

**Yukon Utilities Board  
(YUB)**

1 **TOPIC: Battery Energy Storage System Project (BESS)**

2

3 **REFERENCE: Application, Tab 1.0, PDF pages 5 and 29**

4

5 **QUOTE:** Application, PDF page 5:

6

7 “The Project has been designated by OIC 2020/180 as a “regulated  
8 project” under Part 3 of the Public Utilities Act.”

9

10 Application, PDF page 5:

11

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

18

19 Application, PDF page 29:

20

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

29

30 **QUESTION:**

31

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

34

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

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

3  
4 d) What is the cost of generation from the Whitehorse Rapids facility on a \$/MWh  
5 basis? Please provide this on a full cost basis, not just variable costs.

6  
7 e) Please explain how this project qualifies as an “energy project,” as defined in  
8 Section 36 of the Public Utilities Act. If the project does not qualify as an “energy  
9 project”, please explain whether the project qualifies as a “regulated project”, as  
10 defined in Section 36 of the Public Utilities Act.

11  
12 f) Please provide a summary of any legislative requirements, policy and/or  
13 development goals that require YEC to pursue new renewable energy  
14 developments, specifying any metrics to express such requirements or goals as  
15 quantifiable objectives.

16  
17 g) Please explain how the BESS project being proposed in this application addresses  
18 the requirements or goals in terms of the metrics identified in the response to (a).  
19 In the response, please include any externalities associated with the proposed  
20 project, such as but not limited to emissions from fossil fuels used to recharge the  
21 batteries, in order to understand the net impact of the project with respect to the  
22 identified requirements or goals.

23  
24 h) The application cites several uses of the BESS project other than the primary driver  
25 of meeting the N-1 capacity criteria. Please explain how these other uses will affect  
26 the life expectancy of the batteries. Do the potential other uses (operating reserve,  
27 peak shifting, etc.) conflict with the N-1 criteria? Please explain.

28  
29 **ANSWER:**

30  
31 **(a)**

32  
33 The BESS is an energy storage asset that supports generation supply to the YIS. It is  
34 neither a generation asset (i.e., it does not generate electricity) nor a transmission asset  
35 (i.e., it does not transmit electricity from one location to another location).

1 **(b)**

2

3 The BESS is linked into substation facilities associated with the Whitehorse Rapids facility.  
4 However, BESS is located outside this facility – and its operation may interact with  
5 generation from sources beyond the Whitehorse Rapids facility.

6

7 **(c)**

8

9 No. The BESS will be charged with energy available on the grid at the time. The source  
10 of this energy will change depending on the season and the system load. YEC intends  
11 that the BESS asset will be charged by surplus hydro whenever feasible due to the obvious  
12 cost advantage, however, there are circumstances where other sources of generation will  
13 serve this function. As documented in S.4.2.3 – Project Economics and summarized in  
14 response to YUB-YEC-1-70, the project is justified on several use scenarios:

15

16 1) N-1 Dependable Capacity Use – unlikely event (one in 10 years); recharge likely  
17 by diesel generation;

18

19 2) Operating Reserve Use – unplanned generation events (one 30 minute event per  
20 month); recharge by hydro generation; and

21

22 3) Peak shifting – recharge assumed by LNG (75%) and hydro (25%).

23

24 Although the Whitehorse Rapids hydro may be the prime renewable electricity source for  
25 charging the BESS, other YEC hydro generation as well as IPP renewable generation will  
26 be used when available and required. Thermal generation charging for the BESS is likely  
27 to be provided by the Whitehorse thermal facilities – but if required other thermal facilities  
28 will be utilized.

29

30 **(d)**

31

32 Hydro generation capital and operating costs from the Whitehorse Rapids facility (or any  
33 other YEC hydro source) are largely unaffected by any incremental generation provided  
34 for the BESS. A short-term incremental operating cost of 0.5 cents/kWh is estimated by  
35 YEC for such incremental hydro generation.

1 Almost all of the BESS's estimated cost savings for ratepayers, as reviewed in Table 4-3  
2 of the Application, involve minimal BESS energy charging and discharging over each year.  
3 Ratepayer costs from hydro generation use for BESS recharging are only impacted by net  
4 incremental or variable hydro costs. Please see response to YUB-YEC-1-70 for review of  
5 Table 4-3 information, as well as review of incremental hydro costs per kWh for charging  
6 of the BESS.

7

8 **(e)**

9

10 The BESS Project has been designated, in OIC 2020/180, as a Regulated Project under  
11 Part 3 of the *Public Utilities Act* (the PUA) pursuant to section 36 of this Act. The BESS  
12 Project has therefore been determined to be an "energy project" as defined in section 36  
13 of the PUA.

14

15 **(f) and (g)**

16

17 Ongoing policy developments at the territorial and Federal level are impacting or expected  
18 to impact the manner in which YEC generates electricity and evaluates potential  
19 resources.

20

21 In 2020, the Yukon government released its final "Our Clean Future: A Yukon strategy for  
22 climate change, energy and a green economy." Overall, the strategy focuses on the  
23 reduction of greenhouse gas emissions in the territory via implementation of a number of  
24 policy actions. This strategy outlines a number of targets expected to directly impact YEC  
25 and the Yukon electricity sector. These targets and policies affect YEC in two primary  
26 areas: reduction of greenhouse gas emissions (via increase in renewable electricity  
27 generation), and expected increase in electricity demand (via electrification initiatives to  
28 reduce emissions in other sectors).

29

30 Most critically, the "Our Clean Future" strategy mandates that an average of 93% of  
31 electricity generated on the grid must be produced from renewable sources, with an  
32 aspirational target of 97% of renewable electricity, based on a long-term average, by 2030.  
33 Several of the key policy changes or requirements from the "Our Clean Future" strategy  
34 expected to impact YEC are highlighted in the table below.

Element	Description
Action #E1	While aiming for an aspirational target of 97 per cent by 2030, develop legislation by 2023 that will require at least 93 per cent of the electricity generated on the Yukon Integrated System to come from renewable sources, calculated as a long-term rolling average.
Action #L1	Create a Clean Energy Act by 2023 that legislates our greenhouse gas reduction targets and our commitments to energy efficiency and demand-side management to hold the Government of Yukon accountable.
Action #E2	Require some of the diesel used to generate electricity on the Yukon Integrated System and in off-grid communities to be substituted with clean diesel alternatives like biodiesel and renewable diesel beginning in 2025, aiming for around 20 per cent.
Action #E9	Develop a framework by 2022 for First Nations to economically participate in renewable electricity projects developed by Yukon's public utilities.
Action #E7	Work with Yukon's public utilities to continue to implement the Independent Power Production Policy that enables independent power producers, including Yukon First Nations and communities, to generate and sell electricity to the grid.
Action #E8	Increase the limit of the Standing Offer Program under the Independent Power Production Policy from 20 gigawatt hours (GWh) to 40 GWh by 2021 to support additional community-based renewable energy projects on Yukon's main electrical grid.
Action #E10	Continue to deliver the Micro-generation Program in collaboration with Yukon's public utilities, targeting 7 megawatts (MW) of installed renewable electricity capacity by 2030.
Action #T1	Work with local vehicle dealerships and manufacturers to establish a system by 2024 to ensure zero emission vehicles are 10 per cent of light duty vehicle sales by 2025 and 30 per cent by 2030.
Target (page 35)	Our target for 2030 is to have at least 4,800 zero emission vehicles registered in the territory.
Target (page 44)	Our targets are to replace 1,300 residential fossil fuel heating systems with smart electric heating systems.

1

2 At the Federal level, in 2020 the Government of Canada tabled Bill C-12, the Canadian  
3 Net-Zero Emissions Accountability Act. This act sets a target for Canada to emit net-zero  
4 carbon by 2050.

5

6 In December 2020, the Federal Government released an update to its federal carbon  
7 price, with continued increases in the carbon pricing, reaching \$170 per tonne in 2030. In

1 2022, the Government of Canada will begin enforcing its Clean Fuel Standard, which  
2 establishes fossil fuel suppliers to reduce the carbon intensity of their liquid fossil fuels  
3 used in Canada. This standard will be applied via establishment of a credit market, where  
4 entities must create or buy credits to come into compliance with the performance standard.  
5 This policy is expected to increase the costs for fossil fuels used to power thermal  
6 generation.

7  
8 Policies expected to increase electricity demand are also emerging at the Federal level.  
9 For example, the Government of Canada has set a target of zero emission vehicles  
10 reaching 10% of light-duty vehicles sales by 2025, 30% by 2030 and 100% by 2040.

11  
12 These territorial and federal policy initiatives clearly indicate it can be expected that as  
13 time passes, technologies which emit greenhouse gas emissions will be subject to  
14 additional restrictions, risks, and costs, such as those for carbon offset credits, carbon  
15 taxation, or other fuel surcharges. While YEC expects to continue to require thermal  
16 generation to reliably operate the grid for the foreseeable future, the BESS project  
17 presents a unique opportunity to diversify the utility's provision of N-1 dependable  
18 capacity. This diversification reduces YEC's exposure to the impact these policy changes  
19 could have, while providing a net ratepayer benefit compared to diesel rentals. In addition,  
20 they indicate that the demand for electricity will continue to increase as a result of  
21 electrification policy initiatives targeting multi-sector greenhouse gas emissions  
22 reductions. As YEC has forecast, this will result in a growing need for N-1 dependable  
23 capacity.

24  
25 The BESS Project supports renewable generation by providing added opportunities for  
26 renewable generation to displace thermal generation on the grid. These opportunities are  
27 linked mainly to secondary uses of the BESS, e.g., operating reserve or diesel peak  
28 shifting uses where thermal generation is displaced, and "grid reliability and secondary  
29 services" uses that facilitate integration of intermittent renewable generation on the grid.  
30 The Application provides estimates of expected net thermal generation reduction  
31 associated with the BESS Project, e.g., Table 3-3 shows Hatch estimates of average  
32 thermal generation that could be avoided by BESS use as an operating reserve. Overall,  
33 the BESS project supports the requirement for provision of more N-1 dependable capacity,  
34 while reducing greenhouse gas emissions and avoiding thermal generation.

35  
36 Anecdotally, given the focus of both Yukon government and the Government of Canada  
37 on addressing climate change and eliminating greenhouse gases where possible, YEC

1 expects the policy pressures facing thermal generation assets to increase, and the  
2 benefits of emission-reducing project such as the BESS to continue to add increasing  
3 value. As discussed further in YUB-YEC-1-32, the 10-Year Renewable Electricity Plan  
4 sets out a portfolio which does not eliminate YEC's requirement for thermal generation,  
5 but reduces its reliance on thermal generation under normal operating conditions. The  
6 portfolio in the 10-Year Plan includes both the BESS project as well as 12.5 MW of  
7 permanent replacement diesel.

8  
9 **(h)**

10  
11 The annual cycling (i.e., the number of charge-discharge cycles per year) expected for the  
12 BESS is relatively low; therefore, the primary driver for degradation is calendar aging. The  
13 secondary use cases as described do not accelerate the BESS aging, and are included in  
14 the throughput calculation used to determine the project life.

15  
16 The secondary use cases do not conflict with the BESS primary use case. The BESS is  
17 not intended to provide secondary use cases during an N-1 event (which is defined as 2  
18 weeks in length). The BESS will be used to supply the peak load over the next 2 weeks  
19 after an N-1 event until the Aishihik generation or transmission can be restored. If the  
20 BESS is partially charged at the time of initial event, it will be used as best possible to  
21 reduce outages, and will be recharged overnight and used beginning the next day to cover  
22 the peak.

23  
24 Please see also Chapter 7 of the Hatch Feasibility Study Report (Appendix B of the  
25 Application).

1 **TOPIC: Project Alternatives**

2

3 **REFERENCE: Application, Tab 1.0, PDF page 5**

4

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

13

14 **QUESTION:**

15

16 a) Please provide the meaning of “enhanced blackstart capability”.

17

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

19

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

22

23 **ANSWER:**

24

25 **(a)**

26

27 This means that the performance of the BESS in a blackstart scenario is superior to either  
28 diesel or hydro generators as the technology has a much shorter reaction time and the  
29 ability to self-energize. Please see also page 13 of the Application which provides further  
30 detail on the blackstart benefits of the BESS.

31

32 **(b)**

33

34 No. All YEC diesel units have the ability to blackstart. The LNG units are not typically used  
35 for blackstart as described in YUB-YEC-1-41(c). The blackstart performance  
36 characteristics of each generation resource varies.

1 (c)

2

3 YEC maintains operating reserve by running thermal and hydro units at a lower than  
4 maximum capacity, to allow operators to "ramp up" the units when required to respond to  
5 changes to load or system events. Please see response to YUB-YEC-1-36 for more detail  
6 on YEC's operating reserve.

1 **TOPIC: Transmission Requirements for the Battery Energy Storage**  
2 **System Project**

3  
4 **REFERENCE: Application, Tab 3.1, PDF page 9; Application, Tab 3.3, PDF page**  
5 **26; 2021 General Rate Application, Appendix 5.1-2, page 5.1-7**

6  
7 **QUOTE:** “The BESS will be connected to the Yukon Energy Whitehorse Rapids  
8 facility by a new 1.7 km 34.5 kV transmission line that goes north of the  
9 KDFN site, following existing easements through forested crown land  
10 until it meets and follows the path of the existing ATCO Electric Yukon  
11 (AEY) 34.5 kV line to the Whitehorse Rapids facility (see Appendix A,  
12 Figure A-1 for a map of the BESS site, the Project transmission line  
13 connection to the Whitehorse Rapids facility, and the connection  
14 therein to the Riverside Substation).”

15  
16 “Final design will assess the final routing on crown land and the most  
17 cost-effective strategy for this connection related to the AEY line, e.g.,  
18 either build double circuit poles with the existing AEY line or build  
19 another set of poles with a single circuit (if there is enough area in the  
20 easement). The Project transmission connection design will be part of  
21 Yukon Energy’s Whitehorse Interconnection Project to adjust  
22 interconnection of YEC’s existing and incoming generation assets at  
23 Whitehorse, with added transmission extension connection to the  
24 Riverside Substation.”

25  
26 Application, PDF page 26:

27  
28 “The Whitehorse Interconnection Project will require design and  
29 engineering to change the interconnection configuration for generation  
30 assets at Whitehorse to avoid creation of a new N-1 contingency at the  
31 S-150 substation. This will likely include routing several connections to  
32 the Riverside substation. Completion of this project will facilitate the  
33 connection of the BESS and the other identified generation projects to  
34 the Whitehorse Rapids facility.”

1                   2021 General Rate Application, page 5.1-7:  
2

3                   “The 10-Year Renewable Electricity Plan outlines a number of potential  
4                   new projects being planned over the next decade ... Design and  
5                   engineering is required to change the interconnection of YEC’s existing  
6                   and incoming generation assets at Whitehorse, since the diesel  
7                   replacement and new battery projects will be adding dependable  
8                   capacity to the system. An alternative interconnection scheme must be  
9                   developed and constructed to enable interconnection of these new  
10                  capacity projects and to avoid creation of a new N-1 contingency. The  
11                  first stage of the project is to examine the transmission requirements of  
12                  all new projects collectively to examine the options for interconnection  
13                  and determine the most cost-effective solution for connecting to the  
14                  grid. Engineering of an alternative connection will facilitate the BESS  
15                  project in 2022.”  
16

17                  **QUESTION:**  
18

- 19                  a) Please provide further details on the transmission line alternatives being  
20                  considered to connect the BESS. For example, is YEC considering single pole or  
21                  double pole circuits? Has YEC started developing the exact routing of these  
22                  transmission line alternatives?  
23
- 24                  b) Please provide details of studies assessing the viability of the transmission line  
25                  alternatives being considered to connect the BESS (e.g., connection study  
26                  assessing the impact of a transmission line alternative on YEC's electricity system;  
27                  routing studies for optimally connecting the project).  
28
- 29                  c) Please provide an update on the Whitehorse Interconnection Project. For example,  
30                  what design and engineering has been conducted by YEC to date? If any  
31                  connection studies have been conducted, please provide those studies outlining  
32                  the alternatives being explored.  
33
- 34                  d) Please explain the system impacts of not going ahead with the Whitehorse  
35                  Interconnection Project. For example, what system concerns would surface if the  
36                  Battery Energy Storage System Project connected to the existing system in  
37                  Whitehorse?

1 e) Please explain any amendments to the Whitehorse Interconnection Project if the  
2 Battery Energy Storage System Project was not constructed and YEC continued  
3 to rely on thermal and diesel generation. Would there be a reduction in the system  
4 infrastructure required and a reduction in the costs of the Whitehorse  
5 Interconnection Project?  
6

7 **ANSWER:**

8  
9 **(a) and (b)**

10  
11 Appendix A, Figure A-1 of the Application provides a map of the BESS site, the BESS  
12 Project 34.5 kV transmission line connection from the BESS site to the Whitehorse Rapids  
13 facility, and the proposed Whitehorse Interconnection Project connection from the  
14 Whitehorse Rapids facility to the Riverside Substation (S171).  
15

16 YEC is currently looking at utilizing ATCO's existing right-of-way (ROW) to the extent  
17 possible for the transmission line connection from the BESS site to the Whitehorse Rapids  
18 facility. Various alternatives for routing and design will be assessed and finalized as the  
19 project engineering advances.  
20

21 **(c)**

22  
23 The Whitehorse Interconnection Project is in the preliminary stages. An Owner's Engineer  
24 and Project Manager RFP has been released. No detailed engineering or design work has  
25 been completed. Various alternatives for the transmission route are under consideration.  
26 Upon the selection of the Owner's Engineer a route will be finalized and DBM will be  
27 developed for the transmission line and substation modifications  
28

29 **(d)**

30  
31 If the Whitehorse Interconnection Project was not pursued, the recent and planned  
32 projects in the Whitehorse area would trigger an increase in the N-1 planning criterion  
33 from the current 37 MW. A new N-1 contingency would be created as these planned  
34 projects increase the total dependable capacity connected to the grid in Whitehorse (e.g.,  
35 the single largest contingency on the grid would change from Aishihik to the S150  
36 substation). This would result in a requirement for YEC to add additional dependable

1 capacity to the grid beyond that which is already forecast to be required and would trigger  
2 the need for additional investments in new resources.

3

4 **(e)**

5

6 The Whitehorse Interconnection Project entails undertaking system upgrades which are  
7 required regardless of whether the BESS project is constructed given the number of  
8 projects planned in the Whitehorse area (including the WH2 uprating, WH4 uprating,  
9 replacement of retired diesel, and the temporary rental diesel units).

1 **TOPIC: Diesel Displacement**

2

3 **REFERENCE: Application, Tab 3.1, PDF page 7**

4

5 **QUOTE:** "The BESS will also provide other benefits, including: operating reserve  
6 that reduces thermal generation requirements; enhanced blackstart  
7 capability; opportunities for diesel-peak shifting; and other system  
8 benefits."  
9

10 **QUESTION:**

11

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

14

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

16

17 **ANSWER:**

18

19 **(a)**

20

21 No. Depending on the load and generation availability, the BESS will sometimes be  
22 charged with LNG, particularly to enable diesel peak-shifting (for this use case, the Hatch  
23 analysis estimated that 75% of the BESS charging would come from LNG and 25% from  
24 hydro). It is not expected that the BESS will be charged with diesel, except during an N-1  
25 event when the grid will be generation constrained.

26

27 **(b)**

28

29 Other system benefits include grid reliability and ancillary services, load loss stabilization,  
30 and reactive power support. Please see Section 3.1.2.2 of the Application which provides  
31 further detail on these benefits.

1 **TOPIC: Baseload Thermal Generation**

2

3 **REFERENCE: Application, Tab 4.1.1, PDF page 28, footnote 32**

4

5 **QUOTE:** “Seasonal water storage is typically needed for hydro facilities to be  
6 fully utilized in winter. In Yukon, controlled seasonal storage exists at  
7 Aishihik and to a much lesser extent at Mayo, but is largely unavailable  
8 at Whitehorse. As a result, there is an increasing need to rely on  
9 thermal generation to meet baseload energy loads in winter and early  
10 spring when grid loads are highest and hydro water flows are  
11 constrained.”

12

13 **QUESTION:**

14

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

17

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

20

21 **ANSWER:**

22

23 **(a)**

24

25 Yes, the BESS could potentially be charged with thermal generation at certain times,  
26 depending on the system load.

27

28 **(b)**

29

30 The BESS will be used all year for different purposes, but the winter and early spring in  
31 particular will have the potential for a large benefit from thermal peak shaving given the  
32 constraints of water availability.

1 **TOPIC: Capital Costs**

2

3 **REFERENCE: Application, Tab 3.1, PDF page 7**

4

5 **QUOTE:** "The preliminary capital cost estimate (2020\$, +/- 30% accuracy) is  
6 \$31.7 million..."

7

8 **QUESTION:**

9

10 a) Does YEC consider the project viable if the capital cost comes in at \$41.2 million  
11 (+ 30%)? Please explain and demonstrate.

12

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

15

16 c) What would be the cost impacts if there is a delay in the project in either 2021 or  
17 2022?

18

19 **ANSWER:**

20

21 **(a) and (b)**

22

23 The BESS Project continues to yield NPV savings for ratepayers over the life, as assessed  
24 in Table 4-3 of the Application, if the capital costs increase by 30% to \$41.2 million before  
25 contributions as reviewed in response to JM-YEC-1-33 (d).

26

27 Ratepayer NPV savings as assessed in Table 4-3 will drop to zero if capital costs increase  
28 to approximately \$44 million (37% increase over the estimate included in the Application)  
29 before contributions.

30

31 Please also see response to YUB-YEC-1-55 (b-c), (d) and (f), and JM-YEC-1-33 (b), (c)  
32 and (d).

33

34 **(c)**

35

36 YEC does not have an assessment of the cost impact if there is a delay in the project in  
37 either 2021 or 2022, beyond noting the deferral in securing ratepayer net cost savings.

- 1 Should the in-service date be delayed beyond fall 2022, costs of securing and operating
- 2 additional temporary diesel rental units would be incurred for the winter of 2022/23.

1 **TOPIC: Debenture Investment Opportunity**

2

3 **REFERENCE: Application, Tab 3.1, PDF page 7**

4

5 **QUOTE:** “The Project Committee met regularly thereafter in 2020 with a  
6 particular focus on the work required to recommend a preferred site  
7 and to review a draft Term Sheet that evolved to include a debenture  
8 investment opportunity for both TKC and KDFN based on 25% of the  
9 equity portion of YEC’s net rate base cost of the BESS project.”

10

11 **QUESTION:**

12

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

15

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

18

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

21

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

25

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

29

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

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

4  
5 h) YEC states that "Yukon Energy will execute the necessary transactions with Yukon  
6 Development Corporation (dividend or equity injection) to maintain this ratio on an  
7 annual basis." Please explain what is meant by this statement and fully describe  
8 the necessary transactions to give effect to the dividend or equity injection on an  
9 annual basis.

10  
11 **ANSWER:**

12  
13 **(a)**

14  
15 The debenture will be based on final capital costs net of grants and any costs disallowed  
16 by the YUB for recovery through rates.

17  
18 **(b)**

19  
20 The timing for the capital investment with respect to the debenture has not yet been  
21 determined by the parties. It is expected that a reasonable time period would be required  
22 after the project enters service and YEC determines the final net capital cost amount.

23  
24 **(c)**

25  
26 The debenture investment key terms as included in the Term Sheet are provided at pages  
27 18-19 of the Application, and are copied below:

28  
29 1. KDFN and TKC will each be offered the opportunity to provide a loan to YEC in  
30 accordance with the following principles:

31  
32 a. YEC's Net Rate Base Cost for the Project is YEC's final capital cost for  
33 developing the Project less any funding contributions to YEC for the Project  
34 and any costs disallowed by the YUB from inclusion in rates.

- 1                   b. The BESS Equity Cost is 40% of the Net Rate Base Cost, and reflects the  
2                   portion of the Net Rate Base Cost that is financed by YEC equity.  
3
- 4                   c. KDFN and TKC will each be offered the opportunity to provide a Loan  
5                   Investment of up to 25% of the BESS Equity Cost. The following example  
6                   outlines the process, assuming a final BESS net rate base cost of \$15.2  
7                   million after grants:
- 8
- 9                   i. Assuming YUB approval of these costs, YEC's Net Rate Base Cost  
10                  would be \$15.2 million and this would be funded by 40% equity [the  
11                  BESS Equity] of \$6.1 million and by 60% long-term debt of \$9.1  
12                  million.
- 13
- 14                  ii. KDFN and TKC would each have the opportunity to provide a Loan  
15                  Investment of up to \$1.52 million, i.e., each up to 25% of the \$6.1  
16                  million BESS Equity Cost.
- 17
- 18                  2. The Loan Investment opportunity will be available for a specified period after the  
19                  Project is in service and YEC's final net rate base (after contributions and YUB  
20                  review) is determined by YEC and communicated to KDFN and TKC.
- 21
- 22                  3. The term for each Loan Investment will be based on the remaining portion of the  
23                  expected asset life.
- 24
- 25                  4. YEC will provide the following annual payments to KDFN and TKC with regard to  
26                  each of KDFN and TKC's Loan Investment:
- 27
- 28                  a. Repayment of principal at equal annual amounts over the Term; and  
29
- 30                  b. An annual return on the Loan Investment balance then applicable times  
31                  YEC's actual final rate of return on equity (actual percentage return for a  
32                  completed fiscal year) for YEC's utility regulatory income for the completed  
33                  fiscal year most recently filed with the YUB (YEC's last approved equity  
34                  return included in rates is 8.70%).

1 **(d) (e) (f)**

2  
3 The current debenture investment under review by the Board is a loan arrangement with  
4 no equity interest in any portion of the rate base costs. More specifically, the financing as  
5 described for the debenture investment being reviewed by the Board does not offer any  
6 rights of ownership to the First Nations. KDFN and TKC do not have any legal ownership  
7 of the facility, nor do they have any ability or authority to direct the operations of the utility.

8  
9 The agreement will include the ability to explore an option for the First Nations to acquire  
10 full ownership of the battery after five years, subject to YG approval. Any such negotiation  
11 and/or change in ownership would be subject to a separate regulatory process and is not  
12 contemplated as part of the Application. This option has not been evaluated for any  
13 impacts with respect to the *Public Utilities Act*.

14  
15 **(g)**

16  
17 While this instrument is legally a debt, YEC proposes to treat this financing as equity for  
18 rate-making purposes (i.e., as part of the 40% equity share in the capital structure used to  
19 determine return on rate base) with the interest rate paid equal to YEC actual ROE in any  
20 year.

21  
22 Given the equity return payable for the debenture will not change the 40% equity share in  
23 the capital structure, it will provide the same overall return as it would provide currently for  
24 YDC and there is no impact to ratepayers.

25  
26 Additionally, the following information is provided at page 19 of the Application:

27  
28 In accordance with current accounting regulations, the Project First Nation  
29 debentures would be treated as long term debt given the nature of the financial  
30 instrument. However, the equity return paid on this instrument is well above the  
31 market rate for long term debt that Yukon Energy would expect to pay. Therefore,  
32 for the purposes of rate-making (i.e., revenue requirement determination by the  
33 YUB), Yukon Energy proposes to treat this investment as equity for the purpose of  
34 maintaining the 60:40 debt to equity capital structure for Yukon Energy as  
35 approved by the YUB. To the extent that the outstanding balance of the First Nation  
36 investment affects this ratio, Yukon Energy will execute the necessary transactions  
37 with Yukon Development Corporation (dividend or equity injection) to maintain this

1 ratio on an annual basis. As well, any rate applications to the YUB will show this  
2 debenture as a component of equity for revenue requirement determination; in this  
3 way, there is no net impact to ratepayers from this transaction.

4

5 In summary, the debenture investment as proposed will have no net impact to ratepayers.  
6 The net investment will be included, for rate making purposes, within YEC's 40% equity  
7 share of rate base financing – and any payments of interest on the debentures will be  
8 based on YEC actual net earnings. The debenture investment will not be included, for rate  
9 making purposes, in YEC's 60% long term debt share of rate base financing.

10

11 **(h)**

12

13 YEC trues up capital and long term debt each year to comply with the YUB-approved  
14 capital structure of 60:40 debt to equity. Assuming this financing proposal is accepted, in  
15 the year the transaction closed, after assessing total rate base and net income, YEC would  
16 adjust YDC equity as necessary to ensure the corporation remains at the 40% equity level  
17 (with the debenture included as part of the equity level). The exact disposition or source  
18 of the equity is not known at this time as that decision would be made by the shareholder  
19 at the time of the adjustment. The annual process that YEC conducts to achieve this is  
20 described below.

21

22 On an annual basis YEC makes the necessary transactions with Yukon Development  
23 Corporation (YDC) to maintain the 60% debt and 40% equity financing for net rate base.

24

25 • When the equity ratio is lower than 40%, then YEC transfers a portion of the YDC  
26 long-term debt to equity [equity injection] as required to provide the 60% long term  
27 debt and 40% equity financing.

28

29 • When the equity ratio is higher than 40%, a dividend amount is calculated as  
30 required and this calculated dividend amount loaned back by YDC to YEC as long-  
31 term debt to provide the 60% long term debt and 40% equity financing.

32

33 This is demonstrated in Schedules 7 and 11 in Tab 7 of the 2021 GRA. For example,  
34 Schedule 7 for 2019 shows required dividend at amount of \$2.871 million [line 5] to  
35 maintain 60/40 debt to equity ratio, this amount then borrowed back as long-term debt in  
36 Schedule 11 [line 11].

37

- 1 The referenced statement indicates that this annual practice would assume that the First
- 2 Nation debenture investment balance is treated as part of YEC equity for the purpose of
- 3 these annual adjustments.

1 **TOPIC: Site Size**

2

3 **REFERENCE: Application, Tab 3.1.1, PDF page 8**

4

5 **QUOTE:** "The site for the BESS will be on a 1.5 ha site that Yukon Energy will  
6 lease..."

7

8 "Total area required for the system is likely to be accommodated within  
9 0.35 ha, i.e. a small portion of the leased site."

10

11 **QUESTION:**

12

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

15

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

18

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

21

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

24

25 **ANSWER:**

26

27 **(a) and (b)**

28

29 The 0.35 ha represents only the required area for the containers and inverter equipment.  
30 Additional space is required to enable road access and to appropriately space the  
31 containers for safety purposes as described in YUB-YEC-1-46.

32

33 YEC also required clearance around the site to ensure appropriate spacing between the  
34 equipment and any future potential development (e.g., should an adjacent parcel become  
35 occupied and a building erected on the land). The additional space is also required to  
36 enable clearing to provide adequate clearance between the BESS and the forested area,  
37 to prevent fire spread in the event of a wildfire. YEC based its determination of the

1 requirement for 1.5 ha on these requirements in collaboration with input from its third-party  
2 BESS expert.

3

4 **(c) and (d)**

5

6 The following criteria and metrics were the primary drivers of the selection of the KDFN  
7 Whitehorse site:

8

9 • **Minimizing Costs to Ratepayers:** While the capital and operating costs for the  
10 TKC and KDFN Whitehorse sites were relatively equivalent, the terms of the  
11 commercial lease offers received from the First Nation partners resulted in a net  
12 present value of 45% savings in lease costs of the KDFN Whitehorse site  
13 compared to the TKC Whitehorse site.

14

15 • **Providing Certainty to Execution:** The offer for the KDFN site included specific  
16 details on the path to project development, by an experienced proponent who has  
17 executed similar land deals in the past. There was no uncertainty regarding the  
18 ability to appropriately zone the property, which was a risk for the TKC site as  
19 described in YUB-YEC-1-59 part (c).

20

21 • **First Nations Benefits Optimization:** The terms of the lease offer from KDFN  
22 included a provision to share the benefits of the lease with TKC. The sharing of the  
23 lease benefits enables an optimized benefits package for both First Nations whose  
24 Traditional Territories the project is located on. This enables negotiation of  
25 balanced benefits in the Project Agreements.

26

27 • **Maximizing Technical Benefits:** Neither site had any restrictions in its ability for  
28 the BESS project to provide the technical and grid services.

1 **TOPIC: Other Costs**

2

3 **REFERENCE: Application, Tab 3.1.1, PDF page 9**

4

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

14

15 **QUESTION:**

16

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

22

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

25

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

29

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

1 **ANSWER:**

2

3 **(a)**

4

5 Two feasible routes for the project were initially identified: one which follows existing rights  
6 of way and would twin with the existing ATCO line; or a new route which would follow  
7 Robert Service Way to the Whitehorse Rapids Generating Station. The route selection  
8 prioritized utilizing existing rights of way, minimizing disturbance and visual impact. These  
9 elements are expected to minimize permitting requirements and costs for the route.

10

11 **(b)**

12

13 The costs to connect the BESS project to the Whitehorse Rapids Facility (e.g., the  
14 transmission line from the BESS project to the facility fenceline) are included in the  
15 preliminary engineering estimate. Please see Table 3-4 (page 16) of the Part 3 Application  
16 (\$595,000 for grid connection).

17

18 **(c)**

19

20 The capital costs are currently being estimated and are not yet available. The Whitehorse  
21 Interconnection Project is expected to be in service in Q4 2022.

22

23 **(d)**

24

25 Please see response to YUB-YEC 1-3(e).

1 **TOPIC: Thermal Management**

2

3 **REFERENCE: Application, Tab 3.1.1, PDF page 9**

4

5 **QUOTE:** "Thermal management and heating of the system will be critical for  
6 Yukon Energy when selecting the BESS vendor."  
7

8

9 **QUESTION:**

10

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

11

12 b) Will this required aspect of the project, thermal management and heating, be  
13 outsourced on an ongoing basis or will it be part of the containerized system?  
14

15

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

19

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

23

24 **ANSWER:**

25

26 **(a)**

27

28 Thermal management and heating of the system refers to the requirement to maintain the  
29 temperature within the container housing the battery cells within a certain range.

30

31 **(b)**

32

33 Thermal management and heating will be provided by an HVAC system that is built into  
each container.

1 (c)

2

3 The use of energy to run the HVAC system has been accounted for in the overall energy  
4 balance of the system and the O&M cost estimates.

5

6 (d)

7

8 The BESS will have a modest electric consumption during idling periods to cover  
9 auxiliaries and heating in the winter. It is anticipated that this electric consumption would  
10 be 2-4% of the total annual energy throughput. However, the consumption will depend on  
11 the selected vendor's system configuration. Heating load will also vary year to year  
12 depending on the ambient conditions.

13

14 The auxiliary consumption is primarily accounted for in the BESS efficiency (assuming  
15 15% more energy needed to charge than is discharged to account for electric, transformer,  
16 inverter, battery, and auxiliary losses).

17

18 During the procurement process, an element of vendor evaluation will be consideration of  
19 lower auxiliary consumption. Further evaluation will be completed once the preferred  
20 vendor and configuration are selected, and detailed information is available on the heating  
21 system and auxiliary consumption.

1 **TOPIC: BESS Life**

2

3 **REFERENCE: Application, Tab 3.1.1, PDF page 9**

4

5 **QUOTE:** "A lifetime of 20 years therefore is reasonable with a modest overbuild  
6 or capacity augmentation at year ten."

7

8 **QUESTION:**

9

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

12

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

15

16 **ANSWER:**

17

18 **(a)**

19

20 A modest overbuild would take place at the beginning of the project, by constructing more  
21 energy storage capacity than the end-of-life 40 MWh. The estimated project capacity cost  
22 provided assumes that 20% additional installed capacity is initially installed to preserve  
23 end-of-life storage capacity. The details of the specific selected battery technology and  
24 vendor offering (which have not yet been determined through the procurement process)  
25 will define the final size of overbuild required.

26

27 Alternatively, capacity augmentation would require adding new batteries in year 10 of the  
28 project to offset degradation and ensure the 40 MWh of energy storage capacity was  
29 provided for the entire 20 year project lifespan.

30

31 The method to be used by YEC to ensure end-of-life energy storage capacity will be  
32 defined once further details from the vendors is provided in the procurement process,  
33 including costs and advantages or disadvantages of each approach.

1 **(b)**

2

3 The estimated cost for the 20% overbuild is the cost of an additional 8 MWh of energy  
4 storage capacity. This is estimated to cost \$3.7 million. This cost is included in the capital  
5 project cost provided in the Application.

1 **TOPIC: End of Life**

2

3 **REFERENCE: Application, Tab 3.1.1, PDF page 9**

4

5 **QUOTE:** "At the end of life, many battery vendors will take back the battery  
6 modules – which ensures that the batteries are treated properly and  
7 places responsibility of disposal on the supplier."  
8

8

9 **QUESTION:**

10

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

13

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

16

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

18

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

21

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

24

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

27

28 **ANSWER:**

29

30 **(a) to (c)**

31

32 The appropriate replacement capacity at the project end-of-life will be determined through  
33 YEC's long-term planning process in the future, as would be the case with generation  
34 projects nearing retirement. The next long-term resource plan with a planning horizon  
35 beyond the life of the BESS will identify options for replacing the capacity provided by the  
36 project, including replacement with additional batteries, consideration of other  
37 technologies and future price changes, or extension of the project life.

1 A determination of the best course of action will be made when the batteries come to end-  
2 of-life based on the current technology and grid requirements at that time. The cost will  
3 also be determined at that time, as there is uncertainty with regard to the price of  
4 technology options 20 years in the future.

5  
6 YEC is currently in the first phase of its procurement process to select a battery vendor.  
7 In the first phase, vendors have been given the option to share their solution for end-of-  
8 life replacement and its estimated cost to help allow YEC to understand what the market  
9 is currently expecting to be able to provide in the future. In general, given the policy  
10 initiatives and forecast of increased penetration of electric vehicles in Yukon, Canada, and  
11 the world in the future, it is anticipated that disposal and recycling solutions for lithium-ion  
12 batteries will be widespread in 20 years.

13  
14 **(d)**

15  
16 As described further in the response to YUB-YEC-1-13, the first phase (qualification) of  
17 YEC's two-phase procurement process to select a battery vendor has been initiated. In  
18 this qualifying phase, potential vendors have been asked to outline the recycling and  
19 disposal options expected to be available for their equipment at end-of-life. The responses  
20 regarding disposal in this first phase will inform YEC's understanding of the current  
21 market's offerings, and enable the Company to determine what to specify in this regard  
22 for the disposal requirements for the second phase of procurement (the Request for  
23 Proposals).

24  
25 **(e)**

26  
27 The vendor selection criteria for the second phase of procurement has not yet been  
28 determined.

29  
30 **(f)**

31  
32 The cost to YEC to ensure proper end-of-life treatment is not known at this time and was  
33 not included in the project cost. Typically, retirement costs are not included in the capital  
34 or operating costs associated with a project justification.

1 **TOPIC: Competitive Procurement Process and the Different Battery**  
2 **Chemistries**

3  
4 **REFERENCE: Application, Tab 3.1.1, PDF page 9; Application, Tab 4.2.2, PDF**  
5 **page 37; Application, Appendix B: Hatch Report, PDF page 73;**  
6 **Application, Appendix B: Hatch Report, PDF page 83**

7  
8 **QUOTE:** Application, PDF page 9:  
9  
10 "... A competitive procurement process has been initiated to select  
11 battery vendors qualified to design a battery able to meet Yukon  
12 Energy's operational requirements and Yukon's northern climate..."

13  
14 Application, PDF page 37:  
15  
16 "There are three common utility scale lithium ion battery technologies:  
17 nickel manganese cobalt lithium (NMC), nickel cobalt aluminum lithium  
18 (NCA), and lithium iron phosphate (LFP). Yukon Energy will consider  
19 vendor proposals for all three technologies in order to ensure a  
20 competitive process with sufficient bidders and the ability to select the  
21 specific solution based on both technical compliance and price."  
22 (footnote removed)

23  
24 Application, PDF page 73:  
25  
26 "... (LFP) battery cell chemistry is preferred since it is inherently safer  
27 and has a lower capital cost. However, Yukon Energy should not limit  
28 vendors to only LFP suppliers in the RFP to get a full range of bids and  
29 confirm this assessment."

30  
31 Application, PDF page 83:  
32  
33 "The most common chemistry is a [NMC] battery. This chemistry  
34 typically has the lowest capital cost. It is better suited for higher energy  
35 applications and has a limited power response.

1                    “[NCA] batteries are also common for grid scale applications. These  
2                    batteries provide higher power performance, making them better suited  
3                    for applications with rapid response requirements. However, these  
4                    batteries typically have higher costs compared to other options.  
5

6                    “[LFP] batteries are used in grid scale applications. These batteries  
7                    offer a blend of moderate power and energy capacity making them ideal  
8                    for versatile applications. LFP batteries are also generally regarded as  
9                    the safest technology and are therefore, typically used in indoor  
10                    applications. LFP batteries are gaining increased popularity, with many  
11                    vendors exploring this technology.”  
12

13 **QUESTION:**  
14

- 15                    a) Please describe the competitive procurement process that has been initiated to  
16                    select battery vendors qualified to design a battery that is able to meet YEC’s  
17                    operational requirements and the requirements of Yukon’s northern climate.  
18
- 19                    b) Please provide the status of the procurement process. For example, which specific  
20                    vendors have been considered and what learnings are there regarding the  
21                    procurement for this project? Please comment on any impacts to the timing or  
22                    costs for the project.  
23
- 24                    c) For the vendors discussed in part (b), please indicate which technology the vendor  
25                    is proposing (NMC, NCA or LFP) and provide any summaries from vendors on how  
26                    they will technically comply with YEC’s requirements for this project. For example,  
27                    what are the performance capabilities offered to comply with YEC’s system needs?  
28
- 29                    d) Please confirm that the preferred battery chemistry for the Battery Energy Storage  
30                    System Project is LFP and describe its advantages over the other two battery  
31                    chemistries. If a determination has not been made, please explain the benefits and  
32                    limitations of each of the battery chemistries for YEC’s system. (For example,  
33                    suppose the NMC battery chemistry was utilized. What advantage would this  
34                    technology bring to Yukon’s system in the near term and long term? What are the  
35                    safety risks with using this battery chemistry?)

1 **ANSWER:**

2

3 **(a) to (c)**

4

5 YEC is conducting a two-stage procurement process to select its battery vendor. The first  
6 stage, a Request for Qualifications (RFQF), will allow YEC to evaluate vendors from the  
7 perspective of: (1) commercial qualifications; (2) methodology; and (3) general technical  
8 offerings and options. Vendors that meet YEC's standards for pre-qualification in this  
9 stage will be invited to participate in the second stage of the competition via a formal  
10 Request for Proposals (RFP). The second stage of the procurement will more deliberately  
11 focus on a final technical specification and price, informed by the learnings from the initial  
12 stage.

13

14 YEC is currently in the first stage of the procurement process. The RFQF was released  
15 on December 15, 2020. The documentation included draft detailed BESS technical  
16 specifications for the vendors' consideration and comment as well as a questionnaire to  
17 solicit market information on available offerings across a range of topics. The RFQF  
18 subsequently closed on March 1, 2021. YEC received 14 vendor proposals in response  
19 to the RFQF and is currently in the evaluation phase for stage 1. At this time, the specific  
20 vendors and technologies participating in the procurement process cannot be disclosed.

21

22 The evaluation criteria for the stage 1 qualification process consists of:

23

- 24 • Corporate and work team experience;
- 25 • Equipment and technical;
- 26 • Methodology, schedule and budget; and
- 27 • Safety, Environment, and Sustainability.

28

29 Following selection of qualified vendors via the evaluation of stage 1, YEC will incorporate  
30 any learnings from the vendors and current market offerings into its final RFP and detailed  
31 technical specifications. This may include updating requirements such as performance  
32 capabilities, maintenance and/or contracting options, end-of-life disposal and/or recycling,  
33 and other considerations as identified during stage 1 of the procurement process.

1 (d)

2

3 The lithium iron phosphate chemistry has not been definitively selected for the project.  
4 YEC's procurement process for the BESS vendor has only specified that a lithium-ion  
5 technology must be provided.

6

7 The preferred battery chemistry will be selected during the procurement process, based  
8 on the vendor offering that aligns best with YEC's needs and provides the best value  
9 proposition (i.e., meeting technical requirements, safety requirements, with an acceptable  
10 cost). This approach was taken in an effort not to restrict the vendor pool, and in  
11 recognition of the rapid development pace of the battery technology market and potential  
12 improvements in specific offerings as a result.

13

14 The general benefits and limitations of the different chemistries are outlined in Section 4.1  
15 and Section 8.2 of the Hatch Report (Appendix B to the Application). Please also see  
16 Attachment 1 to this response which provides more information on the benefits and  
17 limitations of each chemistry type. Note that the benefits and risks of specific vendor  
18 offerings may be different than those for the general chemistry. Accordingly, YEC will use  
19 the detailed information provided in potential vendor bids to evaluate the relative benefits  
20 and limitations of each technology.

<b>Cathode Technology</b>	<b>Advantages</b>	<b>Disadvantages</b>
Lithium Iron Phosphate (LFP)	<ul style="list-style-type: none"> <li>- Very good thermal stability</li> <li>- Good cycle life</li> <li>- Good power capability</li> <li>- Cobalt, Nickel Free Cathode</li> </ul>	<ul style="list-style-type: none"> <li>- Lower energy density/larger footprint</li> <li>- Newer technology</li> <li>- Lower Voltage</li> </ul>
Lithium Nickel Manganese Cobalt Oxide (NMC)	<ul style="list-style-type: none"> <li>- Can be tailored for high power or high energy systems</li> <li>- Tend to be more suited for energy applications</li> <li>- Can operate at high voltages</li> <li>- Highest Energy Density (smallest footprint)</li> <li>- Most common chemistry</li> </ul>	<ul style="list-style-type: none"> <li>- Moderate charge state thermal stability (reducing safety)</li> <li>- Lower cycle life</li> <li>- Lower Calendar Life</li> </ul>
Lithium Nickel Cobalt Aluminum (NCA)	<ul style="list-style-type: none"> <li>- Good energy and power capabilities</li> <li>- Tend to be more suited for power applications</li> <li>- Moderate Cycle life</li> <li>- Long Calendar Life</li> </ul>	<ul style="list-style-type: none"> <li>- Moderate charge state thermal stability (reducing safety)</li> <li>- Capacity is reduced if operated at higher temperatures</li> </ul>

1 **TOPIC: Stable Hydro Operation**

2

3 **REFERENCE: Application, Tab 3.1.2, PDF page 10**

4

5 **QUOTE:** "... opportunities for more stable hydro operation during periods of  
6 downstream winter ice formation ..."

7

8 **QUESTION:**

9

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

13

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

16

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

19

20 **ANSWER:**

21

22 **(a)**

23

24 The current proposal for Aishihik GS license renewal includes winter flow management  
25 downstream of the generation station to improve ice conditions on the lower Aishihik River,  
26 reduce winter overflow-related flooding and other effects on the Aishihik River (no such  
27 restrictions are included in the existing license). The downstream Monitoring and Adaptive  
28 Management Plan that provides, among other matters, for this winter flow management is  
29 being developed for submission to the Yukon Water Board by October 15, 2022 that  
30 incorporates data collected in 2020, 2021 and 2022 under the monitoring plan required for  
31 the environment downstream of the Aishihik GS.

32

33 BESS could be used for stabilizing hydro operation during periods of downstream winter  
34 ice formation, reducing downstream winter flooding and icing problems and enhancing  
35 hydro unit efficiency. During periods of downstream winter ice formation daily fluctuation  
36 in hydro generation in response to load will lead to fluctuations in downstream flows that  
37 can hamper effective ice formation and cause related downstream flooding and over-bank

1 ice conditions. Constraining hydro operation to prevent such impacts can require  
2 increased thermal generation. The BESS could be used to stabilize hydro operation  
3 without incurring added thermal generation costs, and concurrently also has the potential  
4 to enhance hydro unit efficiency.

5

6 **(b) and (c)**

7

8 As described in YUB-YEC-1-14(a), the BESS could be used to reduce the daily flow  
9 variability the units are required to output to balance the system and prevent units from  
10 having to operate at a suboptimal level due to restrictions, which would help to mitigate  
11 some of the downstream issues during winter ice formation at Mayo and Whitehorse as  
12 well as at Aishihik. YEC is still exploring these options.

1 **TOPIC: Capacity Reserve and Demand Reduction**

2

3 **REFERENCE: Application, Tab 3.1.2.1, PDF page 10**

4

5 **QUOTE:** "For the BESS to contribute to this N-1 capacity reserve, it needs to be  
6 able to reduce the non-industrial peak demand during the day, and then  
7 be recharged overnight, for up to two weeks during the coldest winter  
8 months."

9

10 **QUESTION:**

11

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

16

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

21

22 **ANSWER:**

23

24 **(a) and (b)**

25

26 The BESS is used to meet the referenced peak demand load on YIS and subsequently  
27 acts to reduce generation during the peak, i.e., the BESS supplies the energy required to  
28 meet this load.

1 **TOPIC: BESS Use**

2

3 **REFERENCE: Application, Tab 3.1.2.1, PDF pages 10 to 13**

4

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

12

13 **QUESTION:**

14

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

17

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

23

24 **ANSWER:**

25

26 **(a) and (b)**

27

28 YEC rates are based on costs as approved by the Yukon Utilities Board. Accordingly, any  
29 battery cost reductions from estimates (due to technology improvements or any other  
30 factors) will be reflected in rates as soon as the Board has the opportunity to review costs  
31 and rates, and savings are therefore passed on to ratepayers rather than retained by the  
32 utility.

33

34 The question also asks if YEC would respond to a 30% lower vendor cost by purchasing  
35 a larger energy capacity than the 40 MWh useable energy storage currently proposed for  
36 the BESS Project. YEC is not considering any such option, and the Application does not  
37 include consideration of any such option. Table 3-2 of the Application shows that the

- 1 optimal BESS energy capacity sizing for the peak day currently is either 35 MWh or 40
- 2 MWh, i.e., each provide ability to avoid the requirement for four 1.8 MW diesel rental units.
- 3 Each 5 MWh addition to BESS energy capacity adds approximately \$2.9 million to the
- 4 Project estimated capital cost (see footnote 6 in the Application).

1 **TOPIC: Rental of Diesel Units**

2

3 **REFERENCE: Application, Tab 3.1.2.1, PDF page 13**

4

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

7

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

11

12 **QUESTION:**

13

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

17

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

21

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

24

25 **ANSWER:**

26

27 **(a)**

28

29 Based on the N-1 capacity criteria requirement YEC must maintain sufficient dependable  
30 capacity during the critical winter grid peak period to meet non-industrial load when a  
31 failure occurs to the single largest system component. The sufficient dependable capacity  
32 must be maintained each year during winter months, from November through February,  
33 regardless of frequency or probability of the occurrence of the N-1 event as it cannot be  
34 guaranteed or forecast when an N-1 event would occur. Rental of diesel units during this  
35 period is being used to address the existing N-1 dependable capacity gap.

1 Similar to the diesel rental units, YEC would maintain the BESS ready annually for an N-  
2 1 event regardless of occurrence.

3

4 **(b)**

5

6 As reviewed below, YEC does not require diesel rentals beyond the winter peak period –  
7 and therefore has not assessed the added cost for annual diesel rentals.

8

9 YEC defines dependable capacity as the maximum output that a resource can reliably  
10 provide over two consecutive weeks during the four winter months (November to  
11 February) based on the inflows in the five driest inflow years in history; for thermal  
12 resources, dependable capacity is assumed to be equal to the installed capacity. The  
13 dependable capacity for the hydro units is lower compared to the installed capacity of the  
14 units due to winter flow restrictions as well as reservoir water storage conditions.

15

16 YEC has sufficient capacity outside of the winter months to meet an N-1 event considering  
17 much higher available capacity from hydroelectric units as well as much lower peak during  
18 non-winter months. Therefore, YEC does not require rental units for the non-winter  
19 months.

20

21 **(c)**

22

23 YEC followed a competitive process for sourcing diesel rentals as follows:

24

25 **2018/19**

- 26 • YEC ran one-year public competitive tender process for 6 – 2 MW diesel  
27 generators for placement at the Whitehorse Rapids Generation Station (WRGS)  
28 for the winter heating season (approximately 5 months).
- 29 • Two bids were received:

30

Vendor Quote

31

Trinity Power \$1,860,059

32

Finning Canada \$1,557,881

33

34 A contract was awarded to Finning Canada.

1 **2019/20**

- 2 • YEC ran a three-year public competitive tender process for up to 8 – 2 MW units  
3 for the season; annual renewals are at the discretion of YEC.  
4 • Three bids were received; one bid was deemed non-compliant and was therefore  
5 excluded from the price evaluation:

6 Vendor Quote

7 United Rentals \$3,706,685

8 Finning Canada \$1,913,234

9

10 Due to additional generation risk from low water in Mayo, YEC elected to rent one  
11 additional 2 MW unit.

12

13 **2020/21**

- 14 • Based on the forecast model, 17 – 2 MW units are required for the 20/21 heating  
15 season.  
16 • 10 units were placed in the WRGS under the unit rates per 19/20 RFP; 7 units  
17 were placed in Faro through contract extensions with Finning Canada; unit rates  
18 for Faro units were based on market conditions at the time.

19

20 YEC is actively searching the market for cost-effective options for rental units for future  
21 rental periods.

1 **TOPIC: Charge Degradation**

2

3 **REFERENCE: Application, Tab 3.1.1, PDF page 8, footnote 2**

4

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

11

12 **QUESTION:**

13

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

17

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

20

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

22

23 **ANSWER:**

24

25 **(a)**

26

27 Due to the fact that the degradation depends on the specific technology and differs from  
28 vendor to vendor, no specific information can be provided until such time as the vendor  
29 has been selected. No battery vendor has yet been selected.

30

31 **(b)**

32

33 See Appendix B of the Application (pdf pages 84-86) which provides the Hatch Report  
34 Section 4.1.2, which discusses degradation. Degradation is a known phenomenon with  
35 lithium ion batteries and is managed through capacity overbuild or augmentation part way  
36 through the lifespan, as well as through management of battery use.

1 YEC will operate the BESS within the vendor specified parameters to manage the lifespan.

2

3 **(c)**

4

5 No. The project is an important element in the portfolio derived in YEC's 10-Year  
6 Renewable Electricity Plan. It provides N-1 dependable capacity to the system, which  
7 there is currently a shortfall of, and a net benefit for ratepayers from fuel savings. It also  
8 provides grid stability and reliability services described further in YUB-YEC-1-36, the  
9 importance of which will likely increase as more variable renewable generation (e.g., wind  
10 and solar) is incorporated on the system due to the Independent Power Producer Standing  
11 Offer Program.

1 **TOPIC: Charge Degradation**

2

3 **REFERENCE: Application, Tab 3.1.2.1, PDF pages 10 to 13**

4

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

8

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

9

10

11

12

13 **QUESTION:**

14

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

17

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

20

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

22

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

25

26 e) What does “frequency excursion” mean?

27

28 **ANSWER:**

29

30 **(a)**

31

32 Please see response to YUB-YEC-1-1(h).

33

34 **(b)**

35

36 Yes. Please see response to YUB-YEC-1-1(h).

1 (c)

2

3 Under normal operation, if the BESS is discharged it will be recharged during the night or  
4 by another event (e.g., loss of load or increase in variable renewable energy). The  
5 frequency for recharge under normal operations cannot be usefully estimated at this time,  
6 given the range of possible uses and likely variance during different seasons.

7

8 (d)

9

10 Yes.

11

12 (e)

13

14 The grid's frequency must be kept within a defined band (typically +/- 0.5 Hz).  
15 Occasionally, a deviation in grid frequency outside the necessary band occurs. This is  
16 referred to as a frequency excursion (a period when the grid frequency deviates outside  
17 of the allowable range).

18

19 Please see also Section 5.2.4 of the Hatch Feasibility Study report (page B-42, Appendix  
20 B to the Application, pdf page 98) for more information.

1 **TOPIC: Existing Operating Reserve Mechanism**

2

3 **REFERENCE: Application, Tab 3.1.2, PDF pages 14 and 15**

4

5 **QUOTE: Application, PDF page 14:**

6

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

11

12 Application, PDF page 15:

13

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

17

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

21

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

29

30 “Based on 2019/2020 year YIS operation and average annual water  
31 flow, the average monthly operating reserve on hydro turbines ranges  
32 from 2 MW to 8 MW across the year (includes all months), with an  
33 annual average of 4.8 MW. Based on this operating reserve and  
34 2019/2020 YIS operations, the annual average amount of thermal  
35 generation that could be avoided by BESS use as an operating reserve  
36 has been estimated by Hatch for the 20 MW/40 MWh option at 1.8 GWh

1 of diesel generation and 17.0 GWh of LNG generation...” (footnotes  
2 removed)

3

4 **QUESTION:**

5

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

9

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

14

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

18

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

22

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

27

28 **ANSWER:**

29

30 **(a)**

31

32 Typically, 10-minute and 30-minute operating reserve is maintained on most electrical  
33 grids in order to enable load to be served while a generator is brought online to replace  
34 the lost generation (most generators can start-up in 10 to 30 minutes). This same reserve  
35 duration was applied for this use case of the BESS. Please also refer to Section 5.2.2 of  
36 the Hatch report (provided as Appendix B of the Application, pdf page 96). If a generator

1 trip/supply insufficiency occurs, the BESS could cover up to 20 MW of load until thermal  
2 generation can be brought online - estimated at 10-30 minutes.

3  
4 **(b)**

5  
6 There have been no instances where hydro has failed to meet the spinning reserve  
7 requirement.

8  
9 **(c)**

10  
11 Please refer to Table 4-1 on page 28 of the Application which provides the remaining  
12 additional capacity needs of the system. The BESS reduces the capacity needs/shortfall  
13 by 7MW, which would have otherwise been provided by additional temporary rental diesel.

14  
15 **(d)**

16  
17 YEC is unable to quantify the percentage increase in efficiency the hydro generators will  
18 experience, as it will depend on the operational considerations and system configuration  
19 at any given time.

20  
21 The efficiency increase results from a hydro unit operating at its most efficient point on its  
22 efficiency curve (e.g. maximizing energy generation vs water use). The benefit will depend  
23 on the amount of time the unit would have been operating below this point and where on  
24 its efficiency curve it would have otherwise been operating due to system conditions and  
25 operational requirements (e.g., how much reserve or load-following it was required to  
26 provide at any point in time). The benefits calculation for the operating reserve use case  
27 does not include credit for this efficiency increase, only for the thermal fuel savings. Any  
28 efficiency increase benefit would be an additional benefit to those estimated in the  
29 Application.

30  
31 **(e)**

32  
33 Provision of operating reserve by the hydro units without BESS would not necessarily  
34 require generator upgrades, but rather results in thermal generation costs for ratepayers  
35 (see below).

1 In order to provide operating reserve, a hydro unit must be operated at less than its full  
2 capability (e.g., not outputting the amount of energy it could) in order to be available to  
3 "ramp up" to address a loss of generation. If the load is greater than the available hydro  
4 generation (which decreases when hydro is providing operating reserve), then thermal  
5 generation is required to provide the additional energy required to meet the load. The  
6 BESS provides operating reserve which allows the hydro generation to be run at a higher  
7 output, reducing thermal fuel costs to provide that same energy (as well as increasing  
8 hydro unit efficiency). Without BESS, added thermal generation requirements are  
9 expected.

10

11 Requirement to run existing thermal generation more frequently without BESS would not  
12 likely lead to a need to install more thermal generation.

1 **TOPIC: Load Loss Events**

2

3 **REFERENCE: Application, Tab 3.1.2.2, PDF page 14; Application, Appendix B:**  
4 **Hatch Report, PDF page 130**

5

6 **QUOTE:** Application, PDF page 14:

7

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

9

10 Application, PDF page 130:

11

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

17

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

20

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

24

25 **QUESTION:**

26

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

32

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

1 **ANSWER:**

2

3 **(a)**

4

5 BESS would be responding to an over frequency event (more generation on grid than  
6 load) to bring the grid back within the allowable range and prevent instability on the grid.

7 See also responses to YUB-YEC-1-36 and YUB-YEC-1-61. The BESS would provide  
8 stability to the system for both over and under frequency events. The frequency of system  
9 disturbances can range from 70-120 from small to large events annually.

10

11 **(b)**

12

13 See response to YUB-YEC-1-61.

1 **TOPIC:** **Reduction of Greenhouse Gas Emissions**  
2  
3 **REFERENCE:** **Application, Tab 3.1.2.2, PDF page 14; Application, Tab 3.4, PDF**  
4 **page 27; Application, Appendix B: Hatch Report, PDF pages 78**  
5 **and 79**  
6  
7 **QUOTE:** Application, PDF page 14:  
8  
9 “Diesel peak shifting: The BESS can be discharged in lieu of diesel  
10 generation during peak and recharged overnight with LNG generation  
11 or hydro generation, reducing thermal generation fuel costs and GHG  
12 emissions...”  
13  
14 Application, page 27:  
15  
16 “The Project will also have positive environmental and socio-economic  
17 effects. Notably, the Project is expected to provide for reduced  
18 greenhouse gas and particulate emissions resulting from the  
19 displacement of thermal generation emissions...”  
20  
21 Application, PDF page 78:  
22  
23 “Yukon Energy operates 3 natural gas gensets located in Whitehorse,  
24 with a dependable capacity of 13.2 MW, each with a maximum capacity  
25 of 4.4 MW. The gas gensets are used as backup power, to provide  
26 energy during low water periods, and to meet peak demand in the  
27 winter.  
28  
29 “Yukon Energy operates 4 diesel power plants: The Faro Diesel plant  
30 has 2 gensets, the Dawson City Diesel plant has 6 gensets, the Mayo  
31 Diesel plant has 3 gensets, and the Whitehorse Diesel plant has 4  
32 gensets. The diesel gensets have a dependable capacity of 25.8 MW.  
33 Diesel generation is used as backup to meet the load and to cover peak  
34 demands, primarily in the winter when hydroelectric generation is  
35 lowest. The diesel gensets are also used for outage restoration.

1 "ATCO owns several backup diesel generators connected to the grid  
2 that are used to supply local emergency power in the communities they  
3 are located in."

4  
5 "The natural gas units are dispatched to run before any diesel is run,  
6 due to their lower fuel cost and reduced GHG emissions."

7

8 **QUESTION:**

9

10 a) Please indicate whether YEC recorded the emission levels from the thermal  
11 generating units, which include owned diesel generating units, rented diesel  
12 generating units and owned liquefied natural gas generating units. If so, please  
13 provide the emission levels of carbon dioxide (CO<sub>2</sub>), methane, nitrogen oxides  
14 (NO<sub>x</sub>), sulphur dioxide (SO<sub>2</sub>), volatile organic compounds and primary particulate  
15 matter from the thermal generating units for the last 5-10 years.

16

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

20

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

23

24 **ANSWER:**

25

26 **(a)**

27

28 Emissions from each thermal generator are reported annually under YEC's air emissions  
29 permit and pursuant to ECCC's mandatory NPRI program. The data is calculated as  
30 opposed to measured. A table of the annual emissions for each thermal unit for the years  
31 2011 to 2019 is provided as Attachment 1 to this response.

32

33 **(b)**

34

35 The battery is expected to reduce carbon dioxide emissions by more than 20,000 tonnes  
36 over 20 years. Please see Attachment 1 to this response for further details.

1 (c)

2

3 Prior to the 10-Year Renewable Electricity Plan, the Resource Plans completed by YEC  
4 focused on meeting system requirements at the lowest cost to ratepayers, while meeting  
5 applicable environmental regulations. The metrics considered for this objective did not  
6 necessarily prioritize reducing YEC's reliance on thermal generation.

7

8 Prior to the 10-Year Plan, the last Resource Plan completed by YEC was in 2016 and  
9 proposed a 20 MW greenfield thermal facility, though it considered renewable resource  
10 alternatives including hydro and wind. As described further in YUB-YEC-1-1(f), in late  
11 2019 Yukon government released its "Our Clean Future" climate change strategy, and  
12 indicated it would be introducing a legislative requirement for YEC to provide electricity  
13 which is 93% renewable (non-emitting) on average. This requirement, along with other  
14 policy actions described in YUB-YEC-1-1(f), significantly changes the landscape and the  
15 objectives used for developing resource plans. Accordingly, the 10-Year Renewable  
16 Electricity Plan reflects YEC's current, updated strategy, which is focused on reducing  
17 YEC's reliance on thermal generation.

Table 1 - Summary of Yukon Energy 2011 Electricity Generation and Gaseous Emissions from Diesel Sources

Facility	Unit ID	Total 2011 Operating Time (hrs)	Total 2011 Energy Produced (KWh)	Emission Rates <sup>1</sup> (g/KWh)				Total Annual Emissions (tonne)			
				NO2	SO2	CO	PM2,5	NO2	SO2	CO	PM2,5
Whitehorse	WD1	79	231,000	8.82	0.01	0.52	0.13	2.038	0.003	0.119	0.031
	WD2	48	163,440	8.82	0.01	0.52	0.13	1.442	0.002	0.084	0.022
	WD3	12	36,720	8.82	0.01	0.52	0.13	0.324	0.001	0.019	0.005
	WD4	451	985,100	8.82	0.01	0.52	0.13	8.693	0.014	0.508	0.132
	WD5	550	1,182,058	8.82	0.01	0.52	0.13	10.430	0.017	0.610	0.158
	WD6	530	1,064,590	8.82	0.01	0.52	0.13	9.394	0.015	0.549	0.143
	WD7	1,138	2,908,080	8.82	0.01	0.52	0.13	25.661	0.041	1.501	0.390
<b>Plant Total</b>		<b>2,808</b>	<b>6,570,988</b>	-	-	-	-	<b>57.982</b>	<b>0.092</b>	<b>3.391</b>	<b>0.881</b>
Faro	FD1	50	150,002	8.82	0.01	0.52	0.13	1.32	0	0	0
	FD3	153	2,231,670	8.82	0.01	0.52	0.13	19.69	0	1	0
	FD5	32	48,090	8.82	0.01	0.52	0.13	0.42	0	0	0
	FD7	573	1,342,740	8.82	0.01	0.52	0.13	11.85	0	1	0
<b>Plant Total</b>		<b>809</b>	<b>3,772,502</b>	-	-	-	-	<b>33.289</b>	<b>0.053</b>	<b>1.947</b>	<b>0.506</b>
Mayo	MD1	404	250,110	8.82	0.01	0.52	0.13	2.207	0.004	0.129	0.034
	MD2	388	237,930	8.82	0.01	0.52	0.13	2.099	0.003	0.123	0.032
<b>Plant Total</b>		<b>792</b>	<b>488,040</b>	-	-	-	-	<b>4.306</b>	<b>0.007</b>	<b>0.252</b>	<b>0.065</b>
Dawson	DD1	1,924	989,091	8.82	0.01	0.52	0.13	8.728	0.014	0.510	0.133
	DD2	2,311	1,634,024	8.82	0.01	0.52	0.13	14.419	0.023	0.843	0.219
	DD3	1,840	1,302,058	8.82	0.01	0.52	0.13	11.489	0.018	0.672	0.174
	DD5	3,043	3,351,407	8.82	0.01	0.52	0.13	29.573	0.047	1.729	0.449
	YM1	153	214,872	8.82	0.01	0.52	0.13	1.896	0.003	0.111	0.029
<b>Plant Total</b>		<b>9,271</b>	<b>7,491,452</b>	-	-	-	-	<b>66.105</b>	<b>0.105</b>	<b>3.866</b>	<b>1.004</b>

Notes:

1 Source of emissions rates is the stack testing results prepared by Levelton Consultants Ltd on behalf of Yukon Energy in 2011 and previously submitted to Yukon Government.

**Table 1 - Summary of Yukon Energy 2012 Electricity Generation and Gaseous Emissions from Diesel Sources**

Facility	Unit ID	Total 2012 Operating Time (hrs)	Total 2012 Energy Produced (KWh)	Emission Rates <sup>1</sup> (g/KWh)				Total Annual Emissions (tonne)			
				NO2	SO2	CO	PM2.5	NO2	SO2	CO	PM2.5
Whitehorse	WD1	14.8	28,800	8.82	0.01	0.52	0.13	0.254	0.000	0.015	0.004
	WD2	13.0	37,440	8.82	0.01	0.52	0.13	0.330	0.001	0.019	0.005
	WD3	14.0	43,200	8.82	0.01	0.52	0.13	0.381	0.001	0.022	0.006
	WD4	88.2	185,300	8.82	0.01	0.52	0.13	1.635	0.003	0.096	0.025
	WD5	114.5	227,688	8.82	0.01	0.52	0.13	2.009	0.003	0.117	0.031
	WD6	255.0	519,580	8.82	0.01	0.52	0.13	4.585	0.007	0.268	0.070
	WD7	447.9	1,163,232	8.82	0.01	0.52	0.13	10.264	0.016	0.600	0.156
<b>Plant Total</b>		<b>947.4</b>	<b>2,205,240</b>	-	-	-	-	<b>19.459</b>	<b>0.031</b>	<b>1.138</b>	<b>0.296</b>
Faro	FD1	10.0	19,119	8.82	0.01	0.52	0.13	0.17	0	0	0
	FD3	14.2	9,870	8.82	0.01	0.52	0.13	0.09	0	0	0
	FD5	40.5	14,490	8.82	0.01	0.52	0.13	0.13	0	0	0
	FD7	263.6	489,300	8.82	0.01	0.52	0.13	4.32	0	0	0
<b>Plant Total</b>		<b>328.4</b>	<b>532,779</b>	-	-	-	-	<b>4.701</b>	<b>0.007</b>	<b>0.275</b>	<b>0.071</b>
Mayo	MD1	25.4	9,030	8.82	0.01	0.52	0.13	0.080	0.000	0.005	0.001
	MD2	22.0	8,085	8.82	0.01	0.52	0.13	0.071	0.000	0.004	0.001
<b>Plant Total</b>		<b>47.5</b>	<b>17,115</b>	-	-	-	-	<b>0.151</b>	<b>0.000</b>	<b>0.009</b>	<b>0.002</b>
Dawson	DD1	97.0	49,655	8.82	0.01	0.52	0.13	0.438	0.001	0.026	0.007
	DD2	63.0	41,819	8.82	0.01	0.52	0.13	0.369	0.001	0.022	0.006
	DD3	116.0	75,005	8.82	0.01	0.52	0.13	0.662	0.001	0.039	0.010
	DD5	123.0	127,061	8.82	0.01	0.52	0.13	1.121	0.002	0.066	0.017
	YM1	8.6	6,510	8.82	0.01	0.52	0.13	0.057	0.000	0.003	0.001
<b>Plant Total</b>		<b>407.6</b>	<b>300,050</b>	-	-	-	-	<b>2.648</b>	<b>0.004</b>	<b>0.155</b>	<b>0.040</b>

**Notes:**

1 Source of emissions rates is the stack testing results prepared by Levelton Consultants Ltd on behalf of Yukon Energy in 2011 and previously submitted to Yukon Government.

**Table 1 - Summary of Yukon Energy 2013 Electricity Generation and Gaseous Emissions from Diesel Sources**

Facility	Unit ID	Total 2013 Operating Time (hrs)	Total 2013 Energy Produced (KWh)	Emission Rates <sup>1</sup> (g/KWh)					Total Annual Emissions (tonnes)				
				NO2	SO2	CO	PM2.5	GHG (CO <sub>2</sub> eq)	NO2	SO2	CO	PM2.5	GHG (CO <sub>2</sub> eq)
Whitehorse	WD1	14.5	37,200	8.82	0.01	0.52	0.13	0.0007	0.328	0.001	0.019	0.000	25.9
	WD2	13.5	47,520	8.82	0.01	0.52	0.13	0.0007	0.419	0.001	0.025	0.000	33.1
	WD3	15.7	42,480	8.82	0.01	0.52	0.13	0.0007	0.375	0.001	0.022	0.000	29.6
	WD4	37.2	72,500	8.82	0.01	0.52	0.13	0.0007	0.640	0.001	0.037	0.000	50.6
	WD5	47.0	90,588	8.82	0.01	0.52	0.13	0.0007	0.799	0.001	0.047	0.000	63.2
	WD6	72.0	133,420	8.82	0.01	0.52	0.13	0.0007	1.177	0.002	0.069	0.000	93.1
	WD7	165.4	409,248	8.82	0.01	0.52	0.13	0.0007	3.611	0.006	0.211	0.000	285.5
<b>Plant Total</b>		<b>365.3</b>	<b>832,956</b>	-	-	-	-	-	<b>7.350</b>	<b>0.012</b>	<b>0.430</b>	<b>0.000</b>	<b>581.0</b>
Faro	FD1	12.1	18,436	8.82	0.01	0.52	0.13	0.0007	0.16	0	0	0	12.9
	FD5	16.3	12,810	8.82	0.01	0.52	0.13	0.0007	0.11	0	0	0	8.9
	FD7	599.2	868,560	8.82	0.01	0.52	0.13	0.0007	7.66	0	0	0	605.8
<b>Plant Total</b>		<b>627.5</b>	<b>899,806</b>	-	-	-	-	-	<b>7.940</b>	<b>0.013</b>	<b>0.464</b>	<b>0.000</b>	<b>627.6</b>
Mayo	MD1	25.4	15,120	8.82	0.01	0.52	0.13	0.0007	0.133	0.000	0.008	0.000	10.5
	MD2	22.0	15,015	8.82	0.01	0.52	0.13	0.0007	0.132	0.000	0.008	0.000	10.5
	MD3	10.4	3,360	8.82	0.01	0.52	0.13	0.0007	0.03	0	0	0	2.3
<b>Plant Total</b>		<b>57.8</b>	<b>33,495</b>	-	-	-	-	-	<b>0.296</b>	<b>0.000</b>	<b>0.017</b>	<b>0.000</b>	<b>23.4</b>
Dawson	DD1	46.0	20,385	8.82	0.01	0.52	0.13	0.0007	0.180	0.000	0.011	0.000	14.2
	DD2	46.0	26,374	8.82	0.01	0.52	0.13	0.0007	0.233	0.000	0.014	0.000	18.4
	DD3	51.0	31,824	8.82	0.01	0.52	0.13	0.0007	0.281	0.000	0.016	0.000	22.2
	DD5	42.0	41,434	8.82	0.01	0.52	0.13	0.0007	0.366	0.001	0.021	0.000	28.9
	YM1	25.4	20,370	8.82	0.01	0.52	0.13	0.0007	0.180	0.000	0.011	0.001	14.2
<b>Plant Total</b>		<b>210.4</b>	<b>140,387</b>	-	-	-	-	-	<b>1.239</b>	<b>0.002</b>	<b>0.072</b>	<b>0.001</b>	<b>97.9</b>

**Notes:**

1 Source of CAC emissions rates is the stack testing results prepared by Levelton Consultants Ltd on behalf of Yukon Energy in 2011 and previously submitted to Yukon Government. Emissions from diesel generation from the National Inventory Report (Environment Canada) average approximately 697.5 tonnes of CO<sub>2</sub>e per GWh (or 0.0006975 g/KWh).

**Table 1 - Summary of Yukon Energy 2013 Electricity Generation and Gaseous Emissions from Diesel Sources**

Facility	Unit ID	Total 2012 Operating Time (hrs)	Total 2012 Energy Produced (KWh)	Emission Rates <sup>1</sup> (g/KWh)					Total Annual Emissions (tonnes)				
				NO2	SO2	CO	PM2.5	GHG (CO <sub>2</sub> eq)	NO2	SO2	CO	PM2.5	GHG (CO <sub>2</sub> eq)
Whitehorse	WD1	14.5	37,200	8.82	0.01	0.52	0.13	0.0007	0.328	0.001	0.019	0.000	25.9
	WD2	13.5	47,520	8.82	0.01	0.52	0.13	0.0007	0.419	0.001	0.025	0.000	33.1
	WD3	15.7	42,480	8.82	0.01	0.52	0.13	0.0007	0.375	0.001	0.022	0.000	29.6
	WD4	37.2	72,500	8.82	0.01	0.52	0.13	0.0007	0.640	0.001	0.037	0.000	50.6
	WD5	47.0	90,588	8.82	0.01	0.52	0.13	0.0007	0.799	0.001	0.047	0.000	63.2
	WD6	72.0	133,420	8.82	0.01	0.52	0.13	0.0007	1.177	0.002	0.069	0.000	93.1
	WD7	165.4	409,248	8.82	0.01	0.52	0.13	0.0007	3.611	0.006	0.211	0.000	285.5
<b>Plant Total</b>		<b>365.3</b>	<b>832,956</b>	-	-	-	-	-	<b>7.350</b>	<b>0.012</b>	<b>0.430</b>	<b>0.000</b>	<b>581.0</b>
Faro	FD1	12.1	18,436	8.82	0.01	0.52	0.13	0.0007	0.16	0	0	0	12.9
	FD5	16.3	12,810	8.82	0.01	0.52	0.13	0.0007	0.11	0	0	0	8.9
	FD7	599.2	868,560	8.82	0.01	0.52	0.13	0.0007	7.66	0	0	0	605.8
<b>Plant Total</b>		<b>627.5</b>	<b>899,806</b>	-	-	-	-	-	<b>7.940</b>	<b>0.013</b>	<b>0.464</b>	<b>0.000</b>	<b>627.6</b>
Mayo	MD1	25.4	15,120	8.82	0.01	0.52	0.13	0.0007	0.133	0.000	0.008	0.000	10.5
	MD2	22.0	15,015	8.82	0.01	0.52	0.13	0.0007	0.132	0.000	0.008	0.000	10.5
	MD3	10.4	3,360	8.82	0.01	0.52	0.13	0.0007	0.03	0	0	0	2.3
<b>Plant Total</b>		<b>57.8</b>	<b>33,495</b>	-	-	-	-	-	<b>0.296</b>	<b>0.000</b>	<b>0.017</b>	<b>0.000</b>	<b>23.4</b>
Dawson	DD1	46.0	20,385	8.82	0.01	0.52	0.13	0.0007	0.180	0.000	0.011	0.000	14.2
	DD2	46.0	26,374	8.82	0.01	0.52	0.13	0.0007	0.233	0.000	0.014	0.000	18.4
	DD3	51.0	31,824	8.82	0.01	0.52	0.13	0.0007	0.281	0.000	0.016	0.000	22.2
	DD5	42.0	41,434	8.82	0.01	0.52	0.13	0.0007	0.366	0.001	0.021	0.000	28.9
	YM1	25.4	20,370	8.82	0.01	0.52	0.13	0.0007	0.180	0.000	0.011	0.001	14.2
<b>Plant Total</b>		<b>210.4</b>	<b>140,387</b>	-	-	-	-	-	<b>1.239</b>	<b>0.002</b>	<b>0.072</b>	<b>0.001</b>	<b>97.9</b>

**Notes:**

1 Source of CAC emissions rates is the stack testing results prepared by Levelton Consultants Ltd on behalf of Yukon Energy in 2011 and previously submitted to Yukon Government. Emissions from diesel generation from the National Inventory Report (Environment Canada) average approximately 697.5 tonnes of CO<sub>2</sub>e per GWh (or 0.0006975 g/KWh).

**Table 1 - Summary of Yukon Energy 2014 Electricity Generation and Gaseous Emissions from Diesel Sources**

Facility	Unit ID	Total 2014 Operating Time (hrs)	Total 2013 Energy Produced (KWh)	Emission Rates <sup>1</sup> (g/kWh)					Total Annual Emissions (tonnes)				
				NO2	SO2	CO	PM2.5	GHG (CO <sub>2</sub> eq)	NO2	SO2	CO	PM2.5	GHG (CO <sub>2</sub> eq)
Whitehorse	WD1	14.1	35,400	8.82	0.01	0.52	0.13	0.0007	0.3124	0.0005	0.0183	0.0000	24.7
	WD2	5.6	14,400	8.82	0.01	0.52	0.13	0.0007	0.1271	0.0002	0.0074	0.0074	10.0
	WD3	41.0	115,920	8.82	0.01	0.52	0.13	0.0007	1.0229	0.0016	0.0598	0.0598	80.9
	WD4	68.2	143,400	8.82	0.01	0.52	0.13	0.0007	1.2654	0.0020	0.0740	0.0740	100.0
	WD5	69.2	145,776	8.82	0.01	0.52	0.13	0.0007	1.2863	0.0020	0.0752	0.0752	101.7
	WD6	94.0	208,060	8.82	0.01	0.52	0.13	0.0007	1.8359	0.0029	0.1074	0.1074	145.1
	WD7	129.7	315,420	8.82	0.01	0.52	0.13	0.0007	2.7833	0.0044	0.1628	0.1628	220.0
<b>Plant Total</b>		<b>421.8</b>	<b>978,376</b>	-	-	-	-	-	<b>8.6332</b>	<b>0.0137</b>	<b>0.5048</b>	<b>0.4866</b>	<b>682.4</b>
Faro	FD1	24.7	32,087	8.82	0.01	0.52	0.13	0.0007	0.2831	0.0004	0.0166	0.0166	22.4
	FD7	205.8	305,760	8.82	0.01	0.52	0.13	0.0007	2.6980	0.0043	0.1578	0.1578	213.3
<b>Plant Total</b>		<b>230.5</b>	<b>337,847</b>	-	-	-	-	-	<b>2.9812</b>	<b>0.0047</b>	<b>0.1743</b>	<b>0.1743</b>	<b>235.6</b>
Mayo	MD1	17.1	9,030	8.82	0.01	0.52	0.13	0.0007	0.0797	0.0001	0.0047	0.0047	6.3
	MD2	14.7	8,820	8.82	0.01	0.52	0.13	0.0007	0.0778	0.0001	0.0046	0.0046	6.2
	MD3	14.7	8,400	8.82	0.01	0.52	0.13	0.0007	0.0741	0.0001	0.0043	0.0043	5.9
<b>Plant Total</b>		<b>46.5</b>	<b>26,250</b>	-	-	-	-	-	<b>0.2316</b>	<b>0.0004</b>	<b>0.0135</b>	<b>0.0135</b>	<b>18.3</b>
Dawson	DD1	51.0	23,457	8.82	0.01	0.52	0.13	0.0007	0.2070	0.0003	0.0121	0.0121	16.4
	DD2	65.0	41,563	8.82	0.01	0.52	0.13	0.0007	0.3668	0.0006	0.0214	0.0214	29.0
	DD3	56.0	37,930	8.82	0.01	0.52	0.13	0.0007	0.3347	0.0005	0.0196	0.0196	26.5
	DD5	92.0	90,776	8.82	0.01	0.52	0.13	0.0007	0.8010	0.0013	0.0468	0.0468	63.3
	YM1	4.0	840	8.82	0.01	0.52	0.13	0.0007	0.0074	0.0000	0.0004	0.0004	0.6
<b>Plant Total</b>		<b>268.0</b>	<b>194,566</b>	-	-	-	-	-	<b>1.7169</b>	<b>0.0027</b>	<b>0.1004</b>	<b>0.1004</b>	<b>135.7</b>

**Notes:**

1 Source of CAC emissions rates is the stack testing results prepared by Levelton Consultants Ltd on behalf of Yukon Energy in 2011 and previously submitted to Yukon Government. Emissions from diesel generation from the National Inventory Report (Environment Canada) average approximately 697.5 tonnes of CO<sub>2</sub>e per GWh (or 0.0006975 g/KWh).

Table 1 - Summary of Yukon Energy 2016 Electricity Generation and Gaseous Emissions from Diesel and Natural Gas Sources

Facility	Unit ID	Total 2016 Operating Time (hrs)	Total 2016 Energy Produced (KWh)	Emission Rates <sup>1</sup> (g/kWh)						Total Annual Emissions (tonnes)					
				NO <sub>2</sub>	SO <sub>2</sub>	CO	PM <sub>2.5</sub>	VOC	GHG (CO <sub>2</sub> eq)	NO <sub>2</sub>	SO <sub>2</sub>	CO	PM <sub>2.5</sub>	VOC	GHG (CO <sub>2</sub> eq)
Whitehorse	WD1 <sup>2</sup>														
	WD2 <sup>2</sup>														
	WD3	22	57,600	8.82	0.014	0.52	0.13	-	0.00070	0.5083	0.0008	0.0297	0.0077	-	40
	WD4	181	342,400	8.82	0.014	0.52	0.13	-	0.00070	3.0213	0.0048	0.1767	0.0459	-	239
	WD5	212	462,900	8.82	0.014	0.52	0.13	-	0.00070	4.0846	0.0065	0.2389	0.0620	-	323
	WD6	296	635,200	8.82	0.014	0.52	0.13	-	0.00070	5.6050	0.0089	0.3278	0.0851	-	443
	WD7	98	228,900	8.82	0.014	0.52	0.13	-	0.00070	2.0198	0.0032	0.1181	0.0307	-	160
	WG1	385	1,458,100	1.85	0.003	4.06	0.02	0.91	0.00045	2.6975	0.0044	5.9199	0.0292	1.3269	658
WG2	486	1,793,100	1.85	0.003	4.06	0.02	0.91	0.00045	3.3172	0.0054	7.2800	0.0359	1.6317	809	
<b>Plant Total</b>		<b>1,680</b>	<b>4,978,200</b>	-	-	-	-	-	-	<b>21.254</b>	<b>0.034</b>	<b>14.091</b>	<b>0.296</b>	<b>2.959</b>	<b>2,671</b>
Faro	FD1	15	25,228	8.82	0.014	0.52	0.13	-	0.00070	0.2226	0.0004	0.0130	0.0034	-	18
	FD7	115	165,480	8.82	0.014	0.52	0.13	-	0.00070	1.4602	0.0023	0.0854	0.0222	-	115
<b>Plant Total</b>		<b>129</b>	<b>190,708</b>	-	-	-	-	-	-	<b>1.6828</b>	<b>0.0027</b>	<b>0.0984</b>	<b>0.0256</b>		<b>133</b>
Mayo	MD1	11	7,100	8.82	0.014	0.52	0.13	-	0.00070	0.0627	0.0001	0.0037	0.0010	-	5
	MD2	15	7,800	8.82	0.014	0.52	0.13	-	0.00070	0.0688	0.0001	0.0040	0.0010	-	5
	MD3	10	6,800	8.82	0.014	0.52	0.13	-	0.00070	0.0600	0.0001	0.0035	0.0009	-	5
<b>Plant Total</b>		<b>37</b>	<b>21,700</b>	-	-	-	-	-	-	<b>0.1915</b>	<b>0.0003</b>	<b>0.0112</b>	<b>0.0029</b>	-	<b>15</b>
Dawson	DD1	194	108,400	8.82	0.014	0.52	0.13	-	0.00070	0.9565	0.0015	0.0559	0.0145	-	76
	DD2	301	205,900	8.82	0.014	0.52	0.13	-	0.00070	1.8169	0.0029	0.1062	0.0276	-	144
	DD3	246	167,700	8.82	0.014	0.52	0.13	-	0.00070	1.4798	0.0023	0.0865	0.0225	-	117
	DD4	139	106,700	8.82	0.014	0.52	0.13	-	0.00070	0.9415	0.0015	0.0551	0.0143	-	74
	DD5	326	333,400	8.82	0.014	0.52	0.13	-	0.00070	2.9419	0.0047	0.1720	0.0447	-	233
	YM1	21	12,600	8.82	0.014	0.52	0.13	-	0.00070	0.1112	0.0002	0.0065	0.0017	-	9
<b>Plant Total</b>		<b>1,227</b>	<b>934,700</b>	-	-	-	-	-	-	<b>8.2478</b>	<b>0.0131</b>	<b>0.4823</b>	<b>0.1252</b>	-	<b>652</b>

Notes:

1 Source of CAC emissions rates from diesel is the stack testing results prepared by Levelton Consultants Ltd on behalf of Yukon Energy in 2011 and previously submitted to Yukon Government. CAC emissions from the natural gas-fired generators is per manufacturer specifications. Emissions from diesel generation from the National Inventory Report (Environment Canada) average approximately 697.5 tonnes of CO<sub>2</sub>e per GWh (or 0.0006975 g/kWh). Natural gas GHG emissions are approximately 451 tonnes of CO<sub>2</sub>e per GWh (or 0.000451 g/kWh). Nitrous Oxide emissions in the combustion of natural gas are negligible (i.e., 1.47x10<sup>-17</sup> g/kWh)

2 Units were disconnected/non-operational after June 2015.

**Table 1 - Summary of Yukon Energy 2017 Electricity Generation and Gaseous Emissions from Diesel and Natural Gas Sources**

Facility	Unit ID	Total 2017 Operating Time (hrs)	Total 2017 Energy Produced (KWh)	Emission Rates <sup>1</sup> (g/kWh)						Total Annual Emissions (tonnes)					
				NO <sub>2</sub>	SO <sub>2</sub>	CO	PM <sub>2.5</sub>	VOC	GHG (CO <sub>2</sub> eq)	NO <sub>2</sub>	SO <sub>2</sub>	CO	PM <sub>2.5</sub>	VOC	GHG (CO <sub>2</sub> eq)
Whitehorse	WD1 <sup>2</sup>														
	WD2 <sup>2</sup>														
	WD3	36	34,614	8.82	0.014	0.52	0.13	-	0.00070	0.3054	0.0005	0.0179	0.0046	-	24
	WD4	385	859,200	8.82	0.014	0.52	0.13	-	0.00070	7.5816	0.0120	0.4433	0.1151	-	599
	WD5	433	962,510	8.82	0.014	0.52	0.13	-	0.00070	8.4932	0.0135	0.4967	0.1290	-	671
	WD6	409	910,380	8.82	0.014	0.52	0.13	-	0.00070	8.0332	0.0127	0.4698	0.1220	-	635
	WD7	422	1,081,080	8.82	0.014	0.52	0.13	-	0.00070	9.5394	0.0151	0.5578	0.1449	-	754
	WG1	1,253	4,860,330	1.85	0.003	4.06	0.02	0.91	0.00045	8.9916	0.0146	19.7329	0.0972	4.4229	2,192
	WG2	1,286	4,996,000	1.85	0.003	4.06	0.02	0.91	0.00045	9.2426	0.0150	20.2838	0.0999	4.5464	2,253
<b>Plant Total</b>		<b>4,223</b>	<b>13,704,114</b>	-	-	-	-	-	-	<b>52.187</b>	<b>0.083</b>	<b>42.002</b>	<b>0.713</b>	<b>8.969</b>	<b>7,129</b>
Faro	FD1	15	36,298	8.82	0.014	0.52	0.13	-	0.00070	0.3203	0.0005	0.0187	0.0049	-	25
	FD7	202	244,410	8.82	0.014	0.52	0.13	-	0.00070	2.1567	0.0034	0.1261	0.0328	-	170
	<b>Plant Total</b>		<b>217</b>	<b>280,708</b>	-	-	-	-	-	<b>2.4770</b>	<b>0.0039</b>	<b>0.1448</b>	<b>0.0376</b>		<b>196</b>
Mayo	MD1	24	15,540	8.82	0.014	0.52	0.13	-	0.00070	0.1371	0.0002	0.0080	0.0021	-	11
	MD2	18	11,340	8.82	0.014	0.52	0.13	-	0.00070	0.1001	0.0002	0.0059	0.0015	-	8
	MD3	16	11,865	8.82	0.014	0.52	0.13	-	0.00070	0.1047	0.0002	0.0061	0.0016	-	8
	<b>Plant Total</b>		<b>58</b>	<b>38,745</b>	-	-	-	-	-	<b>0.3419</b>	<b>0.0005</b>	<b>0.0200</b>	<b>0.0052</b>	-	<b>27</b>
Dawson	DD1	65	31,672	8.82	0.014	0.52	0.13	-	0.00070	0.2795	0.0004	0.0163	0.0042	-	22
	DD2	108	66,067	8.82	0.014	0.52	0.13	-	0.00070	0.5830	0.0009	0.0341	0.0089	-	46
	DD3	86	59,136	8.82	0.014	0.52	0.13	-	0.00070	0.5218	0.0008	0.0305	0.0079	-	41
	DD4	104	82,518	8.82	0.014	0.52	0.13	-	0.00070	0.7281	0.0012	0.0426	0.0111	-	58
	DD5	176	190,630	8.82	0.014	0.52	0.13	-	0.00070	1.6821	0.0027	0.0984	0.0255	-	133
	YM1	25	20,580	8.82	0.014	0.52	0.13	-	0.00070	0.1816	0.0003	0.0106	0.0028	-	14
<b>Plant Total</b>		<b>564</b>	<b>450,603</b>	-	-	-	-	-	-	<b>3.9761</b>	<b>0.0063</b>	<b>0.2325</b>	<b>0.0604</b>	-	<b>314</b>

**Notes:**

**1** Source of CAC emissions rates from diesel is the stack testing results prepared by Levelton Consultants Ltd on behalf of Yukon Energy in 2011 and previously submitted to Yukon Government. CAC emissions from the natural gas-fired generators is per manufacturer specifications. Emissions from diesel generation from the National Inventory Report (Environment Canada) average approximately 697.5 tonnes of CO<sub>2</sub>e per GWh (or 0.0006975 g/kWh). Natural gas GHG emissions are approximately 451 tonnes of CO<sub>2</sub>e per GWh (or 0.000451 g/kWh). Nitrous Oxide emissions in the combustion of natural gas are negligible (i.e., 1.47x10<sup>-17</sup> g/kWh)

**2** Units were disconnected/non-operational after June 2015.

**Table 1 - Summary of Yukon Energy 2018 Electricity Generation and Gaseous Emissions from Diesel and Natural Gas Sources**

Facility	Unit ID	Total 2018 Operating Time (hrs)	Total 2018 Energy Produced (KWh)	Emission Rates <sup>1</sup> (g/kWh)						Total Annual Emissions (tonnes)					
				NO <sub>2</sub>	SO <sub>2</sub>	CO	PM <sub>2.5</sub>	VOC	GHG (CO <sub>2</sub> eq)	NO <sub>2</sub>	SO <sub>2</sub>	CO	PM <sub>2.5</sub>	VOC	GHG (CO <sub>2</sub> eq)
Whitehorse	WD3	90	229,680	8.82	0.014	0.52	0.13	-	697.5	2.0267	0.0032	0.1185	0.0308	-	160.2
	WD4	533	1,238,000	8.82	0.014	0.52	0.13	-	697.5	10.9241	0.0173	0.6388	0.1659	-	864
	WD5	561	1,283,599	8.82	0.014	0.52	0.13	-	697.5	11.3265	0.0180	0.6623	0.1720	-	895
	WD6	523	1,189,800	8.82	0.014	0.52	0.13	-	697.5	10.4988	0.0167	0.6139	0.1594	-	830
	WD7	698	1,802,640	8.82	0.014	0.52	0.13	-	697.5	15.9065	0.0252	0.9302	0.2416	-	1,257
	WG1	3,424	13,991,800	1.85	0.003	4.06	0.02	0.91	451.0	25.8848	0.0420	56.8067	0.2798	12.7325	6,310
	WG2	3,221	13,049,000	1.85	0.003	4.06	0.02	0.91	451.0	24.1407	0.0391	52.9789	0.2610	4.5464	5,885
	WG3	713	3,089,200	1.85	0.003	4.06	0.02	0.91	451.0	5.7150	0.0093	12.5422	0.0618	4.5464	1,393
	YM10	2	4,000	8.82	0.014	0.52	0.13	-	697.5	0.0353	0.0001	0.0021	0.0005	-	3
	YM11	2	3,800	8.82	0.014	0.52	0.13	-	697.5	0.0335	0.0001	0.0020	0.0005	-	3
	YM12	2	4,000	8.82	0.014	0.52	0.13	-	697.5	0.0353	0.0001	0.0021	0.0005	-	3
	YM13	2	4,000	8.82	0.014	0.52	0.13	-	697.5	0.0353	0.0001	0.0021	0.0005	-	3
	YM14	0	0	8.82	0.014	0.52	0.13	-	697.5	0.0000	0.0000	0.0000	0.0000	-	0
	YM15	0	0	8.82	0.014	0.52	0.13	-	697.5	0.0000	0.0000	0.0000	0.0000	-	0
	<b>Plant Total</b>		<b>9,771</b>	<b>35,889,519</b>	-	-	-	-	-	-	<b>106.562</b>	<b>0.171</b>	<b>125.300</b>	<b>1.374</b>	<b>21.825</b>
Faro	FD1	11	25,000	8.82	0.014	0.52	0.13	-	697.5	0.2206	0.0004	0.0129	0.0034	-	17
	FD7	173	277,000	8.82	0.014	0.52	0.13	-	697.5	2.4442	0.0039	0.1429	0.0371	-	193
	<b>Plant Total</b>	<b>184</b>	<b>302,000</b>	-	-	-	-	-	-	<b>2.6648</b>	<b>0.0042</b>	<b>0.1558</b>	<b>0.0405</b>	-	<b>211</b>
Mayo	MD1	56	36,120	8.82	0.014	0.52	0.13	-	697.5	0.3187	0.0005	0.0186	0.0048	-	25
	MD2	48	31,080	8.82	0.014	0.52	0.13	-	697.5	0.2742	0.0004	0.0160	0.0042	-	22
	MD3	28	19,320	8.82	0.014	0.52	0.13	-	697.5	0.1705	0.0003	0.0100	0.0026	-	13
	<b>Plant Total</b>	<b>132</b>	<b>86,520</b>	-	-	-	-	-	-	<b>0.7635</b>	<b>0.0012</b>	<b>0.0446</b>	<b>0.0116</b>	-	<b>60</b>
Dawson	DD1	158	66,900	8.82	0.014	0.52	0.13	-	697.5	0.5903	0.0009	0.0345	0.0090	-	47
	DD2	380	253,296	8.82	0.014	0.52	0.13	-	697.5	2.2351	0.0035	0.1307	0.0339	-	177
	DD3	213	145,780	8.82	0.014	0.52	0.13	-	697.5	1.2864	0.0020	0.0752	0.0195	-	102
	DD4	199	169,239	8.82	0.014	0.52	0.13	-	697.5	1.4934	0.0024	0.0873	0.0227	-	118
	DD5	535	581,174	8.82	0.014	0.52	0.13	-	697.5	5.1283	0.0081	0.2999	0.0779	-	405
	YM1	58	50,400	8.82	0.014	0.52	0.13	-	697.5	0.4447	0.0007	0.0260	0.0068	-	35
<b>Plant Total</b>		<b>1,543</b>	<b>1,266,789</b>	-	-	-	-	-	-	<b>11.1781</b>	<b>0.0177</b>	<b>0.6537</b>	<b>0.1697</b>	-	<b>884</b>

**Notes:**

<sup>1</sup> Source of CAC emissions rates from diesel is the stack testing results prepared by Levelton Consultants Ltd on behalf of Yukon Energy in 2011 and previously submitted to Yukon Government. CAC emissions from the natural gas-fired generators is per manufacturer specifications. Emissions from diesel generation from the National Inventory Report (Environment Canada) average approximately 697.5 tonnes of CO<sub>2</sub>e per GWh (or 697.5 g/kWh). Natural gas GHG emissions are approximately 451 tonnes of CO<sub>2</sub>e per GWh (or 451 g/kWh). Nitrous Oxide emissions in the combustion of natural gas are negligible (i.e., 1.47x10<sup>-17</sup> g/kWh)

**Table 1 - Summary of Yukon Energy Corporation 2019 Electricity Generation and Gaseous Emissions from Diesel and Natural Gas Sources**

Facility	Unit ID	Total 2019 Operating Time (hrs)	Total 2019 Energy Produced (KWh)	Emission Rates <sup>1</sup> (g/kWh)						Total Annual Emissions (tonnes)					
				NO <sub>2</sub>	SO <sub>2</sub>	CO	PM <sub>2.5</sub>	VOC	GHG (CO <sub>2</sub> eq)	NO <sub>2</sub>	SO <sub>2</sub>	CO	PM <sub>2.5</sub>	VOC	GHG (CO <sub>2</sub> eq)
Whitehorse	WD3	Decomissioned													
	WD4	163	323,593	8.82	0.014	0.52	0.13	-	697.5	2.86	0.005	0.17	0.04	-	225.7
	WD5	153	309,839	8.82	0.014	0.52	0.13	-	697.5	2.73	0.004	0.16	0.04	-	216.1
	WD6	111	230,214	8.82	0.014	0.52	0.13	-	697.5	2.03	0.003	0.12	0.03	-	160.6
	WD7	27	45,977	8.82	0.014	0.52	0.13	-	697.5	0.41	0.001	0.02	0.01	-	32.1
	WG1	5,048	20,720,448	1.85	0.003	4.06	0.02	0.91	451.0	38.33	0.062	84.13	0.41	18.86	9,344.9
	WG2	5,208	21,451,583	1.85	0.003	4.06	0.02	0.91	451.0	39.69	0.064	87.09	0.43	4.55	9,674.7
	WG3	5,550	22,717,775	1.85	0.003	4.06	0.02	0.91	451.0	42.03	0.068	92.23	0.45	4.55	10,245.7
	YM10	108	216,888	8.82	0.014	0.52	0.13	-	697.5	1.91	0.003	0.11	0.03	-	151.3
	YM11	134	268,788	8.82	0.014	0.52	0.13	-	697.5	2.37	0.004	0.14	0.04	-	187.5
	YM12	118	235,988	8.82	0.014	0.52	0.13	-	697.5	2.08	0.003	0.12	0.03	-	164.6
	YM13	107	213,688	8.82	0.014	0.52	0.13	-	697.5	1.89	0.003	0.11	0.03	-	149.0
	YM14	136	271,388	8.82	0.014	0.52	0.13	-	698.5	2.39	0.004	0.14	0.04	-	189.3
	YM15	102	203,188	8.82	0.014	0.52	0.13	-	699.5	1.79	0.003	0.10	0.03	-	141.7
	YM16	77	154,588	8.82	0.014	0.52	0.13	-	700.5	1.36	0.002	0.08	0.02	-	107.8
	YM17	77	154,588	8.82	0.014	0.52	0.13	-	701.5	1.36	0.002	0.08	0.02	-	107.8
	YM18	0	0	8.82	0.014	0.52	0.13	-	702.5	0.00	0.000	0.00	0.00	-	0.0
	<b>Plant Total</b>		<b>17,120</b>	<b>67,518,529</b>	-	-	-	-	-	-	<b>143.24</b>	<b>0.231</b>	<b>264.81</b>	<b>1.65</b>	<b>27.95</b>
Faro	FD1	29	57,750	8.82	0.014	0.52	0.13	-	697.5	0.5096	0.0008	0.0298	0.0077	-	40
	FD7	497	747,938	8.82	0.014	0.52	0.13	-	697.5	6.5998	0.0105	0.3859	0.1002	-	522
	<b>Plant Total</b>	<b>525</b>	<b>805,688</b>	-	-	-	-	-	-	<b>7.1094</b>	<b>0.0113</b>	<b>0.4157</b>	<b>0.1080</b>		<b>562</b>
Mayo	MD1	43	36,464	8.82	0.014	0.52	0.13	-	697.5	0.3218	0.0005	0.0188	0.0049	-	25
	MD2	41	35,572	8.82	0.014	0.52	0.13	-	697.5	0.3139	0.0005	0.0184	0.0048	-	25
	MD3	37	32,129	8.82	0.014	0.52	0.13	-	697.5	0.2835	0.0004	0.0166	0.0043	-	22
	<b>Plant Total</b>	<b>121</b>	<b>104,166</b>	-	-	-	-	-	-	<b>0.9192</b>	<b>0.0015</b>	<b>0.0537</b>	<b>0.0140</b>	-	<b>73</b>
Dawson	DD1	108	55,114	8.82	0.014	0.52	0.13	-	697.5	0.4863	0.0008	0.0284	0.0074	-	38
	DD2	185	127,747	8.82	0.014	0.52	0.13	-	697.5	1.1272	0.0018	0.0659	0.0171	-	89
	DD3	117	79,851	8.82	0.014	0.52	0.13	-	697.5	0.7046	0.0011	0.0412	0.0107	-	56
	DD4	248	202,571	8.82	0.014	0.52	0.13	-	697.5	1.7875	0.0028	0.1045	0.0271	-	141
	DD5	216	237,909	8.82	0.014	0.52	0.13	-	697.5	2.0993	0.0033	0.1228	0.0319	-	166
	YM1	21	6,200	8.82	0.014	0.52	0.13	-	697.5	0.0547	0.0001	0.0032	0.0008	-	4
<b>Plant Total</b>	<b>895</b>	<b>709,392</b>	-	-	-	-	-	-	<b>6.2597</b>	<b>0.0099</b>	<b>0.3660</b>	<b>0.0951</b>	-	<b>495</b>	

**Notes:**

<sup>1</sup> Source of CAC emissions rates from diesel is the stack testing results prepared by Levelton Consultants Ltd on behalf of Yukon Energy in 2011 and previously submitted to Yukon Government. CAC emissions from the natural gas-fired generators is per manufacturer specifications. Emissions from diesel generation from the National Inventory Report (Environment Canada) average approximately 697.5 tonnes of CO<sub>2</sub>e per GWh (or 697.5 g/kWh). Natural gas GHG emissions are approximately 451 tonnes of CO<sub>2</sub>e per GWh (or 451 g/kWh). Nitrous Oxide emissions in the combustion of natural gas are negligible (i.e., 1.47x10<sup>-17</sup> g/kWh)



**REPORT**

# Greenhouse Gas Mitigation Assessment

## *Proposed Grid Scale Battery Energy Storage System*

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## Distribution List

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## Executive Summary

This report summarizes the greenhouse gas (GHG) mitigation assessment section of the Climate Lens assessment, to meet the funding requirements of Investing in Green Infrastructure program for Yukon Energy Corporation's proposed Grid Scale Battery Energy Storage System (BESS).

Yukon Energy Corporation is proposing to construct a grid scale BESS which would allow for the storage of power to meet peak power demand. The BESS will store power generated from renewable (hydro and wind farm) and non-renewable (diesel and LNG) sources. During winter, peak demand is usually met by using power supplied from thermal sources (diesel or LNG). During the winter season when the BESS is used to store renewable power (wind farm or hydro) it is therefore offsetting power from non-renewable sources. The construction and operation of the BESS will reduce the use of power from thermal sources (diesel or LNG) to meet winter peak power demand and therefore reduce the GHG emissions over the Project life (20 years).

The estimated GHG emission reductions as a result of the Project are summarized as follows:

- The Project would result in a reduction in GHG emissions of **1,122 tCO<sub>2</sub>e in the year 2030**.
- The Project would result in a cumulative reduction in GHG emissions of **8,150 tCO<sub>2</sub>e to the year 2030 (between 2019 and 2030)**.
- Over the anticipated 20-year lifetime of the Project (mid-2023 to 2043), including the Project construction (2019 to mid-2023), the Project results in a net GHG emission reduction of **20,123 tCO<sub>2</sub>e**.

The cost of the federal contribution per CO<sub>2</sub>e reduction for the 2030 calendar year is **\$14,700/tonne CO<sub>2</sub>e**, and the total capital and operational cost of the project per total CO<sub>2</sub>e reduced over the Project lifetime is **\$1,739/tonne CO<sub>2</sub>e**.

## Study Limitations

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## 1.0 INTRODUCTION

The greenhouse gas mitigation assessment (GHG Mitigation Assessment) that follows was requested by Yukon Energy Corporation (YEC) to fulfill Infrastructure Canada's requirement to undertake a greenhouse gas (GHG) mitigation assessment to meet the funding requirements of Investing in Green Infrastructure program. The assessment has been completed according to the guidance provided by Infrastructure Canada's Climate Lens Guidance Document (Infrastructure Canada 2018).

### 1.1 Company Description

Yukon Energy Corporation is a publicly owned electrical utility that was established in 1987. Yukon Energy Corporation is the main generator and transmitter of energy in the Yukon Territory. Currently, YEC has the capacity to generate just over 132 megawatts (MW), mainly from hydro, with small amounts from wind and solar. Diesel and liquified natural gas (LNG) are used for back-up and emergency power, and to meet winter peak demands during very cold weather when renewable energy is not able to meet the power demands.

### 1.2 Project Description

The Project is a grid scale battery energy storage system (BESS) located in Whitehorse across the road (Robert Service Way) from YEC's main power generation facility (Whitehorse Facility). The Whitehorse Facility currently generates power from hydro, diesel and LNG sources. The BESS will include a transformer substation, electrical equipment (including a breaker, air switch, underground termination) and modular climate-controlled battery houses. The BESS will have an 8 MW capacity consisting of 4 MW of spinning reserve and 4 MW of reserve capacity. The power stored by the BESS will be used to assist in meeting peak power demand. The BESS will store power generated from existing hydro, diesel and LNG engines at the Whitehorse Facility. However, in mid-2023 YEC anticipates that a wind farm will be commissioned at the Whitehorse Facility, the wind farm will also be a source of power for the BESS. During the winter months the BESS would allow for storage of renewable power (wind farm and hydro) to meet winter peak demand, this will increase wind power generation rates; the BESS is not anticipated to result in an increase in hydro power generation rates. The use of the BESS, specifically in the winter months, is expected to offset the use of diesel and LNG power generation.

The Project will consist of the following activities:

- The construction of the BESS (transformer substation, electrical equipment and modular battery houses).
- Operation of the BESS over its 20-year life to assist in meeting winter peak power demand.

The Project construction phase is expected to be undertaken over four years from 2019 to mid-2023. The Project is expected to have an operational life of 20 years, from mid-2023 through 2043. During its first year of operation YEC forecasts a reduction in thermal energy generation of 0.8 GWh, and 1.6 GWh in each subsequent operational year.

The construction of the wind farm and subsequent transmission line connecting it to the Whitehorse facility have not been included in the Project since this infrastructure would be constructed regardless of the Project.

## 2.0 METHODOLOGY

### 2.1 Assessment Approach

The GHG Mitigation Assessment for the Project is consistent with the relevant sections of ISO 14064-2:2006 and Canadian guidance documents related to the quantification of GHGs (Canada's National GHG Reporting Program). Emissions of carbon dioxide (CO<sub>2</sub>), methane (CH<sub>4</sub>), and nitrous oxide (N<sub>2</sub>O) were quantified.

Emission factors for CO<sub>2</sub>, CH<sub>4</sub> and N<sub>2</sub>O used in this GHG Mitigation Assessment are consistent with emission factors used in Canada's GHG National Inventory Report (NIR) for 1990-2017 (NIR Report) (ECCC 2019b). Per the Climate Lens Guidance (Infrastructure Canada 2018), the global warming potential (GWP) for CH<sub>4</sub> is assigned the outdated International Panel on Climate Change (IPCC) AR4 100-year GWP value of 25 (Forster et al. 2007), rather than the updated AR5 value of 34 (Myhre et al. 2013).

No removals are anticipated for both the Baseline and Project cases discussed below.

### 2.2 Assessment Cases

**Baseline Case:** In the absence of the Project, the Whitehorse Facility will supply power from the existing hydro, diesel, and LNG generation sources, as well as the wind farm which will be commissioned in mid-2023. Annual and cumulative GHG emissions for the years 2019 through 2043 have been quantified based on existing and forecasted power generation needs provided by YEC. The current and future power generation between 2019 and 2043 were forecasted by YEC (electronic resource, *Hydro Grid Battery Generation Source Forecast Rev 3.xlsx*, provided by Hector Campbell on 16 August 2019). For the Whitehorse Facility, hydro and wind power generation are assumed not to have any GHG emissions. Therefore, the Baseline case includes GHG emissions from power generation using diesel and LNG combustion (GHG emission which are owned or controlled by the proponent are referred to as direct emission or Scope 1).

**Project Case:** Annual and cumulative GHG emissions for the years 2019 to 2043 as a result of the construction of the BESS (2019 to mid-2023), operation of the BESS (mid-2023 to 2043), and power generation with the BESS operational. The Whitehorse Facility wind farm will be commissioned in mid-2023. Consistent with the Baseline case, for the Whitehorse Facility hydro and wind power generation are assumed not to have any GHG emissions.

Specifically, the Project case includes GHG emissions from:

- Construction of the BESS substation from on-road and off-road construction vehicles (direct, Scope 1).
- Power generation from diesel and LNG combustion during construction between 2019 and mid-2023 (direct, Scope 1).
- Power generation and power storage in the BESS (direct, Scope 1).

The YEC Power Generation Forecast, which was used for both the Baseline and Project cases, reflect the results of YEC modelling annual generation forecasts that utilizes the use of hydro, wind, LNG and diesel in that order of priority without and with the BESS respectively.

## 2.2.1 Scope of GHG Mitigation Assessment

The Baseline GHG Mitigation Assessment quantifies direct (Scope 1) emissions from the generation of grid power by YEC during the construction phase of the Project (2019 to mid-2023) and quantifies the direct (Scope 1) emissions from the generation of power in the absence (no power storage to meet winter peak demand) of the Project (mid-2023 to 2043).

The Project case includes direct (Scope 1) emissions from construction activities (2019 to mid-2023) and power generation accounting for the Project (2019 to 2043).

## 2.2.2 Timescale

Both the Baseline and the Project case consider the same timescale from 2019 through 2043. The timescale spans the construction phase (2019 to mid-2023) and the operational phase (mid-2023 to 2043) of the Project. The Project is expected to begin construction in 2019 and the BESS is expected to be commissioned in mid-2023. The useful life of the Project is expected to be 20 years, from mid-2023 through 2043.

## 2.3 Data Collection and Calculation Procedures

Yukon Energy Corporation provided Golder with power generation forecasts from 2019 to 2043 for both the Baseline case and the Project case. The power generation forecast considered the anticipated commissioning of the wind farm in mid-2023, power generation required for future mining operations (i.e., Minto Mine and Victoria Gold mine), and a breakdown of forecast power production by type including hydro, thermal energy and wind (onwards of mid-2023). The power generation forecast reflect the results of YEC modelling annual generation forecasts that utilizes the use of hydro, wind, LNG and diesel in that order of priority without and with the BESS respectively. The proposed conceptual site layouts of the BESS were provided in YEC's Resource Plan, Appendix 5.19 Energy Storage Technology Assessment (TransGrid Solutions Inc 2016).

The BESS construction activities were anticipated to be similar to construction activities related to a substation, therefore on-road and off-road construction fleet were estimated using a construction fleet for a substation.

Assumptions associated with grid power generation in both Baseline and Project emissions are as follows:

- In both the Baseline and Project case, grid power from the Whitehorse Facility will be supplied throughout the Project life from 2019 to 2043.
- For the Baseline case, mid-2023 and beyond, the power generation at the Whitehorse Facility accounts for operation of the wind farm.
- For the Project case, mid-2023 and beyond, the power generation accounts for a BESS with 4 MW of spinning reserve and a 4 MW capacity reserve.
  - Annual hydro power generation rates are anticipated to remain the same between Baseline and Project cases.
  - Annual wind power generation rates are anticipated to increase in the Project case when compared to the Baseline case.

- Annual thermal power (diesel and LNG) generation rates are anticipated to decrease in the Project case compared to the Baseline case.
- In both the Baseline and Project case, an LNG power combustion efficiency of 40.4% was used which is consistent with *Amended Lifecycle Analysis of Diesel and LNG Power Production* life cycle assessment ((S&T)<sup>2</sup> Consultants Inc. 2014).
- In both the Baseline and Project case, a diesel power combustion efficiency of 3.67 kWh/L diesel was used (Taggart 2013).

### 2.3.1 Units

Quantification of emissions of GHGs are reported in tonnes per year (t/yr) of CO<sub>2</sub>, CH<sub>4</sub> and N<sub>2</sub>O. Other key units in the assessment include:

- Carbon dioxide equivalents (CO<sub>2</sub>e): Baseline and Project GHG emissions were converted to units of CO<sub>2</sub>e using the GWP's identified in Canada's NIR (ECCC 2019a, b & c).
- Gigawatt hours of grid energy produced per year (GWh/yr).
- Diesel and LNG fuel consumption in kilolitres per year (kL/yr).

### 2.3.2 Baseline Emissions

#### 2.3.2.1 Grid Power Generation Emissions

There are four power production sources at the Whitehorse Facility hydro, diesel, LNG and wind (onwards of mid-2023). The difference between the Baseline case and the Project case is that some renewable power will be stored in the BESS thereby offsetting power generation from diesel and LNG especially in the winter months.

In this assessment, the applicable power generation activities subject to GHG emissions are power generation from diesel and LNG combustion. Consistent with the ECCC (2019c), no GHG emissions have been assigned for hydro or wind power generation.

##### 2.3.2.1.1 Diesel Grid Power Generation

The GHG emissions from diesel power generation were calculated using the forecasted annual power generation and a diesel volume to power generation conversion factor (Taggart 2013). Emission factors for CO<sub>2</sub>, CH<sub>4</sub>, and N<sub>2</sub>O were taken from Table A6-4 in the ECCC NIR 1990-2017 (ECCC 2019b). Parameters for a sample CO<sub>2</sub> emission calculation for grid diesel combustion for the year 2019 are shown in Table 1.

**Table 1: Parameters for a Sample CO<sub>2</sub> Emission Calculation for Diesel Combustion for the Year 2019**

Notation	Parameter	Unit	Value	Reference
<i>Site Specific Input Parameters</i>				
Energy (from Diesel)	Forecast Energy Required from Diesel Generation	GWh	2.6	YEC Forecast (2019)
<i>Default Parameters</i>				
CF	Diesel to Energy Conversion Factor	kWh/L	3.67	Yukon Greenhouse Gas Emissions: the transportation sector (Taggart 2013)
EF	CO <sub>2</sub> Emission Factor	kg/kL	2,681	ECCC NIR Part 2, Table A6-4 (ECCC 2019b)
UC1	Unit Conversion	kL/L	0.001	—
UC2	Unit Conversion	tonne/kg	0.001	—
UC3	Unit conversion	kWh/GWh	10 <sup>6</sup>	—

$$\text{Annual CO}_2 \text{ Emissions (tonnes)} = \frac{\text{Energy}}{\text{CF}} \times \text{EF} \times \text{UC1} \times \text{UC2} \times \text{UC3}$$

$$\text{Annual CO}_2 \text{ Emissions (tonnes)} = \frac{2.6 \text{ GWh}}{\text{yr}} \times \frac{\text{L}}{3.67 \text{ kWh}} \times \frac{2,681 \text{ kg CO}_2}{\text{kL diesel}} \times \frac{0.001 \text{ kL}}{\text{L}} \times \frac{0.001 \text{ tonnes}}{\text{kg}} \times \frac{10^6 \text{ kWh}}{\text{GWh}}$$

$$\text{Annual CO}_2 \text{ Emissions (tonnes)} = \frac{1,899 \text{ tonnes}}{\text{year}}$$

The grid power generation emission factor used for diesel is provided in Table 2.

**Table 2: Diesel Generation Emission Factor**

Value	CO <sub>2</sub>	CH <sub>4</sub>	N <sub>2</sub> O
Diesel Emission Factor <sup>(a)</sup> (kg/kL)	2,681	0.133	0.4

(a) Emission factors provided in Table A6-4 in the ECCC NIR 1990-2017 (ECCC 2019b).

### 2.3.2.1.2 LNG Grid Power Generation

The GHG emissions from LNG stationary combustion were calculated using guidance from Methodology 1 in ECCC Quantification Requirements (ECCC 2018). Specifically, Equations 2-2 for CO<sub>2</sub> and 2-12 for CH<sub>4</sub> and N<sub>2</sub>O were used. The forecasted annual LNG power in GWh provided by YEC were converted to a natural gas fuel input value in m<sup>3</sup>/year using the high heat value for natural gas. Emission factors for CO<sub>2</sub>, CH<sub>4</sub>, and N<sub>2</sub>O for natural gas combustion were taken from Table A6-1 and A6-2 in the ECCC NIR 1990-2017 (ECCC 2019b for “All Other Uses”). Parameters for CO<sub>2</sub> emission calculation for grid LNG combustion for the year 2019 are provided in Table 3.

**Table 3: Parameters for CO<sub>2</sub> Emissions Calculation for Liquid Natural Gas Combustion for the Year 2019**

Notation	Parameter	Unit	Value	Reference
<i>Site Specific Input Parameters</i>				
Energy (from LNG)	Forecast Energy Required from LNG Generation	GWh	48.5	YEC Forecast (2019)
<i>Default Parameters</i>				
HHV	High Heat Value of Natural Gas	GJ/m <sup>3</sup>	0.038	WCI Table 20-1 (WCI 2011)
EF	CO <sub>2</sub> Emission Factor	g/m <sup>3</sup>	1,901	ECCC NIR Part 2, Table A6-1 (ECCC 2019b)
eff	Efficiency of gas fired engine-generator set	percent	40.4	Amended Lifecycle Analysis of Diesel and LNG Power Production ((S&T) <sup>2</sup> Consultants Inc. 2014)
UC1	Unit Conversion	GJ/GWh	3,600	—
UC2	Unit Conversion	g/tonne	10 <sup>6</sup>	—

$$\text{Annual CO}_2 \text{ Emissions (tonnes)} = \frac{\text{Energy}}{\text{HHV} \times \text{eff}} \times \text{UC1} \times \text{EF} \times \text{UC2}$$

$$\text{Annual CO}_2 \text{ Emissions (tonnes)} = \frac{48.5 \text{ GWh}}{\text{yr}} \times \frac{\text{m}^3}{0.038 \text{ GJ}} \times \frac{1}{0.404} \times \frac{3,600 \text{ GJ}}{\text{GWh}} \times \frac{1,901 \text{ g}}{\text{m}^3} \times \frac{\text{tonne}}{10^6 \text{ g}}$$

$$\text{Annual CO}_2 \text{ Emissions (tonnes)} = \frac{21,620 \text{ tonnes}}{\text{yr}}$$

The grid power generation emission factor used for natural gas is provided in Table 4 below.

**Table 4: Natural Gas Generation Emission Factor**

Value	CO <sub>2</sub>	CH <sub>4</sub>	N <sub>2</sub> O
Natural gas Emission Factor <sup>(b)</sup> (g/m <sup>3</sup> )	1,901	0.49	0.049

(a) Emission factors provided in Table A6-1 and A6-2 in the ECCC NIR 1990-2017 (ECCC 2019b).

### 2.3.3 Project Emissions

#### 2.3.3.1 Construction Emissions

The equipment list and hours of operation estimates for each piece of equipment required during the construction phase were estimated under the assumption that the construction of the BESS would be similar to the construction of a substation, and that vehicular emissions were scalable based on the physical footprint of the BESS.

### 2.3.3.1.1 On-Road Vehicles

As the total fuel sold and vehicle kilometers travelled by the construction vehicles are unknown, guidance from the IPCC Road Transportation (IPCC 2006) was not applicable. Instead, Methodology 1 from ECCC Quantification Requirements (ECCC 2018), Equation 2-3 for CO<sub>2</sub> and Equation 2-16 for CH<sub>4</sub> and N<sub>2</sub>O, were used to calculate GHGs from on-road vehicles. The brake specific fuel capacity for non-road engines published by Environmental Protection Agency (EPA) (2002) and load factors for compression ignition engines (EPA 2010) were used in the absence of equivalent data for on-road vehicles. Parameters for a sample on-road CO<sub>2</sub> emissions calculation for diesel combustion in a pickup truck for 2019 to 22 are provided in Table 5.

**Table 5: Parameters for a Sample CO<sub>2</sub> Emissions Calculation for Diesel Combustion in a Pickup Truck for 2019 to 2022**

Notation	Parameter	Unit	Value	Reference
<i>Site Specific Input Parameters (for Diesel Pickup)</i>				
Hp	Vehicle horsepower	hp	397	Estimated hp for vehicle - Assumption based on 2500HD pickup
N	Number of units	n/a	1	Estimated from substation construction
D	Construction hours per day	Hours/day	8	Estimated from substation construction
L	Length of construction activities	Work days/ construction period	5	Estimated from substation construction
U	Utilization rate of vehicle (percent of time vehicle is operational)	Percent	30	Estimated from substation construction
<i>Default Parameters</i>				
LF	Load factor	—	0.59	Compression ignition load factors (EPA 2010)
BSFC	Brake-specific fuel consumption	lb/hp-hr	0.367	Exhaust and Crankcase Emission Factors (EPA 2002)
EF	CO <sub>2</sub> Emission Factor	g/L	2,681	ECCC NIR Part 2, Table A6-4 (ECCC 2019b)
ρ	Diesel Density	kg/m <sup>3</sup>	870	—
SF	Scaling Factor	m <sup>2</sup> /m <sup>2</sup>	0.994	Scaling factor based on physical footprint of the BESS
UC1	Unit Conversion	Lb/kg	2.24	—
UC2	Unit Conversion	L/m <sup>3</sup>	1,000	—
UC2	Unit Conversion	tonne/kg	10 <sup>-6</sup>	—

$$\text{Construction CO}_2 \text{ Emissions (tonnes)} = \frac{(N \times D \times L \times U \times Hp \times LF \times BSFC_{ik})}{UC1 \times \rho} \times UC2 \times EF \times UC3$$

Construction CO<sub>2</sub> Emissions (tonnes)

$$= 1 \text{ pickup} \times \frac{8 \text{ hours}}{\text{day}} \times \frac{5 \text{ days}}{\text{period}} \times 0.30 \times 397 \text{ hp} \times 0.59 \times \frac{0.367 \text{ lb}}{\text{hp-h}} \times \frac{\text{kg}}{2.24 \text{ lb}} \times \frac{\text{m}^3}{870 \text{ kg}} \times \frac{1,000 \text{ L}}{\text{m}^3} \\ \times \frac{2,681 \text{ g CO}_2}{\text{L}} \times \frac{1 \text{ tonne}}{10^6 \text{ g}} \times \frac{0.994 \text{ m}^2}{\text{m}^2}$$

$$\text{Construction CO}_2 \text{ Emissions (tonnes)} = \frac{1.41 \text{ tonnes}}{\text{period}}$$

Assumptions associated with on-road Project emissions are as follows:

- All vehicles were assumed to be diesel powered.
- GHG emissions for the BESS substation were scaled based on the physical footprint of the BESS. The BESS is currently being designed; therefore, for this assessment the physical footprint was based on conceptual drawings of the BESS developed for YEC's Resource Plan (TransGrid Solutions Inc 2016). Within the Resource Plan (TransGrid Solutions Inc 2016), four conceptual BESS layouts were provided, the layout with the largest footprint (8 MW capacity with 80 MWh option) was selected as this option would result in the most conservative (highest) construction GHG emissions.

The GHG emission factors (EF for CO<sub>2</sub>, CH<sub>4</sub>, and N<sub>2</sub>O) used in the Project case for on-road emissions are summarized in Table 6.

**Table 6: On-Road Emission Factors, Project Case**

Value	CO <sub>2</sub>	CH <sub>4</sub>	N <sub>2</sub> O
EF <sup>(a)</sup> (kg/kL)	2,681	0.14	0.082

(a) Emission factors are the maximum emission factors for heavy duty diesel vehicle (HDDV) from Table A6-12 in the ECCC NIR 1990-2017 (ECCC 2019b).

### 2.3.3.1.2 Off-Road Vehicles

GHG emissions from off-road equipment were calculated in a similar manner to on-road equipment so a sample calculation is not provided.

Assumptions associated with off-road Project emissions are as follows:

- It was conservatively assumed that the off-road equipment will meet Tier 2 emission standards.
- All vehicles were assumed to be diesel powered.
- GHG emissions for the BESS substation were scaled based on the footprint of the BESS facility. The method was consistent as described in Section 2.3.2.1.1.

The GHG emission factors (EF for CO<sub>2</sub>, CH<sub>4</sub>, and N<sub>2</sub>O) used in the Project case off-road emissions are summarized in Table 7.

**Table 7: Off-Road Emission Factors, Project Case**

Value	CO <sub>2</sub>	CH <sub>4</sub>	N <sub>2</sub> O
EF <sup>(a)</sup> (kg/kL)	2,681	0.073	0.022

(a) Emission factors taken from Table A6-12 in the ECCC NIR 1990-2017 (ECCC 2019b) of off-road diesel greater than or equal to 19 kW, tier 1-3.

### 2.3.3.2 Grid Power Generation Emissions

There are four anticipated grid power sources at the Whitehorse Facility, hydro, diesel, LNG and wind (mid-2023 onwards). Grid power generation GHG estimation methods are consistent with the methods detailed in Section 2.3.2.1 for diesel and LNG / natural gas combustion. No additional sample calculations have been provided.

## 2.4 Exclusions from the Assessment

The construction of the wind farm and subsequent transmission line connecting it to the Whitehorse Facility have not been included in the Project since this infrastructure would be constructed regardless of the Project. Furthermore, GHG emissions from the construction of the wind farm and transmission line would negate each other in the net change calculation. It has also been assumed that during operation of the Project, annual GHG emissions from maintenance vehicles will be insignificant and have not been included in the assessment.

### 3.0 BASELINE EMISSIONS

#### 3.1 Direct Emissions (Scope 1)

Direct Baseline emissions are summarized in Table 8 and include power generation from diesel and LNG combustion during between 2019 and 2043 (direct, Scope 1).

**Table 8: Baseline Case Direct Greenhouse Gas Emission Estimates (Scope 1)**

Time Frame	GHG Emissions [t]			GHG Emissions [tCO <sub>2</sub> e] <sup>1</sup>
	CO <sub>2</sub>	CH <sub>4</sub>	N <sub>2</sub> O	
2019 to 2043	616,587	149	22	626,858
Year 2030	42,321	10	2	43,025

t = tonne; CO<sub>2</sub> = carbon dioxide; CH<sub>4</sub> = methane, N<sub>2</sub>O = nitrous oxide; CO<sub>2</sub>e = carbon dioxide equivalents.

<sup>1</sup> Global Warming Potentials from Canada Gazette Notice, 2017.

### 4.0 PROJECT EMISSIONS

#### 4.1 Direct Emissions (Scope 1)

Direct Project emissions are summarized in Table 9 and include the following:

- Construction of the BESS substation from on-road and off-road construction vehicles (direct, Scope 1).
- Power generation from diesel and LNG combustion during construction 2019 and mid-2023 (direct, Scope 1).
- Power generation and power storage in the BESS to meet winter peak demand using wind, diesel and LNG between mid-2023 and 2043 (direct, Scope 1).

**Table 9: Project Case Greenhouse Gas Emission Estimates (Scope 1)**

Timeframe	GHG Emissions [t]			GHG Emissions [tCO <sub>2</sub> e] <sup>1</sup>
	CO <sub>2</sub>	CH <sub>4</sub>	N <sub>2</sub> O	
2019 to 2043	597,156	146	20	606,736
Year 2030	41,244	10	1	41,903

t = tonne; CO<sub>2</sub> = carbon dioxide; CH<sub>4</sub> = methane, N<sub>2</sub>O = nitrous oxide; CO<sub>2</sub>e = carbon dioxide equivalents.

<sup>1</sup> Global Warming Potentials from Canada Gazette Notice, 2017.

## 5.0 ESTIMATED NET CHANGE IN EMISSIONS

Net reductions in GHG emissions are calculated as the difference between total CO<sub>2</sub>e emissions between the Project case and the Baseline case. In this GHG Mitigation Assessment, net GHG reduction calculations include GHGs produced directly by the Project, as required by the Climate Lens guidance document (Infrastructure Canada 2018). The net change over each year of the Project is summarized in Table 10; negative values in the table represent a GHG reduction as a result of the Project being implemented.

**Table 10: Total Net Change in Emissions**

Year No.	Year	Total Project Emissions (A) (t CO <sub>2</sub> e)	Total Baseline Emissions (B) (t CO <sub>2</sub> e)	Total Net Change (A-B) (t CO <sub>2</sub> e)
1	2019	23,851	23,851	0
2	2020	38,429	38,349	80
3	2021	43,161	43,025	136
4	2022	44,998	44,896	102
5	2023	49,180	49,791	-611
6	2024	41,903	43,025	-1,122
7	2025	21,326	22,448	-1,122
8	2026	27,873	28,995	-1,122
9	2027	20,858	21,980	-1,122
10	2028	27,873	28,995	-1,122
11	2029	34,888	36,010	-1,122
<b>12</b>	<b>2030</b>	<b>41,903</b>	<b>43,025</b>	<b>-1,122</b>
13	2031	20,858	21,980	-1,122
14	2032	20,858	21,980	-1,122
15	2033	20,858	21,980	-1,122
16	2034	20,858	21,980	-1,122
17	2035	20,858	21,980	-1,122
18	2036	20,858	21,980	-1,122
19	2037	4,864	5,612	-748
20	2038	6,337	7,085	-748
21	2039	7,820	8,569	-748
22	2040	9,314	10,062	-748
23	2041	10,819	11,567	-748
24	2042	12,333	13,082	-748
25	2043	13,859	14,607	-748
<b>Total</b>		<b>606,736</b>	<b>626,858</b>	<b>-20,123</b>

Based on this analysis:

- The Project would result in a reduction in GHG emissions of **1,122 tCO<sub>2</sub>e in the year 2030**.
- The Project would result in a cumulative reduction in GHG emissions of **8,150 tCO<sub>2</sub>e to the year 2030 (between 2019 and 2030)**.
  - Project emissions, cumulative to 2030 are **416,242 tCO<sub>2</sub>e**.
  - Baseline emissions, cumulative to 2030 are **424,392 tCO<sub>2</sub>e**.
- Over the anticipated 20-year lifetime of the Project (mid-2023 to 2043), and the Project construction (2019 to mid-2023) results in a net GHG emission reduction of **20,123 tCO<sub>2</sub>e**.

## 6.0 COST PER TONNE

A summary of the Project costs is detailed in Table 11.

**Table 11: Summary of Project Costs**

Description	Costs
Total Project Capital	\$25,000,000
Annual Operating Costs	\$500,000
Total Operational Costs over Project Life	\$10,000,000
Total Federal Contribution Requests	\$16,500,000

The cost of the federal contribution per CO<sub>2</sub>e reduction for the 2030 calendar year is \$14,700/tonne CO<sub>2</sub>e, and the sample the calculation is provided below.

$$\frac{\text{Federal Dollars}}{\text{2030 CO}_2\text{e Reduction}} = \frac{\$16,500,000}{1,122 \text{ CO}_2\text{e reduction}} = \frac{\$14,700}{t \text{ CO}_2\text{e}}$$

The total capital (including federal contribution) and operational cost of the Project per total CO<sub>2</sub>e reduced over the Project lifetime is \$1,739/tonne CO<sub>2</sub>e and the sample calculation is provided below.

$$\frac{\text{Total Capital and O\&M Dollars}}{\text{Project life CO}_2\text{e Reduction}} = \frac{\$25,000,000 + \$10,000,000}{20,123 \text{ CO}_2\text{e reduction}} = \frac{\$1,739}{t \text{ CO}_2\text{e}}$$

## 7.0 STATEMENT BY A QUALIFIED PERSON

Please refer to the cover letter accompanying this document submission package.

## 8.0 CONCLUSION

Yukon Energy Corporation is proposing to construct a grid scale BESS which would allow for the storage of power to meet peak power demand. The BESS may store power generated from renewable (hydro and wind farm) and non-renewable (diesel and LNG) sources. During the winter peak demand is usually met by using power generated from thermal sources (diesel or LNG). When the BESS stores renewable power, during the winter, it is therefore offsetting power from non-renewable sources. The construction and operation of the BESS will reduce the use of thermal power and therefore reduce the GHG emissions over its expected Project life of 20 years.

During the BESS' first year of operation YEC forecasts a reduction in thermal energy generation of 0.8 GWh and 1.6 GWh in each subsequent operational year.

A GHG Mitigation Assessment was prepared following the guidance provided in the "*Climate Lens General Guidance, Version 1.1*", dated June 1, 2018 (Infrastructure Canada 2018). Results of the GHG Mitigation Assessment include assessment of a Baseline and Project case. Both cases consider GHG emissions reportable under Canada's existing policy framework.

Predicted reductions in emissions are summarized as follows:

- The Project would result in a reduction in GHG emissions of **1,122 tCO<sub>2</sub>e in the year 2030**.
- The Project would result in a cumulative reduction in GHG emissions of **8,150 tCO<sub>2</sub>e to the year 2030 (between 2019 and 2030)**.
- Over the anticipated 60-year lifetime of the Project (mid-2023-2043), and the Project construction (2019-2022) results in a net GHG emission reduction of **20,123 tCO<sub>2</sub>e**.

The cost of the federal contribution per CO<sub>2</sub>e reduction for the 2030 calendar year is **\$14,700/tonne CO<sub>2</sub>e**, and the total capital and operational cost of the Project per total CO<sub>2</sub>e reduced over the Project lifetime is **\$1,739/tonne CO<sub>2</sub>e**.

## 9.0 CLOSURE

The reader is referred to the Study Limitations section, which precedes the text and forms an integral part of this report.

We trust the above meets your present requirements. If you have any questions or require additional information, please contact the undersigned.

## Signature Page

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JR/RW/SC/rs/no/...

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1 **TOPIC: Blackstart and Outage Restoration**

2

3 **REFERENCE: Application, Tab 3.1.2.2, PDF pages 17 and 18; Application, Tab**  
4 **4.2.1, PDF page 34**

5

6 **QUOTE:** Application, PDF page 17:

7

8 “In the event of a significant grid outage, Yukon Energy must blackstart  
9 the grid. To do so, YEC sectionalizes the grid into smaller load  
10 segments, which are re-energized sequentially using smaller individual  
11 generators. This involves energizing the electrical equipment in the  
12 substation, then the hydro generation, in several increments. As the  
13 system is segmented into numerous load blocks, and some of the  
14 switching is of a manual nature that needs to be conducted by  
15 deploying resources to the field for restoration, this process can take  
16 up to 2 hours, depending on the extent and severity of the outage.”

17

18 “Blackstart events are fairly rare, e.g., average 53 events per year  
19 based on average for 2014-2018 and 79 events per year estimated for  
20 worst case based on 2019 Annual Report with assumed maximum  
21 energy duration equal to the BESS energy capacity (35 or 40 MWh) per  
22 event. However, blackstart outage restoration accounts for more than  
23 half of the estimated BESS annual throughput and cycles under typical  
24 and worst case scenarios. BESS use for blackstart will incur operating  
25 efficiency losses of 15% on the throughput; however, it is assumed that  
26 overall savings from enhanced system restart will more than offset any  
27 efficiency loss costs.”

28

29 Application, PDF page 18:

30

31 “Having the larger BESS (10 MW/40 MWh, 13 MW/40 MWh or 20  
32 MW/40 MWh) will increase the power capacity of the load segments  
33 during blackstart, thus reducing the time required to reenergize the grid.  
34 As well, the higher energy capacity will increase the infrastructure and  
35 power generation that can be re-energized with the BESS. Particularly,  
36 the 20 MW power capabilities provides Yukon Energy with increased  
37 flexibility to significantly increase the segments that can be picked up

1 during the blackstart process, which reduces the time. This 20 MW  
2 inverter capability can also cover the loss of Whitehorse Hydro Unit #4.  
3 It also has the highest operating factor (capacity factor) of all of Yukon  
4 Energy's generation, therefore, and outage of Whitehorse Hydro Unit  
5 #4 can lead to critical outages on the grid. Based on discussions with  
6 Yukon Energy, this hydro unit is the cause of many system outages."  
7 (footnotes removed)

8  
9 Application, PDF page 34:

10  
11 "The Whitehorse Hydro WH4 Uprate Project will increase the maximum  
12 water flow providing 0.9 GWh of annual additional energy, however,  
13 due to downstream Yukon River system ice flow restrictions this project  
14 does not provide additional dependable capacity."  
15

16 **QUESTION:**

- 17
- 18 a) Please provide details of the most severe outage that occurred on YEC's system  
19 in the last ten years. Please explain the cause of the event and the steps taken to  
20 restore the system and the time it took for existing generation to energize the  
21 system.  
22
- 23 b) If the BESS project was installed at the time of the most severe outage mentioned  
24 in part (a), please explain the steps YEC would take to restore the system and  
25 provide the time it would take for restoration for the following battery option  
26 scenarios: 6.6 MW/35 MWh; 7 MW/40 MWh; 8.8 MW/35 MWh; 10 MW/40 MWh;  
27 13 MW/40 MWh; 20 MW/40 MWh.  
28
- 29 c) Considering Whitehorse Hydro Unit #4 is related to many system outages, please  
30 indicate whether YEC conducted any upgrades of this unit in the past to minimize  
31 outages. If upgrades have been conducted, please provide the upgrades  
32 conducted, the reasons for the upgrades and the years in which these occurred.  
33
- 34 d) How frequently will the BESS project be required for blackstart and outage  
35 restoration if the WH4 Uprate Project is completed?

1 **ANSWER:**

2

3 **(a)**

4

5 On April 15, 2014 there was a 97% grid outage. The cause of the event was the loss of  
6 WH4 due to a failure of the governor PLC. The outage occurred at 2:58 am with a system  
7 load of 34.54 MW. Pre-disturbance generation on line was WH4, AH1, MBH1 and MH1.

8

9 The restoration involved a combination of diesel and hydro. The duration of the outage  
10 was 1 hour 20 minutes. Minto Mine was restored after 2 hours 51 minutes.

11

12 **(b)**

13

14 The BESS's ability to minimize the impact of a disturbance involving the loss of WH4  
15 generation is dependent on the total available on line reserve. With insufficient generation  
16 after the WH4 trip the under frequency protected breakers operate to reduce system  
17 loading. The restoration duration is reduced through the use of the battery and its ability  
18 to pick up larger portions of load.

19

20 • **6.6 MW/35 MWh:** The extent of the outage would not be reduced with the battery  
21 picking up 7 MW of the lost WH4 generation. With insufficient generation available  
22 after the loss of WH4 the under frequency protection would trip all 7 feeders.  
23 Restoration duration would be reduced by approximately 25%. Additional  
24 generation would be added to the system to offload the battery. The battery would  
25 be used in conjunction with the hydro/diesel generation to restore the system load.

26

27 • **7.0 MW/40MWh:** The extent of the outage would not be reduced with the battery  
28 picking up 7 MW of the lost WH4 generation. With insufficient generation available  
29 after the loss of WH4 the under frequency protection would trip all 7 feeders.  
30 Restoration duration would be reduced by approximately 25%. Additional  
31 generation would be added to the system to offload the battery. The battery would  
32 be used in conjunction with the hydro/diesel generation to restore the system load.

33

34 • **8.8 MW/35 MWh:** The extent of the outage would be reduced with the battery  
35 picking up 8 MW of the lost WH4 generation. With insufficient generation available  
36 after the loss of WH4 the under frequency protection would trip 4-5 feeders.  
37 Restoration duration would be reduced by approximately 40%. Additional

1 generation would be added to the system to offload the battery. The battery would  
2 be used in conjunction with the hydro/diesel generation to restore the system load.

3

4 • **10 MW/40 MWh:** The extent of the outage would be reduced with the battery  
5 picking up 10 MW of the lost WH4 generation. With insufficient generation  
6 available after the loss of WH4 the under frequency protection would trip 3-4  
7 feeders. Restoration duration would be reduced by approximately 60%. Additional  
8 generation would be added to the system to offload the battery. The battery would  
9 be used in conjunction with the hydro/diesel generation to restore the system load.

10

11 • **13 MW/40 MWh:** The extent of the outage would be significantly reduced with the  
12 battery picking up 13 MW of the lost WH4 generation. The under frequency  
13 protection would have been limited to 2-3 feeders trips. Restoration duration would  
14 be reduced by approximately 75%. Additional generation would be added to the  
15 system to offload the battery. The battery would be used in conjunction with the  
16 hydro/diesel generation to restore the system load.

17

18 • **20 MW/40 MWh:** It is plausible that this event would have been avoided with a  
19 BESS capacity of 20 MW, the loss of WH4 output would have been absorbed by  
20 the battery. Additional hydro/diesel generation would have been placed on line to  
21 offload the battery.

22

23 (c)

24

25 The original WH4 Excitation System was becoming increasingly difficult to support as  
26 technical experts retired and parts became obsolete. Therefore, YEC decided to replace  
27 it with a new and modern Excitation System.

28

29 The WH4 generator also underwent a major mechanical overhaul at the same time as the  
30 Excitation System was being replaced, including installation of a new rotor spider for the  
31 generator. The rotor was found to have propagating cracks that ultimately would have  
32 resulted in the unit being unsafe to operate.

33

34 Both projects were completed in early Q2 2017. Both projects improved the reliability and  
35 availability of the unit.

1 (d)

2

3 The WH4 uprate project does not impact the frequency the BESS will be used for black  
4 start/system restoration. The WH4 uprate increases the output of the unit and is not  
5 expected to improve the transient response. BESS will be used in the majority of system  
6 restorations due to its ability to quickly pickup large sections of load without the  
7 requirement to sectionalize the feeder loads.

1 **TOPIC:** **Load Shedding Events**

2

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

6

7 **QUOTE:** Application, PDF page 19:

8

9 “The BESS will reduce load shedding resulting from frequency  
10 excursions. Large frequency excursion events are relatively infrequent  
11 (8-18 events per year [Hatch, page 69]... However, these events  
12 directly impact customer reliability, particularly in the commercial  
13 sector, which can drive outage-related customer costs. Reduction in  
14 load shedding would result in increased customer reliability.”

15

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

22

23 Application, PDF page 67:

24

25 “The usage of the battery to reduce load shedding events must be  
26 weighed against the imposed degradation.”

27

28 Application, PDF page 68:

29

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

33

34 Application, PDF page 125:

35

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

1 Application, PDF page 125:

2

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

8

9 Application, PDF page 126:

10

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

16

17 “Since McIntyre substation is near Takhini and Whitehorse Substation,  
18 it may be possible for the BESS to respond to frequency deviations at  
19 this substation and avoid load shedding on the ATCO lines. However,  
20 it is imperative that the ability of the BESS to respond in a timely manner  
21 to avoid the system ‘chasing its tail’.”

22

23 Application, PDF page 127:

24

25 “The distribution of frequency deviations at Takhini Substation on S164-  
26 L172 and S164-L170 are presented in Table 6-20 and on S164-L171  
27 and S164-52-7 are presented...”

28

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

32

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

1                   “However, frequency control will lead to higher throughput of the BESS  
2                   and faster degradation of the battery’s capacity. Therefore, a balance  
3                   must be struck between using the BESS to reduce the impacts of  
4                   frequency excursions on the grid and degradation of the BESS.”  
5

6                   **QUESTION:**  
7

- 8                   a) Please provide the duration of the frequency deviations discussed from PDF pages  
9                   125 to 127 of the application for the Whitehorse, McIntyre and Takhini substations.  
10                  For example, how long were the major frequency deviations at these substations?  
11
- 12                  b) Please provide details on how YEC would avoid “chasing its tail” if it decided to  
13                  use the BESS project for frequency deviations at the McIntyre substation. For  
14                  example, what would be the timing required to successfully mitigate frequency  
15                  deviation at this substation?  
16
- 17                  c) For the Takhini substation, the Hatch Report indicated that the BESS project could  
18                  respond to deviations between 56.5 to 59.5 Hz, reducing their impact on power  
19                  quality. Please confirm that the deviation from 60 Hz results in power quality issues  
20                  and not the Battery Energy Storage System Project.  
21
- 22                  d) Please indicate whether YEC will increase the BESS’s frequency regulation as  
23                  more renewable projects connect to the system. If yes, please explain how YEC  
24                  will balance between using the project for frequency regulation and reducing the  
25                  degradation of the battery.  
26

27                  **ANSWER:**  
28

29                  **(a)**  
30

31                  Please see Attachment 1 to this response which provides the duration for all excursions  
32                  greater than +/- 1 Hz (e.g. when the grid frequency dropped below 59 Hz or went above  
33                  61 Hz). As the data shown is collected in 5-minute increments, it is possible events which  
34                  are shown as 5 minutes in duration were in reality shorter. Highlighted events are  
35                  considered the result of offline transducers and should not be considered (e.g., the  
36                  duration may be incorrect due to erroneous data).

1 **(b)**

2

3 The protection of the system against hunting/chasing its tail behavior and oscillations  
4 needs to be defined with a system impact and stability study, which is underway. The  
5 outcomes of the study will determine the control settings that will be programmed into the  
6 BESS to minimize hunting behavior.

7

8 One of the critical components of this study is determining the delay time of the BESS  
9 from the initial event to when the BESS provides a response as well as the response  
10 profile of the inverters (how fast they can go from 0-100% for example). If the BESS is  
11 monitoring a frequency node that is geographically far away from the system then the  
12 delay times of the BESS (inverter controllers, power electronics response, etc.) are  
13 compounded with the transmission signal delay coming from a remote monitoring point.

14

15 The longer this delay then the higher we need to tune integral gain values on the BESS  
16 control system. This would increase the stability of the response and prevent hunting but  
17 slow down the overall reaction. Note that the frequency response of the BESS also needs  
18 to be tuned in relation to the other generator's frequency response.

19

20 **(c)**

21

22 Yes. The power quality issues described are related to other grid events and are not  
23 resultant from the BESS project itself.

24

25 The BESS is not expected to reduce power quality.

26

27 **(d)**

28

29 The BESS will be set to respond to frequency excursions outside a certain range (e.g., +/-  
30 0.5 Hz deviation from 60 Hz). It is anticipated YEC will have control over this range and  
31 can adjust it based on grid operation. Therefore, YEC may choose to increase the range  
32 (e.g., +/-0.8 Hz deviation) to reduce the usage if this were to become an issue with  
33 increased variable renewable integration.

34

35 Additionally, as noted in the Hatch report, the usage for the BESS is currently relatively  
36 low. Therefore, a reasonable increase in usage can be accommodated without significant  
37 impacts on lifespan. Please see also YUB-YEC-1-1(h).

YUB-YEC-1-24 (a) Attachment 1

L151

Deviation (from 60 Hz)	Date	Duration
-20.680	12/11/2017	20 min
-8.920	5/1/2017	30 min
-3.140	8/8/2017	5 min
-2.390	10/30/2017	5 min
-1.580	4/10/2018	5 min
-1.070	4/20/2018	5 min
-2.330	5/31/2019	5 min
-1.110	2/8/2020	50 min
1.660	11/12/2018	5 min
13.550	4/22/2019	30 min

WH T9

Deviation (from 60 Hz)	Date	Duration
-7.508	5/13/2016	8580 min
-7.508	2/18/2017	45 min
-7.508	5/4/2018	14555 min
-7.508	4/22/2019	30 min
-7.508	4/29/2019	4330 min
-1.242	3/4/2016	5 min
-1.328	6/10/2016	5 min
-2.073	1/17/2017	5 min
-3.087	8/8/2017	5 min
-1.920	10/30/2017	5 min
-1.658	4/10/2018	5 min
-1.102	7/25/2018	5 min
-2.897	5/31/2019	5 min
1.536	2/18/2017	25 min
1.072	10/19/2018	5 min
1.487	11/12/2018	5 min

**S164-L172**

Deviation (from 60 Hz)	Date	Duration
-1.500	3/4/2016	5 min
-2.400	1/17/2017	5 min
-1.240	7/28/2017	5 min
-3.590	10/30/2017	5 min
-1.230	4/10/2018	5 min
-2.730	11/12/2018	5 min
-3.370	2/8/2020	20 min
4.510	7/15/2016	5 min
1.580	2/18/2017	25 min
2.030	6/12/2018	5 min
2.490	7/25/2018	5 min

YUB-YEC-1-24 (a) Attachment 1

**S164-L170**

Deviation (from 60 Hz)	Date	Duration
-2.260	3/4/2016	5 min
-2.370	1/17/2017	5 min
-1.230	7/28/2017	5 min
-3.690	10/30/2017	5 min
-1.210	4/10/2018	5 min
-3.120	8/6/2018	10 min
-2.460	11/12/2018	5 min
-1.020	9/9/2019	5 min
-1.630	9/19/2019	70 min
-3.380	2/8/2020	20 min
1.570	2/18/2017	25 min
2.260	7/25/2018	5 min

**S164-L171**

Deviation (from 60 Hz)	Date	Duration
-1.490	3/4/2016	5 min
-2.400	1/17/2017	5 min
-1.250	7/28/2017	5 min
-3.600	10/30/2017	5 min
-1.300	4/10/2018	5 min
-3.690	8/6/2018	10 min
-2.170	11/12/2018	5 min
-1.220	9/19/2019	70 min
-3.390	2/8/2020	20 min
3.800	7/15/2016	5 min
1.570	2/18/2017	30 min
2.030	6/12/2018	5 min

**S164-52-7**

Deviation (from 60 Hz)	Date	Duration
-1.700	3/4/2016	5 min
-2.400	1/17/2017	5 min
-1.250	7/28/2017	5 min
-3.480	10/30/2017	5 min
-1.230	4/10/2018	5 min
-3.750	8/6/2018	10 min
-2.630	11/12/2018	5 min
-1.000	9/9/2019	5 min
-3.390	2/8/2020	20 min
3.210	7/15/2016	5 min
1.580	2/18/2017	30 min
2.020	6/12/2018	5 min

YUB-YEC-1-24 (a) Attachment 1

**S170**

Deviation (from 60 Hz)	Date	Duration
-7.508	7/15/2016	135 min
-7.520	10/11/2016	40 min
-7.514	2/18/2017	45 min
-7.514	4/5/2017	35 min
-7.520	10/11/2017	545 min
-7.514	8/6/2018	12970 min
-7.520	10/30/2019	360 min
-1.933	1/17/2017	5 min
-1.823	8/8/2017	5 min
-2.012	10/30/2017	5 min
-1.603	4/10/2018	5 min
-1.352	7/25/2018	5 min
-2.812	5/31/2019	5 min
1.579	2/19/2017	25 min
1.035	10/19/2018	5 min
2.141	11/12/2018	5 min

1 **TOPIC: Planning Costs**

2

3 **REFERENCE: Application, Tab 3.1.3, PDF page 20, notes 2 and 3 to Table 3-4.**

4

5 **QUOTE:** "Planning Costs are YEC costs to the end of October 2020. Owner's  
6 Costs include final planning prior to final 'go' decision targeted for  
7 July 1, 2021 and Owner's Costs during construction (including site  
8 development KDFN lease charge)."

9

10 **QUESTION:**

11

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

14

15 b) Please distinguish between the amounts of planning costs that are included in line  
16 1 of Table 3-4 and the owner's costs for final planning prior to the "final 'go'  
17 decision".

18

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

20

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

24

25 **ANSWER:**

26

27 **(a)**

28

29 Yes, the YEC planning costs have been finalized as the project moved from the planning  
30 phase into the engineering phase in Q4 2020.

31

32 **(b)**

33

34 The planning costs in line 1 of Table 3-4 include all activities to:

35

36 • Refine the cost estimates and engineering design of the energy storage option  
37 originally identified in the 2016 Resource Plan;

- 1 • Identify potential Project sites, assess the technical and financial attributes of each
- 2 of the site options, and select a Project site;
- 3
- 4 • Complete the feasibility engineering study;
- 5
- 6 • Conduct a public engagement exercise regarding the Project;
- 7
- 8 • Engage with the impacted First Nations, including all partnership activities in the
- 9 trilateral Project Committee described on page 3 of the Application; and,
- 10
- 11 • YEC labour costs for project management and engineering during the activities
- 12 described above.
- 13

14 The Owner's costs in line 7 of Table 3-4 include:

- 15
- 16 • Completion of permitting and assessment activities for the Project;
- 17
- 18 • Project management of all project activities from completion of the feasibility phase
- 19 through to Project commissioning;
- 20
- 21 • Internal YEC labour costs for engineering support during all Project activities from
- 22 completion of feasibility phase through to project commissioning;
- 23
- 24 • Equipment and contractor procurement and contracting;
- 25
- 26 • Legal support;
- 27
- 28 • Construction insurance;
- 29
- 30 • Continued engagement with the impacted First Nations and partnership activities
- 31 conducted after October 2020; and,
- 32
- 33 • The accrual of AFUDC.
- 34

35 (c)

36  
37 Please see Table 1 below.

1  
2

**Table 1: BESS Owner's Cost Breakdown**

<b>Element</b>	<b>Cost (\$000's)</b>
First Nations Engagement, Lease Negotiation & Benefits Agreements	\$ 75
Procurement and Contracting	\$ 63
Assessment and Permitting	\$ 109
YEC Labour (Project Management & Engineering Support)	\$ 322
Communications and Public Engagement	\$ 30
Owners Engineer and PM Services	\$ 1,000
Land Lease Upfront Costs	\$ 120
Construction Insurance	\$ 327
Legal Support	\$ 50
AFUDC	\$ 285
	<b>TOTAL: \$ 2,382</b>

3  
4  
5

**(d)**

6  
7  
8  
9  
10

The Project costs are based on the estimate of current market pricing for battery technology. The Project sizing was selected to enable the provision of N-1 dependable capacity as well as provide additional benefits for the system and ratepayers. Please see the conclusions on page 35 to 36 of the Application regarding the size selection for the BESS.

1 **TOPIC: Annual Operating Costs**

2

3 **REFERENCE: Application, Tab 3.1.3, PDF page 21, notes 1 and 2 to Table 3-5**

4

5 **QUOTE:** "Hatch preliminary cost estimates for selected KDFN site, 20 MW/ 40  
6 MWh size. Opex annual cost includes annual preventive maintenance  
7 costs for the battery (\$60k/year for two technicians, twice per year; plus  
8 \$2.25/kWh/yr and \$4/kW/yr for parts and preventive maintenance)."

9

10 **QUESTION:**

11

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

15

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

18

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

21

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

24

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

27

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

30

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

1 **ANSWER:**

2

3 **(a)**

4

5 The City of Whitehorse has the authority to apply property taxes to land within in its  
6 municipal boundaries by virtue of the *Assessment and Taxation Act (Yukon)* and the  
7 *Municipal Act*.

8

9 **(b)**

10

11 Yes. YEC formally requested the City of Whitehorse consider a reduced tax rate in August  
12 2020, which the City responded to in October 2020. In January 2021, YEC arranged a  
13 delegation of interested parties (YEC, Chu Níikwän Development Corporation, and  
14 Solvest Inc.) to present the request to Mayor and Council. YEC met with the Mayor and  
15 Council on February 10, 2021 to further discuss the submission. YEC continues to pursue  
16 this request for consideration of a reduced tax rate.

17

18 **(c)**

19

20 Technicians are typically on site for one week; however, this will be finalized based on the  
21 preferred vendor and specific maintenance program option selected through the  
22 procurement process.

23

24 **(d)**

25

26 Preventative maintenance would include inspections of the equipment and any  
27 tuning/adjustments required. Parts would include any spare parts/consumables that need  
28 to be replaced periodically.

29

30 **(e)**

31

32 The transmission O&M cost includes the costs for routine maintenance of the assets on  
33 the line as well as any required preventative maintenance such as vegetation  
34 management. As described in Section 11.2 of the Hatch Report provided as Appendix B  
35 of the Application (page 103):

1 In addition to the battery operating cost, there will be annual operating and  
2 maintenance costs for the transmission line to connect the BESS to the substation.  
3 It was estimated that this cost would be approximately 1% of the capital cost. Since  
4 the lines are relatively short, this will be a relatively modest cost. Additionally,  
5 Yukon Energy already has a maintenance program in place for its extensive  
6 transmission and distribution network, and thus this would be a modest increase  
7 to that maintenance program.

8

9 **(f)**

10

11 The economic analysis presented for the project does include recharging costs. See  
12 column C of Table 4-3, in the Application for net recharging costs (i.e., any added thermal  
13 or hydro generation due to BESS) and provision for idling costs. The estimated costs of  
14 \$82.1k for the first year are conservative (i.e., likely high) and include the following:

15

16 1. **N-1 use** – Net recharging cost of \$1.7k (assumed average throughput of 56 MWh  
17 with diesel recharging – net added cost due to BESS is 15% added losses, or 8.4  
18 MWh per year, at assumed diesel fuel price of \$0.2051/kWh). The diesel cost for  
19 the balance of the recharging would be incurred without BESS, assuming diesel  
20 thermal generation is available to supply electricity during the N-1 event.

21

22 2. **Operating reserve use** – Net recharging cost of \$3.7k (assumed average  
23 throughput of 120 MWh, with this table conservatively assuming 15% losses to be  
24 charged by diesel, with diesel assumed to be otherwise being required for the  
25 operating reserve). Operating reserve is likely often to be recharged by hydro at  
26 an incremental cost of \$0.7k per year (120 MWh plus 15% losses at incremental  
27 hydro cost of \$0.005/kWh).

28

29 3. **Peak Shifting use** – Net recharging cost is included in column G net savings for  
30 this use; the 244 MWh/year of throughput is assumed (with 15% losses added) to  
31 be recharged 75% with LNG and 25% with hydro. Also see page B-112, Table 11-  
32 7 and Table 12-1 of the Hatch Feasibility Study report (Appendix B of the  
33 Application) which estimates recharging costs based on peak shifting use based  
34 on YEC's cost to generate as assumed in the Hatch report.

1           4. **Other uses** – Net recharging cost of \$76.6k - Table 4-3 assumes 3,720 MWh of  
2           other use throughput recharged 75% with LNG (\$0.1814/kWh) and 25% with  
3           hydro (\$0.005/kWh), covering blackstart use (Hatch estimated 2,120 MWh/yr  
4           normal recharging), load shedding and renewable integration (Hatch estimated  
5           600 MWh/yr throughput) and 1,000 MWh for other possible uses (e.g., stabilizing  
6           hydro operations during periods of downstream winter ice formation); the net  
7           recharging cost is assumed at 15% of the overall throughput (assuming that the  
8           energy requirement would otherwise have been met with at least the same energy  
9           costs).

10  
11           5. **Idling costs** – Idling cost of \$0.09k is conservative (i.e., too high); it assumed  
12           hydro recharging for 3% per month loss of 48 GWh installed capacity energy in  
13           BESS (17.28 MWh/yr times \$0.005/kWh).

14  
15 **(g)**

16  
17           The initial screening for potential sites for the BESS project was primarily assessed on the  
18           distance from existing substation infrastructure close to the load center of Whitehorse.  
19           Other factors, such as sufficient provision of the space requirements to operate and  
20           maintain the battery safely and efficiently, readiness for utility development, environmental  
21           and socio-economic factors and stakeholder input were considered in the further  
22           screening of the potential sites.

23  
24           Given that the project would be located on overlapping Traditional Territory of Kwanlin  
25           Dun First Nation (KDFN) and Ta'an Kwach'an Council (TKC) and would require the  
26           support of both First Nations to proceed, YEC chose to work in partnership with KDFN  
27           and TKC on the battery project and site selection. The First Nations confirmed the  
28           availability of certain parcels of settlement land for consideration in the Project, and  
29           following engagement with the Project Committee as discussed in the Application, YEC  
30           received offers for two of the potential sites. The sites under consideration all required a  
31           lease cost to YEC and would all be subject to property tax (i.e., the Takhini site would be  
32           subject to a lower Yukon government tax that was not considered in the Hatch analysis),  
33           although the tax impact for the Whitehorse sites was higher than for the Takhini site.  
34           KDFN withdrew the Takhini site from consideration for the project and YEC did not receive  
35           a lease offer for this site. Please see the response to YUB-YEC-1-8 for details on the  
36           selection of the final project site.

1 **TOPIC: Levelized Cost of Capacity**

2

3 **REFERENCE: Application, Tab 3.1.3, PDF page 21**

4

5 **QUOTE:** "The estimated net capital cost for Yukon Energy of \$15.2 million equals  
6 \$2.11 million per MW of dependable capacity (7.2 MW) provided by the  
7 Project."

8

9 **QUESTION:**

10

11 a) Please provide a revised levelized cost of capacity by including all transmission  
12 connection costs and battery costs before government contributions.

13

14 **ANSWER:**

15

16 **(a)**

17

18 As noted in section 3.1.3 of the Application, the Project LCOC (2022\$), which does not  
19 account for YEC thermal fuel cost savings from the other BESS uses, is \$235/kW-year  
20 based on the estimated capital cost (including transmission connection) and operating  
21 cost provision for ongoing recharging losses and idling with only N-1 dependable capacity  
22 use. This assumes \$16.5 million government grants towards the Project. Without the  
23 government grants the LCOC would be \$393/kW-year.

1 **TOPIC: Recharging Losses and Idling**

2

3 **REFERENCE: Application, Tab 3.1.3, PDF page 21**

4

5 **QUESTION:**

6

7 a) Please explain recharging losses and provide details on how they are calculated.

8

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

11

12 **ANSWER:**

13

14 **(a)**

15

16 Recharging losses relate to the battery energy storage system's overall efficiency. A  
17 benchmark of 85% efficiency was used for the lithium ion battery including electrical and  
18 chemical losses, as well as auxiliary power consumed during charging/discharging.

19

20 **(b)**

21

22 Idling is when the BESS is not performing service but is capable of responding if required.  
23 Costs in this operational mode relate to keeping the system heated during the winter, and  
24 powering the protections, controls, and monitoring system. Idling losses are estimated at  
25 3% per month on the BESS energy capacity, assuming hydro generation for recharge.

1 **TOPIC: LCOC of Rented Diesel Units**

2

3 **REFERENCE: Application, Tab 3.1.3, PDF page 21, footnote 29; Application, Tab**  
4 **4.2.3, PDF page 41, footnote 58**

5

6 **QUOTE:** Application, PDF page 21:

7

8 “LCOC for rented diesel units with the same WACC and over the same  
9 20 year life is \$211/kW-year (2022\$) assuming diesel rental costs of  
10 \$162,400/MW connected [includes cost of spares] estimated (2021\$)  
11 for winter 2021/22, 4% year escalation of diesel rental costs, and  
12 \$11/kWh for variable non-fuel O&M. Infrastructure capital costs for  
13 diesel rental at \$3.5 million (2022\$) for 27 MW capacity based on  
14 infrastructure capital costs for the existing rentals [inflated at 2%/year].”  
15 [emphasis added]

16

17 Application, PDF page 41:

18

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

23

24 **QUESTION:**

25

26 a) Please provide the detailed calculations of the \$211/kW-year of the diesel rentals.  
27 Please explain and justify any cost of capital considerations that would apply to the  
28 diesel rental.

29

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

32

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

34

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

1 e) Please provide further explanation and evidence of the 4% escalation rate.  
2

3 **ANSWER:**  
4

5 **(a), (b) and (c)**  
6

7 Please see YUB-YEC-1-29 Attachment 1 which shows the calculation of the Diesel Rental  
8 LCOC.  
9

10 The LCOC calculation is based on the following:  
11

- 12 • Capital cost at \$3.335 million (2019\$) is based on diesel rental site infrastructure  
13 costs included in the 2021 GRA. Please see YEC's 2021 GRA, section 5.2.1.2 that  
14 provides details regarding the infrastructure project costs, specifically N-1 Capacity  
15 Shortage Whitehorse Thermal Rental Site Infrastructure cost noted at \$1.298  
16 million and N-1 Capacity Shortage Faro Thermal Rental Site Infrastructure cost  
17 noted at \$2.037 million to total cost of \$3.335 million. The cost was escalated to  
18 2022\$ based on a 2%/year inflation rate assumption. Similar costs are included in  
19 the BESS capital cost. For example, please see Table 3-4 of the Application where  
20 the BESS capital cost includes planning, site preparation, grid connection and  
21 other costs in addition to the battery system costs.  
22
- 23 • The diesel rentals dependable capacity at 27 MW is based on 15 units rented for  
24 2021/22 winter season [excluding two spares] times 1.8 MW each unit.  
25
- 26 • The forecast diesel rental cost at \$0.169 million/MW is based on diesel rental costs  
27 per connected MW (includes costs for spares) for winter 2021/22 estimated at  
28 \$0.162 million/MW, escalated at 4% to forecast 2022/23 winter rental costs per  
29 MW [total rental cost forecast for 2021/22 winter at \$4.385 million].  
30
- 31 • The forecast annual fixed O&M cost of \$4.561 million is based on \$0.169  
32 million/MW times 27 MW.  
33
- 34 • The variable O&M at 1.1 cents/kW.h is based on recent experience with rental  
35 diesel units. By the way of example, 2021 GRA, Tab 3, Table 3.5 shows diesel  
36 generation non-fuel costs at \$4.370 million [before labour costs] – this is about 1.5

1 cents/kW.h based on forecast diesel generation for 2021 GRA [Table 2.2 at 2,951  
2 MW.h].

3

4 • The weighted average cost of capital at 4.79% is calculated based on YEC's  
5 capital structure at 40% equity and 60% debt with ROE at 8.70% as approved in  
6 2017/18 GRA and proposed in 2021 GRA, and 2.19% debt rates based on new  
7 long-term debt rate forecast in the 2021 GRA as determined using a formulaic  
8 approach as directed by the Board [long-term Canada Bonds rate plus 120 basis  
9 points].

10

11 • The annual energy generation assumed at 2.5 GW.h. The impact from the annual  
12 energy generation and non-fuel variable O&M [1.1 cents/kW.h] is insignificant to  
13 the LCOC calculations. For example, without this variable cost the LCOC for rental  
14 diesel would be \$209.5/MW.

15

16 **(d) and (e)**

17

18 The inflation rate at 4%/year for the diesel rentals is based on most recent experience with  
19 rental costs [for example 2021/22 total rental cost forecast is about 11% higher than  
20 2020/21 rental cost] and expected future increases. The diesel rental service is not widely  
21 available service which impacts rental price negotiations. Please see response to YUB-  
22 YEC-1-17 (c) for more details.

YUB-YEC-1-29 (a) Attachment 1

Diesel Rental LCOC

Capital (\$000)	2019	\$3,335	27.00	MW
Capital (\$000)	2022	\$3,539		

Rental cost	2022	\$169	\$000 per MW
O&M (Fixed)	2022	\$4,561	\$000/yr
O&M (Variable)	2022	\$11	\$/MWh

Life 20 years  
Rental escalation 4.0% per yr

Weighted Average Cost of Capital	4.79%
Inflation Rate	2%
Real Weighted Average Cost of Capital	2.74%

Project LCOC (\$/MW) \$210,723

Year	Diesel Rental Costs				
	Year-End Balance \$000	Depr \$000	Return \$000	O&M \$000	Total \$000
2022	3,362	177	165	4,588	4,930
2023	3,185	177	157	4,772	5,105
2024	3,008	177	148	4,962	5,288
2025	2,831	177	140	5,161	5,478
2026	2,654	177	131	5,367	5,676
2027	2,477	177	123	5,582	5,882
2028	2,300	177	115	5,805	6,097
2029	2,123	177	106	6,038	6,321
2030	1,947	177	98	6,279	6,554
2031	1,770	177	89	6,530	6,796
2032	1,593	177	81	6,791	7,049
2033	1,416	177	72	7,063	7,312
2034	1,239	177	64	7,346	7,586
2035	1,062	177	55	7,639	7,871
2036	885	177	47	7,945	8,169
2037	708	177	38	8,263	8,478
2038	531	177	30	8,593	8,800
2039	354	177	21	8,937	9,135
2040	177	177	13	9,294	9,484
2041	0	177	4	9,666	9,847
NPV					89,099

Year from In-service	Annual Energy GW.h, 2.5	Annual Winter Capacity MW, 27
1	2.50	27.00
2	2.50	27.00
3	2.50	27.00
4	2.50	27.00
5	2.50	27.00
6	2.50	27.00
7	2.50	27.00
8	2.50	27.00
9	2.50	27.00
10	2.50	27.00
11	2.50	27.00
12	2.50	27.00
13	2.50	27.00
14	2.50	27.00
15	2.50	27.00
16	2.50	27.00
17	2.50	27.00
18	2.50	27.00
19	2.50	27.00
20	2.50	27.00

1 **TOPIC: New Diesels**

2

3 **REFERENCE: Application, Tab 3.1.3, PDF page 21, footnote 30**

4

5 **QUOTE:** "LCOC for 12.5 kW new diesel at Takhini estimated at approximately  
6 \$186/kW-year (2022\$), based on Midgard estimate (2019\$) of capex  
7 and opex for 12.5 MW Takhini diesel plant, 40 year life (WACC at  
8 4.92%), escalated for inflation at 2% per year to 2022."

9

10 **QUESTION:**

11

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

16

17 **ANSWER:**

18

19 **(a)**

20

21 Please see table below that compares LCOC for the BESS, Diesel Rental and Takhini  
22 12.5 MW options. The table also includes capital costs (net of grants) and O&M costs for  
23 each option. The capital cost for the diesel rental option is for infrastructure required to  
24 connect the rented diesel units. The capital costs for BESS and 12.5 Takhini options  
25 include infrastructure required to connect to the YIS. Please note that the BESS option  
26 does not include benefits from the Project that would offset annual costs for the Project.  
27 The LCOC for Takhini option is based on the Midgard estimate (2019\$) escalated to  
28 2022\$.

		BESS	Diesel Rental	Takhini 12.5 MW
Dependable Capacity	MW	7.20	27.00	12.50
Capital (\$000)		\$15,812	\$3,539	\$34,489
O&M (Fixed) total	\$000/yr	\$652	\$4,561	\$881
O&M (Variable)	\$/MWh	\$5	\$11	\$11
Life	years	20	20	40
Rental escalation	per yr		4%	
Weighted Average Cost of Capital		4.79%	4.79%	4.92%
Inflation Rate		2.00%	2.00%	2.00%
Real WACC		2.74%	2.74%	2.86%
<i>Estimated Project LCOC (\$/kW-year)</i>		\$235	\$211	\$186

1

1 **TOPIC: Load Forecasts**

2

3 **REFERENCE: Application, Tab 4.1.2, PDF page 29**

4

5 **QUESTION:**

6

7 a) Please provide load forecasts by rate class for the 20 years over which the  
8 proposed BESS project spans.

9

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

14

15 **ANSWER:**

16

17 **(a)**

18

19 Yukon Energy forecasts long-term load only for non-industrial consumers, electric  
20 vehicles, and industrial customers. Please see Attachment 1 to this response for the load  
21 forecasts of these sectors for the next 20 years.

22

23 **(b)**

24

25 The forecast description and methodology is provided in Section 4.3 (pages 24 to 30) of  
26 the 10-Year Renewable Electricity Plan technical report [see UCG-YEC-1-10(a)  
27 Attachment 1]. The relevant excerpt is provided as Attachment 1 to this response.

**Yukon Integrated System Load w. Losses**

(GWh/yr)	<b>Non-Industrial Load</b>	<b>Electric Vehicle Load</b>	<b>Industrial load</b>
2022	442	2	99
2023	450	3	72
2024	455	4	75
2025	458	6	77
2026	461	7	79
2027	461	10	82
2028	465	13	85
2029	469	18	87
2030	465	24	56
2031	465	26	44
2032	465	26	32
2033	463	26	32
2034	463	26	32
2035	464	26	-
2036	466	26	-
2037	467	26	-
2038	470	26	-
2039	472	26	-
2040	475	26	-
2041	477	26	-
2042	479	26	-

### 4.3 Energy Forecasts

This energy forecast for the Yukon Integrated System (YIS) (see Section 1.3) is for the Base Case scenario. Energy refers to the quantity of electricity, expressed in gigawatt-hours (GWh) that is sold over a specified period of time.

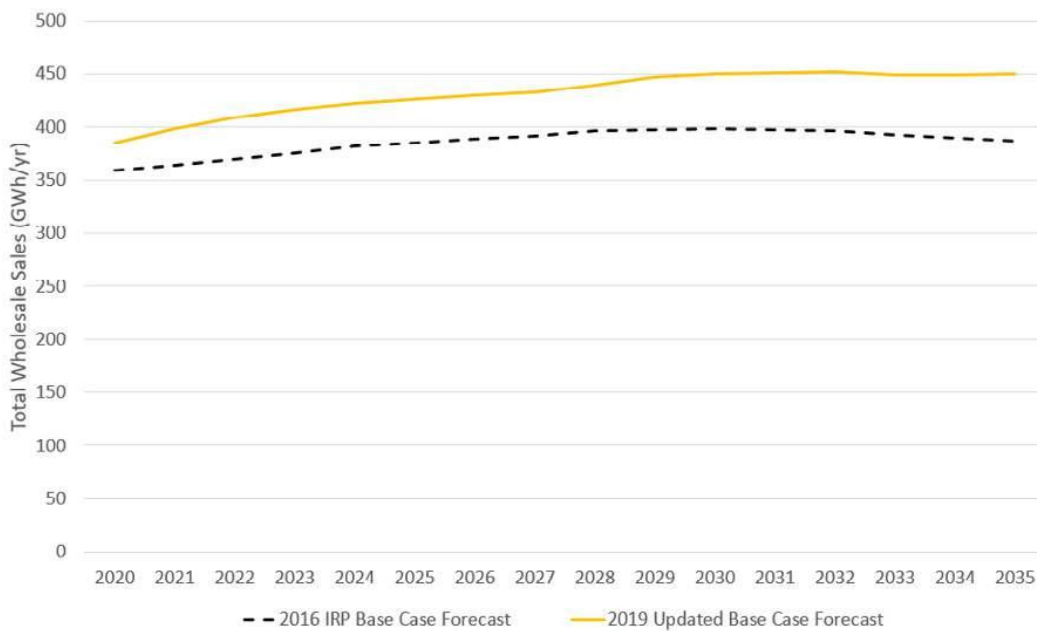
The YIS energy forecast comprises two major elements, wholesale load and industrial (i.e. mining) load, which are combined to produce the total energy forecast. To show how the load forecasts have changed over time, the previous forecast values from the 2016 IRP are included in each of the following graphs.



### 4.3.1 Annual Energy Forecast

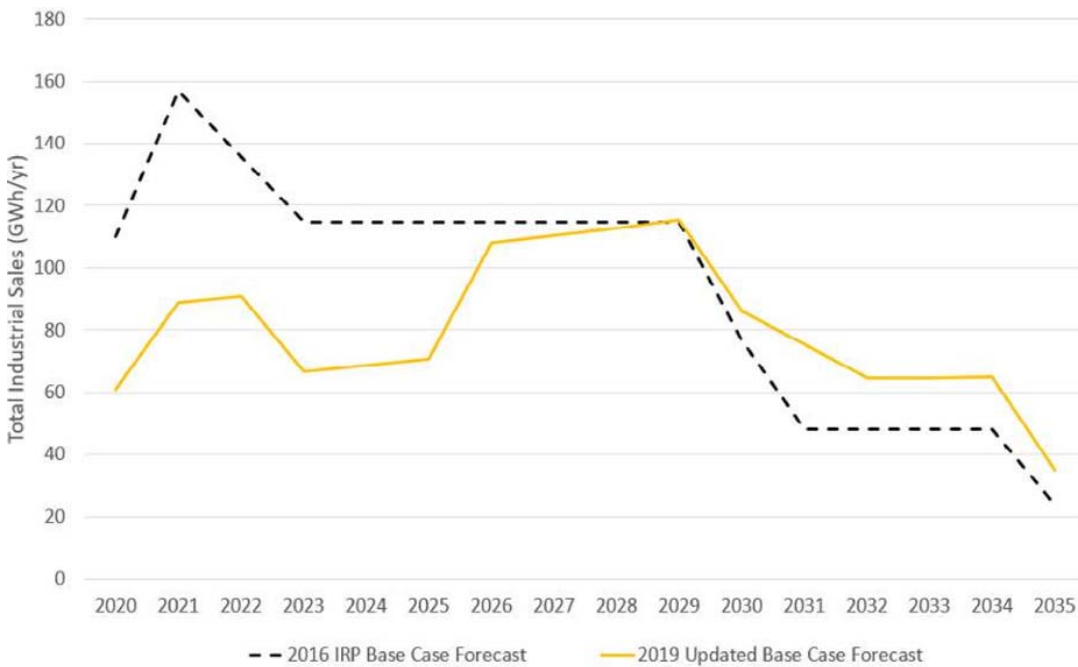
The annual wholesale energy forecast, which includes the incremental Yukon Energy Policy Action loads for the Base Case scenario relative to the 2016 IRP Base Case forecast, is shown in Figure 5. The updated 2019 energy forecast is higher than the 2016 forecast for the entire planning period, including the initial 2020 year. Energy load is higher in 2020 due to higher than forecast economic and population growth over the 2016-2019 period. In addition, the data in Figure 5 illustrates that energy demand is forecast to grow at a higher rate than forecast in the 2016 IRP due to impacts of Yukon government electrification policy actions which include electric vehicles and electrification of space heating.

Figure 5: Base Case - Wholesale Forecast Relative to 2016 IRP Base Case Forecast



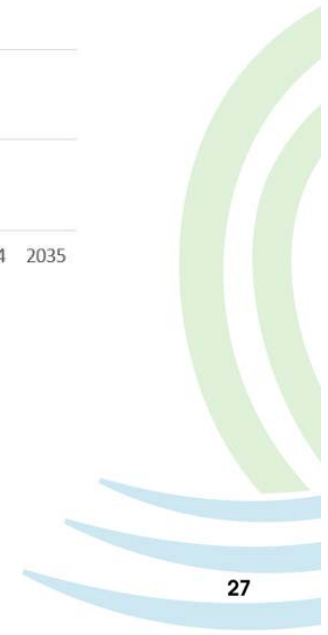
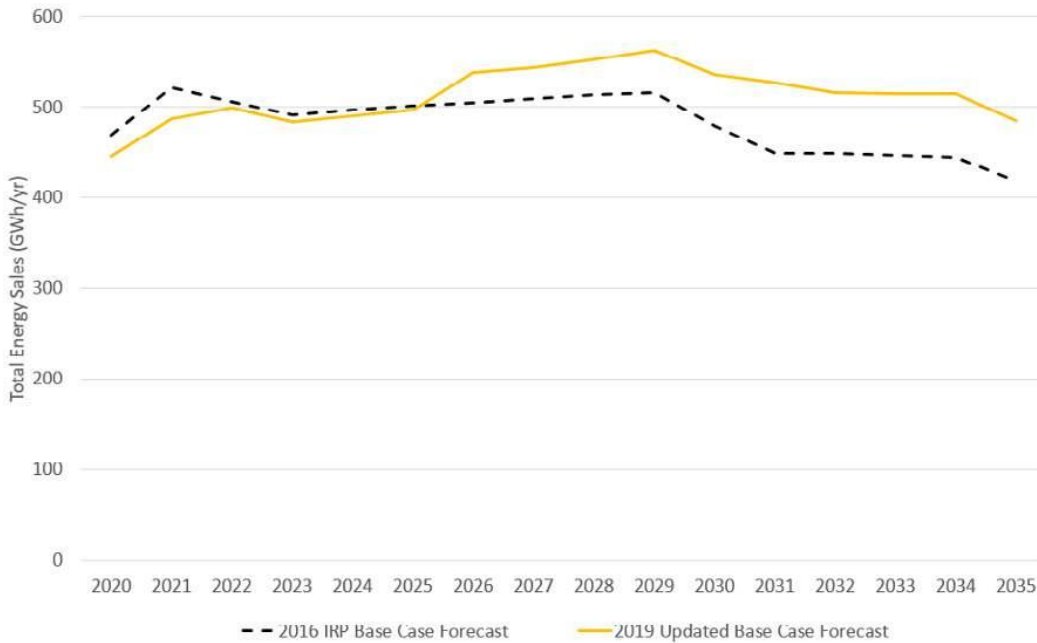
The annual industrial forecast for the Base Case scenario relative to the 2016 IRP Base Case forecast is shown in Figure 6. It should be noted that the 2019 industrial forecast also includes an additional 35 GWh/year load from year 2026 onwards for the assumed electrification of cruise ships in Skagway under this scenario. The observed decrease in forecast industrial load at the start of the planning period (2020-2025) relative to the 2016 forecast is primarily driven by a reduction in the forecast Victoria Gold mining load. The observed increase in forecast industrial load from year 2026 onwards is due to the additional load associated with the electrification of cruise ships in Skagway. Finally, the observed drop-off in industrial load from year 2029 onwards is due to the assumed shut-down of the Eagle Gold mine.

**Figure 6: Base Case - Industrial + Skagway Forecast Relative to 2016 IRP Base Case Forecast**



The total energy forecast (i.e. wholesale + industrial + Skagway) for the Base Case scenario relative to the 2016 IRP Base Case scenario is shown in Figure 7. The forecast increase in wholesale load is partially offset by the reduction in mining load at the beginning of the planning period, but an increase in total energy is observed from year 2026 onwards due to the addition of the Skagway load. As a result, the updated total energy forecast for the Base Case scenario remains very similar to the 2016 forecast, with slightly lower energy demand in the near-term years, and higher energy demand in the latter years of the planning period.

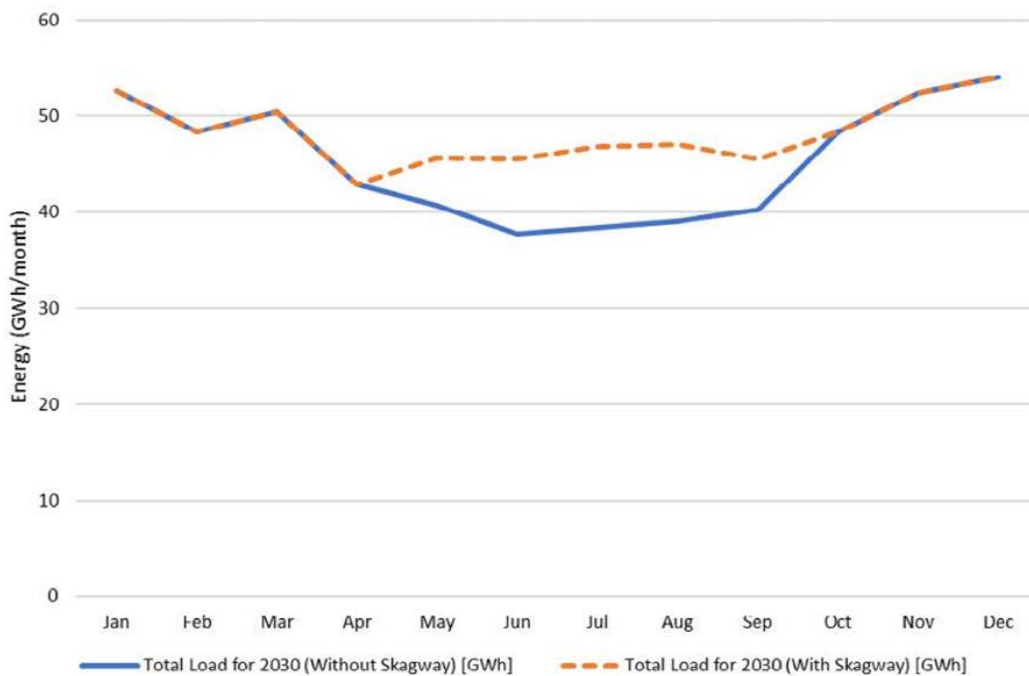
Figure 7: Base Case – Total Energy Forecast Relative to 2016 IRP Base Case Forecast



### 4.3.2 Seasonal Profiles

Seasonal energy profiles help demonstrate how energy demand changes over the course of a year and identifies which months have the highest and lowest energy demand. Figure 8 shows forecast monthly energy profiles for the year 2030 (with and without Skagway load). The figure does not account for any potential summer “load” from a pumped storage resource (e.g. energy consumption to pump water into the upper storage reservoir). Although the shape of the monthly energy profile will vary over the planning period, the YIS will remain a winter peaking system with maximum energy demand occurring in the winter months and lower energy demand in the summer months. Electricity policy changes in Yukon are not expected to change the fundamental challenge of meeting Yukon’s increased energy demand in the winter months.

**Figure 8: Monthly Demand Shape for 2030 (With & Without Skagway Load)**



## 4.4 Peak Capacity Demand Forecast

Peak capacity demand is the maximum instantaneous quantity of electricity that customers require (and YEC must supply), expressed in megawatts (MW). For forecasting and planning analyses, which are conducted using the single-contingency (N-1) planning criterion, industrial demand is excluded from the peak capacity demand as it is assumed during an emergency event industrial customers could be interrupted.

A new peak capacity demand record of 103.84 MW (97.6 MW non-industrial peak) was set on January 14, 2020. The previous record peak was 92.99 MW (90.5 MW non-industrial peak). As a result of this record-breaking peak, YEC was required to update its non-industrial peak capacity demand forecasting model to account for updated information on the actual peak demand of the Yukon system during prolonged cold weather events.

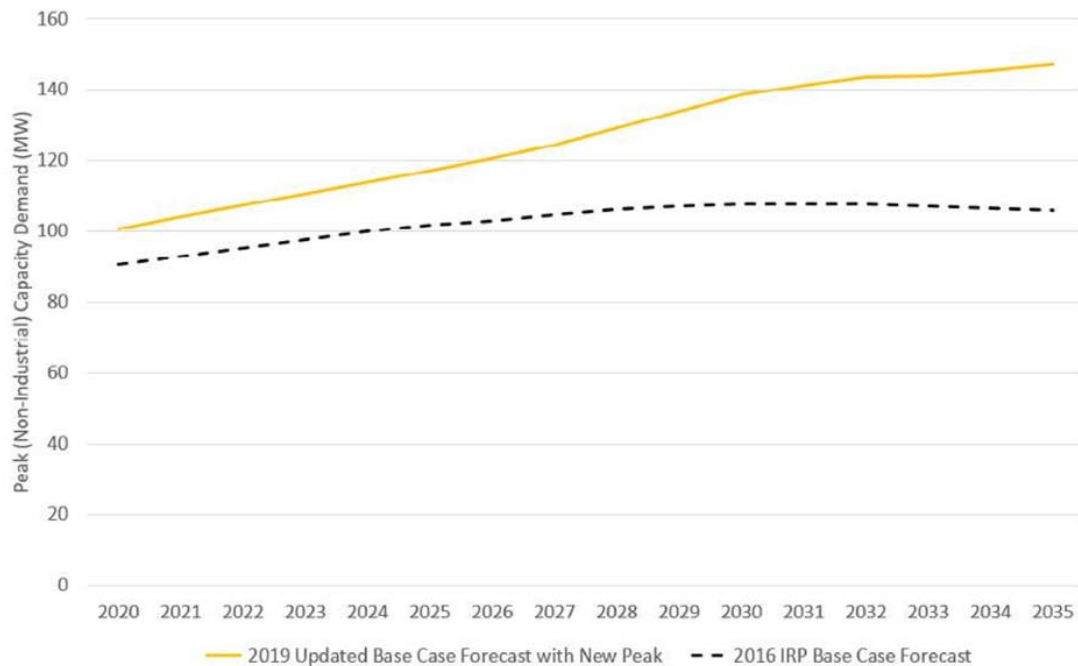
It should be noted that including Skagway in the Base Case does not impact the non-industrial peak capacity demand forecast. Skagway is assumed to add approximately 35 GWh of summer energy per year from year 2026 onwards, but it does not impact the peak capacity demand which occurs in the winter.



The updated non-industrial peak demand for the YIS relative to the 2016 IRP Base Case scenario is shown in Figure 9. The significant growth in the peak non-industrial demand forecast relative to the 2016 IRP Base Case forecast was primarily driven by:

- » increased wholesale demand (e.g. population growth) and
- » government policy actions related to electrification (e.g. electric heating, electric heat pumps and the adoption of electric vehicles).

**Figure 9: Base Case – Updated Peak (Non-Industrial) Capacity Demand Forecast vs. 2016 IRP**



1 **TOPIC: The Role of the Battery Energy Storage System Project with**  
2 **Respect to Evolving Load Conditions**

3  
4 **REFERENCE: Application, Tab 3.1.3, PDF page 22; Application, Tab 4.1.2,**  
5 **PDF pages 29 to -31**

6  
7 **QUOTE:** Application, PDF page 22:

8  
9 “In summary, it is concluded that the specified need to meet near term  
10 forecast requirements for reliable and flexible new capacity on the  
11 Yukon grid would best be met through development of the Project.  
12 Compared to the feasible and best alternative available today (i.e.  
13 diesel rental), at forecast grid loads the Project provides a cheaper and  
14 renewable focused energy option for Yukon Energy and Yukon  
15 ratepayers.” Application, PDF page 29:

16  
17 “The updated firm load forecasts include the impact of several  
18 electrification policies and actions being introduced by the Yukon  
19 government in support of its emission reduction targets. Ongoing  
20 generation projects include: Whitehorse Hydro uprates at WH2 and  
21 WH4, the BESS, renewable energy purchases from Independent  
22 Power Producers (IPP) through the Standing Offer Program, solar  
23 energy from the Micro-Generation program, the Southern Lakes and  
24 Mayo Lake enhanced storage projects, replacement of diesel  
25 generators as they retire, and DSM programs. The three major new  
26 projects YEC is proposing in the 10-Year Renewable Electricity Plan  
27 are: electricity purchases from the planned Atlin Hydro Expansion  
28 Project, construction of a pumped storage facility at Moon Lake, and  
29 upgrading and expansion of the Southern Lakes Transmission Network  
30 to facilitate the Moon Lake project and other potential improvements.

31  
32 “Although Yukon Energy is aiming to displace thermal energy  
33 generation over the next decade with the planned new renewable  
34 generation projects, not all of the added renewable generation sources  
35 will provide dependable capacity. For example, no dependable capacity  
36 will be provided by the expected IPP purchases under the Standing  
37 Offer Program as these are intermittent rather than dispatchable

1 renewables; and enhanced storage projects displace thermal energy  
2 generation with no added dependable capacity. As a result, Yukon  
3 Energy is placing a high priority on new projects that can address the  
4 YIS dependable capacity requirements without reliance on new fossil  
5 fuel thermal generation or rented mobile diesel units.”

6  
7 Application, PDF page 30:

8  
9 “In addition to these new renewable capacity options, the 10-year plan  
10 includes the potential Moon Pump Storage Phase 1 with 35 MW winter  
11 capacity starting in 2028/29 as illustrated in Figure 4-1. The planned  
12 new capacity options also include 12.5 MW of new diesel units to  
13 replace retiring generation in Whitehorse, Faro and Dawson.”

14  
15 Application, PDF page 31:

16  
17 “Due to timing of the supply resources, the N-1 capacity shortfall is  
18 forecast to continue through 2028/29 requiring from 4 to 15 diesel unit  
19 rentals (7 to 27 MW), plus spares as required, each year until the  
20 proposed 35 MW Phase 1 Moon Lake Pump Storage is in-service  
21 (forecast in 2028/29). Figure 4-1 shows the 10 MW Phase 2 Moon Lake  
22 Pump Storage project proposed in 2031/32 to address ongoing N-1  
23 dependable capacity requirements.” (emphasis added)

24  
25 **QUESTION:**

- 26
- 27 a) Please explain whether YEC foresees a future with no reliance on thermal  
28 generation or rented mobile diesel units.
  - 29
  - 30 b) Would YEC be able to balance supply and demand without thermal generation or  
31 rented mobile diesel units?
  - 32
  - 33 c) Would the ongoing renewable generation projects outlined in the 10-Year  
34 Renewable Electricity Plan be capable of ensuring reliability without relying on  
35 thermal generation or rented diesel units?

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

3

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

8

9 **ANSWER:**

10

11 **(a)**

12

13 Once the portfolio outlined in the 10-Year Renewable Electricity Plan is in place (wind and  
14 solar from the Standing Offer Program, BESS, Atlin Hydro, DSM and Moon Lake Pumped  
15 Storage), YEC's reliance on thermal under normal operating conditions will be greatly  
16 reduced. This reduction aligns with the Federal and Territorial policy developments  
17 outlined in the response to YUB-YEC-1-1. However, given the operational challenges  
18 facing an isolated grid, YEC expects to rely on thermal generation for the foreseeable  
19 future, at minimum as emergency backup generation and to address an N-1 event. The  
20 portfolio in YEC's 10-Year Renewable Electricity Plan includes retention of all existing  
21 permanent thermal generation facilities, and assumes 12.5 MW of diesel units are built to  
22 replace retiring diesel generation.

23

24 **(b)**

25

26 No. As shown in Table 4-1 on page 28 of the Application, once all the planned additions  
27 have been completed, including Moon Lake Pumped Storage, YEC will still need to rely  
28 on thermal assets for peaking and backup supply to address an N-1 event.

29

30 **(c)**

31

32 No. Please see response to part (e) below.

1 **(d)**

2

3 As shown in Table 4-1 on page 28 of the Application, the battery offsets additional reliance  
4 on thermal generation. If the BESS were not constructed, YEC would need to incorporate  
5 7 MW of additional diesel beyond that contemplated in YEC's current forecast.

6

7 **(e)**

8

9 As shown in Table 4-1 on page 28 of the Application, Moon Lake Pumped Storage  
10 provides 35 MW of dependable capacity to the YIS. While it is anticipated this will eliminate  
11 the need for temporary rental diesel units, all existing permanent diesel (including the 12.5  
12 MW of new diesel replacing retired units) will still be required to provide N-1 dependable  
13 capacity.

1 **TOPIC: NAV Canada Land Use Assessment**

2

3 **REFERENCE: Application, Tab 3.4, PDF page 26**

4

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

7

8 **QUESTION:**

9

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

13

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

15

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

17

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

22

23 **ANSWER:**

24

25 **(a)**

26

27 The processes for the permits with NAV Canada and Transport Canada were initiated on  
28 March 11, 2021.

29

30 **(b)**

31

32 NAV Canada and Transport Canada assess a proposal to establish the impact of the  
33 proposed physical structure(s) on the air navigation system and installations. This includes  
34 assessing the requirement for obstruction marking and lighting, if required.

1 **(c)**

2

3 While the timelines can vary, the NAV Canada assessment typically takes 8 to 12 weeks,  
4 and the Transport Canada process typically takes 90 days.

5

6 **(d)**

7

8 There may be additional requirements based on the Transport Canada assessment, such  
9 as obstruction marking or lighting of structures (antennae, transmission structures, etc.).

10 The cost impacts of these additional requirements are expected to be minimal and within  
11 the current cost estimate.

1 **TOPIC: Fire and Emergency Response Plan**

2

3 **REFERENCE: Application, Tab 3.4, PDF page 27; Application, Appendix B: Hatch**  
4 **Report, PDF page 90**

5

6 **QUOTE:** Application, PDF page 27:

7

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

12

13 Application, PDF page 90:

14

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

20

21 **QUESTION:**

22

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

26

27 **ANSWER:**

28

29 **(a)**

30

31 YEC has not yet formulated the fire and emergency response plan for the project.

1 **TOPIC: Demand-Side Management (DSM)**

2

3 **REFERENCE: Application, Tab 4.1.3, PDF page 30**

4

5 **QUOTE:** “DSM measures [are] expected to reduce peak demand by 2.2 MW in  
6 2021/22 increasing to 7.0 MW by 2030/31...”

7

8 **QUESTION:**

9

10 a) Please describe how “DSM measures [are] expected to reduce peak demand by  
11 2.2 MW in 2021/22 increasing to 7.0 MW by 2030/31”.

12

13 **ANSWER:**

14

15 **(a)**

16

17 DSM programs reduce the peak demand when energy savings occur at the same time as  
18 a grid peak occurs. These programs can range from incentives to install more efficient  
19 equipment that tends to be used during the grid peak (such as LED lighting, EnergyStar  
20 appliances, or low-flow showerheads) to the utility having control over customer  
21 equipment to turn off or reduce usage during a grid peak.

22

23 The estimate of the reduction of peak demand was calculated based on data from a  
24 Yukon-specific conservation potential review update that was completed for the 2016  
25 Resource Plan using equipment that could be used to design a capacity-focused DSM  
26 program for the utility. This level of DSM savings is part of the portfolio presented in YEC's  
27 10-Year Renewable Electricity Plan.

1 **TOPIC: BESS Project Reliability**

2

3 **REFERENCE: Application, Tab 4.2, starting at PDF page 33**

4

5 **QUESTION:**

6

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

11

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

15

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

19

20 **ANSWER:**

21

22 **(a) to (c)**

23

24 Relevant provisions and metrics for system performance and reliability are reviewed  
25 below, first for BESS primary use and then for BESS secondary use cases. Each review  
26 explains how the proposed BESS project use contributes to the required system  
27 performance and reliability and (where relevant) improves the current solution. Relative to  
28 other alternatives (e.g., diesel units) that contribute to N-1 dependable capacity  
29 requirements, BESS is a lower cost option for ratepayers (see Table 4-3 of the Application,  
30 and response to YUB-YEC-1-44).

31

32 **Primary Use Case**

33

34 The primary use case of the BESS project is related to the provision of N-1 dependable  
35 capacity.

1 YEC's generation capacity planning for the Yukon Interconnected System (YIS) is based  
2 on the single contingency (N-1) dependable capacity criterion, under which the YIS is  
3 required to have enough dependable capacity installed to supply the forecast non-  
4 industrial peak winter demand (i.e., excluding major industrial demand) under the single  
5 largest contingency<sup>1</sup>. The single largest contingency on the YIS is the loss of the Aishihik  
6 generating facility or the transmission line which connects the facility to the Yukon grid.  
7 Inability to supply the non-industrial peak winter demand, which is expected to occur  
8 during a period of the coldest winter temperatures, presents an obvious and acute risk to  
9 human health and safety and public and private infrastructure. Therefore, provision of  
10 sufficient capacity to meet non-industrial peak demand during an N-1 event is the primary  
11 system reliability requirement YEC's planning must adhere to. The BESS project reduces  
12 YEC's current shortfall of N-1 dependable capacity by 7.2 MW. Accordingly, it directly  
13 reduces the Company's temporary diesel rental requirements by 4 units.

14  
15 The most cost-effective alternative to the project, temporary rental diesel units, could  
16 provide N-1 dependable capacity. However, as discussed on page 29 of the Application,  
17 reliance on rented diesel units can create risks as to continuing availability, acceptable  
18 performance and the ability to accommodate the required units. This could expose all grid  
19 customers to unreliable generation capacity.

## 20 21 **Secondary Use Cases**

22  
23 While provision of N-1 capacity is the key reliability obligation for YEC, there are many  
24 other reliability and system performance requirements mandatory to operating the grid in  
25 a stable, reliable manner. For many utilities in North America, these parameters are guided  
26 by metrics explicitly required through the North American Electric Reliability Corporation  
27 (NERC), the regulatory authority that develops and enforces reliability standards for all the  
28 North American interconnected grids. As the YIS is not connected to any other grid, it is  
29 not subject to NERC regulations; however, they provide a useful reference to the major  
30 considerations of grid operation and performance that exist regardless of interconnection  
31 to other jurisdictions<sup>2</sup>.

---

<sup>1</sup> The single largest contingency is defined as loss of the largest single element which could be either a transmission line or a generating station.

<sup>2</sup> The Western Electricity Coordinating Council (WECC) is the regional NERC entity closest to the Yukon. Although the YEC is not bound by the WECC standards these can provide a reference to all major considerations of grid operation and performance. The entirety of the WECC standards can be found here: <https://www.wecc.org/Standards/Pages/Default.aspx>

1 Unlike utilities operating under the jurisdiction of NERC, YEC operates an isolated grid,  
2 which presents unique challenges in the provision of grid reliability services. There are  
3 many system performance metrics that YEC monitors and manages in order to operate  
4 the grid in a stable, reliable manner. The key reliability services which relate to the BESS  
5 secondary use cases are YEC's requirements for:

- 6
- 7 • Operating reserve;
  - 8 • Frequency regulation;
  - 9 • Voltage control; and
  - 10 • Blackstart and outage restoration capability.
- 11

12 Each of these services are described in further detail below.

13

#### 14 ***Operating Reserve***

15

16 In order to be able to respond to system events such as the loss of generation or increase  
17 in load, YEC maintains a minimum operating reserve requirement. Operating reserve is  
18 essentially “stand-by power” that can be called on with short notice to address an  
19 unexpected mismatch between generation and load. When thermal generation is online  
20 to meet demand, YEC's requirement is to maintain sufficient operating reserve to replace  
21 the largest online thermal unit. During periods when there is no thermal generation, YEC  
22 maintains 3 MW of reserve in order to be able to respond to increases in demand.

23

24 Currently, YEC maintains this operating reserve by running hydro and/or thermal units at  
25 an output lower than their maximum capacity, to allow operators to “ramp up” the units  
26 when required. The difference between current output and the unit's maximum available  
27 output is the available operating reserve it is providing to the system (i.e., the amount of  
28 “room” the unit has left to increase its generation by). As described further in YUB-YEC-  
29 51, the BESS would provide up to 20 MW of operating reserve simply when idling on the  
30 system. This will allow hydro units to be operated at a higher output and results in the  
31 reduction of thermal generation, resulting in a fuel cost savings. Further, as the hydro units  
32 may as a result be operated at a more efficient output, additional savings could be incurred  
33 by this use case.

34

35 As intermittent renewables (such as wind and solar) increase in penetration on Yukon's  
36 grid, the operating reserve requirements may increase, in order to enable “following” of  
37 this generation (e.g., the operator will need to be able to replace wind generation if it is

1 declining or solar if clouds are passing by). Given the 40 GWh of annual wind and solar  
2 energy expected to be integrated from the IPP Standing Offer Program, operating reserve  
3 will become an even more critical element of grid reliability in the future for YEC.

4  
5 While operating reserve could in theory be provided by the most cost-effective alternative,  
6 rental diesel units, it would have significant operating cost implications. For rental diesel  
7 units to provide operating reserve, they would need to be online and running. Accordingly,  
8 provision of operating reserve by diesel rental units would require consumption of fuel,  
9 incur fuel and operating costs, and consume operating hours from the rental contract.

10  
11 ***Frequency Regulation***

12  
13 Another key reliability requirement for YEC, assisted by the BESS, is frequency regulation,  
14 which is critical to maintaining system stability. This service corrects for short-term  
15 changes in electricity use that might affect the stability of the power system.

16  
17 In order to prevent under-frequency load-shedding (e.g., the disconnection of electricity  
18 customers due to an under-frequency event), YEC has under-frequency protection on the  
19 system. This protection is implemented through the use of operator alarms, which alert  
20 operators if there has been an excursion outside of the acceptable range.

21  
22 YEC currently manages its system to maintain frequency within the acceptable range. The  
23 BESS will automatically maintain system frequency within a range as described in YUB-  
24 YEC-1-24(d), therefore reducing the likelihood of frequency excursions and/or under-  
25 frequency load shedding. This will directly benefit customers by improving reliability and  
26 reducing the number of outages. Frequency regulation could not be provided by the most  
27 cost-effective alternative, rental diesel units, as these units are primarily used for peaking  
28 generation and are not configured for frequency response automation in the same manner  
29 as the BESS.

30  
31 ***Voltage Control***

32  
33 Maintaining acceptable voltage levels on the power system is also key to system reliability.  
34 Voltage deviations outside of acceptable ranges can wear or damage equipment, trigger  
35 outages, or compromise safety. The acceptable voltage ranges employed by YEC are  
36 shown in the table below.

Description	Location	High Alarm	Low Alarm
L177 70kV	Dawson to Stewart	72.45	65.55
L174 138kV	Stewart Crossing to Minto Landing	145	135
L178 138kV	Carmacks to Faro	145	135
S170 34.5kV	McIntyre	38.5	32.8
S150 34.8kV	S150 Bus 1	37.95	32.7
Mayo Hz	Mayo A Plant Hz	60.7	59.4
WAF Hz	Whitehorse P125 Plant Hz	60.7	59.4

1

2 The voltage in a power system depends on reactive power. As the BESS will be able to  
3 supply real and reactive power simultaneously to the grid, it can assist with automatic  
4 voltage control on the grid. This will improve YEC's ability to prevent or respond to voltage  
5 deviations. The most cost-effective alternative to the project, rental diesel units, could  
6 produce reactive power but would not be configured to automatically assist with voltage  
7 control on the grid.

8

### 9 ***Blackstart and Outage Restoration Capability***

10

11 In the event of a significant grid outage (e.g., blackout), YEC must "blackstart" the grid,  
12 i.e., restore YEC generation units after a total blackstart outage. This involves energizing  
13 equipment in segments and gradually reconnecting customer load. Currently, YEC uses  
14 its hydroelectric facilities to blackstart the grid, by energizing the electrical equipment in  
15 the substation, then the hydro generation, in several increments. This process can take  
16 approximately 2 hours.

17

18 In the event of a blackstart event, YEC must also restore service to customers. This is  
19 related to blackstart restoration, but an operationally separate activity. As described on  
20 page 13 of the Application, the BESS will significantly decrease the time a large grid  
21 outage impacts customers, and therefore increases this aspect of customer reliability.  
22 Please also see response to YUB-YEC-1-23(b) for an explanation of how different BESS  
23 project size options will increase YEC's ability to respond to an extreme outage. While the  
24 most cost-effective alternative, rental diesel units, can support blackstart operations, these  
25 units would not provide the decrease in outage time given their smaller size (e.g., 1.8 MW  
26 individual units compared to the 20 MW BESS).

1 **TOPIC: Challenges Around Rented Diesel Units**

2

3 **REFERENCE: Application, Tab 4.2, PDF page 33**

4

5 **QUOTE:** “Aside from added costs, reliance on rented diesel units can create  
6 risks as to continuing availability, acceptable performance and the  
7 ability to accommodate the required units.”

8

9 “In summary, the ‘status quo’ option is not a feasible alternative today.  
10 Permanent solutions are needed rather than relying upon temporary  
11 options such as rented diesel generators.”

12

13 **QUESTION:**

14

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

19

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

23

24 **ANSWER:**

25

26 **(a)**

27

28 The competitive availability of rented diesel units has shown a limited range of options  
29 (see response to YUB-YEC-1-17(c) for the history of YEC’s rentals). The units ideally need  
30 to be located adjacent to an existing thermal facility – and there are space and other  
31 constraints at these facilities, given that past planning had not considered rented diesel  
32 units as a likely requirement, i.e., capital infrastructure work has been needed to  
33 accommodate diesel rental units. Following the winter of 2019/20, YEC also expanded  
34 considerably its estimated requirement for rented diesel units - and this necessitated  
35 expanding the location for diesel rental units to include the Faro diesel facility as well as  
36 the Whitehorse diesel facility.

1 When YEC expanded rentals to 17 in 2020/21, the additional units were sourced by CAT;  
2 the vendor indicated that the additional 7 units were not available in Western Canada.  
3 Units were sourced from Eastern Canada and Alaska. Additionally, the units are  
4 configured for remote running; reconfiguration is required to ensure the units can be safely  
5 and effectively run on the grid. Finally, the YEC experience with these units has indicated  
6 a lower availability rate than expected. One spare unit has been rented at each location  
7 (Faro and Whitehorse) to ensure dependable capacity is available for the winter peak load  
8 period.

9  
10 **(b)**

11  
12 As reviewed below, Yukon Energy has explored (and continues to explore) permanent  
13 solutions to the N-1 dependable capacity shortfall. Rented diesel units have been adopted  
14 to date as a short-term measure, and the only feasible solution, to current N-1 shortfalls  
15 that exist before permanent solutions can be implemented. As demonstrated by the  
16 proposed BESS project, permanent solutions have not been “dismissed in favour of rented  
17 diesel units” – rented diesels have been implemented until permanent solutions are  
18 approved, developed and in-service.

19  
20 More detail on YEC’s exploration of permanent solutions is provided below. Please also  
21 see the following for additional information:

- 22  
23 • YUB-YEC-1-42 regarding new diesel units at WRGS  
24 • YUB-YEC-1-43 regarding the 20 MW thermal plant option  
25

26 ***YEC’s 2016 Resource Plan and 20 MW Diesel Plant Option***

27 YEC’s 2016 Resource Plan identified an existing and growing N-1 dependable capacity  
28 shortfall and a range of permanent solution options to address this shortfall, including a  
29 new 20 MW greenfield diesel plant option in combination with the BESS option. The rented  
30 diesel option emerged after this plan was concluded as a means of addressing the N-1  
31 dependable capacity shortfall prior to YEC being able to implement permanent solutions.  
32 The YUB reviewed planning for the new 20 MW diesel plant project during the 2017/18  
33 GRA, and noted in Appendix A to Order 2018-10 that it was not persuaded that the project  
34 was the only way to address the predicted capacity shortfall, and that YEC should not  
35 proceed with the project without a detailed business case that considers the alternatives  
36 to the project.

1 Yukon Energy proceeded after the 2016 Resource Plan with additional work to evaluate  
2 project alternatives. Yukon Energy's 2021 GRA filing (Appendix 5.3, section 5.3-2 re  
3 Diesel Retirement Replacement (12.5 MW) project planning) provided the following  
4 update on this activity:

5  
6 This included identifying and evaluating a number of options for a new 20 MW  
7 thermal plant. In October 2019, it was determined that considering the results of  
8 the technical, environmental and socio-economic research, as well as public  
9 feedback, YEC would focus potential options to add or replace capacity at existing  
10 generation facilities on an incremental basis as diesel engines are retired.

11  
12 This includes consideration of the following near term activities:

- 13  
14 • Installation of 5 MW of thermal capacity at the Whitehorse Diesel Plant  
15 (P126);  
16 • Replacement of 5.1 MW of diesel to be retired at the Faro Diesel Plant with  
17 a 5 MW diesel unit;  
18 • Retirement of the existing 2.5 MW of diesel capacity in Dawson City with  
19 installation of 2.5 MW of diesel capacity at the Callison Substation.

20  
21 Efforts in 2020 have focused on preliminary engineering and finalizing a  
22 procurement strategy, defining vendor contracts and milestones, and updating the  
23 overall project schedule.

24  
25 The deferred costs forecast in the Application assume that the project continues,  
26 with spending in WIP increasing from \$0.041 million at the end of 2018 to \$6.395  
27 million by the end of 2021. Dependable capacity from these projects is expected  
28 to be available by winter 2023/24. In the interim, Yukon Energy will continue to rent  
29 diesel generators each winter to ensure an adequate supply of back-up power in  
30 case of an emergency.

31  
32 ***YEC's 10 Year Renewable Electricity Plan***

33 Section 4.2.1 of the BESS Part 3 Application reviews the range of near-term supply options  
34 examined in Yukon Energy's 10-Year Renewable Electricity Plan to address forecast  
35 energy and capacity shortfalls, with a focus on the permanent solution options to help  
36 address the N-1 dependable capacity shortfall that include diesel replacement, Atlin Hydro

- 1 Expansion Project, and Tutshi-Moon Pumped Storage Project – Phase 1. Yukon Energy
- 2 is pursuing actively each of these alternatives.

1 **TOPIC: Energy Storage Technologies**

2

3 **REFERENCE: Application, Tab 4.2.2, PDF page 36**

4

5 **QUOTE:** "There are various energy storage technologies available. Yukon  
6 Energy completed a comprehensive review of the available energy  
7 storage technologies for the 2016 Resource Plan. This study concluded  
8 that batteries, and lithium ion batteries specifically, were the best  
9 energy storage option for the YIS context. The use required by Yukon  
10 Energy involves low cycling, with a need for reliable and quick response  
11 in a northern climate location."

12

13 **QUESTION:**

14

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

17

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

20

21 **ANSWER:**

22

23 **(a)**

24

25 YEC engaged Transgrid to complete a review of energy storage technologies for the 2016  
26 Resource Plan. The report was intended to provide YEC with a better understanding of  
27 what types of energy storage technologies were available to support the power system  
28 requirements.

29

30 The Transgrid analysis included a literature review, estimation of project costs, schedule,  
31 and footprints, and a risk analysis for the various technologies. The report initially  
32 screened the potential of Compressed Air Energy Storage, Flywheel Energy Storage,  
33 Hydrogen Storage, and Electrochemical Storage (including conventional batteries, high  
34 temperature batteries, and flow batteries).

35

36 The assessment considered the technology, performance, maturity and commercial  
37 availability, and pros and cons as applicable to Yukon Energy. The analysis concluded

1 that for YEC's purposes, Electrochemical Storage using either lead acid batteries or lithium  
2 ion batteries would be best suited for YEC's consideration.

3

4 **(b)**

5

6 Table 4-1 on page 17 of the Hatch report (Appendix B to the BESS Application) provides  
7 a summary overview of the differences between various storage technology capabilities.

8

9 The other energy storage technologies considered were not able to meet the Yukon grids  
10 needs as well as lithium ion batteries. The conclusion was based on the calculated power,  
11 energy, and discharge time characteristics required as well as the maturity, cost and  
12 environmental and socio-economic attributes of the technologies.

1 **TOPIC: Dependable Capacity**

2

3 **REFERENCE: Application, Tab 4.2.2, PDF page 40**

4

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

9

10 **QUESTION:**

11

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

14

15 **ANSWER:**

16

17 **(a)**

18

19 Yes. Dependable capacity is based on having sufficient energy storage capacity (MWh)  
20 to reduce the YEC load to a constant load over a 24 hour period on the peak day.

21

22 Please see the following for further details on how this size requirement is calculated, and  
23 how it affects different size options for the battery:

24

- 25 • Section 3.1.2.2 and Table 3-2 of the Application (shows that 35 GWh battery size  
26 needed to displace four diesel rental units (7.2 MW).  
27 • Section 5.1 (page 28-30) and Section 6.1 (page 35-40) of Hatch Report provided  
28 as Appendix B to the Application

1 **TOPIC: Implicit Costs and Operational Benefits**

2

3 **REFERENCE: Application, Tab 4.2.2, PDF page 40**

4

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

11

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

15

16 **QUESTION:**

17

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

20

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

23

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

26

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

29

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

1 **ANSWER:**

2

3 **(a)**

4

5 No. When the BESS is not required for an N-1 event, it is expected to be performing  
6 secondary use cases rather than being idle. These secondary use cases are described in  
7 the Application and in response to YUB-YEC-1-1(h).

8

9 **(b)**

10

11 The Application at Table 4-3 shows the following 20-year present values (PV) for the  
12 Project excluding annual savings from secondary uses:

13

14 • Total Annual Costs PV of \$27.75 million. Excluding net recharging costs for  
15 secondary uses, total annual PV costs with only N-1 use are \$26.49 million over  
16 the 20-year life.

17

18 • BESS annual savings from avoided diesel rental costs (related to N-1 use) are  
19 \$22.65 million PV over the 20-year life.

20

21 • Net PV impact of ratepayer savings from only N-1 use is an added PV cost of \$3.84  
22 million over the 20-year life.

23

24 In summary, the Project as proposed is not economic based only on N-1 considerations.  
25 This reflects increases in Project energy storage capacity (MWh) and useable power (MW)  
26 to accommodate secondary uses, i.e., as shown in Tables 3-2 and 4-2 of the Application,  
27 the cost savings from the displacement of four rented diesel could be secured with an  
28 energy storage capacity of 35 MWh and 8.8 MW useable power (versus the 40 MWh and  
29 20 MW included in the proposed BESS Project).

30

31 **(c)**

32

33 Table 4-3 confirms that operating reserve is the other BESS use providing by far the  
34 biggest cost savings. There are no apparent opportunity costs associated with BESS use  
35 for operating reserve, i.e., this use simply enables reduced thermal generation and  
36 improved hydro generation efficiency without requiring annual BESS throughput levels  
37 that would adversely impact battery life.

1 No specific economic savings have been estimated in Table 4-3 for BESS use to provide  
2 greater operational flexibility to accommodate future changes as more intermittent  
3 renewable resources come online. This potential BESS use has not been shown to  
4 displace development of other assets – if anything, it may help to accommodate added  
5 renewable resource use. Insufficient information is available at this time to discuss usefully  
6 any related opportunity costs related to this BESS use.

7

8 **(d)**

9

10 The analysis assumes end of life capacity of 40 MWh with the expected charging and  
11 discharging pattern for the BESS. The BESS is assumed to not degrade below 40 MWh  
12 of storage capacity. Additionally, as noted in the Hatch report and Table 3-1 of the  
13 Application, the usage for the BESS is currently relatively low. Therefore, a reasonable  
14 increase in usage can be accommodated without significant impacts on degradation.  
15 Please see also responses to YUB-YEC-1-1(h) and YUB-YEC-1-11.

16

17 **(e)**

18

19 YEC is referring both to the near and long term in this statement. In the near term (the  
20 next 1 to 3 years), an annual 40 GWh of intermittent renewable energy (wind and solar)  
21 from the Standing Offer Program will be integrated on the system. Allowing for flexibility in  
22 the BESS operation will enable it to assist in integrating these variable resources while  
23 maintaining system stability and reliability. In the long term (5 to 10+ years), it is unknown  
24 what additional system configuration changes may be undertaken. Again, allowing for  
25 flexibility in the BESS operational ability enables future flexibility to accommodate potential  
26 system changes not fully understood today.

1 **TOPIC: BESS Inverter to 20 MW**

2

3 **REFERENCE: Application, Tab 4.2.2, PDF page 40**

4

5 **QUOTE:** “Increasing the power output of the BESS inverter to 20 MW allows the  
6 BESS to be recharged faster overnight, ensuring that it can be ready  
7 the next day to continue providing dependable capacity under the N-1  
8 event.”

9

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

15

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

24

25 **QUESTION:**

26

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

29

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

32

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

34

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

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

3  
4 f) During a peak load scenario, how long can the BESS cover an outage of WH#4?  
5 Please explain.

6  
7 g) Could existing thermal at Whitehorse cover an outage of WH#4? Please explain.

8  
9 h) Could increased production from Aishihik cover or partially cover for an event  
10 where WH#4 is lost? Please explain.

11  
12 i) Could any of the other WH units cover for the loss of WH#4? Please explain.

13  
14 **ANSWER:**

15  
16 **(a)**

17  
18 No. On a peak winter day during an N-1 event there is no excess hydro energy to recharge  
19 the battery because the maximum hydro capacity under an N-1 event is 32.8 MW  
20 (Whitehorse and Mayo) and the nighttime peak load is approximately 80 MW. It is  
21 expected during a 2 week N-1 event the BESS would be recharged with thermal energy.

22  
23 **(b)**

24  
25 At 7.2 MW output the BESS can discharge for 5.5 hours. However, as shown in Figure 3-  
26 2 of the Application (page 8) under N-1 conditions the BESS will only discharge at 7.2 MW  
27 at the peak. Therefore, the BESS is expected to discharge as required for a longer period  
28 during each day.

29  
30 **(c)**

31  
32 The LNG generation is not typically used for black-start operations. Gas engines do not  
33 have the transient response of diesel generation. The duration to start the LNG generation  
34 is dependent on the season.

35  
36 The LNG is converted to a gas through the use of a vaporizer. The heat source for the  
37 vaporizer is glycol loop system. In the winter, the glycol system is maintained at the proper

1 operating temperature. The send out tank storage is pressurized using a pressure building  
2 coil prior to sending the LNG to the vaporizer. Typical duration for this process and placing  
3 a unit on line is 10-15 minutes.

4  
5 During the summer months YEC has made the decision to drop the glycol system  
6 temperature to ambient to save internal energy consumption. This increases the start time  
7 for the LNG generation to approximately 30 minutes.

8  
9 **(d)**

10  
11 Without the need to preheat fuel process like with LNG Yukon Energy can place diesel  
12 generation on line within 5 minutes. The units are remotely started, idle for 2-3 minutes  
13 then go to rated speed and synchronize to the system.

14  
15 **(e)**

16  
17 The term blackstart is used in reference to a full system restoration. In a full system outage  
18 (blackout) there is no benefit because the diesel generation would have tripped off line.

19  
20 In a partial outage, which is not considered a blackstart scenario, with diesel on line the  
21 system benefit is the transient response the diesel generation provides. Diesel will  
22 respond quicker to load or generation loss than hydro generation.

23  
24 Diesel generation used for baseload is typically used during high loading periods and  
25 provides additional system inertia (stability) to the grid.

26  
27 **(f)**

28  
29 The BESS could cover a 20 MW outage for 2 hours (40 MWh/20 MW = 2 hours); however,  
30 the BESS is not meant to cover a generation outage for an extended period. Coverage of  
31 a loss of WH#4 is meant to be used to respond instantaneously to the outage and prevent  
32 load shedding until other generation, which must be heated, ramped up and synchronized,  
33 can be brought online. Please see response to YUB-YEC-1-20.

1 **(g)**

2

3 No. While existing thermal at Whitehorse could gradually replace the output of a WH#4  
4 loss (e.g., could provide replacement of the dependable capacity), it would not be able to  
5 prevent system outages and load shedding (e.g., the units would need to be already online  
6 at less than maximum output and able to ramp up instantaneously by 20 MW). Offline  
7 thermal units would need to be heated, ramped up, and synchronized, which can take 5  
8 to 30 minutes depending on the generator type. The BESS will be able to respond  
9 instantaneously to loss of WH#4 and accordingly prevent load shedding and grid outages.

10

11 **(h)**

12

13 It is not expected that production at Aishihik could prevent system outages and load  
14 shedding in response to loss of WH#4, as the units would need to be already online at  
15 less than maximum output and able to ramp up instantaneously by 20 MW. Further, the  
16 physical distance of the Aishihik facility from Whitehorse could delay the response to a  
17 WH4 outage.

18

19 **(i)**

20

21 No. The other WH units could not prevent system outages and load shedding in response  
22 to loss of WH#4, as the units would need to be already online at less than maximum output  
23 and able to ramp up instantaneously by 20 MW. This is not possible as the total maximum  
24 output of the three remaining WH units is 7 MW in winter and 19 MW in summer.

1 **TOPIC: Two 6.7 MW Diesel Engines**

2

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

5

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

12

13 **QUESTION:**

14

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

19

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

22

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

25

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

27

28 **ANSWER:**

29

30 **(a)**

31

32 YEC has not revisited the specific diesel options used for assessing the LNG project;  
33 however, as reviewed in response to YUB-YEC-1-37(b), YEC continues to assess thermal  
34 options that include new diesel or LNG units at the Whitehorse Rapids facility. Rented  
35 diesel units have been implemented only until BESS, diesel replacements, and other  
36 permanent solutions are approved, developed and in-service.

1 **(b)**

2

3 An additional thermal unit can also generate energy indefinitely, while the BESS does not  
4 generate electricity, but rather stores generation from other sources and redeploys to  
5 provide a variety of services as described in the Application.

6

7 **(c)**

8

9 The expected life of a thermal unit is typically 40 years.

10

11 **(d)**

12

13 YEC has not recently developed a cost estimate for LNG additions in the range of 13 MW.  
14 The third 4.4 MW LNG unit was recently added to the Whitehorse facility for a cost of  
15 approximately \$8.3 million, utilizing infrastructure already established for accommodating  
16 this unit.

17

18 In general, the economics for selecting an LNG unit over a diesel unit would require an  
19 expected level of generation to enable LNG fuel cost savings relative to diesel to be  
20 material – particularly if new LNG infrastructure (e.g., storage) is required to accommodate  
21 the LNG units. YEC is therefore focusing on options for diesel replacement in its planning  
22 for new thermal units to replace retirements.

1 **TOPIC: 20 MW Thermal Plant not Pursued**

2

3 **REFERENCE: Application, Tab 4.1.3, PDF page 30**

4

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

11

12 **QUESTION:**

13

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

16

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

19

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

23

24 **ANSWER:**

25

26 **(a) to (c)**

27

28 The 2016 Resource Plan identified a new 20 MW greenfield diesel plant as one of the  
29 preferred options for addressing the dependable capacity shortfall gap. The YUB reviewed  
30 planning for the project during the 2017/18 GRA, and noted it was not persuaded that the  
31 project was the only way to address the predicted capacity shortfall, and that YEC should  
32 not proceed with the project without a detailed business case that considers the  
33 alternatives to the project.

1 Following the Board's direction in Order 2018-10, YEC proceeded with the additional work  
2 as required to evaluate project alternatives. This included identifying and evaluating a  
3 number of options for a new 20 MW thermal plant. This work identified that permanent  
4 diesel generation located either adjacent to the Whitehorse landfill or in YEC's existing  
5 P126 building was the most likely option for the 20 MW project.

6  
7 Ongoing Yukon Energy review and consultation on the 20 MW plant options indicated a  
8 wide range of public concerns regarding development of a new large greenfield diesel  
9 plant. In October 2019, it was determined that considering the results of the technical,  
10 environmental and socio-economic research, as well as feedback from the public, YEC  
11 would focus potential options to add or replace capacity at existing generation facilities on  
12 an incremental basis as diesel engines are retired. The results of the public engagement  
13 in particular indicated there is limited social license for a greenfield diesel project in Yukon  
14 at this time.

15  
16 The 10-Year Renewable Electricity Plan) also identified potential renewable generation  
17 options that could significantly reduce the need to rely primarily on thermal generation to  
18 address the forecast N-1 dependable capacity shortfall. Section 4.2.1 of the BESS Part 3  
19 Application reviews the range of near-term supply options examined in Yukon Energy's  
20 10-Year Renewable Electricity Plan to address forecast energy and capacity shortfalls.  
21 Reduction in the reliance on thermal generation aligns with the emerging policy directions  
22 as discussed in YUB-YEC-1-1(f), such as Yukon government's 93% long-term average  
23 renewable electricity requirement and 97% renewable target, and the Federal  
24 government's Net Zero by 2050 policy.

25  
26 YEC's current resource plan (the 10-Year Renewable Electricity Plan) does not  
27 contemplate the construction of a new 20 MW greenfield thermal plant in the future. Should  
28 a change in circumstance trigger a re-evaluation of YEC's long-term resource plan, a  
29 greenfield thermal project may be considered in the future.

30  
31 Please see response to YUB-YEC-1-44(b) for review of the BESS project advantages  
32 relative to new or rented diesel alternatives. Both new and rented diesel options compared  
33 to the BESS Project do not offer the opportunity for the operating reserve use cost savings  
34 as estimated in Table 4-3 – and these savings alone enable the BESS Project to provide  
35 an overall lower cost for ratepayers than the diesel options. The Application notes a range  
36 of other potential BESS secondary use benefits (compared with diesel) that further  
37 enhance the benefits from selection of this alternative.

1 **TOPIC: Reasonable Alternatives to the BESS Project**

2

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

7

8 **QUOTE:** Application, PDF page 66:

9

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

13

14 Application, PDF page 33:

15

16 “4.2.1 Alternatives to the Project

17

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

30

31 **QUESTION:**

32

33 a) Please compare the proposed BESS project to the most cost-effective alternative,  
34 whether it is one among the alternatives mentioned in sections 4.2.1 of the  
35 application and 4 of the Hatch Report or a different one. In the comparison, please  
36 use a table with the variables included in section 12, in addition to elaborating on

1 any other costs, benefits, risks, reliability considerations and/or externalities  
2 deemed relevant.

3

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

10

11 **ANSWER:**

12

13 **(a)**

14

15 Table 4-3 from the Application, which is copied below, compares the proposed BESS  
16 project to the most cost-effective alternative today (i.e., four rented diesel units) to secure  
17 7.2 MW of N-1 dependable capacity to reduce the N-1 dependable capacity shortfall. This  
18 table addresses the variables included in section 12 (Table 12.1 and Table 12.3 for the  
19 selected KDFN site) of the Hatch report, with adjustments as reviewed in the Application  
20 for capex and other variables. The table shows that the BESS project over its life is  
21 expected to provide material cost savings for ratepayers (i.e., \$12.7 million net present  
22 value estimated cost savings) compared to the most cost-effective alternative.

23

24 The question references the variables in Section 12 of the Hatch Report. In order to  
25 facilitate comparison with Section 12 of the Hatch Report, the following are noted  
26 regarding the Table 4-3 analysis of BESS costs and benefits relative to rented diesel units  
27 compared with the Hatch section 12 analysis of BESS costs and benefits relative to rented  
28 diesel units:

29

30 • **Rented diesel alternative:** Both assessments assume rented diesels are the most  
31 cost-effective alternative to the BESS to reduce the N-1 dependable capacity  
32 shortfall.

33

34 • **Capital and Operating Costs:** For the 20 MW/ 40 MWh BESS size option  
35 selected for the Project and assessed in Table 4-3 of the Application, Capex and  
36 Opex are both increased (2020\$) for Table 4-3 compared to Hatch (\$31.698 million  
37 capex vs. \$28.88 million in Hatch before the \$16.5 million grant to reduce these

- 1 costs, \$629k annual Opex vs. \$574k in Hatch report); Table 4-3 assumes 7.2 MW  
2 of dependable capacity provided vs 7.0 MW assumed in Hatch report. See  
3 response to YUB-YEC-1-53 for more detailed explanation of factors explaining  
4 differences in Table 4-3 compared to Hatch for capex and opex costs.  
5
- 6 • **Levelized Cost of Capacity (LCOC):** Hatch estimates LCOC (2020\$) at \$199/kW  
7 per yr for the 20 MW/ 40 MWh BESS at the selected KDFN site based only on the  
8 above net capex and annual opex costs; on the same basis, the Application costs  
9 result in an estimated LCOC of \$226/kW per yr for the BESS Project.<sup>1</sup> These LCOC  
10 comparators to rented diesels both highlighted that BESS feasibility required cost  
11 savings from secondary uses beyond the primary N-1 dependable capacity use.  
12
  - 13 • **NPV (with Savings):** Hatch estimates NPV (2020\$ with savings for BESS  
14 compared to rented diesel units over the 20 year life) at \$49.252 million for the 20  
15 MW/ 40 MWh BESS at the selected KDFN site based on the 20 year cash flow  
16 with the above net capital and annual opex costs and annual savings of \$0.956  
17 million for diesel rentals and \$3.802 million for operating reserve and peak shifting  
18 BESS uses<sup>2</sup>; the Application Table 4-3 estimates NPV with savings for BESS  
19 compared to rented diesel units at \$12.676 million – this materially lower NPV  
20 mainly reflects the reduction of estimated thermal displacement (reduced by two-  
21 thirds to reflect water storage savings impacts with existing operations) as well as  
22 updated thermal fuel prices and corrected incremental hydro generation costs.  
23
  - 24 • **Internal Rate of Return (IRR):** The Hatch Report included the IRR comparator  
25 regarding BESS savings return compared to rented diesels. Hatch estimates IRR  
26 (2020\$) at 34% based on the same cash flow used for the NPC with savings  
27 estimate; based on Table 4-3 annual cash flows excluding capital costs and the  
28 initial net capex of \$15.812 million (2022\$), the IRR is 11% for the Project. The  
29 materially lower IRR for the Application analysis reflects the same adjustments  
30 noted above for the lower NPV with savings.

---

<sup>1</sup> The Application at page 17 provides an LCOC of \$235/kW per yr which is in 2022\$ and also includes provision for ongoing recharging losses and idling with only N-1 dependable capacity use. The Application assumes YEC's updated WACC of 4.794% vs. 4.92% assumed in Hatch report.

<sup>2</sup> See Hatch Table 12.1 for the assumptions re: these annual savings, and page 104 of the Hatch report for the assumed diesel, LNG and hydro generation costs per kW.h.

1 **Table 4.3 from Application - Annual Ratepayer Impacts from BESS (20 MW/ 40 MWh)**  
2

	BESS Annual Costs (\$000)				BESS Annual Savings (\$000)				Net Annual Ratepayer Savings (Costs) (\$000)
	Annual Capital Cost	Annual Operating Cost [excl. recharging]	Annual Net Recharging Cost [15% return loss plus 3% idling loss]	Total Annual Costs	Avoided Diesel Rental Costs	Annual Savings from Operating Reserve Use	Annual Savings from Peak Shifting	Total Annual Savings	
\$000	A	B	C	D=A+B+C	E	F	G	H=E+F+G	I=H-D
Year 1	\$1,530	\$652	\$82	\$2,264	\$1,216	\$1,125	\$11	\$2,351	\$87
Year 2	\$1,492	\$665	\$84	\$2,240	\$1,265	\$1,147	\$11	\$2,423	\$182
Year 3	\$1,454	\$678	\$85	\$2,217	\$1,315	\$1,170	\$11	\$2,496	\$280
Year 4	\$1,416	\$691	\$87	\$2,194	\$1,368	\$1,193	\$11	\$2,573	\$379
Year 5	\$1,378	\$704	\$89	\$2,171	\$1,423	\$1,217	\$12	\$2,651	\$481
Year 6	\$1,340	\$717	\$91	\$2,148	\$1,480	\$1,242	\$12	\$2,733	\$585
Year 7	\$1,302	\$731	\$92	\$2,126	\$1,539	\$1,267	\$12	\$2,817	\$691
Year 8	\$1,264	\$745	\$94	\$2,104	\$1,600	\$1,292	\$12	\$2,904	\$801
Year 9	\$1,226	\$759	\$96	\$2,082	\$1,664	\$1,318	\$12	\$2,994	\$912
Year 10	\$1,189	\$774	\$98	\$2,061	\$1,731	\$1,344	\$13	\$3,088	\$1,027
Year 11	\$1,151	\$789	\$100	\$2,040	\$1,800	\$1,371	\$13	\$3,184	\$1,144
Year 12	\$1,113	\$804	\$102	\$2,019	\$1,872	\$1,398	\$13	\$3,284	\$1,265
Year 13	\$1,075	\$820	\$104	\$1,999	\$1,947	\$1,426	\$13	\$3,387	\$1,388
Year 14	\$1,037	\$835	\$106	\$1,978	\$2,025	\$1,455	\$14	\$3,493	\$1,515
Year 15	\$999	\$851	\$108	\$1,959	\$2,106	\$1,484	\$14	\$3,604	\$1,645
Year 16	\$961	\$868	\$111	\$1,939	\$2,190	\$1,514	\$14	\$3,718	\$1,779
Year 17	\$923	\$885	\$113	\$1,920	\$2,278	\$1,544	\$15	\$3,836	\$1,916
Year 18	\$885	\$902	\$115	\$1,902	\$2,369	\$1,575	\$15	\$3,958	\$2,057
Year 19	\$847	\$919	\$117	\$1,884	\$2,463	\$1,606	\$15	\$4,085	\$2,201
Year 20	\$810	\$937	\$120	\$1,866	\$2,562	\$1,638	\$15	\$4,216	\$2,350
<b>NPV</b>	<b>\$16,318</b>	<b>\$10,147</b>	<b>\$1,286</b>	<b>\$27,751</b>	<b>\$22,647</b>	<b>\$17,612</b>	<b>\$167</b>	<b>\$40,426</b>	<b>\$12,676</b>

Notes:

- 1 2021 assumed as Year 1. Capital costs (Table 3-4) and operating costs (Table 3-5) each escalated 2% for one year inflation.
- 2 YEC WACC at 4.794% per 2021 GRA (real WACC with 2% inflation at 2.739%) is used for all net present values (NPVs).
- 3 Annual Capital Cost includes depreciation (20 year life) and return on mid-year rate base at YEC WACC of 4.794%.
- 4 Annual Net Recharging Cost assumes diesel generation for N-1 dependable capacity and operating reserve recharge losses, 75% LNG and 25% hydro for other recharge losses (peak shifting saving already addresses these losses), and hydro for idling losses.
- 5 Avoided Diesel Rental Costs assumes \$168,896 per MW (2022\$) and 7.2 MW (4 rental units) of dependable capacity.

(b)

New diesel replacements are being considered concurrent with the BESS Project, as noted in YECs 10-Year Renewable Electricity Plan – the N-1 dependable capacity shortfall is large enough to require consideration of multiple concurrent developments.

Comparison of the BESS Project to rented diesel versus new diesel involves similar considerations, subject to differences in the capital and operating costs for the diesel alternatives. The Application notes<sup>3</sup>, for example, estimated LCOC for a 12.5 MW new diesel at Takhini at approximately \$186/kW-year (2022\$) versus estimated LCOC for

<sup>3</sup> Application, footnote 30 (corrected to show 12.5 MW vs 12.5 kW).

1 rented diesels (2022\$) at \$211.kW-yr,<sup>4</sup> suggesting that new diesel units when developed  
2 can offer potential cost savings compared to rented diesels. However, both diesel options  
3 compared to the BESS Project do not offer the opportunity for the operating reserve use  
4 cost savings as estimated in Table 4-3 – and these savings alone enable the BESS Project  
5 to provide an overall lower cost for ratepayers than the diesel options. The Application  
6 notes a range of other potential BESS secondary use benefits (compared with diesel) that  
7 further enhance the benefits from selection of this alternative.

---

<sup>4</sup> Application, footnote 29.

1 **TOPIC: Reasonable Alternatives to the BESS Project**

2

3 **REFERENCE: Application, Tab 4.2.1, PDF pages 33 to 35**

4

5 **QUOTE:** Application, PDF page 34:

6

7 “The reviewed new resource portfolio options to the BESS in the 10-  
8 Year Renewable Electricity Plan include the following:”

9

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

17

18 **QUESTION:**

19

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

24

25 **ANSWER:**

26

27 **(a)**

28

29 DSM is a complementary solution to the BESS project. DSM was selected as a resource  
30 to be deployed along with the battery in the portfolios presented in both the 2016 Resource  
31 Plan and the 10-Year Renewable Electricity Plan. The 10-Year Renewable Electricity Plan  
32 included 7 MW of energy storage and 7 MW of DSM. Both resources together are part of  
33 the portfolio which meets Yukon's N-1 dependable capacity requirements – and each of  
34 these resources is reflected in the 10-Year Renewable Electricity Plan at its reasonable  
35 level of capability.

1 **TOPIC: Public Engagement Process**

2

3 **REFERENCE: Application, Tab 4.2.2, PDF page 38; Application, Tab 5.0, PDF**  
4 **page 45**

5

6 **QUOTE:** Application, PDF page 38:

7

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

17

18 Application, PDF page 45:

19

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

29

30 **QUESTION:**

31

32 a) Please provide further details on stakeholders’ comments around the two  
33 remaining site options. For example, did stakeholders also agree that the KDFN  
34 site was preferable over the TKC site?

35

36 b) Please provide the lease rates offered for both the KDFN and TKC sites.

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

- 3 i. Potential noise and light pollution
- 4 ii. Impact of industrial development in rural residential areas
- 5 iii. Fire and explosion safety
- 6 iv. Health impacts of radiation, electromagnetism and gases
- 7 v. Reduction in property values and impacts on insurance premiums
- 8 vi. Contamination of agricultural land close to the Battery Energy Storage  
9 System Project

10  
11 d) If the concerns mentioned in part (b) have been resolved, please provide further  
12 information on what YEC told stakeholders. If the concerns have not been  
13 resolved, please provide the steps YEC is taking to resolve these concerns. For  
14 example, is YEC maintaining dialogue with stakeholders who have outstanding  
15 concerns?

16  
17 **ANSWER:**

18  
19 **(a)**

20  
21 Site-specific comments can be found in Section 3.3 of the What We Heard Report provided  
22 as Attachment 1 to this response. Stakeholder comments did not indicate any clear  
23 preference between the two remaining sites located within Whitehorse for connection to  
24 the Whitehorse rapids substation facility.

25  
26 **(b)**

27  
28 Land lease terms for this project are not complete; given the sensitivity of this factor to the  
29 negotiations, YEC cannot provide this information at this time.

30  
31 **(c) and (d)**

32  
33 Table 1 below provides YEC's approach to address the concerns raised by stakeholders  
34 during the public engagement process. Following the public engagement process in 2020,  
35 YEC released this information to the public to follow up on how their concerns would be  
36 addressed in the project. This information addressed concerns raised regarding all three  
37 sites considered during the public engagement process.

1 YEC will continue to communicate with the public about how each concern has been  
2 mitigated and/or addressed as further engineering and procurement advances and more  
3 detailed information is available on the particular resolution of each concern.

4  
5  
6

**Table 1: Approach to Addressing Stakeholder Concerns**

Concern	How it will be addressed by YEC
Potential noise pollution	<ul style="list-style-type: none"> <li>• Noise modeling for each site has been conducted.</li> <li>• As a result of the public feedback, noise mitigation measures, where appropriate, will be considered as engineering advances.                             <ul style="list-style-type: none"> <li>○ Options include selecting batteries that are designed to be quiet, installing noise baffles and orienting the HVAC systems away from homes.</li> </ul> </li> </ul>
Potential light pollution	<ul style="list-style-type: none"> <li>• This concern will be addressed in the lighting system design, which will be conducted as engineering advances.</li> <li>• YEC will select lighting that provides appropriate security but does not create unnecessary light pollution.</li> </ul>
Reduction in Property values	This concern was only indicated for the Takhini site, which is not the selected project site.
Increase in Insurance Premiums	YEC has confirmed the battery is not expected to affect the insurance costs for property owners.
Fire and Explosion Safety	<p>Lithium-ion batteries are generally considered safe technology and the risk of a fire in a battery energy storage system is very low. YEC will also take a number of proactive steps to ensure that fire and other safety risks are managed effectively, which are described below.</p> <ul style="list-style-type: none"> <li>• YEC will select a vendor with a proven and reliable battery system, and use qualified technicians to do the installation and startup.</li> <li>• Fire suppression will be a key component of the battery system design and selection. The battery design will use several automated mechanisms to prevent fires from starting. YEC will:                             <ul style="list-style-type: none"> <li>○ Install a fire suppression system and alarms in each battery container.</li> <li>○ Check and maintain the fire suppression system routinely as recommended by the vendor.</li> <li>○ Use fire-retardant packing/module containers to ensure that if a fire does occur, it is isolated to a single pack of battery cells.</li> </ul> </li> </ul>

Concern	How it will be addressed by YEC
	<ul style="list-style-type: none"> <li>○ Use containers with pressure relief valves which, in the event of a fire, allow gas to escape and prevent a container explosion.</li> <li>○ Space the containers apart to prevent a fire from spreading from one container to another.</li> <li>○ Develop a comprehensive fire and emergency response plan and commit to providing the required training to local firefighters and emergency response staff.</li> </ul>
<p>Health impacts of radiation, electromagnetism, and gases</p>	<p>Lithium-ion batteries also do not produce any noxious gases in normal operation. Similar to most electrical facilities, in the very unlikely event of a total facility fire, gases could be released due to the burning of various materials and equipment.</p> <p>Through its selection of battery vendors engineering, YEC will ensure any electromagnetism radiation is below acceptable levels for health and aviation interference. This will be verified in the land use assessment permitting that must be completed prior to the project.</p>
<p>Contamination of agricultural land close to the project</p>	<p>Lithium ion batteries don't contain any acid. This eliminates the hazard of acid spills. The only liquid in a lithium-ion battery is the electrolyte within each battery cell. There is virtually no leak risk of this electrolyte fluid as the amount of fluid in each cell is very minimal. Should a cell be punctured, the fluid would remain within the container for mitigation and cleanup.</p>

1



# Grid-Scale Battery Project

## What We Heard Report

Prepared for: Yukon Energy Corporation  
2 Miles Canyon Road, Whitehorse YT Y1A 6L4

Prepared by: Stantec Consulting Ltd.  
202-107 Main Street Whitehorse YT Y1A 2A7

Date: October 15, 2020





Design with  
community in mind

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## EXECUTIVE SUMMARY

Yukon Energy Corporation (YEC) is building a grid-scale battery storage system in the Whitehorse area. The project was identified in the 10-Year Renewable Electricity Plan and has received \$16.5 million in federal funding from the Government of Canada's Green Infrastructure Stream. For YEC, this battery will help maximize the amount of renewable energy it uses to meet peak demands for power, displace diesel and improve grid reliability. Yukon Energy is currently considering three possible sites for this project. More information can be found in Appendix A.

## ENGAGEMENT OBJECTIVES

In late August and September 2020, Stantec undertook a public and stakeholder engagement process about Yukon Energy's proposed grid-scale battery project. The objectives of this of the engagement process were to:

1. Inform the public that YEC is installing a battery in or near Whitehorse and explain why the project is happening, how the battery works, the projects benefits and how this ties in to YEC's 10 Year Renewable Electricity Plan.
2. Gather public input on each of the three proposed sites.
3. Identify any potential questions or concerns about the battery to ensure they are able to be addressed and/ or incorporated into the site design.

## ENGAGEMENT METHODS

There were four engagement initiatives as part of this project: community meetings, stakeholder meetings, written comments, and property owner outreach.

### Community Meetings

The community meetings consisted of five public meetings. In total, 43 people attended the meetings, with some people attending multiple meetings. Notes from the community meetings are in Appendix B.

Date	Location	No. of Attendees
September 8, 2020	Virtual Meeting #1	7
September 10, 2020	Virtual Meeting #2	3
September 15, 2020	Hootalinqua Firehall	13
September 16, 2020	Yukon Transportation Museum	3
September 17, 2020	Best Western Gold Rush Inn – Town Hall	17
	<b>Total</b>	<b>43</b>

## Stakeholder Meetings

Stantec reached out to several stakeholder groups to offer them the opportunity to participate in a one-on-one meeting and to provide feedback. Some groups provided written comments and they can be found in Appendix C.

Stakeholders who provided feedback or requested a meeting	Stakeholders that did not wish to meet
Yukon Chamber of Commerce Yukon Conservation Society Yukon Government – Highway and Public Works and Department of Environment Utilities Consumers Group Yukoners Concerned About Oil and Gas First Nations Chamber of Commerce	Whitehorse Chamber of Commerce Yukon Government – Energy, Mines and Resources Energy Branch, Climate Change Secretariat, and Major Projects Yukon City of Whitehorse Mayor and Council

## Property Owner Outreach

YEC sent out a letter and information sheet to property owners and businesses within 800 metres of each proposed site to introduce the project, provide information about the battery, the sites, and opportunities to get involved. Representatives from Stantec and YEC also went to each residence and business within 800 metres of the three sites. The purpose of this visit was to provide information, make sure that property owners were aware of the engagement process, answer questions and gather feedback. Notes from these conversations are provided in Appendix D.

## Written Comments

Written comments were also accepted through an online form and by direct email to YEC or Stantec staff. The full set of redacted online and email comments can be found in Appendix E and F.

## WHAT WE HEARD – COMMENT SUMMARY

### Overview

Of the 134 comments received, 59 were through email, 32 were submitted using the online form on YEC’s website, 22 were on facebook and 21 were gathered during door-knocking. Most of the comments (72%) received providing comments specifically about Site A, on the North Klondike Highway. Respondents who do not own property within 800 metres of any of the sites provided most of the comments (66%). People who own property near the Klondike Highway site submitted 27% of the comments and people who own property or businesses near Site C provided 7% of the comments. No property- or business-owners within 800 metres of Site B provided comments.

A detailed review of all comments revealed a series of common themes and the most mentioned themes were:

- Noise
- Fear of an emergency situation
- Property values
- Light pollution
- Ability of local fire fighters to respond to an emergency

In this report, when we say that we received “a few comments” on a matter, we mean less than five. When we say that we received “several comments” we mean five to ten comments.

## Site Selection

### Site A – North Klondike Highway

Site A is located on the North Klondike Highway, south of YEC’s Takhini Substation and is on Kwanlin Dün Frist Nation Settlement Land. Most of the comments received through all sources, were about this site. Many of those who attended the in-person and virtual meetings own properties or live within 800 metres of this proposed site. We received 93 specific comments about this site, with 86% of the comments voicing opposition to placing the battery in this location. Of the 91 written comments we received, 59 of them were a letter template that listed 16 reasons why the sender opposes this site.

During door-knocking in the area, we spoke to several residents who are opposed to the project and several who do not have any issues with the proposal. In general, people who live directly adjacent to the site voiced the strongest opposition to this proposed location. The top concerns were:

- How noise and light produced by the battery may impact their well-being and way of life. Residents do not want to see this type of unsightly industrial development along the North Klondike Highway.
- The engagement was rushed, and some people were offended that YEC selected this site as an option, even though there are many residences close by.
- Safety; the battery may catch fire or explode, and the local volunteer fire department does not have the capacity to contain a fire at the battery site.
- Health impacts of this relatively new technology. People are worried about the impacts of radiation, electromagnetism, gasses, subharmonic frequency and fumes on people and livestock.
- How the proposed project may reduce property values and increase insurance premiums.
- Residents of this area chose to live outside of town and do not want to see utility development in their neighbourhood. Many feel that the battery is not compatible with the quiet rural lifestyle.

### Site B – Near LNG Facility on Robert Service Way

Site B is located just off Robert Service Way, behind the City of Whitehorse snow dump and is on Ta’an Kwäch’än Council Settlement Land. During the engagement process, there were very few specific comments related to this site. There are no residences within 800 metres, and none of the governments or businesses who own property nearby provided feedback. The main concerns were:

- The aesthetics at this site; people do not want to see industrial development at this location as it is an important gateway to the community.
- Noise at this site may impact downtown residents as sound can travel, especially in the winter.

- It is risky to put two main power sources in a river valley, next to a dam, in an earthquake zone. If either the LNG facility or the battery have a catastrophic failure, one could damage the other. The site is also below the end of the airport runway.

### Site C – Northeast Corner of the Alaska Highway and Robert Service Way

Site C is located at the northeast corner of the Alaska Highway and Robert Service Way, north of the entrance to Skookum Asphalt. It is on Kwanlin Dün First Nation Settlement Land. During door-knocking, we heard from a few residents that they have no issues with this site. We also heard from two local business owners who voiced opposition to this site and who shared some specific concerns. The main concerns were:

- The aesthetics at this site; residents and business owners do not want to see industrial development at this location as it is an important gateway to the community.
- The battery may impact the RV park in this area; tourists want to see large utility infrastructure.
- Noise may impact the RV Park and residents who live in the area.
- Health impacts to surrounding residents and large greenhouse in the area. There is also concern that the battery may catch fire and release toxic fumes.
- This proposed site is too close to the runway, river valley, dam and LNG facility.

### Site Selection and Development

Stantec did not set out to gather specific information about support and opposition for the grid-scale battery project as part of the engagement process. However, we can report that while we heard significant opposition to Site A, we received very few comments that voiced opposition to the overall project. Many people see the project's benefits, and support infrastructure that will increase the amount of energy YEC produces using renewable sources. Those who did voice opposition to the project felt that the high costs of the project outweigh the benefits.

Many respondents, especially those who live near Site A, suggested that Sites B and C were preferable, as the nearest residences are farther away, they are both close to YEC's existing infrastructure and there is a staffed fire department nearby. There were a couple of people who voiced the opinion that Site A is the preferred option. Regardless of which site is selected, it is recommended that YEC should perform the following:

- Follow up with residents as this project moves forward.
- Provide a screening or a vegetative buffer, as aesthetics were important to those living near each of the three sites.
- Select appropriate lighting that provides good security but does not create unnecessary light pollution.
- Identify and implement noise-reducing mitigation measures. Options include selecting batteries that are designed to be quiet, installing noise baffles and orienting the HVAC systems away from homes.
- Develop a comprehensive fire response plan and commit to providing the required training to fire fighters. Training will need to be repeated when there is staff turnover.

In addition, a few respondents suggested that YEC should continue to lobby the City of Whitehorse for a reduction in property tax for renewable energy projects.

## Battery Procurement

Through the engagement process, respondents made comments about things that should be considered as YEC goes through the process of selecting and purchasing the battery. Suggestions for what should be considered during procurement are:

- Environmental impacts related to the manufacturing process and the mining of source minerals;
- Cradle to grave greenhouse gas emissions;
- Safety track record;
- Quiet operation and noise reducing mitigation options;
- Ability to work in cold temperatures without comprising the long-term functioning of the battery; and
- Access to advanced metering for energy research.

## Rates and Financial Considerations

Many respondents wanted to know what impact this project would have on electricity rates. Some participants wanted YEC to provide full and detailed project accounting before being asked to provide input on this project. Several respondents suggested that YEC should also include the cost of appropriate mitigation measures as they consider these three sites; Site A may be more expensive because there are so many people living nearby.

Several people provided comments about the overall cost/benefit analysis of this project. Also, a few respondents suggested that the high cost of this project means that other technologies such as electric thermal storage may be more cost effective than a grid-scale battery in terms of cost per kilowatt hour.

## Energy Planning

Whenever YEC undertakes an engagement process, comments are received about energy planning in general. Many respondents want to see YEC continuing to plan and develop renewable projects to meet growing demand. Several respondents want to see YEC develop new renewable electricity sources in the next few years so that LNG and diesel are used only for backup. Several people also want to see demand-side management and energy efficiency programs play a larger role in energy planning.

Respondents wanted to know about the carbon footprint of the grid-scale battery as compared to other projects and want to see YEC focus on sensible, cost-effective and long-term projects. A few participants suggested that YEC should be involved in partnerships with northern energy innovators from Yukon University, Northern Energy Innovation Program or other organizations.

Respondents suggested a suite of other projects that YEC should, in addition to or instead of, the grid-scale battery. Alternative projects suggested are: more reliable hydro, geothermal, pumped storage at Fish Lake, small scale nuclear, compressed air, refrigerant system or a pump storage system other than water, or transitioning the stand-by generation from diesel to a reversible fuel that can be made using spare energy. It is important for YEC to continue to engage the community and stakeholders as it continues to plan for new renewable energy projects to meet growing demand.

## Abbreviations

CEO	Chief Executive Officer
CoW	City of Whitehorse
ED	Executive Director
ETS	Electric Thermal Storage
GY	Government of Yukon
FNCC	First Nation Chamber of Commerce
WCC	Whitehorse Chamber of Commerce
YCC	Yukon Chamber of Commerce
YCS	Yukon Conservation Society
YEB	Yukon Energy Board
YEC	Yukon Energy Corporation
YESAB	Yukon Environment Socio-Economic Board

## 1.0 INTRODUCTION

Yukon Energy Corporation (YEC) is building a grid-scale battery storage system in the Whitehorse area. The project was identified in the 10-Year Renewable Electricity Plan and has received \$16.5 million in federal funding from the Government of Canada's Green Infrastructure Stream. For YEC, this battery will help maximize the amount of renewable energy it uses to meet peak demands for power, displace diesel and improve grid reliability.

Yukon Energy is currently considering three possible sites for this project and they are described below. More information about the project can be found in Appendix A.

### SITE A

On Kwanlin Dün First Nation Settlement land beside our Takhini substation at Km 8.5 North Klondike Highway



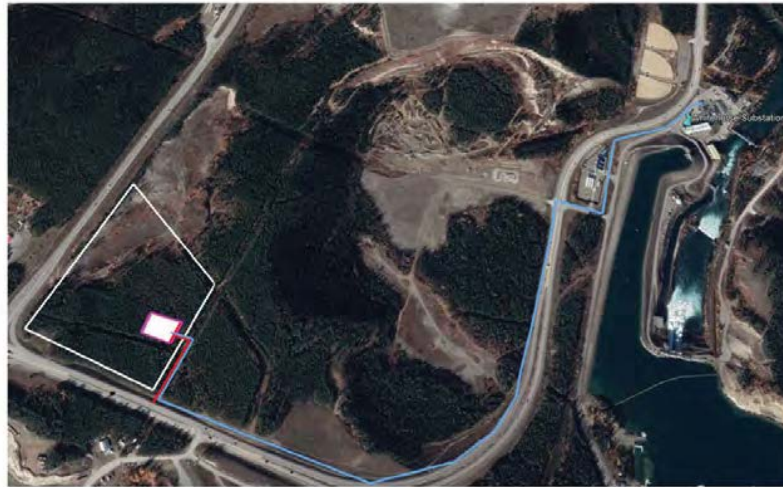
### SITE B

On Ta'an Kwäch'än Council Settlement land across from our Whitehorse LNG facility on Robert Service Way



## SITE C

On Kwanlin Dün First Nation Settlement land at the north east corner of the Alaska Highway and Robert Service Way



Before selecting a site for the grid-scale battery and moving forward with this project, YEC wanted to undertake a public and stakeholder engagement process. The objectives of this engagement process were to:

1. Inform the public that YEC is installing a battery in or near Whitehorse
  - Describe what the battery does and how it works
  - Describe why this project is happening
  - How that ties into YEC's goal of developing renewable electricity and the 10-year Renewable Electricity Plan?
  - How it displaces diesel and improve grid reliability?
2. Gather public input on each of the three proposed sites.
3. Identify any potential questions or concerns about the battery to ensure they are able to be addressed and/ or incorporated into the site design.

In August 2020, Stantec was hired to assist with the engagement process. This What We Heard Report provides a detailed accounting of the results of this engagement process.

## 2.0 ENGAGEMENT METHODS

It was important to YEC that this engagement process be inclusive and transparent. To achieve this, a variety of methods were offered for gathering comments. Input was received through community meetings (three in-person and two virtual), stakeholder meetings, online forms and emails, and door-knocking. YEC created a page on their website (<https://yukonenergy.ca/energy-in-yukon/projects-facilities/battery-storage/>) to present background information, provide information about the community meetings and host the online form. Input from Facebook was gathered informally.

YEC also kicked-off the engagement process by sending an introduction letter and an information brochure to all residents and businesses within 800 metres of each of the three proposed sites. Print and social media ads were also used to provide the public with information about this project.

The following sections describe each of the events, their purpose, and provide an overview of what we heard. Each of the individual comments received from all sources is included and analyzed in Section 3.0.

### 2.1 COMMUNITY MEETINGS

Community meetings were hosted throughout September 2020 in Whitehorse. The purpose of the community meetings was to meet with the public, provide information about the proposed concept, answer questions and gather input. All members of the public were welcome, including property owners and representatives of local stakeholder groups.

All meeting were held following COVID-19 precautions. This included contact tracing, supply of masks and hand sanitizer, promotion of physical distancing, and restricted attendance numbers.

Key messages presented during the meetings included the following:

- YEC will be using the input from all engagement tools to make a decision on the location of the site
- Input is needed from Whitehorse and surrounding area residents and business owners
- There are several opportunities to get involved in the engagement process.

Information brochures were handed out at the entrance of the meeting venue. Zoë Morrison, Stantec, Stephanie Whitehead, YEC, and Joel Gilbaud, Hatch, delivered the presentation while Jamie Davignon, Stantec, was responsible for note taking. Andrew Hall, President and CEO of YEC, was also in attendance at the community meetings. A summary of the meeting discussion is described below and more detailed meeting notes can be found in Appendix B.

### Table Community Meetings Summary

Date	Location	No. of Attendees
September 8, 2020	Virtual Meeting	7
September 10, 2020	Virtual Meeting	3
September 15, 2020	Hootalinqua Firehall	13
September 16, 2020	Yukon Transportation Museum	3
September 17, 2020	Best Western Gold Rush Inn – Town Hall	17
	<b>Total</b>	<b>43</b>

#### Virtual Meeting #1

September 8, 2020

Attendees: 7 members of the community

On September 8<sup>th</sup> at 7 pm Stantec hosted a virtual community meeting using the Microsoft Teams platform. This meeting had seven participants, four of whom own property within 800 m of the proposed Site A. Meeting participants had many questions and voiced concerns about this proposed site. Concerns included: noise impacts, decreases in property values, increasing insurance premiums, light pollution, income loss related to not being about to lease rental cabins, risks related to fire suppression and explosion, and potential risks to human health and the environment.

#### Virtual Meeting #2

September 10, 2020

Attendees: 3 members of the community

On September 10<sup>th</sup> at 5:30 pm Stantec hosted a virtual community meeting using the Microsoft Teams platform. Two of the attendees were Calgary-based representatives of a company that supplies grid-scale batteries. Their questions were focused on issues related to procurement. Specially they wanted to know the projects timelines, the potential capacity/size of the battery, and how the procurement process will be done. There was one other meeting participant who asked about if municipal tax would be collected on First Nations land. No comments were collected during this meeting.

#### Hootalinqua Firehall

September 15, 2020

Attendees: 13 members of the community

On September 15<sup>th</sup>, Stantec hosted a community meeting at the Hootalinqua Fire Hall from 6:30 pm to 8:30 pm. There was a PowerPoint presentation with a question period after. Andrew Hall and Stephanie Whitehead were in attendance from YEC along with Joel Gilbaud from Hatch.

This meeting was aimed to capture feedback from residents in the area and the public in general. As this has the closest residents, comments were mainly related to opposition to the site location, aesthetics, noise, light pollution and safety concerns. Residents were concerned about a possible reduction in property values, decrease in quality of life, and loss of revenues from rental properties. There was

discussion about the risk of fires within the project site itself, as well as the risk of wildfire in general. Concerns were expressed about potential vandalism of the project site. Questions were asked about the environmental impacts, the potential for ground and air contamination, and impacts on nearby water wells. Some residents feel that YEC doesn't care about them and do not trust YEC. Some people feel that the engagement process for the project was rushed.



**Figure 1 Hootlinqua Fire Hall Community Meeting**

**Yukon Transportation Museum**

**September 16, 2020**

Attendees: 2 members of the community

On September 16<sup>th</sup>, Stantec hosted a community meeting at the Yukon Transportation Museum from 6:30 pm to 8:30 pm. There was a PowerPoint presentation with a question period after. Andrew Hall and Stephanie Whitehead were in attendance from YEC along with Joel Gilbaud from Hatch.

The attendance was low at this meeting and because of the interests of participants, the discussion was more technical. Questions were asked about the lifespan of the batteries, how fast the battery can provide power to the grid, how many times can the battery be charged, how the battery will be chosen, will the battery need to be heated and cooled and whether the battery site would be expanded. A resident also asked about the ability to collect data to use for research. At the end of the meeting it was noted that the locations within City limits (Sites B and C) are preferred over Site A.



**Figure 2 Yukon Transportation Museum Community Meeting**

**Best Western Gold Rush Inn – Town Hall**

**September 17, 2020**

Attendees: 17 members of the community

On September 17<sup>th</sup>, Stantec hosted a community meeting at the Gold Rush Inn from 6:30 pm to 8:30 pm. There was a PowerPoint presentation with a question period after. Andrew Hall and Stephanie Whitehead were in attendance from YEC along with Joel Gilbaud from Hatch.

Meeting attendees asked questions about the battery, specifically about the life span, recycling, capacity, primary use, and the potential for site expansion. Concerns were raised about potential rate increase and how the new rates would be calculated. There was discussion about fire suppression and additional resources required to adequately fight a battery fire. There were questions about the reasons for placing the battery on First Nations Settlement Land and potential First Nations investment opportunities. A few residents expressed their concern about how close the proposed North Klondike Highway site is to existing homes. There were also concerns about light pollution, noise, aesthetics, property values and the local quality of life. A second presentation was held around 8:00 pm for several late comers.



**Figure 3 Best Western Gold Rush Inn Community Meeting**

## 2.2 STAKEHOLDER MEETINGS AND INPUT

As part of this project, we reached out to a number of stakeholder groups to offer them the opportunity to provide feedback. The following table summarizes the groups we reached out to, and the responses that were received. Comments provided by stakeholder groups either in writing or during meetings have been incorporated into Section 3.0. Any letters submitted by stakeholders are included in Appendix C.

**Table 1 Stakeholder Meeting Summary**

Stakeholder Group	Meeting	Notes
City of Whitehorse Mayor and Council	N/A	We reached out to Mayor and Council; but they did not want to meet at this time. No feedback was provided.
City of Whitehorse Staff	N/A	We reached out to the City Department of Infrastructure and Operations. No meeting was requested, and no feedback was provided.

Stakeholder Group	Meeting	Notes
Yukon Government	Meeting held Sept 24 9:30 to 10:15 am with: <ul style="list-style-type: none"> <li>Representative of the Department of Environment, Environmental Protection and Assessment</li> <li>Representatives from the Highways and Public Works, Transportation Planning Branch</li> </ul>	In addition we reached out to Yukon Government Energy Branch, Climate Change Secretariat, and Major Projects Yukon, but staff did not wish to attend a meeting at this time.
Yukon Conservation Society	Meeting held Sept 18 1:30 to 2:30 pm with staff.	Written feedback was provided.
Yukoners Concerned About Oil and Gas	N/A	Reached out to by email and phone. No meeting was requested, but written feedback was provided.
Utilities Consumers Group	Meeting held Sept 23 1:30 to 3 pm with representative.	Written feedback was provided.
Whitehorse Chamber of Commerce	N/A	Reached out by phone and email. No meeting was requested, and no feedback was provided.
First Nations Chamber of Commerce	Meeting scheduled for Oct 13 1:00 to 2:00 pm with staff and board members.	N/A
Yukon Chamber of Commerce	Meeting held Sept 28 1:00 to 2:00 pm with staff and members of the Energy Committee.	N/A

## 2.3 DOOR-KNOCKING

In addition to sending out letters and a handout to each property owner within 800 metres of the three proposed sites, representatives from Stantec and YEC went to each residence. The purpose of this visit was to provide information, make sure that property owners were aware of the engagement process, answer questions and gather feedback. We also stopped by businesses and rental units.

In total, we spoke with 16 different people, mostly property owners, but some renters and representatives from business. Comments have been recorded and are included in Appendix D.

## 2.4 WRITTEN COMMENTS

There were two ways that the public could submit written comments. One was through an online form on the YEC website and 32 responses were received this way. Members of the public also submitted input by direct email to either Stantec or YEC staff and a total of 59 email comments were received. Altogether we received 91 written comments and they redacted versions of these comments can be found in Appendix E and Appendix F.

## 2.5 FACEBOOK INPUT

During the engagement process there were several Facebook discussions about this proposed project. These comments are not part of the formal engagement on this project but are relevant to the project in considered in this report. In total there were 22 Facebook post comments which have been included in Appendix G.

## 2.6 NOTES ON THE ENGAGEMENT PROCESS

One thing to note about the engagement process was that a resident provided a template listing a series of 16 concerns and encouraged people to submit this list. Of the 91 written comments we received, 52 of them used this template. From the names on the submissions, we think only a small number of these were from property owners near the three sites. That said, this feedback is included in our report and will be considered along with the other feedback received. In the appendices, we have not repeated the template, but to save space have indicated how many times we received it.

## 3.0 COMMENTS RECEIVED

This section provides a detailed review of the comments received through all different engagement tactics. The feedback has been divided into three sections; Section 3.1 lists the most common questions that we received, Section 3.2 details the comments received by site, and Section 3.3 summarizes the general comments about the project.

In this report, we say that we received “a few comments” on a matter, we mean less than five. When we say that we received “several comments” we mean five to ten comments and whenever we refer to “many comments” we mean more than ten.

### 3.1 REQUEST FOR MORE INFORMATION

Many of those who participated in this engagement process wanted more information about the project before providing feedback. Here is a list of the most common questions that we received:

#### **Questions about the battery technology:**

- How much noise does the battery make? Who completed the noise analysis and how was it conducted? What noise standards are being used and how were they chosen?
- How long will the battery last? How many times can the batteries be recharged? How will it be recycled?
- What will the capacity of the battery be? How much power can it provide during an outage?
- Where will the battery be manufactured? What are the environmental impacts of this process?
- Is this a sustainable project? What is the carbon footprint of the battery?
- How will the battery be chosen? What type of procurement process will be used?
- How much will this project cost?
- Will the battery need to be heated and cooled? How will the battery perform during cold weather?
- How much energy will heating and cooling the battery use?
- Will First Nations be able to invest in this project?

#### **Questions about the site design and development:**

- Will this project lead to a decrease in property values? What about an increase to insurance premiums?
- Is YEC planning to add more batteries and expand the site in the future?
- How were the sites chosen? Why are only First Nations owned lots being considered?
- How will the proposed sites be developed? Will it be lit? Will the batteries be visible from the road?
- Are there any plans to expand the battery project in the future?
- What are the cost differences between the three sites?
- If battery is on First Nations lands, will it be open to other specific funding sources?

#### **Questions about safety and security:**

- What is the fire response plan? Will the local fire fighters require new training? Will the Hootalinqua Volunteer Fire Department be able to respond to a fire on the Takhini Substation site?
- How durable is the battery in extreme situations? i.e. if hit by a bullet, lightning, wildfire, or vandalism

- What environmental impacts will the battery have? Are there emissions, radiation, subharmonic frequencies, gases that will impact human health? What about impacts on livestock or vegetable growing operations? How will this be considered in the decision making?

**Other questions:**

- How much will the electricity rates increase as a result of this project?
- How does YEC determine future demand levels used in their planning?
- Will it be First Nations governments or Developments Corporations that will be involved? What other options have been considered as alternatives to this project?

## 3.2 SITE SPECIFIC COMMENTS

In this section, comments specific to each of the three sites are presented. It is important to note that the majority of the comments received in writing, through door-knocking or during the public meetings were related to Site A.

### Site A - Takhini Substation Site North Klondike Highway

The comments for YEC's Takhini Substation Site on the North Klondike Highway have been sorted into common themes, below.

#### Site Design and Development

- This site will need significant clean-up and remediation before development can occur.
- Would like the site to be designed so that batteries and access road are as far away from the nearest residential property as possible.
- Important to retain access to trails; there are many popular trails in this area used by residents (e.g., on ATVs).
- Concern that once these batteries are installed that YEC may decide to add more capacity and develop the site further.
- Residents would prefer to see a vegetated buffer; do not want to see more industrial development in this area.
- Ground vibrations during construction could impact wells and buildings on nearby properties.

#### Safety and Security

- Concerns that vandalism could lead to damage to the batteries. People feel that vandalism is a growing issue in this area.
- Concern about what will happen if the battery containers are shot; many residents are gun owners and shooting is a common form of vandalism.
- Concerns that the battery may catch fire, explode, or be hit by lightning.
- Concern that a fire at this site would block the Klondike Highway or other access routes and make it difficult for residents to evacuate.
- Residents wanted to know what would happen during a forest fire; there was concern about potential for explosions or the release of toxic fumes during a forest fire.
- Concerns were raised about the capacity of the local volunteer fire department to contain a fire at the battery site. It would take half an hour for help to arrive from Whitehorse.

### **Impacts on Environment and Health**

- Residents are concerned about the environmental and health impacts of the battery; feel that lithium ion batteries are a new technology and the risks may not have been studied or well understood.
- Concerns about health impacts to surrounding residents and livestock; questions about radiation, electromagnetism, gasses, subharmonic frequency and fumes that may be a result of the battery's operation.

### **Noise and Light Impacts**

- Concerns about noise impacts on mental health of residents, enjoyment of quiet rural properties, rental properties and on livestock in the area.
- The most restrictive standards should be applied, not necessarily the ones from Alberta.
- Noise-reducing mitigation measures should be identified and implemented. Battery units should be designed to be as quiet as possible; consider noise baffles and orienting the HVAC systems away from nearby homes.
- A recording studio has been built in this area and there is concern that the noise will impact this use.
- People on the North Klondike Highway are concerned that the lights at the site will impact their ability to see the stars and northern lights. Lights should be as non-intrusive as possible.

### **Property Owner Impacts**

- Property owners are concerned that the proposed project will reduce property values and make it more difficult to lease rental cabins.
- Concern that living close to a grid-scale battery will lead to an increase in home insurance premiums or make it more difficult to get insurance.
- Several residents asked if YEC has considered compensation for home-owners whose properties will be directly impacted.
- This project brings no specific benefits for the people who live in the area; but those who live near the proposed site feel that they will have to deal with all the impacts.

### **Local Lifestyle**

- Residents of this area chose to live outside of town and do not want to see utility development in their neighbourhood. Many feel that the battery is not compatible with the quiet rural lifestyle.
- Some residents stated that they would consider moving if this project goes ahead in this area.
- People have invested both time and money to live out of town and do not want to see rural lifestyle eroded.

### **Engagement Process**

- Some residents feel that the engagement process is being rushed. They want to have time to understand the project, consider information and provide a response.

### **Decision-making Criteria and Site Selection**

- Concern that YEC was not considering residential uses when it proposed this site.
- Residents don't appreciate feeling like human health, safety, and happiness are less important than financial considerations.
- Some residents of this area stated that the sites in Whitehorse are preferable because they are farther from residences, closer to YEC staff and have room for expansion.

- Some residents feel offended that this site was proposed without giving proper consideration to the fact that there are so many residents living nearby. One resident estimated that there are 13 residences within 500 metres of the proposed site.

### Site B – Near LNG Facility on Robert Service Way

#### Site Design and Development

- Concern about aesthetics at this site; residents and business owners do not want to see industrial development at this location as it is an important gateway to the community.
- Should consider potential impacts on dirt bike track.

#### Noise Impacts

- Noise at this site may impact downtown residents as sound can travel quite far, especially in the winter.

#### Safety and Security

- Risky to put two main power sources in a river valley, next to a dam, in an earthquake zone. If either the LNG facility or the battery have a catastrophic failure, one could damage the other. Site is also near the end of the runway.

### Site C – Northeast Corner of the Alaska Highway and Robert Service Way

#### Site Design and Development

- Concern about aesthetics at this site; residents and business owners do not want to see industrial development at this location as it is an important gateway to the community.
- This proposed site is not flat; may be difficult to develop.
- Concern that YEC might expand the site; want to know the full development before providing feedback.

#### Noise Impacts

- Noise may impact RV Park and residents who live in the area.

#### Local Lifestyle

- There are some residents who access trails in this area for walking, tobogganing and biking and do not want to see access cut off.
- Paragliders/hang-gliders use this area; concern that this use may be impacted by the battery development.
- Large RV park in the area; there is concern that a battery may impacts the tourists use and enjoyment of this site.

### **Impacts on Environment and Health**

- Concerns about health impacts to surrounding residents; questions about radiation, electromagnetism, gasses and fumes that may be released.
- Concern that if the battery catches fire toxic fumes will be released and will impact residents.
- Concern that the long-term impacts and potential risks of the battery on human health are not understood.

### **Safety and Security**

- If the site near the airport is selected, will need to consider potential impacts on aviation including OLS height restrictions and electromagnetism.
- Concern that it is both too close to the runway, river valley, dam and LNG facility.

## **3.3 GENERAL COMMENTS**

In this section general comments that apply to the battery regardless of the site selected are sorted into common themes.

### **Battery Technology**

- The battery technology is new, has not been proven and has too many unknowns. People feel that they need more information before they can provide comments.
- If the plan is for the battery to be able to be used during a black start (a black start is the process of restoring power to a grid without relying on the main electric power transmission network), then we need to make sure that it works this way once it is operational.
- Should consider each battery manufacturer's safety history when sourcing the battery to ensure that we end up with a safe product.
- Should select a battery that is under a warranty and will not be degraded by cold weather.
- Consider adding smaller banks of batteries at key community buildings, such as the hospitals and other institutions. This way batteries could be spread out across the grid.
- Representatives of Yukon University want to have access to advanced metering for energy research; this will be much easier to do if it is specified when scoping the battery.

### **Impacts on the Environment and Health**

- Some residents are concerned about health impacts of the battery on surrounding residents and livestock; this includes the potential impacts from radiation, electromagnetism, gasses and fumes that may be produced during normal operations or during a malfunction.
- Producing lithium ion batteries has significant environmental impacts, even if it happens far away from here. When selecting the battery, consider how and where it is being made, choose the option with the lowest environmental impacts.
- Need to base decisions on cradle-to-grave greenhouse gas emissions and environmental impacts.
- Concern that this project is not actually an environmentally friendly or sustainable project.

### **Safety and Security**

- Need to ensure that a comprehensive fire response plan is in place; firefighters need the right tools and information.  
Specialized training for fire fighters will need to be repeated over time to ensure people are trained even when there is staff turn-over.

### **Rates and Costs**

- Some people do not support this project because it will lead to an increase in rates; this is very difficult for people on a fixed income.
- Information on the increase to rates and specific savings associated with this project should be provided so residents have all the information when providing feedback.
- The battery only lasts 20 years and there is concern that the cost is not worth it for this timeframe. Consider cost/benefit analysis.
- People that who are building houses with electric as a primary heat source should have to pay more of the required capital cost. We had enough electricity to meet the needs before the large population increase and now pensioners are paying to subsidize other's choice to go all electric.
- Consideration must be given to the economics of this and future similar projects. The high cost of this project suggests distributed technologies such as electric thermal storage may be more cost effective than a grid-scale battery in terms of \$ per kWh installed, \$ per kW installed, and \$ per lifetime carbon dioxide reductions.
- YEC should also include the cost of appropriate mitigation measures as they consider these three sites; Site A may be more expensive because there are so many people living nearby.
- Would like to know if First Nations will be able to invest in this project.

### **Energy Planning**

- Pleased that YEC is undertaking a 10-year renewable plan and happy with the draft plan.
- Participants want to know that YEC is factoring electric cars into their demand forecasting.
- Participants wanted to know about the carbon footprint of the grid-scale battery as compared to other projects.
- Participants would like to see YEC continuing to plan and develop renewable projects to meet growing demand.
- YEC should be considering truly innovative energy technology such as super-capacitors.
- YEC should be consulting Yukon University, Northern Energy Innovation Program and northern energy innovators rather than hiring southern firms.
- Want to understand YEC largest customers (specifically Yukon government) to continue to reduce energy use and increase efficiency.
- Demand-side management should be a priority over new projects.
- YEC should be working with high demand users to limit consumption during peak times or peak seasons.
- This project does not get us away from renting diesel generators or using LNG; we should be focused on replacing the old diesel units instead.
- YEC should finalize the 10 Year Resource Plan before moving forward on this project.
- YEC should be focusing on getting more reliable hydro, exploring geothermal options or adding pumped storage into Fish Lake.
- Should consider small scale nuclear.
- Consider other options such as compressed air, refrigerant system or a pump storage system other than water. Also consider transitioning the stand-by generation from diesel to a reversible fuel that can be made using spare energy, such as methanol-cycle that can be made from biomass.

- YEC could form partnerships with development companies to develop demonstration-sized projects that would be useful for Yukon's grid.
- The grid-scale battery is a short-term solution to our energy problems; YEC needs to focus on sensible and cost-effective projects.
- YEC needs to bring online about 70 GWh of new renewable electricity in the next three to five years to address current and future energy load and ensure that LNG/diesel is used only as emergency backup. Without a major additional energy project, YEC will be relying on LNG and diesel to meet load demand and charge this massive battery. In order to meet Yukon's GHG reduction target of 50% by 2030 there will be a need for a combination of significant renewable energy projects, like wind, biomass, solar, heat pumps, pumped storage, and geothermal.

### **Engagement Process**

- Do not want to feel rushed to submit input on this project; residents need time to learn, understand the issues and respond.
- YEC needs to commit to letting people know which site is selected and future of this project.
- YEC should provide clear and timely answers to resident's questions.
- YEC should provide a complete development plan up front; if they are planning to expand the site in the future, then this should be made clear now.
- This engagement process is not transparent and is designed so that YEC does not hear the full range of input. Some believe that YEC has already made a decision that this project is going ahead.

### **Site Selection**

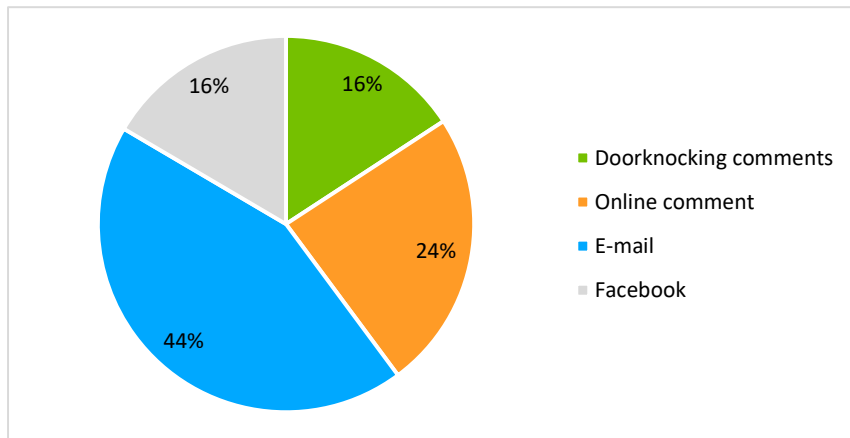
- Site A has the most homes nearby; sites B and C are preferable as nearest residences are farther away. Sites B and C are preferable because they are closer to non-volunteer fire departments who are better able to respond.
- Could consider putting the battery underground in old mine workings on Grey Mountain.
- Some people would like to know YEC's current preferred site.
- Need to consider aesthetics and safety at whichever site is selected.
- YEC should only be considering sites far away from any residences.
- There was support voiced for the battery project and for renewable energy projects in general.
- Some are pleased that YEC is taking bold initiatives and demonstrating the variety of renewable energies available to meet the challenge of moving away from fossil fuels.
- Support for projects that would lead to fewer power outages and a more stable grid.

## 4.0 QUANTITATIVE ANALYSIS

All comments received through door-knocking, emails and online comments were recorded and entered into an Excel spreadsheet to quantify and analyze for common themes. In total, 134 comments were received. All written comments received are included in the appendices.

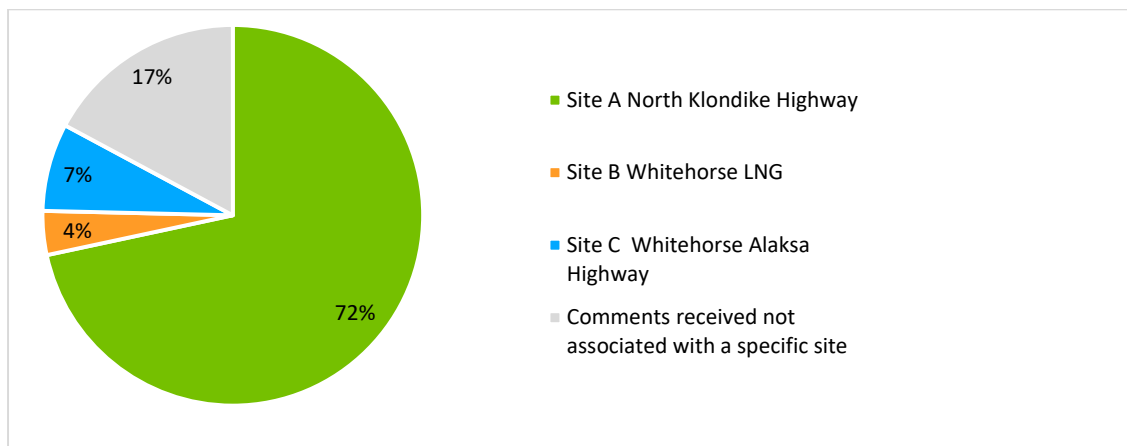
### 4.1 OVERVIEW

Most comments were received through email (59), followed by online comments submitted through the YEC's website (32). This is shown in Figure .



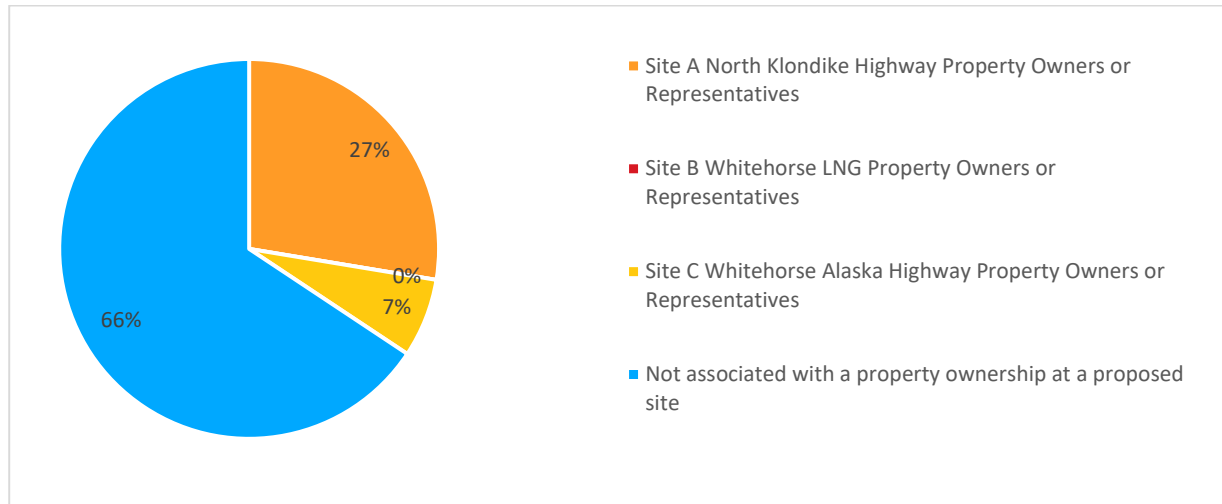
**Figure 4 Comments Received by Feedback Method**

Most of the comments (96) received were related to the proposed Site A North Klondike Highway. This is shown in Figure 5.



**Figure 5 Comments Received by Specific Site**

All comments received were analyzed for their possible connection to a pre-identified property associated with each of the proposed sites. Both persons listed on the property title and property representatives (i.e. tenants or direct family members) were considered during this process. Figure 6 shows that most respondents did not live within 800 metres of any of the proposed sites.



**Figure 6 Comments Received from all Feedback Methods by Respondent Category**

## 4.2 THEMES

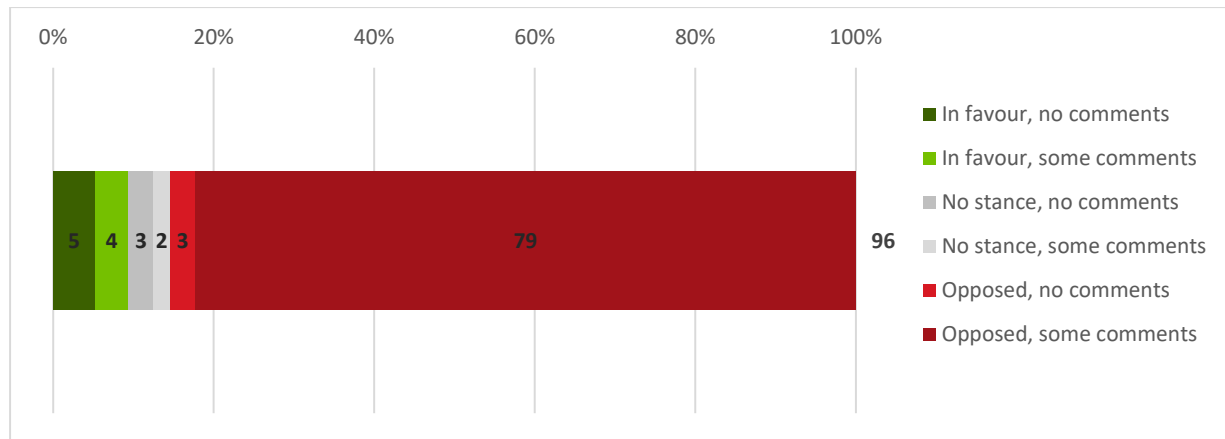
Detailed review of all 134 comments revealed a series of common themes; these themes are discussed in Section 3.3. Often, a single comment covered more than one theme. The themes that were mentioned the most frequently were:

- Noise
- Fear of an emergency situation
- Property values
- Light
- Ability of fire fighters to respond to an emergency situation

### 4.3 SITE A – NORTH KLONDIKE HIGHWAY

#### Overall

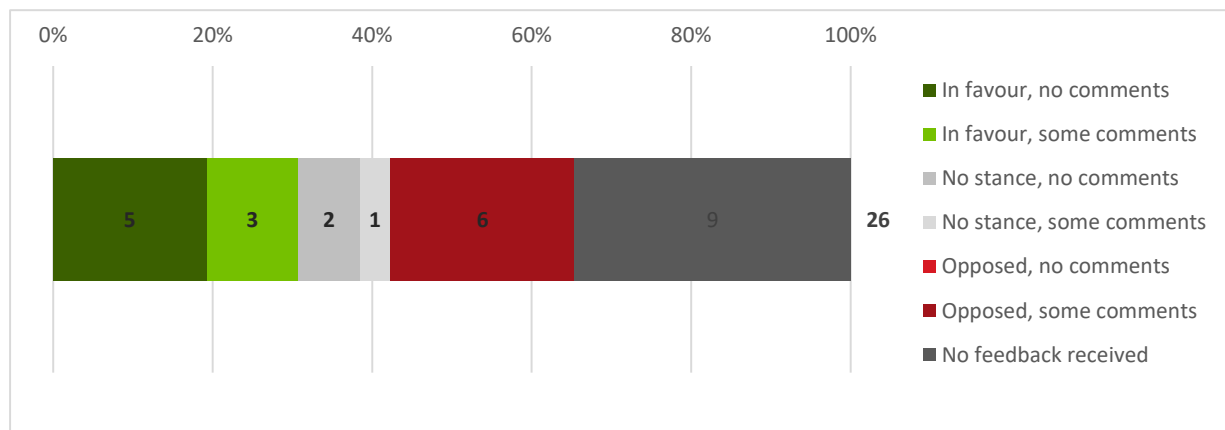
Site A, on the Klondike Highway, received the most comments during the engagement process (96). A total of 17 of the 96 comments were from property owners or representatives. The graphs below are based on Stantec’s interpretation of participants views on this project and are not the results of a survey. The *No Stance - No comments* response means that we spoke to someone who asked questions, but did not provide their opinion about this project overall.



**Figure 7 Site A Feedback Summary, From All Feedback Sources**

#### Comments From Property Owners or Representatives

Feedback received from property owners or representatives associated with the North Klondike Highway Site was considered separately. Although some properties submitted feedback through multiple sources; for the purpose of this graph, each property was considered only once.

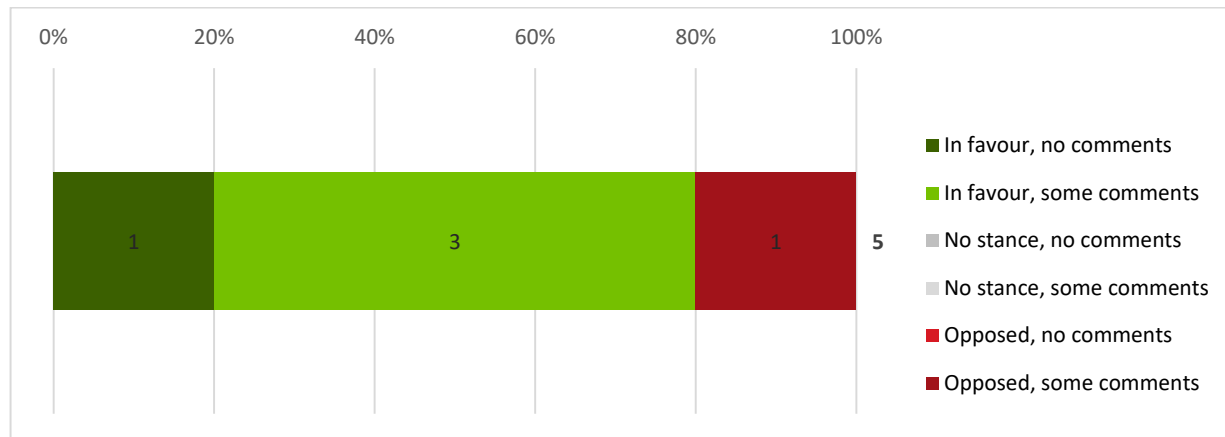


**Figure 8 Site A Feedback Summary, From Property Owners or Representatives**

## 4.4 SITE B – NEAR LNG FACILITY ON ROBERT SERVICE WAY

### Overall

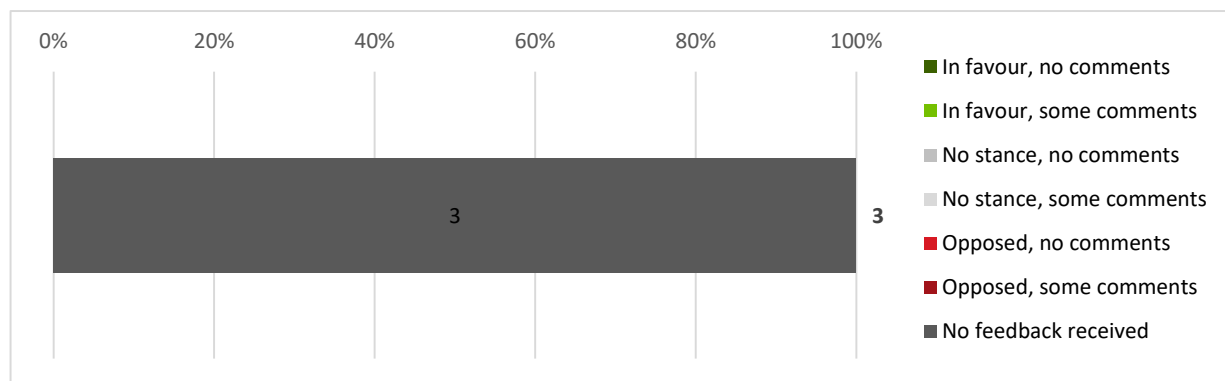
Site B, near the Whitehorse LNG facility, received the fewest comments during the engagement process (5). The graphs below are based on Stantec’s interpretation of participants views on this project and are not the results of a survey. The No Stance, no comments response means that we spoke to someone who asked questions, but did not provide their opinion about this project overall



**Figure 9 Site B Feedback Summary, From All Sources**

### Comments From Property Owners or Representatives

Although three property owners were associated with Site B, no feedback was received from these owners or businesses.

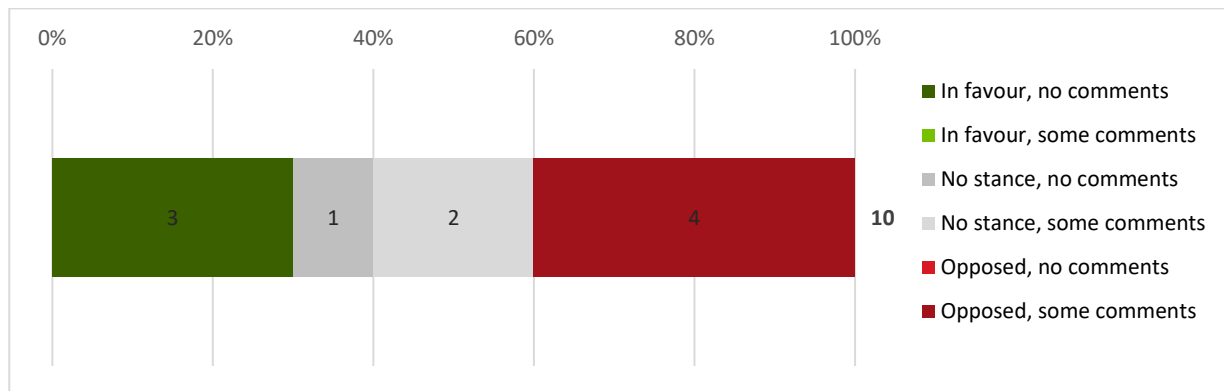


**Figure 10 Site B Feedback Summary, From Property Owners or Representatives**

## 4.5 SITE C – NORTHEAST CORNER OF THE ALASKA HIGHWAY AND ROBERT SERVICE WAY

### Overall

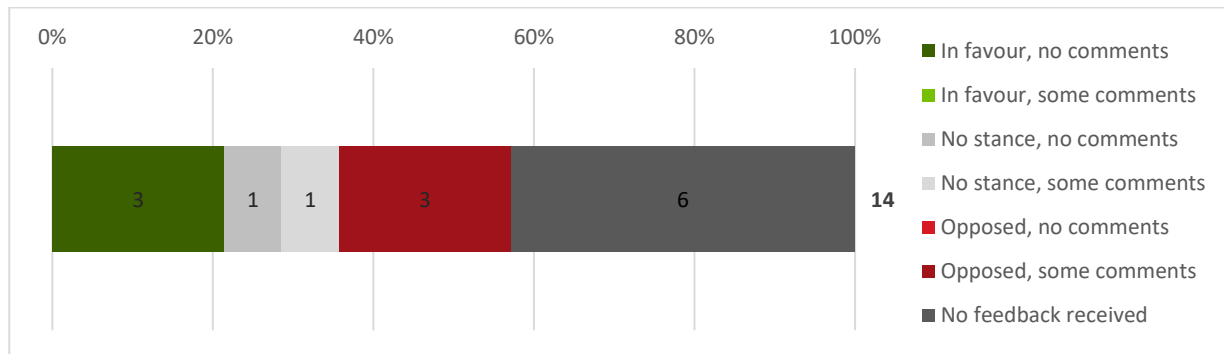
Site C received the ten comments during the engagement process, eight of which were from properties owners or representatives. The graphs below are based on Stantec’s interpretation of participants views on this project and are not the results of a survey. The *No Stance - No Comments* response means that we spoke to someone who asked questions, but did not provide their opinion about this project overall.



**Figure 11 Site C Feedback Summary, From All Sources**

### Comments From Property Owners or Representatives

To provide further information, feedback received from property owners or representatives associated with the Site C was considered separately. Although some properties submitted feedback through multiple sources; for the purpose of this graph, each property was considered only once.



**Figure 12 Site C Feedback Summary, From Property Owners or Representatives**

## 5.0 CONCLUSIONS

This section provides a summary of what was heard during the engagement process about YEC grid-scale battery. Multiple engagement methods were used throughout the process, responses from all methods have been consolidated below. This section is intended to present information and conclusions for YEC staff and decision-makers to consider as they select the site for this project.

We provide an overview of the comments heard about each of the three proposed sites and a summary of the comments heard that are related to the battery project in general.

### 5.1 SITE SELECTION

#### Site A – North Klondike Highway

Most of the comments received through all methods, were about Site A on the North Klondike Highway. Many of those who attended the in-person and virtual meetings own properties or live within 800 metres of Site A. We received 96 specific comments about this site, with 86% of the comments voicing opposition. Of the 91 written comments we received, 52 of them were a letter template that listed the same 6 reasons that the sender opposes this site.

During door-knocking in the area, we spoke to several residents who are opposed to the project and several who do not have any issues with using this proposed site for a battery. In general, people who live directly adjacent to Site A voiced the strongest opposition to this proposed location.

#### Concerns about Site A

- People are concerned that noise and light produced by the battery may impact their well-being and way of life. Residents do not want to see this type of unsightly industrial development along the North Klondike Highway.
- People felt that the engagement was rushed, and some were offended that YEC selected this site as an option, even though there are many residences close by.
- People are concerned about safety; the battery may catch fire or explode, and the local volunteer fire department does not have the capacity to contain a fire at the battery site.
- Concerns about health impacts of this relatively new technology. People are worried about the impacts of radiation, electromagnetism, gasses, subharmonic frequency and fumes on people and livestock.
- Property owners are concerned that the proposed project may reduce property values and increase insurance premiums.
- Residents of this area chose to live outside of town and do not want to see utility development in their neighbourhood. Many feel that the battery is not compatible with the quiet rural lifestyle.

### Site B – Near LNG Facility on Robert Service Way

During the engagement process, there were very few specific comments related to this site. There are no residences within 800 metres, and none of the governments or businesses who own property nearby provided feedback.

#### Concerns about Site B

- Concern about aesthetics at this site; people do not want to see industrial development at this location as it is an important gateway to the community.
- Noise at this site may impact downtown residents as sound can travel quite far, especially in the winter.
- It is risky to put two main power sources in a river valley, next to a dam, in an earthquake zone. If either the LNG facility or the battery have a catastrophic failure, one could damage the other. The site is also below the end of the airport runway.

### Site C – Northeast Corner of the Alaska Highway and Robert Service Way

There were several comments received about Site C. During door-knocking, we heard from some residents that they have no issues with this site. We also heard from two local business owners who voiced opposition to this site and who shared some specific concerns.

#### Concerns about Site C

- Concern about aesthetics at this site; residents and business owners do not want to see industrial development at this location as it is an important gateway to the community.
- Concern that a battery may impact the RV park in this area; this is not the type of development that tourists want to see.
- Noise may impact the RV Park and residents who live in the area.
- Concerns about health impacts to surrounding residents and large greenhouse in the area. There is also concern that the battery may catch fire and release toxic fumes.
- Concern that the battery is too close to the runway, river valley, dam and LNG facility.

## 5.2 SITE SELECTION AND DEVELOPMENT

The objectives of this engagement process were to provide information to the public about this project, answer questions and gather feedback about the three site options. We did not set out to gather quantitative information about support for, and opposition to, the grid-scale battery project. However, we can report that we received very few comments voicing opposition to the overall project. Many people see the project's benefits, and support infrastructure that will increase the amount of energy YEC produces using renewable sources. Those who did voice opposition to the project felt that the high costs of the project outweigh the benefits.

Many respondents, especially those who live near Site A, suggested that Sites B and C were preferable, as the nearest residences are farther away, they are close to existing YEC's infrastructure and there is a staffed fire department in the area. A few people stated that Site A is their preferred option. Whichever site is selected, YEC will need to follow up with residents as this project moves forward.

Regardless of which site is selected, screening or a vegetative buffer should be provided, as aesthetics are important to those living near each of the three sites. Appropriate lighting should be selected that provides good security but does not lead to unnecessary light pollution. Also, noise-reducing mitigation measures should be identified and implemented. Options include selecting batteries that are designed to be quiet, installing noise baffles and orienting the HVAC systems away from nearby homes.

Whichever site is selected, YEC will need to develop a comprehensive fire response plan and will need to commit to providing the required training to fire fighters. Training will need to be repeated when there is staff turnover. A few respondents suggested that YEC should continue to lobby the City of Whitehorse for a reduction in property tax for lots developed for renewable energy projects.

### **5.3 BATTERY PROCUREMENT**

Through the engagement process, several people made comments about items that should be considered as YEC goes through the process of selecting and purchasing the battery. This included:

- Environmental impacts related to the manufacturing process and the mining of source minerals;
- Cradle-to-grave greenhouse gas emissions;
- Safety track record of the company and technology;
- Quiet operation and noise-reducing mitigation options;
- Ability to operate in cold temperatures without comprising the long-term functioning of the battery; and
- Access to advanced metering for energy research.

### **5.4 RATES AND FINANCIAL CONSIDERATIONS**

Many respondents wanted to know what impact this project would have on future electricity rates. A few participants wanted YEC to provide full and detailed project accounting before being asked to provide input. A few respondents suggested that YEC should include the cost of appropriate mitigation measures as they consider these three sites; Site A may be more expensive because there are many people living nearby.

Several people provided comments about the overall cost/benefit analysis of this project. Also, a few respondents suggested that the high cost of this project means that other technologies, such as electric thermal storage, may be more cost effective in terms of cost per kilowatt hour.

### **5.5 ENERGY PLANNING**

Whenever YEC undertakes an engagement process, comments are received about energy planning in general. Many respondents want to see YEC continuing to plan and develop renewable projects to meet growing demand. Several respondents want to see YEC develop new renewable electricity sources in the

next few years so that LNG and diesel are used only for backup. People also want to see demand-side management and energy efficiency programs play a larger role in energy planning.

Respondents wanted to know about the carbon footprint of the grid-scale battery as compared to other projects and want to see YEC focus on sensible, cost-effective and long-term projects. A few participants suggested that YEC should be involved in more partnerships with northern energy innovators from Yukon University, Northern Energy Innovation Program or other organizations.

Respondents suggested a suite of other projects that YEC should, in addition to or instead of, the grid-scale battery. Alternative projects suggested are: more reliable hydro, geothermal, pumped storage at Fish Lake, small scale nuclear, compressed air, refrigerant system or a pump storage system other than water, or transitioning the stand-by generation from diesel to a reversible fuel that can be made using spare energy. It is important for YEC to continue to engage the community and stakeholders as it continues to plan for new renewable energy projects.



## Appendix A INFORMATION HANDOUT



BATTERY STORAGE PART OF OUR  
**Future-Focused Portfolio**



# battery storage system

QUICK INFO SHEET

Yukon Energy is building a grid-scale battery storage system in the Whitehorse area. As one of the projects identified in our 10-Year Renewable Electricity Plan, the new battery is another way we are delivering sustainable, reliable and affordable electricity to Yukoners. It will help us maximize the amount of renewable resources we use to meet peak demands for electricity, burn less diesel fuel and improve the reliability of our grid.

## why energy storage?

On Yukon's isolated power grid, one of the largest challenges we face is meeting peak demands for electricity. This often happens during winter months when water levels are low and customers' need for electricity is high. That's why we have liquefied natural gas (LNG) and diesel engine generators. We turn to them when there's not enough water to generate the power Yukoners need. With the new battery on our grid, we can store extra electricity when there's a lower demand for it and then use it when the demand goes up.



## benefits of energy storage



### It's sustainable

Uses more renewable electricity and less diesel to meet peak demands for power.



### Cuts carbon emissions

Expected to reduce 20,000 tonnes of emissions between 2023 and 2043.



### Saves money

Running diesel engines less means fuel and engine maintenance savings.



### Improves grid reliability

It will be especially useful during sudden outages or decreases in demand.



### Restores power outages faster

It can be turned on at the flip of a switch during a power outage.



April 1, 2021

## how much will this project cost?

The battery will cost between \$27 and \$30 million to build.

**\$16.5 MILLION** will be covered by the Government of Canada's Green Infrastructure Stream.

**\$10.5–13.5 MILLION** will be covered by Yukon Energy.

We will submit an application to the Yukon Utilities Board to include our share of this investment in rates after we install the battery and it's operational.

## what kind of battery will we use?

The most common battery chemistry for grid-scale battery energy storage systems is lithium ion. That's because it is flexible and can be charged many times in its lifetime.

## what will the battery look like?

Our battery energy storage system is expected to be about the same width and half the length of a CFL-sized football field, and the height of two people. It will be made up of container units that are quick and easy to install and made for our northern climate.





## what will the site look like?

The battery site will be fenced and will have monitors, cameras, and alarms to provide security.

## are these batteries safe?

A lithium ion battery is generally considered safe technology. It uses no acid, which eliminates spill and contamination hazards. The risk of fire is very low.

As with any energy storage system, the risks increase if the system is not properly operated or maintained. To manage fire and safety risks, we will:

-  select a vendor with **a reliable battery system**
-  use **qualified technicians** to do the installation and carry out routine maintenance
-  install a monitoring and **fire suppression system** that is **specifically designed for batteries**
-  **prepare a fire response plan** for the local fire department and emergency response staff



## what sites are we considering for the battery?

We'd like to install the battery close to our existing facilities to reduce construction costs and to make it easier and more effective to operate.

We're looking at three sites that appear to fit that bill. One is on Ta'an Kwäch'än Council Settlement Land and the other two are on Kwanlin Dün First Nation Settlement Land.



### SITE A

On Kwanlin Dün First Nation land beside our Takhini substation at Km 8.5 North Klondike Highway



### SITE B

On Ta'an Kwäch'än Council land across from our Whitehorse LNG facility on Robert Service Way



### SITE C

On Kwanlin Dün First Nation land at the north east corner of the Alaska Highway and Robert Service Way

## how will we select the site?

When choosing the battery's final location, we'll consider the following.



distance from existing generation facilities and transmission lines



partnership opportunities



space and technical requirements needed to operate and maintain the battery safely and efficiently



input from Ta'an Kwäch'än Council, Kwanlin Dün First Nation, their development corporations and the public



environmental and socio-economic factors



the site's readiness for utility development

## how to get involved

There are several ways you can get more information and provide your feedback on this project.



### IN-PERSON COMMUNITY MEETINGS

#### Tuesday, September 15

Hootalinqua Fire Hall  
6:30–8:30 pm

#### Wednesday, September 16

Yukon Transportation Museum  
6:30–8:30 pm

#### Thursday, September 17

Best Western Gold Rush Inn  
6:30–8:30 pm

Submit a question or comment to  
[yecbatteryfeedback@stantec.com](mailto:yecbatteryfeedback@stantec.com).

Complete the online comment form  
available on our website,  
[yukonenergy.ca/battery](http://yukonenergy.ca/battery).



### VIRTUAL COMMUNITY MEETINGS

#### Tuesday, September 8

7–9 pm

#### Thursday, September 10

5:30–7:30 pm

Email [yecbatteryfeedback@stantec.com](mailto:yecbatteryfeedback@stantec.com) or  
visit [yukonenergy.ca/battery](http://yukonenergy.ca/battery) to get the virtual  
meeting link and log-in details.

## how will we use stakeholder and public input?

We want to hear your comments about this project and the potential sites. Comments received will be summarized in a What We Heard Report that will be made public. The report will be used by our project team and Board of Directors to determine the final site for the battery and to refine how the site will be designed.

## next steps

We will accept comments until  
September 20, 2020.

Once we have finished the engagement, we will:

- select a final site;
- finish the site design;
- choose and order the battery; and
- get all necessary approvals and permits.

We expect the battery to be operational in 2022.

## COVID-19 protocol

All meetings will include a short presentation and an opportunity for participants to ask questions. If COVID-19 circumstances should deem in-person meetings unsafe, we will replace them with virtual meetings. Please check our website for updated information.

HELP KEEP US  
**COVID-SAFE**

### CONTACT INFORMATION

email: [yecbatteryfeedback@stantec.com](mailto:yecbatteryfeedback@stantec.com) or [communications@yec.yk.ca](mailto:communications@yec.yk.ca)

website: [yukonenergy.ca/battery](http://yukonenergy.ca/battery)



## Appendix B COMMUNITY MEETING NOTES

### A.1 VIRTUAL MEETING #1

#### Home-Owner Concerns

- Concern that property values will go down; would like to know if YEC has considered this
- Insurance: Questions about home insurance. Will premiums go up? Will they be able to get fire insurance?
- Would like to see a compensation package to make up for reduced property values.

#### Takhini Site

##### Site Development and Security

- Light pollution: Concern that light pollution; would like to know what the lighting plans are.
- The existing substation is lit up like a roman candle; do not want the battery to bring this type of light to the North Klondike Highway area. People live there for the rural life-style.
- Concerns that there will be vandalism and breaches to security; vandalism is a growing issue on the North Klondike Highway.
- What will happen if people shoot at the containers? Shooting guns is legal outside City limit; not allowed within City limits.
- The Takhini Road Site will need significant clean-up and remediation before development can happen.

##### Noise

- Noise - Concern about the noise. How was 45 decibels standard set?
- Concern that 45 db is too loud.
- If the 45 db limit is set in the Alberta standard, we should be looking at the standards in other provinces as well. Alberta may have the lowest standards rather than the highest.
- Would like to have information about the nature of the noise study. How was it done? Was it completed by an acoustics firm?
- Was it completed by engineers? Can it the study be made public?

##### Fire and Public Safety

- Concern about risk of fire and explosion.
- Example of the Arizona battery fire; concern that may happen here.
- Concern about a fire on the Highway; this is the only access route for many.
- Want to understand what would happen in case of an external fire, for example a forest fire.
- What is the risk of explosion? What is the blast radius for the explosion?
- Will the Fire Department at Hootalinqua be able to fight a battery fire? If there is a large fire; back-up will be far away. Will they have the training and equipment they need.
- Need to have a safety plan and a plan for how to deal with the toxic smoke that we be the result of a fire.
- Battery fires are specifically difficult to extinguish.

### **Opposition to Takhini Site**

- Opposed to the Takhini site as it is too close to existing residences. Main concerns are related to property values, insurance rate, light, noise and fire risk.

### **Site Selection**

- Could also consider the space available at each site for future expansion.
- Question about if YEC has a first choice for the site.
- In town options should be considered better options because they are close to existing infrastructure.
- Has YEC asked the City of Whitehorse for a property tax break? Should consider this. Both in town sites.
- Will this project need to go through YESAB regardless of which site is selected?

### **Battery**

- Question about how long the batteries last.
- Questions about the specific type of battery that will be used.
- Hard to assess risks with a new technology.
- Should consider each battery manufacturer's history when sourcing the battery to ensure that we end up with a safe product.
- Want to know the levels of subharmonic frequency. Have the studies been done?
- Seems like YEC does not have a firm capacity in mind; feeling that this should be known at this point in the feasibility.
- Questions about the capacity of the battery.
- Will it be possible to recycle the battery at the end of life?

### **Capacity and Future Development**

- Want to know about the capacity of the plant. Also, what will the potential for expansion look like. Concern that once this battery is built, more containers will be added on.
- How much room is there at each site to add capacity and containers?
- Wanted to know how long the battery could provide power during an outage (7 to 8 hours).

### **Energy Planning**

- Want to know how the energy modelling was completed; what was factored in. For example, electric cars.
- Does YEC know the carbon footprint?

## **A.2 VIRTUAL MEETING #2**

### **Site Questions:**

- Will there be municipal property taxes on settlement lands

### **Battery Procurement Questions:**

- How will the battery be scoped?
- What is the timeline for the project?
- How will the procurement be done?

- Can YEC confirm that size of the battery that it will be buying?
- Is there a set spinning reserve that will be required?
- Has Hatch been hired as the Owners Engineer?
- What is the footprint of the site?
- Will the final size of the battery be a consideration?

### A.3 HOOTALINQUA FIREHALL

- How much noise does it make?
- What level of consideration was given to residents near the proposed site?
- What is the db at the site?
- Potential for expansion of the site?
- How close does it need to be to the substation? Limits to how far it can be from the substation
- Why is this a site if residential proximity is taken into consideration?
- What is preferred site? Gathering feedback re: each site
- Advantage to this site because no municipal taxes → YEC talking to City re: reducing taxes
- Tax on FN land? Match lease to life of asset
- Self government agreements → renewable energy opportunities
- What is the cost difference between each site?
- Each site will have the same battery infrastructure
- Each site will have difference site development costs
- Batteries not aesthetically pleasing
- Proposed lighting?
- If the previous LNG proposed facility was placed here, would the battery be there too?
- Does the solar array proposed by Solvest impact the battery?
- What wasn't land by lagoon chosen as a site?
- Ground vibrance during construction & impact to water wells
- Positive affects to residence near site within 1 km?
- Negatives affected to residences at other sites?
- Against eye sore, lighting, noise
- Why haven't other FNs been approached?
- Growth demand starting in 1970?
- Taxation – CoW revenue stream → was to remove as primary driver
- How long will battery capacity last ie. When is another going to be added?
- Where is Moon Lake?
- Against light, noise, view
- Taking away quality of life/way of life
- Lithium explodes with fire / puncture
- Fumes, gases
- Aesthetics
- Effects on livestock → loss in revenues
- Reduction in property value
- Fans blowing
- Financial burdens on homeowners
- Reduction in property value
- Size of fire? Egress?
- Lighting levels? Pollution
- Feel like YEC doesn't care

- No trust with YEC / YG
- Timeline with letters, virtual meetings, in person meetings – RUSHED
- Wildfire risk, little fire breaks → fire break S of Whitehorse
- Increased risk / what happens in low risk situations? → wildfire, truck off road, evacuation plan?
- Fire break to the North? → S of Whitehorse, 500 m wide
- Fire suppression at seacans by YEC (to be completed)
- Consequences of wildlife at battery site?
- Additional training for firefighters?
- Fire hazard study to be completed?
- How much time would neighbors have to leave property if fire?
- Potential for tree barrier for aesthetics possible with fire concerns?
- Cost water supply at site for fire response?
- Toxicity of smoke from fire? YEC to provide composition of fumes
- Fire suppression in seacans?
- Human safety key to site selection
- Illegal dumping – previous concern
- YEC more concerned about short plug in and not surround citizens
- Needs of CoW residents trumping local residents
- Expensive to live in area
- Provide more technical information → make easily available for residents
- Unknowns of technology
- Best internet of all Yukoners
- Will questioned asked be answered clearly and provided to public?
- Has consultation / engagement strategy been approved?
- We don't NOT want the battery, we don't want it at this site
- Great piece of the puzzle to solve energy deficit
- New housing has electric heating
- Carbon to produce / manufacture batteries
- Hydro, solar → green
- Wind expensive / not practical in North
- Hydro focus in future → tourism
- Disposal of batteries? Cost? Recycled?
- Cradle to grave assessment done in 2016 Resource Plan (has GHG emissions)
- Performance review?
- Cautious moving forward with new technologies
- Want Whitehorse sites by YEC (snowdump)
- Property values to consider
- Life styles to consider
- Not against battery storage
- Moved to this area for a particular reason – life style
- Residences not considered re: 2 industrial and 1 residential site

#### **A.4 YUKON TRANSPORTATION MUSEUM**

- Does the 20 MW come on instantly in power outage?
- How many times can they be recharged?
- What is the life of the batteries?
- How will a battery be chosen?
- Ancillary support? How will it degrade the battery?

- Do batteries need to be cooled & heated? What're the loses?
- What is the optimal state of charge to meet objectives?
- What is (n-1)?
- Will battery site be expanded?
- Locations other than Moon Lake closer to Whitehorse for pumped storage?
- What're the taxes on each site?
- More liability at Takhini site?
- Air contamination from internal fire suppression?
- Opportunities to install advanced metering for research?
- Artificial or inertial response?
- Event record date? Performance?
- Remote power system – affect inertia, fault current?
- Install data collector locally? Cautious on amount of data stored due to space limitations
- Monitor controls system – feedback system
- Robert Service locations preferred

## **A.5 BEST WESTERN GOLD RUSH INN – TOWN HALL**

- Diesel / LNG can't black start like battery
- Proximity to existing substation
- Grid batteries in Alaska? Insulated?
- What is size of battery?
- How long to deplete battery storage from black start?
- Plot of land size? Battery footprint?
- FN rental vs lease agreement?
- Specialized training for fire dept? who covers? YEC? YG? CoW?
- Ongoing training
- Any direction from YG to utilities board to cover rate rise?
- 40 mWh battery?
- Savings from diesel / LNG?
- How are FN dev corps involved?
- How to calculate kWhr price?
- How're site going to be selected/
- In Whitehorse option – seem like best options
- Takhini option is close to houses, outside of town, further from fire response
- Noise & light pollution?
- Db at site?
- Location of exact site is unknown
- Cost to homeowner → loss of revenue, blackout blinds, way of life, sound proof walls, safety?
- Water for fire suppression?
- What is YEC going to do to mitigation cons if site at Takhini chosen?
- Potential for expansion?
- Site preference?
- What will this add to the rates? Are we talking pennies?
- Consideration to site underground?
- Life span of battery?
- Disposal of end of battery life?
- Locals may not know what are in seacans

- What signage will be displayed?
- What will be offered to nearby property owners?
- Battery able to store excess capacity to be used in winter?
- Primary use for peaking times?
- Providing inertia for grid?
- Used for re-energizing grid?
- On FN land – other available funding?
- FN investment opportunity?
- Light pollution → purpose of lighting?
- Degradation of lithium battery?
- Manufacturer of battery?
- Batteries warranted?
- Potential environmental impacts? Leaking battery, air quality? What are the mitigation measures?
- Batteries gradually improving?
- Site B is at the end of the runway
- Opportunities for FN?
- Site C is preference
- Cost effective to have more smaller battery banks? Ex at hospital, institution, etc
- Smaller battery banks in addition
- Have both FNs been talked to already?
- What kind of fire suppression? Halogen?
- What kind of electrolyte?

## Appendix C STAKEHOLDER & OTHER LETTERS

Hello Zoe,

Thank you for inviting Yukoners Concerned to take part in the discussion on the Battery Storage Plan.

Yukoners Concerned support the Battery Storage concept as part of Yukon Energy's 10 year renewable plan. We see the value of Yukon Energy's battery in providing grid stability and a quick and easy source of electricity for recovering from a power outage.

One of our concerns is that Yukon Energy must in the next three to five years, bring on line about 70 GWh (we note that in the 2019 Yukon Energy used over 68 GWh of thermal backup on the grid) of new renewable electricity to address current and future energy load and ensure that LNG/diesel is used only as emergency backup. Without a major additional energy project we will be relying on LNG and Diesel to meet load demand and charge this massive battery.

In order to meet Yukon's GHG reduction target of 50% by 2030 there will be a need for a combination of significant renewable energy projects, like wind, biomass, solar, heat pumps, pumped storage, and geothermal to ensure we can meet these targets.

Thank-you

Donald J Roberts  
Chair, Yukoners Concerned

## **Yukon Utilities Consumers' Group (UCG) comments on Yukon Energy Battery Storage Plan**

1. UCG has reviewed all the available information offered on the above plan, including the YEC web page, information package sent out by Stantec, as well as a power point presentation offered to participants. We also checked out the YEC 2016 20 Year Resource Plan, which identifies battery storage research as one of many concepts to consider. Accordingly, we have concluded that there is not ample evidence from all of these, allowing us to give an informed decision of this particular concept.

2. The YEC states in their web: [Building a grid-scale battery is one more way Yukon Energy is delivering sustainable, reliable and affordable electricity to Yukoners](#). The problem here is that they have not given any alternatives to compare with this idea. Not only does this include technology, but also cost comparisons, like LCOE (levelized cost of energy). How can one, including the YEC's and YDC own Boards of Directors, determine if this is indeed the best choice?

3. For example, some alternatives like ramping up some real demand-side-management or energy conservation techniques such as timers on high usage consumption such as hot water tanks and hot tubs etc. to stop the peak bleeding; implementing/mandating thermal heating units for all new buildings; incentives to replace buildings with baseboard heating systems with thermal storage units, incentives to install hot water coils in wood stoves (especially in the outlying communities); employ some non-interest loans, without too many hoops to jump through, to upgrade building efficiencies.

2. For example, some alternatives initiating a new supply-side-management strategy; i.e. what are the results of how purchasing power from the micro-generation program or the IPPs are helping to serve the needs to displace the necessity to build new infrastructure such as battery storage? How has the developments of purchasing power from new community-based solar and wind served the needs to displace the necessity to build new infrastructure such as battery storage?

3. What has YEC done to find alternatives to high demand users during peak hours or peak seasons? Is Yukon Energy working with the mining sector and larger industrial and businesses customers to ensure they are doing their part to establish Peak-Time-Load-Management tools to help solve this issue before we spend many millions on a battery pak?

4. The YEC web goes on to state: **Why a battery?**

On our isolated grid, one of the largest challenges we face is meeting large demands for electricity (known as peak demands) during winter months when water levels are low and customers need for electricity is high. That's why we have liquefied natural gas (LNG) and diesel engine generators. We turn to them when there's not enough water to generate the electricity Yukoners need.

With a new battery on our grid, we can store extra electricity when there's low demand for it and then use it when demand goes up.

**OTHER BENEFITS OF BATTERY STORAGE:**

Saves money. Running diesel engines less means less money is spent on expensive diesel fuel and maintaining diesel engines.

It's a sustainable solution. The battery uses more renewable electricity and less diesel to meet peak demands for power.

Restores power outages faster. By always being "on," the battery serves as a quick and easy source of electricity that can be turned on at the flip of a switch in a power outage.

Cuts carbon emissions. The new battery is expected to reduce carbon emissions in Yukon by more than 20,000 tonnes between 2023 and 2043.

Improves grid reliability. Using the battery during sudden outages or an unexpected decrease in electricity demand helps ensure grid stability.

Maximizes the output of our hydro resources. Using the battery to meet sudden changes in the amount of electricity Yukoners need means we don't have to rely on our hydro units to do this. We can generate more hydro power than before.

5. Yukon Energy does not give us any information on whether we will actually be saving money with this project. Is it cheaper than thermal or smaller hydro projects or is this simply a government push? If it needs more than half of the capital from taxpayers, then it is very likely not revenue neutral. What do we compare this with in LCOE at \$/Mwh.? Only that the lithium ion battery pak will come in \$1,060 per Mwh.<sup>1</sup>

6. Also, this will not get us away from the renting of diesels nor using the LNG plant at certain periods of need. We possibly should be focusing on replacing the old diesel units as they retire (replace as economically feasible as possible in present warehouse), as we will need back-up regardless on what resource we use.

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<sup>1</sup> Yukon Energy 2016 20 Year Resource Plan, page 53

7. Is spending \$30 million on one basket the best alternative for our buck and is there an immediate need? What about Wood Biomass or Gasification in Haines Junction or Whitehorse? What about some smaller hydro projects or run of the river hydro? What about the the proposed Haeckel Hill Wind Farm? What about Nomad Contracting proposal for a Solar Farm outside of Whitehorse? What about National Energy Capital proposed turbines? What about Ta'an Development Corporation plan for geothermal? What about?????
8. There are too many WHAT IFS? What if YEC consults and informs the public on all of these preliminary issues before they stick us with a \$30 million tab? Are they that set on accessing tax-payer funds from the Federal Government to the tune of \$16.5 million? And then sticking ratepayers with a \$13.5 million tab in rate base costs.
9. The YEC has not even finalized their 10 year Resource Plan, nor brought this before their regulator to get proper sanction. But, yet they are proceeding with the battery storage plan.
10. And now the YEC calls this consult. Their motto continues: We have decided on this alternative and now we offer the public some crumbs i.e. where to locate?
11. Not the way we see a consultation process go forward. Does this not leave an LNG taste in your mouth? Or Mayo B? Or a new thermal plant?
12. UCG also has other reservations with battery storage, such as operating this in a northern environment. Are there examples out there of proven short, medium and long-term operation of lithium storage batteries in our extreme northern conditions? The only claim that the Resource Plan identifies is similar installed project in California.<sup>2</sup> Are they also safe to operate at extreme winter conditions?<sup>3</sup> Where will all this lithium, the metal oxide electrodes and other chemicals be disposed of when the batteries are no longer useful? Is it really that environmentally friendly?
13. The newest lithium ion technology claim a 20 year life span. Is this significant cost barrier the best plan for such a short term? The LCOE of lithium ion battery storage is 106 cents per kWh. Even Mayo B, which was a nightmare of cost overruns and flooding problems came in at approximately 20cents per kWh

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<sup>2</sup> Yukon Energy 2016 20 Year Resource Plan, p. 18

<sup>3</sup> Ibid p. 18 Li-ion batteries have several disadvantages such as the metal oxide electrode can become thermally unstable due to over discharge or charge and be subject to thermal runaway if left unchecked.

(before the Federal and YTG grants), while diesel generation is about 26 cents per kWh.<sup>4</sup>

14. And finally has Yukon Energy made use of the newly formed Yukon University and their Northern Energy Innovation Program (NEI), along with their many highly paid management staff, to further test this concept, as well as assessments on other ideas? Or are they simply continuing to use their preferred consulting firms at top dollar?

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<sup>4</sup> Yukon Energy web on Mayo B

September 18, 2020

Yukon Energy Corporation  
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Stephanie Cunha, Manager, Communications  
Via email: [stephanie.cunha@yec.yk.ca](mailto:stephanie.cunha@yec.yk.ca)  
cc: [yecbatteryfeedback@stantec.com](mailto:yecbatteryfeedback@stantec.com)

Re: Yukon Energy Corporation 10 Year Plan

To: Stephanie Cunha, Manager, Communications

The Yukon Conservation Society (YCS) welcomes the opportunity to provide further information on our response to the draft 10-yr plan of the Yukon Energy Corporation (YEC). We have provided earlier comments, particularly concerning our support for connecting to the Atlin hydroelectric scheme and the plan to construct a pumped storage at Moon Lake.

YCS is generally supportive of the Yukon Energy Corporation's Ten Year Plan. YCS does see potential improvements to the Ten Year Plan, but generally YCS is supportive of individual projects within the Ten Year Plan.

YCS maintains that the Yukon should reduce territory wide GHG emissions by at least 50% by 2030. YEC plays a key role in doing this, not only providing existing amounts of renewable energy but also being in the position to displace future amounts of fossil fuel generated energy with renewable energy. For example, as electric vehicles become more common they will replace existing gasoline and diesel powered vehicles with potentially renewable energy powered ones, and oil and propane furnaces will be replaced with electric options.

The key, as always, is to increase the amount of renewable energy and drastically reduce the amount of fossil fuel generated energy. Here is YCS's review of Yukon Energy's Ten Year Plan (points taken from the Yukon Energy website on this issue at <https://yukonenergy.ca/energy-in-yukon/electricity-in-2030/our-draft-10-year-plan/project-descriptions>).

## **PROJECTS UNDER DEVELOPMENT**

### **Whitehorse Hydro #2 Uprate**

YCS is supportive of this. Increasing and improving the efficiency of existing renewable energy infrastructure is one of the most cost efficient and usually the most environmentally benign way to go.

### **Battery Storage**

This is the battery storage project that received federal funding in 2019, not to be confused with the Moon Lake hydro battery storage project. YCS is supportive of this project. However, careful consideration must be given to the economics of this and future similar projects. The high cost of this project suggests distributed technologies such as electric thermal storage may be more cost effective than a grid-scale battery in terms of \$ per kWh installed, \$ per kW installed, and \$ per lifetime CO<sub>2,eq</sub> reductions. Further analysis will be necessary in coordination with Yukon Energy to explore that possibility.

### **Electricity purchases from Independent Power Producers**

YCS is conditionally supportive of this program but a lot depends on how the power is being produced. Projects that are renewable and small-scale (in a Yukon context) are probably acceptable, whereas those that are not will be of concern to YCS. Each IPP project will require an environmental assessment that YCS will participate in and from that YCS will either support or oppose each particular IPP project.

### **Micro-Generation Program**

YCS is conditionally supportive of this program but a lot depends on how the power is being produced. Projects that are renewable and small-scale (in a Yukon context) are probably acceptable, whereas those that are not will be of concern to YCS.

## **PLANNED PROJECTS (BASED ON APPROVALS)**

### **Whitehorse Hydro #4 Uprate**

YCS is supportive of this. Increasing and improving the efficiency of existing renewable energy infrastructure is one of the most cost efficient and usually the most environmentally benign way to go.

### **Incremental Diesel Replacement**

YCS is not generally supportive of this. The capacity of the diesel generators should be replaced with renewable energy options. However, the need for emergency backup generating capacity is understood. Emergency backup diesel generators should be efficient and will, in this concept, require ongoing replacement.

### **Southern Lakes and Mayo Enhanced Storage Projects**

YCS understands the logic behind the proposed Marsh Lake and Mayo Lake enhancement projects (existing infrastructure, extremely short timeline to bring on line). However, YCS has environmental concerns regarding substantial fluctuations in water levels, particularly in regards

to fish habitat along the shore line, and impacts on wetlands (Roop Wetlands on Mayo Lake, Marsh Lake wetlands by the lake outlet). Completion of detailed environmental assessment is required on this issue. Until such time as these are complete YCS reserves judgement on these projects. It is worth noting that similar concerns occur at Aishihik Lake.

### **Demand Side Management Programs**

YCS is generally a strong supporter of Demand Side Management Programs. YCS support would, of course, depend on the particulars of each program. Initiatives such as the Electric Thermal Storage project is a good example of a positive DSM program.

## **POTENTIAL FUTURE PROJECTS**

### **Moon Lake Pumped Storage**

The Moon Lake could provide 20 MW of power with 20 GWh annually of self-generated (from its surrounding watershed) electricity. Moon Lake can store up to 69 GWh annually if there is excess renewable electricity available from the Yukon grid for pumped energy. If this is understood correctly Moon Lake would allow for the additional storage of 49 GWh of excess electricity from wind, PV, and other existing hydro. This is about 3 months of energy storage at 20 MW.

This has to be balanced against the value of the habitat loss at Moon Lake compared against reducing GHG emissions and/or alleviating stresses on the other hydro reservoirs that are impacting their surrounding habitat.

Generally, though, YCS is supportive of the Moon Lake Pumped Storage.

### **Electricity Purchases from the Atlin Hydro Expansion**

The Atlin hydro project could potentially provide 8 MW of power with 46 GWh annually of renewable electricity to the Yukon grid. YCS is supportive of this project.

### **Southern Lakes Transmission Network**

YCS is supportive of major upgrades to the Southern Lakes Transmission Network. However, environmental assessments would still be required on issues such as widening or changes to powerline Rights of Way corridors, access roads and tails to proposed powerlines, location of supporting infrastructure such as transformer substations etc.

YCS has long been concerned that Rights of Way corridors are not planned adequately to reduce their environmental and areal footprints. YCS feels strongly that new transmission lines should be placed within highway rights of way, where they exist.

## **OTHER CONSIDERATIONS**

### **Wind**

The most serious capacity limitation and renewable energy shortfall in the Yukon occurs in the winter and that these limitations are already obvious. The strategy of making up the deficit with diesel and LNG generators may be necessary in the short term but is an expensive and highly undesirable option.

YCS therefore urges acquisition of significant wind power sources in the 10-year plan (either directly through Yukon Energy or by making use of the IPP and micro-generation initiatives) as this offers additional fossil fuel-free electrical generation in the winter as well as a shorter implementation time line than other sources. It is also highly compatible with the Moon Lake pumped storage scheme by providing additional power for storage in the warmer weather season.

### **Solar**

The Yukon has had some solid progress in solar projects lately, with two moderately sized Independent Power Producer solar projects on the horizon. Winter renewables like wind should be more of a focus, especially with ETS and Moon Lake. That being said, solar is particularly useful in the spring when the skies are typically clear, and the days are long and hydro reservoirs are still depleted. There are existing programs in place through the Yukon Government, and these should be developed further. Similar to wind, increases in solar power could either be done directly by YEC or by making use of the IPP and micro-generation initiatives.

Should you have any questions, please contact the undersigned.

Sincerely,

A handwritten signature in black ink, appearing to read 'Coral Voss', written in a cursive style.

Coral Voss  
Executive Director

## Appendix D DOOR-KNOCKING COMMENTS

	Door-Knocking Comments	Themes Used for Graphing Purposes
1	<ul style="list-style-type: none"> <li>Battery infrastructure should be screened from view.</li> </ul>	Screening
2	<ul style="list-style-type: none"> <li>Just giver'</li> </ul>	Support or opposition
3	<ul style="list-style-type: none"> <li>No problems with the proposed site.</li> <li>Designed home to be able to add a solar array in the future.</li> </ul>	Support or opposition
4	<ul style="list-style-type: none"> <li>Questions: What size will it be? What % will my rates increase.</li> <li>Generally the resident supports this project.</li> <li>Would like to see a more stable grid with fewer power outages.</li> <li>YEC needs to plan new sources of energy as demand continues to grow.</li> <li>Concern about the environmental impacts of building this type of battery.</li> </ul>	Environmental impact Parking lot: energy rates
5	<ul style="list-style-type: none"> <li>Does not want access to the area's quadding trails to be cut off by this project.</li> <li>Definitely support for this project and this location is fine.</li> <li>Would like to see projects that lead to more stable power and fewer outages.</li> </ul>	Loss of site from recreational purposes
6	<ul style="list-style-type: none"> <li>Feels that her home is far enough away that there wont be any issues.</li> </ul>	Support or opposition
7	<ul style="list-style-type: none"> <li>Does not want to have the battery so close to her home and her garden/vegetable growing business.</li> <li>Do not want to see this type of infrastructure at the entrance to the community.</li> <li>Concern that the battery may cause emissions or gases that will impact vegetable production.</li> <li>Would not want to see or hear the battery.</li> <li>Concern about environmental impacts of living so close to the battery.</li> <li>Paragliders use this site as well; should reach out to their association.</li> <li>Would prefer the site near LNG generators.</li> </ul>	Screening Screening: aesthetics from roadway Health impacts to surrounding residents Noise Environmental impact Loss of site from recreational purposes
8	<ul style="list-style-type: none"> <li>No issues with the proposed project.</li> </ul>	Support or opposition
9	<ul style="list-style-type: none"> <li>Prefer a battery at this location over LNG or diesel generator.</li> <li>Wife will likely have questions.</li> </ul>	General.
10	<ul style="list-style-type: none"> <li>Questions: <ul style="list-style-type: none"> <li>How much noise?</li> <li>What are the benefits?</li> <li>What are the timelines.</li> </ul> </li> <li>Would like the site to be screened if the project goes ahead.</li> <li>Appreciate that YEC is door knocking in the area</li> </ul>	Noise Screening
11	<ul style="list-style-type: none"> <li>No issues with the proposed site.</li> </ul>	Support or opposition

	<b>Door-Knocking Comments</b>	<b>Themes Used for Graphing Purposes</b>
12	<ul style="list-style-type: none"> <li>• Do not want to see the battery from the road; need to consider the aesthetics at this site.</li> <li>• Would like to have some information from people who have lived near this type of infrastructure; what to understand the long term impacts on health and environment.</li> <li>• Need to consider aviation safety; the area is so close to the airport that there may be impacts.</li> <li>• People who live in the area use that site for recreation; trails and tobogganing hill.</li> <li>• If the battery catches on fire how will the toxic fumes be managed?</li> <li>• Various property owners along Metropolit Land have expansion plans and the battery may not be compatible with these plans.</li> <li>• There is a busy RV part nearby; need to consider that this area may have the highest population density of all three sites, at least during tourist season.</li> <li>• Proposed site is not flat.</li> <li>• North Klondike Highway site may be better because of lower taxes.</li> <li>• Want to know if there is a plan to add more batteries in the future.</li> <li>• Will the batteries have magnetic properties that could impact airplane navigation?</li> <li>• Want to know where batteries will be made.</li> <li>• Would feel more comfortable if YEC had completed research into impacts; for example will radiation or gases be emitted?</li> <li>• Concern that batteries are dangerous; long term impacts and potential risks are not know or well understood.</li> <li>• Yukon Gardens uses lots of power to heat greenhouses; would like to have access to agriculture rates or off-peak rates.</li> </ul>	<p>Screening: Aesthetics from roadway Health impacts to surrounding residents Environmental impact Aviation safety Loss of site from recreational purposes Fear of emergency situation: emergency response - control of fumes Future certainty: expansion Additional information: battery manufacturing Decision-making criteria</p>
13	<ul style="list-style-type: none"> <li>• Access quadding trails in the area.</li> <li>• Question about the noise that would be produced.</li> <li>• No concerns.</li> </ul>	<p>Loss of site from recreational purposes Noise</p>
14	<ul style="list-style-type: none"> <li>• No in favour of this project at this site; many concerns and questions.</li> <li>• Concern that real estate values will go down and that insurance premiums will go up</li> <li>• Battery are not safe.</li> <li>• Volunteer fire department is not equipped to deal with a battery accident, explosion or fire.</li> <li>• Concern that a fire would block the highway or other local roads and resident will not be able to get out.</li> <li>• Need to know what the increase to rates will be; senior on a fixed income and it is very hard to manage when rates are increasing.</li> <li>• Moved to the Yukon to get away from this sort of project.</li> <li>• Do not see battery storage as a sustainable option.</li> <li>• YEC needs to commit to letting people know what they decide to do on this site.</li> <li>• YEC needs to provide clear and timely answers to residents' questions.</li> <li>• Residents should not be rushed to provide input; do not want YEC to rush ahead on something that will be such a negative impact on residents.</li> <li>• Want time to learn, understand and provide timely input.</li> <li>• Need to know what will happen if bullets hit the battery or there is a lighting strike.</li> </ul>	<p>Fear of emergency situation Fear of emergency situation: emergency response Future certainty Additional information: durability of battery in extreme situations Process: timeline Property values Parking lot: energy rates Fear of emergency situation: evacuation feasibility</p>
15	<ul style="list-style-type: none"> <li>• Very disappointed that Yukon Energy would consider this site.</li> <li>• Do not support the battery project in this location.</li> <li>• Resident is very sensitive to lights and sounds.</li> </ul>	<p>Light Noise Health impacts to</p>

	<b>Door-Knocking Comments</b>	<b>Themes Used for Graphing Purposes</b>
	<ul style="list-style-type: none"> <li>• They have just finished building a recording studio and have received YG funding for this project; noise could be a big problem for recording.</li> <li>• This is not a good location for the battery; would be bad for well being of those who live here.</li> <li>• Concern about the risk of a fire and/or explosion.</li> <li>• Would consider moving if this project goes ahead; would not want to live so close to the battery.</li> <li>• Should consider some kind of financial compensation for residents if the project goes ahead at this location.</li> </ul>	<p>surrounding residents Fear of emergency situation Additional information: financial compensation for those impacted Reduction in quality of life</p>

## Appendix E ONLINE FORMS

	Online Form Comments	Themes Used for Graphing Purposes
1	Hello, I live in riverdale and see no issue with this going near LNG plant. Very excited for the 10 year plan! Thanks for taking bold initiatives and demonstrating the variety of renewable energies available to meet the challenge of if truly divesting from fossil fuels.	Support or opposition
2	I feel that you need to find a different place to do this as there are farm animals and family living right there	Health impacts to surrounding residents
3	I am against the construction of the proposed battery projet at the Takhini Substation. I have close family members living >20 meters from the proposed action and surely this poses health hazards as well as safety risks if there were to be a catastrophe at the batery site! Build it somewhere else please!	Health impacts to surrounding residents Fear of emergency situation
4	The public meeting was most appreciated as this proposed facility at Takhini Substation affects only immediate neighbouring residences. The Takhini Substation site should be removed from the list of potential sites due to residential proximity and permanent devaluation of the neighbourhood with light and sound pollution plus subsequent increases to residential insurance and taxation. This is the second time Yukon Energy has attempted to industrialize our area. By offering our homes to industrial development our local First Nations have also sent a clear message that they are not good neighbours and care nothing about their land, the wildlife corridor or the nature of this location. This battery plan is an over-priced temporary bandaid for Whitehorse's overuse of electricity. Yukon needs more reliable hydro power and less foolish experiments. Yukon has two major and well-known geo-thermal sources that have private businesses sitting on them. Yukon Energy should be negotiating with Takhini Hotsprings and Liard Hotsprings for installation of geo-thermal generation systems instead of allowing a few private individuals to waste Yukon's valuable green energy resources on recreation. Thanks for your time and attention to my concerns and consideration of my suggested solutions.	Light Noise Property value: insurance rates Environmental impact Decision-making criteria
5	Proposing this industrial-grade infrastructure in a residential area is preposterous. It should be located near all the other electrical equipment YEC uses to provide their services - down by the dam site which is one of the three options for this project presented.	Support or opposition
6	Hi, I am writing to advocate for the battery location to be at site 1 or 2 rather than site 3 as site 3 is a residential area and will effect surrounding residents.	Support or opposition
7	what are the sound levels and at what levels do extra measures kick in. In case of fire, what toxic fumes become hazards to health	Noise Fear of emergency situation: emergency response - control of fumes
8	Good morning to who it may concern, it sounds like a great project but not by any place that has people living close there must be other places one could put the Project , imagine if some put that in ur back yard and you had to see it . Any way hope you change ur mind and put some where else. Thank you for ur time	Screening
9	I live across the road for km 8.1 Klondike highway and am absolutely opposed to this project at this location. There are several families within 300m of this location and don't need anymore noise or light pollution. The other sites have ZERO residents that live anywhere near the sites. The thought of this site even being in the running defies logic.	Noise Light Health impacts to surrounding residents Property values

	Online Form Comments	Themes Used for Graphing Purposes
	Thank you	Fear of emergency situation: emergency response Reduction in quality of life Loss of view
10	<p>Hello,</p> <p>I am the direct neighbour of 5.1 mayo road site and will be directly affected by this. You have not alerted me to this happening and I am against this. I recently purchased this property and the plan will directly affect my property value. As well, I have a residence right on the side of my property that will be beside the battery. This is my rental cabin and if the battery creates light and noise (which is will) I will have to reduce my rental cost to tenants which will negatively affect me and my quality of life. As well, this is a rural residential area, if this goes ahead it will affect the way of life for myself and the neighbours. We will never be noise free which is of course upsetting. There will also be more light directly beside my property which will affect my ability to see northern lights, which is a huge assets to this property and it's value. Overall I think it is an unacceptable location and am saddened you have not even told me about it. I had to be alerted by others. Please contact me if you would like to discuss further.</p>	<p>Noise Light Health impacts to surrounding residents Environmental impact Fear of emergency situation Additional information: durability of battery in extreme situations Loss of view Screening Property values Fear of emergency situation: emergency response Fear of emergency situation: evacuation feasibility Property values: insurance rates Additional information: financial compensation for those impacted Reduction in quality of life</p>
11	Please reconsider option 3 that close to a residential area with children. I am sure there is zero research on biology impacts on humans. And if that catches fire it could put a family at risk. Please consider that.	<p>Health impacts to surrounding residents Fear of emergency situation</p>
12	<p>I oppose this venture behind my family's land.Relocate to an isolated region.</p> <p>Thank you.</p>	Support or opposition
13	<p>1. Any Engagement with home owners / community prior? 2. Enviromental Study? 3. Stewardship of the project? 4. No Transparency to families?</p> <p>Thank you</p>	<p>Process: engagement timeline Environmental impact Decision-making criteria</p>
14	I am strongly opposed to the Battery site to me on Mayo road. It is less than 10 meters from my family's home. It is explosive & not safe To be so close to residences .	Fear of emergency situation
15	I am opposed to the gridscale battery especially at Takhini Hotsprings	Support or opposition

	Online Form Comments	Themes Used for Graphing Purposes
16	<p>I believe anything that you can do to produce renewable energy is good. Maintaining water levels is also important. I believe the people that are building and developing houses that use electric heat should have to share more of the cost of the required capital cost. We had a enough electricity to meet the needs before the large population increase. Now we as pensioners are paying to subsidize there heat source.</p>	Support or opposition
17	<p>I am against having this large industrial battery storage in my neighborhood. Living on the klondike hwy outside of city limits you expect to have peace and quiet, safety, and dark nights. This facility will be an eyesore both day and night in our neighborhood. And will be loud when walking in the land around it. Property value will be affected even if everything goes well. And have not seen any info of implications if somethig went wrong like leaks ,explosions, abanonment. In short i am against the klondike hwy proposed location of this grid scale battery.</p>	Noise Light Screening Loss of view Property values Fear of emergency situation Environmental impact Additional information: end-of-life for battery
18	<p>Hello,</p> <p>I've recently become aware of the planned battery storage project proposed by Yukon Energy. I want to voice my strong opposition to Option 3 of this plan - developing the battery storage project at the Takhini substation.</p> <p>I have recently in the process of purchasing a home located within 250 m of this proposed site. I am first of all severely disappointed that myself, nor the current owners of the property have been made aware of this potential development by representatives of Yukon Energy. In addition the community engagement email is not functioning - disappointing.</p> <p>Secondly I find it abhorrent that Yukon Energy would consider placing this battery storage facility with it's associated noise and light pollution in close proximity to so many residents. It is of great concern that sound mitigation equipment would need to be installed in order for sound levels at the nearest neighbour to be below permissible sound levels. What would happen if this equipment was to fail. This significant increase in noise and light will have immense impact on my daily life and health. We have purchased this home outside of town to enjoy the peace and quiet which will be taken away from us and surrounding residence.Â</p> <p>There is also additional risk to the residents in the area due to the risk of the batteries. If something were to happen this may result in an explosion affecting a radius possibly greater than 200m. Due to this, the storage unit is not located a safe distance away from surrounding residents (30-50m). My property would be impacted if anything were to occur. This is unacceptable!</p> <p>Additionally, this will negatively impact me as this development will effectively devalue my investment and greatly reduce my ability to enjoy my property.</p> <p>The two locations within the city of Whitehorse are clearly more suited to this development as there are little to no social impacts.</p> <p>The fact that Yukon Energy and the Yukon Government would consider this option - valuing a few dollars saved over residents property values and well being is deeply disappointing. In addition, the collection of Whitehorse municipal taxes would have great benefits for the city of Whitehorse. Which in turn would benefit Whitehorse residents rather than harm them.</p>	Noise Light Health impacts to surrounding residents Environmental impact Fear of emergency situation Additional information: durability of battery in extreme situations Loss of view Screening Property values Fear of emergency situation: emergency response Fear of emergency situation: evacuation feasibility Property values: insurance rates Additional information: financial compensation for those impacted Reduction in quality of life

	Online Form Comments	Themes Used for Graphing Purposes
19	<p>Location: Option 3 makes the most sense: The capital cost of all of them is about the same; option 3 puts it on YE's own land to avoid taxes. I wonder though about the "all the eggs in one basket" approach. Since the batteries and inverters are modular, why can't they be spread out across the grid to help cover threats to the transmission lines? If having firefighting ability nearby is an issue, they could still be placed near communities on or adjacent to the existing lines' right-of-way.</p> <p>I also wonder about the life-cycle environmental and social cost of the battery technology. Sure, the most common type may be lithium-ion, but given the source of the raw materials to make them (are they the same as the small-tech lithium-ion batteries that has made headlines re 3rd-world child labour used to mine the heavy metals?) Your documentation doesn't ask about the technology, or give a breakdown of up-front capital cost, ongoing maintenance cost, and talks about future recyclability and not about how long the new batteries will last before the first ones will need to be replaced and how they will be disposed of if new recycling isn't available. Whereas, old-fashioned lead-acid batteries are probably the most recycled item on the planet, with much of the world's supply of lead for them coming from the Faro mine... Since these are stationary batteries (i.e. not motive), providing proper containment from the get-go shouldn't be a big issue.</p> <p>Presumably since the higher peaks happen in the winter anyway, pump-storage isn't an option (e.g. pumping back up the Whitehorse dam, or doing something at the mines in Faro or Mayo), but what about other geography-based energy storage (e.g. some kind of compressed air or refrigerant system or a pump-storage of something other than water)?</p> <p>What about transitioning some of the stand-by generation from diesel to a reversible fuel: something that can be made using spare energy? Like a methanol-cycle (<a href="http://en.wikipedia.org/wiki/Methanol_economy">en.wikipedia.org/wiki/Methanol_economy</a> and <a href="http://en.wikipedia.org/wiki/Dimethyl_ether">//en.wikipedia.org/wiki/Dimethyl_ether</a>) which can be made from biomass (such as wood from our abundant burt-over areas).</p> <p>Could YE form partnerships with development companies to create what for them would be demonstration-sized projects but for us would be real-world?</p>	Decision-making criteria Fear of emergency situation: emergency response
20	I strongly support battery storage of power in the Yukon. Option 1 makes the most sense to me as the environmental concern is low and it would allow for an expansion of the amount of batteries in the future. I am opposed to option 3 as it is too close to a residential area.	Support or opposition
21	I am against the mayo road location	Support or opposition
22	<p>Option 1 - you are putting "all your eggs in one basket". The LNG should NEVER been built where it is but no point crying about spilled milk. I realize why you suggest this but think about it!!</p> <ol style="list-style-type: none"> <li>1. It's at the end of a runway!!!</li> <li>2. You have two main power sources in a river valley, in front of a dam, in an earthquake zone!!!!</li> <li>3. If either the LNG or the batteries do have a catastrophic failure one would probably take out the other!!!!</li> </ol> <p>Option 2 -</p> <ol style="list-style-type: none"> <li>1. Again, at the end of a runway/flight path</li> <li>2. At least it's higher!</li> <li>3. Still too close for my liking</li> </ol> <p>Option 3</p> <ol style="list-style-type: none"> <li>1. No airport,</li> </ol>	Fear of emergency situation; Support or opposition

	Online Form Comments	Themes Used for Graphing Purposes
	<p>2. On "solid" ground, away from the river 3. Nothing to take out in the infrastructure presently in place 4. Right beside a substation, so easier to tie into. If the entire dam went in an earthquake you have this and the substation, you could move in diesel generators and still have the batteries to help I hope you actually listen to the public THIS time Thank you</p>	
23	<p>Put this somewhere away from peoples homes. It decreases our property value and our home lives. Strongly oppose the takhini substation location - there are too many families in this area.</p>	<p>Property values Reduced quality of life</p>
24	<p>Hello Minister Pillai,</p> <p>I am formally writing to you about the proposed battery project by Yukon Energy Corporation. My mother [Redacted] and I are opposed to the Takhini substation site being selected as the location for the proposed Battery Project.</p> <p>Our property is located within 800 meters (2 Five Mile Road) of the proposed Takhini site and would be impacted if this site was further developed for the battery project.</p> <p>We are opposed for several reasons.</p> <p>We have chosen to rural living for peace that it provides. Yes we are adjacent to the Mayo Road, however the noise from the road is not consistent and 24 hrs a day. This battery project would bring a consistent drone. No one has addressed the issue of the noise from the inverters converting energy to be stored.</p> <p>It is not fair that the main reason for this site being the most appealing is because property taxes are lower. How is it that our own Government can chose to avoid property taxes? This is not an acceptable reason and is not considerate of the people who have chosen a rural way of life.</p> <p>We are concerned about how this project would impact our insurance. Both the possible increase in rates and if there was ever a need to make an insurance claim due to an incident involving the battery project. What compensation and assurance would there be from the Government and Yukon Energy?</p> <p>We are concerned about how this project will impact our property value. What compensation would there be as we anticipate our property being less desirable to live due to the battery project and the noise and safety concerns it brings.</p> <p>We have several safety concerns: This site would not have 24 hr personnel security. While there may be a camera system it will inevitably not be able to monitor for those individuals that cause mischief and shoot a gun at the sea cans. If a bullet were to pierce a battery it could cause a fire or worse cause an explosion. As of late the Mayo road has seen a couple of vehicle fires recently and vandalism is a real concern.</p> <p>Our property is designated as Rural and as such the remaining area should also remain rural and no further infrastructure development be allowed to expand outside the existing foot print of current structures.</p> <p>The risk of fire both from the heat of the batteries themselves and from wildland or structure fires is a very real issue. Our fire department is not equipped to handle a battery fire as well as protect residential structures.</p> <p>We believe this is a band aid solution to Yukon's energy problem and that the</p>	<p>Fear of emergency situation Fear of emergency situation: emergency response Future certainty Additional information: durability of battery in extreme situations Process: timeline Property values Parking lot: energy rates Fear of emergency situation: evacuation feasibility</p>

	Online Form Comments	Themes Used for Graphing Purposes
	<p>Government has failed to develop a long term plan to meet the requirements of Yukoner's.</p> <p>We are concerned that once the Takhini site is developed with a battery project that the site will be increased in size over the subsequent years.</p> <p>We are of the opinion that this technology does not have viable end of life recycling and that Yukon will be left to store and care for the hazardous material. There is no guarantee that the manufacturer will be around at the end of life for these batteries. This is not environmentally friendly to Yukon.</p> <p>Yukon Energy has not shown any data that the carbon footprint through the three stages (manufacturing, end user use and end of life) is any less than our current energy consumption. Would this project merely export Yukon's carbon emissions? Is lithium mining environmentally friendly. How can we compare lithium mining pollution to carbon emissions as a fair trade-off.</p> <p>I would also like you to know that the impression being given right now is that Yukon Energy is trying to rush through the consultation process. They have done a poor job of communicating the public consultations. Very few residents have been made aware of this project. Infact the night of the first virtual meeting September 9, 2020 was the day that we received our notification in the mail. Why is our Government trying to move this through so quickly?</p> <p>Also, the team conducting the public consultation appears ill prepared and it does not appear that an in-depth review of this project has been completed. The team was not prepared with many of the questions during the Microsoft Teams meeting. Again, indicating a sense that the Government and Yukon Energy are scrambling for a solution to Yukon's energy shortage.</p> <p>Will the minister commit to taking Site A Takhini off the table for the battery project?</p> <p>Mr Minister Pillai, I welcome your response and would appreciate further opportunity to discuss my concerns around this project with you. Thank you for taking the time to read my email.</p> <p>Regards,</p> <p>[Redacted]</p>	
25	<p>Really don't appreciate getting late notice of the first team call for this. I got my notice in the mail September 15 and the first team call was that night. I don't want this in our community because it's close to a number of us. The other two sites do not have residents next to them like we are to the Takhini substation. Why should we have to have our area disturbed with noise, and a football field of C-cans in our neighborhood. We live outside of town to enjoy wildlife free from noise and be able to step out of our front door to see northern light. This will have a high impact on our way of life not to mention the added cost of taxes, insurance, electricity costs, noise and the beauty we enjoy will be made ugly, and resale of property will be affected. Please reconsider taking this site out of your planning and let us have the life we enjoy.</p> <p>I am not opposed to battery storage but I am very upset with it being in my backyard. I'm a senior on a pension and the added cost to my property because of this I'm not sure how I can afford the added cost that this will impact me.</p>	Process: engagement timeline

	Online Form Comments	Themes Used for Graphing Purposes
26-32	<p>I am writing you today to express that I am opposed to the Yukon Energy Grid-Scale Battery project at the Takhini Substation.</p> <p>There are many reasons I am writing to you today and they include:</p> <ol style="list-style-type: none"> <li>1. The noise level and how it affects those around it, including the mental health of residents in the area</li> <li>2. The lighting and how it will greatly alter the way of life in this location by removing northern lights viewing and stargazing</li> <li>3. Unknown gases and fumes that may come from the units</li> <li>4. Potential for leaks and ground contamination</li> <li>5. The risk of explosion and lives it would take if this occurred</li> <li>6. The risk of fire from internal and external sources, such as a wildfire</li> <li>7. The risk of vandalism and how this is a large issue in this neighbourhood</li> <li>8. The size and how it will affect our view</li> <li>9. How it will affect resale for properties in this area</li> <li>10. How the local fire station is clearly unable to save structures in the immediate area in event of a catastrophic event</li> <li>11. The increase in the cost of insurance to residents</li> <li>12. The financial increases such as the cost of noise and light reducing equipment, lost rent, loss of cattle/farm sales, loss of horse boarding, secondary driveways as escape routes, time invested to complete these tasks, and attend meetings.</li> <li>13. Potential that potential home buyers will not want to purchase in this area anymore as the attractive factor would be removed.</li> <li>14. Loss of current way of life</li> <li>15. No positives for people in the direct area only loss</li> <li>16. Various safety concerns as a whole</li> </ol> <p>Please consider the other 2 locations for this project as I feel this is not an appropriate area for such a large battery.</p>	<p>Noise Light Health impacts to surrounding residents Environmental impact Fear of emergency situation Additional information: durability of battery in extreme situations Loss of view Screening Property values Fear of emergency situation: emergency response Fear of emergency situation: evacuation feasibility Property values: insurance rates Additional information: financial compensation for those impacted Reduction in quality of life</p>

## Appendix F E-MAILS

	E-Mail Comments	Themes Use for Graphing Purposes
1	<p>Hi Zoe, Below is an email I sent to the minister in regards to the Takhini substation. I believe you are aware of my concerns but wanted to keep you in the loop as well. I thought I sent to you but it came back as not sent. Thanks</p> <p>Hello Minister Pillai, My name is [Redacted] and I am a wife to [Redacted] and mother to [Redacted]. I am a nurse in continuing care, and a women entrepreneur in our lovely city. My family recently purchased the 5.1 Mayo Road property from The Hurburt's. I am writing to you today in regards to the proposal to have Yukon Energy's new large scale battery project build on the 5.1 Mayo Road location at Takhini substation. First off I would like to say I am saddened that this is even been provided as an option, with minimal information anyone can see that it is an unacceptable location other than Yukon Energy will be able to save a few thousand dollars each year on property tax. I do not feel it is right to have such a large impact on our way of life to save a small amount of money. Especially when there are very close alternatives that do not affect homes in this direct way. I am very much so opposed to this project and I will explain more below. I would like to be clear that I am prepared to take this information to any and all media outlets if necessary. My first and greatest concern is the noise level. I recently purchased my property and one of the draws as a buyer was that we were able to leave the city for some quiet. Clearly not guaranteed silence and I understand that but in the middle of the evening/night I can go outside and enjoy what nature has to offer. I paid a great deal for this ability and I am now being told that "hopefully" the noise will be low enough at my house that it's 50db which is considered "acceptable" for a typical Canadian suburb. This is not accounting for the rest of my property which will be louder than this. This noise will be a loud constant hum, I don't not know a Whitehorse suburb that is even this loud. I do not feel comparing a Calgary suburb amount of noise is acceptable in rural Whitehorse. This will affect my mental health, and my families mental health. I also have several rentals on the property that will also be negatively impacted which will end in large reductions of rent to be able to have tenants willing to listen to this noise and I will have a significant reduction in property value. Total I have 3 residences that will be affected and could lead to upwards of almost a million dollars in lost rental income over the next 20 years. So they can save a few dollars... how is this fair? My other concerns, are also very important to me. See below: I will now have an area directly beside my property that has half a football size of trees removed. I will no longer have a lovely view of trees and mountains. I will look at 16-22 (maybe they "don't really know") 40' seacans. Do you want a large number of 40' seacans beside your home? This is not accepted in city subdivisions? Why is this ok? This is not an industrial area. It's rural residential. This also includes, half a football sized area that will now be lit up bright 24/7. Did you know that I can current watch northern lights from my bedroom window? This will no longer be an option with so much light pollution. The light will also have negative effects on my family, tenants, cattle, and pigs. There is also the fire danger to be aware of. These containers will have fire suppression gear that will hopefully work if there is an internal fire. They are "unaware" if the gear will work if a forest fire is to come through this area. If these containers catch fire they may explode or at minimum spread the fire at a much</p>	<p>Noise Light Health impacts to surrounding residents Environmental impact Fear of emergency situation Additional information: durability of battery in extreme situations Loss of view Screening Property values Fear of emergency situation: emergency response Fear of emergency situation: evacuation feasibility Property values: insurance rates Additional information: financial compensation for those impacted Reduction in quality of life</p>

	E-Mail Comments	Themes Use for Graphing Purposes
	<p>faster rate. Wiping out my entire property and all of its structures (13 on my property alone, not counting other neighbours)</p> <p>This risk is also concerning as vandalism is very real in Whitehorse. Just last month a car was lit on fire on this road. Most people will be uneducated that these seacans are explosive batteries. It is a very really risk someone will light one on fire or shoot them with a gun. Unaware that this can cause as explosive reaction. I do not believe the nearby volunteer fire department is the appropriate response team to such a risk. My home and other buildings will likely be all gone from such a small act. If me and my family, including my 18 month old son are lucky enough to survive.</p> <p>There has been no plan of evacuation if something like this was occur. That's on me as a property owner to figure out how to get my family to safety in the event of an emergency. I do not think it is right I need to raise an 18month old, work full time as a essential nurse, help run my husbands home based business and now I need to worry about how I can escape from a football field size explosion or grand size fire? Really! 2020 is hard enough. I am not a dramatic person but something so unreasonable is being pushed on me and forcing me to write you today. There are unknowns about the fumes from these batteries and being less than 5 meters from the site how this will affect my small family over the next 20 years. I do not want my son exposed to this risk to save some property tax.</p> <p>There are other unknowns about increases over the next 20 years to home insurance being beside a fire risk. Expenses for secondary roads for escaping, noise reducing equipment for my home and rentals, light reducing curtains for the homes on the property. Reductions in rental income. Negative impacts to my livestock and subsequent effected income from it over then next 20years, I have cattle currently but have pigs and horses coming in the near future as well. Lastly to note, I am the closest property to this project and have NOT been notified by anyone that it was being considered. No letter or phone call. I learned about it from the last owner, who heard it from someone. This does not feel right. I would have missed all the meetings to become educated on this and have my voice considered.</p> <p>This all leads to the overall negative impact on my property. This was a very expensive property to purchase and now it will be worth significantly less due to the huge changes to the surrounds.</p> <p>To recap, your government and Yukon energy do not want to pay property tax so you are forcing my family personally to loose hundreds of thousands in property value, put us in danger, negatively effect our mental wellbeing, increase our personal yearly expenses and decrease our quality of life. I am asking for you to seriously consider what is being proposed and how it is really going to affect those around this battery plant. I am asking for the 5.1 Mayo Road location to be removed as an option for this project. I am pro moving forward and pro the battery in Whitehorse. I just do not feel it is appropriate to have it in a residential area. Please consider this request. If this is not removed within a reasonable time frame I will be going forward with my story and making sure anyone I can is aware of what is happening.</p> <p>Thank you for your time. Feel free to contact me for clarification or more information. I look forward to your announcement that this location has been removed from the consideration.</p> <p>Sincerely,</p>	
2	<p>Hello Zoe,</p> <p>I have recently become aware of the Yukon Energy Storage Battery project and would like to express my concerns with siting a battery storage facility at the Takhini Substation.</p>	<p>Noise Light Reduced quality of life Fear of emergency situation</p>

	E-Mail Comments	Themes Use for Graphing Purposes
	<p>The takhini substation location is the only option that is within a residential area. I am concerned with the impacts to local residents for the following reasons:</p> <ul style="list-style-type: none"> <li>- The proximity to residential properties. The closest house is 30m and up to 13 properties are within 300m. The storage facility will produce noise and light pollution 24/7. This significantly impacts the quality of life for residents that have worked hard to pay for country residential living.</li> <li>- The risks to human lives. If the battery is punctured or if a wildlife reaches the batteries, there is a risk of explosion. Given the proximity to residents, it is unacceptable to have the battery storage in this location.</li> <li>- In the event of an emergency (fire, explosion), the takhini substation is located 25 minutes from town and would not provide for expedient response by firefighters or ambulance. The other two options are located near the existing Yukon Energy facility at the dam and the proximity would provide greater response times in case of emergency and allow for convenient access for maintenance and inspections.</li> <li>- impacts to property values. The facility will reduce property values due to the unsightly nature of the seacans and noise and light pollution.</li> </ul> <p>Please consider the other two locations near the dam. They would provide for convenience for maintenance, emergencies and a shorter distance to transmit power to the batteries.</p> <p>In conclusion, out of the three locations proposed, the takhini subsubstation option will have the greatest socio-economic impacts and therefore should not be the selected location for the battery storage facility.</p> <p>Thank you for your consideration,</p>	<p>Fear of emergency situation: emergency response Property values Screening Additional information: durability of battery in extreme situations</p>
3	<p>Hello Minister Pillai,</p> <p>I am formally writing to you about the proposed battery project by Yukon Energy Corporation. My mother (Susan Willoughby) and I are opposed to the Takhini substation site being selected as the location for the proposed Battery Project.</p> <p>Our property is located within 800 meters (2 Five Mile Road) of the proposed Takhini site and would be impacted if this site was further developed for the battery project.</p> <p>We are opposed for several reasons.</p> <ol style="list-style-type: none"> <li>1. We have chosen to rural living for peace that it provides. Yes we are adjacent to the Mayo Road, however the noise from the road is not consistent and 24 hrs a day. This battery project would bring a consistent drone. No one has addressed the issue of the noise from the inverters converting energy to be stored.</li> <li>2. It is not fair that the main reason for this site being the most appealing is because property taxes are lower. How is it that our own Government can chose to avoid property taxes? This is not an acceptable reason and is not considerate of the people who have chosen a rural way of life.</li> <li>3. We are concerned about how this project would impact our insurance. Both the possible increase in rates and if there was ever a need to make an insurance claim due to an incident involving the battery project. What compensation and assurance would there be from the Government and Yukon Energy?</li> </ol>	<p>Fear of emergency situation Fear of emergency situation: emergency response Future certainty Additional information: durability of battery in extreme situations Process: timeline Property values Parking lot: energy rates Fear of emergency situation: evacuation feasibility</p>

	<b>E-Mail Comments</b>	<b>Themes Use for Graphing Purposes</b>
	<p>4. We are concerned about how this project will impact our property value. What compensation would there be as we anticipate our property being less desirable to live due to the battery project and the noise and safety concerns it brings.</p> <p>5. We have several safety concerns: This site would not have 24 hr personnel security. While there may be a camera system it will inevitably not be able to monitor for those individuals that cause mischief and shoot a gun at the sea cans. If a bullet were to pierce a battery it could cause a fire or worse cause an explosion. As of late the Mayo road has seen a couple of vehicle fires recently and vandalism is a real concern.</p> <p>6. Our property is designated as Rural and as such the remaining area should also remain rural and no further infrastructure development be allowed to expand outside the existing foot print of current structures.</p> <p>7. The risk of fire both from the heat of the batteries themselves and from wildland or structure fires is a very real issue. Our fire department is not equipped to handle a battery fire as well as protect residential structures.</p> <p>8. We believe this is a band aid solution to Yukon's energy problem and that the Government has failed to develop a long term plan to meet the requirements of Yukoner's.</p> <p>9. We are concerned that once the Takhini site is developed with a battery project that the site will be increased in size over the subsequent years.</p> <p>10. We are of the opinion that this technology does not have viable end of life recycling and that Yukon will be left to store and care for the hazardous material. There is no guarantee that the manufacturer will be around at the end of life for these batteries. This is not environmentally friendly to Yukon.</p> <p>11. Yukon Energy has not shown any data that the carbon foot print through the three stages (manufacturing, end user use and end of life) is any less than our current energy consumption. Would this project merely export Yukon's carbon emissions? Is lithium mining environmentally friendly. How can we compare lithium mining pollution to carbon emissions as a fair trade-off.</p> <p>I would also like you to know that the impression being given right now is that Yukon Energy is trying to rush through the consultation process. They have done a poor job of communicating the public consultations. Very few residents have been made aware of this project. In fact the night of the first virtual meeting September 9, 2020 was the day that we received our notification in the mail. Why is our Government trying to move this through so quickly?</p> <p>Also, the team conducting the public consultation appears ill prepared and it does not appear that an in-depth review of this project has been completed. The team was not prepared with many of the questions during the Microsoft Teams meeting. Again, indicating a sense that the Government and Yukon Energy are scrambling for a solution to Yukon's energy shortage.</p> <p>Will the minister commit to taking Site A Takhini off the table for the battery project?</p> <p>Mr Minister Pillai, I welcome your response and would appreciate further opportunity to discuss my concerns around this project with you. Thank you for taking the time to read my email.</p> <p>Regards,</p>	
4	<p>Hello Yukon Energy, Thank you for this opportunity to provide feedback on Site A. I presume it has been designated Site A as it is your preferred option for a battery storage site, which concerns me.</p>	<p>Fear of emergency situation Fear of emergency situation: emergency</p>

	<b>E-Mail Comments</b>	<b>Themes Use for Graphing Purposes</b>
	<p>I live at [Redacted] and have several concerns regarding your designation of Site A as a proposed battery storage site. I note that you intend to install a fire suppression system specific to batteries. Good. But while you state that the possibility of fire resulting from lithium ion batteries is low, but there is still a risk that it will spread to the surrounding forest. Even a minimal risk of fire is of major concern to those of us who live close to the proposed site, for the following reasons:</p> <ol style="list-style-type: none"> <li>1. The prevailing winds are from the south-east, sweeping quite strongly up the mountain where Vista Road is located. Though we have enjoyed a wet summer, usually conditions are tinder dry in this area. I am unsure of the reason for this, but I do know that we receive much less rain than town. Once ignited, a fire could rapidly take every structure north and northwest of Site A for miles within a short period of time.</li> <li>2. We are dependent on a volunteer fire department which has limited access to a continuous source of pressurized water to fight fires.</li> <li>3. In the event of a fire at Site A, would the power be cut to the surrounding area? This would cut power to well pumps, making water inaccessible. Home owners without emergency generators would be unable to mount even a minimal defense.</li> <li>4. Business owners/operators in the vicinity have already experienced difficulty obtaining fire insurance and many find the cost prohibitive. Those who lose businesses might well never recover.</li> <li>5. The location of such a facility so close in proximity to dwellings concerns me. People who have recently purchased property at premium prices could find their property taking a plunge in value.</li> </ol> <p>It seems to me that Site B or C would be preferable as they are not located in residential areas and are closer to fire stations with more rapid response capabilities, as well as to other emergency response organizations.</p> <p>Very truly yours,</p>	<p>response Property values: insurance rates Property values</p>
5	<p>Hello,</p> <p>I am writing to you today to express that I am opposed to the Yukon Energy Grid-Scale Battery project at the Takhini Substation.</p> <p>I live directly across the highway from the current Substation and proposed Battery project.</p> <p>There are many reasons I am writing to you today and they include:</p> <p>The noise level and how it affects those around it, including the mental health of residents in the area.</p> <p>The lighting and how it will greatly alter the way of life in this location by removing northern lights viewing and stargazing</p> <p>The size and how it will affect our view</p> <p>How it will affect resale for properties in this area</p> <p>How the local fire station is clearly unable to save structures in the immediate area in event of a catastrophic event</p> <p>Potential that potential home buyers will not want to purchase in this area anymore as the attractive factor would be removed.</p> <p>Loss of current way of life</p> <p>There is absolutely nothing positive for anyone that lives in the area.</p>	<p>Noise Light</p>

	E-Mail Comments	Themes Use for Graphing Purposes
	<p>Please consider the other 2 locations for this project as I feel this is not an appropriate area for such a large battery. Thank you for your time,</p>	
6	<p>Hello Zoe, I have recently become aware of the Yukon Energy Battery Storage project and would like to express my concerns with siting a battery storage facility at the Takhini Substation. The Takhini substation location is the only option that is within a residential area. I am concerned with the impacts to local residents for the following reasons: - The proximity to residential properties. The closest house is 30m and up to 13 properties are within 300m. The storage facility will produce noise and light pollution 24/7. This significantly impacts the quality of life for residents that have worked hard to pay for country residential living. - The risks to human lives. If the battery is punctured or if a wildlife reaches the batteries, there is a risk of explosion. Given the proximity to residents, it is unacceptable to have the battery storage in this location. - In the event of an emergency (fire, explosion), the Takhini substation is located 25 minutes from town and would not provide for expedient response by firefighters or ambulance. The other two options are located near the existing Yukon Energy facility at the dam and the proximity would provide greater response times in case of emergency and allow for convenient access for maintenance and inspections. - Impacts to property values. The facility will reduce property values due to the unsightly nature of the seacans and noise and light pollution. Please consider the other two locations near the dam. They would provide for convenience for maintenance, emergencies and a shorter distance to transmit power to the batteries. In conclusion, out of the three locations proposed, the Takhini substation option will have the greatest socio-economic impacts and therefore should not be the selected location for the battery storage facility. I see no reason for 13 families and homes to be negatively impacted with this project when there are suitable, if not better, options available. Thank you for your consideration,</p>	<p>Noise Light Reduced quality of life Fear of emergency situation Fear of emergency situation: emergency response Property values Screening</p>
7	<p>Good day, I am writing to you today in regards to the proposed Yukon Energy battery locations. I recently found out through some of the other residents out in the Takhini area about this proposed development. I think it's a great idea to build a battery to cut down on the diesel generator use in the winter and reduce emissions. However as a resident that will be affected by the construction and then the running of the battery if it is constructed beside the Takhini substation I really hope that this does not happen. My understanding from reading the information that has been provided is that there is a risk of explosion. I understand that this is a small risk with proper maintenance and observation. I feel that the fact that it is even possible should dictate that it cannot be constructed anywhere near a residence where the event would be catastrophic. Also it would be much easier to maintain and observe if it was constructed at location 1 or 2. I also read that there would be lights and noise all year. I firmly believe that the people that have chosen to live in that area did so to enjoy the peace and quiet being out of town. It would be disappointing if Yukon Energy decided to ruin people's peace and quiet over a price tag.</p>	<p>Fear of emergency situation Light Noise Decision-making criteria Process: engagement timeline Property values Reduction in quality of life</p>

	E-Mail Comments	Themes Use for Graphing Purposes
	<p>I would like to know why I am only finding out about this proposed project now, it must have been in the works for quite some time if the end date for public engagement is only a week away.</p> <p>The fact that it has been proposed to build in this area with residences being directly affected with no serious effort made to inform people of said proposal is unacceptable. This has a direct affect on quality of living, value of property, and safety in the area for all nearby residences. I am aware that there are a small number of residences that would be affected by this battery storage, however option 1 doesn't poorly affect any residences. This fact alone answers the question for me as to which location should be chosen.</p> <p>As I stated above I sincerely hope that Yukon energy and anyone else involved in the decision making process will give more weight to the quality of life for residents as opposed to saving a few bucks.</p>	
8	<p>Hi Zoe - I'm wondering about the noise and light contributions of the project - or any air emissions. Can you direct me to materials characterizing these issues? Thanks</p>	<p>Noise Light Environmental impact</p>
9	<p>Hello All,</p> <p>I've recently become aware of the planned battery storage project proposed by Yukon Energy. I want to voice my strong opposition to Option 3 of this plan - developing the battery storage project at the Takhini substation.</p> <p>As a homeowner located within 250 m of this proposed site I am first of all severely disappointed that I have not been made aware of this potential development by representatives of Yukon Energy.</p> <p>In addition the community engagement email is not functioning - disappointing. Secondly I find it abhorrent that Yukon Energy would consider placing this battery storage facility with it's associated noise and light pollution in close proximity to so many residents.</p> <p>I have spent a considerable sum of money purchasing and developing this land in the past year and this development will effectively devalue my investment and greatly reduce my ability to enjoy my property.</p> <p>The two locations within the city of Whitehorse are clearly more suited to this development as there are little to no social impacts.</p> <p>The fact that Yukon Energy and the Yukon Government would consider this option - valuing a few dollars saved over residents property values and well being is deeply disappointing.</p> <p>Regards,</p>	<p>Process: engagement timeline Noise Light Property values Decision-making criteria</p>
10	<p>So after reading Friday's paper nobody seems to want this facility in their backyard and I do not want it in my backyard at the intersection of Robert Service Way and speaking with my neighbours they do not want it either.</p> <p>I am somewhat puzzled regarding the three locations that been picked, I understand that one of the criteria requirements being location must be on First Nation's property but if that means it has to be close to residences then maybe that criteria should be changed and this facility be installed somewhere that it isn't in somebody's backyard.</p> <p>To build this heavy industrial facility at the entrance to our city would be absurd not to mention it would reduce property values substantially in this area. There is a lovely RV park kitty corner to this location and I'm sure their business would be affected if this location were chosen.</p> <p>When your representatives were at my home educating and discussing the location for this facility, the topic that these batteries were quite flammable never</p>	<p>Decision-making criteria Property values Fear of emergency situation Fear of emergency situation: emergency response - containment of fumes Health of surrounding residents</p>

	E-Mail Comments	Themes Use for Graphing Purposes
	<p>came up, now that the article in the Yukon News, mentions this possible hazard. So even though this would be a very unlikely disaster to happen, I understand that the smoke and fumes from this type of a fire would be very dangerous, thus I do not want this in my backyard either!</p> <p>Please reply that you have received this message.</p> <p>Regards</p>	
11	<p>Hello,</p> <p>In regards to the proposed battery farm location at the top of Robert service way I would also like to object as I am the owner of an RV Park at the corner of Hamilton and Robert service way. This would be an eyesore for my customers who are looking to come to the Yukon to experience nature rather than an industrial battery site. I also think having this be at the entrance to our city impact tourism negatively in general. It is with these points in mind that I would strongly object to this being considered for the location of the batteries. Thank you</p>	Screening: aesthetics from the roadway
12	<p>I am against having this large industrial battery storage in my neighborhood. Living on the klondike hwy outside of city limits you expect to have peace and quiet, safety, and dark nights.</p> <p>This facility will be an eyesore both day and night in our neighborhood. And will be loud when walking in the land around it. Property value will be affected even if everything goes well. And have not seen any info of implications if something went wrong like leaks ,explosions, abanonment. In short i am against the klondike hwy proposed location of this grid scale battery</p>	<p>Light Noise Reduction in quality of life Screening Property values Fear of emergency situation Environmental impact Additional information: end-of-life for battery</p>
13	<p>Dear Zoe Morrison,</p> <p>I've only today become aware of the planned battery storage project proposed by Yukon Energy. I would like to start off by saying I am in favor of creating clean sustainable energy options for the Yukon and I am supportive of the battery storage project. However, I want to voice my strong opposition to Site Option 3 of this plan - developing the battery storage project at the Takhini substation.</p> <p>I have many concerns with Yukon Energy considering placing this battery storage facility so close to residents with it's associated Health and Safety risks, especially the noise and light pollution in close proximity to so many residents. It is of great concern that sound mitigation equipment would need to be installed in order for sound levels at the neighbouring properties to be below permissible sound levels (Battery Site Location Option 3, Yukon Energy Website). What would happen if this equipment was to fail? What are the impacts to surrounding residences? This significant increase in noise and light will have immense impact on our daily life and health.</p> <p>There is also additional risk to the residents in the area due to the risk of the batteries. If something were to happen this may result in an explosion affecting a radius possibly greater than 200m. Due to this, the storage unit is not located a safe distance away from surrounding residents (30-50m). My property would be impacted if anything were to occur. This is an unacceptable risk for residents.</p> <p>I am in the process of purchasing a property 150 m from the proposed Site Option 3 and our home will be located approximately 250 m away. We have purchased this home outside of town to enjoy the peace and quiet it has to</p>	<p>Process: engagement timeline Noise Light Sound Fear of emergency situation Fear of emergency situation: emergency response Decision-making criteria Health impacts to surrounding residents Property values Reduction in quality of life</p>

	<b>E-Mail Comments</b>	<b>Themes Use for Graphing Purposes</b>
	<p>offer, which will be taken away from us and the many other surrounding residents. With all of this in mind and the proximity of the battery storage, our residential property value will be significantly decreased along with the surrounding properties. It will also greatly reduce our ability to enjoy our property, impacting our quality of life.</p> <p>The two locations within the city of Whitehorse are clearly more suited for this development as there are little to no health and social impacts. As mentioned on the Yukon Energy Website, the nearest neighbours are greater than 150m away and of industrial nature, not residential. This greater distance from the storage facility will result in noise levels from the battery to be below permissible sound levels at the nearest neighbour for both options 1 and 2, which are in close proximity to the Whitehorse Substation. This close proximity to the Whitehorse substation would also allow very quick responses to any emergencies.</p> <p>I also believe that the collection of Whitehorse municipal taxes would have great benefits for the City of Whitehorse. Which in turn would benefit Whitehorse residents rather than harm them.</p> <p>In conclusion, I hope that Yukon Energy and the Yukon Government would not consider site option 3 - valuing a few dollars saved over residents health and well being. I am also disappointed with the communication of this potential development by representatives of Yukon Energy. I am finding out about this possible development only after virtual access to public meetings has passed and I am currently working away from Whitehorse and cannot attend the in person meeting next week. This is extremely concerning and disappointing to not be able to have a voice in this decision.</p> <p>Regards,</p>	
14	<p>Hello Zoe,</p> <p>I received your contact from a neighbor and am sending you this email in regards to the planned Yukon battery storage project. The email for community engagement does not appear to be functioning, so if i should be contacting someone else please let me know.</p> <p>In the past year I have purchased land across from the Takini substation to build my home. Construction is planned to begin in early October of this year, I have already spent time, money and considerable effort to clear the land at the build site which would be less than 300 m from the battery farm.</p> <p>This 5 acre property cost a considerable sum of money in order to have the peace and quiet of the countryside. I have no issue with the current electrical station as there is no noise and little light pollution.</p> <p>The construction of the battery storage and the associated noise and light pollution will devalue my land, house and my enjoyment of the land I have worked my lifetime to afford.</p> <p>I was unaware of the potential for this development at the time of sale and it appears thus far Yukon energy has done a terrible job of outreach/community engagement. As one of the closest land owners I am disgusted I needed to be informed from a neighbor about the upcoming meetings and the potential for this development to take place rather than being informed directly from a Yukon energy representative.</p> <p>Furthermore I find it reprehensible that Yukon energy has even considered to place this battery farm within 30 to 50 m of a residential property. While it is clear for the two Whitehorse options efforts have been made to conceal the battery farm from the roadway where there are no residential properties to consider. The same</p>	<p>Property values Noise Light Process: engagement timeline Decision-making criteria</p>

	E-Mail Comments	Themes Use for Graphing Purposes
	<p>effort is not being made for option 3 where you have multiple residences under 300 m from the facility.</p> <p>Overall disappointed that Yukon Energy appears to have a complete disregard for residents property values and personnel well being to even consider option 3 to save money.</p> <p>Thank you for your time,</p>	
15	<p>Hello,</p> <p>I just wanted to bring my concerns forward in regards to putting this battery storage out near Takhini subdivision, site A.</p> <p>There is a young family that moved out of town to have a quite, safe place to raise their family and now has to be worried about a giant field of batteries. This is so unacceptable and upsetting to hear the possibility this could happen here, as many people live in the Yukon to be away from the noise and light of a city. We have beautiful country residential land here and should be protected at all costs.</p> <p>The other two options are great as they are not near subdivisions and are closed to what are already industrialized areas in Whitehorse.</p> <p>Please consider not putting this battery site at Site A as there are much better options for this.</p> <p>Thank you,</p>	<p>Noise Light Fear of emergency situation Reduced quality of life</p>
16-58	<p>Hello,</p> <p>I am writing you today to express that I am opposed to the Yukon Energy Grid-Scale Battery project at the Takhini Substation.</p> <p>There are many reasons I am writing to you today and they include:</p> <ol style="list-style-type: none"> <li>1. The noise level and how it affects those around it, including the mental health of residents in the area</li> <li>2. The lighting and how it will greatly alter the way of life in this location by removing northern lights viewing and stargazing</li> <li>3. Unknown gases and fumes that may come from the units</li> <li>4. Potential for leaks and ground contamination</li> <li>5. The risk of explosion and lives it would take if this occurred</li> <li>6. The risk of fire from internal and external sources, such as a wildfire</li> <li>7. The risk of vandalism and how this is a large issue in this neighbourhood</li> <li>8. The size and how it will affect our view</li> <li>9. How it will affect resale for properties in this area</li> <li>10. How the local fire station is clearly unable to save structures in the immediate area in event of a catastrophic event</li> <li>11. The increase in the cost of insurance to residents</li> <li>12. The financial increases such as the cost of noise and light reducing equipment, lost rent, loss of cattle/farm sales, loss of horse boarding, secondary driveways as escape routes, time invested to complete these tasks, and attend meetings.</li> <li>13. Potential that potential home buyers will not want to purchase in this area anymore as the attractive factor would be removed.</li> <li>14. Loss of current way of life</li> <li>15. No positives for people in the direct area only loss</li> <li>16. Various safety concerns as a whole</li> </ol>	<p>Noise Light Health impacts to surrounding residents Environmental impact Fear of emergency situation Additional information: durability of battery in extreme situations Loss of view Screening Property values Fear of emergency situation: emergency response Fear of emergency situation: evacuation feasibility Property values: insurance rates Additional information: financial compensation for those impacted Reduction in quality of life</p>

	<b>E-Mail Comments</b>	<b>Themes Use for Graphing Purposes</b>
	Please consider the other 2 locations for this project as I feel this is not an appropriate area for such a large battery.  Thank you for time,	

## Appendix G FACEBOOK INPUT

Facebook Comments	Themes Used for Graphing
<p>Solar panels, wind turbines and batteries have a useful life of about 10 years max. warranty says 25 but companies fold before the units fail, so they let the lawyers sort it out. Cheap Chinese products seldom last more the...</p>	<p>Additional information: end-of-life for battery</p>
<p>Re: Solar panels... Yup they should brand SMN as "nuclear batteries"</p>	<p>Misc. comment</p>
<p>Re: Solar panels... Small modular nuclear would be amazing, too bad there is negative stigma around nuclear right now, nuclear needs a rebirth</p>	<p>Misc. comment</p>
<p>Re: Solar panels... I've read a fair amount about nuclear and one of the sad things about it is that BWR reactors fit far too conveniently into the nuclear fuel chain in order to keep loads of very specialist fissile material around other government projects in defense ...</p>	<p>Misc. comment</p>
<p>Re: Solar panels... Thorium wasn't used because it doesn't produce bomb materials. The electricity produced was a useful byproduct of the uranium route chosen, it made the programme easier to sell to the public</p>	<p>Misc. comment</p>
<p>Re: Solar panels... Image a world where profiteering war dogs didn't shape our energy landscape, globally. Even now you've got people laughing at your comments as if the all somehow know better than you about renewable falsehoods. Consensus is a powerful drug.</p>	<p>Misc. comment</p>
<p>Re: Solar panels... The Covid Consensus is another example of that fallacy. Yes, Crichton said it well: "there is no such thing as consensus science. If it's consensus, it isn't science. If it's science, it isn't consensus."</p>	<p>Misc. comment</p>
<p>I'm wondering how green is getting all the material for these green product? No one seems to tell us of the chemicals used or how its disposed of. In the end, no one will give a cost to the consumer</p>	<p>Additional information: connection between batteries and sustainability</p>
<p>Re: I'm wondering... Batteries &amp; solar cells made in china are not 'green' in any sense of the word. Too many Yukoners believe toxic pollution is OK if it happens in Chine but that's believe in the 'peeing end of the pool'. Most of the mercury pollution in north America comes from dirty coal burning in China.</p>	<p>Additional information: connection between batteries and sustainability Environmental impact</p>
<p>Why don't they tell the public what going green did in Ontario a few years ago. Then to go back people could not pay the power bills. This going green thing just costs and costs and to get rid of the waste from it is an toher thing!</p>	<p>Misc. comment</p>

Facebook Comments	Themes Used for Graphing
Pumped storage into Fish Lake would be a lot more efficient with a longer useful lifetime than batteries to store excess power from intermittent renewables like solar	Decision-making criteria
That a good one what that cost?? It won't be them for sure ,and a money grab for some that likely retiring some were else anyway.	Misc. comment
It is juste Another way to wate money and big money [3 thumbs down]	Misc. comment
And how often do the batteries have to be changed??	Additional information: end-of-life for battery
<p>Re: And how often...</p> <p>About every 3 pandemics, but it gets expense because the hipsters keep mistaking them for tiny homes and getting electrocuted while trying to live in there. Climate change is the worst!</p>	Misc. comment
Make a contract with Tesla????	Misc. comment
Costs more to set up than its worth	Decision-making criteria
<p>Re: Costs more to...</p> <p>could you back up your claim with some evidence?</p>	Misc. comment
<p>Re: Costs more to...</p> <p>Look at every single time a feel good energy program is put on by any government any where how cost effective they are</p>	Misc. comment
Oh are we going to see our power rates go up	Parking lot: energy rates
Great. Get ready for skyrocketing electrical bills	Parking lot: energy rates
Would an electric vehicle be an appliance? [Link to Yukon Government website]	Misc. comment

1 **TOPIC: Investing in Canada Infrastructure Program**

2

3 **REFERENCE: Application, Tab 4.2.3, PDF page 41**

4

5 **QUOTE:** "The preliminary net capital cost estimate for Yukon Energy, after the  
6 \$16.5 million funding from the Federal government's 'Investing in  
7 Canada Infrastructure Program ('ICIP'), is \$15.2 million."  
8

8

9 **QUESTION:**

10

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

12

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

15

16 **ANSWER:**

17

18 **(a)**

19

20 See Attachment 1 to this response which provides the Transfer Payment Agreement  
21 between Yukon government and Yukon Energy. Please note that while the funding is  
22 sourced from the Federal government, the program rules require the monies to be flowed  
23 to YEC through the Yukon Government.

24

25 **(b)**

26

27 ICIP funding is based on specific project applications that meet the program criteria; it is  
28 possible other projects could qualify under the program but that would require a separate  
29 application. YEC does not have the authority to re-allocate this funding to other projects.

**Appendix 1 – Preliminary Schedule**

# **Transfer Payment Agreement**

## **Project Funding for Yukon Grid Scale Battery Energy Storage System (ESS) Project**

**THIS AGREEMENT** made at Whitehorse, Yukon

**BETWEEN:**

**The Government of Yukon**, as represented by the President and CEO of the Yukon Development Corporation ('YG')

**AND:**

**Yukon Energy Corporation.**, a body corporate carrying on business under the laws of Yukon with an address of 2 Miles Canyon Rd., Whitehorse, YT Y1A 6L4, as represented by the President and CEO (the "Recipient")

being collectively the parties (the "Parties") to this Transfer Payment Agreement (the "Agreement").

**WHEREAS**

- A. The Governments of Canada and Yukon have agreed to the *Integrated Bilateral Agreement for the Investing in Canada Infrastructure Program* ("ICIP"), which provides funding based on certain terms and conditions for infrastructure investment that supports sustainable and inclusive communities, while driving economic growth;
- B. The Recipient wishes to undertake the building of a battery energy storage system;
- C. The project to undertake the Yukon Grid Scale Battery Energy Storage System (ESS) has been approved by Canada for funding under ICIP (the Project);
- D. Yukon has agreed to provide the Recipient with financial assistance from ICIP carry out the Project

**NOW THEREFORE** in consideration of the mutual promises contained in this Agreement, the Parties agree as follows:

**1. This Agreement**

This Agreement, together with all the Schedules and appendices, shall be read collectively and constitutes the whole Agreement between the Parties, and no oral or written representations on its subject matter are valid unless incorporated in this

## Appendix 1 – Preliminary Schedule

Agreement. This Agreement will be deemed to have been made in and will be interpreted and enforced by the courts in Yukon and in accordance with the laws in force in the Yukon.

### 2. Definitions and Interpretation

#### 2.1 In this Agreement:

“Asset Disposal Period” means the period commencing from the Effective Date and ending five (5) years after the Project Closure Date.

“Budget” means the total amount of revenues and expenses, including any ‘in-kind’ and ‘own-resources’ assistance, budgeted for the Project and detailing the use of Funds as set out in Schedule B;

“Effective Date” means the date of the Minister of Infrastructure Canada’s approval of the project;

“Eligible Expenditures” means those costs of the Project incurred and paid by the Recipient and eligible for reimbursement by Canada as set out in Schedule G (Eligible and Ineligible Expenditures);

“Financial Report” means a report of all actual and budgeted Project revenues and expenses in the format of Schedule F;

“Funds” means the financial assistance provided by YG to the Recipient pursuant to this Agreement;

“Ineligible Expenditures” means those Project costs that are not eligible for reimbursement under this Agreement as set out in Schedule G (Eligible and Ineligible Expenditures);

“Project” means the activities and work plan as more fully described in Schedule A;

“Project Approval Date” means August 30, 2019, the date the Project was approved by Infrastructure Canada;

“Project Closure Date” means the date of total performance on the project;

“Project Report” means a report of Project activities and deliverables in the format of Schedule D;

“Records” means invoices, receipts, vouchers, bank statements and all transactional information pertaining to incurred expenses and commitments made by the Recipient or its agents in carrying out the Project and the obligations of this Agreement;

### Appendix 1 – Preliminary Schedule

“Substantial Completion” is when the prime consultant hired by the Recipient for the Project certifies the Project is substantially complete;

“Terms of Payment” means the terms of payment as set out in Schedule C;

“Total Performance” is when the work has been completed, and all contractors have complied with the contracts and all orders, instructions and requests made pursuant thereto, both to the satisfaction of the prime consultant, and the engineer has issued a Certificate of Total Performance to the contractor(s);

“Working Day” is Monday through Friday, excluding statutory holidays.

- 2.2 In this Agreement, words importing a singular number shall include the plural and vice versa, as required by the context.
- 2.3 In this Agreement, headings are inserted only for convenience of reference and shall not affect its construction or interpretation.

### 3. The Project

- 3.1 The Recipient shall use the Funds to carry out the Project in accordance with Schedules A and B.
- 3.2 The Recipient will provide all necessary labour, materials, tools, approvals and licenses (if applicable), and equipment to perform the Project and Agreement.
- 3.3 The Recipient shall ensure that the Recipient and its officers, employees, contractors, and agents are qualified and competent to perform the Project, and have the necessary skills, knowledge, certification, and ability to perform the Project.

### 4. Term

- 4.1 The term of this Agreement shall be from the Effective Date to December 31, 2022.

### 5. Provision of Financial Assistance

- 5.1 YG shall provide the Recipient with Funds for the purpose of the Project in an amount not to exceed \$16,500,000.
- 5.2 YG shall pay the Funds to the Recipient in accordance with the Terms of Payment.
- 5.3 The obligation of YG to provide the Funds is subject to the following:
- 5.3.1 the *Financial Administration Act* (Yukon);

### **Appendix 1 – Preliminary Schedule**

- 5.3.2 money being appropriated by the Legislature for the purpose of this Agreement;
  - 5.3.3 the Recipient abiding by the terms and conditions of this Agreement;
  - 5.3.4 the Recipient abiding by the Design Review process prior to project tendering in accordance with Schedule A
- 5.4 The Recipient warrants that it has declared all amounts owing to YG and that the Recipient is not in default of any payment schedule in respect of the amounts owing to YG.

#### **6. Financial Accountability**

- 6.1 In respect of the Funds, the Recipient shall:
- 6.1.1 incur expenses only for the purposes of this Agreement;
  - 6.1.2 allocate the Funds received in accordance with this Agreement;
- 6.2 The Recipient shall submit to YG, no later than January 31, April 30, July 31 and October 31 of each year, a Financial Report as laid out in Schedule F with content acceptable to YG and accompanied by:
- copies of invoices, receipts and vouchers; and
  - certification by an officer of the Recipient;
- 6.3 YG shall not be obliged to pay any bills or other costs incurred during the term of this Agreement that are submitted after the expiry or termination of this Agreement.
- 6.4 Any Funds provided through this Agreement that are:
- 6.4.1 not expended at the expiry or termination of this Agreement;
  - 6.4.2 not properly expended for the purposes of this Agreement; or
  - 6.4.3 in excess of the reduced amount of Funds under 7.2

shall constitute a debt due to YG and shall, upon request by YG, be repaid immediately by the Recipient to YG. Any interest owing on this debt is calculated from the date the amount became repayable. In addition to any rights YG may have under this Agreement, in law or in equity, YG may set off any liability arising from the Recipient to YG under this Agreement or otherwise against any liability arising from YG to the Recipient.

## Appendix 1 – Preliminary Schedule

### 7. Reduction of the Funds

- 7.1 The Recipient shall immediately advise YG in writing if:
- 7.1.1 the Recipient receives additional payments or, excepting volunteer time, any other form of contribution, gift, or grant in respect of the Project other than those described in the Budget; or
  - 7.1.2 the Recipient or any other contributor reduce their contribution to the Project.
- 7.2 If it comes to the attention of YG that the Recipient received additional assistance referred to in 7.1, then YG may reduce the Funds by such amount as it may decide.
- 7.3 YG shall give the Recipient thirty (30) days' written notice before reducing the Funds.
- 7.4 The reduced amount of Funds under 7.2 shall be the amount of financial assistance for the purposes of this Agreement.

### 8. Project Reporting Requirements

- 8.1 The Recipient shall in a form and with content acceptable YG:
- 8.1.1 submit to YG a quarterly Project Report, to be completed in the format laid out in Schedule D;
  - 8.1.2 submit a final Project Report for the term of this Agreement to YG in the format laid out in Schedule E;
  - 8.1.3 Where required, provide data to demonstrate the Community Employment Benefits of the project.
- 8.2 At all times during the performance of the Project, YG shall have access to all design, inspection, and materials testing documents.
- 8.3 The Recipient shall provide YG, upon request, a copy of tender advertisements, the issued for tender and issued for construction drawings and specifications. These may be submitted electronically.
- 8.4 The Recipient represents and warrants that all factual matters and materials submitted to YG are true and accurate, and that all estimates, forecasts, and other related matters involving judgment were prepared in good faith.

## Appendix 1 – Preliminary Schedule

### 9. Procurement

- 9.1 The Recipient will ensure that contracts are awarded in a way that is fair, transparent, competitive, consistent with value for money principles, consistent with YG's Contracting and Procurement Regulation and Contracting and Procurement Directive ([http://www.hpw.gov.yk.ca/pdf/contract\\_procurement\\_regulation\\_directive.pdf](http://www.hpw.gov.yk.ca/pdf/contract_procurement_regulation_directive.pdf)) or in a manner otherwise acceptable to YG, and if applicable, in accordance with the Canadian Free Trade Agreement and international trade agreements.
- 9.2 If the Recipient is in breach of section 9.1, upon notification to the Recipient, YG reserves the right to deem any expenditures arising from or related to such breach as Ineligible Expenditures and non-reimbursable under this Agreement.
- 9.3 If the Recipient is in breach of section 9.1 or 9.2, upon notification to the Recipient, YG reserves the right to deem any expenditures arising from or related to such breach as Ineligible Expenditures and non-reimbursable under this Agreement.

### 10. Retention of Infrastructure Assets

- 10.1 Unless otherwise agreed to by the Parties, the Recipient will retain title to and ownership of the Project for five (5) years after the Project Closure Date.
- 10.2 The Recipient shall notify YG in writing, one hundred eighty (180) days in advance if, at any time during the Asset Disposal Period, the Recipient, directly or indirectly, intends or proposes to dispose of, sell, lease, encumber, or use the Asset in a manner other than as described in their request for funding under the New Building Canada Fund or in the Agreement.
- 10.3 Subject to section 10.4, if the Recipient, directly or indirectly, disposes, sells, leases, encumbers, or uses the Asset in a manner other than as described in the Agreement, then the Recipient shall promptly and fully reimburse YG for the full Funds received by the Recipient for the Project under this Agreement.
- 10.4 For greater certainty, section 10.3 does not apply if the Recipient disposes, sells, or leases the Asset to Canada, a Crown corporation acting as agent for Canada, YG, or a Crown corporation acting as agent for YG.
- 10.5 Sections 10.1 to 10.4 shall survive the expiry or termination of this Agreement..

### 11. Audit

- 11.1 The Recipient shall:
- 11.1.1 acknowledge that YG or its agents may audit any or all of the Records, including financial records of the Recipient or its agents, whether directly or indirectly related to this Agreement, as is necessary to satisfy YG that the objectives and

### **Appendix 1 – Preliminary Schedule**

activities of the Project have been carried out and that the Funds have been spent in accordance with the terms of this Agreement;

- 11.1.2 keep all Records in a safe and secure manner for six (6) years after the expiry or termination of this Agreement, unless otherwise notified in writing by YG that such information and documents are no longer needed;
- 11.1.3 make such Records available for audit by YG upon reasonable notice, and permit YG to audit and inspect the Records, and to take extracts from and make copies of the Records;
- 11.1.4 provide reasonable facilities to YG for such audits and inspections, and provide YG with all information necessary to understand the Records;
- 11.1.5 immediately reimburse YG any overpayments or non-allowed expenses, as determined by the audit; and
- 11.1.6 maintain any personal records in respect of this Agreement in an appropriate and confidential manner.

#### **12. Access to Staff, Records and Premises**

- 12.1 Upon reasonable notice, the Recipient shall provide YG with access to the Recipient's staff, Records and premises for purposes related to monitoring, reviewing or auditing the activities undertaken in relation to this Agreement, and related to the evaluation of the effectiveness or efficiency of the Project.

#### **13. Evaluation**

- 13.1 The Recipient shall maintain, in a manner acceptable to YG, case files and other data that may be required for on-going monitoring, review and evaluation of the Project.
- 13.2 The Recipient shall cooperate with YG in the event that YG undertakes, at its own expense, any evaluation studies in respect of this Project, and shall provide copies of existing information, data, and statistics that YG reasonably requires to carry out such evaluation studies.

#### **14. Communication and Public Acknowledgement**

- 14.1 Any information released or announced to the public in any form by the Recipient in respect of the Project shall adequately acknowledge the contribution made by YG.
- 14.2 Any information released or announced to the public in any form by YG in respect of the Project shall adequately acknowledge the contribution made by the Recipient.

### **Appendix 1 – Preliminary Schedule**

14.3 The Recipient will provide to YG any assistance YG requires to comply with the Communications Protocol of ICIP which is attached as Schedule H.

14.4 The Recipient will erect signage at the site of the Project as required by the Communications Protocol. The signage guideline can be found here:  
<https://www.infrastructure.gc.ca/pub/signage-panneaux/intro-eng.html>

#### **15. Legal Relationship**

15.1 Nothing in this Agreement shall create the relationship of principal and agent, employer and employee, partnership or joint venture between the Parties.

15.2 The Recipient shall not make any representation that the Recipient is an agent of YG and shall ensure that any officers, employees, contractors, members, agents or successors of the Recipient do not make any representation that could reasonably lead any member of the public to believe that the Recipient, its officers, employees, contractors, members, agents or successors are agents of YG.

#### **16. Liability**

16.1 The Recipient shall use due care in carrying out the Project and in performing its obligations under this Agreement to ensure that it does not cause any injury (including death) to persons, damage or loss to property or infringement of rights.

16.2 YG shall not be liable for any action or inaction of the Recipient or any of the Recipient's officers, employees, contractors, members or agents during the performance of the Project.

16.3 YG shall not be liable for any injury to the Recipient, its officers, employees, contractors, members or agents or for any damage to or loss of property of the Recipient, its officers, employees, contractors, members or agents caused by, arising from, or in any way related to the performance of this Agreement.

16.4 The Recipient shall comply with all applicable YG policies and standards, federal, territorial, and municipal laws in the performance of the Project and its obligations under this Agreement, including, but not limited to: any applicable permits, codes, or safety legislation. Upon request by YG, the Recipient shall provide proof of compliance with any law, policy, or standard to the reasonable satisfaction of YG.

#### **17. Conflict of Interest**

17.1 No member of the Yukon Legislative Assembly shall be admitted to any share or part of this Agreement or to any benefit arising from it, unless such benefits are available to the population at large.

### Appendix 1 – Preliminary Schedule

- 17.2 No official or employee of the Government of Yukon shall be admitted to any share or part of this Agreement or to any benefit arising from it without the written consent of the official's or employee's Minister, unless such benefits are available to the population at large.
- 17.3 No current or former public servant or public officer holder to whom the *Conflict of Interest (Members and Ministers) Act*, Part 13 of the *Public Service Act*, the *Cabinet and Caucus Employees Act*, or Policy 3.39 of the Yukon Government General Administration Manual applies shall derive any direct benefit from this Agreement, including any employment, payment or gifts, unless the provision and receipt of such benefits is in compliance with such legislation and policy.
- 18. Intellectual Property Rights**
- 18.1 Any material produced by the Recipient in carrying out its obligations under this Agreement shall vest in and remain the property of the Recipient, unless otherwise agreed. The Recipient shall inform YG as to what material, if any, has been produced under this Agreement.
- 18.2 The Recipient grants to YG a non-exclusive, irrevocable, perpetual, worldwide, fully-paid and royalty-free licence to make, copy, translate, use, produce or further develop all materials for any purpose, except sale or licensing in commercial competition with the Recipient. YG's licence also includes the right to disclose the components to other organisations for information purposes only. Section 18.2 shall survive the expiry or termination of this Agreement.
- 19. Confidentiality**
- 19.1 YG and the Recipient shall both protect any confidential information according to applicable federal, provincial or territorial legislation.
- 19.2 YG and the Recipient shall use all reasonable efforts to protect confidential information from disclosure to third parties. Such efforts shall be in accordance with the *Access to Information and Protection of Privacy Act* (Yukon).
- 19.3 The Recipient shall ensure that all personal or confidential information related to or arising from this Agreement that is provided by YG to which the Recipient or its officers, employees, contractors, members, agents, or successors become privy shall be treated as confidential and shall not be disclosed without the written consent of YG or the individual to whom the information relates.
- 19.4 YG shall ensure that all personal information to which YG, its officers, employees, contractors and agents become privy shall be treated as confidential in accordance with the *Access to Information and Protection of Privacy Act* (Yukon).

## Appendix 1 – Preliminary Schedule

### 20. Indemnification

- 20.1 The Recipient shall save harmless and fully indemnify YG, its officers, employees, contractors and agents from and against all claims, liabilities, and demands arising directly or indirectly from:
- 20.1.1 any act, omission, or negligence of the Recipient, its officers, employees, contractors, members, agents or successors arising in connection with this Agreement;
  - 20.1.2 any breach of this Agreement by the Recipient, its officers, employees, contractors, members, agents or successors unless such breach is a direct result of a breach by YG of its obligations under this Agreement; and
  - 20.1.3 any injury (including death) to persons, damage or loss to property, infringement of rights, or any claims, demands, or liabilities whatsoever that may arise directly or indirectly out of the performance or non-performance (in whole or in part) of the Recipient's obligations under this Agreement;
- 20.2 The above indemnity shall include all reasonable legal costs and shall survive the expiry or termination of this Agreement.

### 21. Assignment

- 21.1 This Agreement shall not be assigned, transferred, subcontracted or otherwise delegated by the Recipient without the prior written consent of YG. Any attempt to assign, transfer, subcontract or otherwise delegate any of the rights, duties, or obligations of this Agreement without written consent is void and of no effect.

### 22. Amendment

- 22.1 Any amendments to this Agreement shall be made in writing and executed by both Parties.

### 23. Successors

- 23.1 This Agreement is binding upon the Parties and their respective administrators and successors.

### 24. Severability

- 24.1 If any of the terms or provisions of this Agreement are found invalid or unenforceable in whole or in part, then the remaining terms and provisions shall continue in full force and effect.

### Appendix 1 – Preliminary Schedule

#### 25. Breach or Non-fulfillment

- 25.1 The Recipient shall give YG notice of the breach or non-fulfillment of any provision of this Agreement.
- 25.2 The failure of the Recipient to give notice to YG of the breach or non-fulfillment of any provision of this Agreement shall not constitute acceptance by YG of:
- 25.2.1 the breach or non-fulfillment;
  - 25.2.2 a further breach or non-fulfillment of the same provision; or
  - 25.2.3 the breach or non-fulfillment of any other provision of this Agreement.

#### 26. Termination

- 26.1 Either Party may terminate this Agreement without cause by giving the other Party thirty (30) days' written notice of its intention to terminate.
- 26.2 The Recipient shall, within thirty (30) days of giving or receiving notice of intention to terminate, discharge any outstanding obligations under this Agreement.
- 26.3 In addition to any default that would at law entitle YG to terminate the Agreement, any of the following shall also constitute a default by the Recipient:
- 26.3.1 the Recipient fails to perform or comply with any term, condition or obligation under this Agreement;
  - 26.3.2 the Recipient, in support of its application for funding, or proposal, or in connection with this Agreement, has made materially false or misleading representations or statements, or provided materially false or misleading information to YG;
  - 26.3.3 the Recipient fails to make progress so as to jeopardise the success or outcome of the Project in accordance with this Agreement;
  - 26.3.4 in the opinion of YG, there is a detrimental change in the Recipient's ability to carry out its responsibilities under this Agreement;
  - 26.3.5 the Recipient is no longer in good standing or ceases to operate;
  - 26.3.6 the Recipient becomes bankrupt or insolvent, goes into receivership or takes the benefit of any statute being in force from time to time relating to bankrupt or insolvency debtors; or

### Appendix 1 – Preliminary Schedule

- 26.3.7 the Recipient is dissolved, or an order is made or resolution passed for the winding up of the Recipient.
- 26.4 If, in the opinion of YG, an event of default occurs, then YG may, with prior notice to the Recipient and without restricting any remedies otherwise available:
- 26.4.1 arrange, under specific terms and conditions, for the Project to be completed or continued by another;
- 26.4.2 require that the Recipient takes such reasonable actions as may be necessary to remedy the event of default;
- 26.4.3 audit or cause to have audited the accounts and Records of the Recipient;
- 26.4.4 direct the Recipient to repay forthwith to YG all or part of the Funds paid under this Agreement;
- 26.4.5 withhold all or part of the Funds payable under this Agreement; or
- 26.4.6 terminate the Agreement and YG's obligation to provide any further Funds to the Recipient.
- 26.5 YG may exercise any one or more of the remedies set out in 26.4.

#### 27. Obligations Surviving Termination

- 27.1 All obligations of the Recipient shall expressly, or by their nature, survive expiry or termination of this Agreement until, and unless, they are fulfilled, or by their nature, expire.

#### 28. Notice

- 28.1 Any written communication, report, or notice required pursuant to this Agreement may be given by personal delivery to the undersigned, or by fax, electronic mail or by prepaid mail to the addresses set out below. A notice shall be considered to be received if delivered personally on the date of delivery; if delivered by fax, two (2) business days after transmission; or if delivered by mail, three (3) business days after mailing or by email the day the email is sent.

If to YG:

Geoff Woodhouse, Senior Policy Analyst  
Yukon Development Corporation (D1)  
Government of Yukon  
PO Box 2703  
Whitehorse, Yukon Y1A 2C6

**Appendix 1 – Preliminary Schedule**

If to the Recipient:  
Ed Mollard, Chief Financial Officer  
Yukon Energy Corporation  
2 Miles Canyon Road  
Whitehorse, YT Y1A 6L4

**29. Signing of this Agreement**

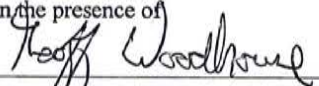
29.1 Each Party represents and warrants that it has full power and authority to enter into, perform, and execute this Agreement, and that each person signing this Agreement on behalf of a Party has been properly authorized and empowered to enter into and execute this Agreement.

**30. Counterparts**

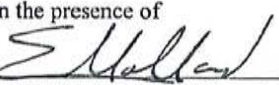
30.1 This Agreement may be executed in counterparts, each of which will be considered an original, and all of which will constitute one and the same document.

**IN WITNESS WHEREOF** the Parties have executed this Agreement by their duly authorized representatives on the date first written.

**GOVERNMENT OF YUKON**  
as represented by the  
President and CEO, Yukon Development Corp.

In the presence of  
  
*(name and signature of witness 19 years of age or older)*

**YUKON ENERGY CORPORATION**  
as represented by the  
President and CEO

In the presence of  
  
*(name and signature of witness 19 years of age or older)*

  
Justin Ferbey

  
Andrew Hall

## Appendix 1 – Preliminary Schedule

### Schedule A

#### Project

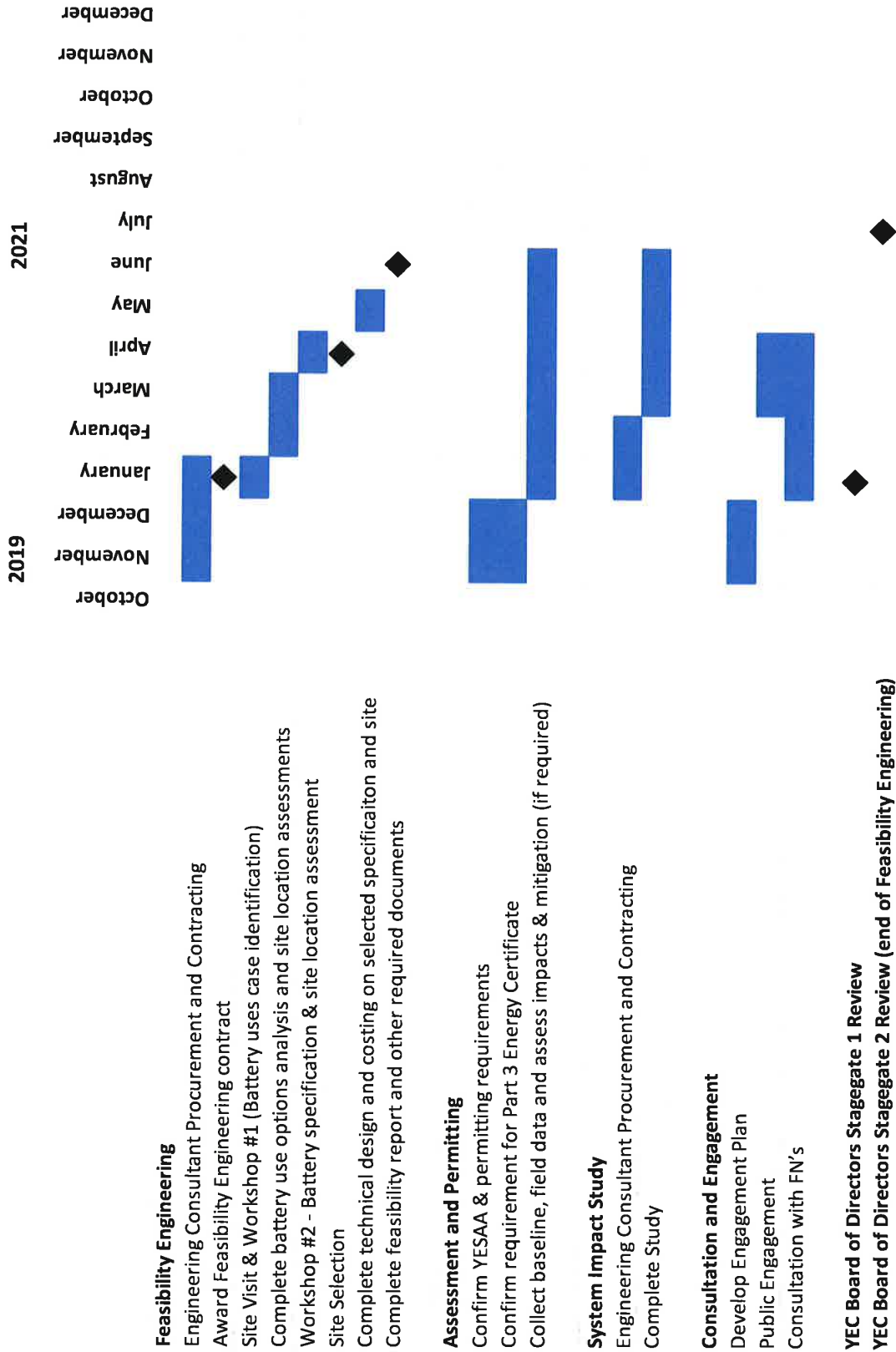
##### A1.0 Deliverables

- The acquisition and installation of a 40 MWh battery storage system with 8 MW capacity

##### A2.0 Work Plan

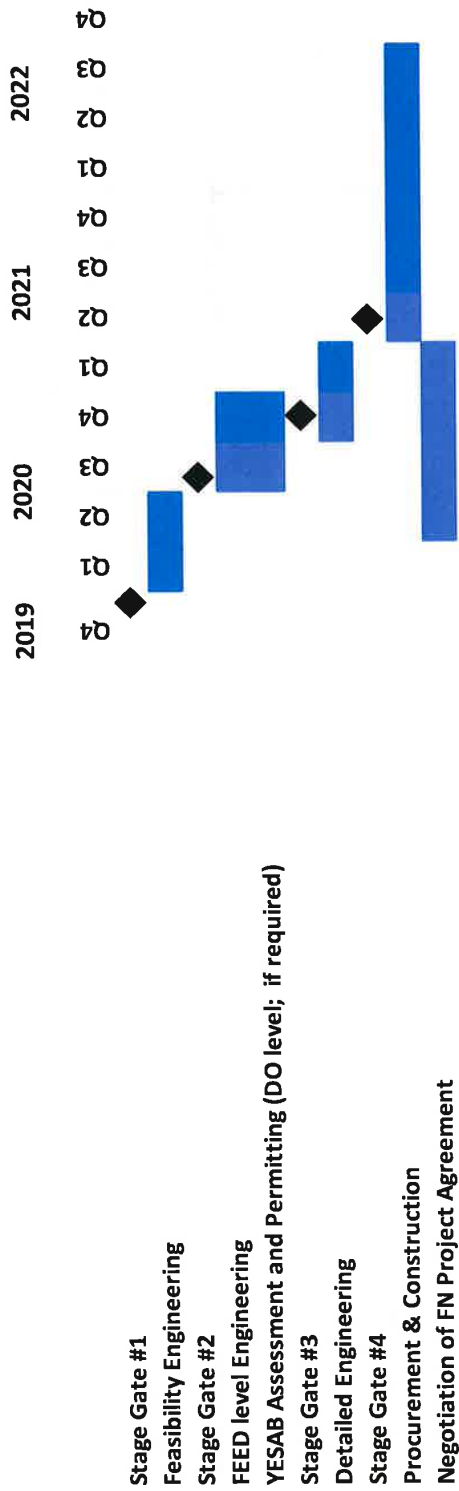
- A2.1 The Recipient shall carry out the Project in accordance with the work plan and deliverables as described in Schedule A as initially approved in writing by YG and attached to Schedule A as an appendix.

**Appendix 1 – Preliminary Schedule**



Appendix 1 – Preliminary Schedule

APPENDIX 3 – PRELIMINARY SCHEDULE FOR BESS PROJECT



## Schedule B

### Budget

#### B2.0 Budget and Expenses

- B2.1 The Recipient shall carry out the Project in accordance with the Budget outlined below
- B2.2 Eligible Expenses for the purposes of this Agreement shall be: those expenses directly related to the Project; identified as Eligible as defined in Schedule G; and set out in the attached Budget.
- B2.3 The Recipient may, on prior written approval from YG, reallocate dollar amounts between eligible expenses within the approved Budget, such changes must align with the original scope of the project. For greater certainty, such reallocation does not constitute an amendment for the purposes of this Agreement.

*Table 2 – Grid Battery Budget*

Item	Budget (\$)
Planning/Permitting	100,000
Engineering	250,000
Civil/building	550,000
Batteries	22,000,000
Substation and power-line	1,300,000
Commissioning	100,000
Project management services	250,000
Owners engineer	250,000
Internal expenses and labour	50,000
Communications	50,000
First Nations benefits	100,000
<b>Total</b>	<b>25,000,000</b>

## **Schedule C**

### **Terms of Payment**

#### **C1.0 Funds**

C1.1 YG shall pay to the Recipient the Funds as follows:

- a) payments will be made based on:
  - i) Financial Reports (Schedule F), showing: eligible costs to date; eligible costs since the previous Financial Report; copies of invoices, receipts and vouchers; and certification by an officer of the Recipient; and
  - ii) Project Reports (Schedule D) showing that the project is progressing in accordance with the work plan in Schedule A and terms and conditions of this Agreement which will include evidence satisfactory to YG that funds have been spent on the Project for Eligible Expenditures.
- b) The final ten per cent (10%) of the Funds for the Project will be held by YG until the Recipient submits a final Project Report acceptable to YG. The final Project Report will be submitted on the form attached as Schedule E.
- c) YG may delay payment of claims until the Recipient has erected a project sign per s. 14.4

## Schedule D

### Project Report

**To be submitted with each Financial Report**

**Date:** \_\_\_\_\_

**Project Name:**

**1. Work Completed to date:**

Describe what work has been completed to date, and since the last Project Report.

**2. Contract Information**

Please list all contracts awarded for the Project. In cases where contracts were not competitively tendered, please provide a brief rationale below this table (e.g. "Contract x was not competitively tendered as it was below the sourcing threshold")

Project Component	Contractor	Competitively Tendered Y/N?	Award date	Percentage complete
[add rows as needed]				

Please provide copies of: public advertisements (tender, RFP, etc.), tender review minutes and scoring tables, where applicable. (Skip this step if these have been submitted with a previous Project Report).

**3. Environmental Reporting**

Please state any environmental concerns or issues that arose during the performance of the work since the last progress report and how it was addressed. If applicable, please provide the YESAB online registry number for the environmental assessment.

**4. Regulatory Reporting**

Include any regulatory permits that must be sought for the work and the status of these permits or licenses.

**5. Next Steps**

Please provide a brief description on the next steps on the project and updated work plan if there have been any changes to the work plan since the last report.

**6. Photos**

Please provide photos of the project and project signage.

**7. Challenges**

List challenges the projects is currently facing and how these will be addressed.

**I certify on behalf of the Recipient that the statements made in this report are accurate, true and complete;**



## Schedule E

### Final Project Report

a) Please provide a brief overview of the benefits of the project.

b) Please provide photographs of the project that show the progression of the work. (Photos may be digital via email or storage media)

The Recipient, by its authorized representative, certifies the following;

- 1) The Project was completed and the total completion certificate was issued on [insert date].
- 2) I have received the following documents for the [insert name of project] Project:
  - i. [Insert List name of relevant documents, e.g. certificate of completion, certificate of performance, occupancy permit, etc.] signed by [Insert Name], a (Insert Profession, e.g., professional engineer) for the Project.
  - ii. [Insert: Add same text as in i. for each document]
- 3) All contracts for work on the Project were awarded in a way that was transparent, competitive, fair, impartial and consistent with value for money principles.
- 4) All contractors for work on the Project have been paid.
- 5) Any environmental issues that arose during the Project were resolved. YESAA File number (insert number)
- 6) The Recipient has not sold, leased, transferred, encumbered or otherwise disposed of the land or asset constructed as a result of this Project.

Recipient authorized representative;

\_\_\_\_\_  
Print Name

\_\_\_\_\_  
Print Title

\_\_\_\_\_  
Signature

\_\_\_\_\_  
Date

I certify on behalf of YG that this Project is complete:

\_\_\_\_\_  
Print Name

\_\_\_\_\_  
Print Title

\_\_\_\_\_  
Signature

\_\_\_\_\_  
Date

## Schedule F

### Financial Report

**Project:**  
**Claim Number:**

Project Expenses	This Report	To Date
<b>Project Expenses Claimed</b>		
Total Approved Eligible Expenditures		[Fund amount]
Remaining Eligible Expenditures		
<b>Ineligible Costs</b>		
Total Project Cost – Eligible & Ineligible		

**Calculation of Current Claim**

Total Expenses Submitted for Payment	
<b>Total Payment This Claim</b>	

I certify on behalf of the Recipient that the amounts claimed are Eligible, accurate, true, and complete, and incurred in accordance with the provisions of the Agreement;

\_\_\_\_\_  
**Recipient Authorized Signing Officer/Title**

\_\_\_\_\_  
**Date**

I certify on behalf of YG that I have made a determination on the basis of the evidence presented by the Recipient that the payment being made is for Eligible Expenditures as defined in the Agreement;

\_\_\_\_\_  
**Yukon Authorized Signing Officer/Title**

\_\_\_\_\_  
**Date**

## Schedule G

### Eligible and Ineligible Expenditures

#### **G.1. Eligible Expenditures**

Eligible Projects will support public infrastructure, defined as tangible capital assets primarily for public use and/or benefit.

Eligible Expenditures will include the following:

- i. All costs considered by Canada and Yukon to be direct and necessary for the successful implementation of an eligible Project, excluding those explicitly identified in section A.1 e) (Ineligible Expenditures), and which may include capital costs, design and planning, and costs related to meeting specific Program requirements, including completing climate lens assessments as outlined in paragraph h) of section 4 (Commitments by Yukon) and creating community employment benefit plans;
- ii. The incremental costs of employees of a Recipient may be included as Eligible Expenditures for a Project under the following conditions:
  - a) The Ultimate Recipient is able to demonstrate that it is not economically feasible to tender a Contract for the same work; and
  - b) The arrangement is approved in advance and in writing by Canada.
- iii. Costs will only be eligible if incurred after the Project Approval Date, except for costs associated with completing climate lens assessments as outlined in paragraph h) of section 4 (Commitments by Yukon), which are eligible before Project approval, but can only be paid if and when a Project is approved by Canada for contribution funding under this Agreement.

#### **G.2. Ineligible Expenditures**

The following are deemed ineligible expenditures:

- i. Costs Incurred before the Project Approval Date and any and all expenditures related to contracts signed prior to Project approval, except for expenditures associated with completing climate lens assessments as required under paragraph h) of section 4 (Commitments by Yukon);
- ii. Costs Incurred for cancelled Projects;
- iii. Costs of relocating entire communities;
- iv. Land acquisition;
- v. Leasing land, buildings and other facilities; leasing equipment other than equipment directly related to the construction of the Project; real estate fees and related costs;
- vi. Any overhead costs, including salaries and other employment benefits of any employees of the Ultimate Recipient, any direct or indirect operating or administrative costs of Ultimate Recipients, and more specifically any costs related to planning, engineering, architecture, supervision, management and other activities normally carried out by the Ultimate Recipient's staff, except in accordance with paragraph iii. of section A.1 c) (Eligible Expenditures);
- vii. Financing charges, legal fees, and loan interest payments, including those related to easements (e.g. surveys);

- viii. Any goods and services costs which are received through donations or in kind;
- ix. Provincial sales tax, goods and services tax, or harmonized sales tax for which the Ultimate Recipient is eligible for a rebate, and any other costs eligible for rebates;
- x. Costs associated with operating expenses and regularly scheduled maintenance work;
- xi. Cost related to furnishing, as well as non-fixed assets which are not essential for the operation of the Asset/Project; and
- xii. All capital costs, including site preparation and construction costs, until Canada has confirmed that environmental assessment and Aboriginal consultation obligations as required under sections 11 (Environmental Assessment) and 12 (Aboriginal Consultation) have been met and continue to be met.

## Schedule H

### Communications Protocol

#### H.1 Purpose

- a) This Communications Protocol outlines the roles and responsibilities of Canada and Yukon, as well as those of the Recipient, with respect to Communications Activities related to this Agreement and the Projects funded through it.
- b) This Communications Protocol will guide the planning, development and implementation of all Communications Activities to ensure clear, consistent and coordinated communications to the Canadian public.
- c) The provisions of this Communications Protocol apply to all Communications Activities related to this Agreement and any Projects funded under this Agreement.

#### H.2 Guiding Principles

- a) Communications Activities undertaken in accordance with this Communications Protocol should ensure that Canadians are informed of infrastructure investments made to help improve their quality of life and that they receive consistent information about funded Projects and their benefits.
- b) Yukon is responsible for communicating the requirements and responsibilities outlined in this Communications Protocol to Recipients.

#### H.3 Joint Communications

- a) Canada, Yukon and the Recipient will have Joint Communications about the funding of the Project(s).
- b) Joint Communications under this Agreement should not occur without the prior knowledge and agreement of all Parties as well as the Recipient, where applicable.
- c) All Joint Communications material will be approved by Canada and Yukon prior to release, and will recognize the funding of all parties.
- d) Canada, Yukon or the Recipient may request Joint Communications to communicate to Canadians about the progress or completion of the Project(s). The requestor will provide at least 15 business days' notice to the other Party. If the Communications Activity is an event, it will take place at a mutually agreed date and location.
- e) The requestor of the Joint Communications will provide an equal opportunity for Canada, Yukon or the Recipient to participate and choose their own designated representative (in the case of an event).
- f) Yukon or the Recipient will be responsible for providing onsite communications and logistics support. Any related costs are eligible for cost-sharing in accordance with the formula outlined in the funding agreement.
- g) Canada has an obligation to communicate in English and French. Joint communications products must be bilingual and include the Canada wordmark and other Parties' logos. Canada will provide the translation and final approval on products.
- h) The conduct of all Joint Communications will follow the *Table of Precedence for Canada*.

#### **H.4 Individual Communications**

- a) Notwithstanding section B.4 of this Communications Protocol (Joint Communications), Canada and Yukon retain the right to meet their obligations to communicate information to Canadians about the Agreement and the use of funds through their own Communications Activities.
- b) Canada will post a copy of this Agreement on its website, in addition to information on any of the projects funded through it.
- c) Canada, Yukon and the Recipient may each include general Program messaging and examples of projects funded through the Agreement in their own Communications Activities. The authoring Party will not unreasonably restrict the use of such products or messaging by the other Parties, and if web or social media based, from linking to it.
- d) Canada, Yukon or the Recipient may issue digital communications to communicate progress of the Project(s).
- e) Where a web site or web page is created to promote or communicate progress on a funded Project or Projects, it must recognize federal funding through the use of a digital sign or through the use of the Canada wordmark and the following wording, "This project is funded in part by the Government of Canada." The Canada wordmark or digital sign must link to Infrastructure Canada's website, at [www.infrastructure.gc.ca](http://www.infrastructure.gc.ca). Canada will provide and publish guidelines for how this recognition is to appear.
- f) The Recipient will be required to send a minimum of one photograph to each of the Parties of the construction in progress, or of the completed project, for use in social media and other digital individual communications activities. Sending the photos will constitute permission to use and transfer of copyright. Photographs are to be sent to [INFC.photos@canada.ca](mailto:INFC.photos@canada.ca) along with project name and location.

#### **H.5 Operational Communications**

- a) The Recipient is solely responsible for operational communications with respect to Projects, including but not limited to: calls for tender, or construction and public safety notices. Operational communications as described above are not subject to the federal official language policy.
- b) Canada does not need to be informed on operational communications. However, such products should include, where appropriate, the following statement, "This project is funded in part by the Government of Canada." As appropriate, operational communications will also recognize the funding of Yukon in a similar manner.

#### **H.6 Media Relations**

- a) Canada and Yukon will share information promptly with the other Party should significant media inquiries be received or emerging media or stakeholder issues arise to a Project or the overall fund.

#### **H.7 Signage**

- a) Canada, Yukon or the Recipient may request a sign recognizing their funding contribution to a Project.
- b) Where a physical sign is to be installed, unless otherwise agreed upon by Canada, it will be the Recipient who will produce and install a joint physical sign that recognizes funding of each Party at each Project site in accordance with current federal signage guidelines.
- c) The joint sign design, content and installation guidelines will be provided by Canada.

- d) The recognition of funding contributions of each Party and the Recipient will be of equal prominence and visibility.
- e) Digital signage may also be used in addition or in place of a physical sign in cases where a physical would not be appropriate due to project type, scope, location or duration.
- f) Where the Recipient decides to install a permanent plaque or other suitable marker with respect to a Project, it must recognize the federal and territorial contribution and be approved by Canada and Yukon.
- g) The Recipient agrees to inform Yukon of sign installations through the Project progress reports referenced in section 14 of this Agreement.
- h) Where a physical sign is being installed, signage should be installed at each Project site one (1) month prior to the start of construction, be visible for the duration of that Project, and remain in place until one (1) month after construction is completed and the infrastructure is fully operational or opened for public use.
- i) Signage should be installed in a prominent and visible location that takes into consideration pedestrian and traffic safety and visibility.

**B.9 Communicating With Recipients**

- a) Yukon agrees to facilitate, as required, communications between Canada and the Recipient for Communications Activities.

**B.10 Advertising Campaigns**

- a) Recognizing that advertising can be an effective means of communicating with the public, Canada and/or Yukon may, at their own cost, organize an advertising or public information campaign related to this Agreement or eligible Projects. However, such a campaign will respect the provisions of this Agreement. In the event of such a campaign, the sponsoring Party or Recipient will inform the other Parties or Recipient of its intention no less than twenty-one (21) working days prior to the campaign launch.

## **Schedule I**

### **Consultation with Stakeholders**

Prior to and during construction activities the Recipient shall engage and consult with impacted stakeholders, including but not limited to: YG departments, First Nations, private and other stakeholders identified about the Project. The Recipient will convey to stakeholders all relevant information concerning the planned construction activities, environmental effects, and their impacts. The Recipient will mitigate impacts to the best of their abilities.

The Recipient will provide full and fair consideration to any comments, concerns, information, or proposed alternatives provided by stakeholders and where practicable incorporate stakeholder proposals into the Recipient course of action. Where it is not possible, the Recipient will provide, adequate explanation as to why proposals cannot be incorporated.

## **Schedule J**

### **Conflict Guidelines**

Recipients and employees involved in the procurement of this Project are required to disclose any actual, potential or perceived conflicts of interest with vendors involved in the procurement process and for those conflicts to be appropriately addressed to remove the conflict.

A perceived conflict of interest can arise where a reasonable person could form the view that a participating vendor has an unfair advantage. Conflicts may include but are not limited to actual, potential or perceived conflicts of interest, for example:

- a vendor that has a familial or close personal relationship with employees or officials of the Recipient;
- a vendor who had past employment with, or served on the board of directors of, the Recipient;
- a vendor lobbying public entity decision makers involved in the procurement; or
- a vendor who is or was involved in the creation, implementation or evaluation of the current procurement.

The foregoing is not an exhaustive list but simply outline some examples for illustrative purposes.

1 **TOPIC: Annual Savings in Diesel Rental Costs**

2

3 **REFERENCE: Application, Tab 4.2.3, PDF page 41**

4

5 **QUOTE** "Based on displacing winter 2022/23 diesel rental costs of  
6 approximately \$168,900/MW, the year 1 (2022) annual savings in  
7 diesel rental costs approximates \$1.216 million per year and these cost  
8 savings are assumed to escalate at 4% per year over the 20-year  
9 Project." (footnote omitted)

10

11 **QUESTION:**

12

13 a) Please provide the detailed derivation of the annual savings of \$1.216 million per  
14 year.

15

16 **ANSWER:**

17

18 **(a)**

19

20 The estimated annual avoided diesel rental costs are calculated as expected dependable  
21 capacity from Project at 7.2 MW [four diesel units] times annual forecast diesel rental cost  
22 at \$0.169 million/MW [7.2 MW \* \$0.169 million = \$1.216 million].

23

24 The forecast diesel rental cost at \$0.169 million/MW is based on diesel rental costs per  
25 connected MW (includes costs for spares) for winter 2021/22 estimated at \$0.162  
26 million/MW escalated at 4% to forecast 2022/23 winter rental costs per MW [total rental  
27 cost forecast for 2021/22 winter at \$4.385 million].

1 **TOPIC: Improved Efficiency of Hydro Turbines**

2

3 **REFERENCE: Application, Tab 4.2.3, PDF page 42**

4

5 **QUOTE:** "Improved efficiency of the hydro-turbines by operating them at their  
6 most efficient output more frequently, leading to more energy  
7 production with the same amount of water flow."  
8

8

9 **QUESTION:**

10

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

13

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

16

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

18

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

21

22 **ANSWER:**

23

24 **(a)**

25

26 The BESS will allow YEC to keep the hydro units at their respective optimum operating  
27 point while the load varies, rather than the hydro units being required to load-follow. Load-  
28 following, or the provision of operating reserve, requires the unit to operate at a less than  
29 optimum operating point. Please see also the response to YUB-YEC-1-20(d).

30

31 **(b)**

32

33 The system control center (SCC) monitors the hydro units in real time. SCADA displays  
34 kW's per cubic meter second flow information to the operator. This information is utilized  
35 to run the hydro units at the most efficient operating zone possible.

1 The head elevation (forebay minus tailrace) is a factor in the efficiency of hydro units.  
2 Where possible YEC maintains the forebay levels near the higher operating range to  
3 increase the head elevation and as a result the efficiency and output of the hydro.

4  
5 The system operators are issued frequent generation dispatches. These dispatches  
6 define unit operating ranges and stack orders for hydro and thermal generation. The  
7 dispatch provides direction to run hydro in the most efficient manner possible based on  
8 the current inflows.

9

10 **(c)**

11

12 The higher the kW per cubic meter of water value the more efficient the unit is running.  
13 This is displayed to the operator real-time. Each hydro unit has an efficiency curve based  
14 provided by the OEM.

15

16 **(d)**

17

18 The differences in efficiencies in the summer versus winter months is related to how much  
19 water is in the reservoir. The higher the water behind the dam is, the more efficient the  
20 plant can operate.

1 **TOPIC: Economic Benefits of Other Secondary use Cases for the Battery**  
2 **Energy Storage System Project**

3

4 **REFERENCE: Application, Tab 4.2.3, PDF page 42**

5

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

14

15 **QUESTION:**

16

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

19

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

23

24 **ANSWER:**

25

26 **(a)**

27

28 The events are relatively infrequent and will vary year to year and are therefore difficult to  
29 quantify accurately. The impact of a shorter outage or less frequent outages on customer  
30 satisfaction is significant though not easily represented in a monetary value as it  
31 represents a customer reliability benefit.

32

33 **(b)**

34

35 YEC forecasts planned outages, but not forecast forced grid outages. However, YEC does  
36 expect a reduction in unplanned outages and a decrease in the duration and extent of  
37 outages with the addition of the BESS.

1 **TOPIC: Operating Reserve**

2

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

4

5 **QUOTE:** Application, PDF page 42:

6

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

16

17 Application, PDF page 16:

18

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

27

28 **QUESTION:**

29

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

33

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

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

3

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

5

6 e) Please state all assumptions made to support the net annual fuel cost savings of  
7 \$1.125 million.

8

9 **ANSWER:**

10

11 **(a)**

12

13 When Yukon Energy is experiencing high water all of the hydro generator capacity is used  
14 to generate power and therefore can't be used for operating reserve. Spinning reserve  
15 only occurs when a generator is not at nameplate capacity. Please see also the responses  
16 provided to YUB-YEC-1-2 (c) and YUB-YEC-1-20 (e).

17

18 **(b)**

19

20 In order to provide operating reserve, generally the BESS would be idling (the provision  
21 of the reserve is by the battery being available to discharge when required). The only  
22 draws will be for auxiliary loads. In the event of an outage, if there is a generation trip or a  
23 spike in demand, the BESS would respond to cover the load until other generation can be  
24 brought online and synchronized. Please see response to YUB-YEC-1-28 (b).

25

26 **(c) through (e)**

27

28 Please see Table 1 below that shows the assumptions used and calculation of annual  
29 savings from operating reserve use as provided in Table 4-3 of the Application.

**Table 1: BESS Operating Reserve Use Savings**

		Annual Operating Reserve Use Savings as per Table 12-1 of Appendix B	Assumed Savings for Table 4-3
		A	B=A*1/3
1	Annual Diesel Savings, MW.h	1,837	612
2	Annual LNG Savings, MW.h	17,043	5,681
3=1+2	Total Thermal Savings, MW.h	18,880	6,293
Fuel Costs:			
4	Diesel cost		0.2051 \$/kWh
5	LNG cost		0.1814 \$/kWh
6	Hydro Operating Cost		0.005 \$/kWh
7=1*4+2*5-3*6	Total annual savings, \$000		1,125

The estimated savings in column A are based on Table 12-1 of Hatch Report [Appendix B of the Application]. As section 6.3.1 of the Hatch Report notes, the operating reserve use requirement was calculated based on 2019/2020 compared to average annual water flow (i.e., 2019/2020 showed hydro energy at or below the “average year’s” water flow); the assessment was done to estimate additional hydro generation that could displace LNG or diesel generation in each hourly timestep, based on maximum output from each hydro plant assuming annual average water for each week.

Please see sections 6.3.1 and 6.3.2 of the Hatch Report that provide details on how the operating reserve use benefits are estimated.

The Hatch Report 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. As noted in Section 3.1.2.2. of the Application the full benefits of the thermal displacement as estimated by Hatch are not expected to be realized given the relationship between thermal generation and subsequent hydro storage availability. Therefore, to be conservative, net thermal generation reduction from BESS operating reserve use is assumed to be about one-third of the Hatch estimates or 612 MWh of diesel and 5,681 MWh of LNG (see column B in Table 1 above).

In summary, the annual net cost saving of \$1.125 million in Table 4-3 of the Application was based on one-third of the Hatch estimated thermal displacements and updated 2021 thermal fuel prices, as shown in Table 1 above.

- 1 This net cost saving estimate was not based on a high water year.
- 2
- 3 No statistical analyses were conducted to estimate a confidence interval. The benefits are
- 4 estimated using 2019/20 data compared to average annual water flow. The actual benefits
- 5 can vary significantly from the estimate due to demand, water availability and other factors.

1 **TOPIC: Table Calculations**

2

3 **REFERENCE: Application, Tab 4.2.3, PDF page 43, Table 4-3**

4

5 **QUESTION:**

6

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

8

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

11

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

14

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

18

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

22

23 **ANSWER:**

24

25 **(a)**

26

27 Please see YUB-YEC-1-52 Attachment 1 for the version of Table 4-3 in MS Excel format  
28 with formulae intact.

29

30 **(b)**

31

32 Please see YUB-YEC-1-52 Attachment 1 for the version of Table 4-3 in MS Excel format  
33 with formulae intact. This provides details regarding the calculation of the rows in question.

1 (c) and (d)

2

3 The capital cost includes initial overbuild but does not include capacity augmentation at  
4 year 10. It is noted that overbuild and augmentation are expected to be mutually exclusive  
5 (i.e., either one or the other is provided, not both).

6

7 The Hatch Report [Appendix B] shows that the lifetime of 20 years is reasonable with a  
8 modest overbuild or capacity augmentation at year ten. The energy storage is expected  
9 to require an overbuild due to the limited state-of-charge range and degradation over the  
10 Project life. Therefore, for the purpose of the analysis the Project cost includes 20%  
11 overbuild. The overbuild requirements will be confirmed during procurement process  
12 based on specific vendor recommendations.

13

14 No capacity augmentation in year 10 was assumed to be required given the initial  
15 overbuild. YEC does not have a cost estimate for augmentation. Please see also response  
16 to YUB-YEC-1-11.

17

18 (e)

19

20 As discussed in Section 4.2.3 of the Application the quantified benefits used in Table 4-3  
21 include the following:

22

23 • **Primary Use – Dependable Capacity: Avoided Diesel Rental Costs:** The  
24 proposed BESS energy and power capacity sizing [20 MW/40 MWh] will provide  
25 7.2 MW of dependable capacity. Based on displacing winter 2022/23 diesel rental  
26 costs of approximately \$168,900/MW, the Year 1 (2022) annual savings in diesel  
27 rental costs approximates \$1.216 million per year. These cost savings are  
28 assumed to escalate at 4% per year over the 20-year Project. Please see YUB-  
29 YEC-1-52 Attachment 1 for the version of Table 4-3 in MS Excel format with  
30 formulae intact that shows the details of the calculations of avoided diesel rental  
31 costs. YEC expects the BESS will result in a reduction of four diesel units, and  
32 therefore it can be described as “firm” forecast based on current grid load  
33 forecasts.

34

35 • **Secondary Use - Operating Reserve:** The Hatch August 2020 Report concluded  
36 that use of the BESS to provide operating reserve has the greatest economic

1 benefit among the identified additional use cases with benefits of BESS use for  
2 operating reserve noted to be two-fold:

- 3 ○ A direct reduction in diesel and natural gas genset operation hours and  
4 energy generation; and
- 5 ○ Improved efficiency of the hydro-turbines by operating them at their most  
6 efficient output more frequently, leading to more energy production with the  
7 same amount of water flow.

8

9 The Hatch Report (see Appendix B of the Application) estimated that when the 20  
10 MW/40 MWh BESS is used as operating reserve it could save up to 1,837 MWh  
11 of diesel and 17,043 MWh of LNG, or \$3.374 million, based on 2021 GRA fuel  
12 prices. However, as noted in Section 3.1.2.2. of the Application, these estimates  
13 may not be fully realized due to water storage savings with the existing operations,  
14 and that net thermal generation reduction from BESS operating reserve use is  
15 approximately one-third of these estimates, i.e., the operating reserve annual net  
16 fuel cost saving is reduced to approximately \$1.125 million (2022\$). Please see  
17 YUB-YEC-1-52 Attachment 1 for the version of Table 4-3 in MS Excel format with  
18 formulae intact that shows the details of the calculations of operating reserve  
19 benefits. Please also see YUB-YEC-1-51 for details on BESS savings from  
20 operating reserve use.

21

22 Unlike the dependable capacity benefits, the benefits from operating reserve  
23 cannot be described as “firm” forecasts as these are not firmly measurable and  
24 fluctuate on daily basis based on grid loads and generation outputs.

25

- 26 • **Secondary Use – Diesel Peak Shifting:** The estimated net cost savings from  
27 BESS diesel peak shifting based on 2019 operations and indicate relatively small  
28 net economic benefits approximating \$10,600/year (2022\$) after consideration of  
29 LNG and hydro operating costs for recharging of BESS. These benefits also  
30 cannot be described as “firm” forecasts as these are not firmly measurable and  
31 fluctuate on daily basis based on grid loads and generation outputs.

**Assumptions**

Capital net of grant (\$000) - 2020\$	<b>\$15,198</b>			
Capital net of grant (\$000) - 2022\$	<b>\$15,812</b>			
Project Life	20 years			
Weighted Average Cost of Capital	4.79%			
Inflation	2%	Annual Diesel Savings OR	MW.h	Benefits -MW.h
Diesel rental	\$169 \$000/MW	Annual LNG Savings OR	1,837	612
Dependable Capacity	7.2 MW	Total thermal savings	17,043	5,681
Diesel Rental Inflation	4%		18,880	6,293
Fuel Costs:			MW.h	
Diesel cost	0.2051 \$/kWh	Annual Diesel Savings Peak Shift		244
LNG cost	0.1814 \$/kWh	Shift 75% to LNG, 25% to Hydro		287
Hydro Operating Cost	0.005 \$/kWh			

Table 4-3: Annual Ratepayer Impacts from BESS (20 MW/ 40 MWh)

	BESS Annual Costs (\$000)				BESS Annual Savings (\$000)				Net Annual Ratepayer Savings (Costs) (\$000)
	Annual Capital Cost	Annual Operating Cost [excl. recharging]	Annual Net Recharging Cost [15% return loss plus 3% idling loss]	Total Annual Costs	Avoided Diesel Rental Costs	Annual Savings from Operating Reserve Use	Annual Savings from Peak Shifting	Total Annual Savings	
\$000	A	B	C	D=A+B+C	E	F	G	H=E+F+G	I=H-D
Year 1	\$1,530	\$652	\$82	\$2,264	\$1,216	\$1,125	\$11	\$2,351	\$87
Year 2	\$1,492	\$665	\$84	\$2,240	\$1,265	\$1,147	\$11	\$2,423	\$182
Year 3	\$1,454	\$678	\$85	\$2,217	\$1,315	\$1,170	\$11	\$2,496	\$280
Year 4	\$1,416	\$691	\$87	\$2,194	\$1,368	\$1,193	\$11	\$2,573	\$379
Year 5	\$1,378	\$704	\$89	\$2,171	\$1,423	\$1,217	\$12	\$2,651	\$481
Year 6	\$1,340	\$717	\$91	\$2,148	\$1,480	\$1,242	\$12	\$2,733	\$585
Year 7	\$1,302	\$731	\$92	\$2,126	\$1,539	\$1,267	\$12	\$2,817	\$691
Year 8	\$1,264	\$745	\$94	\$2,104	\$1,600	\$1,292	\$12	\$2,904	\$801
Year 9	\$1,226	\$759	\$96	\$2,082	\$1,664	\$1,318	\$12	\$2,994	\$912
Year 10	\$1,189	\$774	\$98	\$2,061	\$1,731	\$1,344	\$13	\$3,088	\$1,027
Year 11	\$1,151	\$789	\$100	\$2,040	\$1,800	\$1,371	\$13	\$3,184	\$1,144
Year 12	\$1,113	\$804	\$102	\$2,019	\$1,872	\$1,398	\$13	\$3,284	\$1,265
Year 13	\$1,075	\$820	\$104	\$1,999	\$1,947	\$1,426	\$13	\$3,387	\$1,388
Year 14	\$1,037	\$835	\$106	\$1,978	\$2,025	\$1,455	\$14	\$3,493	\$1,515
Year 15	\$999	\$851	\$108	\$1,959	\$2,106	\$1,484	\$14	\$3,604	\$1,645
Year 16	\$961	\$868	\$111	\$1,939	\$2,190	\$1,514	\$14	\$3,718	\$1,779
Year 17	\$923	\$885	\$113	\$1,920	\$2,278	\$1,544	\$15	\$3,836	\$1,916
Year 18	\$885	\$902	\$115	\$1,902	\$2,369	\$1,575	\$15	\$3,958	\$2,057
Year 19	\$847	\$919	\$117	\$1,884	\$2,463	\$1,606	\$15	\$4,085	\$2,201
Year 20	\$810	\$937	\$120	\$1,866	\$2,562	\$1,638	\$15	\$4,216	\$2,350
<b>NPV</b>	<b>\$16,318</b>	<b>\$10,147</b>	<b>\$1,286</b>	<b>\$27,751</b>	<b>\$22,647</b>	<b>\$17,612</b>	<b>\$167</b>	<b>\$40,426</b>	<b>\$12,676</b>

Notes:

- 1 2021 assumed as Year 1. Capital costs (Table 3-4) and operating costs (Table 3-5) each escalated 2% for one year inflation.
- 2 YEC WACC at 4.794% per 2021 GRA (real WACC with 2% inflation at 2.739%) is used for all net present values (NPVs).
- 3 Annual Capital Cost includes depreciation (20 year life) and return on mid-year rate base at YEC WACC of 4.794%.
- 4 Annual Net Recharging Cost assumes diesel generation for N-1 dependable capacity and operating reserve recharge losses, 75% LNG and 25% hydro for other recharge losses (peak shifting saving already addresses these losses), and hydro for idling losses.
- 5 Avoided Diesel Rental Costs assumes \$168,896 per MW (2022\$) and 7.2 MW (4 rental units) of dependable capacity.

Supporting table - BESS Annual O&M Costs (20 MW/ 40 MWh)

Inflation Rate

2%

Year	Lease \$000	Annual OPEX \$000	Property Tax \$000	Insurance \$000	Transmission O&M \$000	Total O&M \$000
2022	55.2	239.3	309.0	41.6	7.3	652.4
2023	55.7	244.1	315.2	42.4	7.4	664.9
2024	56.3	249.0	321.5	43.3	7.6	677.6
2025	56.8	253.9	327.9	44.2	7.7	690.6
2026	57.4	259.0	334.5	45.0	7.9	703.8
2027	58.0	264.2	341.2	45.9	8.0	717.3
2028	58.6	269.5	348.0	46.9	8.2	731.1
2029	59.1	274.9	354.9	47.8	8.4	745.1
2030	59.7	280.4	362.0	48.8	8.5	759.4
2031	60.3	286.0	369.3	49.7	8.7	774.0
2032	60.9	291.7	376.7	50.7	8.9	788.9
2033	61.6	297.5	384.2	51.7	9.1	804.1
2034	62.2	303.5	391.9	52.8	9.2	819.5
2035	62.8	309.5	399.7	53.8	9.4	835.3
2036	63.4	315.7	407.7	54.9	9.6	851.4
2037	64.0	322.1	415.9	56.0	9.8	867.8
2038	64.7	328.5	424.2	57.1	10.0	884.5
2039	65.3	335.1	432.7	58.3	10.2	901.5
2040	66.0	341.8	441.3	59.4	10.4	918.9
2041	66.6	348.6	450.2	60.6	10.6	936.6

1 **TOPIC: Summary of Cost Economic Assessment**

2

3 **REFERENCE: Application, Tab 4.2.3, Table 4-3: Annual Ratepayer Impacts from**  
4 **the BESS (20 MW/40 MWh), PDF page 43; Appendix B: Hatch**  
5 **Report, Tables 12-1 to 12-4, PDF pages 173 to 176**

6

7 **QUESTION:**

8

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

11

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

14

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

18

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

22

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

24

25 **ANSWER:**

26

27 **(a)**

28

29 Confirmed.

30

31 **(b) to (d)**

32

33 See Attachments 1 to 3 to this response.

1 (e)

2  
3 Table 12-2 in Appendix B provides a summary of assessments for a location at the TKC  
4 site and 12-4 for the location in KDFN land near Takhini Substation. These sites were not  
5 selected for the Project, therefore, the information from these tables is not used in the  
6 Application.

7  
8 The following explains variances between Table 12-3 of Hatch Report [Appendix B] and  
9 Table 4-3 of the Application:

- 10  
11 • **Capital costs:** Table 12-3 of Appendix B shows the capital cost for a 20 MW/40  
12 MWh battery at \$28.880 million (2020\$). As noted in note #1 to Table 3-4 of the  
13 Application the preliminary cost estimates included in Hatch Report [Appendix B]  
14 do not include Planning Costs and Owner's Costs. Including these costs, the total  
15 Project cost would be \$31.698 million (2020\$) before grants, or \$15.198 million  
16 after grants as shown in YUB-YEC-52 Attachment 1 [detailed calculations for Table  
17 4-3].
- 18  
19 • **O&M costs:** Table 12-3 of Appendix B shows the O&M cost for a 20 MW/40 MWh  
20 battery at \$0.574 million (2020\$) – escalated to 2022\$ at 2%/year inflation rate this  
21 would be \$0.597 million (2022\$). This O&M expense estimate, however, does not  
22 include annual lease costs for the selected site. Table 4-3 shows total annual O&M  
23 at \$0.652 million (2022\$) – this includes annual lease cost at \$0.055 million, or  
24 \$0.597 million when exclude lease costs which is the same as annual costs from  
25 the Hatch Report [Appendix B] escalated to 2022\$.
- 26  
27 • **Levelized Cost of Capital (LCOC):** Hatch estimates LCOC (2020\$) at \$199/kW  
28 per yr for the 20 MW/ 40 MWh BESS at the selected KDFN site based only on the  
29 above Hatch net capex and annual opex costs; on the same basis using Table 4-  
30 3 capex and opex costs, the Application costs result in an estimated LCOC of  
31 \$226/kW per yr for the BESS Project.<sup>1</sup>

---

<sup>1</sup> The Application at page 17 provides an LCOC of \$235/kW per yr which is in 2022\$ and also includes provision for ongoing recharging losses and idling with only N-1 dependable capacity use. The Application assumes YEC's updated WACC of 4.794% vs. 4.92% assumed in Hatch report.

- 1       • **NPV (with Savings):** Hatch estimates NPV (2020\$ with savings over the 20 year  
2       life) at \$49.252 million for the 20 MW/ 40 MWh BESS at the selected KDFN site  
3       based on the 20 year cash flow with the above net capital and annual opex costs  
4       and annual savings of \$0.956 million for diesel rentals and \$3.802 million for  
5       operating reserve and peak shifting BESS uses<sup>2</sup>; the Application Table 4-3  
6       estimates NPV with savings at \$12.676 million – this materially lower NPV mainly  
7       reflects the reduction of estimated operating use thermal displacement (reduced  
8       by two-thirds to reflect water storage savings impacts with existing operations) as  
9       well as updated thermal fuel prices and corrected incremental hydro generation  
10      costs.  
11
- 12      • **Internal Rate of Return (IRR):** Hatch estimates IRR (2020\$) at 34% based on the  
13      same cash flow used for the NPV with savings estimate; based on Table 4-3  
14      annual cash flows excluding capital costs and the initial net capex of \$15.812  
15      million (2022\$), the IRR is 11% for the Project. The materially lower IRR for the  
16      Application analysis reflects the same adjustments noted above for the lower NPV  
17      with savings.  
18

19      The project economics in the Application do not include LCOE as the Project is not  
20      intended to be an energy project. The primary focus of the Project is providing N-1  
21      dependable capacity to replace rented diesel units as well as providing other system  
22      benefits.  
23

24      Please see YUB-YEC-52 Attachment 1 for more detail on the calculations and  
25      assumptions for Table 4-3 of the Application.

---

<sup>2</sup> See Hatch Table 12.1 for the assumptions re: these annual savings, and page 104 of the Hatch report for the assumed diesel, LNG and hydro generation costs per kW.h.

1 **TOPIC: Owner's Engineer with Experience**

2

3 **REFERENCE: Application, Tab 4.3, PDF page 43**

4

5 **QUOTE:** "These risks are generally being addressed through an early vendor  
6 selection process, assisted by an owner's engineer with experience  
7 procuring battery vendors..."

8

9 **QUESTION:**

10

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

12

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

15

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

17

18 **ANSWER:**

19

20 **(a)**

21

22 Yes. YEC has selected an Owners Engineer for this project.

23

24 **(b)**

25

26 The consultant's experience and qualifications are outlined in Attachment 1 to this  
27 response. Managing costs is not the responsibility of the Owners Engineer. The Project  
28 Manager will be responsible for Managing Project costs.

29

30 **(c)**

31

32 Yes.

## 1. Executive Summary

Hatch is very pleased to submit the following Proposal in response to Yukon Energy Corporation's (Yukon Energy) Request for Proposals (RFP) RFP-2020-033, released on January 7, 2021, for Owner's Engineering Services for a Battery Energy Storage system.

Hatch understands that Yukon Energy is seeking proposals from engineering consultants to support the procurement of a 20 MW/40 MWh Battery Energy Storage System (BESS). The scope of work includes reviewing expression of interest responses from BESS suppliers, preparing a short list of suppliers, finalizing the request for proposals for BESS suppliers, preparation of a request for proposals for EPC contractors and supporting Yukon Energy during the procurement process to respond to technical questions, evaluate bids, and contract negotiations as required. After selection of the BESS Supplier and EPC Contractor, the scope includes support for design reviews, acceptance test monitoring, construction and commissioning monitoring, and technical project management.

Hatch Ltd. is a Canadian, employee-owned, multi-disciplinary engineering firm with over 9,000 employees working in 65 offices around the world. As a global engineering and projects management company, Hatch has over \$50 billion in capital projects under management at any given time, with a number of them above \$1 billion. Hatch is committed to providing its clients with quality and cost-effective services within a given budget and within the parameters set by our clients.

Hatch has significant prior experience in the design, procurement, and construction management of energy projects, including several energy storage systems for Canadian utilities and isolated microgrids. Hatch's team has a deep technical understanding of BESS technology, applications, and deployment experiences. Hatch also has significant bench strength and experience in the design of the balance of plant for storage projects, including site preparation and civil works and grid interconnection design.

Hatch brings proven and robust project management, quality management and cost management processes to the project, based on our expertise in managing projects both large and small around the world. We will also bring our fundamental commitment to safety, and to developing long-term relationships with our clients by providing high quality and trusted expertise in engineering services from feasibility through to commissioning.

Hatch is uniquely qualified to support Yukon Energy as its Owner's Engineer for this project, as our team is currently supporting the procurement of several other utility scale BESSs for Canadian utilities, remote communities, and arctic industrial sites. Hatch has the following experience:

- Working with SaskPower to support the procurement of a 20 MW/20 MWh BESS to provide reliability services to their grid.
- Working with NT Energy, a division of Northwest Territories Power Corporation, to provide technical Owner's Engineering for the Inuvik Wind + Storage Microgrid, which includes a 3.5 MW/1.75 MWh BESS.
- Working with De Beers Canada and Switch Power to support the procurement and installation of a 2 MW/1 MWh BESS for the Gahcho Kué Mine in the Northwest Territories.
- Working with Hydro Quebec as owner's engineer to support the procurement of 5 battery energy storage systems for remote first nations communities in the Nunavik Region.

- Lead Engineer and Consultant for Glencore and Tugliq Energy in the integration of two 3 MW wind turbines and a 3 MW/1.5 MWh BESS for the Raglan Mine in Northern Quebec.

Hatch's previous work on the feasibility study for this project allows the team to quickly ramp up after kick-off and reduces the time to review and gather information on the project. Our team's previous knowledge of this project and the Yukon grid will allow the team to complete the tasks more efficiently.

In summary, Hatch's team has broad experience supporting clients to integrate BESSs. Hatch has the right team to support and deliver this project in accordance with Yukon Energy's vision and objectives and would be a valuable partner in this innovative project.

## 2. About Hatch

"We are committed to maintaining high standards of ethical behavior in the conduct of our business. We are accountable to our clients, communities, and employees for conducting our business in a manner which is safe, respectful, legal, and sustainable."

**John Bianchini**  
CEO Hatch



**For 11 years in a row, Hatch has been named one of the Canada's Best Employers Managed Companies Canada's Top 100 Employers (2021)**

Hatch Ltd. is a private, employee-owned Canadian engineering, technology, and construction management firm with its head office in Mississauga, Ontario. With 4,000 staff in Canada, and 9000 staff worldwide, Hatch has been providing its North American and international clients superior engineering and consulting services since 1955 based upon our four key commitments which we refer to as our Band of Principles. These commitments include:

- **Safety:** Our safety record surpasses industry standards, and it is a testament to the diligence of our people and the transfer of this mindset to everyone we work with and for. Hatch's safety record has improved even as our business has doubled. Our record currently stands at 0.03 lost time injuries (LTIs) for every 200,000 man-hours of project work completed (12 month rolling average, as of Dec 3, 2020).
- **Quality:** Achieving the highest attainable standards to enable asset owners achieve their business goals, safely and responsibly—that's always the key objective. But quality is never an accident. It results from the efforts of determined, leading experts with world-class skills, who deliver the best projects, always.
- **Sustainability:** Delivering projects sustainably is important not just for the long-term health of our planet, it is increasingly an important financial driver for our clients. Sustainability to Hatch is about providing services that benefit not just our clients' businesses, but the communities and environment in which we live.
- **Innovation:** For Hatch, innovation is quite simple: it is a new idea or way of working, which can be big or simply incremental, and which delivers a cost saving or a new revenue opportunity. We look to our clients to help us drive our own innovation processes.

As a testament of our commitment to our clients and employees, in 2021 Hatch was recognized as one of Canada's Top 100 Best Employers for the eleventh year in a row and one of Canada's Best Managed Companies for the past 13 years.

Hatch has helped clients develop both large and small projects globally, ranging from a few hundred thousand dollars to multi-billions of dollars. Regardless of size, we strive to give each client the benefit of Hatch's well recognized project development expertise and advanced project control systems, and first and foremost is our commitment to safety.

We have nearly 100 years of power sector and project delivery experience in more than 150 countries. As a global engineering and projects management company, Hatch has over \$50 billion in capital projects under management at any given time, with a number of them above \$1 billion. Hatch is committed to providing its clients with quality and cost-effective services within a given budget and within the parameters set by our clients.

Our work in the energy sector is carried out by our power and oil & gas business units. The power business unit (BU) is made up of specialty groups focusing on power delivery & integration, smart grid & asset management, microgrid & hybrid power systems, hydropower, renewable power, thermal power, and nuclear power. The power BU operates around the world and has staff in the majority of Hatch's 65 offices. This global presence gives us a broad perspective on power sector issues and allows us to identify best practices for a variety of risk factors and conditions. Specialty groups within the power BU are supported by several practices within Hatch, including advisory (consulting and business improvement), digital, and environmental services.

Hatch has had no material claims or lawsuits for the last ten (10) years.

## 2.1. Board of Directors

Hatch is a Canadian controlled private corporation, which is employee owned. Ownership of Hatch is widely held by approximately 1,000 shareholders who are all current employees. Our Board of Directors is listed in Table 1, below.

**Table 1: List of Board of Directors, Hatch**

Name	Surname	Title
Kurt	Strobele	Chairman
John	Bianchini	CEO & President
Martin	Doble	Global Managing Director, Strategy and Development
Robert	Francki	Global Managing Director, Energy and Project Delivery Group
Joe	Lombard	Global Managing Director, Metals
Nils	Voermann	Global Managing Director, Technologies
Michael	Schatz	Global Managing Director, Infrastructure
Andrew W.	Dunn	Managing Partner, Canadian Shield Capital

## 2.2. Financial/Business Profile

Hatch's letter of financial worth is attached in Appendix B. Hatch will provide the necessary insurance certificates, as requested by Yukon Energy, upon award of the project.

The necessary procurement documentation completed Appendices 1 – 5, 7-8 from the Request for Proposal, are included in Appendix A.

## 2.3. Energy Storage

Hatch has a long history in the transmission and distribution sector, with over 90 years of experience, and over 25 years' experience in the renewable power and energy storage sectors. Hatch has worked with clients in many countries across the globe. Particularly related to this project, Hatch has extensive experience developing renewable, hybrid and energy storage projects across Canada and the Canadian

Arctic. Hatch is currently working on hybrid power and energy storage projects in the Yukon, Northwest Territories, Nunavut, and the Nunavik region of northern Quebec.

Hatch is currently working with NT Energy (a division of Northwest Territories Power Corporation), and Hydro Quebec to support battery specification, procurement, and installation. Hatch is also working with a De Beers Canada to support the procurement of a BESS for their mine in the Northwest Territories.

Hatch's team has extensive experience regarding battery installation in Canada and the Canadian Arctic, particularly considering the cold Canadian climate and its implications on system requirements. Additionally, Hatch's team has worked closely with several battery vendors to define battery performance, degradation and specify warranty requirements for the owner.

Hatch holds a seat on the Canadian Standards Association/International Electrotechnical Commission (CSA/IEC) committee for Electrical Energy Storage Systems, helping to set precedent for energy storage technologies global standardization. Hatch's battery storage expertise has spanned all development phases of energy storage projects for residential, commercial, and industrial systems including planning and development phase, as well as procurement, implementation, and commissioning services.

#### **2.4. Transmission & Distribution Systems Expertise**

Hatch conducts both transmission and distribution level connection impact studies for clients large and small and has worked extensively across Canada on renewable energy and energy storage projects from feasibility to final commissioning. Our understanding of the local codes and standard will provide ease in integrating our knowledge to this project. Hatch also has comprehensive experience in the planning, design, construction, and operation of all types of electricity distribution facilities, including distribution feeders, transformers, and secondary/low-voltage (LV) systems, as well as state-of-the-art in system protection equipment. We have global experience with overhead, underground, and submarine distribution systems in a wide range of configurations ranging from 2.4-kV to 69-kV. Our variety of experience in the design of substations and overhead distribution lines under a range of conditions and constraints makes us well suited to providing Yukon Energy with the necessary engineering expertise to prepare EPC packages which will ensure a high-quality result and reduce project risks.

#### **2.5. Representative Experience/References**

Hatch has the capabilities to offer Yukon Energy the required experience in all required categories; battery energy storage procurements, including specification, procurement support, bid evaluation, and contract negotiations. Additionally, experience in other owner's engineering roles is also included to demonstrate design review capabilities, FAT testing witnessing, and construction monitoring.

The below project examples exhibit our past experiences and depth of knowledge and trust within the battery energy storage industry. If any additional information is required for any of the below mentioned project, Yukon Energy is welcome to inquire through the Hatch contact.

Hatch has also provided a list of our extensive energy storage experience in Appendix G.

**Detailed Design, Procurement Support and Installation Supervision for a 2MW/1 MWh Battery, De Beers Canada, Gahcho Kué Mine, Northwest Territories.**

Hatch is currently supporting De Beers with the specification and procurement of a 2 MW/1 MWh BESS to support solar PV integration at the Gahcho Kué Mine in the Northwest Territories. The BESS will be installed in 2022.

De Beers is currently integrating a 2.4 MW solar PV installation at the mine and plans to use the BESS to provide operating reserve, reduce diesel genset operating hours, and provide solar PV firming. Additionally, other reliability services will be provided by the BESS to provide stability to the mine's microgrid.



Hatch completed the following services as part of the project:

- Use case assessment and Battery Sizing
- Battery Specifications
- Controls Requirements and Specification
- Procurement support for the BESS and controls (expression of interest, bidder shortlisting, technical support during procurement, bid evaluation and contract negotiation support)
- Detailed Electrical and Civil design for the Balance of Plant
- Design Review for BESS supplier
- FAT testing support
- Construction Supervision and Commissioning Support

**Utility Battery Feasibility Study and Procurement Support, Yukon Energy Corporation, Whitehorse, Yukon Territory**

Yukon Energy has a capacity shortage for the N-1, Ongoing reliability criterion, they currently rent diesel gensets to meet the requirements. Yukon Energy is exploring the potential to use a battery energy storage system (BESS) as part of their reserve capacity. Additionally, it is possible to use the BESS to support diesel fuel reduction by providing supplementary operating reserve and peak shaving.



Hatch completed the following services as part of the feasibility study:

- Use case assessment and estimate of diesel fuel savings and GHG emission reductions
- Battery sizing and chemistry recommendation
- Assessment of potential sites and connection points
- CAPEX and OPEX estimate
- Preliminary layout and interconnection design for preferred site
- Performance specification for the battery

- Geotechnical Assessment Support
- Noise Assessment
- Community Consultation Support
- Battery Request for Quotation Draft for Bids

**Battery Energy Storage System Procurement for 5 Remote Villages in Nunavik, Quebec, Client: Hydro Quebec, Ongoing**

Hatch is working with Hydro Quebec to support the procurement of 5 battery energy storage systems for remote first nations communities in the Nunavik Region. Hatch is working with Hydro Quebec to support the procurement process and as an Owner's Engineer for vendor design review.



Hatch's scope of work to date has included:

- Preparation of an Expression of Interest
- Evaluation of Submissions to the EOI
- Detailed Request for Proposal Preparation
- Technical support during bid clarifications
- Bid Evaluation
- Technical review of proposed designs from selected vendor
- Support in determining the technical requirements for the inverter

Hatch will continue to support Hydro Quebec as they install the first battery. As well, Hatch will support Hydro Quebec as they continue in the procurement process for the other villages.

This project is part of a larger overall goal, in which Hydro Quebec will install energy storage + wind turbines to power these communities. Hydro Quebec is targeting diesel-off operation for these communities for prolonged periods.

**Inuvik High Point Wind + Battery Integration, Owner's Engineering, Client: Northwest Territories Energy, Ongoing**



Hatch has been contracted by Northwest Territories Energy (NT Energy) as the Technical Owner's Engineer for the wind + storage microgrid in Inuvik. The first phase involved development of a hybrid model for a proposed 3.5 MW wind energy plant and energy storage system in northern Canada. A hybrid power dispatch model was developed to evaluate

the impacts of incorporating renewable generation and battery power to the existing power plant whilst still ensuring reliable production for the client's net load and meeting thermal shortfalls experienced due to a decrease in generator waste heat. The system study incorporated considerations (spinning reserve, frequency, and voltage control) regarding grid operation with fossil generators on- and off-line.

The scope of work also included economically sizing the BESS and developing the BESS and transformer specifications to go to market for requests for proposals.

In the procurement phase of the project, Hatch supported NT Energy, completing the following scope:

- Preparation of detailed specifications for a 3.5 MW/1.75 MWh battery energy storage system

- Technical Bidder review
- Bidder interview and clarification requests
- Formal proposal evaluation
- Support in technical contract negotiation and technical warranty agreement (battery degradation)
- Hatch is also currently supporting the specification of a microgrid controller for the site.

In the next phases of the project, Hatch will provide owner's engineering services, including engineering design review, FAT test observation, and construction and commissioning monitoring.

**Raglan Mine Microgrid Feasibility Study and Detailed Engineering, Client: Tugliq Energy Co. and Glencore, Phase 1: 2012-2015, Phase 2: 2017-2019**

Development and installation of a microgrid, consisting of two 3 MW wind turbines, energy storage, and existing diesel generators for a remote mine in Northern Canada. The goal of this project was to reduce dependence on diesel and ensure high quality, uninterrupted power supply to the mining facility.



The main services provided in this study include the following:

- A power options screening study, which included a review of energy storage technologies and their potential application to the site
- Scoping, prefeasibility, and feasibility studies of the 3.0 MW wind turbine in combination with 600 kW of energy storage (flywheel, lithium-ion battery, and hydrogen) in Phase 1
- Development of applications and use cases for each energy storage system to select the appropriate technology
- Detailed specification of the energy storage, procurement (RFP and vendor selection) in Phase 2
- Design the operation and control strategy, programming, and delivery of microgrid controller to provide fast response to reduce wind power variation and provide signals to the operator to change the diesel generator unit commitment.
- Engineering design, procurement, and commissioning of a skid-mounted flywheel energy storage system
- Construction and commissioning support

**Wataynikaneyap Power Transmission Project, Wataynikaneyap Power LP [Partnership of Fortis and First Nations LP], Ongoing**

Hatch has been contracted for the design and construction management of 230/115/44/25 kV lines and substations including preparing the EPC RFP, issuing and executing the RFP on behalf of the client and assisting client in the evaluation, negotiation and finalization of the contract, managing the EPC contractor including technical reviews, construction monitoring, quality checks, change control, risk management, document control and administrative management.



### 3. Proposed Personnel

The key team members to carry out this task order are listed below. The teams have been selected to provide the project with a pool of highly qualified personnel with experience directly relevant for the mandate.

Please refer to Appendix C for CV's of the proposed personnel.

#### **Michel Carreau, PhD Project Sponsor and Senior Advisor**



Michel is an Energy Specialist with a PhD from the Massachusetts Institute of Technology and a Post-Doctorate from Boston University with more than 32 years of experience in this field. Michel is Hatch's Director of Hybrid Power and oversees Hatch's delivery of services for remote power systems globally. He has expertise in the development of a wide range of energy projects in remote communities including, hybrid power (traditional generators + renewables), hydropower, wind, solar, thermal, biomass, geothermal and energy storage. He has managed multi-disciplinary teams for innovative projects that have been delivered in more than 20 countries.

Michel brings valuable experience and extensive involvement with conceptual studies, detailed feasibility studies, implementation and operation of hybrid power and energy storage projects in remote locations. In particular, Michel has:

- 25 years of experience working for utilities in hydro power optimization, hybrid power and industrial size energy storage (HQ, NL Hydro, BC Hydro, Brookfield, BPA, PacifiCorp, South California Edition, etc.)
- A strong background in all the use case definitions integration challenges of delivering a hybrid power, with batteries, project in remote grids included detailed project cost (CAPEX and OPEX) and operation performance, repairs, and warranties
- Demonstrated experience in wind and solar power and energy storage development and integration with gensets and hydropower to ensure power quality and grid stability of the hybrid system.

Michel is currently the project engineer for the Hydro Quebec project, procuring 5 battery systems for remote Arctic villages in Nunavik, and the senior advisor for the Inuvik Wind + Energy Storage project where Hatch is the Owner's Engineer for Northwest Territories Energy and the Senior advisor for the SaskPower Battery Energy Storage Procurement Support.

Michel has extensive experience progressing projects beyond the study stage. He has been the technical project lead for the Raglan Mine 6 MW wind hybrid power and 3 MW Lithium-Ion battery in the Quebec Arctic; he led this project for 6 years from conceptual study to construction as well as during two years of operation to optimize its performance in Arctic conditions through blizzards, rime ice, and glazing periods. Michel was key to the development of the control and operation strategy to achieve optimal performance of the hybrid power.

**Joel Guilbaud, PhD – Owner's Engineer and Senior Project Manager (Vancouver)**



Joel is an energy specialist with a Ph.D. in Energy and Economics from the UCL Energy Institute. He has expertise in modeling and optimizing energy projects as well as energy efficiency reviews for utilities and mining clients. He has also gained considerable experience in cost optimization and decision-analysis from the various business ventures and research projects in which he was involved. Joel has over ten years of professional experience and worked with Fortune 500 clients and other market leaders.

Joel worked in more than eight countries and published several publications on hybrid renewable power systems. He also worked with the British Ministry of Energy and Climate Change on energy storage policy and regulations in the UK.

Joel was the project manager for development of the Yukon Energy Battery Study and Procurement support. In this project, Joel led the development of storage use cases and sizing of the BESS as well as supporting site design interconnection, controls, community consultation and procurement specifications.

Joel is currently the project manager for the BESS procurement support with SaskPower and the Gahcho Kué Mine solar PV + storage microgrid detailed engineering and procurement support.

Recently, Joel has worked on several hybrid power studies combining wind or solar with battery energy storage for remote arctic mines and communities. Joel is the project manager for the detailed engineering of a megawatt scale solar + battery installation for a mine in the Northwest Territories. Joel was the technical lead for this project in the prefeasibility and feasibility phases, performing detailed modeling of the system to appropriately size the battery, define the use case(s) and quantify the benefits of the battery to grid stability and diesel fuel reduction.

**Mark Mitchell – Battery Controls and Inverter Subject Matter Expert & Deputy Project Manager(Vancouver)**



Mark is a Microgrid & Power System Specialist with a diversified background in power system controls and energy storage systems and an electrical engineering background. He has extensive experience working with renewable energy and energy storage projects from conceptual studies to procurement, commissioning, and operation.

Mark has supported utilities and independent power producers in Canada and worldwide in selecting, specifying, designing, and integrating energy storage systems into their existing power networks. Recently, Mark led the Raglan Microgrid project, which saw the integration of 6 MW of wind power and a 3 MW energy storage system into a remote power system in the Quebec Arctic.

Mark specializes in the constructability and “make it work” aspects of energy storage system integration; this comes from his extensive hands-on experience working with inverters, batteries, flywheels, compressed air, and hydrogen systems both on site and in the office through planning, design, and remote operations support. He has worked on several project that have led to commissioning and operation and is therefore well aware of the requirements that ultimately lead to successful project implementation.

### **Jocelyn Zuliani PhD – Battery Energy Storage Subject Matter Expert**



Jocelyn is the energy storage lead in the eGRID Hybrid Power and Energy Storage group at Hatch. Her work focuses on integrating energy storage technologies with renewable power energy resources to reduce the need for fossil fuel energy sources.

Jocelyn was the technical lead on the previous project to support the sizing and specification of a large-scale BESS for Yukon Energy. Jocelyn's work included reviewing the current grid operations and completing an assessment of the potential benefits the BESS can provide for the grid operator to improve power quality and reliability, in order to determine the preferred sizing for the BESS. She also supported preparation of the detailed specifications for the procurement of the battery.

Jocelyn is also supporting the procurement of the BESS for SaskPower and the Gahcho Kué Mine, preparing the technical specifications for both of these projects. In the next phases, she will support the bid review and evaluation. Jocelyn recently supported the specification of several battery energy storage systems for remote first nations communities in Northern Quebec.

Prior to starting at Hatch, Jocelyn completed her Ph.D. studying ultracapacitor energy storage technology. Jocelyn has published 7 peer-reviewed journal articles.

### **Jean Carl Moubarak – Battery Energy Storage Specialist & Project Coordinator**



Jean Carl is a hybrid power specialist and project manager who has been part of Hatch's eGRID team since 2019. An engineering graduate from McGill University, he has focused his professional endeavors on renewable and alternative energy such as wind, solar, nuclear power as well as energy storage and hydrogen. He has gained considerable experience in renewable energy development, hybrid power systems, microgrid optimization, energy, and financial modelling, as well as the integration of clean energy to both arctic and warm environments.

Jean Carl is the Deputy Project Manager and Energy Storage Specialist for the Hydro Quebec battery procurement project, supporting the specification of the battery energy storage system, as well as site specific requirements for the Arctic climate. He also is the main client contact, coordinating the Hatch team to support the client through the procurement process. His experience on this project brings valuable understanding of key considerations for energy storage systems in Arctic climates.

### **Kurt Forster – Cyber Security Expert**



Kurt is the Cyber Security and Cyber Resilience Lead in the Hatch Digital team.

He has worked in the Oil & Gas industry and IT for Operational Technology (OT) Groups servicing the Cyber Security needs and requirements of clients and Internal groups for Honeywell, Shell, Cenovus, Canexus, Wintershall, BP, Equate, Saudi Aramco and many more.

Kurt is a Military Veteran of 12 years who has worked all over the world. Mainly in the Canada, UK, Netherlands, Germany, Kuwait, South Africa.

### **Sameh Kodsi PhD, PEng, PE – Power System Studies Lead**



Dr Kodsi has more than 26 years of consulting experience in bulk transmission system. Sameh has extensive experience with modelling, operation, and system impact analysis, including steady state, transient, flicker emission, sub and super harmonic domains. He has conducted and led several bulk transmissions, and generation interconnection studies. He also led several hosting capacity analysis studies on both transmission and distribution sides of the power systems. Dr. Kodsi has extensive experience with dynamic stability (transient and small signal stability) analysis for the North American bulk transmission grid. His in-depth bulk transmission planning and system impact studies experience includes the integration of renewable energy resources (wind and solar), battery energy storage systems (BESS), offshore wind integration, AC transmission (FERC Order 1000 and load expansion studies), HVDC integration (FERC Order 1000, feasibility, pre-specifications, and operational studies) and FACTS (sizing and pre-specifications).

He led several system impact studies associated with BESS in Arizona from 20 MW to 550MW. In addition, he developed a grid hosting capacity technique to evaluate the optimal size of battery energy storage considering charging/discharging states, deferral of transmission upgrades and provided ancillary services (e.g., frequency response). The modelling of the utility scale BESS has considered plant controllers as well as coordination among system plant controllers.

Dr. Kodsi holds professional engineering licenses in Ontario, Manitoba, Alberta, Yukon, Newfoundland and Labrador, and the State of Minnesota (USA).

### **Elham Karimi PhD – Power System Studies Specialist**



Elham is an Electrical EIT with the Mississauga Hatch Office and she is a member of the PD&I group. Her main areas of expertise include system studies of distribution systems, including the development of DER integration projects (PV systems, Wind turbines, Energy storage systems); economic analysis of hybrid microgrids; frequency, voltage regulation and power flow studies; power quality assessment and harmonic analysis; mathematical modeling; power system simulations and optimization.

At Hatch, she has been involved in various power system studies and business case assessment of solar and wind projects, hydrogen-fuel cell, and electric truck projects. She has experience in conducting power system simulations using various software, including PSCAD, PSS®E, EasyPower, Matlab, etc. and has been involved in various projects performing interconnection studies, system analysis, forensics investigations, feasibility studies and system modeling.

### **Sirous Ghelichkhani, PEng – Lead Electrical Engineer (Vancouver)**



Sirous is a Senior Electrical Engineer with 23 years of experience in electrical engineering and project management, conceptual and detail design, implementation and commissioning of power distribution systems, generation station systems, industrial control systems, distributed control system (DCS), supervisory control and data acquisition system (SCADA), and fire and gas detection systems (F&G). Experience also includes technical support for field installation of electrical and I&C equipment, supervising construction & commissioning teams, planning, scheduling, quality control (QC) and quality

assurance (QA).

Twelve (12) years of experience gained primarily in hydroelectric generation includes: providing technical specification and bid evaluation for major electrical equipment for hydroelectric generating stations; conceptual and detail engineering of unit monitoring and control systems, equipment layout for generating station; balance of plant systems and integration with plant mechanical systems; industrial PLC-based automation; MV and LV distribution systems; condition assessment of generating units; field installation of electrical and I&C equipment; distributed control system (DCS); supervisory control and data acquisition system (SCADA), and communication networks.

Sirous previously supported the Yukon Energy battery project, preparing the electrical scope for the basic engineering terms of reference. Sirous holds a professional engineering license in the Yukon Territory.

**Justin Brain - Electrical EIT & Site Supervisor (Vancouver)**



Justin is an electrical engineer-in-training and graduate of the University of Victoria with a degree in Electrical Engineering, specializing in power systems. Justin has 3 years of experience with feasibility and implementation level design for multiple BC Hydro Spillway Gates projects, Fortis BC Dam Safety instrumentation projects, and BC Hydro substation instrumentation replacement projects. He has also conducted arc flash, load flow, short circuit and motor starting power system studies for multiple spillway and generating facilities across Canada.

Recently, Justin has been the lead programmer for a protection, alarm, and metering PLC system being implemented at a BC Hydro spillway facility. This work includes programming of the CPU, multiple HMIs, and Modbus communication devices.

**Daniel Andres-Molina, PEng - Lead Civil Engineer**



Daniel is a Civil Engineer with extensive experience in civil design and construction management, particularly in infrastructure for remote mine sites. He has experience in various fields of engineering design, with a strong focus on earthworks, overall water management and retention structures as well as surface infrastructure. He developed most of his construction management skills while working on site as construction superintendent, managing over 200 pieces of equipment, environment, health and safety, work front planning and community and industrial relations.

Daniel's construction background in remote sites is reflected in his designs with designs optimized based on materials availability and overall project picture. In addition, his global experience has played in his favor, facilitating his integration and management of multidisciplinary and multicultural team.

Lately Daniel has worked on several energy storage projects, supporting the preliminary layout design, geotechnical campaign planning and management, and procurement support. Daniel has also been working on wind and solar project both in the design phase as well as due diligence review of implemented civil designs in working renewable power projects.

**Charlie Harrison, P.Eng. (BC, AB, YK, NT/NU) – Senior Geotechnical Engineer (Vancouver)**



Charlie is a senior geotechnical engineer with over 15 years of experience in site characterization for projects underlain by soil – soft soils such as clay, liquefiable sediments – and rock. Charlie has worked on a multitude of projects providing consulting services to public and private clients across municipal, heavy civil – hydropower projects, water supply dams, and highways – and mining.

Charlie's experience includes the assessment of existing, as well as design of new, projects with sites underlain by both soil and rock. His experience includes foundations, slopes, tunnels, and other geotechnically related aspects of major projects.

Charlie has significant experience working on multi-disciplinary projects, acting as the owner's engineer, as well as the contractor's engineer, when projects have been carried out using the design-build approach. On the owner's team, Charlie has been involved with the preparation of reference designs, preparation of scopes of work, drawings, technical design specifications and contracts, and RFPs.

Charlie has also acted as the resident engineer for several projects where he was responsible for reviewing the geotechnical and civil engineering aspects of a project for both the owner's engineering team, as well as the contractor's engineering team.

Charlie holds a professional engineering license in the Yukon Territory.

**Tajinder (TJ) Singh, EIT. –Civil and Geotechnical EIT (Vancouver)**



Tajinder is a geotechnical Engineer-In-Training with relevant experience in project coordination, construction supervision and quality assurance, geotechnical investigations and subsurface characterization, and geotechnical analysis and design. He is currently pursuing his Master of Engineering degree at the University of British Columbia with a focus on seismic geotechnical engineering and advanced geotechnical modelling.

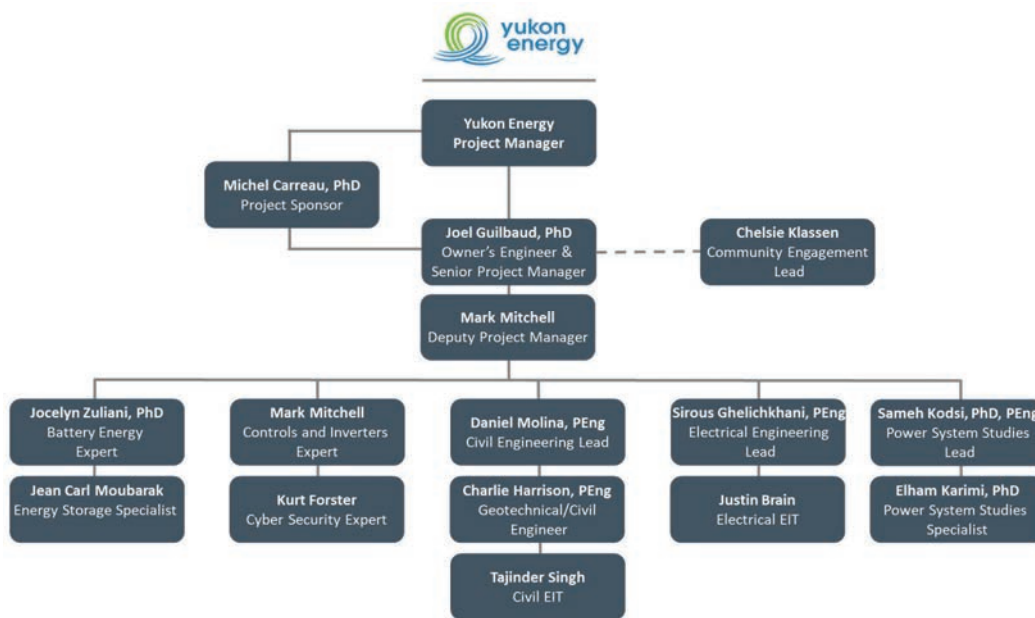
Tajinder provided design and construction services for the CN Thornton expansion project. His responsibilities included the support of all geotechnical components including the geotechnical analysis, preparation, and review of technical specifications and IFC drawings, on-site support, and the geotechnical analysis and design of foundations, retaining walls, slopes, and reinforced subgrades. This project is currently in-construction and ongoing.

For this project, Tajinder will provide support pertaining to preparation of the engineering, procurement, and construction (EPC) civil package, design review, evaluation of bids, and construction monitoring.

**Chelsie Klassen –Community Engagement Lead**



Chelsie Klassen is experienced in Indigenous collaboration, community engagement, issues management and communications. She leads an Indigenous engagement practice that delivers regulatory, economic participation and stakeholder management expertise for mining, energy, and infrastructure clients internationally. Chelsie began her career negotiating surface land contracts for large projects and soon found her niche in Indigenous engagement on oil sands, conventional oil and natural gas, offshore oil and liquefied natural gas developments. She has led traditional knowledge assessments with several First Nations groups during her assignment at Imperial’s Cold Lake operations in Northeastern Alberta and has worked extensively in Canada’s north with Inuvialuit and Gwich’in communities. Chelsie created a one-of-a-kind efficiency model to evaluate resources needed for effective community engagement efforts on major projects. She has facilitated and managed stakeholder consultation with Indigenous and non-Indigenous community members, regulators, government officials, media, and project proponents.



**Figure 1: Project Organization Chart**

We have selected the resources based on their expertise and past experience. For civil and electrical engineering, subject matter experts with past experience on energy storage have been selected, support by staff in Vancouver, familiar with the region and who can access the site relatively easily.

**3.1. Suitability and Availability of Resources**

Hatch’s project team has broad experience supporting the specification, procurement, and installation of battery energy storage systems in the Canadian climate. The proposed team members have been directly involved in Hatch’s support for the procurement of a BESS for the community of Inuvik in the Northwest Territories and support for Hydro Quebec in the procurement of BESSs for 5 isolated communities in the Nunavik Region. Additionally, this team is currently working with De Beer’s Canada

to support the specification, procurement of a 2 MW/1 MWh BESS, and will continue supporting the design review and installation phases of this project.

Hatch's team is very familiar with the Yukon Energy grid and operations. The proposed team has also been heavily involved in the feasibility study the Yukon Energy Battery, supporting the sizing and specification of a 20 MW/40 MWh battery. Hatch's power system studies experts have previously studied the Yukon Energy grid on past projects and are familiar with Yukon Energy's current operating strategies. This will allow our team to complete the tasks efficiently and quickly for the project.

The members of this team are familiar with the intricacies and specific considerations associated with procurement and installation of a battery energy storage system in the Canadian Arctic.

Hatch also has a dedicated team which can support Yukon Energy, if required, to work with the local First Nations, who own the land that this project will be developed on. Hatch's community engagement team has worked on a wide range of projects on First Nations land and directly with First Nations to support clean energy project development.

Hatch offers one of the largest pools of engineering resources in North America. Our Canadian offices numbers over 2,000 staff and is one of the largest worldwide. Virtually all the energy staff are permanent employees and have many years of experience with our company.

In the various offices in North America, Hatch has a wealth of engineering talent across all the major disciplines related to energy storage. Our staff has experience in all types of energy facilities, structures and construction monitoring services and construction management. Also, we have comprehensive experience in a wide range of services including procurement and construction support, asset management, economic and financial analysis, power system planning and operational improvements, equipment selection services, geotechnical investigations, and environmental assessments.

#### 4. References

Hatch's references are included in Yukon Energy's form in Appendix A.

- Owner's Engineer for Inuvik 3.5 MW Wind + 3.5 MW Battery Storage Microgrid; Client: Northwest Territories Energy – A subsidiary of Northwest Territories Power Corporation
  - ◆ Contact: John Craig; [jcraig@mavengroup.ca](mailto:jcraig@mavengroup.ca); +1 (416) 543 9732
- Owner's Engineer for Battery Energy Storage for 5 villages in Nunavik; Client: Hydro Quebec
  - ◆ Contact: Nancy Ste. Croix; [ste-croix.nancy@hydro.qc.ca](mailto:ste-croix.nancy@hydro.qc.ca); +1 (418) 368-4534 poste 4904534
- Owner's Engineer for 2.4 MW Solar + 2MW Battery Storage Microgrid for Gahcho Kué Mine in the Northwest Territories; Client: De Beers Canada & Switch Power
  - ◆ Contact: Etienne Van der Linde; [evanderlinde@switchpower.ca](mailto:evanderlinde@switchpower.ca); +1 (403)-200-1718
- Project: Raglan Mine 6 MW Wind + 3 MW Battery Storage Microgrid; Client: Tugliq Energy Co.
  - ◆ Contact: Nicolas Seguin; [nseguin@tugliq.com](mailto:nseguin@tugliq.com); +1-514-216-5546

#### 5. Scope of Work

Yukon Energy has issued an RFP to engage an Engineering consultant for the services lists in Section 4 of the RFP: Scope of Work. Hatch has reviewed the RFP, RFP documents, and fully understands the

1 **TOPIC: Impacts on Ratepayers**

2

3 **REFERENCE: Application, Tab 4.3, PDF pages 43 and 44**

4

5 **QUOTE:** "Potential impacts on ratepayers relate to ultimate Project capital costs  
6 and the impact on rates, as well as any potential impacts on Project  
7 performance and timing that enhance or reduce the expected BESS  
8 benefits related to reduced thermal generation and improved reliability  
9 for customers."

10

11 **QUESTION:**

12

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

15

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

18

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

22

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

25

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

28

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

31

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

1 **ANSWER:**

2

3 **(a)**

4

5 NPV savings from operating reserve over the life of the Project as estimated in Table 4-3  
6 of the Application are \$17.612 million. Without any of these savings, the Project NPV  
7 impact on ratepayers would be a net added cost of \$4.936 million.

8

9 In summary, the project results in positive NPV savings for ratepayers as long as the  
10 annual operating reserve savings obtained amount to at least 29% of the benefit assumed  
11 in the Application (e.g., at least \$0.326 million in year one, rather than the estimated  
12 \$1.125 million).

13

14 **(b) and (c)**

15

16 The Application provides estimates of 20-year capital and operating costs as well as  
17 savings from the Project, based on the best available current information. Actual results  
18 will vary from these estimates. YEC's management objective is to secure the lowest  
19 feasible costs for the required facilities, and to enhance the annual savings from the  
20 Project to the extent that is reasonably feasible.

21

22 YEC's risk management of capital costs as described in section 4.3 of the Application  
23 includes an early vendor selection process, assisted by an owner's engineer with  
24 experience procuring battery vendors, in order to ensure a competitive process with  
25 sufficient bidders and the ability to select the specific solution based on both technical  
26 compliance and price, taking into consideration the Whitehorse climate conditions and  
27 Yukon Energy's specific requirements. In the event that vendor capital cost bids are  
28 materially higher than the Application estimates, YEC will also have options to reduce the  
29 scale of the BESS in order to reduce capital costs without material reductions in Table 4-  
30 3 estimated savings.

31

32 YEC's risk management of operating costs includes ongoing efforts to reduce the property  
33 tax that accounts for approximately 48% of the current estimated operating cost (Table 3-  
34 5 of the Application).

35

36 YEC's risk management of savings estimated from the Project focuses on ensuring that  
37 at least 7.2 MW of useable dependable capacity is provided by the Project (as this is the

1 key factor affecting avoided diesel rental costs). Operating reserve use benefits, which  
2 provide almost all of the remaining savings estimated from the Project, are dependent on  
3 the Project being able to operate as planned as well as annual water conditions and actual  
4 thermal fuel prices – YEC’s ongoing maintenance and operations planning addresses  
5 management of the risks that are under YEC’s control in this regard (see Table 3-5,  
6 footnote 2 regarding annual preventive maintenance). The functionality of the BESS will  
7 be incorporated into YEC’s daily and seasonal generation resource planning processes  
8 with the overall objective of maximizing generation from available renewable resources  
9 and minimizing thermal generation.

10  
11 **(d)**

12  
13 As noted in section 4.2.3 of the Application and Table 4-3, under the forecast net capital  
14 costs assumed in the Application the net present value (2022\$) of the costs is \$27.751  
15 million over the life of the Project compared to the net present value of benefits of \$40.426  
16 million. This results in a benefit to Yukon ratepayers with a present value saving of \$12.676  
17 million.

18  
19 If the gross capital costs are 30% higher than assumed in the Application (i.e., capital  
20 costs of \$41.207 million before the \$16.5 million grant), then the net present value (2022\$)  
21 of the costs as assessed in Table 4-3 of the Application would be \$37.961 million over the  
22 life of the Project compared to the net present value of benefits of \$40.426 million resulting  
23 in benefit Yukon ratepayers with present value savings of \$2.466 million. This would be  
24 about \$10.210 million lower than the estimate in the Application, however, the Project  
25 would still show net benefits to ratepayers over the Project life.

26  
27 Please also see response to JM-YEC-1-33(d).

28  
29 **(e)**

30  
31 If the annual operating costs are 30% higher than assumed in the Application, then the  
32 net present value (2022\$) of the costs as assessed in Table 4-3 of the Application would  
33 be \$30.795 million over the life of the Project compared to the net present value of benefits  
34 of \$40.426 million. This results in a benefit to Yukon ratepayers, with present value savings  
35 of \$9.632 million. This would be about \$3.044 million lower than the estimate in the  
36 Application, however, the Project still would show net benefits to ratepayers over the  
37 Project life.

1 **(f)**

2

3 If the annual recharging costs are 30% higher than assumed in the Application, then the  
4 net present value (2022\$) of the costs as assessed in Table 4-3 of the Application would  
5 be \$28.136 million over the life of the Project compared to the net present value of benefits  
6 of \$40.426 million. This results in benefits to Yukon ratepayers with present value savings  
7 of \$12.290 million. This would be about \$0.386 million lower than the estimate in the  
8 Application, however, the Project still would show net benefits to ratepayers over the  
9 Project life.

10

11 **(g)**

12

13 YEC is not able to provide statistical estimates of probability for any of the events  
14 addressed in parts (a) to (d) above.

15

16 Overall, YEC's assessment is that the probability of securing net cost savings for  
17 ratepayers over the life of the BESS Project is very high. This assessment reflects the  
18 options available as reviewed above to control capital costs and prevent a 30% escalation  
19 of these costs. This assessment also reflects the specific limited scope adopted for the  
20 estimated savings and the high likelihood of securing at least 7.2 MW of useable  
21 dependable capacity as well as material operating reserve use thermal cost savings.

1 **TOPIC: Conventional Construction Technologies and Applicable**  
2 **Construction and Design Practices**

3

4 **REFERENCE: Application, Tab 6.2, PDF page 48**

5

6 **QUOTE:** “The Project will be built using conventional construction technologies  
7 suited for northern climate conditions and following all applicable  
8 construction and design practices for works of this nature, including  
9 building and electrical codes and adhering to industry best practices.”

10

11 **QUESTION:**

12

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

15

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

18

19 **ANSWER:**

20

21 **(a)**

22

23 Conventional construction methodologies that will be utilized during this project include:  
24 typical civil works (grading, application of soils and crushed stone, packing), ground grid  
25 design and installation (crushed stone, fence and equipment grounding), fencing  
26 installation as per safety standards (correct height and gaps under the fence), cable trench  
27 installation, piles driven for steel structures required for electrical equipment (disconnect  
28 switches, breakers, buss works, t-line connection), concrete pad for transformer complete  
29 with an oil containment system and control building installation.

30

31 **(b)**

32

33 Construction practices are standard (please see response to YUB-YEC-1-56(a)).

34

35 The BESS will be designed to meet the following standards, which are industry best  
36 practices:

37

- UL 1642 Standard for Lithium Batteries.

- 1       • UL 1973 Standard for Batteries for Use in Light Electric Rail (LER) Applications
- 2       and Stationary Applications
- 3       • UL 9540 Standard for Energy Storage Systems and Equipment
- 4       • NFPA 855 - Standard for the Installation of Stationary Energy Storage Systems
- 5       • IEEE 1547 Standard for Interconnecting Distributed Resourced with Electric Power
- 6       Systems.
- 7       • UL 1741 Inverters Converters, Controllers and Interconnection System Equipment
- 8       for Use with Distributed Energy Resources.

1 **TOPIC: Growing Gap in the N-1 Reserve Capacity**

2

3 **REFERENCE: Application, Appendix B: Hatch Report, PDF page 75**

4

5 **QUOTE:** "Yukon Energy completed an integrated resource plan in 2016, which  
6 identified a growing gap in the N-1 Reserve Capacity. Currently, Yukon  
7 Energy rents diesel gensets each year to cover the capacity gap during  
8 the peak load during the winter period."  
9

10 **QUESTION:**

11

12 a) Please provide further details on the identified growing gap in the N-1 Reserve  
13 Capacity. For example, what is the cause of this growing gap? Assuming no  
14 Battery Energy Storage System Project was installed, would the number of diesel  
15 generating units required in the forthcoming years grow?  
16

16

17 **ANSWER:**

18

19 **(a)**

20

21 The growing gap in the N-1 reserve capacity is caused primarily by the significant growth  
22 in the non-industrial peak demand forecast (see more detail below).  
23

23

24 In January 2020, YEC experienced a new record peak capacity demand of 103.84 MW  
25 (97.6 MW non-industrial). As a result of this record-breaking peak YEC was required to  
26 update its non-industrial peak capacity demand forecasting model to account for updated  
27 information on the actual peak demand of the YIS experienced during a prolonged cold  
28 weather event. This updated information takes into account the current penetration of  
29 electric heating. The significant growth in the peak non-industrial forecast for the next 10  
30 years is primarily driven by increased wholesale demand (e.g., population growth) and  
31 government policy actions related to electrification (including increased electric heating,  
32 electric heat pumps, and the adoption of electric vehicles).  
33

33

34 Section 4.1.2, Figure 4-1 and Table 4-1 of the Application provide details on all of the  
35 factors affecting the N-1 dependable capacity gap forecast through to 2030/31 and  
36 beyond. If the BESS were not installed, an additional 4 temporary diesel generating units

- 1 (7 MW) would be required in each of the years from 2022/23 onward shown in Table 4-1
- 2 on page 28 of the Application.

1 **TOPIC: Effect of the Project on Rates**

2

3 **REFERENCE: Application, Appendix B: Hatch Report**

4

5 **QUESTION:**

6

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

14

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

18

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

22

23 **ANSWER:**

24

25 **(a) through (c)**

26

27 The BESS is not expected to be in service until 2022. No costs related to the BESS are  
28 included in YEC's 2021 GRA, therefore, there is no impact to 2021 test year costs.

29

30 Table 4-3 in the Application provides Project costs and savings by key categories for each  
31 year of the Project operation, and is therefore retained for the response to this question.  
32 Reconciliation of Table 4-3 costs and savings with section 12 information in the Hatch  
33 Report has been provided in response to another IR (please see response to YUB-YEC-  
34 1-44(a)).

1 Implementation of the BESS Project will affect future YEC rate applications after 2021  
2 primarily with regard to the following main revenue requirement categories relating to  
3 Table 4-3 annual costs and savings:

- 4  
5 • Capital project costs greater than \$1 million (property, plant and equipment).  
6 Capital costs will affect revenue requirement categories for rate base, return on  
7 rate base (interest and return on equity), depreciation and amortization (these  
8 costs are shown together in Table 4-3 of the Application, column A, annual capital  
9 cost).
- 10  
11 • Project non-fuel operating costs (column B in Table 4-3) will affect revenue  
12 requirement categories for various non-fuel operating and maintenance expenses.
- 13  
14 • Project recharging costs (column C in Table 4-3) and savings from operating  
15 reserve use and peak shifting (columns F and G in Table 4-3) will affect revenue  
16 requirement categories for fuel costs.
- 17  
18 • Project savings from avoided diesel rental costs (column E in Table 4-3) will affect  
19 revenue requirement categories for production costs (“diesel”) under non-fuel  
20 operating and maintenance expenses.

21  
22 Table 4-3 of the Application illustrates estimates for annual costs and savings from the  
23 Project over the Project life. The table assumes for simplicity year 1 operation in 2022 and  
24 shows net annual savings to the customers at \$87,000 for 2022, increasing to \$2,350,000  
25 for year 20 of operation. This information indicates that the impact to customer bills would  
26 not be notable for initial years due to the impact of upfront capital costs. For example, a  
27 high level of the estimated customer bill impact for 2022 would be less than a 0.1%  
28 reduction in average customer bills, increasing to about 2% by end of the Project life.  
29 Estimates of impacts on customer bills are of course sensitive to allow the other factors  
30 affecting YEC revenue and load requirements over the life of the BESS Project.

1 **TOPIC: Sites Comparison**

2

3 **REFERENCE: Application, Appendix B: Hatch Report, Table 1-2, PDF page 70**

4

5 **QUESTION:**

6

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

9

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

13

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

15

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

18

19 **ANSWER:**

20

21 **(a)**

22

23 Please see Attachment 1 to this response which provides the Noise Assessment  
24 completed by Hatch as part of the Feasibility Study. The study did not find any specific  
25 controls for noise applicable in Yukon. In the absence of noise regulations in Yukon, this  
26 assessment was completed based on the Alberta Energy Regulators Directive 038: Noise  
27 Control. Table 5.1 outlines the permissible sound levels at each of the sensitive receptors  
28 identified surrounding the Whitehorse sites. Table 5.2 provides the same information for  
29 the Takhini site. If the sound level modelled at any of these receptors is above the  
30 permissible level noise controls would be required for the design.

31

32 The analysis concluded that no noise controls would be required for either of the  
33 Whitehorse sites; however, noise controls would be required for the Takhini site.

1 (b)

2

3 Noise modelling at both TKC and KDFN sites in Whitehorse were below the permissible  
4 noise level. Based on noise, this would result in a lower social risk for these two sites  
5 compared to the KDFN Takhini site. The results of the public engagement process also  
6 firmly established a much higher social risk for the Takhini site than the two Whitehorse  
7 sites.

8

9 (c)

10

11 Based on metrics shown Table 1-2 on page B-14 of the Application, there were risks  
12 identified for all the sites, which were taken into consideration when evaluating and  
13 selecting the project site.

14

15 **KDFN – Takhini site:**

- 16 • Distance from Whitehorse:
- 17 ○ Uncertainty regarding ability for BESS to deliver blackstart services from  
18 that distance.
- 19 ○ Response time (and operational costs) for YEC staff to respond to  
20 operational issues on-site or conduct inspections.
- 21 • Noise levels above permissible levels would require noise control mitigation  
22 measures.
- 23 • Uncertainty regarding potential contamination: the site has abandoned structures,  
24 vehicles and storage barrels that need to be cleaned up and may have resulted in  
25 contamination.
- 26 • No additional space available on nearby land (e.g., should the project require a  
27 larger footprint to accommodate unforeseen design elements, or an alternative  
28 container configuration, the site would be inadequate).
- 29 • Site is not level and requires grading and clearing.

30

31 **TKC - Whitehorse site:**

- 32 • Site located in previous floodplain. Uncertainty regarding the potential for the  
33 ground to become saturated during the spring.
- 34 • Uncertainty regarding the ability and time required to appropriately zone the site  
35 for utility use.
- 36 • Transmission line routing would cross through a recreational area (requiring taller  
37 poles).

1 **KDFN – Whitehorse site:**

- 2     • Site is not level and requires grading and clearing.  
3     • Access road required to be built.

4

5 **(d)**

6

7 YEC relied on input from TKC and KDFN through the trilateral Project Committee to inform  
8 YEC of any potential negative effects of a particular site. YEC understands the Chief and  
9 Council of both First Nations passed resolutions supporting the offers to YEC for the land,  
10 and that consideration of potential negative effects would have been given to inform the  
11 First Nations' decisions to confirm the site availability. YEC received commercial offers for  
12 the KDFN and TKC Whitehorse sites; KDFN withdrew the Takhini site from consideration  
13 in the Project Committee.



---

Yukon Energy Corporation  
Utility Battery Feasibility Study  
H362094

Engineering Report  
Engineering Management  
Utility Battery Feasibility Study Final Report - Phase 1

# Appendix C

## Noise Assessment Study

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H362094-00000-200-006-0001, Rev. 0,

Appendix C

Ver: 04.03

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Project Report

July 10, 2020

## Yukon Energy Utility Battery Feasibility Study

Distribution  
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### Siting Noise Impact Study

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Appendix A – Noise Contour Plots

Appendix B – Source Sound Power Calculations and Mitigation Insertion Loss

### Revision History

Rev #	Description of Change	Date Revised
A	Client Review – June 9, 2020 BESS - Structured Decision Making Workshop	May 28, 2020
B	Inclusion of 13 MW and 20 MW options	July 10, 2020

## 1. Introduction

Yukon Energy Corporation (Yukon Energy), established in 1987, is the public electric utility wholly owned by the Yukon Government. Yukon energy is a vertically integrated, regulated utility that owns and operates all power generation and distribution for the territory. Yukon Energy has retained Hatch to complete a feasibility assessment for the proposed battery energy storage system (BESS) to be added to the Yukon Energy grid. As part of this feasibility, a noise impact assessment was requested in order to evaluate cumulative noise impact of the BESS on the surrounding community.

The scope of this assessment includes the noise impact modelling of the BESS battery cells, inverters, and transformer for four battery layouts across three potential sites. The predicted sound levels are compared to community noise guidelines. Where predicted noise levels exceed permissible community sound level limits, high level noise controls (barriers, silencers, etc.) are proposed to mitigate noise emissions to acceptable levels.

### 1.1 Facility Description

The BESS equipment and layout are identical for each siting location. The major noise sources are the transformer, inverters, and batteries. Under typical operation, the BESS can run continuously for 24 hours, 7 days a week.

Each BESS has 3 layout options as listed below:

- A. 10 MW / 40 MWh – 14 x 4 MWh Battery Units, 7 x 1.5 MW Inverters, 1x 10 MW Transformer
- B. 13 MW / 40 MWh – 14 x 4 MWh Battery Units, 7 x 1.9 MW Inverters, 1x 13 MW Transformer
- C. 20 MW / 40 MWh – 14 x 4 MWh Battery Units, 7 x 2.9 MW Inverters, 2x 10 MW Transformer

The inverters and batteries will be operated within modified sea containers. The transformer will likely operate within an enclosure to protect it from the harsh arctic environment; however, for the purposes of this noise assessment, the transformer is conservatively modelled without an enclosure.

## 2. Study Areas

There are 3 proposed sites for the BESS, all on First Nation Settlement Land. The first site is on Ta'an Kwach'an Council (TKC) land and the other two are on Kwanlin Dun First Nation (KDFN) land.

- 1. TKC C-28B Property, near Whitehorse Substation accessed off Robert Service Way
- 2. KDFN C-34B Property, near Whitehorse Substation at the intersection of the Alaska Highway and Robert Service Way, accessed off Robert Service Way

3. KDFN C-135B Property, near Takhini Substation accessed off the Klondike Highway

The following figures present the layout of the proposed sites near Whitehorse and Takhini. The battery layout proposed for each site is approximately 3,500 m<sup>2</sup>.

**2.1 Whitehorse**

The Whitehorse location has two possible sites, which are on TKC (Figure 2-1) and KDFN lands. The proposed KDFN site has two battery layout options (Figure 2-2 and Figure 2-3). This noise assessment evaluates all three layout options individually across both the TKC and KDFN sites.



**Figure 2-1 : TKC Land Near Whitehorse.**



**Figure 2-2 : KDFN Land near Whitehorse – Option 1**



**Figure 2-3 : KDFN Land near Whitehorse – Option 2**

## 2.2 Takhini

The Takhini KDFN land and the proposed battery layout are shown in Figure 2-4, adjacent to the Takhini substation. The Takhini site has one proposed layout.



Figure 2-4 : KDFN Site Near Takhini.

### 3. Regulatory Framework and Sound Level Limits

#### 3.1 Municipal

The City of Whitehorse and the City of Takhini do not have a specific noise bylaw. However for the City of Whitehorse, there are provisions regarding nuisance noise in the Maintenance Bylaw. The Maintenance Bylaw only qualifies the noise and its nuisance. It does not identify sound level limits, nor does it ask to refer to some other existing regulations.

#### 3.2 Territorial / Provincial

##### 3.2.1 Yukon Territories

There are currently no jurisdictional noise regulations for the Yukon Territory. The only legal document concerning noise is the *Noise Prevention Act* (Yukon Government, 2002) which mainly limits the generation of excessive noise during the night time hours (23:00 to 07:00) The Act does outline any sound level limits, nor does it refer to other regulations as guidance.

Upon a literature review of community noise assessments completed for locations within the Yukon Territory, it was consistently observed that these assessments employed the Province of Alberta noise guidelines. An example of this approach was completed for the Whitehorse Upper Tank Farm Remediation Project in 2013 (RWDI, 2013).

### 3.2.2 Alberta

To assess the noise impact of energy projects on the surrounding community, the Alberta Energy Regulator (AER) Directive 038: Noise Control (hereafter referred to as Directive 038) (AER, 2007) is commonly applied.

Directive 038 regulates environmental noise emissions of energy related facilities in Alberta. It practices a balanced approach – it does not guarantee that residents in the area will not hear noise emanating from a facility in the outdoors. Its intent is to avoid impacting the indoor environment of nearby sensitive uses.

Directive 038 sets receptor-based Permissible Sound Levels (PSLs), which are based on adjusted existing ambient sound levels. The PSL is calculated as follows:

$$PSL = \text{Basic Sound Level} + \text{Daytime Adjustment} + \text{Class A Adjustment} + \text{Class B Adjustment}$$

The applicable PSL is calculated according Table 3-1 below:

**Table 3-1 Directive 038 Basic Sound Levels (dBA)**

Parameter	Basic Sound Level		
	1-8 Dwellings	9-160 Dwellings	>160 Dwellings
Category 1 >500 metres from major roadways & railways	40 <sup>(1)</sup>	43	46
Category 2 30 to 500 metres from major roadways & railways	45	48	51
Category 3 < 30 metres from major roadways & railways	50	53	56

(1) Based on rural ambient level of 35 dBA in Alberta plus 5 dB above ambient.

Table 3-2 presents the applicable adjustments to the Basic Sound Level and determines the applicable PSL.

**Table 3-2 Directive 038 Adjustments to Basic Sound Levels and Resulting PSL(dBA)**

Adjustment Type	Adjustment Value
Daytime Adjustment Accounts for differing operations during day or night	<b>None</b> Facility will be continuously operating during the daytime and nighttime
Class A1 Adjustment Seasonal adjustment for wintertime complaints	<b>None</b> Not to be used for design purposes
Class A2 Adjustment Ambient sound level adjustment	<b>None</b> No data suggesting higher ambient levels. Requires authority approval.
Class B Adjustment	<b>None</b>

Adjustment to account for duration of activity	Facility will operate for more than 60 days continuously
<b>Applicable PSL</b>	<b>Basic Sound Level + 0 dB</b>

Note that PSLs do not apply to emergency situations. As per Directive 038, an emergency is defined as an unplanned event that requires immediate attention to avoid the loss of life, injury, or damage to property. Any event more frequent than four times a year is not considered unplanned.

## 4. Methodology and Assumptions

Sound level prediction was based on the ISO 9613-2 (International Organization for Standardization (ISO), 1993) methodology utilizing the CadnaA noise prediction software package. Table 4-1 summarizes the modelling parameters.

**Table 4-1 Modelling Parameters**

Parameter	Details
Facility Geometry	Given the preliminary nature of this assessment, the equipment layout of each site was considered identical. Batteries, inverters, and the transformer were modeled as point sources.
Duty Cycles	All equipment was assumed to be operating continuously for 100 percent of the time.
Ground Conditions	The following ground absorption coefficients were assumed: G = 0.5 within and surrounding the facility G = 0.0 over bodies of water
Terrain Elevation	Topography was applied, based on the Yukon Government Corporate Spatial Warehouse, by Gematic Yukon.
Weather	Temperature: 10°C Relative Humidity: 70%

## 5. Sensitive Receptors

### 5.1.1 Whitehorse Sites

The nearest sensitive receptors surrounding the Whitehorse sites are mostly residential areas and hotels, while schools and daycares are located in Riverdale. Commercial and industrial locations are not considered receptors as these locations will not be affected by the overnight noise continuously emitted by the facility. The neighbourhood of Riverdale, in the city of

Whitehorse, is located approximately one kilometer north east of the TKC site, across the Yukon river.

The permissible sound level (PSL) for each receptors is evaluated based on the acoustic class category. As per Table 3-2, no further adjustments are applied to the basic sound level to evaluate the final PSL. PSLs for each receptor are presented in Table 5-1 and the location of each receptor relative to the potential sites are illustrated in Figure 5-1.

**Table 5-1 : Sensitive receptors surrounding the Whitehorse sites**

Receptor ID	UTM NAD 83 Coordinates		Description	Acoustic Class Category	PSL
	X	Y			
R1	496509	6727777	Hotel Black Spruce	2	45
R2	496716	6726911	Residential	2	45
R3	496699	6727503	RV Park	2	45
R4	497816	6729223	Residential	2	48
R5	498102	6729152	Residential	1	43
R6	498304	6729571	School	1	43
R7	496442	6727918	Residential	2	45
R8	495810	6727814	Residential	2	48
R9	498499	6729191	Residential	1	43
R10	498708	6729601	School	1	43
R11	498051	6729855	School	1	43
R12	498406	6729727	Daycare	1	43



**Figure 5-1 : Whitehorse Receptor's Locations**

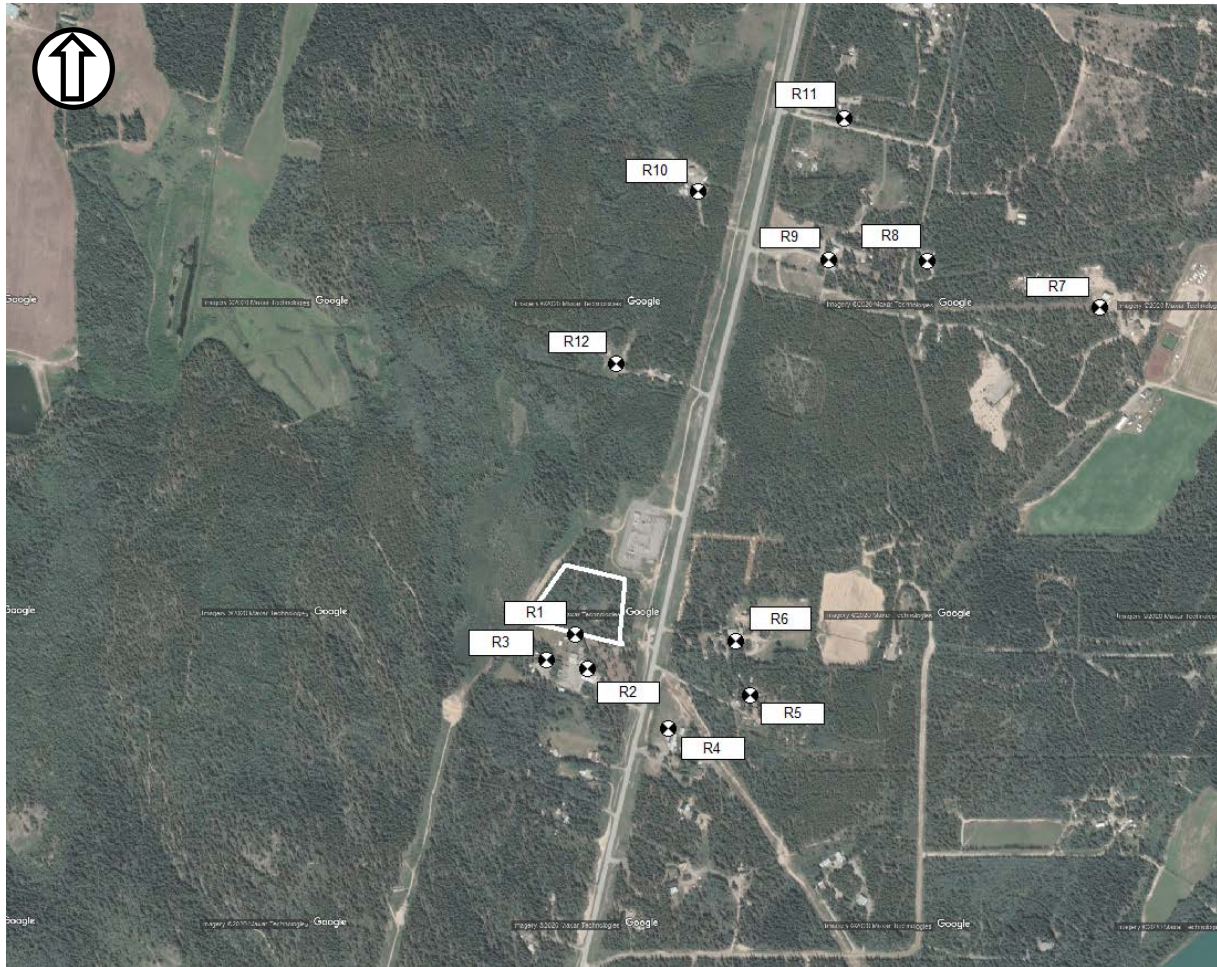
### **5.1.2 Takhini Sites**

The nearest sensitive receptors to the Takhini site are exclusively residential with some located within 150 meters of the site. Commercial and industrial locations are not considered receptors as these locations will not be affected by the overnight noise continuously emitted by the facility

The permissible sound level (PSL) for each receptors is evaluated based on the acoustic class category. As per Table 3-2, no further adjustments are applied to the basic sound level to evaluate the final PSL. PSLs for each receptor are presented in Table 5-2 and the location of each receptor relative to the potential site is illustrated in Figure 5-2.

**Table 5-2 : Sensitive receptors surrounding the Takhini site**

Receptor ID	UTM NAD 83 Coordinates		Description	Acoustic Class Category	PSL
	X	Y			
R1	489584	6749168	Residential	2	45
R2	489607	6749103	Residential	2	45
R3	489528	6749119	Residential	2	45
R4	489761	6748988	Residential	2	45
R5	489917	6749051	Residential	2	45
R6	489890	6749154	Residential	2	45
R7	490586	6749796	Residential	1	40
R8	490256	6749882	Residential	2	45
R9	490068	6749887	Residential	2	45
R10	489818	6750018	Residential	2	45
R11	490098	6750157	Residential	2	45
R12	489661	6749687	Residential	2	45



**Figure 5-2 : Takhini Receptor's Locations**

## 6. Noise sources

The main sources of noise from this project will be batteries, inverters and the transformer. The batteries and inverters will be placed within 20-foot standard sea containers, while the transformer in an simple enclosure to protect it from excessive snow buildup.

All noise sources were modeled as non-directional point sources. These point sources were located at the center of each source and conservatively modeled at the standard sea container height of 2.85-metres above grade.

Transformers and inverters commonly emit an acoustic tone. To account for the tonal noise components of these sources, a penalty of 5 dB was conservatively applied to the transformer and inverters as outlined in (AER, 2007).

The transformer was conservatively modeled without an enclosure.

The auxiliary transformer to support the facility and other equipment inside eHouse do not emit any significant noise due to their limited capacity. Consequently, the noise emission of the auxiliary transformer and eHouse were not modeled .

## 6.1 Point Sources

### 6.1.1 TKC Land Near Whitehorse

The battery facility noise sources for the TKC site near Whitehorse are listed in Table 6-1 and illustrated in Figure 6-1.

**Table 6-1 – Noise sources at the TKC Site Near Whitehorse**

Source ID	Qty	Description	Total Sound Power Level (dBA)	Correction (dB)	Height (m)	Mitigation
<b>Layout A - 10 MW / 40 MWh</b>						
B11 – B17 B21 – B27	14	4 MWh Battery	79.4	0	2.85	None
I01 – I07	7	1.5 MW Inverter	92.3	5	2.85	None
T01	1	10 MW Transformer	92.3	5	2.85	None
<b>Layout B - 13 MW / 40 MWh</b>						
B11 – B17 B21 – B27	14	4 MWh Battery	79.4	0	2.85	None
I01 – I07	7	1.9 MW Inverter	93.3	5	2.85	None
T01	1	13 MW Transformer	95.3	5	2.85	None
<b>Layout C - 20 MW / 40 MWh</b>						
B11 – B17 B21 – B27	14	4 MWh Battery	79.4	0	2.85	None
I01 – I07	7	2.9 MW Inverter	95.2	5	2.85	None
T01	2	10 MW Transformer	92.3	5	2.85	None



**Figure 6-1 Battery Site Layout (A & B), TKC Land Near Whitehorse**

**6.1.2 KDFN Land Near Whitehorse – Option 1 and 2**

The battery facility noise sources for the KDFN site near Whitehorse are listed in Table 6-2 and illustrated in Figure 6-2 and Figure 6-3.

**Table 6-2 Noise sources at the KDFN Site Near Whitehorse – Option 1. Identical for Option 2**

Source ID	Qty	Description	Total Sound Power Level (dBA)	Correction (dB)	Height (m)	Mitigation
<b>Layout A - 10 MW / 40 MWh</b>						
B11 – B17 B21 – B27	14	4 MWh Battery	79.4	0	2.85	None
I01 – I07	7	1.5 MW Inverter	92.3	5	2.85	None
T01	1	10 MW Transformer	92.3	5	2.85	None
<b>Layout B - 13 MW / 40 MWh</b>						
B11 – B17 B21 – B27	14	4 MWh Battery	79.4	0	2.85	None
I01 – I07	7	1.9 MW Inverter	93.3	5	2.85	None
T01	1	13 MW Transformer	95.3	5	2.85	None
<b>Layout C - 20 MW / 40 MWh</b>						
B11 – B17 B21 – B27	14	4 MWh Battery	79.4	0	2.85	None
I01 – I07	7	2.9 MW Inverter	95.2	5	2.85	None
T01	2	10 MW Transformer	92.3	5	2.85	None

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**Figure 6-2 Battery Site Layout (A & B), KDFN Land Near Whitehorse – Option 1**

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Figure 6-3 Battery Site Layout (A & B), KDFN Land Near Whitehorse – Option 2

**6.1.3 KDFN Site Near Takhini**

The battery facility noise sources for the KDFN site near Whitehorse are listed in Table 6-2 and illustrated in Figure 6-4.

Table 6-3 Noise sources at the KDFN Site Near Takhini

Source ID	Qty	Description	Total Sound Power Level (dBA)	Correction (dB)	Height (m)	Mitigation
<b>Layout A - 10 MW / 40 MWh</b>						
B11 – B17 B21 – B27	14	4 MWh Battery	79.4	0	2.85	None
I01 – I07	7	1.5 MW Inverter	92.3	5	2.85	Yes*
T01	1	10 MW Transformer	92.3	5	2.85	Yes*

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<b>Layout B - 13 MW / 40 MWh</b>						
B11 – B17 B21 – B27	14	4 MWh Battery	79.4	0	2.85	None
I01 – I07	7	1.9 MW Inverter	93.3	5	2.85	Yes*
T01	1	13 MW Transformer	95.3	5	2.85	Yes*
<b>Layout C - 20 MW / 40 MWh</b>						
B11 – B17 B21 – B27	14	4 MWh Battery	79.4	0	2.85	None
I01 – I07	7	2.9 MW Inverter	95.2	5	2.85	Yes*
T01	2	10 MW Transformer	92.3	5	2.85	Yes*

\* Refer to Section 7.2 for further details on proposed noise mitigation



**Figure 6-4 Battery Site Layout (A & B), KDFN Site Near Takhini**

## 6.2 Noise Sources Sound Power Spectra

A summary of the sound power frequency spectra for the battery facilities described above are presented in Table 6-4. The sound power levels listed Table 6-4 do not include tonality penalties or attenuations from noise controls. Further details on the calculation of the sound power spectra are included with Appendix B.

**Table 6-4 Source Sound Power Spectra**

ID	Octave Sound Power Spectrum (dB)										
	31.5	63	125	250	500	1000	2000	4000	8000	A	lin
4 MWh Battery	80.6	79.7	74.2	85.5	77.0	69.8	63.2	57.2	49.0	79.4	88.1
1.5 MW Inverter	86.0	85.0	86.0	87.0	85.0	83.0	78.0	72.0	68.0	87.3	93.5
1.9 MW Inverter	87.0	86.0	87.0	88.0	86.0	84.0	79.0	73.0	69.0	88.3	94.5
2.9 MW Inverter	88.9	87.9	88.9	89.9	87.9	85.9	80.9	74.9	70.9	90.2	96.3
10 MW Transformer	83.9	89.9	91.9	86.9	86.9	80.9	75.9	70.9	63.9	87.3	96.0
13 MW Transformer	86.9	92.9	94.9	89.9	89.9	83.9	78.9	73.9	66.9	90.3	99.0

## 7. Impact Assessment

### 7.1 Predicted Noise Levels

Table 7-1 summarizes the predicted sound levels for the sensitive receptors surrounding the TKC and KDFN sites near Whitehorse. The results show that all surrounding receptors are compliant with the Permissible Sound Levels (PSL) determined for each receptor.

The presence of a potential for low frequency noise was calculated by subtracting the overall dBA levels from dBC levels as per the Alberta Energy Regulator noise guidelines (AER, 2007). All receptor dBC-dBA levels were calculated to be less than 20 dB. Therefore, no receptor is anticipated to experience excessive low frequency noise from the BESS.

Noise contours plots showing the extent of community noise from each layout are presented in Appendix A.

**Table 7-1 Noise Levels from TKC and KDFN Sites Near Whitehorse**

Rec. ID	Description	Class <sup>1</sup>	PSL (dBA)	Predicted Sound Level (dBA)								
				TKC			KDFN Layout 1			KDFN Layout 2		
				A	B	C	A	B	C	A	B	C
R1	Hotel Black Spruce	2	45	17	19	20	31	32	33	31	32	34
R2	Residential	2	45	10	12	13	24	25	26	23	24	26
R3	RV Park	2	45	20	21	23	32	32	34	30	31	33
R4	Residential	2	48	25	26	28	8	21	23	20	21	23
R5	Residential	1	43	13	14	16	20	9	11	16	17	18

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Rec. ID	Description	Class <sup>1</sup>	PSL (dBA)	Predicted Sound Level (dBA)								
				TKC			KDFN Layout 1			KDFN Layout 2		
				A	B	C	A	B	C	A	B	C
R6	School	1	43	20	21	23	-	-	-	-	-	-
R7	Residential	2	45	23	25	26	35	36	38	32	33	35
R8	Residential	2	48	20	21	22	27	28	30	25	26	28
R9	Residential	1	43	20	21	22	17	18	20	-	-	-
R10	School	1	43	-	0	2	-	-	-	-	-	-
R11	School	1	43	0	2	3	-	-	-	-	-	-
R12	Daycare	1	43	19	20	21	-	-	-	-	-	-

'-' indicates a predicted sound level in the inaudible range below the reference sound pressure level of 20 µPa

<sup>1</sup> Acoustic Classification

	Compliant with PSL
	Non-compliant with PSL

Table 7-2 summarizes the predicted sound levels for the sensitive receptors surrounding the KDFN site near Takhini. The results show that all but three surrounding receptors are compliant with the Permissible Sound Levels (PSL) determined for each receptor.

When mitigation is applied as described in Section 7.2, the remaining three receptors become compliant.

The presence of a potential for low frequency noise was calculated by subtracting the overall dBA levels from dBC levels as per the Alberta Energy Regulator noise guidelines (AER, 2007). All receptor dBC-dBA levels were calculated to be less than 20 dB. Therefore no receptor is anticipated to experience excessive low frequency noise from the battery facility.

Noise contours plots showing the extent of community noise from each layout are presented in Appendix A.

**Table 7-2 Noise Levels from KDFN Site Near Takhini**

Rec. ID	Description	Class <sup>1</sup>	PSL (dBA)	Predicted Sound Level (dBA)					
				KDFN					
				A		B		C	
				No mitigation	With mitigation	No mitigation	With mitigation	No mitigation	With mitigation
R1	Residential	2	45	50	43	51	44	53	45
R2	Residential	2	45	46	38	47	39	49	40
R3	Residential	2	45	46	38	47	38	48	40
R4	Residential	2	45	40	32	41	33	43	34

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Rec. ID	Description	Class <sup>1</sup>	PSL (dBA)	Predicted Sound Level (dBA)					
				KDFN					
				A		B		C	
				No mitigation	With mitigation	No mitigation	With mitigation	No mitigation	With mitigation
R5	Residential	2	45	39	30	40	31	41	32
R6	Residential	2	45	35	32	42	33	43	34
R7	Residential	1	40	27	19	29	20	30	21
R8	Residential	2	45	30	22	31	22	32	23
R9	Residential	2	45	31	23	33	24	34	25
R10	Residential	2	45	31	23	32	24	34	25
R11	Residential	2	45	28	20	30	21	31	22
R12	Residential	2	45	37	29	39	30	40	31

<sup>1</sup> Acoustic Classification

	Compliant with PSL
	Non-compliant with PSL

## 7.2 Noise Control Measures

For the battery facility on KDFN site near Takhini to comply with the permissible sound level (PSL) limits, the following noise control measures will need to be applied.

- ◆ Acoustic silencers on cooling and heating ventilation openings for the inverter sea containers
- ◆ A transformer acoustic enclosure.

The minimum performance of the above mention noise controls measures for the inverters and transformer at the Takhini site shall be as listed in Table 7-3.

The evaluation of the proposed noise control measure insertion losses are calculated in Appendix B under the *Estimated Frequency Spectra for Inverter and Enclosure Reduction*.

Images of a typical transformer acoustic enclosure and an inverter with ventilation silencers are shown in Figure 7-1.

**Table 7-3 Minimum Sound Reduction Insertion Losses**

Mitigation	Insertion Loss (dB)									
	31.5	63	125	250	500	1000	2000	4000	8000	Ovl. IL
Inverter Ventilation Silencers	4	3	5	7	12	10	9	5	2	7
Transformer Enclosure	1	10	16	22	26	24	27	25	27	26



**Figure 7-1 (a) Transformer Acoustic Enclosure (b) Inverter Enclosure with Silencers**

## 8. Cost Estimate of Noise Control Measures

The estimated cost of noise control measure to be applied at the Takhini site are as follows:

- ◆ 16,000 CAD - Transformer Enclosure having a surface area of approximately 100m<sup>2</sup>
- ◆ 49,000 CAD – Acoustic silencers for 7 enclosed inverters (7,000 CAD each)

The total cost estimate of the noise control measures at Takhini site in order to achieve the PSL for all surrounding receptors will be approximately 65,000 CAD.

## 9. Conclusions and Recommendations

A noise impact assessment was performed for a total of four proposed layouts across three potential sites. In the absence of jurisdictional noise regulations for the Yukon Territory, the Alberta Energy Regulator (AER) Directive 038: Noise Control (AER, 2007) was used as the applicable guideline.

Sound levels from three layouts across two sites near Whitehorse were found to be in compliance with permissible sound levels (PSLs) for all surrounding receptors without the need for additional noise controls.

Sound levels from the Takhini site layout were found to exceed PSLs at three surrounding receptors. By applying a transformer enclosure and ventilation silencers for the inverter containers, sound levels at all surrounding receptors of the Takhini site were found to fall within compliance.

For every option, the presence of low frequency noise is not anticipated with a calculated dBC-dBA metric of less than 20 dB for all receptors.

To avoid the added cost of noise controls, Hatch recommends a selection of on the three layouts near Whitehorse.

## 10. References

- AER. (2007, February). *Directive 038: Noise Control (Revised edition, February 16, 2007)*. Récupéré sur Alberta Energy Regulator: <https://www.aer.ca/documents/directives/Directive038.pdf>
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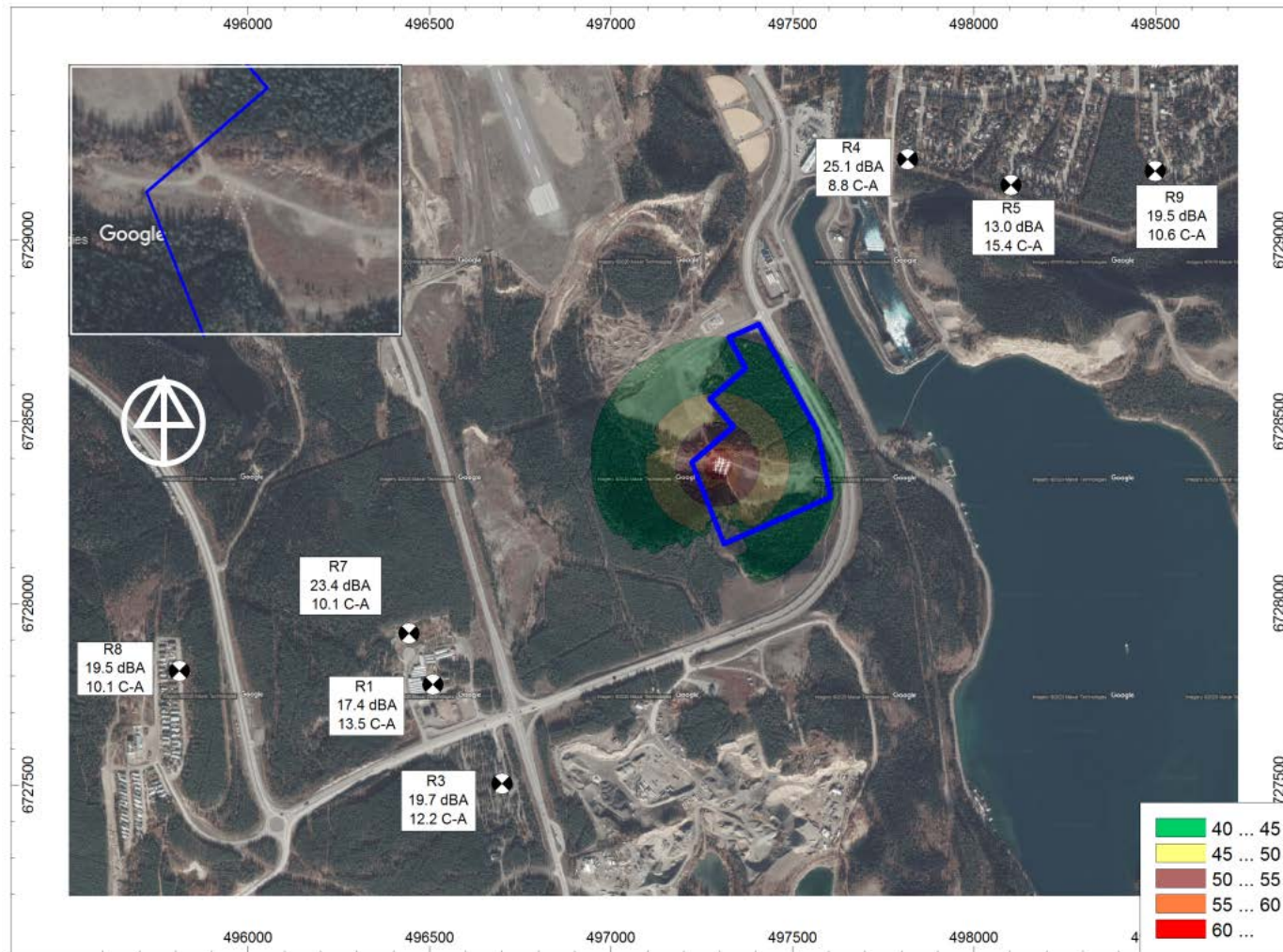
Mélanie Sicard  
MS:ms  
Attachment(s)/Enclosure

# **Appendix A**

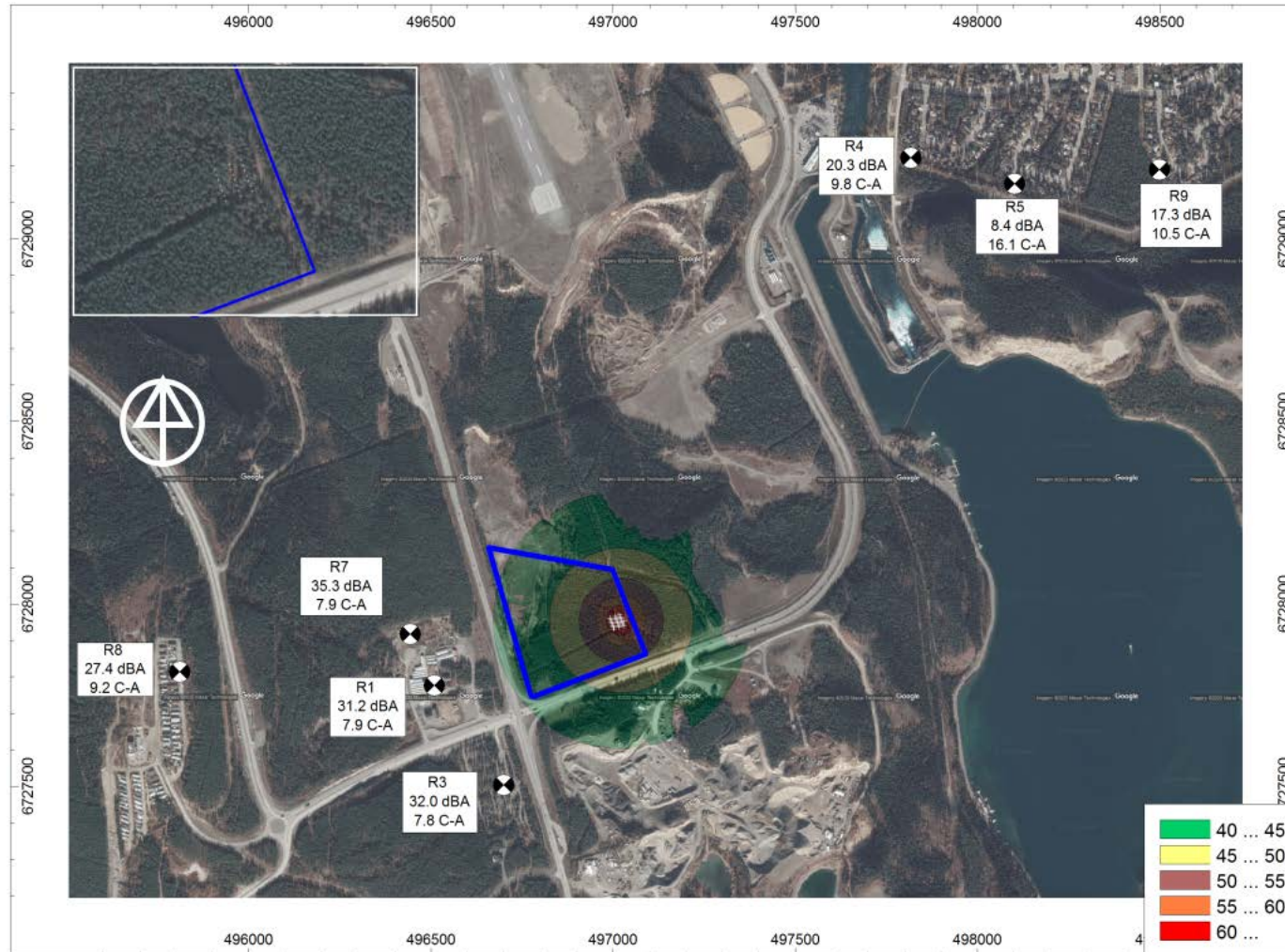
## **Noise Contour Plots**

### **Layout A – 10 MW**

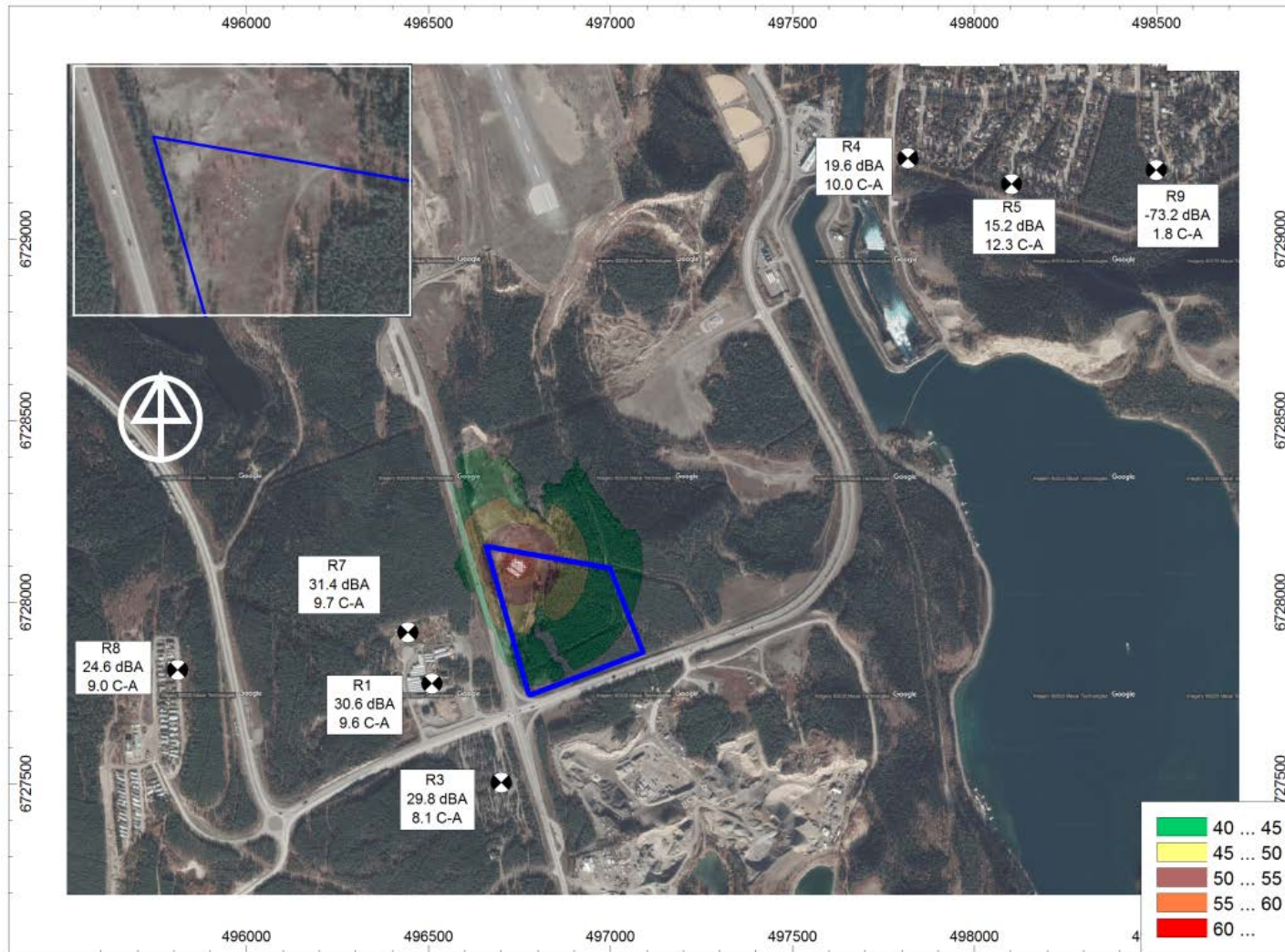
### TKC Site Near Whitehorse



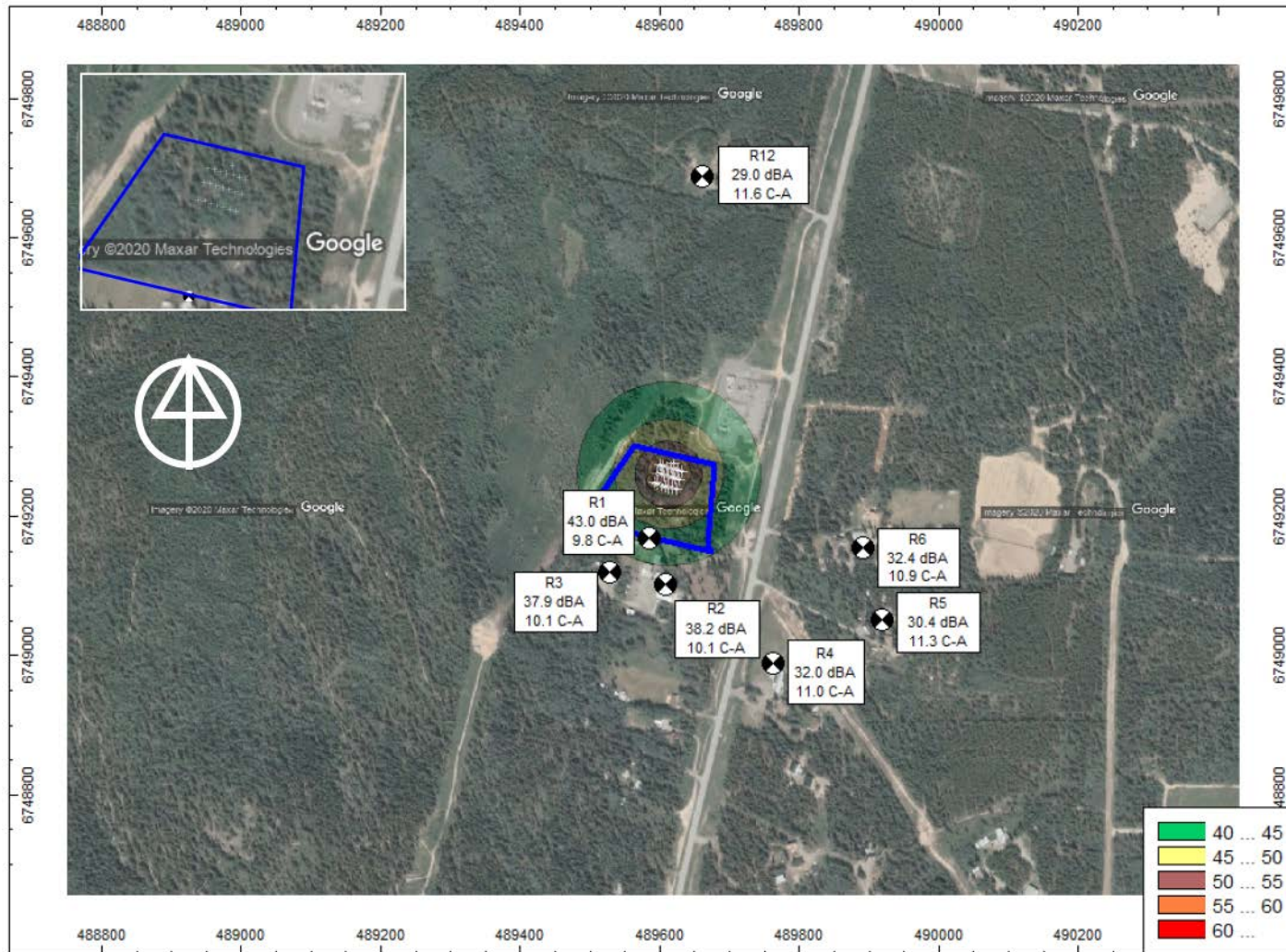
### KDFN Site Near Whitehorse – Option 1



### KDFN Site Near Whitehorse – Option 2



### KDFN Site Near Takhini – with noise controls



# **Appendix B**

## **Source Sound Power Calculations and Mitigation Insertion Loss**



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Siting Noise Impact Study

Estimated Frequency Spectra for Transformers

Transformer - 13.8kV/44kV/10MVA - Oil filled

Manufacturer	Model	L [m]	W [m]	H [m]	Offset [m]	Side	Back	Total Area
	10MW	2.26	3.15	3.43	0.3	21.3	28.0	49.3

From Handbook of Noise and Vibration Control (Crocker, 2007, page 1335-1336, Eq. 18 and Table 20)

Average Lp 68.0 dBA Based on NEMA TR1-1993 (R2000), Table 0-2, immersed power transformers  
Estimated surface area 49.3 m<sup>2</sup> Estimated based on Culter-Hammer catalogue. 0.6 of the depth was taken into account since the catalogue presents Air-Natural type transformer where radiators are normally larger than these of Air-Forced type

Correction factors are in dB

Freq. (Hz)	31	63	125	250	500	1000	2000	4000	8000	Notes
C1	-11.0	-5.0	-3.0	-8.0	-8.0	-14.0	-19.0	-24.0	-31.0	Outdoors, indoors in mechanical room over 140 m <sup>3</sup>
C2	-11.0	-2.0	3.0	-2.0	-2.0	-11.0	-19.0	-24.0	-31.0	Indoors
C3	-11.0	-2.0	3.0	2.0	2.0	-4.0	-9.0	-14.0	-21.0	Serious Noise Problems

Sound Power Level calculated as Lw=Average Lp + 10\*log(Estimated surface area) + C + 10

Freq. (Hz)	31	63	125	250	500	1000	2000	4000	8000	Combined [dB]
C1 based [dB]	83.9	89.9	91.9	86.9	86.9	80.9	75.9	70.9	63.9	96.0
C2 based [dB]	83.9	92.9	97.9	92.9	92.9	83.9	75.9	70.9	63.9	101.0
C3 based [dB]	83.9	92.9	97.9	96.9	96.9	90.9	85.9	80.9	73.9	103.0

Resulting A-weighted sound power level

Freq. (Hz)	A-Weight	C1 based [dBA]	C2 based [dBA]	C2 based [dBA]
31	-39.4	44.5	53.5	58.5
63	-26.2	63.7	66.7	66.7
125	-16.1	75.8	81.8	81.8
250	-8.6	78.3	84.3	88.3
500	-3.2	83.7	89.7	93.7
1000	0.0	80.9	83.9	90.9
2000	1.2	77.1	77.1	87.1
4000	1.0	71.9	71.9	81.9
8000	-1.1	62.8	62.8	72.8
LwA [dBA]		87.3	92.3	97.1

Used in the study

Cutler-Hammer  
January 2003  
Ref. No. 0443

Substation Transformers  
General Descriptors  
15.0-5

Standard Features — Liquid-Filled Transformer

- ① Cover — welded to tank.
- ② Cooling tubes (Radiators).
- ③ Automatic resealing mechanical pressure relief device.
- ④ HV bushing, three total, located in ANSI Segment 2.
- ⑤ LV bushing, four total (not connected), located in ANSI Segment 4.
- ⑥ Note: HV and LV bushings may be cover mounted or full-height construction may be reversed.
- ⑦ Z-Bar flanges.
- ⑧ Lifting loops — two for lifting cover only.
- ⑨ Lifting hooks — four for lifting complete unit.
- ⑩ Jacking provisions on tank or base.
- ⑪ Ground pad — two total.
- ⑫ Drain valve — for combination lower filler press connection and complete drain with sampler.
- ⑬ Base (may be flat or formed).
- ⑭ Control cabinet for alarm lead termination.
- ⑮ Diagram instruction nameplate with warning nomenclature.
- ⑯ De-energized tap changer with padlock provisions.
- ⑰ Liquid temperature indicator with maximum indicating hand.
- ⑱ Upper valve for upper filler press connection.
- ⑲ Magnetic liquid level gauge.
- ⑳ Vacuum pressure gauge with air test and Svedberg valve.

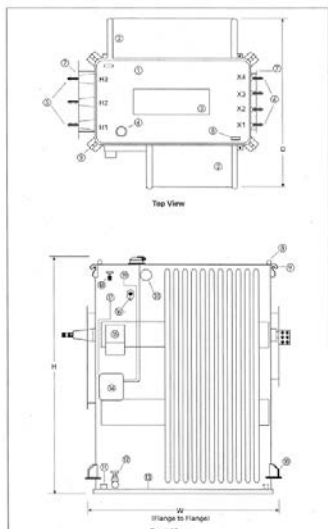


Figure 15.0-1. Liquid-Filled Primary Unit Substation Transformer with Well-Mounted HV and LV Bushings.  
Note: See Pages 15.0-6 and 15.0-7 for dimensions and weights.

Cutler-Hammer  
January 2003  
Ref. No. 0443

Substation Transformers  
Layered Dimensions  
15.0-7

For special 55°C rise units, bus duct throats, and air terminal chambers, see Notes at bottom of page for dimensions which should be added to the table dimensions.

Table 15.0-7. 60°C Rise, Oil-Filled HV 34500V, 200 BIL, LV 13800V, 95 BIL

kVA Rating	Weight (Lbs. Rtg)	Gallons (Silent) Liquid	Dimensions in Inches (mm)	Height	Width	Depth
750	7000 (3170)	300 (1248)	115 (2921.0)	67 (1701.8)	66 (1676.4)	60 (1524.0)
1000	7700 (3500)	300 (1248)	115 (2921.0)	67 (1701.8)	79 (2006.6)	60 (1524.0)
1500	9800 (4400)	300 (1248)	115 (2921.0)	67 (1701.8)	88 (2238.2)	60 (1524.0)
2000	11,300 (5130)	410 (1552)	115 (2921.0)	71 (1803.4)	112 (2844.8)	60 (1524.0)
2500	12,800 (5840)	450 (1703)	115 (2921.0)	71 (1803.4)	132 (3354.8)	60 (1524.0)
3000	13,700 (6240)	460 (1745)	115 (2921.0)	72 (1828.8)	130 (3303.0)	60 (1524.0)
3750	16,200 (7320)	520 (1968)	115 (2921.0)	85 (2154.0)	136 (3454.4)	60 (1524.0)
5000	19,700 (8900)	660 (2496)	117 (2971.8)	100 (2540.0)	138 (3505.2)	60 (1524.0)
7500	25,270 (11570)	910 (3456)	128 (3276.8)	124 (3148.8)	138 (3505.2)	60 (1524.0)
10,000	29,200 (13230)	1480 (5600)	136 (3454.4)	127 (3228.0)	140 (3566.0)	60 (1524.0)

Table 15.0-8. 55°C Rise, Oil-Filled HV 34500V, 200 BIL, LV 13800V, 95 BIL

kVA Rating	Weight (Lbs. Rtg)	Gallons (Silent) Liquid	Dimensions in Inches (mm)	Height	Width	Depth
750	7300 (3292)	340 (1287)	115 (2921.0)	68 (1727.2)	67 (1701.8)	60 (1524.0)
1000	8040 (3650)	380 (1452)	115 (2921.0)	68 (1727.2)	80 (2032.0)	60 (1524.0)
1500	9900 (4504)	390 (1476)	115 (2921.0)	68 (1727.2)	84 (2137.6)	60 (1524.0)
2000	11,700 (5312)	430 (1628)	115 (2921.0)	71 (1803.4)	116 (2942.4)	60 (1524.0)
2500	13,100 (5956)	460 (1745)	115 (2921.0)	71 (1803.4)	136 (3454.4)	60 (1524.0)
3000	14,400 (6538)	500 (1897)	115 (2921.0)	76 (1930.4)	129 (3271.2)	60 (1524.0)
3750	16,700 (7580)	540 (2049)	116 (2961.0)	77 (1965.6)	136 (3454.4)	60 (1524.0)
5000	20,400 (9252)	740 (2808)	124 (3148.8)	95 (2413.0)	139 (3530.6)	60 (1524.0)
7500	26,470 (11987)	1190 (4502)	133 (3378.0)	122 (3098.8)	140 (3566.0)	60 (1524.0)
10,000	29,390 (13311)	1790 (6652)	132 (3352.8)	125 (3175.0)	142 (3607.0)	60 (1524.0)

Table 15.0-9. 60°C Rise, Oil-Filled HV 34500V, 200 BIL, LV 13800V, 95 BIL

kVA Rating	Weight (Lbs. Rtg)	Gallons (Silent) Liquid	Dimensions in Inches (mm)	Height	Width	Depth
750	3110 (1406)	410 (1552)	115 (2921.0)	72 (1828.8)	63 (1600.2)	60 (1524.0)
1000	3270 (1474)	260 (1000)	115 (2921.0)	72 (1828.8)	90 (2286.0)	60 (1524.0)
1500	3570 (1620)	410 (1552)	115 (2921.0)	72 (1828.8)	93 (2367.0)	60 (1524.0)
2000	3720 (1684)	460 (1745)	115 (2921.0)	72 (1828.8)	108 (2743.2)	60 (1524.0)
2500	3900 (1760)	470 (1778)	115 (2921.0)	74 (1879.8)	109 (2768.8)	60 (1524.0)
3000	4090 (1846)	510 (1930)	115 (2921.0)	74 (1879.8)	109 (2768.8)	60 (1524.0)
3750	4390 (1982)	540 (2049)	115 (2921.0)	77 (1965.6)	107 (2718.0)	60 (1524.0)
5000	4840 (2192)	710 (2670)	122 (3098.8)	84 (2130.0)	108 (2768.8)	60 (1524.0)
7500	52,220 (23620)	1056 (3972)	128 (3276.8)	123 (3132.0)	108 (2768.8)	60 (1524.0)
10,000	56,460 (25460)	1556 (5792)	136 (3454.4)	124 (3148.8)	108 (2768.8)	60 (1524.0)

Notes: 1. Dimensions are APPROXIMATE. Refer to the transformer's outline drawing for actual dimensions for construction.

Table 15.0-10. 65°C Rise, Silicone-R-Temp/ROTEMP-Filled HV 34500V, 75 BIL, LV 2000V, 45 BIL

kVA Rating	Weight (Lbs. Rtg)	Gallons (Silent) Liquid	Dimensions in Inches (mm)	Height	Width	Depth
750	4950 (2230)	160 (608)	87 (2209.8)	48 (1219.2)	76 (1929.6)	60 (1524.0)
1000	5940 (2697)	180 (681)	87 (2209.8)	52 (1320.8)	82 (2082.6)	60 (1524.0)
1500	7650 (3451)	220 (832)	87 (2209.8)	59 (1498.8)	85 (2157.0)	60 (1524.0)
2000	9270 (4209)	250 (946)	87 (2209.8)	62 (1574.4)	107 (2717.8)	60 (1524.0)
2500	10,830 (4926)	280 (1060)	87 (2209.8)	62 (1574.4)	110 (2804.4)	60 (1524.0)
3000	12,360 (5634)	340 (1287)	87 (2209.8)	63 (1626.0)	121 (3071.4)	60 (1524.0)
3750	14,540 (6601)	380 (1443)	87 (2209.8)	67 (1701.8)	122 (3098.4)	60 (1524.0)
5000	18,630 (8453)	560 (2104)	98 (2491.2)	68 (1727.2)	123 (3132.0)	60 (1524.0)

Table 15.0-11. 65°C Rise, Silicone-R-Temp/ROTEMP-Filled HV 13800V, 95 BIL, LV 2000V, 45 BIL

kVA Rating	Weight (Lbs. Rtg)	Gallons (Silent) Liquid	Dimensions in Inches (mm)	Height	Width	Depth
750	5070 (2276)	160 (608)	87 (2209.8)	48 (1219.2)	76 (1929.6)	60 (1524.0)
1000	6090 (2766)	180 (681)	87 (2209.8)	52 (1320.8)	82 (2082.6)	60 (1524.0)
1500	7720 (3500)	220 (832)	87 (2209.8)	59 (1498.8)	85 (2157.0)	60 (1524.0)
2000	9270 (4209)	250 (946)	87 (2209.8)	62 (1574.4)	107 (2717.8)	60 (1524.0)
2500	10,830 (4926)	280 (1060)	87 (2209.8)	62 (1574.4)	110 (2804.4)	60 (1524.0)
3000	12,360 (5634)	340 (1287)	87 (2209.8)	63 (1626.0)	121 (3071.4)	60 (1524.0)
3750	14,540 (6601)	380 (1443)	87 (2209.8)	67 (1701.8)	122 (3098.4)	60 (1524.0)
5000	18,630 (8453)	560 (2104)	98 (2491.2)	68 (1727.2)	123 (3132.0)	60 (1524.0)

Table 15.0-12. 65°C Rise, Silicone-R-Temp/ROTEMP-Filled HV 13800V, 95 BIL, LV 13800V, 95 BIL

kVA Rating	Weight (Lbs. Rtg)	Gallons (Silent) Liquid	Dimensions in Inches (mm)	Height	Width	Depth
750	5340 (2414)	180 (681)	87 (2209.8)	48 (1219.2)	76 (1929.6)	60 (1524.0)
1000	6320 (2778)	190 (719)	87 (2209.8)	51 (1298.4)	82 (2082.6)	60 (1524.0)
1500	7890 (3576)	220 (832)	87 (2209.8)	58 (1482.6)	85 (2157.0)	60 (1524.0)
2000	9400 (4232)	260 (984)	87 (2209.8)	61 (1561.8)	109 (2768.8)	60 (1524.0)
2500	11,000 (4976)	290 (1098)	87 (2209.8)	61 (1561.8)	115 (2911.8)	60 (1524.0)
3000	12,470 (5661)	310 (1173)	87 (2209.8)	66 (1676.4)	115 (2911.8)	60 (1524.0)
3750	14,890 (6744)	360 (1368)	87 (2209.8)	68 (1727.2)	121 (3071.4)	60 (1524.0)
5000	18,330 (8322)	540 (2044)	93 (2367.0)	68 (1727.2)	122 (3098.4)	60 (1524.0)
7500	23,330 (10622)	970 (3671)	98 (2491.2)	111 (2819.4)	121 (3071.4)	60 (1524.0)
10,000	28,090 (12722)	1320 (4983)	101 (2565.0)	114 (2895.0)	121 (3071.4)	60 (1524.0)



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**Estimated Frequency Spectra for Transformers**

**Transformer - 13.8kV/44kV/10MVA - Oil filled, Forced Air Cooled**

Manufacturer	Model	L [m]	W [m]	H [m]	Offset [m]	Side	Back	Total Area
	13MW	2.26	3.15	3.43	0.3	21.3	28.0	49.3

From Handbook of Noise and Vibration Control (Crocker, 2007, page 1335-1336, Eq. 18 and Table 20)

Average LpA 71.0 dBA Based on NEMA TR1-1993 (R2000), Table 0-2, immersed power transformers  
Estimated surface area 49.3 m<sup>2</sup> Estimated based on Cutler-Hammer catalogue. 0.6 of the depth was taken into account since the catalogue presents Air-Natural type transformer where radiators are normally larger than these of Air-Forced type

Correction factors are in dB

Freq. (Hz)	31	63	125	250	500	1000	2000	4000	8000	Notes
C1	-11.0	-5.0	-3.0	-8.0	-8.0	-14.0	-19.0	-24.0	-31.0	Outdoors, indoors in mechanical room over 140 m <sup>3</sup>
C2	-11.0	-2.0	3.0	-2.0	-2.0	-11.0	-19.0	-24.0	-31.0	Indoors
C3	-11.0	-2.0	3.0	2.0	2.0	-4.0	-9.0	-14.0	-21.0	Serious Noise Problems

Sound Power Level calculated as Lw=Average LpA + 10\*log(Estimated surface area) + C + 10

Freq. (Hz)	31	63	125	250	500	1000	2000	4000	8000	Combined [dB]
C1 based [dB]	86.9	92.9	94.9	89.9	89.9	83.9	78.9	73.9	66.9	99.0
C2 based [dB]	86.9	95.9	100.9	95.9	95.9	86.9	78.9	73.9	66.9	104.0
C3 based [dB]	86.9	95.9	100.9	99.9	99.9	93.9	88.9	83.9	76.9	106.0

Resulting A-weighted sound power level

Freq. (Hz)	A-Weight	C1 based	C2 based	C2 based
31	-39.4	47.5	56.5	61.5
63	-26.2	66.7	69.7	69.7
125	-16.1	78.8	84.8	84.8
250	-8.6	81.3	87.3	91.3
500	-3.2	86.7	92.7	96.7
1000	0.0	83.9	86.9	93.9
2000	1.2	80.1	80.1	90.1
4000	1.0	74.9	74.9	84.9
8000	-1.1	65.8	65.8	75.8
LwA [dBA]		90.3	95.3	100.1

Used in the study

**E-T-N | Cutler-Hammer** Substation Transformers 15.0-5  
January 2003 Ref. No. 0443

**Standard Features — Liquid-Filled Transformer**

- ① Cover — welded to tank.
- ② Cooling tubes (radiators).
- ③ Note: Radiator position and number of radiators vary based upon design.
- ④ Bolted handhole on cover.
- ⑤ Automatic resealing mechanical pressure relief device.
- ⑥ HV bushing, three total, located in ANSI Segment 2.
- ⑦ LV bushing, four total (two connected), located in ANSI Segment 4.
- ⑧ Note: HV and LV bushings may be cover mounted or self-right correction may be reversed.
- ⑨ Z-Bar flange.
- ⑩ Lifting loops — two for lifting cover only.
- ⑪ Lifting hooks — four for lifting complete unit.
- ⑫ Jacking provisions on tank or base.
- ⑬ Ground pad — two total.
- ⑭ Drain valves — for combination tower filter press connection and complete drain with sampler.
- ⑮ Base (may be flat or formed).
- ⑯ Control cabinet for alarm lead termination.
- ⑰ Diagram instruction nameplate with warning nameplate.
- ⑱ Oil-mergized tap changer with padlock provisions.
- ⑲ Liquid temperature indicator with maximum indicating hand.
- ⑳ Upper valve for upper filter press connection.
- ㉑ Magnetic liquid level gauge.
- ㉒ Vacuum pressure gauge with air test and Scepter/air valve.

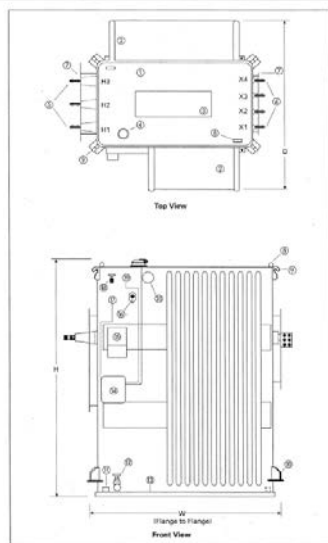


Figure 15.0-1. Liquid-Filled Primary Unit Substation Transformer with Wall-Mounted HV and LV Bushings  
Note: See Figures 15.0-2 and 15.0-3 for dimensions and weights.

**E-T-N | Cutler-Hammer** Substation Transformers 15.0-7  
January 2003 Ref. No. 0443

**Layer Dimensions**

For special 65°C rise units, bus duct throats, and air terminal chambers, see Notes at bottom of page for dimensions which should be added to the table dimensions.

**Table 15.0-7. 65°C Rise, Oil-Filled HV 2400V, 200 BIL LV 2400V, 45 BIL**

VVA Rating	Weight Lbs. (kg)	Gallons (Liters) Liquid	Dimensions in inches (mm)
			Height Width Depth
750	7000 (3176)	300 (1136)	115 (2921.0) 68 (1727.2) 66 (1676.4)
1000	7700 (3500)	300 (1136)	115 (2921.0) 68 (1727.2) 78 (2006.6)
1500	2800 (1268)	300 (1136)	115 (2921.0) 68 (1727.2) 86 (2187.2)
2000	11,300 (5138)	410 (1550)	115 (2921.0) 71 (1803.4) 112 (2848.8)
2500	12,800 (5804)	450 (1702)	115 (2921.0) 71 (1803.4) 122 (3098.8)
3000	13,700 (6247)	460 (1741)	115 (2921.0) 72 (1828.8) 125 (3175.0)
3750	15,000 (7275)	520 (1966)	115 (2921.0) 85 (2158.6) 126 (3241.4)
5000	19,700 (8940)	600 (2284)	117 (2971.8) 100 (2540.0) 138 (3505.2)
7500	25,270 (11,474)	1070 (4046)	124 (3148.4) 128 (3265.6)
10,000	38,290 (17,430)	1480 (5600)	127 (3225.0) 140 (3566.0)

**Table 15.0-8. 65°C Rise, Oil-Filled HV 3600V, 200 BIL LV 4500V, 65 BIL**

VVA Rating	Weight Lbs. (kg)	Gallons (Liters) Liquid	Dimensions in inches (mm)
			Height Width Depth
750	7200 (3262)	340 (1287)	115 (2921.0) 68 (1727.2) 67 (1701.8)
1000	8040 (3650)	380 (1432)	115 (2921.0) 68 (1727.2) 80 (2032.0)
1500	8900 (4044)	395 (1478)	115 (2921.0) 68 (1727.2) 84 (2137.6)
2000	11,700 (5315)	435 (1628)	115 (2921.0) 71 (1803.4) 114 (2948.4)
2500	13,100 (5966)	460 (1741)	115 (2921.0) 72 (1828.8) 124 (3148.4)
3000	14,400 (6538)	500 (1870)	115 (2921.0) 76 (1930.4) 128 (3251.2)
3750	16,200 (7389)	540 (2044)	115 (2921.0) 77 (1968.8) 136 (3484.4)
5000	21,400 (9702)	740 (2790)	124 (3148.4) 95 (2413.0) 129 (3292.0)
7500	31,470 (14,287)	1190 (4450)	133 (3373.2) 122 (3098.8) 140 (3556.0)
10,000	38,290 (17,430)	1590 (5850)	132 (3358.4) 125 (3175.0) 146 (3683.0)

**Table 15.0-9. 65°C Rise, Oil-Filled HV 3600V, 200 BIL LV 13800V, 95 BIL**

VVA Rating	Weight Lbs. (kg)	Gallons (Liters) Liquid	Dimensions in inches (mm)
			Height Width Depth
750	9110 (4136)	410 (1550)	115 (2921.0) 72 (1828.8) 63 (1600.2)
1000	9710 (4424)	410 (1550)	115 (2921.0) 72 (1828.8) 75 (1915.0)
1500	10,700 (4855)	410 (1550)	115 (2921.0) 72 (1828.8) 93 (2362.2)
2000	12,210 (5542)	450 (1702)	115 (2921.0) 72 (1828.8) 109 (2773.2)
2500	13,000 (6174)	470 (1778)	115 (2921.0) 74 (1879.6) 109 (2788.8)
3000	14,500 (6605)	510 (1921)	115 (2921.0) 77 (1968.8) 121 (3098.8)
3750	16,500 (7522)	540 (2044)	115 (2921.0) 77 (1968.8) 137 (3479.8)
5000	20,400 (9250)	710 (2671)	122 (3098.8) 84 (2137.6) 138 (3505.2)
7500	22,220 (10,080)	1050 (3927)	128 (3265.6) 123 (3124.2) 138 (3505.2)
10,000	38,460 (17,461)	1550 (5707)	126 (3218.4) 134 (3418.4) 148 (3769.2)

Notes: 1. Dimensions are APPROXIMATE. Refer to the transformer's outline drawing for actual dimensions for construction.

**Table 15.0-10. 65°C Rise, Silicone/R-Temp./0/0TEMP-Filled HV 6000V, 75 BIL LV 2400V, 45 BIL**

VVA Rating	Weight Lbs. (kg)	Gallons (Liters) Liquid	Dimensions in inches (mm)
			Height Width Depth
750	6000 (2723)	160 (603)	87 (2206.8) 68 (1727.2) 76 (1929.6)
1000	5940 (2697)	160 (603)	87 (2206.8) 68 (1727.2) 82 (2083.6)
1500	7800 (3541)	220 (832)	87 (2206.8) 69 (1754.8) 85 (2143.6)
2000	9270 (4209)	250 (946)	87 (2206.8) 62 (1574.8) 87 (2217.6)
2500	10,800 (4896)	290 (1092)	87 (2206.8) 62 (1574.8) 110 (2814.6)
3000	12,200 (5539)	340 (1287)	87 (2206.8) 63 (1600.2) 121 (3074.4)
3750	14,540 (6601)	360 (1358)	87 (2206.8) 67 (1701.8) 122 (3098.8)
5000	18,000 (8165)	500 (1870)	98 (2494.2) 68 (1727.2) 123 (3124.2)

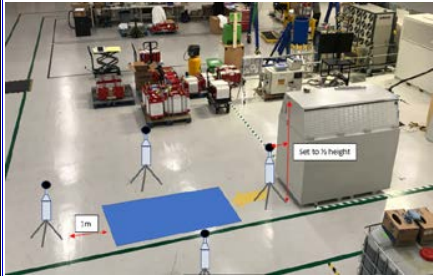
**Table 15.0-11. 65°C Rise, Silicone/R-Temp./0/0TEMP-Filled HV 13800V, 95 BIL LV 2400V, 45 BIL**

VVA Rating	Weight Lbs. (kg)	Gallons (Liters) Liquid	Dimensions in inches (mm)
			Height Width Depth
750	5010 (2279)	160 (603)	87 (2206.8) 68 (1727.2) 79 (2006.6)
1000	6000 (2723)	160 (603)	87 (2206.8) 68 (1727.2) 82 (2083.6)
1500	7200 (3262)	200 (757)	87 (2206.8) 66 (1676.4) 116 (2948.4)
2000	8270 (3759)	210 (792)	87 (2206.8) 66 (1676.4) 119 (3022.6)
2500	9270 (4209)	250 (946)	87 (2206.8) 69 (1754.8) 119 (3022.6)
3000	10,500 (4773)	270 (1016)	87 (2206.8) 68 (1727.2) 122 (3098.8)
3750	14,300 (6529)	300 (1136)	87 (2206.8) 68 (1727.2) 122 (3098.8)
5000	18,400 (8344)	400 (1496)	98 (2494.2) 68 (1727.2) 122 (3098.8)
7500	22,100 (10,023)	500 (1870)	98 (2494.2) 68 (1727.2) 122 (3098.8)
10,000	38,290 (17,430)	1160 (4200)	116 (2948.4) 116 (2948.4) 131 (3327.6)

**Table 15.0-12. 65°C Rise, Silicone/R-Temp./0/0TEMP-Filled HV 13800V, 95 BIL LV 4500V, 65 BIL**

VVA Rating	Weight Lbs. (kg)	Gallons (Liters) Liquid	Dimensions in inches (mm)
			Height Width Depth
750	6340 (2864)	160 (603)	87 (2206.8) 68 (1727.2) 79 (2006.6)
1000	6320 (2778)	160 (603)	87 (2206.8) 68 (1727.2) 82 (2083.6)
1500	7860 (3568)	200 (757)	87 (2206.8) 66 (1676.4) 116 (2948.4)
2000	9040 (4122)	240 (894)	87 (2206.8) 68 (1727.2) 119 (3022.6)
2500	11,000 (5000)	260 (983)	87 (2206.8) 64 (1628.8) 119 (3022.6)
3000	12,470 (5661)	310 (1173)	87 (2206.8) 66 (1676.4) 119 (3022.6)
3750	14,500 (6624)	360 (1358)	87 (2206.8) 68 (1727.2) 121 (3074.4)
5000	18,200 (8292)	440 (1604)	98 (2494.2) 68 (1727.2) 122 (3098.8)
7500	21,300 (9659)	570 (2137)	98 (2494.2) 68 (1727.2) 122 (3098.8)
10,000	38,290 (17,430)	1230 (4532)	114 (2895.6) 114 (2895.6) 131 (3327.6)

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Estimated Frequency Spectra for Batteries															
Battery Supplier	Metric	Octave Band (dB)										OVL (dBA)	Notes		
		31.5	63	125	250	500	1000	2000	4000	8000					
Quinios	Lp (Sound Pressure)											65	@ 1m	40' container (2.2 MW/h)	
Saft (20' container)	Lp (Sound Pressure)											56	@ 2m	within 20' container (2.5 MW/h) assume +6 dB @ 1m = 62 dBA area @ 2m from 20' container (6.1L x 2.4mW x 2.6m H)	
Tesla	Lp (Sound Pressure)											82	@ 1m	210 kWh (no container level)	
<b>Calculations:</b>															
<i>Step 1: Select Saft Container battery - convert Lp to Lw</i>															
Saft (20' container)	Lw (Sound Power)											79	▲	216	Area Envelope of 216 m2 surrounding 20' container
<i>Step 2: Obtain a sample spectrum</i>															
Avalon Battery - Force Cooled Battery	Lw (Sound Power)	75	74	68	80	71	64	57	51	43	73			Lw derived from measurements 2019-01-29 open vents 40 kWh 12 kW Max, 10 kW Rating 1.8m x 1.45m x 2m 66 dBA @ 1m - 2018 Measurement	
A-wt		-39	-26	-16	-9	-3	0	1	1	-1					
Avalon Battery - Lw (W/W0)	W/W0	3.E+03	6.E+04	2.E+05	1.E+07	6.E+06	2.E+06	7.E+05	2.E+05	2.E+04					
<i>Step 3: Shift Sample Spectrum to achieve overall LwA of Saft 20' Container</i>															
Spectral Shift	dB											6		6	Spectral shift to LwA= 79.4 dBA
Saft Container Lw Spectrum		81	80	74	85	77	70	63	57	49	79	▼	79	79	Final Lw Spectra to use in Model
															
<b>Avalon 232 AFB3 DC Flow Battery Battery Acoustic Test Setup</b>															

1 **TOPIC: Risks associated with the BESS project and its alternatives**

2

3 **REFERENCE: Application, Appendix B: Hatch Report, Section 4, PDF pages 81**  
4 **to 92**

5

6 **QUESTION:**

7

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

13

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

16

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

19

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

22

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

26

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

31

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

35

36 h) Please explain if there are any risk factors that would result in savings lower than  
37 the difference between the net costs of the proposed BESS project and those of

1 the most cost-effective alternative. If any such risks are identified, please provide  
2 an estimate for this type of risk. As part of the response, please consider any risks  
3 from potential project delays.

4

5 **ANSWER:**

6

7 **(a) to (e), (h)**

8

9 A detailed risk assessment for the full scope of the BESS has not been completed due to  
10 the early phase of the project. YEC's project management process for Large Capital  
11 projects requires a risk assessment as part of each stage gate approval process which  
12 determines a risk-based contingency budget that is included in the total budget for a given  
13 project stage. The contingency amount included in Table 3-4 is a simple calculation of  
14 15% of project costs (excluding planning costs and owner's costs) based on the current  
15 class IV estimate. This contingency budget is intended to capture the cost of potential risk  
16 events during the execution of the project and will be further refined prior to the project  
17 construction stage.

18

19 It is difficult to make a useful comparison of the cost of potential risk events between two  
20 different alternative projects. Each project has unique risks that will be mitigated in  
21 different ways based on the specific risk drivers, potential impacts, and likelihood of a  
22 particular identified risk. Further, YEC does not typically perform a risk assessment on  
23 projects that are not being executed.

24

25 Risks arising from the operation and functioning of the completed facilities and  
26 components will be identified as part of the system impact study. The cost of mitigating  
27 these risks is not expected to be material and will likely involve adjustments to operational  
28 guidelines and other procedures. To address physical damage to infrastructure, YEC will  
29 seek input from our insurer's loss control engineers as part of the detailed design phase  
30 following the selection of a vendor.

31

32 Due to the long life of the asset and the current state of BESS and recycling technology,  
33 there is minimal value in assessing risks associated with disposal at the end of the  
34 expected lifespan. Anecdotally, the world is moving to a less-carbon intensive future and  
35 large investment in carbon free solutions is occurring and is expected to continue to grow.  
36 It is reasonable to assume that most risks associated with this solution will decrease in  
37 coming years, not increase. In general, given the policy initiatives and forecast of

1 increased penetration of electric vehicles in Yukon, Canada, and the world in the future, it  
2 is anticipated that disposal and recycling solutions for lithium-ion batteries will be  
3 widespread in 20 years.

4  
5 **(f)**  
6

7 The project justification is based on the forecast lifecycle of the battery; the replacement  
8 asset and any related regulations or conditions are not known and are not part of the  
9 project scope. YEC expects to have ample time prior to the project's end-of-life to assess  
10 the options then available, and there is no apparent reason today for concern about there  
11 being a range of safe and reliable solution options for YEC's consideration at that time.  
12 Please see response to YUB-YEC-1-12.

13  
14 **(g)**  
15

16 Future conditions that may affect the price of LNG are difficult to project; in general, YEC  
17 would expect upward pressure on the transportation costs for this commodity as the world  
18 shifts to carbon-free sources of energy but there are numerous other factors that could  
19 materially influence the market price:

- 20
- 21 - Production levels;
  - 22 - Volume of exports and imports;
  - 23 - Variations in weather;
  - 24 - Level of economic activity;
  - 25 - Price and availability of alternative fuels.
- 26

27 YEC has no basis for assessing these risks for inclusion in the BESS project assessment.  
28 LNG price impacts with regard to the BESS project relate to the savings expected when  
29 (a) LNG is used to displace diesel for BESS peak shifting and/or (b) LNG use is displaced  
30 by BESS operating reserve use. BESS savings for operation reserve use will increase if  
31 LNG price increases, and decrease if LNG price declines. LNG price changes will have  
32 the reverse effects on savings related to BESS peak shift use. Overall, there is no apparent  
33 basis today for concern that LNG price changes might undermine the economic feasibility  
34 of the BESS project.

1 **TOPIC: Controls and Dispatching Algorithms**

2

3 **REFERENCE: Application, Appendix B: Hatch Report, PDF pages 87 and 137**

4

5 **QUOTE: Application, PDF 137:**

6

7 “Currently, Yukon Energy operates with a blended manual and  
8 automated dispatch control system.

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

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

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

19

20 **Application, PDF page 87:**

21

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

30

31 **QUESTION:**

32

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

34

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

36

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

1 d) Has YEC contemplated upgrading to a fully automated dispatch control system?  
2 Please explain whether it has contemplated any costs for these upgrades in its  
3 cost analysis.  
4

5 **ANSWER:**

6  
7 **(a)**

8  
9 The primary function of the BESS is to provide 7.2 MW of firm capacity for N-1 reserve.  
10

11 • If an N-1 event occurs, the BESS would be called to discharge throughout the day,  
12 over 8-10 hours, supplying a portion of the load, and recharge overnight. The  
13 BESS would need to perform this service for up to 14 consecutive days.  
14

15 • N-1 events are rare, with none occurring in the last three years.  
16

17 Secondary functions of the BESS include the following:

18 • To provide supplementary operating reserve to the grid, allowing hydro turbines  
19 and thermal generation to operate at a more efficient output.  
20

21 • Provide occasional reliability services to discharge prior to load shedding events  
22 or to charge in the event of a significant load loss. These events are short in  
23 duration. It is expected the BESS would only perform a partial charge or discharge  
24 cycle.  
25

26 • To initiate blackstart procedures on the grid. The BESS must be capable of self-  
27 energizing and energizing adjacent substation and hydro-generation. The BESS  
28 will support the restoration process through feeder load pickup.  
29

30 • Perform diesel peak shifting for 1-4 hours – discharging during peak periods and  
31 recharging in the late evening.  
32

33 • The BESS will be called on up to 70 times per year to discharge for 1-4 hours.  
34

35 • To offer reactive power support to the grid as required.

1 The BESS system will be operated in a remote passive mode for the majority of the time.  
2 Set-point values will be applied by SCC, once a value is met the BESS will become active.  
3 For example, with frequency set-points of 59.5 Hz and 60.5 Hz the BESS will remain  
4 passive with these parameters. If the frequency drops below 59.5 Hz the BESS will  
5 discharge, conversely if the frequency rises above 60.5 the BESS will charge. Reactive  
6 power can be dispatched in a similar method.

7

8 To offset thermal requirements the BESS system output would be dispatched by set points  
9 sent by the SCC operator. This would also apply to the recharge rate.

10

11 **(b)**

12

13 YEC currently has an existing Supervisory, Control and Data Acquisition System  
14 (SCADA). YEC SCADA will communicate with the BESS Power Plant Controller over a  
15 defined communication protocol.

16

17 **(c)**

18

19 The costs to integrate the BESS into the existing SCADA system are included into the  
20 overall project budget as part of the overall Balance of Plant (BOP) work. The specific  
21 costs will be detailed upon selecting the Vendor and Contractor for this project.

22

23 **(d)**

24

25 The BESS will be dispatched automatically as part of its expected design and functionality.

1 **TOPIC: Primary Use Case: N-1 Capacity Reserve**

2

3 **REFERENCE: Application, Appendix B: Hatch Report, PDF page 94**

4

5 **QUOTE:** "For the BESS to contribute to the capacity reserve, it needs to be able  
6 to reduce the peak demand during the day, and then be recharged  
7 overnight."  
8

8

9 **QUESTION:**

10

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

13

14 **ANSWER:**

15

16 **(a)**

17

18 Please refer to Table 6-1 (page 38) in the Hatch Report provided as Appendix B to the  
19 Application. The minimum recharging power is shown for each scenario. In all cases, the  
20 BESS can be recharged overnight at less than the firm capacity and within the allocated  
21 period. Accordingly, it is extremely likely, and expected, that the BESS can reduce peak  
22 demand during the day and adequately recharge overnight during an N-1 event.

1 **TOPIC: Reactive Power**

2

3 **REFERENCE: Application, Appendix B: Hatch Report, PDF pages 96 and 99**

4

5 **QUOTE:** “Reactive power requirements must be considered and a blackstart  
6 procedure should be developed to determine the maximum value of the  
7 load segments that can be picked up.”

8

9 **QUESTION:**

10

11 a) The application does not mention any reactive power concerns. Is YEC expecting  
12 such concerns to arise in the future? Please explain.

13

14 **ANSWER:**

15

16 **(a)**

17

18 As noted in the Application at page 10, YEC is not currently expecting any reactive power  
19 concerns on the YIS.

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

3

4 **QUESTION:**

5

6 a) Please provide the determination of the capital costs in Tables 6-2 and 6-3.

7

8 b) How likely is it that YEC could procure a BESS at the sizes indicated in the tables  
9 at the estimated capital costs? Are those costs “all-in” FOB Whitehorse? Please  
10 explain.

11

12 **ANSWER:**

13

14 **(a)**

15

16 Please see Table 11-1 and 11-4 in the Hatch Report (provided as Appendix B of the  
17 Application).

18

19 **(b)**

20

21 The cost estimate was provided by a third-party expert based on their knowledge of the  
22 current BESS market. It includes allocation for all major components, delivery to site, and  
23 installation. YEC is currently completing a procurement process, as described in YUB-  
24 YEC-1-13, which will increase the certainty of the BESS costs.

1 **TOPIC: Operating Reserve**

2

3 **REFERENCE: Application, Appendix B: Hatch Report, PDF pages 111 and 112**

4

5 **QUOTE:** "The potential benefits will vary year to year depending on water  
6 availability. Benefits will be greater in years with higher water flow  
7 volumes and will be lower in years with lower water availability."  
8

8

9 **QUESTION:**

10

11 a) In years with higher water flow volumes, is it more economical to use hydro for  
12 operating reserve even if it is less efficient for the turbines than the BESS? Please  
13 explain and demonstrate with a numerical example.  
14

14

15 b) Are BESS savings strictly based on the alternative use of thermal generation to  
16 provide operating reserve? Please explain.  
17

17

18 **ANSWER:**

19

20 **(a)**

21

22 No. When YEC is experiencing high water flows, often the hydro generators must be  
23 operated at maximum output and therefore cannot be used for operating reserve.  
24 Accordingly, during years with high water flow volumes the BESS will directly reduce the  
25 amount of thermal generation as it will reduce the number of thermal units required to be  
26 online to provide the operating reserve unavailable from the hydro units.  
27

27

28 **(b)**

29

30 For the operating reserve use case, the savings to be provided by the BESS as estimated  
31 in the Hatch Report were strictly calculated based on the avoidance of thermal generation  
32 when the BESS could provide operating reserve. It does not include any of the other  
33 potential benefits that may arise from the operating reserve use case, such as increased  
34 efficiency of the hydro turbines. Please refer to Section 6.3 of the Hatch Report provided  
35 as Appendix B of the Application (page B-51 to B-52).

- 1 Please see response to YUB-YEC-1-51((c) through (e)) for review of operating reserve
- 2 use savings as estimated in Table 4-3 of the Application, and the differences in this regard
- 3 from the savings estimate in the Hatch Report.

1 **TOPIC: Secondary Use Case Ranking**

2

3 **REFERENCE: Application, Appendix B: Hatch Report, PDF page 133**

4

5 **QUOTE:** “Based on the analysis, using the BESS to provide supplementary  
6 operating reserve has the greatest benefit as a secondary use case.  
7 This usage allows for the offset of between 1.7-1.8 GWh of diesel  
8 generation on average, and 13-17 GWh of LNG.”

9

10 **QUESTION:**

11

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

14

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

17

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

21

22 **ANSWER:**

23

24 **(a) and (b)**

25

26 Yes, these values are based on long term average water availability.

27

28 The operating reserve was calculated based on 2019/2020 compared to average annual  
29 water flow and the assessment was done to estimate additional hydro generation that  
30 could displace LNG or diesel generation in each hourly timestep, based on average water  
31 year water flows.

32

33 **(c)**

34

35 The water availability differs by reservoir. Based on historical water records [inflows  
36 available for outflow used for the LTA thermal estimates] for the 1981-2018 years:

- 1       • **For Aishihik Lake (for the AGS generation)** - About 34% of water years show  
2       inflows available for outflow that are higher than long-term average, while 66% are  
3       below.  
4
- 5       • **For Mayo Lake (for Mayo hydro generation)** - About 45% of water years show  
6       inflows available for outflow that are higher than long-term average, while 55% are  
7       below.  
8
- 9       • **For March Lake (for the WRGS generation)** - About 50% of water years show  
10      inflows available for outflow that are higher than long-term average, and the  
11      remaining 50% are below.

1 **TOPIC: Control Considerations**

2

3 **REFERENCE: Application, Appendix B: Hatch Report, PDF page 137**

4

5 **QUOTE:** "Yukon Energy may elect not to use the BESS for secondary  
6 applications (other than operating reserve), to keep it fully charged in  
7 case there is an N-1 event that cannot be covered without the BESS."  
8

8

9 **QUESTION:**

10

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

13

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

16

17 **ANSWER:**

18

19 **(a)**

20

21 Yes. The details of these potential secondary applications are described in detail in  
22 Section 3.1.2.2 (beginning on page 9) of the Application.

23

24 **(b)**

25

26 Please see response to YUB-YEC-1-1 (h). The secondary use cases do not conflict with  
27 the ability to provide N-1 capacity. However, as outlined in the Hatch Report (see Appendix  
28 B of the Application), due to operational considerations YEC may choose on a given day  
29 in the winter not to use the BESS to provide diesel peak shifting or respond to frequency  
30 events. This information was within the context of the operational strategy that will be  
31 developed for the BESS.

1 **TOPIC: Capacity Overbuild**

2

3 **REFERENCE: Application, Appendix B: Hatch Report, PDF page 141**

4

5 **QUOTE:** "In the next phase of the project, it will be imperative to work with the  
6 vendors based on the estimated duty cycle and calendar aging to select  
7 the appropriate capacity overbuild."

8

9 **QUESTION:**

10

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

12

13 **ANSWER:**

14

15 **(a)**

16

17 Please see response to YUB-YEC-1-11(a).

1 **TOPIC: Noise Assessment Study**

2

3 **REFERENCE: Application, Appendix B: Hatch Report, PDF page 61**

4

5 **PREAMBLE:** The Hatch Report references “Appendix C – Noise Assessment Study”

6

7 **QUESTION:**

8

9 a) Please provide the noise assessment study as referenced as Appendix C to the  
10 report.

11

12 **ANSWER:**

13

14 **(a)**

15

16 Please see YUB-YEC-1-59(a) Attachment 1.

1 **TOPIC: Cost of Energy Used from the BESS**

2

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

5 **QUESTION:**

6

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

15

16 **ANSWER:**

17

18 **(a)**

19

20 The full cost of energy used from the BESS is included in the economic analysis in section  
21 4.3.2 and summarized in Table 4-3 of the Application. This analysis is a net present value  
22 calculation based on total net cost including the incremental cost of energy driven  
23 recharging the battery under various use scenarios.

24

25 Table 4-3 includes annual BESS capital costs, operating costs, and net recharging costs  
26 – as well as annual BESS savings for avoided diesel rental costs and displaced thermal  
27 fuel costs (diesel and LNG) from operating reserve use and peak shifting.

28

29 As highlighted in Table 4-3, the estimated benefits (savings) provided by the BESS relate  
30 almost entirely to two uses, each of which involve minimal BESS energy charging and  
31 discharging over each year:

32

33 1. **N-1 dependable capacity use**, which enables avoided diesel rental costs – the  
34 significant cost savings from this use involve the BESS simply being available  
35 when an N-1 event occurs (which is very infrequent, normally one event in 10  
36 years), at which time recharging is likely to involve diesel generation. This use  
37 therefore involves minimal BESS energy charging and discharging over each year.

1           2. **Operating reserve use**, which enables avoided thermal generation costs – the  
2           significant cost savings from this use involve the BESS being available when an  
3           unplanned event occurs where generation trips or is insufficient (which is  
4           infrequent, estimated normally at one 30 minute event per month), at which time  
5           recharging is expected to involve hydro generation. The majority of this use case  
6           provision is expected to be met simply by the BESS being available on the system.  
7           This use therefore involves minimal BESS energy charging and discharging over  
8           each year.

9  
10          3. **Peak shifting** is the third BESS use addressed in Table 4-3. The relatively small  
11          net cost savings from this use involve the BESS using LNG generation (75%) and  
12          hydro generation (25%) to displace diesel generation.

13  
14          In summary, the impact of energy charging and discharging over each year is minor  
15          relative to the overall BESS economic feasibility.

16  
17          In response to the specific focus of the question regarding use of hydro generation to  
18          recharge the BESS, relevant net ratepayer cost impacts are noted as follows:

19  
20          • Hydro generation capital and most hydro generation operating costs are not  
21          affected by incremental generation required for the BESS. Short-term incremental  
22          costs related to added hydro generation for BESS recharging are estimated by  
23          YEC at 0.5 cents per kWh. [BESS operating reserve use is also expected to  
24          enhance the efficiency of hydro generation – but this benefit will be ignored for the  
25          purpose of responding to this question.]

26  
27          • The 0.5 cents per kWh incremental hydro generation cost for BESS recharging  
28          would be augmented by efficiency losses related to BESS operation (15%) plus  
29          any related line losses required to move the hydro generation to the BESS (likely  
30          to be minimal [e.g., 1%] but could be higher [say 10%]), increasing the incremental  
31          hydro cost from 0.5 cents/kWh to between 0.58 cents/ kWh and 0.63 cents/ kWh.

32  
33          • Table 4-3 includes incremental hydro generation costs and related efficiency  
34          losses related to BESS recharging; however, no attempt has been made in Table  
35          4-3 to address any related changes to line losses.

1 **TOPIC: Geotechnical Investigation**

2

3 **REFERENCE: Application, Appendix B: Hatch Report, PDF page 144**

4

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

10

11 **QUESTION:**

12

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

16

17 **ANSWER:**

18

19 **(a)**

20

21 No geotechnical work has been completed to date. The geotechnical program is expected  
22 to be conducted in Q2 2021.