10.00%	5,436	150,227	60,334	-2,756	99,999,999,999.0
Lognorm	3	N/A	ok		10.00%	4,747	183,640	88,495	-120	99,999,999,999.0
Weibull	4	N/A	ok		10.00%	3,466	155,664	60,178	-11,888	99,999,999,999.0
Expon	5	N/A	ok		10.00%	12,448	137,585	59,198	-980	99,999,999,999.0
ExtValue	6	N/A	bad		10.00%	7,344	126,393	53,330	-99,999,999,999	99,999,999,999.0
Logistic	7	N/A	bad		10.00%	-12,481	126,969	41,466	-99,999,999,999	99,999,999,999.0
Normal	8	N/A	ok		10.00%	-16,166	176,821	60,334	-99,999,999,999	99,999,999,999.0
Pareto	9	N/A	very bad		10.00%	459	11,040,167	N/A	155	99,999,999,999.0
Empirical						4,135	157,964	60,334	155	412,378.0

**NOTES**  
The row highlighted in yellow is the selected severity distribution

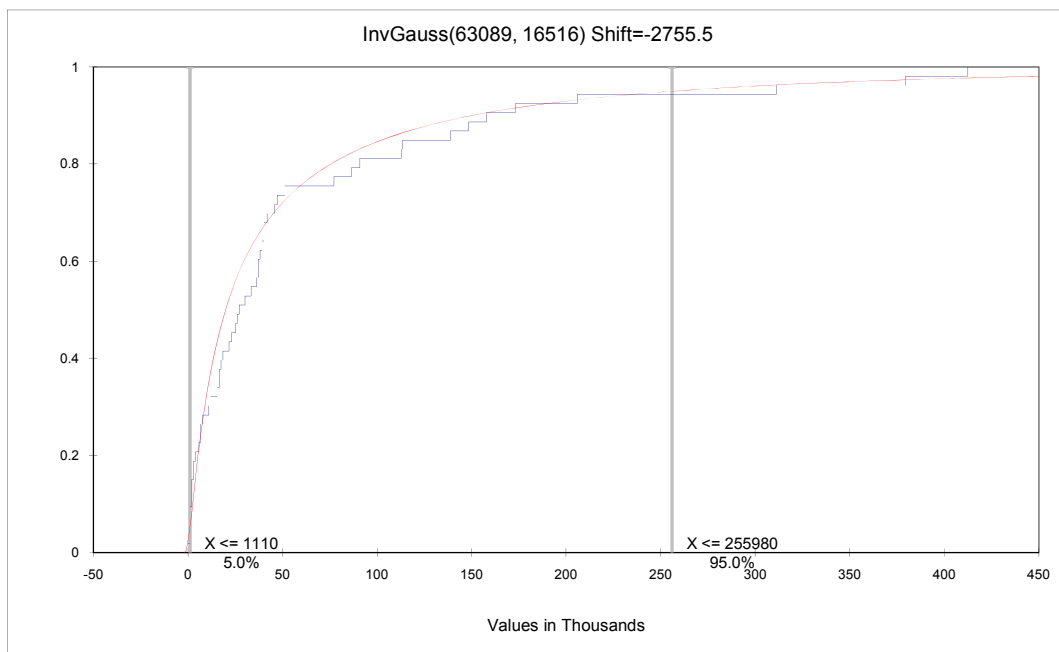
**Commercial Property Severity - Comparison of Fitted Distributions - Probability Density Function**



Yukon Energy Corporation  
IAO Actuarial Consulting Services - An Aon Company  
Actuarial Valuation for Reserve for Injury and Damages as at December 31, 2009

Exhibit 3  
Sheet 3

**Commercial Property Severity - Comparison of Fitted Distributions - Cumulative Distribution Function**



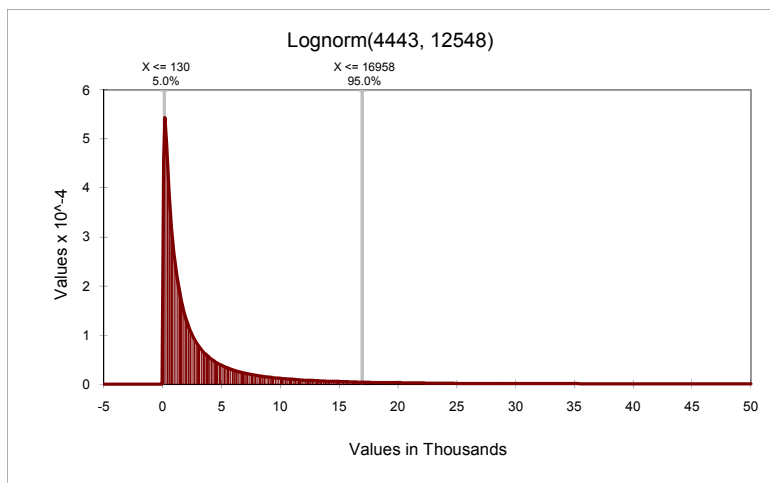
Yukon Energy Corporation  
IAO Actuarial Consulting Services - An Aon Company  
Actuarial Valuation for Reserve for Injury and Damages as at December 31, 2009

Exhibit 3  
Sheet 4

**CGL Annual Losses Distribution Selection**

Mean: 4,443  
Standard Deviation: 12,548

Distribution Selection: 4,443 RiskLognorm(4443, 12548)



Yukon Energy Corporation  
 IAO Actuarial Consulting Services - An Aon Company  
 Actuarial Valuation for Reserve for Injury and Damages as at December 31, 2009

Exhibit 3  
 Sheet 5

**Commercial Auto Severity - Comparison of Fitted Distributions - Summary**

Fitting Distribution	Fitting Period	Statistics								Goodness of Fit	
		Parameters	Left X(5%)	Right X(95%)	P(X<=0)	Mean	Std. Dev.	Variance	RMS Error	Rank	
Empirical	All		1,062	17,766	10.00%	6,116	9,641	87,481,002			
InvGauss	All	Shift m l	312 5,804 1,077 1,077	876	14,096	10.00%	6,116	13,470	181,448,863	N/A	2 2 2 2
Lognorm	All	Shift b	482 7,991 41,707 41,707	805	16,129	10.00%	8,473	41,707	1,739,432,750	N/A	3 3 3 3
Logistic	All	Shift m s	N/A 4,017 4,137 4,137	-1,719	13,107	10.00%	4,017	7,504	56,306,018	N/A	5 5 5

	Rank	Root-mean square error	Shape Graph	Difference 10^-6	P(X<=0)	90% Range		Mean	Min	Max
						Left X	Right X			
Pearson5	1	N/A	ok		10.00%	904	14,735	N/A	235	99,999,999,999.0
InvGauss	2	N/A	ok		10.00%	876	14,096	6,116	312	99,999,999,999.0
Lognorm	3	N/A	ok		10.00%	805	16,129	8,473	482	99,999,999,999.0
Pareto	4	N/A	ok		10.00%	729	22,326	N/A	505	99,999,999,999.0
Logistic	5	N/A	ok		10.00%	-1,719	13,107	4,017	-99,999,999,999	99,999,999,999.0
Normal	6	N/A	bad		10.00%	-1,998	18,471	6,116	-99,999,999,999	99,999,999,999.0
ExtValue	7	N/A	bad		10.00%	622	12,724	5,297	-99,999,999,999	99,999,999,999.0
Expon	8	N/A	ok		10.00%	1,427	13,095	5,786	175	99,999,999,999.0
Triang	9	N/A			10.00%	4,625	27,188	13,512	505	39,528.0
Empirical						1,062	17,766	6,116	505	37,100.0

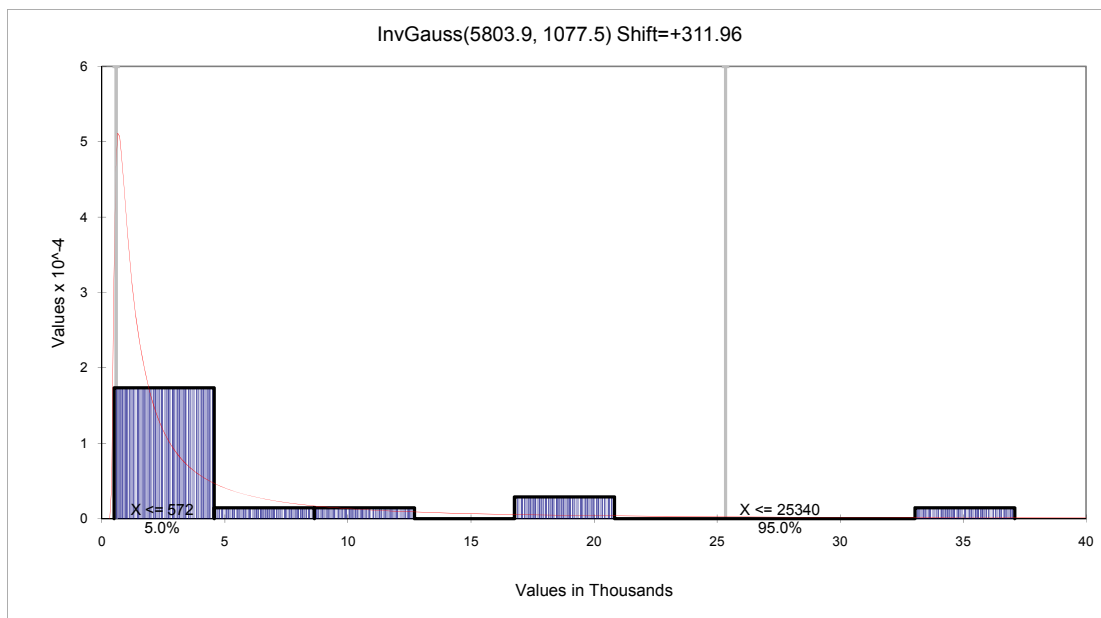
**NOTES**

The row highlighted in yellow is the selected severity distribution

Yukon Energy Corporation  
IAO Actuarial Consulting Services - An Aon Company  
Actuarial Valuation for Reserve for Injury and Damages as at December 31, 2009

Exhibit 3  
Sheet 6

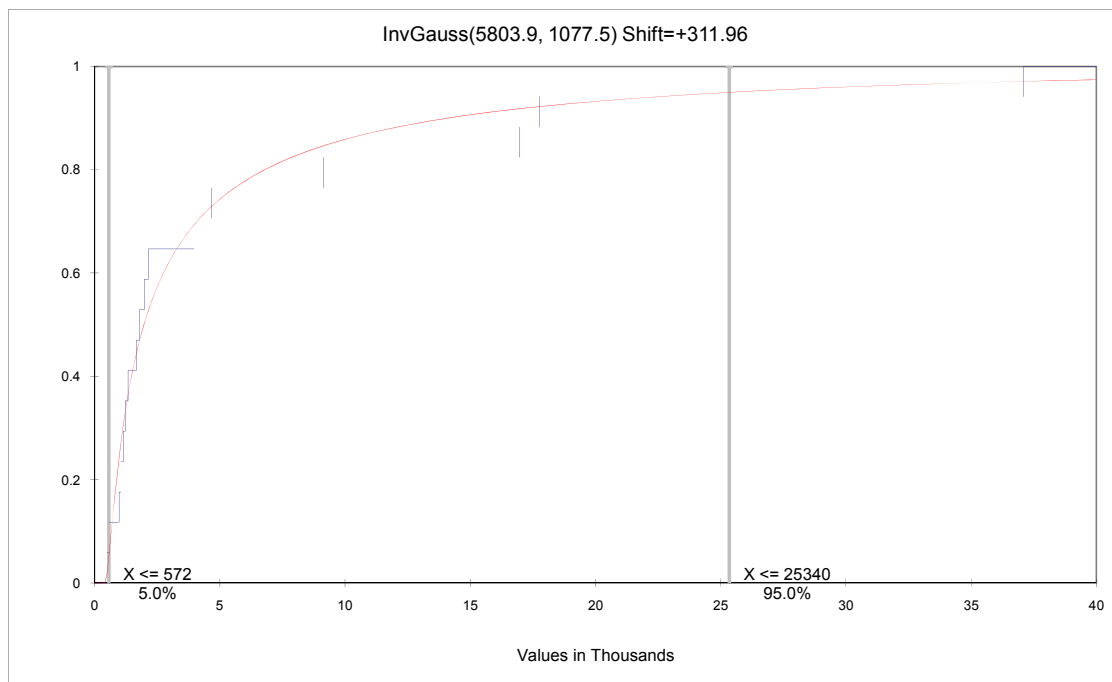
**Commercial Auto Severity - Comparison of Fitted Distributions - Probability Density Function**



Yukon Energy Corporation  
IAO Actuarial Consulting Services - An Aon Company  
Actuarial Valuation for Reserve for Injury and Damages as at December 31, 2009

Exhibit 3  
Sheet 7

**Commercial Auto Severity - Comparison of Fitted Distributions - Cumulative Distribution Function**



*Yukon Energy Corporation*  
*IAO Actuarial Consulting Services - An Aon Company*  
*Actuarial Valuation for Reserve for Injury and Damages as at December 31, 2009*

**Exhibit 4**  
**Sheet 1**

**Annual Claims Cost Projection - Commercial Property ( excluding auto exposures)**

Property Losses at Expected Level: 240,807

Property Losses distribution

Minimum	-
Maximum	2,976,473
Mean	240,807
Std Deviation	271,568
Variance	73,749,360,000
Skewness	3
Kurtosis	13
Errors Calculated	-
Mode	-
5% Perc	9,836
10% Perc	22,892
15% Perc	35,395
20% Perc	49,111
25% Perc	62,733
30% Perc	78,257
35% Perc	94,934
40% Perc	113,147
45% Perc	132,171
50% Perc	152,560
55% Perc	173,682
60% Perc	199,140
65% Perc	230,450
70% Perc	268,633
75% Perc	316,764
80% Perc	377,562
85% Perc	456,653
90% Perc	584,731
95% Perc	774,142

*Yukon Energy Corporation*  
*IAO Actuarial Consulting Services - An Aon Company*  
*Actuarial Valuation for Reserve for Injury and Damages as at December 31, 2009*

**Exhibit 4**  
**Sheet 2**

**Annual Claims Cost Projection - Auto Only**

Property Losses at Expected Level: 6,063

Property Losses distribution

Minimum	-
Maximum	321,795
Mean	6,063
Std Deviation	14,342
Variance	205,681,500
Skewness	6
Kurtosis	67
Errors Calculated	-
Mode	-
5% Perc	-
10% Perc	-
15% Perc	-
20% Perc	-
25% Perc	-
30% Perc	-
35% Perc	-
40% Perc	647
45% Perc	921
50% Perc	1,245
55% Perc	1,720
60% Perc	2,285
65% Perc	3,064
70% Perc	4,061
75% Perc	5,382
80% Perc	7,406
85% Perc	10,360
90% Perc	16,001
95% Perc	28,863

*Yukon Energy Corporation*  
*IAO Actuarial Consulting Services - An Aon Company*  
*Actuarial Valuation for Reserve for Injury and Damages as at December 31, 2009*

**Exhibit 4**  
**Sheet 3**

**Annual Claims Cost Projection - CGL**

CGL Losses at Expected Level: 4,443

CGL Losses distribution

Minimum	-
Maximum	250,000
Mean	4,443
Std Deviation	12,548
Variance	157,446,593
Skewness	-
Kurtosis	-
Errors Calculated	-
Mode	-
5% Perc	130
10% Perc	222
15% Perc	319
20% Perc	426
25% Perc	546
30% Perc	682
35% Perc	838
40% Perc	1,019
45% Perc	1,231
50% Perc	1,483
55% Perc	1,786
60% Perc	2,158
65% Perc	2,624
70% Perc	3,225
75% Perc	4,028
80% Perc	5,159
85% Perc	6,886
90% Perc	9,900
95% Perc	16,958

**Annual Claims Cost - Total: 251,313**

Yukon Energy Corporation  
IAO Actuarial Consulting Services - An Aon Company  
Actuarial Valuation for Reserve for Injury and Damages as at December 31, 2009

Exhibit 5  
Sheet 1

**Claims Data**

Calendar Year	Accident Year	Total Incurred	Description	Age	LDL	Trending Factor	Ultimate Losses	Claims Counts
[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	
		[a]	[a]		[b]	[c]	[3]*[6]*[7]	if [3]>0
1993	1993	118,578		204	1.000	1.173	139,042	1
1994	1994	149,176		192	1.000	1.161	173,189	1
1995	1995	-		180	1.000	1.149	-	0
1996	1996	1,852		168	1.000	1.138	2,108	1
1997	1997	100,000	Ins deductible-J00053 S150 T10 Failure	156	1.000	1.127	112,683	1
1997	1997	100,000	Ins deductible- Whse Fire J98007	156	1.000	1.127	112,683	1
1998	1998	369,624	98DCF adj see WDF DCF files je 911	144	1.000	1.116	412,378	1
1998	1998	20,796	98DCF adj see WDF DCF files je 1019	144	1.000	1.116	23,201	1
1998	1998	34,675	J00084 S150 T10 Failure 2nd Occurance to rvse	144	1.000	1.116	38,686	1
1998	1998	77,652	J98009 L170 Forest fire Faro	144	1.000	1.116	86,634	1
1998	1998	42,476	J98011 Forest fire Little Fox Lk	144	1.000	1.116	47,390	1
1998	1998	34,282	S/B post clsg adj 1998 Diesel burned during fire waiting period	144	1.000	1.116	38,247	1
1999	1999	46,450	TF J00053 S150 T10 Failure 1997 balance	132	1.000	1.105	51,309	1
1999	1999	16,704	TF J00084 S150 T10 Failure 2nd occurrence 1997 balance	132	1.000	1.105	18,452	1
1999	1999	32,806	TF M99021 Frazil Ice	132	1.000	1.105	36,238	1
1999	1999	5,882	TF M99017 - Wind Damage	132	1.000	1.105	6,498	1
1999	1999	27,360	TF M99018 - Wind Damage	132	1.000	1.105	30,222	1
1999	1999	41,625	TF M99019 - Wind Damage	132	1.000	1.105	45,979	1
2000	2000	36,533	Reallocate JE 1019(1998) O&M/Fuel-not reserve	120	1.000	1.094	39,956	1
2000	2000	2,761	Yukon Explosives-Replacement climbing equip	120	1.000	1.094	3,019	1
2000	2000	354	Fuel for generator at Fox Lake fire	120	1.000	1.094	387	1
2000	2000	83,159	TF J00105 Frazil Ice Nov 2000	120	1.000	1.094	90,950	1
2001	2001	25,000	Payment of Deductible to Kendall Adj for Fire Fighting cost	108	1.000	1.083	27,071	1
2002	2002	145	Olson Construction	96	1.000	1.072	155	1
2002	2002	2,160	Olson Construction	96	1.000	1.072	2,316	1
2002	2002	5,456	M02002	96	1.000	1.072	5,850	1
2002	2002	20,271	M02003	96	1.000	1.072	21,734	1
2002	2002	72,055	M02008	96	1.000	1.072	77,253	1
2003	2003	357,407	J03002 WH3 Turbine	84	1.000	1.062	379,394	1
2004	2004	150,298	VW2 Ring Gear Repair	72	1.000	1.051	157,964	1
2005	2005	3,974	Computer Stolen	60	1.000	1.041	4,135	1
2005	2005	5,726	TF J05001 Dwsn Hse H20 Dmge	60	1.000	1.041	5,958	1
2005	2005	1,773	Repair marsh lk dam	60	1.000	1.041	1,845	1
2006	2006	15,275	TF J05002 - Takhini Substation Break-In	48	1.000	1.030	15,738	1
2006	2006	32,347	TF J05006 - Kulan Break In	48	1.000	1.030	33,327	1
2006	2006	10,849	TF J05007 - L171 Lightning Arrestor Failure	48	1.000	1.030	11,178	1
2006	2006	35,348	R06001 - L171 Insulator Failure	48	1.000	1.030	36,419	1
2006	2006	35,620	R06002 - Whitehorse Hydrant Leak	48	1.000	1.030	36,700	1
2006	2006	302,098	J06002 - WH1 Hub and Blade Overhaul	48	1.000	1.030	311,252	1
2006	2006	199,814	J06001 - Aishihik Cable Repair	48	1.000	1.030	205,869	1
2007	2007	39,073	R07001 - L174 Broken Pole	36	1.000	1.020	39,859	1
2007	2007	17,261	R07002 - Water Damage at MLCS	36	1.000	1.020	17,608	1
2007	2007	6,965	R07003 - Kulan Warehouse Water Damage	36	1.000	1.020	7,105	1
2008	2008	40,431	R08001-L172 Insulator Failure	24	1.026	1.010	41,882	1
2008	2008	11,244	R08002- Rock Creek Crossing	24	1.026	1.010	11,647	1
2008	2008	24,880	R08004-Outage Damages- Oct.2008	24	1.026	1.010	25,772	1
2008	2008	1,042	YEC Knocked over Street Light	24	1.026	1.010	1,079	1
2008	2008	15,063	Repair Flood Cost Damage	24	1.026	1.010	15,603	1
2008	2008	15,900	R06002 - Whitehorse Hydrant Leak	24	1.026	1.010	16,470	1
2008	2008	1,368	R08004-Outage Damages- Oct.2008	24	1.026	1.010	1,417	1
2008	2008	24,352	R08005-Aishihik Sub Cable Failure	24	1.026	1.010	25,226	1
2009	2009	118,000		12	1.258	1.000	148,449	1
1998	1998	33,254	TF C0115 new truck replacement je 808	144	1.000	1.116	37,100	1
1999	1999	4,221	Loss on vehicle #T 34 - Oct 98	132	1.000	1.105	4,662	1
2002	2002	1,000	Royal & Sun Alliance-deductible re w/o unit 44	96	1.000	1.072	1,072	1
2002	2002	1,252	A1 Auto Body	96	1.000	1.072	1,342	1
2002	2002	905	Irving Collision	96	1.000	1.072	970	1
2002	2002	1,861	J02001	96	1.000	1.072	1,995	1
2003	2003	2,027	A1 Auto Body	84	1.000	1.062	2,152	1
2003	2003	1,033	Norcan Leasing	84	1.000	1.062	1,097	1
2003	2003	529	Norcan Leasing	84	1.000	1.062	562	1
2003	2003	1,565	Norcan Leasing	84	1.000	1.062	1,661	1

2003	2003	1,000	UAB Buzzeo Loss Adj--Bank Rec Item	84	1.000	1.062	1,062	1
2003	2003	475	Norcan Leasing	84	1.000	1.062	505	1
2003	2003	15,996	J01006 Veh Vandalism	84	1.000	1.062	16,980	1
2003	2003	3,745	Norcan Leasing	84	1.000	1.062	3,975	1
2004	2004	16,904	Service Truck Fire Loss	72	1.000	1.051	17,766	1
2005	2005	1,000	Third Party Vehicle Damage - Mayo	60	1.000	1.041	1,041	1
2005	2005	1,169	Service Truck Fire Loss	60	1.000	1.041	1,217	1
2006	2006	1,740	R06003 - Unit 63 Vehicle Theft	48	1.000	1.030	1,792	1
2008	2008	8,814	R08003-Polaris Ranger & Trailer Rplcm	24	1.026	1.010	9,130	1
Total		3,032,430					3,301,608	

Notes

[a] From YEC

[b] Exhibit 1, Sheet 1, Column 12

[c] Judgmentally selected annual trend 1%

\*Highlighted rows are auto losses

Yukon Energy Corporation  
 IAO Actuarial Consulting Services - An Aon Company  
 Actuarial Valuation for Reserve for Injury and Damages as at December 31, 2009

**Exhibit 5**  
**Sheet 2**

**Loss Development Factor**

Age [1]	Property Incurred LDF [2]	CGL Incurred LDF [3]
	[a]	[b]
12	1.179	1.871
24	1.025	1.182
36	1.000	0.905
48	1.000	0.893
60	1.000	0.998
72	1.000	1.000
84	1.000	1.000
96	1.000	1.000
108	1.000	1.000
120	1.000	1.000
132	1.000	1.000
144	1.000	1.000
156	1.000	1.000
168	1.000	1.000
180	1.000	1.000
192	1.000	1.000
204	1.000	1.000
216	1.000	1.000
228	1.000	1.000
240	1.000	1.000
252	1.000	1.000
264	1.000	1.000
276	1.000	1.000
288	1.000	1.000
300	1.000	1.000
312	1.000	1.000

Notes

[a] Ambest 2008

[b] IAO UMS

## Appendix C

Yukon Energy Corporation  
IAO Actuarial Consulting Services - An Aon Company  
Actuarial Valuation for Reserve for Injury and Damages as at December 31, 2009

**Exhibit 1**  
**Sheet 1**

**Summary of Discounted Claims Liabilities**  
As at December 31, 2009

**Total**

Accident Year	Case Loss Reserves	IBNR Estimate	Undiscounted	Present Value of	Claim Development PFAD	Reinsurance Recovery PFAD	Interest Rate PFAD	Discounted	Discount Factor (8) / (3)
			Claims Liabilities (1) + (2)	Undiscounted Claims Liabilities (4)				Claims Liabilities (4)+(5)+(6)+(7)	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
2008	15,146	15,948	31,094	30,485	2,067 -	0	49	32,601	1.048
2009	95,730	67,944	163,674	159,476	9,778 -	0	340	169,594	1.036
<b>Total</b>	<b>110,876</b>	<b>83,892</b>	<b>194,768</b>	<b>189,961</b>	<b>11,845 -</b>	<b>0</b>	<b>389</b>	<b>202,195</b>	<b>1.038</b>

ULAE - Actuarial Liabilities: -

Total Discounted Claims Liabilities: 202,195  
Total Undiscounted Claims Liabilities: 194,767

Discount Factor: 1.038

Yukon Energy Corporation  
IAO Actuarial Consulting Services - An Aon Company  
Actuarial Valuation for Reserve for Injury and Damages as at December 31, 2009

Exhibit 1  
Sheet 2

**Summary of Discounted Claims Liabilities**  
As at December 31, 2009

**Commercial Property (Including Auto losses)**

Accident Year	Case Loss Reserves	IBNR Estimate	Undiscounted	Present Value of	Claim Development PFAD	Reinsurance Recovery PFAD	Interest Rate PFAD	Discounted	Discount Factor (8) / (3)	
			Claims Liabilities (1) + (2)	Undiscounted Claims Liabilities				Claims Liabilities (4)+(5)+(6)+(7)		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	
1993	-	-	-	-	-	-	-	-	-	
1994	-	-	-	-	-	-	-	-	-	
1995	-	-	-	-	-	-	-	-	-	
1996	-	-	-	-	-	-	-	-	-	
1997	-	-	-	-	-	-	-	-	-	
1998	-	-	-	-	-	-	-	-	-	
1999	-	-	-	-	-	-	-	-	-	
2000	-	-	-	-	-	-	-	-	-	
2001	-	-	-	-	-	-	-	-	-	
2002	-	-	-	-	-	-	-	-	-	
2003	-	-	-	-	-	-	-	-	-	
2004	-	-	-	-	-	-	-	-	-	
2005	-	-	-	-	-	-	-	-	-	
2006	-	-	-	-	-	-	-	-	-	
2007	-	-	-	-	-	-	-	-	-	
2008	15,146	4,783	19,929	19,637	982	-	0	24	20,643	1.036
2009	95,730	30,233	125,963	123,392	6,170	-	0	209	129,771	1.030
Total	110,876	35,016	145,892	143,029	7,152	-	-	233	150,414	1.031

**Commercial General Liability**

Accident Year	Case Loss Reserves	IBNR Estimate	Undiscounted	Present Value of	Claim Development PFAD	Reinsurance Recovery PFAD	Interest Rate PFAD	Discounted	Discount Factor (8) / (3)	
			Claims Liabilities (1) + (2)	Undiscounted Claims Liabilities				Claims Liabilities (4)+(5)+(6)+(7)		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	
1999	-	-	-	-	-	-	-	-	-	
2000	-	-	-	-	-	-	-	-	-	
2001	-	-	-	-	-	-	-	-	-	
2002	-	-	-	-	-	-	-	-	-	
2003	-	-	-	-	-	-	-	-	-	
2004	-	-	-	-	-	-	-	-	-	
2005	-	-	-	-	-	-	-	-	-	
2006	-	-	-	-	-	-	-	-	-	
2007	-	-	-	-	-	-	-	-	-	
2008	-	11,165	11,165	10,848	1,085	-	0	25	11,958	1.071
2009	-	37,711	37,711	36,084	3,608	-	0	131	39,823	1.056
Total	-	48,876	48,876	46,932	4,693	-	-	156	51,781	1.059

Yukon Energy Corporation  
IAO Actuarial Consulting Services - An Aon Company  
Actuarial Valuation for Reserve for Injury and Damages as at December 31, 2009

Exhibit 2  
Sheet 1

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**Summary of Undiscounted Claims Liabilities -Total**

Acc Yr [1]	Case Reserve [2]	IBNR [3]	Total Claims Liabilities [4]
			[2]+[3]
2008	15,146	15,948	31,094
2009	95,730	67,943	163,673
Total	110,876	83,891	194,767

ULAE: 0  
Total Undiscounted Claims Liabilities as at December 31, 2009: 194,767

Yukon Energy Corporation  
 IAO Actuarial Consulting Services - An Aon Company  
 Actuarial Valuation for Reserve for Injury and Damages as at December 31, 2009

Exhibit 2  
 Sheet 2

**Claims Liabilities Analysis - Commercial Property ( including auto exposures)**

Acc Yr	Total SOV (\$000)	Vehicle Adjustment Factor	Total Exposure (\$000)	Total Incurred	Age	LDF	Ultimate-Loss Development Method	Loss Rate	Ultimate-Loss Rate Method	Ultimate-BF Method	Ultimate Loss Selected	IBNR	Implied LDF
[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]	[10]	[11]	[12]	[13]	[14]
	[a]		[2]*[3]	[a]		[b]	[5]*[7]	[8]/[4]/1000	[4]*[15]*1000	[5]+[10]*(1-1/[7])		[12]-[5]	[12]/[5]
1993	596,037	1.05	625,839	118,578	204	1.000	118,578	0.019%	159,224	118,578	118,578	-	1.000
1994	596,037	1.05	625,839	149,176	192	1.000	149,176	0.024%	159,224	149,176	149,176	-	1.000
1995	596,037	1.05	625,839	-	180	1.000	-	0.000%	159,224	-	-	-	1.000
1996	596,037	1.05	625,839	1,852	168	1.000	1,852	0.000%	159,224	1,852	1,852	-	1.000
1997	596,037	1.05	625,839	200,000	156	1.000	200,000	0.032%	159,224	200,000	200,000	-	1.000
1998	596,037	1.05	625,839	612,760	144	1.000	612,760	0.098%	159,224	612,760	612,760	-	1.000
1999	596,037	1.05	625,839	175,048	132	1.000	175,048	0.028%	159,224	175,048	175,048	-	1.000
2000	596,037	1.05	625,839	122,807	120	1.000	122,807	0.020%	159,224	122,807	122,807	-	1.000
2001	596,037	1.05	625,839	25,000	108	1.000	25,000	0.004%	159,224	25,000	25,000	-	1.000
2002	596,037	1.05	625,839	105,105	96	1.000	105,105	0.017%	159,224	105,105	105,105	-	1.000
2003	596,037	1.05	625,839	383,777	84	1.000	383,777	0.061%	159,224	383,777	383,777	-	1.000
2004	711,843	1.05	747,435	167,202	72	1.000	167,202	0.022%	190,160	167,202	167,202	-	1.000
2005	716,118	1.05	751,924	13,642	60	1.000	13,642	0.002%	191,302	13,642	13,642	-	1.000
2006	722,599	1.05	758,729	633,092	48	1.000	633,092	0.083%	193,033	633,092	633,092	-	1.000
2007	728,080	1.05	764,484	63,299	36	1.000	63,299	0.008%	194,498	63,299	63,299	-	1.000
2008	734,119	1.05	770,825	143,093	24	1.025	146,670	0.019%	196,111	147,876	147,876	4,783	1.033
2009	746,304	1.05	783,619	118,000	12	1.179	139,093	0.018%	199,366	148,233	148,233	30,233	1.256
Total				3,032,430			3,057,100		2,915,933	3,067,446	3,067,446	35,016	
							Max Loss Rate:	0.098%					
							Min Loss Rate:	0.000%					
							Average:	0.027%					
							Average excluding Max & Min:	0.024%					
							Selected Loss Rate [15]	0.025%					

Notes  
 [a] From YEC  
 [b] From Exhibit 3, Sheet 2

Yukon Energy Corporation  
IAO Actuarial Consulting Services - An Aon Company  
Actuarial Valuation for Reserve for Injury and Damages as at December 31, 2009

Exhibit 2  
Sheet 3

**Claims Liabilities Analysis - CGL**

Acc Yr	Total Exposure (Revenue \$000)	Total Incurred	Age	LDF	Ultimate-Loss Development Method	Loss Rate	Ultimate-Loss Rate Method	Ultimate-BF Method	Ultimate Loss Selected	IBNR
[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]	[10]	[11]
1999	23,377	0	132	1.000	-	0.250%	58,437	-	-	-
2000	23,479	0	120	1.000	-	0.250%	58,692	-	-	-
2001	24,595	0	108	1.000	-	0.250%	61,482	-	-	-
2002	24,595	0	96	1.000	-	0.250%	61,482	-	-	-
2003	24,839	0	84	1.000	-	0.250%	62,092	-	-	-
2004	25,782	0	72	1.000	-	0.250%	64,449	-	-	-
2005	26,889	0	60	0.998	-	0.250%	67,216	135	-	-
2006	28,061	0	48	0.893	-	0.250%	70,146	8,386	-	-
2007	28,386	0	36	0.905	-	0.250%	70,958	7,464	-	-
2008	29,047	0	24	1.182	-	0.250%	72,611	11,165	11,165	11,165
2009	32,413	0	12	1.871	-	0.250%	81,025	37,711	37,711	37,711
Total						Selected Loss Rate [12][c] 0.250%	1,079,213	32,890	48,875	48,875
<b>RFID Total IBNR As at December 31, 2009</b>										<b>83,891</b>

**Notes**

[a] From YEC  
[b] From Exhibit 3, Sheet 2  
[c] Judgmentally selected  
[d] From YEC 2009 Financial Statement

Yukon Energy Corporation  
IAO Actuarial Consulting Services - An Aon Company  
Actuarial Valuation for Reserve for Injury and Damages as at December 31, 2005

Exhibit 3  
Sheet 2

Claims Data

Calendar Year	Accident Year	Total Incurred	Description	Age	LDF	Ultimate Losses	Claims Counts
[1]	[2]	[3]	[4]	[5]	[6]	[3]*[6]*[7]	[9]
		[a]	[a]		[b]		if [3]>0
1993	1993	118,578		204	1.000	118,578	1
1994	1994	149,176		192	1.000	149,176	1
1995	1995	-		180	1.000	-	0
1996	1996	1,852		168	1.000	1,852	1
1997	1997	100,000	Ins deductible-J00053 S150 T10 Failure	156	1.000	100,000	1
1997	1997	100,000	Ins deductible- Whse Fire J98007	156	1.000	100,000	1
1998	1998	369,624	98DCF adj see WDF DCF files je 911	144	1.000	369,624	1
1998	1998	20,796	98DCF adj see WDF DCF files je 1019	144	1.000	20,796	1
1998	1998	34,675	J00084 S150 T10 Failure 2nd Occurance to rvse	144	1.000	34,675	1
1998	1998	77,652	J98009 L170 Forest fire Faro	144	1.000	77,652	1
1998	1998	42,476	J98011 Forest fire Little Fox Lk	144	1.000	42,476	1
1998	1998	33,254	TF C0115 new truck replacement je 808	144	1.000	33,254	1
1998	1998	34,282	S/B post clsg adj 1998 Diesel burned during fire waiting period	144	1.000	34,282	1
1999	1999	4,221	Loss on vehicle #T 34 - Oct 98	132	1.000	4,221	1
1999	1999	46,450	TF J00053 S150 T10 Failure 1997 balance	132	1.000	46,450	1
1999	1999	16,704	TF J00084 S150 T10 Failure 2nd occurrence 1997 balance	132	1.000	16,704	1
1999	1999	32,806	TF M99021 Frazil Ice	132	1.000	32,806	1
1999	1999	5,882	TF M99017 - Wind Damage	132	1.000	5,882	1
1999	1999	27,360	TF M99018 - Wind Damage	132	1.000	27,360	1
1999	1999	41,625	TF M99019 - Wind Damage	132	1.000	41,625	1
2000	2000	36,533	Reallocate JE 1019(1998) O&M/Fuel-not reserve	120	1.000	36,533	1
2000	2000	2,761	Yukon Explosives-Replacement climbing equip	120	1.000	2,761	1
2000	2000	354	Fuel for generator at Fox Lake fire	120	1.000	354	1
2000	2000	83,159	TF J00105 Frazil Ice Nov 2000	120	1.000	83,159	1
2001	2001	25,000	Payment of Deductable to Kendall Adj for Fire Figing cost	108	1.000	25,000	1
2002	2002	1,000	Royal & Sun Alliance-deductible re w/o unit 44	96	1.000	1,000	1
2002	2002	1,252	A1 Auto Body	96	1.000	1,252	1
2002	2002	905	Irving Collision	96	1.000	905	1
2002	2002	145	Olson Construction	96	1.000	145	1
2002	2002	2,160	Olson Construction	96	1.000	2,160	1
2002	2002	5,456	M02002	96	1.000	5,456	1
2002	2002	20,271	M02003	96	1.000	20,271	1
2002	2002	72,055	M02008	96	1.000	72,055	1
2002	2002	1,861	J02001	96	1.000	1,861	1
2003	2003	2,027	A1 Auto Body	84	1.000	2,027	1
2003	2003	1,033	Norcan Leasing	84	1.000	1,033	1
2003	2003	529	Norcan Leasing	84	1.000	529	1
2003	2003	1,565	Norcan Leasing	84	1.000	1,565	1
2003	2003	1,000	UAB Buzzeo Loss Adj--Bank Rec Item	84	1.000	1,000	1
2003	2003	475	Norcan Leasing	84	1.000	475	1
2003	2003	357,407	J03002 WH3 Turbine	84	1.000	357,407	1
2003	2003	15,996	J01006 Veh Vandalism	84	1.000	15,996	1
2003	2003	3,745	Norcan Leasing	84	1.000	3,745	1
2004	2004	16,904	Service Truck Fire Loss	72	1.000	16,904	1
2004	2004	150,298	WW2 Ring Gear Repair	72	1.000	150,298	1
2005	2005	3,974	Computer Stolen	60	1.000	3,974	1
2005	2005	1,000	Third Party Vehicle Damage - Mayo	60	1.000	1,000	1
2005	2005	1,169	Service Truck Fire Loss	60	1.000	1,169	1
2005	2005	5,726	TF J05001 Dwsn Hse H20 Dmge	60	1.000	5,726	1
2005	2005	1,773	Repair marsh lk dam	60	1.000	1,773	1
2006	2006	15,275	TF J05002 - Takhini Substation Break-In	48	1.000	15,275	1
2006	2006	32,347	TF J05006 - Kulan Break In	48	1.000	32,347	1
2006	2006	10,849	TF J05007 - L171 Lighning Arrestor Failure	48	1.000	10,849	1
2006	2006	35,348	R06001 - L171 Insulator Failure	48	1.000	35,348	1
2006	2006	35,620	R06002 - Whitehorse Hydrant Leak	48	1.000	35,620	1
2006	2006	1,740	R06003 - Unit 63 Vehicle Theft	48	1.000	1,740	1
2006	2006	302,098	J06002 - WH1 Hub and Blade Overhaul	48	1.000	302,098	1
2006	2006	199,814	J06001 - Aishihik Cable Repair	48	1.000	199,814	1
2007	2007	39,073	R07001 - L174 Broken Pole	36	1.000	39,073	1
2007	2007	17,261	R07002 - Water Damage at MLCS	36	1.000	17,261	1
2007	2007	6,965	R07003 - Kulan Warehouse Water Damage	36	1.000	6,965	1
2008	2008	40,431	R08001-L172 Insulator Failure	24	1.033	41,782	1
2008	2008	11,244	R08002- Rock Creek Crossing	24	1.033	11,620	1
2008	2008	8,814	R08003-Polaris Ranger & Trailer Rplcm	24	1.033	9,109	1
2008	2008	24,880	R08004-Outage Damages- Oct.2008	24	1.033	25,711	1
2008	2008	1,042	YEC Knocked over Street Light	24	1.033	1,077	1
2008	2008	15,063	Repair Flood Cost Damage	24	1.033	15,566	1
2008	2008	15,900	R06002 - Whitehorse Hydrant Leak	24	1.033	16,431	1

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2008	2008	1,368	R08004-Outage Damages- Oct.2008	24	1.033	1,414	1
2008	2008	24,352	R08005-Aishihik Sub Cable Failure	24	1.033	25,166	1
2009	2009	118,000		12	1.256	148,233	1
Total		3,032,430				3,067,446	70

Notes

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[a] From YEC

[b] Exhibit 2, Sheet 2, Column 14

[c] Judgmentally selected annual trend 1%

**Loss Development Factor**

Age [1]	Property Incurred LDF [2] [a]	CGL Incurred LDF [3] [b]
12	1.179	1.871
24	1.025	1.182
36	1.000	0.905
48	1.000	0.893
60	1.000	0.998
72	1.000	1.000
84	1.000	1.000
96	1.000	1.000
108	1.000	1.000
120	1.000	1.000
132	1.000	1.000
144	1.000	1.000
156	1.000	1.000
168	1.000	1.000
180	1.000	1.000
192	1.000	1.000
204	1.000	1.000
216	1.000	1.000
228	1.000	1.000
240	1.000	1.000
252	1.000	1.000
264	1.000	1.000
276	1.000	1.000
288	1.000	1.000
300	1.000	1.000
312	1.000	1.000

Notes

[a] Ambest 2008

[b] IAO UMS