**Yukon Energy Corporation**
**Battery Energy Storage System Project**

**Yukon Utilities Board**
**Information Requests Round 1 to**
**Yukon Energy Corporation (YEC)**

**YUB-YEC-1-01**

**Reference:** **Application, Tab 1.0, PDF pages 5 and 29**

**Issue:** **Battery Energy Storage System Project (BESS)**

**Quote:** Application, PDF page 5:

"The Project has been designated by OIC 2020/180 as a "regulated project" under Part 3 of the *Public Utilities Act.*"

Application, PDF page 5:

"The Project will provide a containerized lithium ion battery energy storage system ("BESS") located on undeveloped Kwanlin Dun First Nation ("KDFN") Category B settlement land in Whitehorse near the intersection of Robert Service Way and the Alaska Highway, and connected by a transmission line to the Yukon Energy Whitehorse Rapids facility."

Application, PDF page 29:

"As reviewed in Yukon Energy's 2016 Resource Plan as well as the current 10-Year Renewable Electricity Plan, Yukon Energy continues to pursue new renewable energy developments to displace growth in thermal generation requirements, and also to implement a Demand Side Management (DSM) program aimed to reduce load growth, especially peak demand reductions. These activities will allow YEC to continue meeting Yukoners' growing demands for renewable electricity, while also supporting Yukon government's emission reduction targets."

**Request:**

(a) Does YEC consider BESS to be a generation asset or a transmission asset? Please explain.

(b) Does YEC consider BESS to be a separate asset or does it consider the project to be an extension of the Whitehorse Rapids facility? Please explain.

(c) Does YEC expect the Whitehorse Rapids facility to be the only generation source for charging the BESS asset? Please explain.

(d) What is the cost of generation from the Whitehorse Rapids facility on a $/MWh basis? Please provide this on a full cost basis, not just variable costs.

(e) Please explain how this project qualifies as an "energy project," as defined in Section 36 of the *Public Utilities Act*. If the project does not qualify as an "energy project", please explain whether the project qualifies as a "regulated project", as defined in Section 36 of the *Public Utilities Act.*

(f) Please provide a summary of any legislative requirements, policy and/or development goals that require YEC to pursue new renewable energy developments, specifying any metrics to express such requirements or goals as quantifiable objectives.

(g) Please explain how the BESS project being proposed in this application addresses the requirements or goals in terms of the metrics identified in the response to (a). In the response, please include any externalities associated with the proposed project, such as but not limited to emissions from fossil fuels used to recharge the batteries, in order to understand the net impact of the project with respect to the identified requirements or goals.

(h) The application cites several uses of the BESS project other than the primary driver of meeting the N-1 capacity criteria. Please explain how these other uses will affect the life expectancy of the batteries. Do the potential other uses (operating reserve, peak shifting, etc.) conflict with the N-1 criteria? Please explain.

**YUB-YEC-1-02**

**Reference:** **Application, Tab 1.0, PDF page 5**

**Issue:** **Project alternatives**

**Quote:** "The Project will provide 40 MWh of energy storage capacity and 7.2 MW of dependable capacity (i.e. displace four 1.8 MW diesel rental units) to the Yukon Integrated System ('YIS') for 20 years, reducing Yukon Energy's need to rely on rental of diesel generators during the winter months to address N-1 capacity shortfalls. It will also provide operating reserve that reduces thermal generation requirements, opportunities for diesel-peak shifting, enhanced blackstart capability, and other system benefits."

**Request:**

(a) Please provide the meaning of "enhanced blackstart capability".

(b) By definition, are all YEC thermal units considered as blackstart? Please explain.

(c) In its current operations, how does YEC maintain operating reserve for electricity service? Please explain.

**YUB-YEC-1-03**

**Reference:** **Application, Tab 3.1, PDF page 9; Application, Tab 3.3, PDF page 26; 2021 General Rate Application, Appendix 5.1-2, page 5.1-7**

**Issue:** **Transmission requirements for the Battery Energy Storage System Project**

**Quotes:** Application, PDF page 9:

"The BESS will be connected to the Yukon Energy Whitehorse Rapids facility by a new 1.7 km 34.5 kV transmission line that goes north of the KDFN site, following existing easements through forested crown land until it meets and follows the path of the existing ATCO Electric Yukon (AEY) 34.5 kV line to the Whitehorse Rapids facility (see Appendix A, Figure A-1 for a map of the BESS site, the Project transmission line connection to the Whitehorse Rapids facility, and the connection therein to the Riverside Substation)."

"Final design will assess the final routing on crown land and the most cost-effective strategy for this connection related to the AEY line, e.g., either build double circuit poles with the existing AEY line or build another set of poles with a single circuit (if there is enough area in the easement). The Project transmission connection design will be part of Yukon Energy's Whitehorse Interconnection Project to adjust interconnection of YEC's existing and incoming generation assets at Whitehorse, with added transmission extension connection to the Riverside Substation."

Application, PDF page 26:

"The Whitehorse Interconnection Project will require design and engineering to change the interconnection configuration for generation assets at Whitehorse to avoid creation of a new N-1 contingency at the S-150 substation. This will likely include routing several connections to the Riverside substation. Completion of this project will facilitate the connection of the BESS and the other identified generation projects to the Whitehorse Rapids facility."

2021 General Rate Application, page 5.1-7:

"The 10-Year Renewable Electricity Plan outlines a number of potential new projects being planned over the next decade … Design and engineering is required to change the interconnection of YEC's existing and incoming generation assets at Whitehorse, since the diesel replacement and new battery projects will be adding dependable capacity to the system. An alternative interconnection scheme must be developed and constructed to enable interconnection of these new capacity projects and to avoid creation of a new N-1 contingency. The first stage of the project is to examine the transmission requirements of all new projects collectively to examine the options for interconnection and determine the most cost-effective solution for connecting to the grid. Engineering of an alternative connection will facilitate the BESS project in 2022."

**Request:**

(a) Please provide further details on the transmission line alternatives being considered to connect the BESS. For example, is YEC considering single pole or double pole circuits? Has YEC started developing the exact routing of these transmission line alternatives?

(b) Please provide details of studies assessing the viability of the transmission line alternatives being considered to connect the BESS (e.g. connection study assessing the impact of a transmission line alternative on YEC's electricity system; routing studies for optimally connecting the project).

(c) Please provide an update on the Whitehorse Interconnection Project. For example, what design and engineering has been conducted by YEC to date? If any connection studies have been conducted, please provide those studies outlining the alternatives being explored.

(d) Please explain the system impacts of not going ahead with the Whitehorse Interconnection Project. For example, what system concerns would surface if the Battery Energy Storage System Project connected to the existing system in Whitehorse?

(e) Please explain any amendments to the Whitehorse Interconnection Project if the Battery Energy Storage System Project was not constructed and YEC continued to rely on thermal and diesel generation. Would there be a reduction in the system infrastructure required and a reduction in the costs of the Whitehorse Interconnection Project?

**YUB-YEC-1-04**

**Reference:** **Application, Tab 3.1, PDF page 7**
**Issue:** **Diesel displacement**
**Quote:** "The BESS will also provide other benefits, including: operating reserve that reduces thermal generation requirements; enhanced blackstart capability; opportunities for diesel-peak shifting; and other system benefits."

**Request:**

(a) Will the BESS project only charge when there is no thermal operation on the YIS? Please explain.

(b) What is meant by the phrase "other system benefits"?

**YUB-YEC-1-05**

**Reference:** **Application, Tab 4.1.1, PDF page 28, footnote 32**
**Issue:** **Baseload thermal generation**
**Quote:** "Seasonal water storage is typically needed for hydro facilities to be fully utilized in winter. In Yukon, controlled seasonal storage exists at Aishihik and to a much lesser extent at Mayo, but is largely unavailable at Whitehorse. As a result, there is an increasing need to rely on thermal generation to meet baseload energy loads in winter and early spring when grid loads are highest and hydro water flows are constrained."

**Request:**

(a) If thermal generation is required to meet baseload energy loads in winter and early spring, will thermal generation be running during times when BESS is charging?

(b) Does YEC expect that winter and early spring will be the prime conditions for using the BESS? Please explain.

**YUB-YEC-1-06**

**Reference:** **Application, Tab 3.1, PDF page 7**
**Issue:** **Capital costs**
**Quote:** "The preliminary capital cost estimate (2020$, +/- 30% accuracy) is $31.7 million…"

**Request:**

(a) Does YEC consider the project viable if the capital cost comes in at $41.2 million (+ 30%)? Please explain and demonstrate.

(b) At what cost (and percentage increase in cost over $31.7 million) will the project no longer be viable? Please explain.

(c) What would be the cost impacts if there is a delay in the project in either 2021 or 2022?

**YUB-YEC-1-07**

**Reference:** **Application, Tab 3.1, PDF page 7**
**Issue:** **Debenture investment opportunity**
**Quote:** "The Project Committee met regularly thereafter in 2020 with a particular focus on the work required to recommend a preferred site and to review a draft Term Sheet that evolved to include a debenture investment opportunity for both TKC and KDFN based on 25% of the equity portion of YEC's net rate base cost of the BESS project."

**Request:**

(a) Is the debenture based on the preliminary capital cost estimate or will it be based on final project costs?

(b) When is the capital investment with respect to the debenture due from the participating parties?

(c) Please provide any agreements or the terms and conditions of the debenture investment opportunity.

(d) Please confirm that these agreements will not result in either TKC or KDFN becoming a public utility providing service to customers in the Yukon under all applicable provisions of the *Public Utilities Act*. Please explain.

(e) Please explain whether the debenture investment opportunity is, or will be, structured as an option to purchase the 25% equity portion of the rate base costs for the BESS project.

(f) If the 25% equity portion of YEC's rate base costs is formalized in an agreement or other binding document, please explain why an equity ownership for TKC and KDFN does not result in TKC and KDFN meeting the definition of "public utility" under the *Public Utilities Act*?

(g) As the debenture investment is described as a loan, why should the Board consider, and ratepayers pay, anything higher than YEC's cost of debt? Please fully explain.

(h) YEC states that "Yukon Energy will execute the necessary transactions with Yukon Development Corporation (dividend or equity injection) to maintain this ratio on an annual basis." Please explain what is meant by this statement and fully describe the necessary transactions to give effect to the dividend or equity injection on an annual basis.

**YUB-YEC-1-08**
**Reference:** **Application, Tab 3.1.1, PDF page 8**
**Issue:** **Site size**
**Quote:** "The site for the BESS will be on a 1.5 ha site that Yukon Energy will lease…"

"Total area required for the system is likely to be accommodated within 0.35 ha, i.e. a small portion of the leased site."

**Request:**

(a) Please explain why YEC is leasing space that is in excess of three times greater than the space required.

(b) Please explain YEC's decisions and costs that demonstrate the prudency of the lease decision for 1.5 ha.

(c) Please provide all reasoning in support of the selection of the KDFN site utilizing the Whitehorse Substation.

(d) Please further explain why the TKC Land - Whitehorse was not picked as the preferred site.

**YUB-YEC-1-09**
**Reference:** **Application, Tab 3.1.1, PDF page 9**
**Issue:** **Other costs**
**Quote:** "Final design will assess the final routing on crown land and the most cost-effective strategy for this connection related to the AEY line, e.g., either build double circuit poles with the existing AEY line or build another set of poles with a single circuit (if there is enough area in the easement). The Project transmission connection design will be part of Yukon Energy's Whitehorse Interconnection Project to adjust interconnection of YEC's existing and incoming generation assets at Whitehorse, with added transmission extension connection to the Riverside Substation."

**Request:**

(a) What procurement policies, federal requirements, or other considerations were given to assess the final routing over Crown land as the best recommended option for this project, e.g., considerations such as lease term in the agreements, routing over settlement lands, or required federal government approvals of leases versus rights-of-way?

(b) Please confirm that the costs to connect the BESS project are not included in the preliminary engineering estimate. If not confirmed, please explain.

(c) Please provide further information on YEC's Whitehorse Interconnection Project (WIP). What are the estimated capital costs for this project and when is it expected to be in service?

(d) If there was no BESS project, would the WIP be necessary? If so, what would the costs be without BESS project considerations?

**YUB-YEC-1-10**

**Reference:** **Application, Tab 3.1.1, PDF page 9**
**Issue:** **Thermal management**
**Quote:** "Thermal management and heating of the system will be critical for Yukon Energy when selecting the BESS vendor."

**Request:**

(a) Please explain what is meant by the above statement.

(b) Will this required aspect of the project, thermal management and heating, be outsourced on an ongoing basis or will it be part of the containerized system?

(c) Are thermal management costs intended to be recovered as capital costs? Are any costs for thermal management included in the preliminary project estimate? Please explain and describe any costs included or excluded.

(d) From an O&M perspective, what does YEC forecast the annual thermal management costs to be for each year of its expected 20-year life? Please provide details.

**YUB-YEC-1-11**

**Reference:** **Application, Tab 3.1.1, PDF page 9**
**Issue:** **BESS life**
**Quote:** "A lifetime of 20 years therefore is reasonable with a modest overbuild or capacity augmentation at year ten."

**Request:**

(a) Please provide further details of what a "modest overbuild or capacity augmentation at year ten" entails for the scope of the project.

(b) Please provide a cost estimate of the modest overbuild or capacity augmentation at year ten.

**YUB-YEC-1-12**

**Reference:** **Application, Tab 3.1.1, PDF page 9**

**Issue:** **End of life**

**Quote:** "At the end of life, many battery vendors will take back the battery modules – which ensures that the batteries are treated properly and places responsibility of disposal on the supplier."

**Request:**

(a) Please explain what happens at end-of-life. Is YEC expecting to replace the batteries?

(b) If the batteries will be replaced, what is the expected cost for replacement batteries?

(c) If the batteries are not replaced, how does YEC plan to replace the lost capacity?

(d) What will you require of prospective battery vendors to ensure that they will take back the battery at end of life for proper recycling and disposal?

(e) What weight does proper end-of-life treatment of the battery have, in the decision matrix, when choosing a vendor?

(f) What is the cost to the purchaser to ensure proper end-of-life treatment and where would this appear in the project cost included in this application?

**YUB-YEC-1-13**

**Reference:** **Application, Tab 3.1.1, PDF page 9; Application, Tab 4.2.2, PDF page 37; Application, Appendix B: Hatch Report, PDF page 73; Application, Appendix B: Hatch Report, PDF page 83**

**Issue:** **Competitive procurement process and the different battery chemistries**

**Quotes:** Application, PDF page 9:

"… A competitive procurement process has been initiated to select battery vendors qualified to design a battery able to meet Yukon Energy's operational requirements and Yukon's northern climate…"

Application, PDF page 37:

"There are three common utility scale lithium ion battery technologies: nickel manganese cobalt lithium (NMC), nickel cobalt aluminum lithium (NCA), and lithium iron phosphate (LFP). Yukon Energy will consider vendor proposals for all three technologies in order to ensure a competitive process with sufficient bidders and the ability to select the specific solution based on both technical compliance and price." (footnote removed)

Application, PDF page 73:

"… (LFP) battery cell chemistry is preferred since it is inherently safer and has a lower capital cost. However, Yukon Energy should not limit vendors to only LFP suppliers in the RFP to get a full range of bids and confirm this assessment."

Application, PDF page 83:

"The most common chemistry is a [NMC] battery. This chemistry typically has the lowest capital cost. It is better suited for higher energy applications and has a limited power response.

"[NCA] batteries are also common for grid scale applications. These batteries provide higher power performance, making them better suited for applications with rapid response requirements. However, these batteries typically have higher costs compared to other options.

"[LFP] batteries are used in grid scale applications. These batteries offer a blend of moderate power and energy capacity making them ideal for versatile applications. LFP batteries are also generally regarded as the safest technology and are therefore, typically used in indoor applications. LFP batteries are gaining increased popularity, with many vendors exploring this technology."

**Request:**

(a) Please describe the competitive procurement process that has been initiated to select battery vendors qualified to design a battery that is able to meet YEC's operational requirements and the requirements of Yukon's northern climate.

(b) Please provide the status of the procurement process. For example, which specific vendors have been considered and what learnings are there regarding the procurement for this project? Please comment on any impacts to the timing or costs for the project.

(c) For the vendors discussed in part (b), please indicate which technology the vendor is proposing (NMC, NCA or LFP) and provide any summaries from vendors on how they will technically comply with YEC's requirements for this project. For example, what are the performance capabilities offered to comply with YEC's system needs?

(d) Please confirm that the preferred battery chemistry for the Battery Energy Storage System Project is LFP and describe its advantages over the other two battery chemistries. If a determination has not been made, please explain the benefits and limitations of each of the battery chemistries for YEC's system. (For example, suppose the NMC battery chemistry was utilized. What advantage would this technology bring to Yukon's system in the near term and long term? What are the safety risks with using this battery chemistry?)

**YUB-YEC-1-14**

**Reference:** **Application, Tab 3.1.2, PDF page 10**
**Issue:** **Stable hydro operation**
**Quote:** "… opportunities for more stable hydro operation during periods of downstream winter ice formation …"

**Request:**

(a) Please describe any changes to downstream flows required or anticipated to be required at the Aishihik Hydro facility as a result of the ongoing relicensing process, and please describe how the BESS can assist in mitigating downstream issues.

(b) Please explain whether the BESS will assist in mitigating any issues (such as downstream issues) for the hydroelectric facilities located in Mayo and Whitehorse.

(c) How does the proponent plan to use the BESS to address other downstream issues identified at the Mayo Hydro facility and the Whitehorse Rapids facility?

**YUB-YEC-1-15**

**Reference:** **Application, Tab 3.1.2.1, PDF page 10**
**Issue:** **Capacity reserve and demand reduction**
**Quote:** "For the BESS to contribute to this N-1 capacity reserve, it needs to be able to reduce the non-industrial peak demand during the day, and then be recharged overnight, for up to two weeks during the coldest winter months."

**Request:**

(a) Please explain whether the quoted paragraph is intended to mean that the BESS needs to be able to meet the non-industrial peak demand during the day rather than the BESS needs to be able to reduce the non-industrial peak demand during the day.

(b) If the response to (a) is no, please explain how YEC proposes to reduce demand by implementing supply-side measures rather than demand-side measures to reduce demand. In your response, please identify those supply-side measures relevant to this project as well as their expected impact on the project.

**YUB-YEC-1-16**

**Reference:** **Application, Tab 3.1.2.1, PDF pages 10 to 13**
**Issue:** **BESS use**

**Preamble:** BESS primary use is capacity reserve under the N-1 dependable capacity criteria. An N-1 event is anticipated to happen once in a ten-year period, with a duration of 2 weeks. During an N-1 event, the purpose of the BESS is to reduce daytime peaks. The Hatch Report states little returns (does not result in any further reduction in rental diesel gensets) above 45 MWh. Battery technology is improving and costs are reducing.

**Request:**

(a) What is the contingency if the project cost is on the lower level of +/-30% because of technological advances and decreasing costs?

(b) Will the savings be passed on to ratepayers if battery technology reduces costs? Alternatively, will a battery with a larger energy capacity and power capability be purchased in anticipation of further load growth throughout the project's lifetime, considering that "forecast peak winter load requirements continue to grow well beyond the next 10-20 years"?

**YUB-YEC-1-17**

**Reference:** **Application, Tab 3.1.2.1, PDF page 13**

**Issue:** **Rental of diesel units**

**Quote:** "In summary, BESS use for N-1 capacity reserve enables Yukon Energy to save annual rental costs for 7.2 MW of mobile diesel."

"Using the BESS only to provide N-1 dependable capacity reserve would result in it being kept fully charged and idle to respond to one of these rare events, i.e. assumed once per 10 years."

**Request:**

(a) Please explain if and how the rental of diesel units on a recurrent, annual basis takes into account the cited statement, namely that N-1 events occur approximately once every 10 years.

(b) Please explain how the price of renting diesel units under the circumstances in the quote, in which they may or may not be used with a given probability, compares to the price of renting the same diesel units which will be available for use at all times.

(c) Please explain, if any, negotiations there have been in the past, or currently, to rent the diesel units at a discounted price.

**YUB-YEC-1-18**

**Reference:** **Application, Tab 3.1.1, PDF page 8, footnote 2**

**Issue:** **Charge degradation**

**Quote:** "The energy storage is expected to require an overbuild due to the limited state-of-charge range and degradation over the Project life. The overbuild requirements will be confirmed during procurement process based on specific vendor recommendations. The conceptual layout in Figure A-2 assumes a 20% overbuild (total 48 MWh) for illustrative purposes."

**Request:**

(a) Please provide a graph showing the degradation of the batteries, by each year, for the entire project. Use time as the variable for the X-axis and MW as the variable along Y-axis.

(b) Please list the factors that affect degradation and how YEC will mitigate those factors.

(c) Do the functions of the projects conflict with other goals?

**YUB-YEC-1-19**
**Reference: Application, Tab 3.1.2.1, PDF pages 10 to 13**
**Issue: BESS use**

**Preamble:** Considering the project's primary use – dependable capacity and reducing daytime peaks in an N-1 event – what are the limitations of using the BESS for the other uses described below?

- N-1.
- One event in 10 years, duration 2 weeks.
- Project life, 20 years = 1040 weeks.
- N-1 = 4 weeks/1040 weeks.

**Request:**

(a) What other uses of the BESS can happen concurrently without compromising the primary use?

(b) Can the BESS be used to meet daily peaks outside an N-1 event? Why or why not?

(c) How often does the BESS need to recharge under normal operation?

(d) Since it is only partially charged, does it only need to recharge every night during an N-1 event?

(e) What does "frequency excursion" mean?

**YUB-YEC-1-20**
**Reference: Application, Tab 3.1.2, PDF pages 14 and 15**
**Issue: Existing operating reserve mechanism**
**Quote:** Application, PDF page 14:

"Operating reserve is carried on the electric grid to accommodate variations in the load or to cover the loss of a generator. This is achieved by operating a hydro generator below its maximum capacity, to allow its output to be increased quickly, if required…

Application, PDF page 15:

"Improved efficiency of the hydro-turbines by operating them at their most efficient output more frequently, leading to more energy production with the same amount water flow."

"The BESS can provide this operating reserve by remaining at a moderate to high state-of-charge (SOC) and acting as a backup to generation."

"For the BESS to discharge as part of the operating reserve application, an unplanned event needs to occur where generation trips or is insufficient. This is an infrequent event (estimate of one 30 minute event per month, with worst case of one event per week), and in operating reserve use the BESS therefore will be primarily idling with sufficient energy stored to provide this operating reserve and not cycling frequently.

"Based on 2019/2020 year YIS operation and average annual water flow, the average monthly operating reserve on hydro turbines ranges from 2 MW to 8 MW across the year (includes all months), with an annual average of 4.8 MW. Based on this operating reserve and 2019/2020 YIS operations, the annual average amount of thermal generation that could be avoided by BESS use as an operating reserve has been estimated by Hatch for the 20 MW/40 MWh option at 1.8 GWh of diesel generation and 17.0 GWh of LNG generation…" (footnotes removed)

**Request:**

(a) Please explain how the estimated time for generation trips or insufficiency was determined. For example, did YEC or Hatch look over these events in the past ten years and average out the time and duration of these events?

(b) Please explain if there have been instances in the past where the hydro generator has failed to meet the requirements as an operating reserve. If this is the case, please provide the number of those instances in the past ten years, on a per annum basis.

(c) Please indicate the amount of diesel and LNG generation and the duration of this generation that will still be required after the Battery Energy Storage System Project is installed.

(d) Please provide the percentage increase in efficiency the hydro generators will experience once the BESS project is installed. Additionally, please explain how the percentage increase was derived.

(e) Please explain the impacts of continuing to utilize the hydro generator as an operating reserve in absence of the BESS project. At what point would YEC be required to upgrade its generators to maintain reliable service? Would YEC need to install more diesel and LNG generation to supply load?

**YUB-YEC-1-21**

**Reference:** **Application, Tab 3.1.2.2, PDF page 14; Application, Appendix B: Hatch Report, PDF page 130**

**Issue:** **Load loss events**

**Quote:** Application, PDF page 14:

"Load loss events on the YIS are rare and short in duration…"

Application, PDF page 130:

"In the event that the load drops or a transmission or distribution line goes down, Yukon Energy may have significantly more generation online than load to consume it, creating an imbalance on the grid … Therefore, the BESS could be used as a load in these short duration scenarios to recharge and store some of the excess generation."

"This benefit is only available if the BESS is partially charged at the time of the event."

"If the 40 MWh BESS is selected it could be idled at partial state of charge (e.g. 75-85% which is 30-34MWh of energy), and the remaining energy capacity could be charged during a load loss event."

**Request:**

(a) Given the infrequency of these events, please explain how often YEC would use the BESS project for load loss events and what parameters would be applied for use. For example, was there an event (or were there events) in the past ten years in which utilizing this project would have significantly improved operation of the system?

**(b)** How would YEC coordinate between utilizing the BESS project for load loss events and keeping this battery partially charged? For example, would YEC develop models to forecast future load loss events or would it passively use this benefit (i.e., if the battery was partially charged at the time of a load loss event)?

**YUB-YEC-1-22**

**Reference:** **Application, Tab 3.1.2.2, PDF page 14; Application, Tab 3.4, PDF page 27; Application, Appendix B: Hatch Report, PDF pages 78 and 79**

**Issue:** **Reduction of greenhouse gas emissions**

**Quote:** Application, PDF page 14:

"**Diesel peak shifting:** The BESS can be discharged in lieu of diesel generation during peak and recharged overnight with LNG generation or hydro generation, reducing thermal generation fuel costs and GHG emissions…"

Application, page 27:

"The Project will also have positive environmental and socio-economic effects. Notably, the Project is expected to provide for reduced greenhouse gas and particulate emissions resulting from the displacement of thermal generation emissions…"

Application, PDF page 78:

"Yukon Energy operates 3 natural gas gensets located in Whitehorse, with a dependable capacity of 13.2 MW, each with a maximum capacity of 4.4 MW. The gas gensets are used as backup power, to provide energy during low water periods, and to meet peak demand in the winter.

"Yukon Energy operates 4 diesel power plants: The Faro Diesel plant has 2 gensets, the Dawson City Diesel plant has 6 gensets, the Mayo Diesel plant has 3 gensets, and the Whitehorse Diesel plant has 4 gensets. The diesel gensets have a dependable capacity of 25.8 MW. Diesel generation is used as backup to meet the load and to cover peak demands, primarily in the winter when hydroelectric generation is lowest. The diesel gensets are also used for outage restoration.

> "ATCO owns several backup diesel generators connected to the grid that are used to supply local emergency power in the communities they are located in."
>
> "The natural gas units are dispatched to run before any diesel is run, due to their lower fuel cost and reduced GHG emissions."

**Request:**

(a) Please indicate whether YEC recorded the emission levels from the thermal generating units, which include owned diesel generating units, rented diesel generating units and owned liquefied natural gas generating units. If so, please provide the emission levels of carbon dioxide (CO2), methane, nitrogen oxides (NOX), sulphur dioxide (SO2), volatile organic compounds and primary particulate matter from the thermal generating units for the last 5-10 years.

(b) Please explain the reduction in emissions that will be observed by connecting and operating the BESS. If possible, please provide a numerical value showing the reduction in emissions.

(c) Prior to the inception of the 10-Year Renewable Electricity Plan, please discuss the other alternatives YEC contemplated to reduce reliance on diesel generation.

**YUB-YEC-1-23**

**Reference:** **Application, Tab 3.1.2.2, PDF pages 17 and 18; Application, Tab 4.2.1, PDF page 34**

**Issue:** **Blackstart and outage restoration**

**Quote:** Application, PDF page 17:

> "In the event of a significant grid outage, Yukon Energy must blackstart the grid. To do so, YEC sectionalizes the grid into smaller load segments, which are re-energized sequentially using smaller individual generators. This involves energizing the electrical equipment in the substation, then the hydro generation, in several increments. As the system is segmented into numerous load blocks, and some of the switching is of a manual nature that needs to be conducted by deploying resources to the field for restoration, this process can take up to 2 hours, depending on the extent and severity of the outage."
>
> "Blackstart events are fairly rare, e.g., average 53 events per year based on average for 2014-2018 and 79 events per year estimated for worst case based on 2019 Annual Report with assumed maximum energy duration equal to the BESS energy capacity (35 or 40 MWh) per event. However, blackstart outage restoration accounts for more than half of the estimated BESS annual throughput and cycles under typical and worst case scenarios. BESS use for blackstart will incur operating efficiency losses of 15% on the throughput; however, it is assumed that overall savings from enhanced system restart will more than offset any efficiency loss costs."

Application, PDF page 18:

"Having the larger BESS (10 MW/40 MWh, 13 MW/40 MWh or 20 MW/40 MWh) will increase the power capacity of the load segments during blackstart, thus reducing the time required to reenergize the grid. As well, the higher energy capacity will increase the infrastructure and power generation that can be re-energized with the BESS. Particularly, the 20 MW power capabilities provides Yukon Energy with increased flexibility to significantly increase the segments that can be picked up during the blackstart process, which reduces the time. This 20 MW inverter capability can also cover the loss of Whitehorse Hydro Unit #4. It also has the highest operating factor (capacity factor) of all of Yukon Energy's generation, therefore, and outage of Whitehorse Hydro Unit #4 can lead to critical outages on the grid. Based on discussions with Yukon Energy, this hydro unit is the cause of many system outages." (footnotes removed)

Application, PDF page 34:

"The Whitehorse Hydro WH4 Uprate Project will increase the maximum water flow providing 0.9 GWh of annual additional energy, however, due to downstream Yukon River system ice flow restrictions this project does not provide additional dependable capacity."

**Request:**

(a) Please provide details of the most severe outage that occurred on YEC's system in the last ten years. Please explain the cause of the event and the steps taken to restore the system and the time it took for existing generation to energize the system.

(b) If the BESS project was installed at the time of the most severe outage mentioned in part (a), please explain the steps YEC would take to restore the system and provide the time it would take for restoration for the following battery option scenarios: 6.6 MW/35 MWh; 7 MW/40 MWh; 8.8 MW/35 MWh; 10 MW/40 MWh; 13 MW/40 MWh; 20 MW/40 MWh.

(c) Considering Whitehorse Hydro Unit #4 is related to many system outages, please indicate whether YEC conducted any upgrades of this unit in the past to minimize outages. If upgrades have been conducted, please provide the upgrades conducted, the reasons for the upgrades and the years in which these occurred.

(d) How frequently will the BESS project be required for blackstart and outage restoration if the WH4 Uprate Project is completed?

**YUB-YEC-1-24**

**Reference:** **Application, Tab 3.1.2.2, PDF page 19; Application, Appendix B: Hatch Report, PDF pages 67 and 68; Application, Appendix B: Hatch Report, PDF pages 125 to 127-**

**Issue:** **Load shedding events**

**Quote:** Application, PDF page 19:

"The BESS will reduce load shedding resulting from frequency excursions. Large frequency excursion events are relatively infrequent (8-18 events per year [Hatch, page 69]… However, these events directly impact customer reliability, particularly in the commercial sector, which can drive outage-related customer costs. Reduction in load shedding would result in increased customer reliability."

"Frequency excursions are likely to increase as more intermittent renewables are added to the grid, increasing potential BESS benefits from this use in future years. Reduction in load shedding and renewable integration accounts for 19% to 22% of the estimated BESS annual throughput and cycles under typical and worst case scenarios…" (footnote removed)

Application, PDF page 67:

"The usage of the battery to reduce load shedding events must be weighed against the imposed degradation."

Application, PDF page 68:

"It is not recommended to use the battery for grid frequency regulation continuously, as this will lead to high annual throughput and faster degradation."

Application, PDF page 125:

"It is unlikely the BESS could have avoided the significant frequency deviation events, below 56.5 Hz, which lasted for several hours."

Application, PDF page 125:

"The distribution of frequency deviations at Whitehorse Substation on WH4 T9 and L151 are presented … There were 8 major deviation events where the frequency dropped below 56.5 Hz for extended periods of time. Otherwise there were 33 deviations on WH4-T9 between 59.5 Hz and 56.5 Hz, and 32 deviations on L151."

Application, PDF page 126:

"The distribution of frequency deviations at McIntyre Substation, for S170, are presented … There were 9 major deviation events where the frequency dropped below 56.5 Hz for extended periods of time. Otherwise there were 33 deviations on S170 between 59.5 Hz to 56.5 Hz.

"Since McIntyre substation is near Takhini and Whitehorse Substation, it may be possible for the BESS to respond to frequency deviations at this substation and avoid load shedding on the ATCO lines. However, it is imperative that the ability of the BESS to respond in a timely manner to avoid the system 'chasing its tail'."

Application, PDF page 127:

"The distribution of frequency deviations at Takhini Substation on S164-L172 and S164-L170 are presented in Table 6-20 and on S164-L171 and S164-52-7 are presented…"

"Load shedding at Takhini is based on frequency excursions below 56.5 Hz, therefore, there was only 1-2 events over the past 4 years where the BESS would have reduced load shedding."

"As well, the BESS could provide frequency support, responding to the deviations between 59.5 – 56.5 Hz as well, reducing their impact on power quality that is sent to the rest of the grid.

"However, frequency control will lead to higher throughput of the BESS and faster degradation of the battery's capacity. Therefore, a balance must be struck between using the BESS to reduce the impacts of frequency excursions on the grid and degradation of the BESS."

**Request:**

(a) Please provide the duration of the frequency deviations discussed from PDF pages 125 to 127 of the application for the Whitehorse, McIntyre and Takhini substations. For example, how long were the major frequency deviations at these substations?

(b) Please provide details on how YEC would avoid "chasing its tail" if it decided to use the BESS project for frequency deviations at the McIntyre substation. For example, what would be the timing required to successfully mitigate frequency deviation at this substation?

(c) For the Takhini substation, the Hatch Report indicated that the BESS project could respond to deviations between 56.5 to 59.5 Hz, reducing their impact on power quality. Please confirm that the deviation from 60 Hz results in power quality issues and not the Battery Energy Storage System Project.

(d) Please indicate whether YEC will increase the BESS's frequency regulation as more renewable projects connect to the system. If yes, please explain how YEC will balance between using the project for frequency regulation and reducing the degradation of the battery.

**YUB-YEC-1-25**

**Reference:** **Application, Tab 3.1.3, PDF page 20, notes 2 and 3 to Table 3-4.**
**Issue:** **Planning costs**
**Quote:** "Planning Costs are YEC costs to the end of October 2020. Owner's Costs include final planning prior to final 'go' decision targeted for July 1, 2021 and Owner's Costs during construction (including site development KDFN lease charge)."

**Request:**

(a) Have YEC planning costs been finalized? If not, what is the current forecast of the total planning costs?

(b) Please distinguish between the amounts of planning costs that are included in line 1 of Table 3-4 and the owner's costs for final planning prior to the "final 'go' decision".

(c) Please provide a full breakdown of all the costs included in owner's costs.

(d) The battery is 72% of the total project cost. How has the decreasing cost of the technology factored into decisions around sizing versus achieving savings on the project?

**YUB-YEC-1-26**

**Reference:** **Application, Tab 3.1.3, PDF page 21, notes 1 and 2 to Table 3-5**
**Issue:** **Annual operating costs**
**Quote:** "Hatch preliminary cost estimates for selected KDFN site, 20 MW/ 40 MWh size. Opex annual cost includes annual preventive maintenance costs for the battery ($60k/year for two technicians, twice per year; plus $2.25/kWh/yr and $4/kW/yr for parts and preventive maintenance)."

**Request:**

(a) Please explain why property taxes apply on First Nations settlement land? Does the City of Whitehorse have authority to assess and collect property taxes on this land?

(b) Has YEC attempted to negotiate a reduced tax rate with the City of Whitehorse? Please explain.

(c) How long would the technicians be on site for each of their semi-annual visits for maintenance?

(d) Please explain the difference between what is considered "parts" and what is considered "preventative maintenance".

(e) Please explain what is involved in the transmission O&M for the 1.7 km transmission line.

(f) Annual operating costs do not include recharging costs. Please describe recharging costs for various throughputs.

(g) What considerations were made to site the project in a location that does not require annual property tax costs or lease costs to landowners?

**YUB-YEC-1-27**

**Reference:** **Application, Tab 3.1.3, PDF page 21**
**Issue:** **Levelized cost of capacity**
**Quote:** "The estimated net capital cost for Yukon Energy of $15.2 million equals $2.11 million per MW of dependable capacity (7.2 MW) provided by the Project."

**Request:**
Please provide a revised levelized cost of capacity by including all transmission connection costs and battery costs before government contributions.

**YUB-YEC-1-28**

**Reference:** **Application, Tab 3.1.3, PDF page 21**
**Issue:** **Recharging losses and idling**

**Request:**
(a) Please explain recharging losses and provide details on how they are calculated.

(b) Please explain what is meant by "idling" and provide a further description on how it impacts costs.

**YUB-YEC-1-29**

**Reference:** **Application, Tab 3.1.3, PDF page 21, footnote 29; Application, Tab 4.2.3, PDF page 41, footnote 58**
**Issue:** **LCOC of rented diesel units**
**Quote:** Application, PDF page 21:

"LCOC for rented diesel units with the same WACC and over the same 20 year life is $211/kW-year (2022$) assuming diesel rental costs of $162,400/MW connected [includes cost of spares] estimated (2021$) for winter 2021/22, 4% year escalation of diesel rental costs, and $11/kWh for variable non-fuel O&M. Infrastructure capital costs for diesel rental at $3.5 million (2022$) for 27 MW capacity based on infrastructure capital costs for the existing rentals [inflated at 2%/year]." [emphasis added]

Application, PDF page 41:

"The 4% escalation reflects recent YEC experience on escalation of diesel rental costs at rates greater than overall consumer price inflation (consumer price inflation is assumed at 2% per year in the current analysis)."

**Request:**
(a) Please provide the detailed calculations of the $211/kW-year of the diesel rentals. Please explain and justify any cost of capital considerations that would apply to the diesel rental.

(b) Please describe and explain the need for infrastructure capital costs for the existing diesel rentals. Why are such costs not shown for the BESS?

(c) Please explain and justify the $11/kWh cost for variable non-fuel O&M.

(d) Please justify the 4%/year escalation for the diesel rental costs when current inflation rates are not trending at 4%.

(e) Please provide further explanation and evidence of the 4% escalation rate.

**YUB-YEC-1-30**
**Reference:** **Application, Tab 3.1.3, PDF page 21, footnote 30**
**Issue:** **New diesels**
**Quote:** "LCOC for 12.5 kW new diesel at Takhini estimated at approximately $186/kW-year (2022$), based on Midgard estimate (2019$) of capex and opex for 12.5 MW Takhini diesel plant, 40 year life (WACC at 4.92%), escalated for inflation at 2% per year to 2022."

**Request:**
Please provide a table comparing the three options (the BESS, diesel rental, new diesel). For the table, show capital expenditures, operating expenditures, variable cost escalators, infrastructure capital and a listing of all the assumptions made for each option.

**YUB-YEC-1-31**
**Reference:** **Application, Tab 4.1.2, PDF page 29**
**Issue:** **Load forecasts**

**Request:**
(a) Please provide load forecasts by rate class for the 20 years over which the proposed BESS project spans.

(b) Please indicate what the forecast methodology is and provide any methodological details, such as parameters chosen, assumptions made and scenarios contemplated, in support of the selected methodology as well as the estimates resulting from the methodology.

**YUB-YEC-1-32**
**Reference:** **Application, Tab 3.1.3, PDF page 22; Application, Tab 4.1.2, PDF pages 29 to -31**
**Issue:** **The role of the Battery Energy Storage System Project with respect to evolving load conditions**
**Quotes:** Application, PDF page 22:

"In summary, it is concluded that the specified need to meet near term forecast requirements for reliable and flexible new capacity on the Yukon grid would best be met through development of the Project. Compared to the feasible and best alternative available today (i.e. diesel rental), at forecast grid loads the Project provides a cheaper and renewable focused energy option for Yukon Energy and Yukon ratepayers."

Application, PDF page 29:

"The updated firm load forecasts include the impact of several electrification policies and actions being introduced by the Yukon government in support of its emission reduction targets. Ongoing generation projects include: Whitehorse Hydro uprates at WH2 and WH4, the BESS, renewable energy purchases from Independent Power Producers (IPP) through the Standing Offer Program, solar energy from the Micro-Generation program, the Southern Lakes and Mayo Lake enhanced storage projects, replacement of diesel generators as they retire, and DSM programs. The three major new projects YEC is proposing in the 10-Year Renewable Electricity Plan are: electricity purchases from the planned Atlin Hydro Expansion Project, construction of a pumped storage facility at Moon Lake, and upgrading and expansion of the Southern Lakes Transmission Network to facilitate the Moon Lake project and other potential improvements.

"Although Yukon Energy is aiming to displace thermal energy generation over the next decade with the planned new renewable generation projects, not all of the added renewable generation sources will provide dependable capacity. For example, no dependable capacity will be provided by the expected IPP purchases under the Standing Offer Program as these are intermittent rather than dispatchable renewables; and **enhanced storage projects displace thermal energy generation with no added dependable capacity**. As a result, Yukon Energy is placing a high priority on new projects that can address the YIS dependable capacity requirements without reliance on new fossil fuel thermal generation or rented mobile diesel units."

Application, PDF page 30:

"In addition to these new renewable capacity options, the 10-year plan includes the potential Moon Pump Storage Phase 1 with 35 MW winter capacity starting in 2028/29 as illustrated in Figure 4-1. The planned new capacity options also include 12.5 MW of new diesel units to replace retiring generation in Whitehorse, Faro and Dawson."

Application, PDF page 31:

"Due to timing of the supply resources, the N-1 capacity shortfall is forecast to continue through 2028/29 requiring from 4 to 15 diesel unit rentals (7 to 27 MW), plus spares as required, each year until the proposed 35 MW Phase 1 Moon Lake Pump Storage is in-service (forecast in 2028/29). Figure 4-1 shows the 10 MW Phase 2 Moon Lake Pump Storage project proposed in 2031/32 to address ongoing N-1 dependable capacity requirements." (emphasis added)

**Request:**

(a) Please explain whether YEC foresees a future with no reliance on thermal generation or rented mobile diesel units.

(b) Would YEC be able to balance supply and demand without thermal generation or rented mobile diesel units?

(c) Would the ongoing renewable generation projects outlined in the 10-Year Renewable Electricity Plan be capable of ensuring reliability without relying on thermal generation or rented diesel units?

(d) How does the BESS project offset reliance on thermal generation given that new diesel generation is required in YEC's future forecast?

(e) YEC included 12.5 MW of new diesel units in its future capacity options and also stated that rented diesel units would be required until the Moon Lake Pumped Storage Project was put in to service. Please clarify whether the Moon Lake Pumped Storage Project will eliminate the need for diesel units.

**YUB-YEC-1-33**

**Reference:** **Application, Tab 3.4, PDF page 26**

**Issue:** **NAV Canada Land Use Assessment**

**Quote:** "Land use assessments by NAV Canada and Transport Canada for aviation safety will also be required."

**Request:**

(a) The project is expected to require a NAV Canada land use assessment and a Transport Canada aeronautical obstruction clearance. When will the processes for these permits be initiated?

(b) What is the process undertaken by NAV Canada and Transport Canada?

(c) What is the projected timeline for these assessments?

(d) As the proposed location for the BESS is near the end of a runway adjacent to the Whitehorse airport, are additional requirements to the project or the property necessary to satisfy any NAV Canada concerns? What costs are likely to be associated with such changes? Please explain.

**YUB-YEC-1-34**

**Reference:** **Application, Tab 3.4, PDF page 27; Application, Appendix B: Hatch Report, PDF page 90**

**Issue:** **Fire and emergency response plan**

**Quotes:** Application, PDF page 27:

"Yukon Energy will also develop a comprehensive fire and emergency response plan and provide training to local firefighters to address concerns related to fire or emergency situations as part of project implementation."

Application, PDF page 90:

"In addition to the safety measures put in place by the battery vendor, a fire response plan will be prepared by Yukon Energy and provided to the local fire department and emergency response staff. The fire department and emergency response staff will receive appropriate training on how to handle lithium ion battery fires."

**Request:**

Please indicate whether YEC has a preliminary formulation of the fire and emergency response plan it would put in place. If so, please provide further details on the documents it has started preparing for this plan.

**YUB-YEC-1-35**

**Reference:** **Application, Tab 4.1.3, PDF page 30**

**Issue:** **Demand-side management (DSM)**

**Quote:** "DSM measures [are] expected to reduce peak demand by 2.2 MW in 2021/22 increasing to 7.0 MW by 2030/31…"

**Request:**

Please describe how "DSM measures [are] expected to reduce peak demand by 2.2 MW in 2021/22 increasing to 7.0 MW by 2030/31".

**YUB-YEC-1-36**

**Reference:** **Application, Tab 4.2, starting at PDF page 33**

**Issue:** **BESS project reliability**

**Request:**

(a) Please identify any mechanisms, rules, guidelines and regulations, or any other relevant provisions that have to be complied with for system performance and reliability purposes with respect to both the primary use and secondary use cases of the BESS project.

(b) Please identify any metrics, indicators or industry standards associated with the response to (a), identifying performance levels, parameters or relevant thresholds designed to ensure system reliability.

(c) Based on the responses to (a) and (b), please explain how the proposed BESS project represents an improvement with respect to the current solution and/or the most cost-efficient alternative.

**YUB-YEC-1-37**

**Reference:** **Application, Tab 4.2, PDF page 33**
**Issue:** **Challenges around rented diesel units**
**Quote:** "Aside from added costs, reliance on rented diesel units can create risks as to continuing availability, acceptable performance and the ability to accommodate the required units."

"In summary, the 'status quo' option is not a feasible alternative today. Permanent solutions are needed rather than relying upon temporary options such as rented diesel generators."

**Request:**

(a) Please elaborate on the issues found in the rented diesel units currently connected to the Yukon Integrated System. For example, please provide details on the difficulty in finding rented diesel units and the challenges faced in locating and connecting the current diesel units.

(b) Please explain whether YEC explored any permanent solutions in the past. If so, please provide details on permanent solutions explored and why they were dismissed in favour of rented diesel units.

**YUB-YEC-1-38**

**Reference:** **Application, Tab 4.2.2, PDF page 36**
**Issue:** **Energy storage technologies**
**Quote:** "There are various energy storage technologies available. Yukon Energy completed a comprehensive review of the available energy storage technologies for the 2016 Resource Plan. This study concluded that batteries, and lithium ion batteries specifically, were the best energy storage option for the YIS context. The use required by Yukon Energy involves low cycling, with a need for reliable and quick response in a northern climate location."

**Request:**

(a) Please provide a summary of the review conducted by YEC on energy storage technologies in its 2016 Resource Plan.

(b) Please explain the drawbacks of connecting other energy storage technologies on to the Yukon Integrated System.

**YUB-YEC-1-39**

**Reference:** **Application, Tab 4.2.2, PDF page 40**

**Issue:** **Dependable capacity**

**Quote:** "YEC selected the 20 MW/40 MWh BESS system size in order to deliver the 7.2 MW of N-1 dependable capacity in combination with the other use cases, which result in a net benefit to ratepayers (as described in Section 4.2.3)."

**Request:**

Does the dependable capacity level change depending on the option for battery size chosen by YEC? Please explain.

**YUB-YEC-1-40**

**Reference:** **Application, Tab 4.2.2, PDF page 40**

**Issue:** **Implicit costs and operational benefits**

**Quote:** "This sizing ensures that provision of the N-1 dependable capacity does not limit YEC's ability to deploy the BESS for other uses and realize their benefits, enables faster recharging overnight, and provides greater operational flexibility to accommodate future changes in the configuration and operational needs of the grid as more intermittent renewable resources come online."

**Preamble:** The Board wants to better understand the drivers for this project. YEC has stated that the primary driver for this project is to satisfy the N-1 capacity criteria.

**Request:**

(a) The N-1 criteria is for capacity during a catastrophic event. Therefore, during non-catastrophic times, does this represent idle capacity? Please explain.

(b) If N-1 is the primary driver, please provide the economic analysis on this project using only N-1 considerations.

(c) If the BESS displaces other assets for operational flexibility, please provide the opportunity costs of that displacement. Please explain all assumptions.

(d) If the BESS is charged more frequently, how is the degradation of the batteries reflected in YEC's economic analysis?

(e) What time frame is YEC referring to regarding "accommodate future changes"?

**YUB-YEC-1-41**

**Reference:** **Application, Tab 4.2.2, PDF page 40**

**Issue:** **BESS Inverter to 20 MW**

**Quote:** "Increasing the power output of the BESS inverter to 20 MW allows the BESS to be recharged faster overnight, ensuring that it can be ready the next day to continue providing dependable capacity under the N-1 event."

"Increased power and energy capacity increases BESS capability to provide blackstart benefits; in particular, the 20 MW power capabilities provide Yukon Energy with increased flexibility to significantly increase the size of the load segments that can be picked up during the blackstart process, which reduces the time required for grid restoration.

"The 20 MW inverter capability can also cover the loss of Whitehorse Hydro Unit #4 which has the highest operating factor (capacity factor) of all of Yukon Energy's generation; therefore, an outage of Whitehorse Hydro Unit #4 can lead to critical outages on the grid. Outages caused by the loss of Whitehorse Hydro Unit #4 occur on average once per year, however, given the larger size of this unit the resulting load shedding is more extensive. This is particularly true in the summer when WH4 is providing a larger portion of generation on the grid."

**Request:**

(a) During a peak winter load scenario and an N-1 event (loss of Aishihik transmission line), is there any excess hydro available to recharge the BESS? Please explain.

(b) In the event of an N-1 event (loss of Aishihik transmission line), at a rated capacity of 7.2 MW, how long can the BESS supply energy? Please explain.

(c) How long is the blackstart process for LNG? Please explain.

(d) How long is the blackstart process for diesel? Please explain.

(e) If thermal is part of baseload generation, does this give YEC some flexibility with respect to blackstart operations? Please explain.

(f) During a peak load scenario, how long can the BESS cover an outage of WH#4? Please explain.

(g) Could existing thermal at Whitehorse cover an outage of WH#4? Please explain.

(h) Could increased production from Aishihik cover or partially cover for an event where WH#4 is lost? Please explain.

(i) Could any of the other WH units cover for the loss of WH#4? Please explain.

**YUB-YEC-1-42**

**Reference:** **YEC Application for Proposed Whitehorse Diesel – Natural Gas Project,, Tab 4.2.3, PDF page 30**

**Issue:** **Two 6.7 MW diesel engines**

**Quote:** "For comparative purposes, an alternative has been examined assuming two new 6.7 MW diesel engines (13.4 MW), with the first unit installed in late 2014 at an estimated capital cost of $22.5 million (this unit will not fully meet the 7.0 MW required new capacity for early 2015 under Base Case loads) and the second unit installed in late 2015 at an estimated capital cost of $11.0 million…" (Footnotes removed)

**Request:**

(a) Given that this alternative option provided 13.4 MW of additional capacity, therefore meeting current and future N-1 requirements, and represents a capital cost at the end of 2013 of $33.5 million (assuming 2013 dollars), has YEC considered this alternative versus the rented diesel option? Please explain.

(b) Please identify the benefits of using an additional thermal unit that cannot be provided by using the BESS. Please explain each benefit.

(c) The BESS has an expected project life of 20 years. Given similar energy outputs, what is the expected life of a diesel or other thermal unit? Please explain.

(d) What would the cost be for a similarly sized LNG unit? Please explain.

**YUB-YEC-1-43**

**Reference:** **Application, Tab 4.1.3, PDF page 30**

**Issue:** **20 MW thermal plant not pursued**

**Quote:** "Second, YEC in January 2020 provided information on its new 10-Year Renewable Electricity Plan to address impacts of the Yukon government Climate Change Strategy, YEC's Board Strategic Plan and the decision not to pursue a new 20 MW thermal plant at this time, and other updated information. YEC has subsequently released its completed 10-Year Renewable Electricity Plan." (footnotes removed)

**Request:**

(a) Please provide further information on the 20 MW thermal plant. For example, what would be the fuel source of combustion and where would this plant be located?

(b) Please provide further detail as to why YEC decided not to pursue the thermal plant in the near term.

(c) Please indicate whether YEC has considered constructing this plant at a future date. Under what circumstances would YEC be required to construct and operate a thermal plant?

**YUB-YEC-1-44**

**Reference:** **Application, Tab 4.2.1, PDF pages 31 to 35; Appendix B: Hatch Report, PDF pages 33 and 66; Appendix B: Hatch Report, Section 12, PDF pages 170 to 176; YEC Application for Proposed Whitehorse Diesel – Natural Gas Project, Section 4.2.3, PDF pages 28 to 31**

**Issue:** **Reasonable alternatives to the BESS project**

**Quote:** Application, PDF page 66:

"A battery energy storage system (BESS) was identified as one of several options to address this capacity gap and reduce the number of diesel gensets rented each year.

Application, PDF page 33:

"4.2.1 Alternatives to the Project
Yukon Energy's 10-Year Renewable Electricity Plan examined a wide range of near-term resource supply options to address forecast energy and capacity shortfalls. Many of these options do not provide dependable capacity; and the new resources that will provide dependable capacity would generally not displace what the BESS option can provide, i.e. the identified permanent resource capacity options are generally all needed to remove reliance on rented diesels for addressing the forecast capacity shortfall reviewed in Table 4-1. Moon Lake pumped storage, when developed, is the only identified resource option aside from default new thermal fossil fuel generation that has the capability to remove the forecast N-1 dependable capacity shortfall." [footnotes omitted]

**Request:**

(a) Please compare the proposed BESS project to the most cost-effective alternative, whether it is one among the alternatives mentioned in sections 4.2.1 of the application and 4 of the Hatch Report or a different one. In the comparison, please use a table with the variables included in section 12, in addition to elaborating on any other costs, benefits, risks, reliability considerations and/or externalities deemed relevant.

(b) Please explain if and why a new diesel alternative, like the one discussed in section 4.2.3 Diesel Generation Alternatives to the Project of the YEC LNG project application, should be included among the relevant alternatives considered in response to (a). As part of the response, please comment on the costs and on any efficiencies that could result from the use of diesel generators with different characteristics, such as size, capacity, etc.

**YUB-YEC-1-45**
**Reference:** **Application, Tab 4.2.1, PDF pages 33 to 35**
**Issue:** **Reasonable alternatives to the BESS project**
**Quote:** Application, PDF page 34:

> "The reviewed new resource portfolio options to the BESS in the 10-Year Renewable Electricity Plan include the following:"

"Demand Side Management (DSM): DSM involves using incentives, electricity rate structures, and building and appliance codes and standards to encourage customers to reduce the amount of electricity they use. The current focus of the DSM programs is on measures that deliver peak capacity savings (i.e. reductions in peak electricity consumption). The DSM programs are expected to reduce peak demand by 7 MW by 2030/31."

**Request:**
Please explain why demand-side management measures (quoted above) are identified as an alternative as opposed to a complementary solution to the issues identified as the motivation for this project, namely the need for additional capacity as well as any associated environmental considerations/requirements.

**YUB-YEC-1-46**
**Reference:** **Application, Tab 4.2.2, PDF page 38; Application, Tab 5.0, PDF page 45**
**Issue:** **Public engagement process**
**Quote:** Application, PDF page 38:

> "The two remaining site options [(the site on TKC Settlement Land across from Yukon Energy's LNG Plant on Robert Service Way and the site on KDFN Settlement Land on the northeast corner of the Alaska Highway and Robert Service Way)] located within Whitehorse for connection to the Whitehorse rapids substation facility generally offered relatively equivalent benefits and costs, including the cost of property taxes. Yukon Energy received lease proposals from both KDFN and TKC for these two sites and selected the KDFN site in this area as the preferred site option based on the lease rates offered."

> Application, PDF page 45:

> "General concerns identified regarding the Project related to potential noise and light pollution, impact of an industrial development in rural residential areas, fire and explosion safety, health impacts of radiation, electromagnetism, and gases, reduction in property values and impacts on insurance premiums, and contamination of agricultural land close to project in case of accidents and malfunctions. Many of these concerns are being addressed through a combination of site selection and selection of the battery technology and planned engineering." (footnote removed)

**Request:**

(a) Please provide further details on stakeholders' comments around the two remaining site options. For example, did stakeholders also agree that the KFDN site was preferable over the TKC site?

(b) Please provide the lease rates offered for both the KFDN and TKC sites.

(c) Please indicate whether stakeholders still have outstanding concerns for the following issues:

i. Potential noise and light pollution

ii. Impact of industrial development in rural residential areas

iii. Fire and explosion safety

iv. Health impacts of radiation, electromagnetism and gases

v. Reduction in property values and impacts on insurance premiums

vi. Contamination of agricultural land close to the Battery Energy Storage System Project

(d) If the concerns mentioned in part (b) have been resolved, please provide further information on what YEC told stakeholders. If the concerns have not been resolved, please provide the steps YEC is taking to resolve these concerns. For example, is YEC maintaining dialogue with stakeholders who have outstanding concerns?

**YUB-YEC-1-47**

**Reference:** **Application, Tab 4.2.3, PDF page 41**
**Issue:** **Investing in Canada Infrastructure Program**
**Quote:** "The preliminary net capital cost estimate for Yukon Energy, after the $16.5 million funding from the Federal government's 'Investing in Canada Infrastructure Program ('ICIP'), is $15.2 million."

**Request:**

(a) What are the terms and conditions of the ICIP funding?

**(b)** Could ICIP funding have been used for any alternatives to the BESS project? Please explain.

**YUB-YEC-1-48**

**Reference:** **Application, Tab 4.2.3, PDF page 41**
**Issue:** **Annual savings in diesel rental costs**
**Quote:** "Based on displacing winter 2022/23 diesel rental costs of approximately $168,900/MW, the year 1 (2022) annual savings in diesel rental costs approximates $1.216 million per year and these cost savings are assumed to escalate at 4% per year over the 20-year Project." (footnote omitted)

**Request:**

Please provide the detailed derivation of the annual savings of $1.216 million per year.

**YUB-YEC-1-49**

**Reference:** **Application, Tab 4.2.3, PDF page 42**

**Issue:** **Improved efficiency of hydro turbines**

**Quote:** "Improved efficiency of the hydro-turbines by operating them at their most efficient output more frequently, leading to more energy production with the same amount of water flow."

**Request:**

(a) Please explain how the BESS project allows YEC to operate its hydro-turbines more efficiently.

(b) Regardless of the BESS project, does YEC strive to operate its hydro-turbines as efficiently as possible? Please explain.

(c) How does/will YEC measure this higher efficiency? Please explain.

(d) What is the difference in hydro unit efficiencies between summer and winter months? Please explain.

**YUB-YEC-1-50**

**Reference:** **Application, Tab 4.2.3, PDF page 42**

**Issue:** **Economic benefits of other secondary use cases for the Battery Energy Storage System Project**

**Quote:** "The YIS will benefit from other secondary uses cases such as blackstart and outage restoration, reduction in load shedding (via frequency regulation) and renewable integration, load loss stabilization and reactive power support; however, the economic benefits from these use cases cannot be estimated [i.e. while there are no economic impact estimates provided in the Hatch Report, it is recognized that customers will receive benefits from reduced outage durations and other reliability benefits provided by the Project]."

**Request:**

(a) Please explain why the economic benefits from these secondary use cases cannot be estimated.

(b) Please explain if YEC forecasted the reduction of grid outages with the Battery Energy Storage System Project installed and, if applicable, provide this forecasted number for the next ten years.

**YUB-YEC-1-51**

**Reference:** **Application, Tab 4.2.3, PDF pages 16 and 42, Table 3-3**

**Issue:** **Operating reserve**

**Quote:** Application, PDF page 42:

"Table 3-3 shows that when the 20 MW/40 MWh BESS is used as operating reserve it could save up to 1,837 MWh of diesel and 17,043 MWh of LNG, or $3.374 million, based on 2021 GRA fuel prices. Section 3.1.2.2. also notes that these estimates may not be fully realized due to water storage savings with the existing operations, and that net thermal generation reduction from BESS operating reserve use is approximately one-third of Table 3-3 estimates, i.e. the operating reserve annual net fuel cost saving is reduced to approximately $1.125 million (2022$)."

Application, PDF page 16:

"YEC cost saving and GHG reduction benefits from the BESS operating reserve use result from the reduction in thermal generation that otherwise is required when hydro units are used for operating reserve. Requirements to recharge the battery as a result of this use are infrequent, and would use excess hydro generation at minimal incremental YEC cost. Potential thermal generation reduction benefits from this BESS reserve use will be greater in years with higher water flows and lower in years with lower water availability."

**Request:**

(a) In section 3.1.2.2, YEC states that the BESS can provide operating reserve when excess water is available. If there is excess water available, then can hydro provide the operating reserve? Please explain.

(b) If the BESS is used for operating reserve, is it static storage or is there some draw from the battery for this purpose? Please explain.

(c) Is the annual net cost savings of $1.125 million noted above based on a high water year? Please explain.

(d) What confidence interval is attached to the net fuel cost savings of $1.125 million?

(e) Please state all assumptions made to support the net annual fuel cost savings of $1.125 million.

**YUB-YEC-1-52**
**Reference: Application, Tab 4.2.3, PDF page 43, Table 4-3**
**Issue: Table calculations**

**Request:**

(a) Please provide Table 4-3 in Excel format with formulae intact.

(b) Please provide the detailed calculations for the values in each column for rows Year 1, Year 4, Year 10, Year 16 and Year 20.

(c) Does Table 4-3 include the modest overbuild or capacity augmentation at year ten? Please explain.

(d) If Table 4-3 does not include the modest overbuild or capacity augmentation at year ten, then please provide a revised Table 4-3 which includes the modest overbuild or capacity augmentation at year ten.

(e) The savings outlined in Table 4-3 describe: avoided rental diesels, operating reserve use, and annual peak shifting. Are these savings firm forecasts resulting from BESS's intended use? Please explain.

**YUB-YEC-1-53**
**Reference: Application, Tab 4.2.3, Table 4-3: Annual Ratepayer Impacts from the BESS (20 MW/40 MWh), PDF page 43; Appendix B: Hatch Report, Tables 12-1 to 12-4, PDF pages 173 to 176**
**Issue: Summary of cost economic assessment**

**Request:**

(a) Please confirm that Tables 12-2, 12-3 and 12-4 use the savings estimate identified in section 11 and Table 12-1 as cash inflows for NPV calculation purposes.

(b) Please provide a column for Tables 12-2, 12-3 and 12-4 to show savings as a separate item that can be reconciled with Table 12-1.

(c) Please provide a copy of Table 12-1 in Excel format with formulas that allow for a clear understanding of the calculations and how the final savings figure was obtained for each of the compared options.

(d) Please provide a copy of Tables 12-2, 12-3 and 12-4 in Excel format with formulas that allow for a clear understanding of the calculations of how the NPV was obtained for each of the compared options.

(e) Please reconcile Table 4-3 with Tables 12-2, 12-3 and 12-4.

**YUB-YEC-1-54**

**Reference:** **Application, Tab 4.3, PDF page 43**
**Issue:** **Owner's engineer with experience**
**Quote:** "These risks are generally being addressed through an early vendor selection process, assisted by an owner's engineer with experience procuring battery vendors…"

**Request:**

(a) Has YEC selected an owner's engineer for this project?

(b) If the answer to (a) is yes, then what experience do they have in similarly sized installations in cold climates and in managing costs of a BESS project?

(c) Are the owner's engineer's costs included in the BESS capital costs?

**YUB-YEC-1-55**

**Reference:** **Application, Tab 4.3, PDF pages 43 and 44**
**Issue:** **Impacts on Ratepayers**
**Quote:** "Potential impacts on ratepayers relate to ultimate Project capital costs and the impact on rates, as well as any potential impacts on Project performance and timing that enhance or reduce the expected BESS benefits related to reduced thermal generation and improved reliability for customers."

**Request:**

(a) Please discuss the impact on ratepayers if the savings from operating reserve do not materialize or do not materialize to the level assumed in this application.

(b) Please provide a discussion on what measures YEC will take to ensure that all savings from this project, as identified in the application, will occur as stated.

(c) Similarly, please provide a discussion on what measures YEC will take to ensure that all capital and O&M costs from this project, as identified in the application, will occur as stated.

(d) Please discuss the impact on ratepayers if the capital costs for this project come in 30% higher or more relative to the preliminary engineering estimate.

(e) Please discuss the impact on ratepayers if the operating costs for this project come in 30% higher or more for the annual operating costs.

(f) Please discuss the impact on ratepayers if the operating costs for this project come in 30% higher or more for the annual net recharging costs.

(g) For each of the items listed in parts (a) to (d) above, please provide YEC's opinion on the probability of that event occurring.

**YUB-YEC-1-56**

**Reference:** **Application, Tab 6.2, PDF page 48**
**Issue:** **Conventional construction technologies and applicable construction and design practices**
**Quote:** "The Project will be built using conventional construction technologies suited for northern climate conditions and following all applicable construction and design practices for works of this nature, including building and electrical codes and adhering to industry best practices."

**Request:**

(a) Please elaborate on the conventional construction technologies that will be utilized specifically for the Battery Energy Storage System Project.

(b) Please elaborate on the applicable construction and design practices that will be followed specifically for the Battery Energy Storage System Project.

**YUB-YEC-1-57**

**Reference:** **Application, Appendix B: Hatch Report, PDF page 75**
**Issue:** **Growing gap in the N-1 Reserve Capacity**
**Quote:** "Yukon Energy completed an integrated resource plan in 2016, which identified a growing gap in the N-1 Reserve Capacity. Currently, Yukon Energy rents diesel gensets each year to cover the capacity gap during the peak load during the winter period."

**Request:**

Please provide further details on the identified growing gap in the N-1 Reserve Capacity. For example, what is the cause of this growing gap? Assuming no Battery Energy Storage System Project was installed, would the number of diesel generating units required in the forthcoming years grow?

**YUB-YEC-1-58**

**Reference:** **Application, Appendix B: Hatch Report**
**Issue:** **Effect of the project on rates**

**Request:**

(a) Please provide a table showing the main revenue requirement categories used by YEC in their calculation of rates for the next and/or current applicable test period. As part of the response, please include a breakdown of items comprising the cost category to which the BESS project costs belong, including the avoided costs or savings resulting from the implementation of the BESS project. Please reconcile the figures provided in response to this IR with those in section 12, Preliminary Economic Assessment of the Hatch Report.

(b) Please provide an estimate of the impact of the BESS project costs and savings on an average customer's bill for all the customer classes affected by such costs and savings.

(c) Please indicate if and how the revised rates resulting from the implementation of the BESS project will affect any ongoing or future YEC applications for rate true-ups.

**YUB-YEC-1-59**
**Reference: Application, Appendix B: Hatch Report, Table 1-2, PDF page 70**
**Issue: Sites comparison**

**Request:**

(a) Please confirm that controls are required if noise exceeding 30dB in TKC Land-Whitehorse and 40dB in KDFN Land-Whitehorse occurs.

(b) If part (a) is confirmed, please indicate whether TKC Land-Whitehorse and KDFN Land-Whitehorse entail higher social risk, as that term is used on PDF pages 155 and 156, than KDFN Land-Takhini.

(c) How do other risks, if any, compare across the three alternative sites?

(d) How do the three alternative sites compare in terms of potential negative effects to the KDFN and TKC?

**YUB-YEC-1-60**
**Reference: Application, Appendix B: Hatch Report, Section 4,, PDF pages 81 to 92**
**Issue: Risks associated with the BESS project and its alternatives**

**Request:**

(a) Please provide a list to summarize all the risks associated with the BESS project, classifying them, if necessary, into risks associated with the site, installation and interconnection of the BESS system facilities and components, with the operation and functioning of the facilities and components, and with disposal at the end of the expected lifespan.

(b) Please identify the prevention and mitigation measures for the risks identified in response to (a).

(c) Please provide an estimate of the costs associated with the risks identified in response to (a) and (b).

(d) Please provide an analysis of how the costs identified in response to (c) compare between the BESS project and the most cost-efficient alternative.

(e) Please explain whether the costs identified in response to (c) are fully or partially covered, or not covered at all, by the insurance costs included as part of the analyses provided in the Hatch Report.

(f) Please list and explain any contractual terms, agreements, rules and regulations, and/or any other relevant provisions allowing for a transition that will ensure continuity of a safe and reliable solution to the need addressed by the BESS project once the expected lifespan of the asset is reached.

(g) Please comment on expected future conditions affecting the price of LNG compared to diesel and the extent to which this represents a risk to be included as part of this project assessment.

(h) Please explain if there are any risk factors that would result in savings lower than the difference between the net costs of the proposed BESS project and those of the most cost-effective alternative. If any such risks are identified, please provide an estimate for this type of risk. As part of the response, please consider any risks from potential project delays.

**YUB-YEC-1-61**
**Reference: Application, Appendix B: Hatch Report, PDF pages 87 and 137**
**Issue: Controls and dispatching algorithms**
**Quote:** Application, PDF 137:

"Currently, Yukon Energy operates with a blended manual and automated dispatch control system.

"For the BESS to be effectively respond to frequency excursions, generation loss, over loading, excess generation, and reactive power compensation, it is typical to have an automated control system for dispatch."

"The benefit to Yukon Energy of having an automated control scheme with a manual override is they can adjust their dispatch based on the daily conditions.

"**As Yukon Energy moves forward with the development of this project, the operating strategy for the BESS will need to be developed for both routine operation and extreme/rare scenarios."**

Application, PDF page 87:

"…the BESS will be required to dispatch either based on an automated algorithm or based on a manual or system operator input command from a remote site. This controls system will need to be purchased and modified or designed for the specific requirements of the host grid. As well, interface between the BESS controls provided by the OEM, the dispatch controller and the overall grid controller will need to be considered when selecting and programming the dispatching controller."

**Request:**

(a) Please explain how YEC plans to operate, control, and dispatch the BESS.

(b) Does YEC have an existing control system that will work with the BESS?

(c) Are any costs to acquire or modify an existing control system included in the preliminary engineering estimate? If confirmed, please identify those costs. If not, please explain what YEC forecasts those costs to be.

(d) Has YEC contemplated upgrading to a fully automated dispatch control system? Please explain whether it has contemplated any costs for these upgrades in its cost analysis.

**YUB-YEC-1-62**
**Reference:** **Application, Appendix B: Hatch Report, PDF page 94**
**Issue:** **Primary use case: N-1 capacity reserve**
**Quote:** "For the BESS to contribute to the capacity reserve, it needs to be able to reduce the peak demand during the day, and then be recharged overnight."

**Request:**
During an N-1 event, how likely is it that the BESS can reduce peak demand during the day and then can adequately recharge overnight? Please explain.

**YUB-YEC-1-63**
**Reference:** **Application, Appendix B: Hatch Report, PDF pages 96 and 99**
**Issue:** **Reactive power**
**Quote:** "Reactive power requirements must be considered and a blackstart procedure should be developed to determine the maximum value of the load segments that can be picked up."

**Request:**
The application does not mention any reactive power concerns. Is YEC expecting such concerns to arise in the future? Please explain.

**YUB-YEC-1-64**
**Reference:** **Application, Appendix B: Hatch Report, Tables 6-2 to 6-4, PDF pages 104 and 105-Issue: Estimated capital costs**

**Request:**
(a) Please provide the determination of the capital costs in Tables 6-2 and 6-3.
(b) How likely is it that YEC could procure a BESS at the sizes indicated in the tables at the estimated capital costs? Are those costs "all-in" FOB Whitehorse? Please explain.

**YUB-YEC-1-65**
**Reference:** **Application, Appendix B: Hatch Report, PDF pages 111 and 112**
**Issue:** **Operating reserve**
**Quote:** "The potential benefits will vary year to year depending on water availability. Benefits will be greater in years with higher water flow volumes and will be lower in years with lower water availability."

**Request:**
(a) In years with higher water flow volumes, is it more economical to use hydro for operating reserve even if it is less efficient for the turbines than the BESS? Please explain and demonstrate with a numerical example.
(b) Are BESS savings strictly based on the alternative use of thermal generation to provide operating reserve? Please explain.

**YUB-YEC-1-66**

**Reference:** **Application, Appendix B: Hatch Report, PDF page 133**
**Issue:** **Secondary use case ranking**
**Quote:** "Based on the analysis, using the BESS to provide supplementary operating reserve has the greatest benefit as a secondary use case. This usage allows for the offset of between 1.7-1.8 GWh of diesel generation on average, and 13-17 GWh of LNG."

**Request:**

(a) Please confirm that the numbers derived in the quote are based on LTA hydro generation.

(b) If part (a) is not confirmed, please provide the assumptions that support that derivation.

(c) If part (a) is confirmed, for the previous 35 years, please provide a breakdown of the number of years with above LTA water flows, the number of years with water flows equal to LTA and the number of years with water flows below LTA.

**YUB-YEC-1-67**

**Reference:** **Application, Appendix B: Hatch Report, PDF page 137**
**Issue:** **Control considerations**
**Quote:** "Yukon Energy may elect not to use the BESS for secondary applications (other than operating reserve), to keep it fully charged in case there is an N-1 event that cannot be covered without the BESS."

**Request:**

(a) Is YEC considering using the BESS for secondary applications other than operating reserve?

(b) If the answer to part (a) is confirmed, how will this use affect YEC's ability to respond during an N-1 event? Please explain.

**YUB-YEC-1-68**

**Reference:** **Application, Appendix B: Hatch Report, PDF page 141**
**Issue:** **Capacity overbuild**
**Quote:** "In the next phase of the project, it will be imperative to work with the vendors based on the estimated duty cycle and calendar aging to select the appropriate capacity overbuild."

**Request:**

Has YEC firmly established its required capacity overbuild? Please explain.

**YUB-YEC-1-69**

**Reference:** **Application, Appendix B: Hatch Report, PDF page 61**
**Issue:** **Noise Assessment Study**

**Preamble:** The Hatch Report references "Appendix C – Noise Assessment Study"

**Request:**

Please provide the noise assessment study as referenced as Appendix C to the report.

**YUB-YEC-1-70**

**Issue:** **Cost of energy used from the BESS**

**Preamble:** The Board would like to understand the full cost of energy used from the BESS.

**Request:**

Assuming the source of energy for the BESS is from hydro, please provide the full cost of a MWh of energy that the BESS provides to the system. The cost should include the full production costs from the hydro facility, the line losses to transmit the energy to the BESS, the losses and limitations due to the use of the BESS, the full costs of the BESS asset capital and O&M and the line losses for the energy transmitted from the BESS. Please state all your assumptions and separately show each of the incremental costs as outlined in this question. Provide the response in terms of $/MWh.

**YUB-YEC-1-71**

**Reference:** **Application, Appendix B: Hatch Report, PDF page 144**

**Issue:** **Geotechnical investigation**

**Quote:** **"Given the lack of geotechnical information in the proposed sites, except for Takhini substation, Hatch recommends carrying out a geotechnical investigation program to understand the soil conditions and better define civil and foundation work for the proposed development."**

**Request:**

Please provide an update on geotechnical investigation programs carried out by YEC. For example, what information has been obtained on the civil and foundational work for the BESS on its proposed locations?