UTILITIES CONSUMERS' GROUP
(UCG)

TOPIC:

REFERENCE:

Application, page 1

YEC indicates that "the planned in-service date for Mayo B of late 2011 reflects requirements of Yukon Energy's funding agreement with the federal government for Mayo B and Stage 2 of the Carmacks-Stewart Transmission Project (CSTP) connecting the Mayo-Dawson (MD) and Whitehorse-Aishihik-Faro (WAF) grids. The timing for Mayo B also reflects the opportunity to displace diesel generation energy requirements associated with growing power loads on both grids".

QUESTION:

a) Please explain the requirements of the funding agreement with the Federal government that are determining the construction schedule of this Yukon infrastructure project.

b) What efforts have been taken to extend the funding agreement timeframes to allow for a more complete and thorough review of this project? Please provide all correspondence related to these efforts.

ANSWER:

(a)

Section 3 of the Federal Funding Agreement sets out the obligations of the parties; section 3.1 notes the contribution to be paid by Canada is subject to the Terms and Conditions of the agreement, including Schedule B. Section 3.1(a) states that Canada will not pay more than 50% of the Eligible Costs (up to $71 million) during the three Fiscal Years starting in 2009-2010 and ending in 2011-2012. Section 3.2 obligates the funding recipient (YEC) to be responsible for complete, diligent and timely Project Implementation within the costs and deadlines specified in the Agreement. This would include the requirement to have the project complete by funding deadline of March 31, 2012 per the timeline provided in Section 3.1(a) and in Schedule B2 (estimated completion date of December 31, 2011).

(b)

YEC is obligated to meet the terms and conditions of the Agreement, in order to be eligible to receive the $71 million in federal funding towards the Legacy Project. This includes meeting the timelines provided in Schedule B.

See also, response to CW-YEC-1-12.

Further response on March 18, 2009

The answer provided to part (b) noted that YEC is obligated to meet the timeline under the GIF funding agreement. The follow-up from UCG now requests information on "negotiation" of the agreement. To address the further information requested, in the context of the original question, no efforts have been taken by Yukon Energy to extend the GIF funding agreement timelines for the $71 million of federal funds. There was no negotiation with the Federal Government related to these timelines, as it was understood by Yukon Energy that in order to obtain the funding under GIF, Yukon Energy was required to complete the Legacy Project by March 31, 2012. As set out in YEC's YESAB Mayo B Project Proposal Submission filed in February 2009, YEC also understood that this could be achieved within a proper regulatory review period.

TOPIC:

REFERENCE:

Application, pages 2

"Mayo B was included in YEC's 20 Year Resource Plan 2006-2025 (the "Resource Plan") as part of an inventory of hydro project options (see Appendix B of the Resource Plan) available to meet forecast load growth scenarios. The projects included in Appendix B of the Resource Plan represented "the primary alternatives identified based on review of the numerous studies conducted in Yukon." Mayo B was specifically discussed as one of a group of small projects being considered (within the 5 to 10 MW range). Small hydro projects in the range of 5 to 10 MW were considered potential candidates for development under the 25 MW industrial scenario or larger (see Resource Plan, Chapter 5). These projects could also potentially be part of a development plan under the larger 40 MW scenario".

QUESTION:

a) Please explain any differences between the "Mayo B" project proposed in Appendix B of the Resource Plan and the Mayo Hydro Enhancement Project currently before the YUB.

b) Please provide evidence where the YUB referenced the "Mayo B" project in its January 15, 2007 Report to Commissioner in Executive Council regarding YEC's 20-Year Resource Plan.

c) Please provide details of the specific review that was conducted of the Mayo Hydro Enhancement Project during the review of the Resource Plan.

ANSWER:

(a)

The project as discussed in the 20-Year Resource Plan was discussed as a potential enhancement to the existing facility at Mayo. The response to UCG-YEC-1-89(c) filed

during the Yukon Energy 2008/2009 GRA provides an excerpt from Appendix B of the 20-Year Resource Plan which notes as follows regarding Mayo B:

> The existing hydro site at Mayo has the potential to be enhanced by various changes in configuration, either to develop further head below the existing reservoir or an expansion of capacity utilizing the same head. This leads to multiple potential alternatives. However, as a supply option to WAF, these various projects are only of relevance if the Carmacks- Stewart transmission line is previously in service. The full capability of various potential Mayo enhancements to supply an interconnected WAF and MD system (as opposed to MD on its own) has not been fully studied, and should be re-examined in the event that the interconnection proceeds. One configuration alternative considered is a 10 MW, 48 GW.h, $101 million (2005$) variation based on a separate conveyance route from the existing reservoir to a new plant lower in elevation than the existing plant, which would be able to operate in parallel with the existing plant. This concept has an initial LCOE of 11.2 cents/kW.h. Various other concepts require further study. However, although work is still in preliminary stages, it must be recognized that it is possible no credible facility enhancements of this type exist at Mayo.

The currently proposed project has been subject to, and further defined by, more rigorous, detailed review and feasibility planning (as discussed in detail in the project description provided in section 3.1 of the Mayo B Part III Application and Attachment A2-1 which describes alternatives and alternative configurations considered). Conceptually, the current Mayo B project reflects the configuration alternative as discussed in the Resource Plan, but with a lower level of expected overall added generation.

(b)

The Mayo B project is not specifically referenced[1] in the Board's report, however, the Board does address and endorse in the report the long term planning approach of YEC.

[1] Much of the focus of attention at the time of the 20-year Resource Plan and the Board's report was meeting near term capacity requirements discussed in Chapter 4 of the 20-Year Resource Plan, as well as other near term developments proposed by YEC. However, longer term planning requirements and scenarios were reviewed and addressed in the report (without specific reference to Mayo B or any other small hydro projects in the range of 5-10 MW that may be candidates for development under Chapter 5 forecasts under the 25 MW industrial scenario or larger).

While not recommending a specific longer-term project such as Mayo B, the Board sets out a process for review of the next project determined to be required to meet longer term load requirements.

In its report the Board recommended that YEC continue to monitor potential material load additions and, when warranted, make a filing with the Board when new facilities are required to meet increased loads, outlining the risk of proceeding, the benefits to existing ratepayers, and sensitivities to existing ratepayers if the economic life of the project is shorter than forecast.

Specifically, the report to the Commissioner in Executive Council regarding the 20-Year Resource Plan notes at page 7 (with regard to discussion of longer term industrial load forecast discussed in detail in Chapter 5 of the 20-year Resource Plan):

> The Board is cognizant of the risks within this type of forecast and yet sees benefits to all ratepayers when infrastructure is constructed for industrial developments. The Board recognizes the efforts of YEC in investigating future potential industrial loads and the planning guidelines it follows when assessing these potential developments and agrees with the balanced approach that YEC utilizes. It is recommended that YEC continue to monitor these potential material load additions and, when warranted, make a filing with the Board when new facilities are required to meet these increased loads. Within the filing, YEC should outline the risk of proceeding, the benefits to existing ratepayers, and sensitivities to existing ratepayers if the economic life of the project is shorter than forecast. Further, YEC should outline how its contribution policy is being applied and what contributions it will receive from the industrial customer for the infrastructure created to satisfy the load.

At page 49, the report notes that it agrees with YEC's long term planning approach utilized in the Resource Plan and notes that, "when YEC proposes a new facility, YEC is to outline the risk of proceeding, the benefits to existing ratepayers, and sensitivities to existing ratepayers if the economic life of the project is shorter than forecast.[2]"

[2] Specifically, the Board notes at page 47 of the Report to the Minister that, "The Board agrees with the long-term planning approach utilized by YEC in the Plan. The approach by YEC in assessing the industrial development factors versus the Yukon Energy factors is balanced. On a go-forward basis, YEC should attach probabilities to the industrial development scenarios. This would assist the Board in comparative analysis when future resource plans are filed or when applications

(c)

The Mayo B Expansion was discussed in Chapter 5 of the Yukon Energy 20-Year Resource Plan (see, Chapter 5 and Appendix B of that filing) as part of an inventory of hydro project options. The details provided were summaries from previous studies, and included an estimated LCOE as noted.

As noted at page B-1 of the Resource Plan, the projects included in Appendix B represented "the primary alternatives identified to date based on review of the numerous studies conducted in Yukon." Mayo B was specifically discussed in that document as one of a group of small projects being considered (within the 5 to 10 MW range) at page B-10. The Resource Plan noted that small hydro projects in the range of 5-10 MW were potential candidates for development under Chapter 5 forecasts under the 25 MW industrial scenario or larger. These projects could also potentially be part of a development plan under the larger 40 MW scenario.

Further response March 18, 2010

To clarify further, when discussing longer-term planning for projects to be committed after 2008 (the last year for projects included in the Chapter 4 near term plan), the Resource Plan hearing reviewed potential load scenarios, and the need to plan for such scenarios arising, and did not specifically review the merits of any one project in this regard such as Mayo B. As noted in the response to UCG-YEC-1-3(b), the Board recommended that YEC continue to monitor potential load additions and make a filing with the Board when new facilities are required to meet increased loads. YEC has followed the Board's recommendation in this regard.

As noted in the response, Mayo B was therefore discussed in the 20-Year Resource Plan as one potential small hydro project [among a suite of options in the range of 5-10 MW] that may be developed to meet the 25 MW industrial load forecast scenario). While Chapter 4 of the Resource Plan addressed in detail projects related to meeting near term capacity requirements (to be met by 2009), Chapter 5 of the Resource Plan (and Appendix B wherein Mayo B was specifically outlined) discussed and addressed longer

under Part 3 of the Public Utilities Act are submitted. As recommended in the Load Forecast section, when YEC proposes a new facility, YEC is to outline the risk of proceeding, the benefits to existing ratepayers, and sensitivities to existing ratepayers if the economic life of the project is shorter than forecast."

term planning scenarios and options available to meet these scenarios. Chapter 5 was not a review per se of any individual project; it was a review of a plan for proceeding with longer-term supply options, including how to ensure supplies could be brought on line when required. Mayo B was included in that filing as one option among a suite of possible options for addressing a particular longer term industrial load scenario that YEC would need to plan to address. In particular, Mayo B was noted as meeting some key preferred characteristics that would guide ongoing actions – such as being an enhancement to an existing project rather than entailing the complexities of a new "Greenfield" project.

TOPIC:

REFERENCE:

Application, page 5, 12; Application Attachment E; December 18, 2009 Letter from Minister to YUB

On page 5, the application states that the Mayo Hydro Enhancement Project will be developed at an estimated cost of $120 million "to help supply growing MD and WAF grid power loads with renewable energy that displaces required diesel generation".

On page 12, the application contains a table showing a breakdown of project costs and financing. Yukon ratepayers are contributing $66.65 million and Federal taxpayers are contributing $53.35 million of the current $120 million estimated cost of a project expected to add 10 MW to the gross generation capacity at Mayo.

In her December 18, 2009 letter to the YUB, the Yukon's Minister of Justice stated that "Mayo B will receive up to 53.3 million dollars from the Government of Canada as part of the Canada-Yukon Energy Corporation Green Infrastructure Fund: Agreement for the Yukon Green Energy Legacy Project 2009-1012011-2012".

QUESTION:

a) Please confirm YEC's understanding that for the YUB's energy generation model analysis used during its review of YEC's 20 Year Resource Plan, the YUB assumed that hydro generation in the Mayo-Dawson grid was not assumed to supply WAF loads due to line losses.

b) Please provide details of the electricity customer base served by the Mayo-Dawson grid.

c) Please explain how any single infrastructure project estimated to cost $120 million (or $12 million per MW) could be justified for a ratepayer base identified in (b) or even a Yukon-wide ratepayer base of less than 17,500.

d) Please provide illustrations of what similar projects have cost per MW and per ratepayer in other jurisdictions.

e) Please compare the cost per MW of the proposed Mayo B project with the cost of installing new site-specific diesel generation (estimated to be $1.035 million per MW in the 2008-2009 GRA).

f) Please provide YEC's explanation of how the Federal government's contribution to the proposed Mayo B project would be less than $53.3 million.

g) Please reconcile YEC's assumption of $53.35 million contribution from the Federal government and the Minister's determination of a maximum $53.3 million contribution from the Federal government.

h) Please provide details of the annual carrying costs that will be incurred by the staggered funding outlined in Attachment E to the Application.

i) Please provide details by cost component of costs incurred to date for the proposed Mayo B project for each historical year and estimated for subsequent years.

j) Please discuss the risks to ratepayers that the capital costs could exceed $120 million.

k) Please provide details of how YEC determined that the proposed project would only qualify for $53.3 million of the $71 million available from the Federal government.

ANSWER:

(a)

Confirmed, as reviewed in UCG-YEC-1-6(b).

Notwithstanding this specific comment in the YUB report, discussion of the CSTP project in the YEC Resource Plan was not based on any such premise. As reviewed in response to UCG-YEC-1-3, Resource Plan references to Mayo B specifically noted a need to have the CSTP connection in place as a precondition to further examination of this development.

(b), **(c)**, **(d)** and **(e)**

Contrary to the second paragraph of the above preamble, YEC has secured $83.5 million in contributions towards the Mayo B project ($53.35 million of federal funding provided through the federal contribution agreement and $30.15 million of no cost capital contribution from YDC), reducing the overall project costs to ratepayers from $120 million to $36.5 million (and not $66.65 million as above-noted).

As noted in the Mayo B Application, this project is being advanced to meet the near term and long term electricity requirements of the Yukon integrated grid by providing a source of renewable generation that will be available to displace the increasing requirement for costly baseload diesel generation. Mayo B is not being proposed to supply specifically the electricity customer base served by only the current Mayo Dawson grid.

Contributions towards the project provided by Canada and YDC, have materially reduced the LCOE to within or below 8 to 10 c/kWh levelized cost target range. As noted, such costs are well within the range of current BC hydro development project costs to ratepayers (see also YUB-YEC-1-27(c)).To ensure ratepayers are not adversely affected in the initial years of project in service, flexible debt financing will also be provided by YDC that will cap annual net generation costs at 10-11 cents/kWh (2012$).

It is not meaningful, for the purpose of assessing ratepayer cost per kW.h of useful energy, to compare capital cost per MW of a hydro generation unit with the capital cost per MW of a diesel generation unit. The meaningful cost comparison is present value LCOE per kW.h assessed over the economic life of the hydro generation option, as provided in the Application.

Further response on March 18, 2010 re: (b)

YEC reiterates that Mayo B is not being proposed to supply specifically the electricity customer base served by only the current Mayo Dawson grid. By the time the project is projected to be in service, the MD and WAF grids will be integrated by the CSTP, so there is no basis to analyze either individual grid on a standalone basis. However, to expand on YEC's response, for 2009, the Mayo Dawson forecast grid loads were set out in Table 2.3 of YEC's 2008/09 GRA which indicated 1108 residential customers, 378 general service customers, and 3 wholesale delivery locations (Stewart Crossing and Keno). At that time there was no industrial customer on the Mayo-Dawson system. This

customer base is to be increased in 2010 with the planned connection of the Alexco mine and mill load. By early 2011, after completion of CSTP Stage 2, the Mayo Dawson grid will become connected to the WAF grid.

Further response on March 29, 2010 re: (b)

By the time the project is projected to be in service, the MD and WAF grids will be integrated by the CSTP, so there will be no further standalone "MD grid" per se.

For 2009, the Mayo Dawson forecast grid loads were set out in Table 2.3 of YEC's 2008/09 GRA which indicated 1108 residential customers, 378 general service customers, and 3 wholesale delivery locations (Stewart Crossing and Keno). At that time there was no industrial customer on the Mayo-Dawson system. This customer base is to be increased in 2010 with the planned connection of the Alexco mine and mill load.

Energy usage in test year 2009 is also set out in Table 2.3 of the 2008/09 GRA, as follows:

- Residential – 8,759 MW.h
- General Service – 13,976 MW.h
- Industrial – 0 MW.h
- Streetlights – 180 MW.h
- Space Lights – 13 MW.h
- Wholesale (Stewart Crossing and Keno) – 857 MW.h (note that this is the approved value from the compliance filing – it was adjusted pursuant to Order 2009-8 from the value included in Tab 2 of the GRA)
- Secondary – 630 MW.h

YEC does not have demand totals by rate class for the Mayo Dawson grid. Table 2.6 of the 2008/2009 GRA the system peak demand forecast for the 2009 test year is 5 MW, with total forecast annual generation of 30.686 GW.h.

Retail loads are forecast to increase at the same 1.85%/year as for all Yukon retail loads.

By early 2011, after completion of CSTP Stage 2, the Mayo Dawson grid will become connected to the WAF grid.

Further response on March 18, 2010 re: (e)

Yukon Energy reaffirms its response to this question - it is simply not meaningful, for the purpose of assessing ratepayer cost per kW.h of useful energy, to compare capital cost per MW of a hydro generation unit (which brings with it both capacity and energy) with the capital cost per MW of a diesel generation unit (which is only focused on capacity – the energy costs must also consider fuel). The meaningful cost comparison at a minimum requires the present value LCOE per kW.h assessed over the economic life of the hydro generation option, as provided in the Application. Yukon Energy's present value assessment in the Application only considered savings in diesel generation incremental operating costs (fuel and incremental O&M) and did not consider savings in diesel generation capital costs (due to deferral of such facilities over the life of Mayo B).

However, to expand on YEC's response, YEC notes that the projected ratebase cost per MW for Mayo B is $3.61 million/MW in 2012$ ($36.5 million divided by 10.1 MW as the estimated installed capacity) and for new site-specific diesel generation no updates have been completed since the 2008/09 GRA cited by UCG (which estimated costs at $1.035 million/MW in 2009$).

(f), **(g)** and **(h)**

Please see response to CW-YEC-1-2, CW-YEC-1-25, and CW-YEC-1-21(f) as regards the Federal Funding Agreement and cash flow assessments relevant to YEC.

Further response on March 18, 2010 re: (f)

The response to CW-YEC-1-2 provides the circumstances in which the full level of funding (up to $71 million) would not be available. Under section 3.1(a) of the Agreement Canada will not pay more than 50% of the total Eligible Costs during the three Fiscal Years starting in 2009-2010 and ending in 2011-2012, i.e., if such costs are less than $142 million, or fail to be in accordance with the Fiscal Year breakdown in Schedule B2, as amended in accordance with the Agreement, Canada could not pay the full $71 million.

Except as noted in the response, YEC is not able to identify any reasonable way in which the federal funding would be less than $53.3 million. YEC also notes that the most

up to date estimates for Mayo B demonstrate that eligible costs will be beyond what is necessary to qualify for the $53.3 million.

(i)

Please see response provided to CW-YEC-1-5(a) and CW-YEC-1-2(f) and (g).

Further response on March 18, 2010

To expand on YEC's response, costs incurred to date for Mayo B are $1.880 million to the end of 2008 and a cumulative total (including 2008) of $7.441 million to year-end 2009. In the cost category breakdown in CW-YEC-1-5(a) these are entirely in the category of pre-construction and other permitting/regulatory planning costs.

(j)

Please see discussion provided at page 35-36 of the Part III Application and response provided to CW-YEC-1-12 and CW-YEC-1-13.

(k)

The allocation was based on the estimated Eligible Costs as filed in the application for federal funding and Canada's award of up to $71 million for the Legacy Project. Please see response to CW-YEC-1-2(a), (b) and (c).

Further response on March 18, 2010

YEC's answer is responsive. YEC has provided a copy of the Federal Funding Agreement. The $53.3 million amount of funding available for Mayo B is governed by the Federal Agreement (see Schedule B2 of that Agreement available in Attachment E of the Mayo B Application, which reflects fully the information that Canada relied upon to determine the $71 million funding amount and the allocation of this funding between Mayo B and CSTP Stage 2 components of the Legacy Project).

TOPIC:

REFERENCE:

Response to YUB-YEC-1-38 – YEC 2008-2009 GRA

"As noted in the Project Proposal, the Project cost estimates to date reflect a period of study oriented to confirming the technical ability to construct the Project, and the timing and configuration of major Project components. The estimates reflect activities oriented towards a "Level 3 – Feasibility" stage of study, and are subject to design refinement, and changing market conditions (including general economic conditions for construction in western Canada).

The cost of the Project is presently estimated at $120 million (including escalation, interest during construction, and contingencies of 15% to 25% depending on the Project component). This estimate has been subjected to a preliminary third-party review. This review indicated that there may be a potential upward adjustment to the cost of up to 5%."

QUESTION:

a) Please provide a copy of the third party review of the $120 million cost estimate.

b) Please confirm YEC's understanding that for the YUB's energy generation model analysis used during its review of YEC's 20 Year Resource Plan, the YUB assumed that hydro generation in the Mayo-Dawson grid was not assumed to supply WAF loads due to line losses.

c) For all capital projects completed over the last 15 years, currently underway or currently proposed valued at over $1 million, please provide the original estimated cost, the date this cost estimate was made and the final cost (or updated cost if not finished).

d) For all projects identified in (c), please provide the cost-benefit worksheets used by the YEC's Project Review Committee.

e) For all projects identified in (c), please provide details of the costs paid by any party other than ratepayers (i.e., government grants / loans, third party contributions).

ANSWER:

(a)

The third party review noted was performed January 2009 at a very early stage in cost estimating. Since that time the scope of the project has been further refined, such that the earlier review is no longer relevant.

See discussion of the project description in the Application at section 3.1.1 of the Application which notes the YESAB filing was revised in July 2009 to delete the Mayo enhanced storage and then updated November 20, 2009 to reflect ongoing design refinements resulting from geotechnical field studies and engineering (i.e., the canal/penstock option was determined to not be cost effective and it was determined to extend the penstock through the entire distance to the new powerhouse; routing changes for the penstock were also required to avoid a zone of discontinuous permafrost; and tunnel construction was modified to move the connection at the existing intake closer to the intake structure).

Further Response on March 18, 2010

To expand on its response, the requested report is provided as an attachment to this correspondence. The report consists of a one page letter dated February 3, 2009 and a one page table attached at that time (totaling to $115.690 million) which was amended in a February 5, 2009 table based on further discussion with the project engineers (totaling to $113.016 million). Consistent with ensuring maximum value for future competitively tendered unit price subcontracts that are expected to be let for the Mayo B project, unit pricing has been redacted from the attached report.

The independent review on its face indicated overall costs at approximately 5% lower than KGS' estimates. However, the key reason for the review was to cross-check specific individual line items rather than the simple focus on one overall number. In this context, KGS' views upon review of the IPE report was that project costs could in fact be 4-5% higher than previously estimated by KGS. Specifically, upon review of the

individual line items KGS was concerned that the IPE review indicated higher cost estimates on the key items KGS wanted independent review of (i.e., canal bulk excavation and camp man days – IPE increased man days by 50%), this indicated to KGS the potential to revise these particular items in their own estimate upwards. The IPE report did indicate lower cost estimates on other items (powerhouse mechanical and electrical and low pressure penstock, which also lowered related contingencies); however, KGS was comfortable with its estimates on these items and therefore no revision was made by KGS to its estimates. It was noted that being within 5% of this type of estimate indicates that the estimates are on track and not that they need to be materially revised.

(b)

As stated in response to UCG-YEC-1-5(a), this is confirmed as reviewed below. Notwithstanding this specific comment in the YUB report, discussion of the CSTP project in YEC's Resource Plan was not based on any such premise. As reviewed in response to UCG-YEC-1-3, Resource Plan references to Mayo B specifically noted a need to have the CSTP connection in place as a precondition to further examination of this development.

The question is in effect referencing what the Board noted at page 23 of its report.[1] When addressing its own assessment of annual diesel generation for YEC's and an alternative expansion plan (to assess the potential relevance of fuel cost savings in assessing different specific alternatives then under review), the Board noted that "it should be emphasized that, due to many assumptions made and several modeling limitations, these generation figures are only adequate for the purpose of comparing the relative merits of one plan over the other and to verify YEC's assertion". At footnote 18 the Board went on to note as follows with regard to the assumptions used by the YUB in its model:

> The Board used an energy generation model that "dispatches" generating units to supply the load, which was represented by the same load duration curves (LDC) used in the LOLE calculation. This model also accounts for random outages of generating units using the equivalent load method, i.e. the LDCs are modified using the FOR of each generator after dispatched, so that the next generator in the staking order would face a slightly higher load that accounts for

[1] The YUB Report to Commissioner in Executive Council re YEC 20-Year Resource Plan – Jan. 15/07.

the outages of generators already dispatched. Only units connected to the WAF were used in the analysis and there was no consideration of must-run units and/or units that run for emergency standby or voltage support purposes. Also, hydro generation in the MD grid was not assumed to supply WAF loads due to line losses.

(c), **(d)** and **(e) [Revised March 29, 2010]**

The information requested is not relevant and in any event simply cannot be assembled in the time frame set out for responding to IRs. Further all projects of such magnitude that are in Rate Base have already been subjected to review by the YUB.

The current proceeding is to obtain the YUB's report and recommendations on the potential benefits, costs, risks and customer impacts that influence whether or not Mayo B should proceed as proposed. Please refer to the Minister's Terms of Reference for this proceeding.

Further Response on March 29, 2010

In Order 2010-05 the Board directed that YEC provide in response to part (c) "the original estimated cost and the final costs for the past 10 years" and directed that YEC respond to part (d) by showing the cost-benefit analysis for those projects greater than $1 million for the past 10 years. No further response was required for part (e), as the Board does not consider the information requested relevant to this proceeding.

There are seven capital projects completed by YEC over the last 10 years valued at over $1 million. For each of these projects, the original estimated cost (i.e., the estimate available when final approval to proceed with the project was sought within YEC), the final cost, and the cost benefit analysis used by YEC when the project was approved are as follows[2]:

1. **Wind Generator Project** – This project was completed in 2000; it was subject to public review and costs were approved to be included in ratebase as part of the 2005 Required Revenues and Related Matters Application.

[2] Slight differences in reported actual and GRA application numbers relate to prior years spending, final accounting adjustments for AFUDC and ES&G etc for the other projects.

The costs approved by the YUB as applied for in the 2005 Application were $1.974 million in 2000 and $0.029 million in 2001 (for total of $2.003 million). The final cost of the project was $2.080 million.

Attachment 2 provides the December 15, 1998 Capital Expenditure Approval Request (CEAR) approval for a commercial-scale wind research and development project in amount of $2 million. The project was initiated to utilize $2 million of available no cost funding from the Yukon Government.

2. **Whitehorse Rapids Dam Seismic Restraint –** This project was completed 2002; it was reviewed and costs were approved to be included in ratebase as part of the 2005 Required Revenues and Related Matters Application (total of $1.054 million with $0.183 million in 2001 and $0.871 million in 2002 as described in the Application). Final costs for this project were $0.189 million for Phase 1 and $0.862 million for Phase 2 (total $1.051 million).

   The original business case (December 21, 2000) for developing an updated cost estimate for the Whitehorse Rapids Upstream Wingwall Seismic Restraint is provided as Attachment 3, with an original cost estimate of approximately $0.721 million. This project was to address Canadian Dam Safety Guidelines with respect to earthquake loads.

3. **MH 1 and MH2 Capacity Increase –** This project was completed in 2002; it was reviewed and its costs were included in ratebase as part of the 2005 Required Revenues and Related Matters Application (total of $1.026 million for MH1). Table 5.2 of that Application notes $0.284 in 2001 and $0.742 in 2002 for a total of $1.026 spending on the MH1/MH2 Capacity Increase (this relates directly to costs incurred for MH1). The Application also includes $0.959 for MH2 Rebuild/Runner Replacement.

   Total final costs for the MH1 project were $1.017 million (relates to MH1/MH2 Capacity Increase noted above); total final costs of $0.962 were incurred for MH2 (relates to the rebuild/runner replacement). The cost differences between final costs and the 2005 Required Revenues Application costs are due to reallocation of consultation costs between work orders ($0.070 consulting costs moved to work orders for C02038 Exciter Upgrade from Mayo Hydro and C02111 MH2). Also MH2 final costs included costs transferred from MH1 (consulting costs to assess both units were initially charged to MH1).

The CEAR revision requests in February 2003 for MH1 and MH2 are provided as Attachment 4 and provide the cost history and cost benefit of the project. Original cost estimates (at February 19, 2003) are indicated in this CEAR information to have been approximately $1.91 million for MH1 and MH2.

4. **Mayo Dawson –** This project was completed and brought into service in 2003. It was been reviewed in detail by the YUB and other parties and its costs were approved to be included in ratebase as part of the 2005 Required Revenues and Related Matters Application. YUB-YEC-1-19 filed during the 2005 Required Revenues and Related Matters proceeding (provided in Attachment 5) provides a detailed description and explanation of the Mayo Dawson Project costs. It notes that the approved original budget for the project was $29.046, and the final cost to the end of 2005 was $33.746 million. A detailed review of these cost variances was also provided in the response, including scope changes, extra costs needed to be incurred to address contractor deficiencies, Yukon Energy's added costs due to the significantly increased workload with respect to management and engineering that arose as a result of underperformance by the construction contractor, and the material outstanding matters remaining today with respect to claims and counterclaims between the contractor and Yukon Energy.

   Other materials provided as part of that public review process, also included in Attachment 5 are as follows[3]:

   a. Tables 5.4, in the 2005 Required Revenues and Related Matters Application provided the summary of the economics over the life of the project and Tables 5.5 and 5.6 in that filing provided the detailed annual impacts for 2005 and each following year.
   b. McMahon-YEC-1-17(b) filed during the 2005 Required Revenues proceeding also summarized the record in the Application materials on the Project benefits and costs

   The response to YUB-YEC-1-13 filed during the 2008/2009 GRA (and included in Attachment 5) provides the calculation of the "substantial benefits to ratepayers" due to the Mayo Dawson Transmission Project based on the fuel prices in effect at the end of 2008.

[3] The Mayo Dawson Transmission Line Project Feasibility Study was also provided as a response to UCG-YEC-1A35(i) in that 2005 proceeding.

5. **Aishihik #1 (AH1) Rewind –** This project was fully completed in 2004; it was reviewed and its costs were included in ratebase as part of the 2005 Required Revenues and Related Matters Application (total of $1.216 million).

   Attachment 6 provides the February 2004 CEAR review of the project costs. The cost included in the CEAR request is noted as $1.210 million (previous CEAR approval of $0.975 million with additional request of $0.235 million[4]).

6. **Aishihik #2 (AH2) Rewind** – This project was completed 2006; it was reviewed and its costs were included in ratebase as part of the 2008/2009 Yukon Energy General Rate Application. Total costs approved by the YUB during that proceeding were $1.304 million (these costs were included in table 5.2 of the Application as $0.731 million for rewind stator; $0.268 million for rewind rotor and $0.305 million for rewind mechanical).

   The PID reviewed by the YEC Board (provided as Attachment 7) notes that AH2 budget was estimated at $1.3 million and this estimate was increased to $1.55 million. Total final costs for the project were $1.332 million. The AH2 rewind was less than budgeted due to lower than expected stator rewinding costs.

7. **Carmacks Stewart Transmission Project (CSTP) ($38.383 million, with customer and other contribution offsets of $34.639 million) –** This project was completed in 2008 and its costs were reviewed by the YUB and approved for inclusion in ratebase in 2009 as part of the 2008/2009 GRA. The business case for this project (including costs and benefits assessment) has been previously reviewed in detail as part of the 20-Year Resource Plan[5], the Minto PPA hearing,

[4] It notes $0.700 million budgeted in 2003 for replacement of stator coils and repairs to thrust collar and a subsequent decision to rebuild all rotor poles while unit was apart and rewind contractor was on site – adding additional cost of $200,000. During disassembly problem areas were discovered that needed to be addressed, adding a further $75,000 to project cost for total of $975,000. A CEAR revision was provided in 2004 for $235,000 ($135,000 for hydro alignment, to address unit balancing required to be undertaken in two stages and delays due to Remote Terminal Unit undergoing simultaneous upgrade which delayed testing and commissioning of unit); second increase of $100,000 as contingency to address $103,000 of work items claimed by GEC and disputed by YEC.

[5] The following references from the Resource Plan hearing process are provided as support for the business case for the project. (Note materials filed during the Resource Plan hearing process, including the 20-Year Resource Plan are available on the Board's website at http://yukonutilitiesboard.yk.ca/proceedings/yec_20/). Pages 7-11 of the Summary section of the 20-Year Resource Plan provides an overview of near term options to address near term requirements and opportunities to 2012 and to provide for over 21 MW of new WAF firm winter capacity by 2012. These options included Whitehorse Mirrlees, Carmacks-Stewart Transmission Project and Aishihik 3rd Turbine. Chapter 4 of the Resource Plan addresses in detail the near term capacity requirements, including planning approach and timeline and a review of requirements, options, assessment of options and proposed actions. Further materials filed during that review process include the following:

the CSTP Part III hearing. Subsequent to the Resource Plan hearing the CSTP economics were reviewed as part of the Minto PPA hearing and as part of the Part 3 Hearing. The Part 3 Application related to this project included the following material relevant to the business case for the CSTP[6]. These extensive earlier public reviews addressed the rationale, options, and initial cost estimates, as well as benefits and potential impacts of the projects on ratepayers. The recommendations of the YUB from each of these proceedings is part of the public record.

Updated information for 2008/2009 was provided Section 5.2.1 of the 2008/2009 GRA (provided in Attachment 8); it was noted that this information did not fundamentally change the earlier rationale or business case for the project. During the 2008/2009 GRA, the Board assessed the prudence of these project expenditures prior to approving the inclusion of project costs in ratebase.

Per the Summary Cost Table provided in Appendix 7[7], the original estimated cost (i.e., construction approval budget) approved by the YEC Board was $8.813 million for the Minto Spur and $27.788 million for the CS Main Line. The final cost for the Spur line was $10.582 million (a 20.1% variance from Board of Director's budget), and the final cost for the CS Main Line was $27.873 million (a 0.3% variance from Board of Director's budget). These costs and cost changes were reviewed and explained in detail during the 2008/2009 GRA.

(1). Supplementary Materials (filed May, 2006) – this filing provided an update on Resource Plan information related to the Carmacks-Stewart Transmission Project (Tab 2 of document);
(2).Exhibit B-16 (filed November, 2006) – provided updated information for the Carmacks-Stewart Transmission Project (pages 6-12). Table 2 provided at page 5 of the document set out the capacity requirements and Yukon Energy's updated proposals to meet these requirements with Faro Mirrlees Rehabilitation in 2007, Whitehorse Mirrlees Life Extensions in 2008, 2009, and 2010, Carmacks-Stewart Transmission Line in 2009 and Aishihik 3rd turbine in 2009. The resulting system balance is shown in the second column from the right of the sheet. The column to the far right describes the system in the event that the full interconnection of Carmacks-Steward does not occur in 2009 as planned;
(3) The discussion of the CSTP included an update on the YESAB filing and a discussion of alternatives to the project, as well as updates related to Minto and Carmacks Copper mines and project economics (page 9-12). This included a discussion of capital costs and ratepayer benefits.

[6] See, Application for an Energy Project Certificate and an Energy Operation Certificate regarding the Proposed Carmacks-Stewart Transmission Project): (1) Summary of project economics is provided at page 7; (2)Assessment of justification and need for the project (pages 12-15); (3) Assessment of risks (pages 15 – 19) including assessment of both Stage 1 risks and Stage 2 Risks; and (4) Assessment of effect of project on ratepayers (pages 19 – 20).

[7] Stage I Carmacks-Stewart/Minto Spur Transmission Projects Initial Cost Estimates, Construction Budgets, and Final Costs

Information detailing initial costs, final costs and explaining how these costs evolved is provided in Attachment 8 as follows:

- **Section 5.1.2 of the 2008/2009 GRA** provides a review of the Project, its costs, how these costs changed and the justification for inclusion of the costs in ratebase.
- **Stage I Carmacks-Stewart/Minto Spur Transmission Projects Initial Cost Estimates, Construction Budgets, and Final Costs (Summary Cost Table)** noting Sept 07 YEC BOD Construction approval Budget (i.e., costs when final decision to proceed with construction the Project was made by the YEC Board of Directors); Final Cost at February 2009; scope changes and cost implications due to YESAB Decision document requirements; contributions and net cost to ratepayers.
- **LE-YEC-1-46 and LE-YEC-1-47** - filed during the 2008/2009 GRA detailing costs for CS Main Line and Minto Spur.
- **YECL-YEC-1-9** - describes in detail all scope changes in the construction of the CSTP to Minto Mines spur line and Pelly Crossing and the costs associated with each change.
- **YUB-YEC-1-36 (a) and (b)** – details and updates overall net benefit of project to ratepayers.

TOPIC:

REFERENCE:

Application, Attachment A2, page 3

A decision to not proceed with the Project or any other renewable generation enhancement project in Yukon, would be expected to result in the following:

- The Yukon power systems will experience ongoing growth that cannot be served from existing renewable power sources. Consequently, given Yukon Energy's general obligation to serve customers who request service within its franchise area, the utility will be required to utilize non-renewable generation to service the loads, almost certainly diesel generation.

- Long-term power costs in Yukon will not benefit from the enhanced stability associated with capital intensive renewable power generation such as increased hydro (and that accordingly would occur with Mayo B). This would likely lead to materially higher power rates over time than would be the case with the Project, and separately may lead to more industrial customers electing to generate their own on-site power with fossil fuel generation rather than connect to the grid.

- Ongoing diesel generation in Yukon that arises, which could otherwise have been displaced by the Project, will generate approximately 700 tonnes of GHG emissions per GW.h of electricity generated.

- Economic development opportunities that could be realized from the project will not occur.

QUESTION:

a) Please provide details of the likelihood that the growth in electricity demand in the Mayo area will be anything but minimal.

b) Please provide details of the analysis used to determine that "materially higher power rates" would occur without the proposed Mayo B project.

c) Please confirm that on-site generation would be a viable alternative to the proposed Mayo B project for any industrial load that may only exist for a limited life (e.g., 7-10 years) of a mine.

d) Please provide details of the "economic development opportunities that could be realized" only because of the proposed Mayo B project and without any of the alternative electricity supply options available.

ANSWER:

(a)

The above quote is not specific to Mayo and notes that "Yukon power systems will experience ongoing growth that cannot be served from existing renewable power sources."

The grid is expected to be integrated before 2012 via the completion of CSTP Stage 2. Attachment D of the Application notes consolidated electrical loads on the integrated system are expected to increase from approximately 368 GW.h in 2009 (the sum of WAF and MD) to more than 600 GW.h by 2042. Load growth on MD will include 5.8 GWh of new industrial load (Alexco) along with 1.85% forecast growth in non-industrial load. It is noted that after 2011 (when the grids are expected to be interconnected) Minto and Alexco are both expected to add new loads until 2012-13 when both mines are expected to reach full capacity at a combined load of 50 GWh (excluding losses). Carmacks Copper is expected to add a further 52 GWh in 2012, with overall loads on the system expected to grow to 495 GWh through 2016.

Further response on March 18, 2010

Yukon Energy's response noted that the referenced quote in the Application was not specific to the Mayo area. To respond to the specific information requested, focusing on the request for information on individual delivery locations on the integrated system (as opposed to overall integrated system loads that must be served in a coordinated fashion), YEC notes that the Mayo area sales (excluding all other integrated system loads, such as Dawson and the Alexco mine site) are entirely retail sales, and total approximately 6.3 GW.h non industrial firm power sales in Mayo, Elsa and Keno area

(this excludes 0.6 GW.h of secondary sales). The firm sales are forecast to grow at the standard 1.85% used for all retail sales (on the order of 0.1 GW.h per year).

(b)

Figure D-2 at page D-5 of Attachment D notes material requirements to supply baseloads from diesel generation, driving material fuel-related costs on the system which would be reflected in rates. Figure D-3 provides the annual diesel cost without Mayo B from 2012 until 2031, and notes forecast transition to material diesel generation from 2012 to 2017 would drive costs (absent Mayo B) 30-40% higher than current Yukon-wide revenue requirements. The analysis underlying the tables provided in Attachment D is provided in response to YUB-YEC-1-25(a).

(c)

The Minto mine connection, which was reviewed and recommended by the YUB in a similar Part III review of the CSTP, is one example where a mine in fact started its operation as an isolated diesel site and was then connected to the grid. However, on a go-forward basis, all of the mine loads included in the Application's load forecasts are now not isolated diesel site options. Please see responses to YUB-YEC-1-37 (c) and (d). Industrial customers that are connected to the hydro grid system, such as Minto and Alexco (as well as Carmacks Copper in future forecasts), make up a portion of the grid firm load requirements that Yukon Energy must plan for and serve from utility generation on a non-discriminatory basis.

(d)

Specific examples have not been referenced at this time. In the past, however, it was demonstrated that the major mining operations at Faro and Keno, which provided the basis to develop the hydro infrastructure that benefits Yukon ratepayers today, were highly dependent on development of new hydro generation resources. In the longer term, future economic development opportunities in Yukon may well be foregone if the supply of cost effective renewable hydro generation such as Mayo B is not developed to displace reliance on diesel generation.

YUKON UTILITIES BOARD
(YUB)

TOPIC: Generation Planning/Mayo A Plant

REFERENCE:

The Application

PREAMBLE:

On pages 5 and 6 of the Application, YEC addresses the operation of the existing power plant at Mayo subsequent to the commissioning of the Mayo B project.

QUESTION:

a) Without the Mayo B project, what would be the annual energy production expected from the existing Mayo A units for each year of the period 2009 to 2019?

b) What would be the plant's capacity factor in each year of that period?

c) With the Mayo B project, both with and without the additional Mayo Lake drawdown, what would be the annual energy production expected from the existing Mayo A units for each year of that same period?

d) What would be the plant's capacity factor in each year of that period?

e) For the Mayo B project, both with and without the additional Mayo Lake drawdown what would be the annual energy production expected from the Mayo B units for each year of that same period?

f) What would be the Mayo B plant's capacity factor in each year of that period?

g) What sorts of maintenance outages would require the Mayo B plant to be entirely or partially taken out of service?

h) How frequently would such outages be required? For instance footnote 44 on page 30, dealing with operating and maintenance costs appears to suggest once in 10 years for a major overhaul.

i) Except for maintenance outages, doesn't the Mayo B project render the Mayo A plant virtually redundant given the reduction in energy output at Mayo A with the commissioning of the Mayo B plant? Explain the reasons for your answer.

j) If the Mayo A plant is not redundant, what reduction in its economic value occurs once the Mayo B project is commissioned because the full amount of annual energy it is currently capable of producing is not likely to be produced in the future?

ANSWER:

(a), **(b)**, **(c)**, **(d)**, **(e)** and **(f)**

Modeling for the Mayo B project and the integrated grid is focused on the system following connection of the two current grids (WAF and MD) with the completion of CSTP Stage 2 in 2011 and of Mayo B by the end of 2011. Forecasts of the type requested are available for the period only after 2011.

For 2012 to 2016, firm grid loads as reviewed in the referenced Table 1 as required to be served from dispatchable generation increase from 456 GW.h in 2012 to about 495 GW.h in 2016, and are therefore generally in a range approximating the 468 GW.h grid load level that has been modeled in detail.[1] Accordingly, to address the issues in this question for the period from 2012 to 2016, analysis is provided for the 468 GW.h grid load level.

The gross generation information requested for this load level is presented in Table 1 below for Mayo A and Mayo B firm generation output assuming long term average water flows. It is noted that the overall IS generation model used in the Application addresses generation by the overall system, and by overall plant (i.e, the Mayo plant, for combined Mayo A and Mayo B output) and does not provide assessments broken out separately for Mayo A versus Mayo B. In preparing separately the assessment below, overall Mayo plant generation it is necessary to assign the system wide secondary energy to each individual plant. As a result, while the analysis helps to explain "gross" versus "net" generation and the relative utilization of Mayo A versus Mayo B, the overall plant results

[1] The Application addresses net generation from the Mayo B project at this load level, e.g., at page 27 of the Application, estimated net generation of 28.2 GW.h is shown for this load level. This assessment reflects overall IS model analysis.

are difficult to compare with the Application's IS model net generation assessments without specific reference to both firm and secondary loads.

Table 1: Mayo A and Mayo B output

Mayo A and B plant output (GW.h/year) and Capacity Factor at a 468 GW.h grid load level

	Mayo A generation (GW.h/year)	Capacity factor at 5.4 MW installed capacity	Mayo B generation (GW.h/year)	Capacity factor at 10.1 MW assumed peak capacity
No Mayo B	36.1	76.4%	n/a	n/a
Mayo B (with Mayo Lake Enhanced Storage)	13.7	29.1%	59.2	66.9%
Mayo B - no Mayo Lake Enhanced Storage	14.0	29.5%	56.0	63.3%

After 2016, the forecast load to be served from dispatchable generation drops to a lower load level (439 GW.h in 2018 and 391 GW.h in 2019) due to assumed mine closings. The load level of 417 GW.h was fully modeled and exhibits values very close to those in Table 1 (either very close or lower by no more than approximately 2 GW.h).

(g) and **(h)**

In general terms, the only activities requiring a complete plant outage would be on any equipment that is common to both units such as penstock, trash racks, head gate, unit TIV valves or tailrace. In addition there is some common electrical equipment such as station service system or common bus/switchgear or substation maintenance requiring a full plant outage.

Individual unit outages would be more frequent.

Most outages would be of very short duration in relation to annual energy production (e.g., hours). As noted in footnote 44, major outages (lasting weeks at a time, such as for major overhauls) would typically be very infrequent, such as once every 10 years.

(i) and **(j)**

No. See the response to part (c) of this question. Mayo A remains an important source of generation on the Yukon system even after the commissioning of Mayo B, in large part

because of its ability to use water that would otherwise be required to be spilled for fish and fish habitat protection. Despite a reduced output, Mayo A remains a valuable and low cost source of energy for Yukon, and also provides enhanced overall reliability of generation at the Mayo plant than would occur if only the new Mayo B plant was retained.

TOPIC: Displaced diesel/hydro generation

REFERENCE:

Mayo Hydro Enhancement Project (Mayo B) Application; page 13

"Net generation" impacts of Mayo B are sensitive to assumed overall loads on the WAF/MD systems, and changes to annual grid generation load are forecast to change long term average net generation from Mayo B; for example, under the base case forecast, Mayo B net generation contribution to the system (**with Mayo Lake enhanced storage**) approximates 26.4 GW.h in 2012, and ranges from 14.9 to 41.4 GW.h/yr over the Project's assumed 65 year economic life, **reflecting the impact of changes during this period in overall forecast WAF/MD annual dispatchable generation loads.** By comparison, gross generation at Mayo B during this same period would be expected to fluctuate considerably less under the same forecast load conditions. **[Emphasis added]**

PREAMBLE:

The YUB wishes to understand the above.

QUESTION:

a) Please provide the study, assumption and accompanying analysis that led to the base case forecast, wherein "Mayo B net generation contribution to the system approximates 26.4 GW.h in 2012, and ranges from 14.9 to 41.4 GW.h/yr over the Project's assumed 65 year economic life."

b) Please provide the base case forecast, i.e. the approximate GW.h in 2012 and the range of output (GW.h) over the Project's assumed 65 year economic life, without Mayo Lake enhanced storage.

c) Please explain what is meant by the statement, "By comparison, gross generation at Mayo B during this same period would be expected to fluctuate considerably less under the same forecast load condition." Please provide an example.

d) YUB notes the statement that:

"Net Generation" impacts of Mayo B are sensitive to assumed overall loads on the **WAF/MD systems**, and changes to annual grid generation load are forecast to change long-term average net generation from Mayo B" **[Emphasis added]**

a) Please provide sensitivity analyses wherein the changes to annual grid generation load are within +/- 10% and +/- 5% of the base case generation load forecast.

e) Provide a detailed explanation regarding the water conditions that were used, i.e. extreme low, median water and extreme high water conditions, over the Project's assumed 65-year economic life.

ANSWER:

(a)

The net generation values used in each scenario are provided in the response to YUB-YEC-1-25(a).

Mayo B's "net generation contribution to the system" is in effect the diesel generation that Mayo B is forecast to displace that would otherwise be required on the existing and currently committed system, given the forecast firm grid loads to be served. "Net generation" from Mayo B varies therefore from year to year, as noted, depending on the forecast firm grid load levels. The base case load forecast assumptions and analysis adopted for this assessment are set out in Attachment D of the Application, and explain the varying integrated system loads assumed for 2012, 2019 and the remainder of the assumed 65 year economic life of the Mayo B project.

In order to estimate Mayo B net generation at any specific forecast firm grid load levels, the analysis in YUB-YEC-1-25(a) uses a method of estimating the mean net generation contribution of Mayo B corresponding to each particular load level (with different contribution values depending on whether enhanced storage at Mayo Lake is included in the analysis). The net effect of this analytical approach, which is explained in more detail below, is shown in Figure 1 below. The loads in Figure 1 do not arise from any particular forecast or scenario – they are the comprehensive modeling to show the relationship between load and generation at each load level:

Figure 1: Mean Generation to Serve Loads at Varying Levels

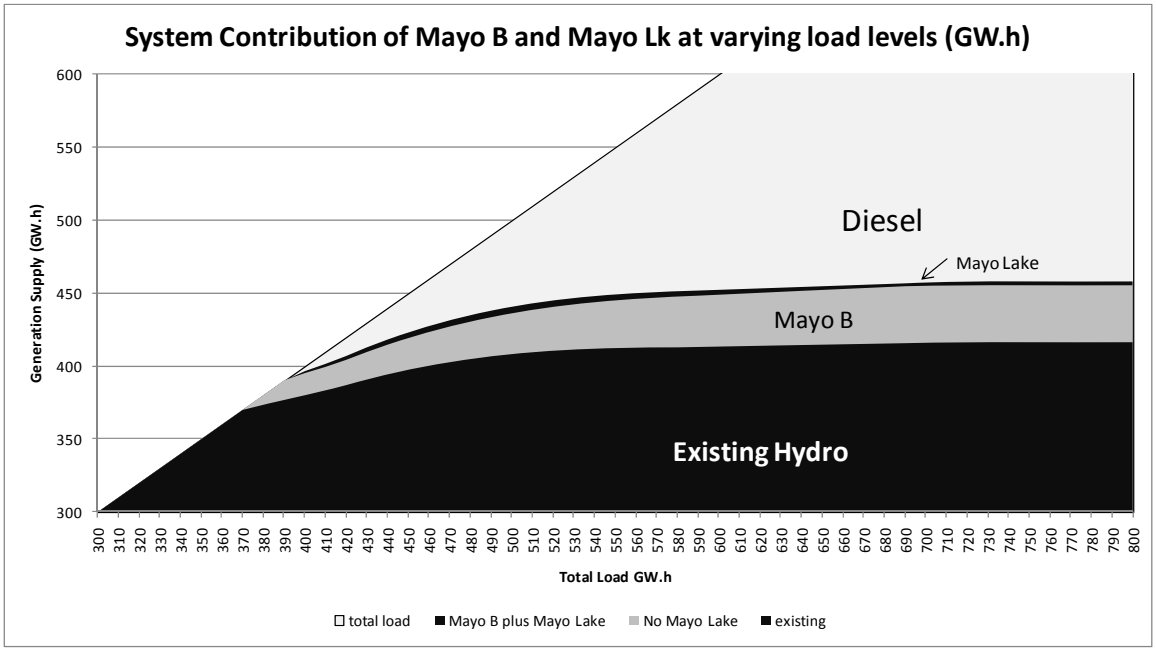

Figure 1 was derived from a detailed hydrologic model that was developed for Yukon Energy. That model considers the full range of potential inflows based on records for each location over the period 1987 to 2007 inclusive. The model runs on a weekly time step and is designed to replicate the dispatch of YEC's hydroelectric stations that would be used in the operation of the integrated system given the specific loads forecast to arise in each week including, for example, the following key modeling aspects:

- Key parameters for each plant such as head losses, efficiency, and maximum peak flows;
- Water licence and fisheries permit conditions for each plant; and
- Peaking constraints, as relevant.

The model produces a full range of possible generation values depending on the water flow and overlapping intra-year effects (such as water in storage at year-end). For economic modeling purposes, the model is used to generate mean output values at

select representative annual firm integrated grid load levels (for example, 417 GW.h, 468 GW.h, and 575 GW.h) for three output variables[1]:

- Hydro generation to serve firm load;
- Diesel generation to serve all residual firm load; and
- Excess hydro generation which can be used to supply secondary loads without affecting the management of water on the system.[2]

Figure 1 represents the interpolation of mean firm generation results for firm load levels between these modeled values, and largely linear extrapolation for values outside this range. To ensure very high load levels are not excessively extrapolated, the maximum generation from the hydro system is capped at the firm plus secondary hydro generation arising in the highest modeled (575 GW.h) load case.[3]

The specific Mayo B assumptions used in deriving these values are as follows:

- Maximum Mayo B plant flow of 19 cms, corresponding to 10.1 MW maximum peak;
- Minimum required flows of 5 cms in winter from Mayo A, and in summer 6 cms from Mayo A, with a total 11 cms in summer downstream from Mayo B;

[1] The values were selected to generally represent the approximate near-term grid loads with Minto and Alexco but without Carmacks Copper (417 GW.h), near-term loads with Carmacks Copper (468 GW.h) and a higher load level representative of longer-term loads, or loads in the near term were all 3 of the noted mines to arise, plus approximately an additional 100 GW.h of industrial load (total 575 GW.h).

[2] This value represents only the generation that could have occurred at times when a plant was simultaneously spilling water and was not fully loading all turbines, such that the specific quantity of water could equally be run through the generating station without having to draw down the water in storage.

[3] To be specific, in the 575 GW.h case, there remains certain situations where the model will indicate secondary energy is available which could be generated to displace diesel generation if only there were loads to use this quantity of power. In the case of Mayo B, the 575 GW.h case indicates a net contribution to serve firm loads of 38.0 GW.h, plus a net contribution to secondary power availability of 3.4 GW.h. It is assumed that the absolute maximum net benefit of Mayo B is the sum of these two values (41.4 GW.h) which based on extrapolation would be achieved once loads reach approximately 720 GW.h. This approach may slightly understate the true maximum benefits of Mayo B, as a fully considered load case at the 720 GW.h level may also indicate some water management changes that could be implemented to further increase the net benefit of the plant; however, these load levels are very high and only assumed to occur far into the future, so are of limited consequence to the discounted economic analysis and as such were not individually modeled.

- 1.5% of output of Mayo B is assumed for station service;

- Mayo Lake licenced range as stated for the case (either existing, or with enhanced storage) with a 2.8 cms minimum outflow from Mayo Lake;

- Mayo B generating efficiency of 0.904 at full flow (19 cms);

- Rule curves are implemented for winter generation, to ensure that Mayo Lake is not drawn down so far at a given time during the winter that, should the lowest recorded inflows occur, YEC will not be able to simultaneously meet both the minimum licenced elevation constraint and the minimum outflow constraints for the remainder of the winter; and

- An effective 1% forced outage rate is assumed for Mayo B, only applied to situations where the plant is operating at full load[4]. Other Yukon plants use 3% as the forced outage rate, but the lower value for Mayo B reflects the fact that during forced outages of Mayo B, if there is no ability to store the given water there is the alternative ability to generate using this same water at Mayo A such that the effect of forced outages is of less magnitude than, for example, at Whitehorse in summer (where if the plant is otherwise operating at full load, a forced outage will inevitably lead to increased spill).

(b)

Please see YUB-YEC-1-25(a).

(c)

The statement means that forecast annual gross firm load generation at Mayo B and A (i.e., actual plant generation output) is much less sensitive to grid firm load levels than is the case for this plant's forecast annual net generation (i.e., estimated plant generation that displaces diesel generation that would otherwise have been required on the grids). To demonstrate, the Application describes (at pages 27-28) the Mayo B "net generation" (the Mayo B contribution to system diesel displacement) as 19.2 GW.h at a grid load of

[4] At times when operating at partial load, a forced outage would result in the given quantity of water being stored for later use, so no net effect on generation – if operating at full load such later makeup could not be as readily assumed to practically occur.

416.7 GW.h, 28.2 GW.h at a grid load of 468.1 GW.h, and 38.0 GW.h at a grid load of 575 GW.h – which reflects a variance of 18.8 GW.h over this range of grid load. In contrast, Mayo B "gross generation" for firm load, ignoring potential secondary sales generation, varies only 5.8 GW.h over this same range of grid load.[5]

This statement is explained in large part by the way in which the Mayo plant is assumed to be operated within the overall integrated grid system. The Mayo generation system (comprising Mayo B and Mayo A, as well as Mayo Lake storage) once completed will be one of the more flexible resources on Yukon Energy's system, given the annual storage available, but will not be as flexible as Aishihik which has a storage range that is more of a multi-year nature and a larger relative installed capacity (particularly once the Aishihik 3rd turbine is completed). The new Mayo B operation, however, will also have higher minimum flow requirements than currently exist at Mayo A, which will set new generation priorities for the Mayo plant relative to Whitehorse plant (under summer low flow conditions in particular). Consequently in most situations on the new integrated system Mayo generation will be dispatched to a full output level in priority to Aishihik, and to the extent there is excess water on the system under some seasonal or annual situations the spillage would tend to occur at Aishihik (while Mayo's generation would remain near its full potential). The Mayo plant will also be dispatched to its new low flow requirements in priority to other plants where required. The overall result of this mode of operation is that gross generation at the Mayo plant will tend to be maintained through a wide range of load levels, and the impact of grid loads on changes to grid hydro generation will tend to be focused at the Aishihik plant for various loads and at the Whitehorse plant during low flow summer conditions.

By way of example, under the present situation on WAF (e.g., 2009 test year loads), there is typically surplus hydro generation. Were a new wind turbine to be installed, for example, under these load conditions, the "net" contribution to the grid would be basically zero. However given the very inflexible nature of wind generation, the new wind turbine itself would be very high priority in the dispatch order and would typically generate its full "gross" potential, but the "net" effect would solely be to drive increased spillage typically at Aishihik compared to what would have been the case without the new wind turbine.

[5] Overall gross generation contribution of Mayo B at the Mayo plant is approximately 39.9 GW.h at 416.7 GW.h grid load, 36.8 GW.h at 468.1 GW.h, and 42.6 GW.h at 575 GW.h grid load.

To use a Mayo B specific example, at the 468 GW.h load level, the response to YUB-YEC-1-21REVISED(a) indicates that absent Mayo B, the existing Mayo A plant would generate 36.1 GW.h. With Mayo B under this same scenario, the existing plant would generate 13.7 GW.h and Mayo B would generate 59.2 GW.h for a total 72.9 GW.h from the Mayo complex. This is an increase in generation of 36.8 GW.h. However, due to changes that occur at other hydro plants at this load level, the "net contribution" of Mayo B under this load level is 28.2 GW.h, which underlies the analysis shown in YUB-YEC-1-25(a)[6]. Although Aishihik shows a net reduction of 2.6 GW.h in firm generation, Whitehorse shows a net reduction 6.0 GW.h in firm generation almost all due to summer impacts related to minimum flow requirements[7] (i.e., additions of summer generation required at Mayo to meet new low flow requirements that, under certain low load conditions, cause the need to spill small quantities of run of river generation at Whitehorse). This is set out in Table 1 below:

Table 1: Changed production, by plant, from the addition of Mayo B at a 468 GW.h Dispatchable Load Level

	With Mayo B			No Mayo B			Difference		
468.1 GW.h load	Firm	Secondary	Total	Firm	Secondary	Total	Firm	Secondary	Total
Whitehorse	243.3	13.9	257.3	249.3	6.6	255.9	-6.0	7.4	1.4
Aishihik	114.3	7.1	121.4	116.9	4.8	121.7	-2.6	2.2	-0.3
Mayo	72.9	7.0	79.9	36.1	1.2	37.3	36.8	5.8	42.5
Mayo A	*13.7*		*0.0*	*36.1*		*0.0*	*-22.4*		*0.0*
Mayo B	*59.2*		*0.0*	*0.0*		*0.0*	*59.2*		*0.0*
Diesel	37.5	0.0	37.5	65.7	0.0	65.7	-28.2	0.0	-28.2
TOTAL	468.1	28.0	496.0	468.1	12.6	480.6	0.0	15.4	15.4

NOTES:
- Does not distinguish betwteen secondary energy produced at Mayo A or B.
- Secondary Energy noted is the potential to serve secondary from water otherwise required to be spilled, where turbines are available to generate with this water. It does not reflect using storage for the purposes of serving secondary.

[6] See YUB-YEC-1-21 (a) to (f) where it is noted that, due to different models used, the overall plant results provided in that response (i.e., the 36.8 GW.h noted here) are difficult to compare with the Application's IS model net generation assessments (i.e., the 28.2 GW.h noted here) without specific reference to both firm and secondary loads.

[7] Overall, 5.5 GW.h of the 6.0 GW.h reduction at Whitehorse occurs in summer months.

(d)

For YEC's approach to determining the net contribution of Mayo to the system under differing load scenarios, see YUB-YEC-1-30A(a). The LCOEs arising from the requested cases are as follows in Table 2:

Table 2: LCOE sensitivity to variations in load forecast

(throughout the entire 65 year scenario)

Scenario	LCOE (cents/kW.h)
Base Case (with Carmacks Copper and Mayo Lake)	6.69
All loads (including industrial and losses) up by 10% throughout the scenario	5.92
All loads (including industrial and losses) up by 5%	6.24
All loads (including industrial and losses) down by 5%	7.53
All loads (including industrial and losses) down by 10%	8.77

(e)

Please see YUB-YEC-1-30A (a). The range of water conditions was also reviewed in Attachment C to the Application (Table C-1 reviews impacts on existing generation of this range).