

**John Maissan
(JM)**

1 **TOPIC: Project Description**

2
3 **REFERENCE: Page 3 and 5 Re. new 1.7 km 34.5 kV transmission line:**

4
5 **QUESTION:**

6
7 a) Has YEC now secured the easements on Crown land?

8
9 b) With respect to the portion on or following the ATCO power lines, please outline
10 the results of discussions to date with ATCO Electric Yukon (ATCO).

11
12 c) Please provide YEC plans if discussions with ATCO have not resulted in an
13 agreement.

14
15 **ANSWER:**

16
17 **(a) to (c)**

18
19 No, YEC has yet not secured easements on Crown Land.

20
21 It is YEC's understanding from its discussions with ATCO Electric Yukon (AEY) to date
22 that they are supportive of the proposed interconnection route. No formal agreement has
23 been drafted between YEC and AEY. YEC will further engage with AEY in pursuit of an
24 agreement during the detailed design of the interconnection.

1 **TOPIC: Section 3 Project Description**

2

3 **REFERENCE: Page 3 Re. “grid-sized BESS with 40 MWH of useful energy**
4 **storage capacity”**

5

6 **QUESTION:**

7

8 a) Please provide the nameplate storage capacity included in the project budget.

9

10 **ANSWER:**

11

12 **(a)**

13

14 The project costs are for a 40 MWh BESS with a 20% overbuild, resulting in a 48 MWh
15 energy storage capacity at the beginning of project life. Please see the response to YUB-
16 YEC-1-11.

TOPIC: Section 3 Project Description

REFERENCE: Page 4 Re. "...LNG plant – Three units with combined installed capacity of 13.2 MW and dependable capacity of 12.6 MW":

QUESTION:

a) Does the 12.6 MW of dependable capacity signify that when the LNG units are base loaded for continuous operation the three-unit plant is operated at 12.6 MW (4.2 MW each)?

b) If not, please indicate the normal base load level for the units when in continuous operation.

ANSWER:

(a) and (b)

Yes. 12.6 MW of dependable capacity is what YEC can rely on the three LNG units to provide under continuous operation.

TOPIC: Section 3 Project Description

REFERENCE: Page 4 Re. "Mobile / rented diesel units...":

QUESTION:

a) Do these units have a nameplate capacity of 1.8 MW or is this the normal base load level for continuous operation?

b) If 1.8 MW is the base load for continuous operation, please provide the nameplate (peak) capacity.

ANSWER:

(a) and (b)

1.8 MW is the nameplate, peak, and dependable capacity of the temporary diesel units. They can be operated continuously at this level.

1 **TOPIC:** **Section 3 Project Description**

2

3 **REFERENCE:** **Page 4 Re. KDFN site lease:**

4

5 **QUESTION:**

6

7 a) Is 1.5 ha the area of the entire KDFN Category B settlement land parcel?

8

9 b) If not, what portion of the entire parcel is this?

10

11 **ANSWER:**

12

13 **(a)**

14

15 No, the 1.5 ha is a portion of the KDFN Category B Settlement land.

16

17 **(b)**

18

19 It is approximately 15% of the parcel.

1 **TOPIC: Section 3 Project Description**

2
3 **REFERENCE: Page 4 Re. battery container system modules:**

4
5 **QUESTION:**

6
7 a) Please confirm that the containers will have insulated floors as well as walls and
8 roof.

9
10 b) If not confirmed please explain.

11
12 **ANSWER:**

13
14 **(a) and (b)**

15
16 Yes, the container walls, roof, and floors will be insulated.

1 **TOPIC:** **Section 3 Project Description**

2

3 **REFERENCE:** **Pages 4 and 5 Re. transformer(s) “...(provision for 2 X 20 MW if**
4 **this level of redundancy is selected).”**

5

6 **QUESTION:**

7

8 a) How many transformers are provided for in the project budget?

9

10 b) If the answer is one, please explain on what bases and when YEC will decide to
11 procure a second transformer.

12

13 **ANSWER:**

14

15 **(a)**

16

17 One Main power transformer is included in the Project budget.

18

19 **(b)**

20

21 At this point in time, YEC has no plans to procure a second transformer. As a result, YEC
22 does not know the basis for which a second transformer is required.

1 **TOPIC:** **Section 3 Project Description**

2

3 **REFERENCE:** Page 5 Re. "A competitive procurement process has been initiated to
4 select battery vendors qualified to design a battery able to meet Yukon
5 Energy's operational requirements..."

6

7 **QUESTION:**

8

9 a) Please provide an update on this procurement process and the present status.

10

11 **ANSWER:**

12

13 **(a)**

14

15 Please see response to YUB-YEC-1-13.

TOPIC: Section 3 Project Description

REFERENCE: Page 5 Re. BESS life of 20 years and "...or capacity augmentation at year ten."

QUESTION:

a) If the "typical year" number of cycles are experienced would YEC extend the project life to 25 or 30 years?

b) In battery systems it is typically not recommended to mix batteries of significantly different ages or use histories. Furthermore lithium-ion battery technology is evolving fairly rapidly, please explain if capacity augmentation at year ten is a realistic option / expectation compared to an overbuild at the outset.

c) Is the future battery augmentation option described provided as a possible means of holding the BESS project on budget by reducing the initial build size if price quotes come in higher than expected?

ANSWER:

(a)

BESS life is currently set at 20 years, which is the upper limit that most vendors provide. YEC will need to assess the ability to extend the battery's life as it approaches 20 years or decide if an alternative technology is more appropriate at that time.

(b)

Vendors are developing strategies within their controls and battery management systems to accommodate partial augmentation throughout the batteries life span.

YEC will work with the selected vendor to select the most appropriate approach to achieve a 20 year lifespan (either initial overbuild or capacity augmentation) based on vendor recommendations, the available technology and the risks.

1 **(c)**

2

3 No. Future battery augmentation is a standard approach to extend the life of a BESS,
4 where the other components have a 20-year (or greater) lifespan (e.g., containers,
5 inverter, transformer, etc.).

6

7 While the preliminary capital cost would be lower with augmentation versus capacity
8 overbuild, BESS vendors will be evaluated on total lifecycle costs, not only initial capital
9 cost.

1 **TOPIC:** **Section 3 Project Description**

2

3 **REFERENCE:** **Page 5 Re. “At the end of life, many battery vendors will take back**
4 **the battery modules...”:**

5

6 **QUESTION:**

7

8 a) Is this a requirement that YEC is putting in their procurement process for vendors?

9

10 b) If not, why not?

11

12 **ANSWER:**

13

14 **(a) and (b)**

15

16 Please see response to YUB-YEC-1-12(d).

TOPIC: Section 3 Project Description

REFERENCE: Page 6 Table 3-1 Re. frequency of use and number of cycles:

QUESTION:

- a) The BESS Use frequency column on the left side of each of the two cases add up to many more cycles (i.e. 165+ for Typical Year case) than the “Total Throughput Useable Cycles” (i.e. 79 for Typical Year case). Please explain how these numbers can be different.
- b) The Hatch report (Appendix B at page B-27) indicates that the state of charge for a battery should be between 10% and 90%, does this mean using 10% of the battery capacity 8 times in small cycles is equivalent to one “Total Throughput Useable Cycle”?
- c) The author has not heard of the term “Total Throughput Useable Cycles” before, please define this term. Is this a term used only by lithium-ion battery manufacturers to describe / measure the useful lives of their batteries?

ANSWER:

(a)

“Frequency” in this table is the number of events; other than N-1 events, none of these events result in a full discharge of the battery. “BESS Use” in this table is the estimated MWh discharged per year for these events (assumptions for the events are provided in Appendix B of the Application, Hatch report, Section 8).

- For N-1 events, one 2-week event is assumed in 10 years. The one event involves BESS Use of 40 MWh times 14 days = 560 MWh; this equals an average annual use of 56 MWh.
- For Operating Reserve, 1 event per month is assumed – each event is assumed to be 30 minutes, with 20 MW/2 = 10 MWh BESS Use; annual BESS Use then equals 10 times 12 months = 120 MWh.

- For Blackstart Outage Restoration, 53 events assumed per year with average BESS Use of 40 MWh/event.
- For Peak Shifting, 244 MWh per year BESS Use as estimated in Hatch Report (Section 6.4.2.4, Application pages B-64 to B-65) for events at Whitehorse and Faro.
- For Renewable Integration, 100 cycles assumed per year at 15% discharge of battery capacity (40 MWh) = 6 MWh BESS Use per event.

“Total Annual Throughput” in this table is a metric used to estimate the total energy discharged by the BESS over the year (sum of all energy discharged, i.e., sum of BESS Use in the table). This is used by vendors to estimate degradation.

“Total Throughput Useable Cycle” is the total discharged energy for the year (MWh) divided by the energy storage capacity of the system (40 MWh).

(b)

No. Total throughput useable cycle is based on total useable capacity (40 MWh in this case) so you could do 10 discharge events of 10% to achieve 1 cycle (10 x 4 MWh/event = 40 MWh discharged energy).

As noted in the Hatch Report (Appendix B of Application, page B-47), the 20% overbuild required due to the limited state-of-charge range (20%-100% or 10%-90%, depending on the vendor recommendation) results in the “useable energy” as reference, e.g., the Project’s installed capacity of 48 MWh provides the referenced useable energy of 40 MWh.

(c)

Yes. Total Throughput Useable Cycle is the total discharged energy (MWh) divided by the energy storage capacity (40 MWh). This is one metric used by battery vendors to estimate degradation.

TOPIC: Section 3 Project Description

REFERENCE: Pages 6 – 10 Re. BESS N-1 Capacity Reserve use and Other BESS Uses:

QUESTION:

- a) In an N-1 event when the BESS is being used to provide the 7.2 MW of Dependable Capacity all useable energy in the battery appears to be used, in this circumstance are all “Other BESS Uses” excluded?
- b) If, as it appears, the N-1 use of BESS excludes all other uses, would the “other uses” be excluded as the YIS system approaches a peak load day to be available for a potential N-1 requirement?
- c) If some of the “other uses” can be provided while the N-1 need is being served, which are they?
- d) If the BESS is being used for one or more “other uses” when an N-1 event occurs how would the BESS be transitioned to N-1 use and how would 7.2 MW of dependable capacity be provided during that transition time?

ANSWER:

(a)

During an N-1 event, most of the other use cases would be excluded. However, the BESS may be able to provide frequency response (e.g., adjust its output to manage frequency excursions).

(b)

It is not necessarily assumed that “other uses” will be excluded as YIS approaches a peak load day. If the BESS is partially charged at the time of initial N-1 event, it will be used as best possible to reduce outages, and will be recharged overnight and used beginning the next day to cover the peak.

1 **(c)**

2
3 The BESS's output can be adjusted to respond to frequency excursions (i.e., if frequency
4 is high, BESS output can be reduced).

5
6 **(d)**

7
8 The BESS is not meant to prevent an instantaneous N-1 outage, but rather to be firm
9 capacity for two weeks until Aishihik generation and/or transmission can be restored. The
10 responses provided above confirm how BESS operation will enable this firm capacity to
11 be provided.

TOPIC: Section 3 Project Description

REFERENCE: Page 10 Re. "Operating reserve":

QUESTION:

a) Is "operating reserve" the same as what is often referred to as "spinning reserve"?

b) If not please explain the differences.

ANSWER:

(a) and (b)

The terms are similar as both relate to standby capacity to manage unplanned loss of generation or increases in load. Quite often these are used interchangeably, but there is a slight deviation. Spinning Reserve is "spinning" generation that is available to the operator on a short interval to meet demand. Operating Reserve includes all generation, including non-spinning assets, that are available to the operator on a short interval to meet demand.

1 **TOPIC: Section 3 Project Description**

2
3 **REFERENCE: Page 10 Re. Diesel peak shifting:**

4
5 **QUESTION:**

6
7 a) Please confirm that LNG peak shifting can and would occur when LNG is being
8 used on the margin in the same manner as described for diesel peak shifting.

9
10 b) If not confirmed please explain.

11
12 **ANSWER:**

13
14 **(a) and (b)**

15
16 LNG peak shifting could occur when operationally feasible. Unit operating restrictions will
17 need to be given consideration when assessing the potential for LNG peak shifting, as the
18 ability to peak-shift LNG will depend on the particular circumstances at the time.

1 **TOPIC: Section 3 Project Description**

2
3 **REFERENCE: Page 10 Re. Diesel peak shifting. To provide a clearer**
4 **understanding of the use of diesel and LNG for thermal generation**
5 **and the potential for diesel and / or LNG peak shifting please**
6 **provide the following:**

7
8 **QUESTION:**

- 9
10 a) For the period January 2019 through February 2021 please provide a table of
11 actual monthly total generation broken down by: hydro, IPP plus micro-generation,
12 LNG thermal, and diesel thermal.
13
14 b) For the period January 2020 through 2021 (using GRA forecast generation for
15 March through December 2021) please provide a similar table but using hydro
16 generation figures based on long-term average water availability.
17

18 **ANSWER:**

19
20 **(a)**

21
22 Please see JM-YEC-1-15 (a) Attachment 1 which provides the actual monthly generation
23 for hydro, LNG and diesel generation for the period from January 1, 2019 to the end of
24 February 2021. During this time period, no IPP energy was generated. Micro-generation
25 is embedded in the load and is not visible to YEC.
26

27 **(b)**

28
29 Please see JM-YEC-1-15 (b) Attachment 1 which provides the expected long-term
30 average generation based on long-term average water availability [38 water years]. As
31 requested, the table uses actual total generation numbers for the period from January
32 2020 through February 2021, and March through December 2021 are forecasts from the
33 2021 GRA. Please see notes to the table that explain assumptions used for LTA
34 calculations.

Actual Generation for the period from January 2019 to February 2021

		Total MWh	Hydro MWh	Wind/SOP MWh	Diesel MWh	LNG MWh
2019	JAN	47,771	40,215	-	991	6,565
	FEB	44,425	36,990	-	91	7,345
	MAR	35,785	27,216	-	35	8,534
	APR	34,653	25,041	-	168	9,444
	MAY	28,684	20,970	-	21	7,692
	JUN	25,973	24,566	-	600	806
	JUL	29,380	29,222	-	158	1
	AUG	29,071	29,013	-	36	22
	SEP	32,041	31,020	-	37	984
	OCT	40,102	32,808	-	102	7,191
	NOV	42,155	33,408	-	196	8,551
	DEC	50,636	40,350	-	1,357	8,929
	Total	440,676	370,819	-	3,793	66,065
2020	JAN	58,659	41,507	-	7,946	9,206
	FEB	48,294	38,492	-	1,900	7,902
	MAR	47,088	35,107	-	2,869	9,112
	APR	39,294	27,787	-	4,912	6,595
	MAY	32,766	27,666	-	193	4,907
	JUN	32,117	30,986	-	44	1,087
	JUL	33,180	33,137	-	33	10
	AUG	33,144	33,096	-	41	7
	SEP	33,033	32,057	-	259	717
	OCT	42,472	41,864	-	434	175
	NOV	52,738	47,778	-	1,088	3,872
	DEC	52,198	46,069	-	2,005	4,124
	Total	504,984	435,546	-	21,723	47,714
2021	JAN	48,657	43,652	-	1,518	3,487
	FEB	58,064	47,385	-	5,454	5,225

Actual/Forecast Generation; LTA Hydro and LTA Thermal

		Total MWh	LTA Hydro MWh	Wind/SOP MWh	LTA Thermal MWh
2020	JAN	58,659	47,515	-	11,144
	FEB	48,294	39,120	-	9,175
	MAR	47,088	38,142	-	8,945
	APR	39,294	31,829	-	7,465
	MAY	32,766	26,541	-	6,225
	JUN	32,117	30,628	-	1,489
	JUL	33,180	33,028	-	152
	AUG	33,144	33,144	-	-
	SEP	33,033	33,033	-	-
	OCT	42,472	39,558	-	2,914
	NOV	52,738	42,720	-	10,019
	DEC	52,198	42,282	-	9,916
	Total	504,984	437,541	-	67,443
2021	JAN	48,657	39,489	-	9,168
	FEB	58,064	47,124	-	10,940
	MAR	47,351	38,430	178	8,744
	APR	43,313	35,152	251	7,910
	MAY	40,037	32,494	261	7,283
	JUN	38,233	31,712	273	6,248
	JUL	38,935	34,197	263	4,474
	AUG	38,786	34,826	249	3,711
	SEP	41,171	34,620	185	6,367
	OCT	44,008	40,958	125	2,924
	NOV	48,974	39,747	47	9,181
	DEC	54,562	44,282	19	10,261
	Total	542,092	453,032	1,851	87,210

Notes:

1. YEC does not calculate LTA hydro and thermal on monthly basis. The LTA hydro and thermal are based on annual numbers. In order to provide monthly breakdown of the annual LTA, the breakdown for June through October was prepared based on average hydro generation for the last three years; and the breakdown for the remainder months is prepared based on share of the monthly load compared to the total annual load.
2. The LTA thermal for 2020 is based on LWRF estimate and excludes Fish Lake impact.
3. The LTA thermal for 2021 is calculated based on LTA thermal calculation table provided in 2021 GRA, Appendix 2.1.
4. The total generation numbers for the period from January 2020 through February 2021 are actuals. March through December 2021 are forecasts from 2021 GRA.
5. The LTA thermal is not broken down to diesel and LNG. For LTA assessments, LNG is expected to be up to 90% of total thermal.

TOPIC: Section 3 Project Description

REFERENCE: Page 10 (and page 23 bottom) Re. Grid reliability and ancillary services:

QUESTION:

a) Please explain what level of intermittent energy supply can be stabilized by the BESS. Would this be the 40 GWh per year of IPP SOP energy supply, or would it be more related to the capacity of individual projects (e.g. risk of tripping off)?

b) In the absence of a hydro energy surplus, could a surplus of intermittent energy be used to charge the BESS for “other uses” including diesel (or LNG) peak shifting?

ANSWER:

(a)

Stabilization relates to the capacity of generation (MW). The BESS can be used to cover unplanned loss of renewable generation or variance in the output of generation (e.g., if wind output begins to decline). The BESS is expected to be able to cover the loss of up to 20 MW of generation for 30 minutes under the current operating reserve assumptions outlined in the Hatch Report (see Appendix B of the Application).

Please see also response to YUB-YEC-1-20(a).

(b)

Yes.

1 **TOPIC:** **Section 3 Project Description**

2
3 **REFERENCE:** **Page 10 Re. "other uses":**

4
5 **QUESTION:**

6
7 a) Can all "other BESS uses" be provided at the same time?

8
9 b) If they cannot all be provided at the same time please list, for each of the "other
10 uses" which "other uses" can and cannot be provided.

11
12 **ANSWER:**

13
14 **(a) and (b)**

15
16 All "other BESS uses" can be provided at the same time, except for blackstart/outage
17 restoration. This service would only be provided in the event of an outage. Reactive power
18 support may be provided at the same time within the total MVA rating of the power
19 conversion system.

20
21 Consideration will be given to the priority of these functions during controller development
22 if multiple functions were to be triggered or in use at the same time.

1 **TOPIC: Section 3 Project Description**

2
3 **REFERENCE: Page 11 Re. operating reserve:**

4
5 **QUESTION:**

6
7 a) If the answer to JM-YEC-1-13 is that “operating reserve” is the same as “spinning
8 reserve”, and if spinning reserve is equated to load following [YEC 2017-2018 GRA
9 response to IR JM-YEC-1-19(c)], would not a high (full) state of charge essentially
10 preclude load following which may require charging as well as discharging?
11

12 **ANSWER:**

13
14 **(a)**

15
16 Correct. If the BESS is at a high state of charge it will not be able to charge at all, or for
17 very long, and could not load-follow "upwards" (for example, charge to offset the ramping
18 up of wind energy or to absorb a loss of load). However, it is anticipated that the BESS
19 will be configured to idle at a moderate state-of-charge in order to be available to respond
20 to system events requiring either charging or discharging. Please see also response to
21 YUB-YEC-1-20(a). The BESS only needs to be partially charged to provide operating
22 reserve.

1 **TOPIC: Section 3 Project Description**

2
3 **REFERENCE: Page 11 Re. operating reserve “there are several weeks in winter**
4 **when no operating reserve benefits can be achieved due to water**
5 **flow limitations.”**

6
7 **QUESTION:**

8
9 a) Please explain this statement by describing in detail the grid load and generation
10 situation(s) during these weeks.

11
12 **ANSWER:**

13
14 **(a)**

15
16 There are several weeks in winter when no operating reserve can be provided by the
17 hydro units due to operating restrictions. For example, during a high load period in the
18 winter, it is likely the output of the generators will be maximized to serve load. If YEC
19 cannot increase their output due to flow limitations, they are unable to provide reserve.
20 Winter restrictions can further limit the ability to increase the output of the units and hence
21 prevent them from providing operating reserve. For example, Mayo Hydro has ramping
22 limitations during the winter, and Whitehorse Rapids GS is subject to Marwell ice flow
23 restrictions which can limit the output of the units.

1 **TOPIC: Section 3 Project Description**

2
3 **REFERENCE: Page 13 Re. Operating reserve"... Based on YEC's 2021 GRA fuel**
4 **prices the annual thermal fuel cost savings ... is about \$1.156**
5 **million."**
6

7 **QUESTION:**
8

9 a) What are the current March 2021 (most recent) YEC LNG and diesel prices?

10
11 b) What would be the annual savings at the current LNG and diesel prices?

12
13 c) If the project is provided with the necessary Part 3 certificates and built, how does
14 YEC propose to measure, record, and track the actual savings?
15

16 **ANSWER:**
17

18 **(a)**
19

20 Current prices are as follows:
21

- 22 • **Diesel** - The weighted average diesel cost is about \$0.2732/kWh based on March
23 2021 diesel fuel prices and 2021 GRA efficiencies.
- 24
- 25 • **LNG** - The average LNG cost is \$0.1936/kWh based on most recent LNG delivered
26 commodity price (Feb 27, 2021) and 2021 GRA efficiencies.
27

28 **(b)**
29

30 Please see response to JM-YEC-1-33(a).
31

32 **(c)**
33

34 YEC will develop procedures before start of project operations to record BESS operating
35 reserve use and estimated savings related to this use.

1 **TOPIC:** **Section 3 Project Description**

2
3 **REFERENCE:** Page 15 Re. Grid Reliability and Ancillary Services “Yukon Energy is
4 also exploring other options such as BESS use for stabilizing hydro
5 operation during periods of downstream winter ice formation, reducing
6 downstream winter flooding ...”:
7

8 **QUESTION:**
9

10 a) Would this potential use extend to mitigating Aishihik River downstream impacts
11 as well as for Whitehorse Rapids and Mayo B?
12

13 **ANSWER:**
14

15 **(a)**
16

17 YEC is still exploring these options, though it is anticipated the BESS could potentially be
18 used to help to mitigate downstream impacts at Aishihik, Mayo and Whitehorse. Please
19 see also response to YUB-YEC-1-14.

TOPIC: Section 3 Project Description

REFERENCE: Page 16 Re. Project Costs:

QUESTION:

a) The text indicates that a 15% contingency is included in the estimate, however the figures in Table 3-4 seem to imply that the 15% contingency was only applied to the Hatch portion of the estimate and no contingency is applied to the YEC portion (Planning Costs and Owner's costs). Is this what was intended?

b) If no contingency is added to the YEC portion of the cost estimate why not?

c) If, as indicated, the estimate is indeed +/- 30%, is it fair to say that the cost estimate is \$31.7 million +/- \$9.5 million?

ANSWER:

(a) and (b)

Contingency was applied on the large equipment purchases and construction, which represent the majority of the project costs. Contingency was not applied to planning costs as they are based on actuals of the planning phase that was completed in November 2020. Contingency was not applied on the Owners Costs as there is less uncertainty regarding these activities.

(c)

Correct.

1 **TOPIC:** **Section 3 Project Description**

2

3 **REFERENCE:** **Page 17 Re. Project Costs Table 3-5 Site Lease:**

4

5 **QUESTION:**

6

7 a) The site lease term is indicated to be 25 years. Does the lease contain an option
8 to extend the lease should the life of the BESS be extended or a BESS
9 replacement at the end of life be contemplated?

10

11 b) If not please explain why not.

12

13 **ANSWER:**

14

15 **(a) and (b)**

16

17 The draft lease includes one renewal option for an additional 25 years.

TOPIC: Section 3 Project Description

REFERENCE: Page 18 Re. Project Costs “in summary...the specified need ...would best be met through development of the project. Compared to the feasible and best alternative available today (i.e., diesel rental) ...”:

QUESTION:

- a) Please explain why replacement diesels (e.g. standard CAT 3616 4.4 MW diesels) for the three retired Mirrlees generators at the existing Whitehorse Rapids diesel plant, at least two of which have been retired since the LNG plant was completed, is or was not feasible in the same time frame.

ANSWER:

(a)

YEC is pursuing the replacement of retired diesel engines with new diesel engines, including 5 MW to replace the retired generation at the Whitehorse Rapids Generating Facility diesel plant. Overall, 12.5 MW of diesel to replace diesel unit retirements is included in YEC's 10-Year Renewable Electricity Plan. Additional capacity, currently provided by rental diesel units, is still required beyond these additions.

1 **TOPIC: Section 3 Project Description**

2
3 **REFERENCE: Pages 20-21 Re. Other Project Planning:**

4
5 **QUESTION:**

6
7 a) Please provide updates on each of these three planning items.

8
9 **ANSWER:**

10
11 **(a)**

12
13 Updates for each of the items noted are as follows:

- 14
- 15 • **Finalize Lease for KDFN Site:** YEC is in the process of reviewing the lease terms
16 and conducting legal review to enable YEC to enter into a lease for the site in the
17 near term. This item is on track.
18
 - 19 • **Procurement Process and Preliminary Engineering:** Please see response to
20 YUB-YEC-1-13 for an update on the BESS procurement process. YEC conducted
21 a procurement process to select an Owner's Engineer for the Project. Hatch was
22 awarded this contract and has initiated the preliminary engineering work for the
23 Project. These items are on track.
24
 - 25 • **Related Other Investigations and Agreements:** The system impact study is
26 currently in progress by the Owner's Engineer. Please see response to YUB-YEC-
27 1-71 for the status of the geotechnical investigation. Engineering for the route and
28 transmission connection has been undertaken, as described in the response to
29 YUB-YEC-1-3. YEC continues to work with both First Nations partners via the
30 Project Committee on a Project Agreement to define the First Nation benefits for
31 the project. These items are on track.

1 **TOPIC: Section 3 Project Description**

2

3 **REFERENCE: Page 22 Re. Summary of Environmental and Socio-economic**
4 **impacts, “The YESSA assessment has not been initiated at this**
5 **time.”**

6

7 **QUESTION:**

8

9 a) Please provide an update of the YESSA assessment that is to be filed by March
10 31.

11

12 **ANSWER:**

13

14 **(a)**

15

16 The draft Project Proposal for the YESAA assessment has been completed. YEC expects
17 to finalize its documentation and submit a Project Proposal to the YESAB Designated
18 Office in early April.

TOPIC: Section 4 Project Justification

REFERENCE: Page 24 Yukon Grid Context, “Seasonal generation constraints also present additional challenges to the YIS. Electricity demand on the YIS is highly variable with seasonal mismatch between the timing of maximum available electricity production from renewable generation ...The result is surplus renewable generation during the summer (which cannot be sold to other jurisdictions) and reliance on thermal generation to supply peak load requirements during winter.”

QUESTION:

- a) Please confirm that there are SCADA connected secondary sales customers (e.g. the Canada Games Centre) that are able and willing to buy surplus energy when available.
- b) Please confirm that there were secondary sales in the last half of 2020 when YEC had surplus hydro generation available due to high water flows.

ANSWER:

(a)

Confirmed.

(b)

Confirmed. Secondary sales were made available during September and October 2020 due to high water inflows and full water reservoirs; secondary sales were again ceased by the end of October due to resumed need for thermal generation.

1 **TOPIC:** **Section 4 Project Justification**

2
3 **REFERENCE:** **Page 25 Re. Evolving Grid Load Conditions, "...Yukon Energy**
4 **continues to pursue ...and also to implement a Demand Side**
5 **Management (DSM) program aimed to reduce load growth,**
6 **especially peak demand reductions."':**

7
8 **QUESTION:**

9
10 a) The author signed up for a "Peak Smart" program in the first few days of it being
11 advertised a year or more ago and has yet to have any equipment installed to
12 enable the remote controls to limit peak load demands, despite following up at
13 least 3 times over the past 8 months. Is this program still being pursued and if so,
14 why does it not appear to be being implemented?

15
16 b) Please describe any other peak load growth limiting DSM initiatives that are
17 currently being contemplated or implemented and indicate whether being
18 contemplated or implemented.

19
20 **ANSWER:**

21
22 **(a)**

23
24 The PeakSmart program continues to be implemented. Over 50% of program installations
25 have been completed by the contractors executing the project. During 2020, customer in-
26 home installations were halted for several months due to COVID-19 restrictions, resulting
27 in delays of the original installation schedule contemplated. Accordingly, the pilot is
28 expected to operate for an additional winter to ensure sufficient data is collected for
29 analysis of the results. YEC has contacted the project contractor to ensure the author is
30 contacted as soon as possible for coordination of device installation.

31
32 **(b)**

33
34 In February 2021, Yukon government issued Order-In-Council 2021/16 which enables
35 YEC to recover through rates the costs reasonably incurred to provide or participate in a
36 demand side management program. In 2021, YEC will initiate the design of a new portfolio

- 1 of DSM programs with a capacity-savings focus to manage peak loads. The program
- 2 design in 2021 will define the specific DSM initiatives to be implemented.

1 **TOPIC: Section 4 Project Justification**

2
3 **REFERENCE: Page 25 Re. "The 10-year Renewable Electricity Plan ... Ongoing**
4 **generation projects include ...":**

5
6 **QUESTION:**

- 7
8 a) Please provide the status of / updates on each of the following: WH2 uprate, WH4
9 uprate, renewable energy purchases from IPP SOP projects, solar energy from the
10 micro-generation program, southern lakes enhanced storage program, Mayo Lake
11 enhanced storage program, replacement of diesel generators (if not already
12 updated in JM-YEC-1-24) and each of the three major projects proposed in the 10-
13 year Renewable Electricity Plan.

14
15 **ANSWER:**

16
17 **(a)**

18
19 Status/ updates for each of the noted projects or programs is as follows:

- 20
21 • **WH2 uprate:** The WH2 uprate project is proceeding according to plan and is
22 expected to be completed in July 2021. Contractors are currently on site
23 disassembling the generator in preparation for major components to arrive on site.
24
25 • **WH4 uprate:** The WH4 uprate project is proceeding according to plan and is
26 expected to be completed in June 2021. The design and manufacturing of the
27 Servo motors have been completed and await delivery to site. Preparations are
28 being made in anticipation for equipment delivery to site.
29
30 • **IPP SOP:** Under the Standing Offer Program (SOP), YEC has executed Electricity
31 Purchase Agreements with two Independent Power Producers (IPPs). The IPP
32 contracts signed to date are expected to provide approximately 2.1 GWh annual
33 renewable energy. YEC is currently working with an additional nine applicants
34 which represent a potential 27 GWh of annual generation. YEC forecasts the total
35 program cap of 40 GWh of annual energy will be provided by program proponents
36 by 2024.

- 1 • **Solar Micro-generation:** The solar micro-generation program is administered by
2 Yukon government. Currently, YEC understands from Yukon government that 2.8
3 GWh of micro-generation solar is expected to be exported to the grid in 2021, rising
4 to 4.6 GWh by 2024.
5
- 6 • **Southern Lakes Enhanced Storage:** Following an additional public engagement
7 effort on the Southern Lakes Enhanced Storage Project (SLESP), in 2020 YEC's
8 Board of Directors decided to move forward with the preparation of a Project
9 Proposal to be considered for submission to YESAB. YEC is engaging with the
10 First Nations who would be impacted by the Project, in particular those who are
11 Decision Bodies under YESAA, to confirm their support for moving forward with a
12 submission to YESAB.
13
- 14 • **Mayo Lake Enhanced Storage:** YEC is currently working with the First Nation of
15 Na-Cho Nyak Dun to facilitate the First Nation's review of the project and
16 understand their perspective prior to the Company's submission of the Project
17 Proposal to the YESAB Designated Office.
18
- 19 • **Diesel Replacements:** YEC is currently conducting preliminary engineering and
20 required assessment activities for the three diesel replacement projects in
21 Whitehorse, Faro, and Dawson, which are expected to be in-service by the winter
22 of 2023/24.
23
- 24 • **Atlin Hydro Expansion:** YEC is in active discussions with THELP Homeland
25 Energy Limited Partnership, who will be the owners of the project, to determine the
26 terms of an Electricity Purchase Agreement. The project is currently expected to
27 be in-service by 2024.
28
- 29 • **Moon Lake Pumped Storage:** Planning for this project is not expected to
30 commence until Federal funding is secured.
31
- 32 • **Southern Lakes Transmission Expansion:** Planning for this project is not
33 expected to commence until Federal funding is secured.

1 **TOPIC: Section 4 Project Justification**

2

3 **REFERENCE: Page 30 Re. Demand Side management:**

4

5 **QUESTION:**

6

7 a) Does YEC propose any DSM programs involving rate structures, or building and
8 appliance codes or standards?

9

10 **ANSWER:**

11

12 **(a)**

13

14 Please see response to JM-YEC-1-28. Program design to be undertaken in 2021 will
15 define the specific DSM initiatives to be implemented.

16

17 YEC understands that rate structure and building and appliance codes or standards are
18 an effective DSM tool; however, they may not be available for the utility itself to pursue at
19 this time under the current regulatory structure.

TOPIC: Section 4 Project Justification

REFERENCE: Page 31 Re. new 20 MW Wind Project:

QUESTION:

- a) Would the proposed 20 MW / 40 MWh BESS be capable of keeping the grid frequency stable with such a wind farm connected to the YIS?
- b) Even if it does not supply dependable capacity, would a 20 MW wind farm not reduce winter diesel and LNG generation, as well as reduce water storage pressure/requirements at Southern Lakes, Mayo Lake, and Aishihik Lake?
- c) Could such a wind farm not provide significant benefits to the grid in reduced thermal generation in the event of a drought such as experienced from 2017 to the summer of 2020?
- d) In the absence of a pumped hydro energy storage system could not a portion of any summer surplus energy be sold as secondary sales to SCADA connected secondary sales customers?

ANSWER:

(a)

A common use case for batteries is to act as a stabilizing entity for fluctuating renewable generators. This can be accomplished on a power (ramp rate control) basis or frequency basis. A BESS of this size would be able to stabilize any frequency variations due to a wind farm.

See also the response to YUB-YEC-1-24(d). The BESS could be set to respond to frequency excursions outside of a certain range (right now +/- 0.5 Hz) irrespective of what generation/load is causing this excursion.

1 **(b)**

2
3 While a wind farm would reduce winter thermal generation, it would increase the
4 pressure/requirements on the Aishihik, Mayo and Whitehorse reservoirs due to its addition
5 of incremental summer energy when the system already experiences an excess of energy
6 availability (unless there was a significant increase in the summer load from new
7 demands). The reservoirs would be required to allow for the shifting of more power from
8 the summer to the winter when its needed and may encounter further challenges in this
9 regard.

10
11 **(c)**

12
13 In drought years a wind farm would reduce thermal generation requirements.

14
15 **(d)**

16
17 Yes, it is anticipated when the IPP Standing Offer Program wind and solar comes online
18 the amount of summer secondary sales will increase.

1 **TOPIC:** **Section 4 Project Justification**

2
3 **REFERENCE:** **Page 39 Re. Table 4-3 Annual Ratepayer Impacts from BESS:**

4
5 **QUESTION:**

6
7 a) Do the savings from Operating Reserve and from Peak Shifting include any
8 variable costs such as consumables and variable labour from reduced operating
9 hours of diesel and LNG generators?

10
11 b) If not, why are these not included as a cost savings?

12
13 **ANSWER:**

14
15 **(a)**

16
17 No, the savings in Table 4-3 only account for the fuel costs.

18
19 **(b)**

20
21 In practice, non-fuel variable cost savings will likely result in additional savings from these
22 use cases above what is presented in the Application. For the purpose of the current
23 assessments, these additional cost savings have not been estimated. Past estimates have
24 suggested that such savings might approximate 1.5 cents per kWh of diesel generation
25 avoided.

TOPIC: Section 4 Project Justification

REFERENCE: Page 39 Re. Table 4-3:

QUESTION:

- a) Please provide an updated Table 4-3 based on the present (March 2021) actual LNG and diesel fuel prices.
- b) Based on the present actual costs of diesel and LNG, at approximately what BESS project cost over-run would the project be break-even?
- c) Please provide a Table 4-3 based on the project coming in at 30% below the estimate.
- d) Please provide a Table 4-3 based on the project coming in at 30% above the estimate.
- e) Please reference the Hatch Report page B-113 and provide a Table 4-3 based on a long-term avoided cost of diesel at \$0.277 per kWh and a long-term avoided cost of LNG at \$0.248 per kWh.

ANSWER:

(a)

Please see Table 1 below that shows updated version of Table 4-3 with most recent actual fuel prices.

**Table 1: Annual Ratepayer Impacts from BESS (20 MW/ 40 MWh) based on
March 2021 Fuel Prices**

\$000	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	
	A	B	C	D=A+B+C	E	F	G	H=E+F+G	I=H-D
Year 1	\$1,530	\$652	\$89	\$2,271	\$1,216	\$1,236	\$25	\$2,477	\$205
Year 2	\$1,492	\$665	\$91	\$2,247	\$1,265	\$1,261	\$25	\$2,550	\$303
Year 3	\$1,454	\$678	\$93	\$2,224	\$1,315	\$1,286	\$26	\$2,627	\$403
Year 4	\$1,416	\$691	\$94	\$2,201	\$1,368	\$1,311	\$26	\$2,705	\$505
Year 5	\$1,378	\$704	\$96	\$2,178	\$1,423	\$1,338	\$27	\$2,787	\$609
Year 6	\$1,340	\$717	\$98	\$2,156	\$1,480	\$1,364	\$27	\$2,871	\$715
Year 7	\$1,302	\$731	\$100	\$2,134	\$1,539	\$1,392	\$28	\$2,958	\$825
Year 8	\$1,264	\$745	\$102	\$2,112	\$1,600	\$1,420	\$28	\$3,048	\$936
Year 9	\$1,226	\$759	\$104	\$2,090	\$1,664	\$1,448	\$29	\$3,141	\$1,051
Year 10	\$1,189	\$774	\$106	\$2,069	\$1,731	\$1,477	\$29	\$3,237	\$1,168
Year 11	\$1,151	\$789	\$109	\$2,048	\$1,800	\$1,506	\$30	\$3,337	\$1,288
Year 12	\$1,113	\$804	\$111	\$2,028	\$1,872	\$1,537	\$31	\$3,439	\$1,412
Year 13	\$1,075	\$820	\$113	\$2,007	\$1,947	\$1,567	\$31	\$3,545	\$1,538
Year 14	\$1,037	\$835	\$115	\$1,987	\$2,025	\$1,599	\$32	\$3,655	\$1,668
Year 15	\$999	\$851	\$117	\$1,968	\$2,106	\$1,631	\$33	\$3,769	\$1,801
Year 16	\$961	\$868	\$120	\$1,949	\$2,190	\$1,663	\$33	\$3,886	\$1,938
Year 17	\$923	\$885	\$122	\$1,930	\$2,278	\$1,697	\$34	\$4,008	\$2,078
Year 18	\$885	\$902	\$125	\$1,912	\$2,369	\$1,730	\$34	\$4,134	\$2,222
Year 19	\$847	\$919	\$127	\$1,894	\$2,463	\$1,765	\$35	\$4,264	\$2,370
Year 20	\$810	\$937	\$130	\$1,876	\$2,562	\$1,800	\$36	\$4,398	\$2,522
NPV	\$16,318	\$10,147	\$1,394	\$27,859	\$22,647	\$19,353	\$386	\$42,386	\$14,527

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.
- 6 The table assumes diesel fuel price at \$0.273/kW.h and LNG fuel price at \$0.194/kW.h based on March 2021 prices.

(b)

Based on the present costs of diesel and LNG as provided above in response to part (a), Table 1 (footnote 6) and the other costs and savings in Table 1, the BESS project would break even for NPV ratepayer cost impacts with capital cost over-run of approximately 42.5%.

(c)

Table 2 below shows an updated version of Table 4-3 assuming a Project capital cost 30% below the estimate included in the Application.

Table 2: Annual Ratepayer Impacts from BESS (20 MW/ 40 MWh) assuming a Project Capital Cost 30% below the estimate included in the Application

\$000	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	
	A	B	C	D=A+B+C	E	F	G	H=E+F+G	I=H-D
Year 1	\$793	\$652	\$82	\$1,528	\$1,216	\$1,125	\$11	\$2,351	\$823
Year 2	\$774	\$665	\$84	\$1,522	\$1,265	\$1,147	\$11	\$2,423	\$900
Year 3	\$754	\$678	\$85	\$1,517	\$1,315	\$1,170	\$11	\$2,496	\$979
Year 4	\$734	\$691	\$87	\$1,512	\$1,368	\$1,193	\$11	\$2,573	\$1,061
Year 5	\$715	\$704	\$89	\$1,507	\$1,423	\$1,217	\$12	\$2,651	\$1,144
Year 6	\$695	\$717	\$91	\$1,503	\$1,480	\$1,242	\$12	\$2,733	\$1,230
Year 7	\$675	\$731	\$92	\$1,499	\$1,539	\$1,267	\$12	\$2,817	\$1,318
Year 8	\$656	\$745	\$94	\$1,495	\$1,600	\$1,292	\$12	\$2,904	\$1,409
Year 9	\$636	\$759	\$96	\$1,492	\$1,664	\$1,318	\$12	\$2,994	\$1,503
Year 10	\$616	\$774	\$98	\$1,489	\$1,731	\$1,344	\$13	\$3,088	\$1,599
Year 11	\$597	\$789	\$100	\$1,486	\$1,800	\$1,371	\$13	\$3,184	\$1,698
Year 12	\$577	\$804	\$102	\$1,483	\$1,872	\$1,398	\$13	\$3,284	\$1,800
Year 13	\$557	\$820	\$104	\$1,481	\$1,947	\$1,426	\$13	\$3,387	\$1,906
Year 14	\$538	\$835	\$106	\$1,479	\$2,025	\$1,455	\$14	\$3,493	\$2,014
Year 15	\$518	\$851	\$108	\$1,478	\$2,106	\$1,484	\$14	\$3,604	\$2,126
Year 16	\$499	\$868	\$111	\$1,477	\$2,190	\$1,514	\$14	\$3,718	\$2,241
Year 17	\$479	\$885	\$113	\$1,476	\$2,278	\$1,544	\$15	\$3,836	\$2,360
Year 18	\$459	\$902	\$115	\$1,476	\$2,369	\$1,575	\$15	\$3,958	\$2,483
Year 19	\$440	\$919	\$117	\$1,476	\$2,463	\$1,606	\$15	\$4,085	\$2,609
Year 20	\$420	\$937	\$120	\$1,476	\$2,562	\$1,638	\$15	\$4,216	\$2,740
NPV	\$8,464	\$10,147	\$1,286	\$19,897	\$22,647	\$17,612	\$167	\$40,426	\$20,530

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.
- 6 The table assumes the capital cost if 30% below the estimate included in the Part 3 Application.

(d)

Table 3 below shows an updated version of Table 4-3 assuming a Project capital cost 30% above the estimate included in the Application.

Table 3: Annual Ratepayer Impacts from BESS (20 MW/ 40 MWh) Assuming the Project Capital Cost 30% above the estimate included in the Application

	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	
	A	B	C	D=A+B+C	E	F	G	H=E+F+G	I=H-D
Year 1	\$2,487	\$652	\$82	\$3,221	\$1,216	\$1,125	\$11	\$2,351	-\$870
Year 2	\$2,425	\$665	\$84	\$3,174	\$1,265	\$1,147	\$11	\$2,423	-\$751
Year 3	\$2,364	\$678	\$85	\$3,127	\$1,315	\$1,170	\$11	\$2,496	-\$630
Year 4	\$2,302	\$691	\$87	\$3,080	\$1,368	\$1,193	\$11	\$2,573	-\$507
Year 5	\$2,240	\$704	\$89	\$3,033	\$1,423	\$1,217	\$12	\$2,651	-\$382
Year 6	\$2,179	\$717	\$91	\$2,987	\$1,480	\$1,242	\$12	\$2,733	-\$254
Year 7	\$2,117	\$731	\$92	\$2,941	\$1,539	\$1,267	\$12	\$2,817	-\$123
Year 8	\$2,055	\$745	\$94	\$2,895	\$1,600	\$1,292	\$12	\$2,904	\$9
Year 9	\$1,994	\$759	\$96	\$2,849	\$1,664	\$1,318	\$12	\$2,994	\$145
Year 10	\$1,932	\$774	\$98	\$2,804	\$1,731	\$1,344	\$13	\$3,088	\$283
Year 11	\$1,871	\$789	\$100	\$2,760	\$1,800	\$1,371	\$13	\$3,184	\$424
Year 12	\$1,809	\$804	\$102	\$2,715	\$1,872	\$1,398	\$13	\$3,284	\$568
Year 13	\$1,747	\$820	\$104	\$2,671	\$1,947	\$1,426	\$13	\$3,387	\$716
Year 14	\$1,686	\$835	\$106	\$2,627	\$2,025	\$1,455	\$14	\$3,493	\$866
Year 15	\$1,624	\$851	\$108	\$2,584	\$2,106	\$1,484	\$14	\$3,604	\$1,020
Year 16	\$1,563	\$868	\$111	\$2,541	\$2,190	\$1,514	\$14	\$3,718	\$1,177
Year 17	\$1,501	\$885	\$113	\$2,498	\$2,278	\$1,544	\$15	\$3,836	\$1,338
Year 18	\$1,439	\$902	\$115	\$2,456	\$2,369	\$1,575	\$15	\$3,958	\$1,503
Year 19	\$1,378	\$919	\$117	\$2,414	\$2,463	\$1,606	\$15	\$4,085	\$1,671
Year 20	\$1,316	\$937	\$120	\$2,372	\$2,562	\$1,638	\$15	\$4,216	\$1,844
NPV	\$26,528	\$10,147	\$1,286	\$37,961	\$22,647	\$17,612	\$167	\$40,426	\$2,466

Notes:

- 2021 assumed as Year 1. Capital costs (Table 3-4) and operating costs (Table 3-5) each escalated 2% for one year inflation.
- YEC WACC at 4.794% per 2021 GRA (real WACC with 2% inflation at 2.739%) is used for all net present values (NPVs).
- Annual Capital Cost includes depreciation (20 year life) and return on mid-year rate base at YEC WACC of 4.794%.
- 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.
- Avoided Diesel Rental Costs assumes \$168,896 per MW (2022\$) and 7.2 MW (4 rental units) of dependable capacity.
- The table assumes the capital cost if 30% above the estimate included in the Part 3 Application.

Please see Table 4 below for the requested information.

Table 4: Annual Ratepayer Impacts from BESS (20 MW/ 40 MWh) based on avoided cost of diesel at \$0.277 per kWh and a long-term avoided cost of LNG at \$0.248 per kWh

\$000	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	
	A	B	C	D=A+B+C	E	F	G	H=E+F+G	I=H-D
Year 1	\$1,530	\$652	\$112	\$2,294	\$1,216	\$1,547	\$14	\$2,777	\$483
Year 2	\$1,492	\$665	\$114	\$2,271	\$1,265	\$1,578	\$14	\$2,857	\$586
Year 3	\$1,454	\$678	\$116	\$2,248	\$1,315	\$1,610	\$14	\$2,939	\$691
Year 4	\$1,416	\$691	\$119	\$2,225	\$1,368	\$1,642	\$15	\$3,024	\$799
Year 5	\$1,378	\$704	\$121	\$2,203	\$1,423	\$1,675	\$15	\$3,112	\$909
Year 6	\$1,340	\$717	\$124	\$2,181	\$1,480	\$1,708	\$15	\$3,203	\$1,022
Year 7	\$1,302	\$731	\$126	\$2,159	\$1,539	\$1,742	\$16	\$3,296	\$1,137
Year 8	\$1,264	\$745	\$129	\$2,138	\$1,600	\$1,777	\$16	\$3,393	\$1,255
Year 9	\$1,226	\$759	\$131	\$2,117	\$1,664	\$1,813	\$16	\$3,493	\$1,376
Year 10	\$1,189	\$774	\$134	\$2,096	\$1,731	\$1,849	\$17	\$3,596	\$1,500
Year 11	\$1,151	\$789	\$136	\$2,076	\$1,800	\$1,886	\$17	\$3,703	\$1,627
Year 12	\$1,113	\$804	\$139	\$2,056	\$1,872	\$1,924	\$17	\$3,813	\$1,757
Year 13	\$1,075	\$820	\$142	\$2,036	\$1,947	\$1,962	\$18	\$3,927	\$1,890
Year 14	\$1,037	\$835	\$145	\$2,017	\$2,025	\$2,001	\$18	\$4,044	\$2,027
Year 15	\$999	\$851	\$148	\$1,998	\$2,106	\$2,041	\$18	\$4,165	\$2,167
Year 16	\$961	\$868	\$151	\$1,979	\$2,190	\$2,082	\$19	\$4,291	\$2,311
Year 17	\$923	\$885	\$154	\$1,961	\$2,278	\$2,124	\$19	\$4,420	\$2,459
Year 18	\$885	\$902	\$157	\$1,944	\$2,369	\$2,166	\$19	\$4,554	\$2,611
Year 19	\$847	\$919	\$160	\$1,926	\$2,463	\$2,210	\$20	\$4,693	\$2,767
Year 20	\$810	\$937	\$163	\$1,909	\$2,562	\$2,254	\$20	\$4,836	\$2,927
NPV	\$16,318	\$10,147	\$1,752	\$28,217	\$22,647	\$24,227	\$217	\$47,091	\$18,874

Notes:

- 2021 assumed as Year 1. Capital costs (Table 3-4) and operating costs (Table 3-5) each escalated 2% for one year inflation.
- YEC WACC at 4.794% per 2021 GRA (real WACC with 2% inflation at 2.739%) is used for all net present values (NPVs).
- Annual Capital Cost includes depreciation (20 year life) and return on mid-year rate base at YEC WACC of 4.794%.
- 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.
- Avoided Diesel Rental Costs assumes \$168,896 per MW (2022\$) and 7.2 MW (4 rental units) of dependable capacity.
- The table assumes diesel fuel price at \$0.277/kW.h and LNG fuel price at \$0.248/kW.h as requested in the IR question.

TOPIC: Appendix B Hatch Report

REFERENCE: Page B-14 Re. TKC Land –Whitehorse Access road:

PREAMBLE:

QUESTION:

a) Is the reference to an 'existing access across from the Yukon Energy access' referring to the Robert Service Way access road toward Yukon Energy (and Miles Canyon Road)?

b) If so, can YEC confirm that Hatch is mistaken with respect to the existence of traffic lights at this intersection?

ANSWER:

(a)

Yes.

(b)

Confirmed. The report was mistaken regarding the existence of traffic lights.

1 **TOPIC:** **Appendix B Hatch Report**

2

3 **REFERENCE:** **Page B-19 Re. “A 2 MW wind farm is currently being planned for**
4 **operation in 2021”:**

5

6 **PREAMBLE:**

7

8 **QUESTION:**

9

10 a) Please describe the wind farm that is being referenced here and what is its present
11 status?

12

13 **ANSWER:**

14

15 **(a)**

16

17 The 2MW wind farm planned for 2021 at the time the Hatch report was authorized is a
18 wind project on Haeckel Hill now known as the Eagle Hill Wind Project. Eagle Hill Wind is
19 now a 4 MW, 100% First Nation owned, fully funded project. The project has secured the
20 site lease and initial site works are expected to begin in summer of 2021. It is currently
21 expected to be operational in 2023.

1 **TOPIC:** **Appendix B Hatch Report**

2

3 **REFERENCE:** **Page B-78 Re. "Several of the major underfrequency events lasted**
4 **for extended periods, one lasting for several days.":**

5

6 **PREAMBLE:**

7

8 **QUESTION:**

9

10 a) Please provide the dates involved in the underfrequency event that lasted for
11 several days and describe the circumstances that caused this event.

12

13 **ANSWER:**

14

15 **(a)**

16

17 Since the Hatch report was authored, further review has indicated the event referenced
18 were the result of offline transducers and their duration should be ignored/excluded as
19 erroneous.

Utilities Consumers' Group (UCG)

1 **REFERENCE: Proposed Battery Energy Storage System Project Application,**
2 **page 1**

3
4 “On December 17, 2020, the Commissioner in Executive Council
5 designated the Project as a regulated project under Part 3 of the Public
6 Utilities Act pursuant to OIC 2020/180.”

7
8 **QUESTION:**

9
10 a) Please provide a copy of all information provided to the Commissioner in Executive
11 Council by YEC or other parties that convinced the Yukon government to designate
12 this proposed Battery Energy Storage System project as a regulated project and
13 details of the process that led to this designation.

14
15 **ANSWER:**

16
17 **(a)**

18
19 OIC 2020/180 designating the Project as a “regulated project” under Part 3 of the *Public*
20 *Utilities Act* is a specific direction of the Yukon Government. Questioning the reasoning
21 behind the enactment of this or any OIC is not within the jurisdiction of the Board.

REFERENCE: YEC 2017-2018 GRA, page 5-31 and page 5-36

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

“Depending on the option selected, the TGS study indicates forecast costs for the Battery project between \$21.7 and \$27.4 million (including costs for planning, permitting and construction) for an initial 15 to 20 year life, after which a replacement battery is estimated to cost between \$17.4 and \$22.1 million (2016\$).”

Board Order 2018-10: Reasons for Decision, December 27, 2018, pages 87-88

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

“Depending on the option selected, the TGS study indicates forecast costs for the Battery project between \$21.7 and \$27.4 million (including costs for planning, permitting and construction) for an initial 15 to 20 year life, after which a replacement battery is estimated to cost between \$17.4 and \$22.1 million (2016\$).

Proposed Battery Energy Storage System Project Application, pages 3 and 32

“The Project will involve a grid-sized BESS with 40 MWh of useful energy storage capacity and 20 MW of inverter and transformer capacity that together will provide 7.2 MW of dependable capacity (i.e., displace four 1.8 MW diesel rental units) to the YIS for 20 years, starting in the winter of 2022/23.”

1 “The preliminary capital cost estimate (2020\$, +/- 30% accuracy) is
2 \$31.7 million; after the \$16.5 million funding from the Federal
3 government’s Investing in Canada Infrastructure Program (“ICIP”), the
4 preliminary net capital cost estimate for Yukon Energy is \$15.2 million.”
5

6 “During the review of YEC’s 2017/18 GRA, the YUB noted a concern
7 that the technology used for battery storage has not been tested in a
8 northern climate. Small scale lithium ion battery energy storage
9 facilities have been successfully applied in the northern regions,
10 including the Raglan Mine [Nunavik, Northern Quebec] completed in
11 2015; and Colville Lake completed by Northwest Territories Power
12 Corporation in 2016.”) for an initial 15 to 20 year life, after which a
13 replacement battery is estimated to cost between \$17.4 and \$22.1
14 million (2016\$).”
15

16 **QUESTION:**
17

- 18 a) Please provide a comparison of the current project proposal to the battery energy
19 storage project contained within YEC’s 2016-2030 Resource Plan and its 2017-
20 2018 General Rate Application.
21
- 22 b) Please confirm that the current price estimate for the proposed Battery Energy
23 Storage System is now between \$22.19 million and \$41.21 million provide 7.2 MW
24 of dependable capacity and displace four 1.8 MW diesel rental units.
25
- 26 c) Please provide a comparison of the ongoing capital and operating costs of the
27 proposed Battery Energy Storage System and the costs of four 1.8 MW diesel
28 rental units.
29
- 30 d) Please provide a detailed year-by-year breakdown, with explanations, of the actual
31 and forecast costs (both up to and after placing into service) for the proposed
32 Battery Energy Storage System project.
33
- 34 e) Please confirm that the proposed cost of between \$22.19 million and \$41.21 million
35 is only for an initial 15-20 year life after which battery replacement will be required.
36 Please confirm the estimated cost of battery replacement.

1 f) Please confirm YEC's understanding that being awarded funding from Canada to
2 support development of the proposed Battery Energy Storage System does not
3 justify the project as being viable from a YUB perspective.

4
5 g) Please provide a table showing the impact the proposed Battery Energy Storage
6 System project will have on the bills of ratepayers in the year it is scheduled to
7 commence operation and each of the first 10 years of operation.

8
9 h) Please provide a comparison of the projects referenced in Northern Quebec and
10 the Northwest Territories to YEC's proposed Battery Energy Storage System and
11 explain in detail the capital and operating costs, the operating environment and
12 alternatives considered to these other projects versus YEC's proposed project.

13
14 i) Please confirm that the last revenue requirement for YEC approved by the YUB
15 was related to 2018 and that current rates do not recover any costs associated
16 with the planning or commissioning of the proposed Battery Energy Storage
17 System.

18
19 **ANSWER:**

20
21 **(a)**

22
23 The 2016 Resource Plan identified a lithium-ion battery as a preferred resource option,
24 which was included in the 2017-18 General Rate Application. Resources considered in
25 long-term planning exercises use initial project assumptions based on meeting load
26 requirements. The feasibility engineering study completed by Hatch refined the design
27 and cost estimates for the project based on a more detailed assessment of system
28 requirements and current technical information.

29
30 **(b)**

31
32 Correct. The proposed BESS has a capital cost estimate of \$31.7M with an accuracy +/-
33 30% resulting in a range of costs between \$22.19M and \$41.21M; and after the \$16.5
34 million funding from the Federal Government's Investing in Canada Infrastructure Program
35 (ICIP), the preliminary net capital cost estimate for Yukon Energy is \$15.2 million.

1 The proposed BESS would provide 7.2 MW of dependable capacity, displacing four 1.8
2 MW diesel rental units.

3
4 **(c)**

5
6 Please see Table 4-3 in the Application and response to YUB-YEC-1-30(a).

7
8 **(d)**

9
10 Table 4-3 in the Application provides BESS project costs and savings by year for each of
11 the 20 operating years. Capital costs details are provided in Table 3-4 and will be incurred
12 in 2021 and 2022.

13
14 **(e)**

15
16 Battery replacement costs are not included in this estimate, which is for a 20 year project
17 life. A determination of the best replacement for the BESS after the 20-year project life will
18 be made when the batteries come to end-of-life, based on the current technology and grid
19 requirements at that time, as well as any potential for project life extension. The cost will
20 also be determined at that time, as there is uncertainty with regard to the price of
21 technology options 20 years in the future. Please see also response to YUB-YEC-1-12(a).

22
23 **(f)**

24
25 As outlined in the Project Justification of the Application, YEC is proposing the BESS
26 project as it provides a net ratepayer benefit compared to temporary diesel rentals. The
27 provision of funding reduces the cost of the project, but is not a justification of project
28 viability. The YUB must consider whether project costs are prudently incurred and
29 reasonable.

30
31 **(g)**

32
33 Please see response to YUB-YEC-1-58(b) and (c).

1 **(h)**

2
3 UCG is requesting detailed information regarding capital and operating costs, operating
4 environment and alternatives considered by developers of other projects of different scale
5 and scope completed in Quebec and Northwest Territories. The requested information is
6 not directly relevant to the assessment of the need and justification for the BESS project.
7

8 The application simply references the Raglan Mine [Nunavik, Northern Quebec] and the
9 Colville lake project as examples of other battery projects completed in northern regions
10 with cold climate conditions. The nature of the projects and developers are very different
11 (i.e., one developer is a mine), compared to the current project and detailed information
12 regarding costs, or alternatives considered for these other projects will not provide any
13 material assistance to the Board in its review.
14

15 **(i)**

16
17 Confirmed. The last YUB approved revenue requirement for YEC was for the 2018 test
18 year (as part of the 2017/18 GRA). The BESS was not forecast to come into service at
19 that time and related BESS costs were not been included in rate base or customer rates
20 as approved at that time.

1 **REFERENCE: YEC 2019 Annual Report, page 21**

2
3 “We received \$16.5 million in federal funding to support the
4 construction of our new battery storage system. Once completed, the
5 new battery will be one of the largest grid-connected batteries in
6 Canada.”

7
8 **YEC Website** [https://yukonenergy.ca/energy-in-yukon/projects-facilities/battery-](https://yukonenergy.ca/energy-in-yukon/projects-facilities/battery-storage/battery-timeline)
9 [storage/battery-timeline](https://yukonenergy.ca/energy-in-yukon/projects-facilities/battery-storage/battery-timeline)

10
11 “We received \$16.5 million in federal funding to support the
12 construction of our new battery storage system. Once completed, the
13 new battery will be one of the largest grid-connected batteries in
14 Canada.”

15
16 **February 21, 2021 News Release, YEC Website**
17 [https://yukonenergy.ca/media/site_documents/CORRECTED Yukon Energy annou](https://yukonenergy.ca/media/site_documents/CORRECTED_Yukon_Energy_announces_battery_location_and_agreement_02222021.pdf)
18 [nces_battery_location_and_agreement_02222021.pdf\)](https://yukonenergy.ca/media/site_documents/CORRECTED_Yukon_Energy_announces_battery_location_and_agreement_02222021.pdf)

19
20 “Yukon Energy announced today that the site on Robert Service Way
21 near the Alaska Highway will be the future home of its grid-scale energy
22 storage project in Whitehorse. Once complete, the 7 megawatt / 40
23 megawatt-hour battery will be the largest grid-connected battery in the
24 North, and one of the largest in Canada.” [Emphasis added]

25
26 **QUESTION:**

27
28 a) Please confirm YEC’s intention to proceed with the proposed Battery Energy
29 Storage System project even if the YUB denies recovery of the costs through rates
30 charged to Yukoners.

31
32 b) Please confirm that YEC’s timeline to have the proposed Battery Energy Storage
33 System installed and operational by November 2022 includes completion of the
34 YUB review process and the issuance by the Minister of Justice of an energy
35 project certificate and an energy operation certificate by the end of June 2021.

1 **ANSWER:**

2
3 **(a)**

4
5 Yukon Energy is proceeding with planning activities required to obtain authorizations and
6 approvals necessary for procurement to be initiated in July 2021 and to allow for initial civil
7 construction to commence in August 2021. Part of this regulatory review process includes
8 a Part 3 review where the YUB will provide its report and recommendations to the Minister
9 of Justice regarding the need and justification for the project. The Board's report will inform
10 the Minister's decision regarding the issuance of an Energy Project Certificate and Energy
11 Operation Certificate for the Project and any applicable terms and conditions. Outcomes
12 of this process will inform whether, and how, Yukon Energy can proceed with the Project.

13
14 The Project is not forecast to be completed until late 2022 and Project costs would not be
15 reviewed by the Board until the next GRA (after 2021). The YUB will only be able to review
16 costs for the Project if YEC is able to secure the necessary Energy Project Certificate and
17 is able to proceed with completion of the Project.

18
19 **(b)**

20
21 The current timeline outlined in Section 3.1 of the Application anticipates completion of the
22 Part 3 review, issuance of decision documents and securing all needed permits and
23 approvals by the end of June to commence procurement and construction in July 2021.

24
25 A Project Energy Certification would be required to be issued in July 2021 prior to
26 commencing construction; an Energy Operation Certificate would be issued after the
27 project is commissioned and prior to the Project commencing operation.

28
29 Project timelines are subject to ongoing review and updating as required.

1 **REFERENCE: Proposed Battery Energy Storage System Project Application,**
2 **page 3**

3
4 “The preliminary capital cost estimate (2020\$, +/- 30% accuracy) is
5 \$31.7 million; after the \$16.5 million funding from the Federal
6 government’s Investing in Canada Infrastructure Program (“ICIP”), the
7 preliminary net capital cost estimate for Yukon Energy is \$15.2 million.”
8

9 **QUESTION:**

10
11 a) Please confirm whether there are any conditions related to the sue [sic] of the
12 funding from the Investing in Canada Infrastructure Program.
13

14 **ANSWER:**

15
16 **(a)**

17
18 Please see response to YUB-YEC-1-47(a).

**REFERENCE: Proposed Battery Energy Storage System Project Application,
pages 6-7, 10**

"Yukon Energy must have sufficient dependable capacity under its N-1 Dependable Capacity Criterion to meet its winter non-industrial peak load without its largest generator (currently the 37 MW Aishihik Hydro connected to Whitehorse by transmission). For the BESS to contribute to this N-1 capacity reserve, it needs to be able to reduce the non-industrial peak demand during the day, and then be recharged overnight, for up to two weeks during the coldest winter months."

"The purpose for the BESS in N-1 events is to reduce the daytime peaks. Given the extensive daily time period related to these peaks, the available energy capacity of the BESS will determine the maximum power reduction that can be achieved, since it will dictate the duration that energy can be supplied throughout the day. In the above figure, the BESS must supply energy over the entire period above the red "flat load" line to achieve 7.2 MW dependable capacity replacement associated with displacing four rented diesel units."

"Rented or permanent thermal generation options to provide N-1 capacity reserve cannot provide these additional benefits."

QUESTION:

- a) Please provide the actual dependable capacity shortfall for each of the last 10 years and forecast for the next 10 years.
- b) Please explain how there is a current and growing need for new capacity to meet requirements under the single contingency (N-1) criterion and provide an explanation of how the design and capacity of the proposed Battery Energy Storage System will be able to fill in that supply need.
- c) If the proposed Battery Energy Storage System is replacing 4 rented diesel units, will they be physically removed from YEC property?

1 **ANSWER:**

2
3 **(a)**

4
5 YEC has rented temporary diesel units when necessary in order to address any
6 dependable capacity shortfalls forecast in the last 10 years, starting after the 2016
7 Resource Plan identified an existing capacity shortfall. The forecasted dependable
8 capacity gap without temporary diesel units is shown on Table 4-1 on page 28 of the
9 Application.

10
11 **(b)**

12
13 Please refer to Table 4-1 on page 28 of the Application which shows the capacity growth
14 and the current and increasing N-1 contingency shortfall. This increase in N-1
15 requirements is driven primarily by population growth, increased use of electricity, and
16 electrification policy initiatives to address climate change (e.g., electric vehicles and
17 increased electric heating). The BESS project will allow daytime peak loads to be shifted
18 to the lower load hours at high, enabling it to provide 7.2 MW of additional dependable
19 capacity to address this growing need.

20
21 **(c)**

22
23 The BESS project eliminates the need for four additional diesel units to address a part of
24 the current existing dependable capacity shortfall. However, units may not be physically
25 removed as the capacity shortfall is projected to increase due to load growth. In the
26 absence of the BESS project, 4 additional diesel rental units would need to be added to
27 the system.

**REFERENCE: Proposed Battery Energy Storage System Project Application,
page 5**

“In order to have the Project in service by November 2022 (i.e., available for winter 2022/23), long lead BESS and related equipment need to be ordered by approximately mid-2021 and initial site preparation activities also need to be completed in August 2021. Yukon Energy is proceeding with the necessary work to advance the Project to a final “go” decision point targeted for July 1, 2021. A competitive procurement process has been initiated to select battery vendors qualified to design a battery able to meet Yukon Energy’s operational requirements and Yukon’s northern climate; selected vendors will then be evaluated based on technical specifications, prices, and other components. Thermal management and heating of the system will be critical for Yukon Energy when selecting the BESS vendor.”

QUESTION:

- a) Please provide an update on the battery vendor selection process, the documentation for the RFP process and the specific criteria upon which vendors will be evaluated.
- b) Please confirm that all costs being incurred for the vendor selection process are not being recovered through existing rates and will form part of the final project costs.
- c) Please confirm that none of the costs related to the proposed Battery Energy Storage System will be added to YEC’s rate base until the project is in-service and the YUB has approved proposed additions to rate base.

ANSWER:

(a)

Please see response to YUB-YEC-1-13.

1 **(b)**

2

3 Confirmed. The forecast cost of procurement of the battery is captured in the Owner's
4 Cost category of the capital cost estimate and will form part of the final project costs.

5

6 **(c)**

7

8 Not confirmed as regards adding to rate base. Projects are added to rate base after they
9 are completed and in service. However, project costs included in rate base are not
10 included in customer rates until they have been reviewed and approved by the YUB as
11 part of a general rate application proceeding.

**REFERENCE: Proposed Battery Energy Storage System Project Application,
pages 10-11**

“Hatch concluded that use of the BESS to provide supplementary reserve has the greatest economic benefit among the identified additional uses. The benefits of the BESS use for operating reserve when excess water is available were noted to be two-fold:

- A direct reduction in diesel and LNG genset operation hours and energy generation; and
- Improved efficiency of the hydro-turbines by operating them at their most efficient output more frequently, leading to more energy production with the same amount water flow.”

QUESTION:

- a) Please provide details of the reductions to YEC revenue requirements and ratepayers bills as a result of the benefits identified.

ANSWER:

(a)

See Table 4-3 in the Application and response to YUB-YEC-1-58. YEC is not attempting to forecast overall revenue requirements, rates, or components of YEC revenue requirement, in the Application, i.e., such matters are addressed in a GRA.

**REFERENCE: Proposed Battery Energy Storage System Project Application,
page 10**

“Yukon Energy is also exploring options for potential use of BESS to stabilize hydro operation during periods of downstream winter ice formation, reducing downstream winter flooding and icing problems and enhancing hydro unit efficiencies.”

QUESTION:

a) Please provide details of the other potential uses of the proposed Battery Energy Storage System being investigated and how these other uses will benefit Yukon ratepayers.

b) Please provide details of the net benefits (i.e., reductions to revenue requirements) expected from these potential uses.

ANSWER:

(a) and (b)

The Application reviews primary BESS use (N-1 capacity reserve) in Section 3.1.2.1 and other BESS uses in section 3.1.2.2. The benefits of these uses are detailed in the application (see Section 4.2.3 which reviews net ratepayer cost savings related to primary BESS use and other use cases. Net benefits are summarized in Table 4.3: Annual Ratepayer Impacts from BESS (20 MW/ 40 MWh).

To the extent other BESS uses and their net benefit are defined and readily quantifiable they are described in the Application, and specifically in Table 4.3.

**REFERENCE: Proposed Battery Energy Storage System Project Application,
page 11**

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

QUESTION:

- a) Please provide details for the next 10 years of the expected water flow / water availability and indicate when the proposed Battery Energy Storage System would be used.

ANSWER:

(a)

The requested information cannot be provided. Yukon Energy cannot forecast actual water flow/ availability for the period requested (i.e., typically YEC can only forecast actual water flows for a period of up to about 18 months); and similarly, cannot indicate when the BESS would be used over the next 10 years.

See response to YUB-YEC-1-66(c) regarding information on long term average water flows.

**REFERENCE: Proposed Battery Energy Storage System Project Application,
pages 18 and 30**

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

“Standing Offer Program (SOP) and Micro-Generation Program: The SOP is outlined in the Independent Power Production (IPP) Policy of the Yukon territorial government issued in 2015. The SOP is included in the 10-Year Renewable Electricity Plan with 40 GWh / year of energy delivered by the IPP sector by the year 2024. The Micro-Generation Policy issued by the Yukon government in October 2013 is applicable to projects up to 50 kW. The micro-generation included in the 10-Year Renewable Electricity Plan envisions 6.5 GWh / year of delivered energy by the year 2024. However, no dependable capacity is available from SOP and micro-generation projects because they will be comprised of intermittent renewable resources such as wind and solar.”

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

QUESTION:

- a) Does YEC currently have a planning strategy to consider facility and non-facility alternatives in tandem to address long-term system constraints / needs such that an optimized and economic solution is proposed to meet the identified constraint or need? Please explain this strategy in detail and how it has been used in related to the proposed Battery Energy Storage Project.

- 1 b) Please describe the key linkages between YEC's infrastructure planning process
2 and its electricity supply planning process, with an emphasis on any considerations
3 relevant to the role of integrated resource planning alternatives. For example, if an
4 integrated resource planning alternative was under consideration to address an
5 infrastructure planning need, could and would YEC take into account as part of its
6 evaluation the impact (if any) of this alternative on its electricity supply needs and
7 costs?
8
- 9 c) In relation to longer-term system needs that may not materialize, does YEC believe
10 that there is any opportunity to incorporate this planning information on system
11 needs into its DSM plans and activities to allocate more of its DSM efforts to the
12 areas where these longer-term needs have been identified, without negatively
13 impacting the overall performance of its DSM efforts?
14
- 15 d) Does YEC agree that in addition to cost, reliability, safety, sustainability and
16 broadly protecting the interests of customers are relevant factors in evaluating and
17 comparing alternative solutions to system needs?
18
- 19 e) Does YEC agree that the YUB has the jurisdiction to review the reasonableness
20 of final project costs before any costs are recovered from ratepayers? When would
21 ratepayers be expected to start paying the costs of the proposed Battery Energy
22 Storage System assuming that YEC was given approval to proceed?
23
- 24 f) Does YEC believe that it is equally incented between developing facility
25 infrastructure and pursuing alternatives like DSM investments?
26
- 27 g) Please indicate whether YEC has or expects to make capacity funding available
28 to Indigenous communities in order to facilitate their participation in relation to the
29 planning and development of the proposed Battery Energy Storage System.
30
- 31 h) Please confirm that YEC is committed to working with Indigenous peoples to
32 achieve benefits for them resulting from YEC's projects and operations, including
33 opportunities in training and education, employment, procurement, business
34 development and community development.
35
- 36 i) Please outline the current areas of public policy that YEC believes are being
37 supported by and align with the proposed Battery Energy Storage System project.

1 **ANSWER:**

3 **(a)**

5 Yes. Please see Yukon Energy's 10-Year Renewable Electricity Plan provided as
6 Attachment 1 to this response.

8 The plan expanded on work completed for Yukon Energy's 2016 Resource Plan, with a
9 specific focus on advancing renewable energy projects to meet renewable portfolio
10 standards articulated in 'Our Clean Future: A Yukon Strategy for Climate Change, Energy
11 and a Green Economy', and updating load forecasts to anticipate additional load growth
12 arising from electrification initiatives supported in 'Our Clean Future: A Yukon Strategy for
13 Climate Change, Energy and a Green Economy'.

15 The updates conducted for the 10-Year Renewable Electricity Plan consisted of a new
16 long term load forecast, expansion of existing hydro inventory, update of financial resource
17 attributes, portfolio analysis and an action plan charting the path for resource development
18 and implementation over the next 10 years.

20 YEC's load forecasts have identified a growing gap in then N-1 Resource Capacity; and
21 the 10-Year Renewable Electricity Plan examines a wide range of near term resource
22 supply options to address forecast energy and capacity shortfalls. Yukon Energy currently
23 rents diesel gensets to address the capacity gap; however, a Battery Energy Storage
24 System was identified in the Resource Plan as one available near-term renewable option
25 to address the capacity gap and reduce the number diesel gensets required to be rented.

27 See also discussion of alternatives provided in Section 4.2 of the Application.

29 **(b)**

31 The question is not clear and it is not clear what the author means by "YEC's infrastructure
32 planning process" and "its electricity supply planning process". Details of Yukon Energy's
33 integrated resource planning process are outlined in the response to part (a) above which
34 provides a link to the 10-Year Renewable Electricity Plan.

1 **(c)**

2
3 The question is not clear as to what is meant by “longer term system needs that may not
4 materialize” or “areas where these longer-term needs have been identified”.

5
6 As noted in part (a) of this response, the 10-Year Renewable Electricity Plan includes
7 updated information regarding long term load forecasts and other information including an
8 expansion of the existing hydro inventory, an update of financial resource attributes,
9 portfolio analysis and an action plan charting the path for resource development and
10 implementation over the next 10 years. Yukon Energy undertakes updates to its resource
11 plan on an ongoing basis to consider new information as required. These updates will
12 consider DSM, as well as new information on other electricity or capacity supply
13 alternatives. The 10-Year Renewable Electricity Plan also considered a number of load
14 forecast scenarios to evaluate the impact of key uncertainties.

15
16 As noted at page 30 of the Application, the current focus of DSM programs is on measures
17 that deliver peak capacity savings (i.e., reductions in peak electricity consumption) and
18 are expected to reduce peak demand by 7 MW by 2030/31.

19
20 **(d)**

21
22 YEC agrees that ratepayer interests are addressed in the planning process through
23 consideration of criteria such as cost, reliability, safety, sustainability.

24
25 **(e)**

26
27 The Board must complete a review, during a YEC general rate application (GRA) process,
28 of Project costs and determine that such costs were prudently incurred prior to such costs
29 being included in rates. This prudence review of the BESS project is not part of YEC’s
30 2021 GRA (as the project is not forecast to come into service until 2022) and would
31 therefore need to be part of YEC’s next GRA.

32
33 **(f)**

34
35 The question is not clear. Yukon Energy’s planning requirements are outlined in the 2016
36 Resource Plan and the 10-year Renewable Electricity Plan.

1 As the primary provider of bulk generation and transmission on the Yukon integrated
2 system Yukon Energy is required to ensure sufficient generation and capacity is available
3 to provide safe and reliable service to the Yukon Integrated System. Yukon Energy must
4 also plan its system in a manner that meets regulatory requirements, and Yukon
5 government policy objectives and guidance provided by the Yukon Government.

6
7 The 2016 Resource Plan and 10-Year Renewable Electricity Plan identify how DSM
8 programs and supply and capacity projects are required and being planned to supply
9 ongoing system needs in a manner that adheres to regulatory requirements and
10 government policy directions. OIC 2021/16 provides direction to enable YEC to recover
11 costs reasonably incurred to provide or participate in a demand-side management
12 program.

13
14 **(g)**

15
16 To date, YEC has not provided capacity funding to its First Nations partners on the project.
17 A Project Agreement with each First Nation will determine the specific benefits to be
18 provided for the project, including consideration of any capacity funding if appropriate.

19
20 **(h)**

21
22 Confirmed.

23
24 **(i)**

25
26 Please see responses to YUB-YEC-1-1(f) and YUB-YEC-1-1(g).

**REFERENCE: Proposed Battery Energy Storage System Project Application,
page 22**

“As discussed in Section 4 below, the 10-Year Renewable Electricity Plan outlines a number of new projects being planned over the next decade to meet Yukon’s growing electricity needs. Many of these projects connect to the grid via the Whitehorse Rapids facility, including the BESS, diesel retirement replacement, hydro uprating projects, and the rental diesel units required to meet N-1 planning criterion. Accordingly, YEC is undertaking the Whitehorse Interconnection Project to facilitate the connection of these required capacity resources to the grid in the Whitehorse area.

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

QUESTION:

- a) Please explain whether the Whitehorse Interconnection Project would be required at the existing planned level if the Battery Energy Storage System project did not proceed.

ANSWER:

(a)

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

**REFERENCE: Proposed Battery Energy Storage System Project Application,
page 22**

“An assessment by the Yukon Environment and Socio-economic Assessment Board (YESAB) Designated Office (DO) is required under the Yukon Environmental and Socio-economic Assessment Act (YESAA) related to specific land use activities required to construct and operate the Project. Land use assessments by NAV Canada and Transport Canada for aviation safety will also be required.

The YESAA assessment has not been initiated at this time. Yukon Energy is undertaking procurement to select a contractor to complete desktop studies required to complete the baseline studies and effects assessment as required to complete the YESAA Project Proposal. This work is targeted to be completed in March 2021 with the Project Proposal filing with the DO by March 31, 2021. The YESAA assessment process is expected be completed and Decision Documents issued by Decision Bodies before the end of June 2021.”

QUESTION:

- a) Please provide an update on the preparation of project proposal filing to the Yukon Environment and Socio-economic Assessment Board Designated Office.
- b) Please provide details of the amount of YESAB-related costs that have been incurred to date and forecast, separated by year. Please ensure that the detail provided is not simply a single number but an actual breakdown of the types of costs incurred.
- c) Please confirm that all YESAB-related costs have been incorporated into the total estimated cost of the proposed Battery Energy Storage System project proposed to be recovered from Yukon ratepayers.

ANSWER:

(a)

Please see response to JM-YEC-1-26.

(b)

Please see the Table below.

	2020	2021 actual	2021 forecast
YEC Cost	\$ 4,882	\$ 4,881	\$ 10,000
Consultants and contractors	\$ 7,331	\$ -	\$ 30,000
Total	\$ 12,213	\$ 4,881	\$ 40,000

(c)

The costs of the YESAA assessment process are captured in the Owners Cost category of the capital costs shown in the Application and will form part of the final project costs that are proposed to be recovered from ratepayers.

**REFERENCE: Proposed Battery Energy Storage System Project Application,
page 23**

“While the assessment and YESAA review is yet to be completed – due to the nature of the Project and due to the outcomes of consultation and site selection processes undertaken to date, the Project is not expected to have any significant environmental effects (e.g., impacts on aquatic environment, vegetation, wildlife or wildlife habitat) or socio-economic effects (e.g., recreation, human health, aesthetic quality, transportation, economy and ratepayers). This conclusion reflects careful consideration of the Project design, as well as consideration of standard mitigation measures that reduce or eliminate potential adverse effects. Some residual effects will occur (e.g., physical presence of the facilities will result in an altered landscape and other changes as long as the facilities are in place), but these are not expected to be significant given the developed and industrial nature of the immediate surroundings that have been persistent on the landscape for the last 55 years or more. The selected site is sheltered from related roadways and is not adjacent to any potentially non-compatible land use.

The Project will also have positive environmental and socio-economic effects. Notably, the Project is expected to provide for reduced greenhouse gas and particulate emissions resulting from the displacement of thermal generation emissions, reduced impacts from YIS disruptions, and enhanced ability to integrate new renewable generation. Other positive effects include the potential for local jobs and business activity during the construction period (including opportunities for KDFN and TKC), savings for Yukon ratepayers compared to what would be required with continued reliance on diesel rentals, and potential business, employment and investment opportunities for KDFN and TKC.”

1 **QUESTION:**

2
3 a) Please provide copies of all internal and external analyses, correspondence and
4 notes that led to these conclusions related to the anticipated environmental socio-
5 economic effects.

6
7 b) Please provide YEC's opinion on whether the YUB's determinations on the
8 proposed Battery Energy Storage System project should wait for conclusions of
9 the YESAB to be determined and published.

10
11 **ANSWER:**

12
13 **(a)**

14
15 Please see YUB-YEC-1-46(a) which provides the "Grid Scale Battery What We Heard"
16 report prepared by Stantec that summarizes the public and stakeholder engagement
17 process for the Project.

18
19 Attachment 1 to this response provides a letter report developed by EDI Environment
20 Dynamics in August 2020. This provides an initial environmental evaluation of sites
21 assessed by YEC for the Project.

22
23 **(b)**

24
25 The determinations to be made by the YUB are not dependent on the conclusions of the
26 YESAA process; and, as was the case for prior YUB Part 3 reviews, the YUB should not
27 need to wait on the results of that process to complete its review and recommendations
28 to the Minister of Justice.

29
30 The following is noted in this regard – further details are provided in Section 3.4 and 6.2
31 of the Application:

- 32
33 1. The Project requires only a Designated Office level assessment which is a less
34 onerous review process, compared to an Executive Committee assessment. It is
35 expected that the Designated Office review can be completed on a timely basis.

1 2. The Project assessable activities relate to land use activities and construction
2 activities for a 1.7 km 34.5 kV transmission line. The project will be located on a
3 greenfield site on land which will be zoned for utility use at the northeast corner of
4 the Alaska Highway and Robert Service Way (south access road) on KDFN
5 Category B Settlement land within an existing environmental and socio-economic
6 setting that has seen commercial and industrial development activities over a
7 sustained period of time. Most of the proposed 1.7 km transmission line connecting
8 the Project to Yukon Energy's Whitehorse Rapids facility fenceline will follow a pre-
9 existing trail and right-of-way (ROW). Given the nature of the land use activities
10 and the fact that the transmission line is short and largely along existing easements
11 or ROWs, the regulatory risk related to the assessment to be undertaken by
12 YESAA for the BESS is considered very low.

13
14 As noted in Section 6.2 of the Application, due to the nature of the project, there are no
15 anticipated material risks of major design modifications resulting from the regulatory
16 approvals and review process for this specific project. The Project will be built using
17 conventional construction technologies suited for northern climate conditions and
18 following all applicable construction and design practices for works of this nature, including
19 building and electrical codes and adhering to industry best practices. No special added
20 costs are anticipated at this time to be required to comply with anticipated material
21 condition in the approvals or permits.



2195 – 2nd Avenue
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P: (867) 393-4882

August 11, 2020

EDI Project No: 20Y0218

Yukon Energy Corporation
#2 Miles Canyon Road
Whitehorse, YT Y1A 6S7

Attention: Stephanie Whitehead, Resource Planning Engineer

RE: Environmental Evaluation of Proposed Battery Storage Facility Site

Yukon Energy Corporation (YEC) is considering three candidate sites for a potential battery storage facility in the Whitehorse area. The purpose of this assessment was to conduct an evaluation of environmental conditions at the three candidate sites to inform the site selection process. Two of these sites (the Robert Service Way [Lower] Site and the Takhini Substation Site) were assessed by EDI in 2019 for a thermal facility proposed by YEC (EDI Environmental Dynamics Inc. 2019). As the battery storage facility would have similar environmental effects as a thermal facility, results from the 2019 survey for these two sites were used for this assessment. The third site, the Robert Service Way (Upper) Site, was assessed in July 2020 and detailed information from the assessment is presented here. For detailed information about the other two sites, refer to the 2019 assessment letter (EDI Environmental Dynamics Inc. 2019). Summary information for all three sites is presented in this letter.

Methodology

The assessment of each site included a desktop review of available information and a reconnaissance-level field survey. The desktop assessment focused on environmental criteria and indicators adapted from a broader review of potential energy resource options evaluated in 2016 (Intergroup Consultants Ltd et al. 2016) (Table 1). In addition to the original indicators, a ‘catch-all’ indicator, “Other Environmental Values”, was added to document any other environmental concerns that were encountered during this assessment. The information examined in the desktop assessment was mostly GIS data, including hydrological data (streams, waterbodies, wetlands), fish distribution information, protected and conservation areas, Wildlife Key Areas (Environment Yukon 2016), caribou ranges, forest cover data and high-resolution satellite imagery. In addition to the GIS data, known occurrences of species of concern within 1,000 m of the potential sites were queried from the Yukon Conservation Data Centre. Potential effects to each indicator at each site were ranked as No Linkage, Low, Moderate, or High according to the criteria described in the 2016 Resource Options Evaluation (Intergroup Consultants Ltd et al. 2016).



A reconnaissance-level field survey was conducted at the Robert Service Way (Upper) Site to identify potential stand and site-level environmental values that are not available from GIS data and background information. This survey followed the same methodology as 2019 surveys. Field surveys included evaluation of three components: (1) vegetation and wildlife habitat conditions, (2) wildlife occurrences and features, such as nests, trails, and dens, and (3) water features.

Prior to field surveys, vegetation communities within 500 m of the site were stratified into habitat types based on vegetation cover and structural stage. The survey route consisted of a meandering transect selected using high-resolution satellite imagery, to provide representative coverage of the habitat strata within and adjacent to the proposed site. Transect density was highest within 200 m diameter of the site centre (i.e. the potential project footprint area) and diminished with increasing distance from the site. Generally, surveys were limited to areas within a radius of 500 m of the site centre unless a potential wildlife feature or productive habitat area was identified from the satellite imagery. Habitat types were classified and described in the field following procedures outlined in *Field Manual for Describing Yukon Ecosystems* (Yukon Government Department of Environment 2017) and the ecosite guide *Southern Lakes Boreal Low Subzone (BOLsL): A Field Guide to Ecosites Identification* (Environment Yukon 2017). Vegetation surveys considered the potential for rare plants to occur, based on ecosystem types present. The rare plant survey methodology was based on the *Alberta Native Plant Council (ANPC) Guidelines for Rare Plant Surveys in Alberta* (Alberta Native Plant Council 2012). Results presented here should be considered as an assessment of the potential for rare plants to occur. A more focused rare plant survey may be warranted for the final site that is selected.

Wildlife surveys focused on locating wildlife features such as raptor nests, bank swallow colonies, dens, well-defined trails and mineral licks. Wildlife observations and general information about habitat values and wildlife sign (e.g. lichen cover for caribou, woodpecker forage sign) were recorded as encountered.

The field crew searched for small water features (i.e. features not visible in the satellite imagery) but none were noted within 200 m of the site.

Results – Robert Service Way (Upper) Site

The dominant ecosite on and surrounding the proposed battery storage facility footprint on the Robert Service Way (Upper) Site is 01: SwAP-Twinflower ecosite, consisting of a P22: Lodgepole Pine/Soapberry vegetation association (Map 1). Most of this ecosite is at a Young Forest structural stage, although a small area along the proposed access road is Mature Forest.

Most of the proposed transmission line footprint follows a pre-existing trail and cutline that consists of three distinct habitats on route to the YEC generating facility (Map 1):

- a narrow band of regenerating lodgepole pine, trembling aspen, and white spruce at a seral Pole-Sapling structural stage along the cutline;
- a narrow band of 01-SwAP-Twinflower ecosite in a ASw06: Trembling Aspen-White Spruce/Soapberry/Fireweed vegetation association at a seral Tall Shrub structural stage under the existing transmission line;



- a cleared area at the bottom of the hill off of the south access of Robert Service Way. Part of this cleared area is currently used for recreational dirt biking.

It is assumed that the proposed transmission line would be constructed on these existing seral areas. However, two adjacent forest areas could be affected. One is the 01-P22 ecosite near the proposed facility location described above. The second is a 01: SwAP-Twinflower ecosite in a Sw26: White Spruce/Soapberry/Step Moss vegetation association at a Mature Forest structural stage (Map 1). Three additional cleared areas occur near the proposed facility, including a gravel pit along the Alaska Highway. These cleared areas are characterized by a high occurrence of introduced and disturbance-induced plant species, including several species recognized as invasive in Yukon (Environment Yukon 2012).

Signs of deer (tracks, pellets, trails, antler rubs) and both ground and red squirrel (burrows, middens, auditory observations) were observed sporadically throughout the Robert Service Way (Upper) Site. One coyote den was found in the young lodgepole pine forest approximately 150 m west of the proposed battery storage facility footprint, and evidence of porcupine feeding was noted on numerous trees along the proposed transmission line footprint. With the exception of the coyote den, no wildlife features, including raptor nests, bank swallow colonies, well-defined trails, or mineral licks were detected during the survey. The coyote den would not be directly impacted by developing the site, and so is not considered a feature of management importance. Coyotes tolerate human activity (as evidenced by the location of this den near the Alaska Highway) and the animals using that den are likely to either continue using it, or relocate to a new den nearby, without any effects to raising young. Bird species observed incidentally included Savanna Sparrow, Dark-eyed Junco, American Robin, Yellow-rumped Warbler, and Swainson's Thrush.

No wildlife species of concern were observed in the Robert Service Way (Upper) Site during the field survey. Based on habitat and range, Olive-sided Flycatcher and Common Nighthawk may occur in the survey area. Two occurrences of species of concern were obtained from the Yukon Conservation Data Centre, but both were outside the potential zone of influence of the Project. One was of a Rusty Blackbird by the Ice Lake Road, approximately 1,000 m northwest of the Robert Service Way (Upper) Site. The other was of Dune Tachinid Fly approximately 1,300 m across the Yukon River/Schwatka Lake.

Summary of the Three Sites

A summary of the key results of this assessment for the three sites is provided in Tables Table 1 and Table 2. For detailed field information for the Robert Service Way (Lower) Site and Takhini Substation Site refer to EDI Environmental Dynamics Inc. (2019). The forested ecosystems observed across all three candidate sites are all common types for the Boreal Low bioclimate zone of Yukon and rare plants are not typically associated with them. Ecosystems that typically host rare plant species are generally uncommon on the landscape and include some types of wetlands, groundwater springs, grasslands, sand dunes, saline areas, and unglaciated areas (Environment Yukon 2017). No especially productive wildlife habitats or concentrations of wildlife sign were noted at any of the three candidate sites.



Management Implications

Based on the information compiled for this evaluation, nothing stands out as a potentially 'significant' environmental value in the context of an Environmental Assessment. Environmental values considered in this assessment are mostly ranked Low or No Linkage and do not preclude development at any of the sites evaluated. However, potential effects do vary somewhat across sites at the site level (Tables 1 and 2).

There were numerous invasive plant species observed in the clearings adjacent to the Robert Service Way (Lower) and Robert Service Way (Upper) Sites, particularly in the clearing currently used for dirt biking at the northeast end of the proposed transmission line associated with the Robert Service Way (Upper) Site. Surface disturbance and travel in these areas has high potential to spread invasive species throughout the footprint and into adjacent forested areas. If either of these sites are selected, appropriate mitigations should be incorporated into development to minimize the potential for invasive species spread.

Closure

If you have any questions about this assessment, please contact Todd Mahon or Elaine Kennedy at 867-393-4882.

Yours truly,

EDI Environmental Dynamics Inc.

Submitted by email

Todd Mahon, MSc. RPBio
Senior Wildlife Ecologist

Submitted by email

Elaine Kennedy, BSc. PBIOL
Vegetation Ecologist

Attachments:

- Table 1. Summary of potential project effect rankings for a suite of environmental indicators across the three candidate battery storage facility sites.
- Table 2. Assessment of potential environmental effects associated with the candidate battery storage facility sites.
- Map 1 Ecosites surrounding the YEC proposed battery storage facility - Robert Service Way (Upper) Site
- Poster summary



Literature cited

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Table 1. Summary of potential project effect rankings for a suite of environmental indicators across the three candidate battery storage facility sites.

Indicator	Site		
	Robert Service Way (Upper) Site	Robert Service Way (Lower) Site	Takhini Substation Site
Species at Risk & Habitat	Low	Low	Low
Protected & Conservation Areas	No Linkage	No Linkage	No Linkage
Wildlife Key Areas	No Linkage	No Linkage	No Linkage
Caribou Ranges	No Linkage	No Linkage	No Linkage
Wetlands	No Linkage	No Linkage	Low-Moderate
Water Quality	Low	Low	Low
Fish & Fish Habitat	Low	Low	Low
Other Environmental Values	Low	No Linkage	No Linkage

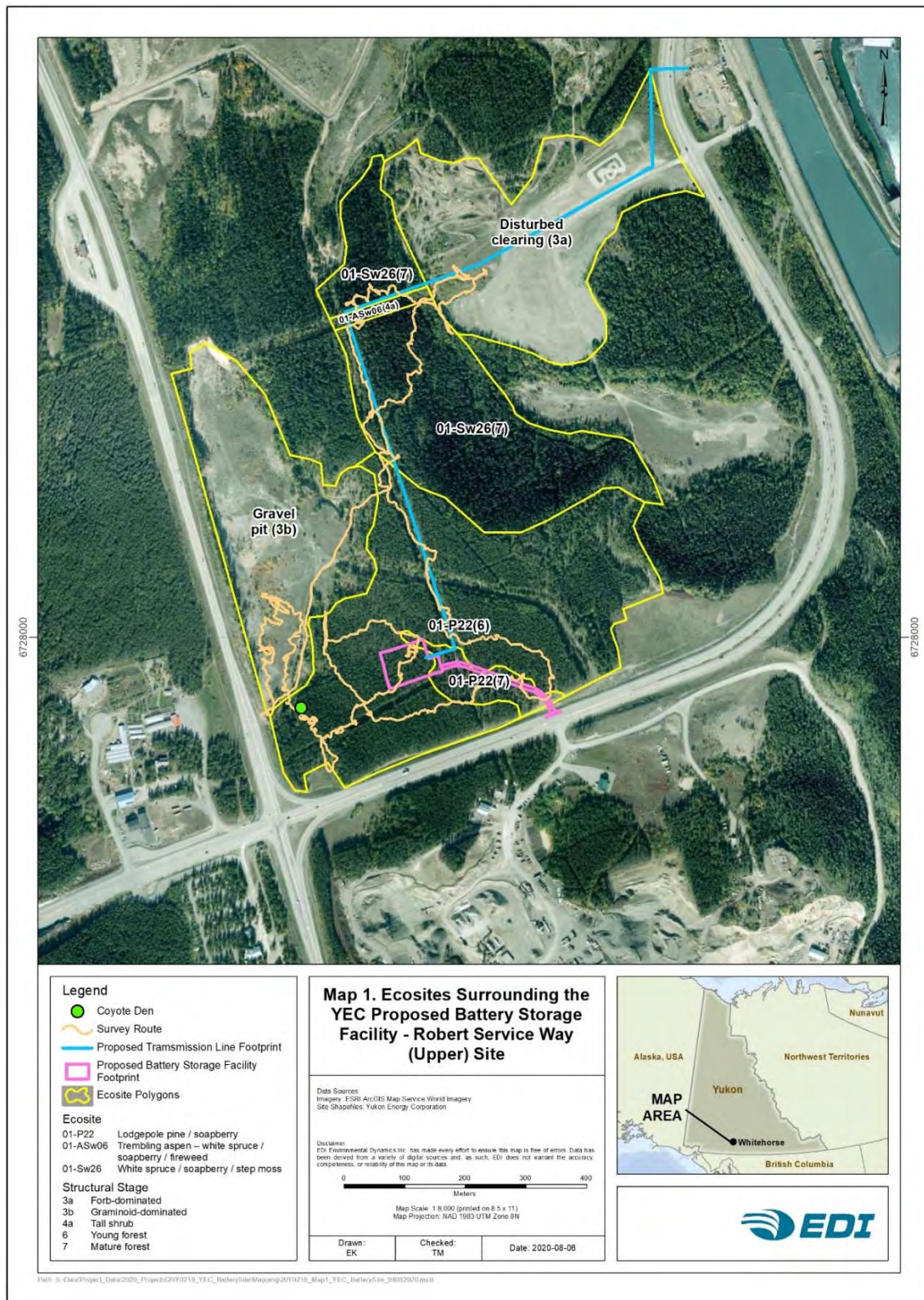


Table 2. Assessment of potential environmental effects associated with the candidate battery storage facility sites.

Project Option	Indicator	Ranking	Assessment
Robert Service Way (Upper) Site (near the Alaska Hwy)	Species at Risk & Habitat	Low	No occurrences of SAR are known in the vicinity. Species that may occur based on habitat and range are: Olive-sided Flycatcher and Common Nighthawk. Dune Tachinid Fly occurs approximately 1,300 m east of footprint across the Yukon River/Schwatka Lake. Rusty Blackbird occurs approximately 1,000 m northwest of footprint by Ice Lake Road.
	Protected & Conservation Areas	No Linkage	
	Wildlife Key Areas	No Linkage	
	Caribou Ranges	No Linkage	
	Wetlands	No Linkage	
	Water Quality	Low	Effects to water are limited to site runoff and are predicted to be minimal after standard mitigation measures.
	Fish & Fish Habitat	Low	No direct effects to fish-bearing waterbodies.
	Other Environmental Values		One coyote den. Potential for invasive species spread from disturbed areas into surrounding forest habitats.
Robert Service Way (Lower) Site (across from YEC generating station)	Species at Risk & Habitat	Low	No occurrences of SAR are known in vicinity. Species that may occur based on habitat and range are: Olive-sided Flycatcher. Dune Tachinid Fly occurs approximately 700 m east across the Yukon River/Schwatka Lake. Rusty Blackbird occurs approximately 1,600 m northwest by Ice Lake Road.
	Protected & Conservation Areas	No Linkage	
	Wildlife Key Areas	No Linkage	
	Caribou Ranges	No Linkage	
	Wetlands	No Linkage	
	Water Quality	Low	Effects to water are limited to site runoff and are predicted to be minimal after standard mitigation measures.
	Fish & Fish Habitat	Low	No direct effects to fish-bearing waterbodies.



Project Option	Indicator	Ranking	Assessment
	Other Environmental Values	No Linkage	None noted.
Takhini Substation Site	Species at Risk & Habitat	Low	No occurrences of SAR are known in vicinity. Species that may occur based on habitat and range are: Olive-sided Flycatcher and Short-eared Owl.
	Protected & Conservation Areas	No Linkage	
	Wildlife Key Areas	No Linkage	
	Caribou Ranges	No Linkage	
	Wetlands	Low-Moderate	Potential footprint may partly overlap with a sedge wetland and shrub swamp.
	Water Quality	Low	Effects to water are limited to site runoff and are predicted to be minimal after standard mitigation measures.
	Fish & Fish Habitat	Low	No direct effects to fish-bearing waterbodies.
	Other Environmental Values	No Linkage	None noted.



Map 1 Ecosites surrounding the YEC proposed battery storage facility - Robert Service Way (Upper) Site



APPENDIX 1. SITE PHOTOGRAPHS



Appendix Photo 1. Lodgepole Pine / Soapberry vegetation association (BOLsl/01-P22) at a Young Forest structural stage is the dominant ecosite within and surrounding the proposed battery storage facility footprint.



Appendix Photo 2. Lodgepole Pine / Soapberry vegetation association (BOLsl/01-P22) at a Mature Forest structural stage located adjacent to the proposed battery storage facility footprint.



Appendix Photo 3. Old gravel pit at a graminoid-dominated Herbaceous structural stage to the northwest of the proposed battery storage facility footprint.



Appendix Photo 4. Regenerating forest at a Pole/sapling Forest structural stage along a pre-existing trail located within the proposed transmission line footprint.



Appendix Photo 5. Regenerating Trembling Aspen – White Spruce / Soapberry / Fireweed vegetation association (BOLsl/01-ASw06) at a Tall Shrub structural stage located within the proposed transmission line footprint.



Appendix Photo 6. White Spruce / Soapberry / Step Moss vegetation association (BOLsl/01-Sw26) at a Mature Forest structural stage located adjacent to the proposed transmission line footprint.



Appendix Photo 7. Disturbed cleared area at a forb-dominated Herbaceous structural stage located within and adjacent to the proposed transmission line footprint.



Appendix Photo 8. Inactive coyote den observed within the Young Lodgepole Pine / Soapberry forest approximately 150 m west of the proposed battery storage facility footprint.

**REFERENCE: Proposed Battery Energy Storage System Project Application,
pages 29-31**

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

“In summary, no feasible renewable resource alternatives to the Project have been identified within the relevant time period. Aside from the potential Moon Lake pumped storage project in the future, the temporary rental diesel option or permanent new diesel development remain the only feasible alternatives that would provide dependable capacity required to address the N-1 shortfall.”

QUESTION:

- a) Please confirm that YEC's current 10-Year Renewable Electricity Plan has not been formally reviewed within a YUB proceeding and has not received any type of approval from the YUB.
- b) Please provide all internal and external analysis undertaken to determine that there are no feasible renewable resource alternatives to the proposed Battery Energy Storage System project.
- c) Please confirm that all of the alternatives considered to the proposed Battery Energy Storage System project are listed on pages 30-31 in the application.

1 **ANSWER:**

2
3 **(a)**

4
5 Confirmed. The 10-Year Renewable Electricity Plan has not been formally reviewed within
6 a YUB proceeding. However, a copy of the 10-Year Renewable Electricity Plan was filed
7 in response to an interrogatory during the 2021 General Rate Application Proceeding (see
8 CW-YEC-1-36(a) Attachment 1 of the 2021 General Rate Application Round 1 IRs).

9
10 The Yukon Utilities Board does not have jurisdiction to approve resource plans or
11 electricity plans, but approves project costs when they are brought before the Board for a
12 prudency review prior to being included in rates.

13
14 **(b) and (c)**

15
16 The 10-Year Renewable Electricity Plan (the Plan) reviewed a range of near-term and
17 long-term resource supply options to address forecast energy and capacity shortfalls. A
18 copy of the Plan is provided as Attachment 1 to UCG-YEC-1-10(a) (and was also filed in
19 the Yukon Energy 2021 GRA in response to CW-YEC-1-36(a)).

20
21 As shown in the attached Table 3 from the 10-Year Renewable Electricity Plan [see
22 excerpt provided Attachment 1 to this response], YEC has considered a broad range of
23 renewable resources in its long-term planning exercises. The Project is required to
24 address a dependable capacity shortfall. Many of the options reviewed in the Plan do not
25 provide dependable capacity; and new resources that will provide dependable capacity
26 would generally not displace what the BESS can provide, i.e., the identified permanent
27 resource capacity options are generally needed to remove reliance on rented diesels for
28 addressing the forecast capacity shortfall. Moon Lake pumped storage, when developed,
29 is the only identified resource option aside from default new fossil fuel generation that has
30 the capability to remove the full forecast N-1 capacity shortfall. The Moon Lake project is
31 dependent on receipt of Federal funding and will not be in-service until 2029 at earliest.

32
33 In summary, and as noted at page 31 of the Application, no feasible renewable resource
34 alternatives to the Project are identified within the relevant time period (the earliest
35 renewable option is the Atlin Hydro Expansion potentially available for winter 2024/25).
36 The 10-Year Renewable Plan portfolio relies on combination of a number of projects in
37 order to address the requirements of the YIS. The BESS project, Atlin Hydro Expansion,

- 1 and Moon Lake are all required in combination to meet the forecast N-1 requirements over
- 2 the long term. The temporary rental diesel option remains the only feasible near-term
- 3 alternative that would provide dependable capacity required to address the N-1 shortfall.

7.2 Future Potential Resource Options

Table 3: Refined List of Future Potential Resource Options

IRP Resource	Options	Installed Capacity (MW)	Dependable Capacity (MW)	Lead Time (Years)	
Hydro Uprate	Aishihik Hydro 1 & Hydro 2 Uprate	1.3 MW	1.3 MW	3 Years	
Small hydro	Primrose (Storage)	13.0 MW	13.0 MW	6 Years	
	Drury (Storage)	10.0 MW	10.0 MW	6 Years	
	Tutshi Windy Arm (Storage)	10.0 MW	10.0 MW	6 Years	
	Wolf River (ROR)	11.0 MW	4.0 MW	6 Years	
	Atlin Hydro Expansion (Storage)	6.0 MW	6.0 MW	5 Years	
	Atlin Hydro Expansion (Storage) with Federal funding	6.0 MW	6.0 MW	5 Years	
Wind	Wind Resource 1	6.0 MW	0.0 MW	5 Years	
	Wind Resource 2	10.0 MW	0.0 MW	5 Years	
	Wind Resource 3	20.0 MW	0.0 MW	5 Years	
Solar	Whitehorse Solar 1	1.0 MW	0.0 MW	2 Years	
	Whitehorse Solar 2	5.0 MW	0.0 MW	2 Years	
	Whitehorse Solar 3	10.0 MW	0.0 MW	2 Years	
Diesel (Comparator)	Generic Greenfield Permanent @ Takhini	10.0 MW	10.0 MW	4 Years	
	Generic Rental @ Whitehorse Substation S150	2.0 MW	2.0 MW	0 Years	
Pumped Storage	Tutshi-Moon (15MW-25GWh)	15.0 MW	15.0 MW	6 Years	
	Tutshi-Moon (15MW-45GWh)	15.0 MW	15.0 MW	6 Years	
	Tutshi-Moon (25MW-50GWh)	25.0 MW	25.0 MW	6 Years	
	Tutshi-Moon (35MW-50GWh)	35.0 MW	35.0 MW	6 Years	
	Tutshi-Moon (15MW-25GWh with Federal Funding)	15.0 MW	15.0 MW	6 Years	
	Tutshi-Moon (15MW-45GWh with Federal Funding)	15.0 MW	15.0 MW	6 Years	
	Tutshi-Moon (25MW-50GWh with Federal Funding)	25.0 MW	25.0 MW	6 Years	
	Tutshi-Moon (35MW-50GWh with Federal Funding)	35.0 MW	35.0 MW	6 Years	
Energy Storage	Lithium-ion	8.0 MW	8.0 MW	2 Years	

Table 3 is a summary of the 19 Future Potential Resources considered in the 10-Year Renewable Electricity Plan along with their associated technical and financial attributes.

	Annual Energy (MWh/Yr)	CAPEX (\$2019)	O&M		LCOC (\$/kW-Yr)	LCOE (\$/kWh-Yr)
			Fixed (\$2019/Yr)	Variable (\$2019/MWh)		
	2,700 MWh	\$5,300,000	\$0	\$5.31	\$185	\$0.09
	74,100 MWh	\$177,500,000	\$3,900,000	\$5.00	\$797	\$0.14
	30,600 MWh	\$110,500,000	\$2,400,000	\$5.00	\$635	\$0.21
	49,300 MWh	\$135,600,000	\$3,700,000	\$5.00	\$860	\$0.17
	79,700 MWh	\$165,100,000	\$3,600,000	\$5.00	\$2,417	\$0.12
	44,700 MWh	\$131,000,000	\$2,900,000	\$5.00	\$1,270	\$0.17
	44,700 MWh	\$32,750,000	\$2,900,000	\$5.00	\$708	\$0.10
	18,100 MWh	\$39,500,000	\$280,000	\$27.26	Not supplied	\$0.17
	29,500 MWh	\$49,200,000	\$290,000	\$21.81	Not supplied	\$0.13
	57,300 MWh	\$73,500,000	\$340,000	\$21.40	Not supplied	\$0.10
	1,100 MWh	\$2,300,000	\$30,000	\$0.00	Not supplied	\$0.13
	5,600 MWh	\$8,100,000	\$150,000	\$0.00	Not supplied	\$0.10
	11,500 MWh	\$16,100,000	\$340,000	\$0.00	Not supplied	\$0.10
	2,500 MWh	\$25,600,000	\$170,000	\$22.00	\$131	\$0.53
	2,500 MWh	\$0.00	\$280,000	\$0.00	\$243	Not Supplied
	19,900 MWh	\$182,500,000	\$2,020,000	\$0.00	\$552	\$0.42
	14,000 MWh	\$194,200,000	\$2,050,000	\$0.00	\$581	\$0.62
	12,000 MWh	\$245,000,000	\$2,100,000	\$0.00	\$421	\$0.88
	10,000 MWh	\$280,000,000	\$2,150,000	\$0.00	\$336	\$1.18
	19,900 MWh	\$45,625,000	\$2,020,000	\$0.00	\$239	\$0.18
	14,000 MWh	\$48,550,000	\$2,050,000	\$0.00	\$248	\$0.27
	12,000 MWh	\$61,250,000	\$2,100,000	\$0.00	\$168	\$0.35
	10,000 MWh	\$70,000,000	\$2,150,000	\$0.00	\$130	\$0.46
	2,800 MWh	\$29,500,000	\$280,000	\$0.00	\$280	Not Supplied

1 **REFERENCE: Proposed Battery Energy Storage System Project Application,**
2 **page 32**

3
4 “There are various energy storage technologies available. Yukon
5 Energy completed a comprehensive review of the available energy
6 storage technologies for the 2016 Resource Plan. This study concluded
7 that batteries, and lithium ion batteries specifically, were the best
8 energy storage option for the YIS context. The use required by Yukon
9 Energy involves low cycling, with a need for reliable and quick response
10 in a northern climate location.”

11
12 **QUESTION:**

- 13
14 a) Please confirm that YEC has not conducted a more recent evaluation of available
15 energy storage technologies since the 2016 evaluation of energy storage
16 technologies by TransGrid Solutions Inc.
17
18 b) Please confirm whether the Yukon’s electricity generation capacity configuration
19 has changed since the configuration that existed 5 years ago when TransGrid
20 conducted their review.
21
22 c) Please confirm that the feasibility assessment completed by Hatch for the current
23 application was limited to evaluating the proposed Battery Energy Storage System
24 only and not on any other available energy storage technologies.
25
26 d) Does YEC have any internal expertise regarding energy storage technologies or
27 is YEC relying entirely on the advice from outside consultants?
28
29 e) Has YEC conducted any independent reviews of the Hatch analysis and evaluation
30 to ensure that the report under review is the best, industry standards based
31 analysis upon which to make determination son [sic] the proposed Battery Energy
32 Storage System?

1 **ANSWER:**

3 **(a)**

5 Please see YUB-YEC-1-38 for a summary of the evaluation energy storage technologies
6 undertaken by YEC since 2016.

8 **(b)**

10 Confirmed. Section 4.1 of the Application updates the Yukon grid context for the Project,
11 including Figure 4-1 and Table 4-1 updates on forecast non-industrial peak and
12 dependable capacity under N-1 capacity planning through to 2030/31, and Section 4.2
13 updates alternatives to the Project based on the recent 10-Year Renewable Electricity
14 Plan (the Plan).

16 A copy of the Plan is provided in response to UCG-YEC-1-10(a) Attachment 1 (and was
17 also filed in the Yukon Energy 2021 GRA in response to CW-YEC-1-36(a)).

19 The inventory of the existing and retiring YEC and ATCO resources and their technical
20 attributes are presented in Appendix A of the Plan (this includes a comparison to
21 dependable capacity for these resources as indicated in the 2016 Resource Plan).

23 **(c)**

25 Not confirmed. Table 4-1 on page 17 of the Hatch report (Appendix B to the BESS
26 Application) provides a summary overview of the differences between various storage
27 technology capabilities.

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

1 **(d)**

2
3 Yukon Energy has resource planning and engineering staff that reviewed the Utility Battery
4 Feasibility Study report and provided professional assessments regarding its findings, and
5 implications for the Yukon Integrated Grid.

6
7 **(e)**

8
9 Hatch was selected to undertake the Utility Battery Feasibility Study following a
10 competitive procurement process where Hatch was determined to be suitably qualified to
11 undertake the feasibility assessment. See YUB-YEC-1-54(b) Attachment 1 for a summary
12 of Hatch's professional qualifications.

13
14 Yukon Energy resource planning and engineering department staff also reviewed and
15 vetted the report findings.

**REFERENCE: Proposed Battery Energy Storage System Project Application,
page 41**

“A public engagement process for the Project was undertaken in Q3 2020. The objectives of the engagement process were to:

1. Inform the public that YEC plans to install a battery in, or near, Whitehorse and explain why the project is happening, how the battery works, project benefits and how it relates to the 10-year Renewable Plan;
2. Gather public input on each of the three proposed site options for the battery project; and
3. Identify any potential questions or concerns about the project to ensure they can be addressed / incorporated into project design where feasible.”

QUESTION:

- a) Please explain why YEC decided on the plan to move forward with the proposed Battery Energy Storage System and then initiated consultation instead of initiating consultation on the issues that need to be addressed and gather input on alternative solutions from stakeholders.
- b) Please describe the rationale behind YEC’s approach to get stakeholder feedback on its preferred approach instead of presenting information and seeking feedback on multiple potential solutions under consideration and stakeholder input on additional solutions YEC may not have considered.
- c) Please provide details of the stakeholder engagement undertaken with respect to the energy storage projects that YEC has referenced in Northern Quebec and the Northwest Territories.

ANSWER:

(a) and (b)

YEC conducted consultation on electricity issues and alternative solutions for its 2016 Resource Plan and the 10-Year Renewable Electricity Plan, which were used to inform

1 the selection of YEC's future portfolio, including the development of the BESS project. The
2 consultation for the 10-Year Plan included the solicitation for feedback on potential
3 additional solutions not under consideration by YEC.

4
5 **(c)**

6
7 The requested information is not relevant to the current proceeding. Stakeholder
8 engagement processes undertaken for projects in Northwest Territories and Quebec do
9 not have any bearing on the matters to be assessed by the YUB as part of the current
10 review process.

11
12 Yukon Energy's "Grid Scale Battery – What We Heard" report is provided as YUB-YEC-
13 1-46(a) Attachment 1 and provides relevant information regarding the engagement
14 process undertaken by YEC for the BESS.

**REFERENCE: Proposed Battery Energy Storage System Project Application,
page 41**

“Engagement activities were undertaken from late August to early September 2020 and included: two virtual community meetings; three in person community meetings; six stakeholder meetings; letters and information sheets to property owners and businesses located within 800 metres of each proposed site; and “door knocking” to each residence and business within this radius. Written comments were also accepted through an online form or by direct email. A final “What we Heard” report was developed summarizing the outcomes of the above engagement process. The majority of comments provided focused on the Takhihi site on the North Klondike Highway – and while there was general support for development of the Project, there was strong opposition to developing the Project at the Takhini location. General concerns identified regarding the Project related to potential noise and light pollution, impact of an industrial development in rural residential areas, fire and explosion safety, health impacts of radiation, electromagnetism, and gases, reduction in property values and impacts on insurance premiums, and contamination of agricultural land close to project in case of accidents and malfunctions. Many of these concerns are being addressed through a combination of site selection and selection of the battery technology and planned engineering.”

QUESTION:

- a) Please provide specifics are the number of individuals who attended and contributed to the community and stakeholder meetings. If individuals attended more than one meeting, please only count them once.
- b) How many written comment submissions were made during the consultation specifically on the proposed Battery Energy Storage System project? Please provide copies of these submissions with personal information redacted.

1 **ANSWER:**

2

3 **(a) and (b)**

4

5 See the What We Heard Report provided as YUB-YEC-1-46 Attachment 1. This report
6 outlines the number of individuals that attended each engagement event and the written
7 comment submissions. For privacy reasons the names of individuals are not identified and
8 therefore YEC cannot comment on whether a stakeholder attended multiple engagement
9 sessions.

1 **REFERENCE: Hatch Utility Battery Feasibility Study Final Report, page B-2**

2
3 "This report has been prepared by Hatch Ltd. (Hatch) for Yukon Energy
4 Corporation (the "Client") for the purpose of assisting the Client with the
5 development of a Utility Battery Feasibility Study."
6

7 **QUESTION:**

8
9 a) Please provide details of the Utility Battery Feasibility Study being developed by
10 YEC that has been informed by the January 2021 Hatch report.
11

12 **ANSWER:**

13
14 **(a)**

15
16 The Utility Battery Feasibility Study referenced was the Hatch report (filed as Appendix B
17 of the Application), along with development of internal YEC estimates for planning and
18 owner's costs.

REFERENCE: Hatch Utility Battery Feasibility Study Final Report, page B-17

“Preferred system sizing is 8.8 MW/35 MWh or 10 MW/40 MWh. Estimated capital cost for each of these options is \$23.8 M and \$26.8 M, respectively, if located on the TKC Land near Whitehorse Substation. Increasing power sizes from 10 MW/40 MWh to 20 MW/40 MWh leads to an increase in the CAPEX by approximately \$1.7-1.8 M. This higher power BESS achieves the lowest LCOC.”

QUESTION:

- a) Please provide a comparison of the cost of the proposed Battery Energy Storage System and the costs identified in the Hatch report.

ANSWER:

(a)

The costs presented by Hatch cover the equipment and construction for the BESS (battery system, power conversion system, and grid connection). The costs provided in the Application include the costs for equipment and construction (estimated by Hatch) in addition to the Planning Costs and Owner's Costs. Please refer to Table 3-4 on page 16 of the Application.

REFERENCE: Hatch Utility Battery Feasibility Study Final Report, page B-18

“Recommended immediate next steps are as follow:

- Conduct the Community Consultation to support site selection
- Preliminary Interconnection for Preferred Site
- Develop a procurement strategy for EPC & EPCM alternatives
- Confirm tax implications if BESS located within Whitehorse
- Conduct geotechnical campaigns for selected sites”

QUESTION:

- a) Please provide details of the actions that YEC has undertaken on each of the recommended next steps contained in the January 2021 Hatch report.

ANSWER:

(a)

The following is noted:

- YEC has conducted the community consultation and public engagement process as outlined in the Application on page 41.
- Please refer to YUB-YEC-1-3 for information on the work conducted to date regarding design of the interconnection for the project site.
- YEC completed procurement of an Owner’s Engineer and designed a two-stage procurement process which is now under way, as described in YUB-YEC-1-13.
- YEC has confirmed the property tax costs and included them in the O&M cost estimates shown in the Application. Please also refer to YUB-YEC-1-26.
- Please refer to YUB-YEC-1-71 for the update on the geotechnical work.

**Yukon Conservation Society
(YCS)**

1 **REFERENCE: Ambient conditions required for life of battery:**

2
3 **QUESTION:**

- 4
5 a) Will it be requested of the vendor during the procurement process to provide details
6 on maintaining ambient conditions for the battery given a range of temperatures?
7 (i.e. heating and cooling of battery containers to maximize life, minimize
8 degradation of batteries)

9
10 **ANSWER:**

11
12 **(a)**

13
14 Yes. The BESS Vendor is responsible for supply of an appropriate thermal management
15 system (heating, cooling, insulation) for the climate and provide details on operation.

REFERENCE: Procurement Process: Raw Materials:

QUESTION:

- a) Will the vendor be responsible for disclosing that raw materials for the batteries
(i.e. Lithium) were sourced in an ethical manner?

ANSWER:

(a)

Battery vendors have been invited to share the sustainability practices, which could include the practices for sourcing the lithium, with their responses to the first phase of the procurement process. Please see response to YUB-YEC-1-13.

1 **REFERENCE: Disposal of batteries at end of life:**

2
3 **QUESTION:**

4
5 a) Will the vendor be responsible for disposal of the batteries at the end of life of the
6 equipment?

7
8 b) If so, will they be bonded to the project for the duration of the project lifespan?

9
10 **ANSWER:**

11
12 **(a) and (b)**

13
14 Please see the response to YUB-YEC-1-12(d).

1 **REFERENCE: Property tax operational expenses:**

2
3 **QUESTION:**

4
5 a) Did a meeting take place with the City of Whitehorse regarding property taxes for
6 the land used for the project?

7
8 b) If so, what were the results of this discussion?

9
10 **ANSWER:**

11
12 **(a) and (b)**

13
14 Please see response to YUB-YEC-1-26(b).

1 **REFERENCE: Opportunities for improved battery technology given recent**
2 **developments in battery technology:**

3
4 **QUESTION:**

5
6 a) Would integrating new batteries at the 10-year mark of the project decrease the
7 lifespan of the existing batteries?

8
9 **ANSWER:**

10
11 **(a)**

12
13 No. Capacity augmentation is standard industry practice. Please see response provided
14 to JM-YEC-1-9.

**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).

TOPIC: Project Alternatives

REFERENCE: Application, Tab 1.0, PDF page 5

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

QUESTION:

- a) Please provide the meaning of “enhanced blackstart capability”.
- b) By definition, are all YEC thermal units considered as blackstart? Please explain.
- c) In its current operations, how does YEC maintain operating reserve for electricity service? Please explain.

ANSWER:

(a)

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

(b)

No. All YEC diesel units have the ability to blackstart. The LNG units are not typically used for blackstart as described in YUB-YEC-1-41(c). The blackstart performance 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.

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

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

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

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

Application, PDF page 26:

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

2021 General Rate Application, page 5.1-7:

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

QUESTION:

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

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).

TOPIC: Diesel Displacement

REFERENCE: Application, Tab 3.1, PDF page 7

QUOTE: “The BESS will also provide other benefits, including: operating reserve that reduces thermal generation requirements; enhanced blackstart capability; opportunities for diesel-peak shifting; and other system benefits.”

QUESTION:

- a) Will the BESS project only charge when there is no thermal operation on the YIS? Please explain.
- b) What is meant by the phrase “other system benefits”?

ANSWER:

(a)

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

(b)

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

1 **TOPIC:** **Baseload Thermal Generation**

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

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.”

13 **QUESTION:**

- 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.

21 **ANSWER:**

23 **(a)**

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

28 **(b)**

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

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

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

(h)

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

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

- When the equity ratio is lower than 40%, then YEC transfers a portion of the YDC long-term debt to equity [equity injection] as required to provide the 60% long term debt and 40% equity financing.
- When the equity ratio is higher than 40%, a dividend amount is calculated as required and this calculated dividend amount loaned back by YDC to YEC as long-term debt to provide the 60% long term debt and 40% equity financing.

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

- 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**

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

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

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."

11 **QUESTION:**

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

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

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

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

25 **ANSWER:**

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

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.

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 **QUESTION:**

9
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 c) Are thermal management costs intended to be recovered as capital costs? Are
16 any costs for thermal management included in the preliminary project estimate?
17 Please explain and describe any costs included or excluded.
18

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

23 **ANSWER:**

24
25 **(a)**

26
27 Thermal management and heating of the system refers to the requirement to maintain the
28 temperature within the container housing the battery cells within a certain range.
29

30 **(b)**

31
32 Thermal management and heating will be provided by an HVAC system that is built into
33 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.

TOPIC: End of Life

REFERENCE: Application, Tab 3.1.1, PDF page 9

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

QUESTION:

- a) Please explain what happens at end-of-life. Is YEC expecting to replace the batteries?
- b) If the batteries will be replaced, what is the expected cost for replacement batteries?
- c) If the batteries are not replaced, how does YEC plan to replace the lost capacity?
- d) What will you require of prospective battery vendors to ensure that they will take back the battery at end of life for proper recycling and disposal?
- e) What weight does proper end-of-life treatment of the battery have, in the decision matrix, when choosing a vendor?
- f) What is the cost to the purchaser to ensure proper end-of-life treatment and where would this appear in the project cost included in this application?

ANSWER:

(a) to (c)

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

TOPIC: Competitive Procurement Process and the Different Battery Chemistries

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

QUOTE: Application, PDF page 9:

“... A competitive procurement process has been initiated to select battery vendors qualified to design a battery able to meet Yukon Energy’s operational requirements and Yukon’s northern climate...”

Application, PDF page 37:

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

Application, PDF page 73:

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

Application, PDF page 83:

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

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.

Cathode Technology	Advantages	Disadvantages
Lithium Iron Phosphate (LFP)	- Very good thermal stability - Good cycle life - Good power capability - Cobalt, Nickel Free Cathode	- Lower energy density/larger footprint - Newer technology - Lower Voltage
Lithium Nickel Manganese Cobalt Oxide (NMC)	- Can be tailored for high power or high energy systems - Tend to be more suited for energy applications - Can operate at high voltages - Highest Energy Density (smallest footprint) - Most common chemistry	- Moderate charge state thermal stability (reducing safety) - Lower cycle life - Lower Calendar Life
Lithium Nickel Cobalt Aluminum (NCA)	- Good energy and power capabilities - Tend to be more suited for power applications - Moderate Cycle life - Long Calendar Life	- Moderate charge state thermal stability (reducing safety) - Capacity is reduced if operated at higher temperatures

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.

TOPIC: BESS Use

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

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

QUESTION:

- a) What is the contingency if the project cost is on the lower level of +/-30% because of technological advances and decreasing costs?
- b) Will the savings be passed on to ratepayers if battery technology reduces costs? Alternatively, will a battery with a larger energy capacity and power capability be purchased in anticipation of further load growth throughout the project's lifetime, considering that "forecast peak winter load requirements continue to grow well beyond the next 10-20 years"?

ANSWER:

(a) and (b)

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

The question also asks if YEC would respond to a 30% lower vendor cost by purchasing a larger energy capacity than the 40 MWh useable energy storage currently proposed for the BESS Project. YEC is not considering any such option, and the Application does not 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.

2019/20

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

Vendor Quote

United Rentals \$3,706,685

Finning Canada \$1,913,234

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

2020/21

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

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

TOPIC: Charge Degradation

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

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

QUESTION:

- a) Please provide a graph showing the degradation of the batteries, by each year, for the entire project. Use time as the variable for the X-axis and MW as the variable along Y-axis.
- b) Please list the factors that affect degradation and how YEC will mitigate those factors.
- c) Do the functions of the projects conflict with other goals?

ANSWER:

(a)

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

(b)

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

TOPIC: Charge Degradation

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

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

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

QUESTION:

- a) What other uses of the BESS can happen concurrently without compromising the primary use?
- b) Can the BESS be used to meet daily peaks outside an N-1 event? Why or why not?
- c) How often does the BESS need to recharge under normal operation?
- d) Since it is only partially charged, does it only need to recharge every night during an N-1 event?
- e) What does “frequency excursion” mean?

ANSWER:

(a)

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

(b)

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**

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

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

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...”

12 Application, PDF page 15:

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.”

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.”

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.

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 (CO₂), methane, nitrogen oxides
14 (NO_x), sulphur dioxide (SO₂), 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 it's "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 ¹ (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
Plant Total		2,808	6,570,988	-	-	-	-	57.982	0.092	3.391	0.881
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
Plant Total		809	3,772,502	-	-	-	-	33.289	0.053	1.947	0.506
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
Plant Total		792	488,040	-	-	-	-	4.306	0.007	0.252	0.065
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
Plant Total		9,271	7,491,452	-	-	-	-	66.105	0.105	3.866	1.004

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 ¹ (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
Plant Total		947.4	2,205,240	-	-	-	-	19.459	0.031	1.138	0.296
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
Plant Total		328.4	532,779	-	-	-	-	4.701	0.007	0.275	0.071
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
Plant Total		47.5	17,115	-	-	-	-	0.151	0.000	0.009	0.002
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
Plant Total		407.6	300,050	-	-	-	-	2.648	0.004	0.155	0.040

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 ¹ (g/KWh)					Total Annual Emissions (tonnes)				
				NO2	SO2	CO	PM2.5	GHG (CO ₂ eq)	NO2	SO2	CO	PM2.5	GHG (CO ₂ 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
Plant Total		365.3	832,956	-	-	-	-	-	7.350	0.012	0.430	0.000	581.0
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
Plant Total		627.5	899,806	-	-	-	-	-	7.940	0.013	0.464	0.000	627.6
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
Plant Total		57.8	33,495	-	-	-	-	-	0.296	0.000	0.017	0.000	23.4
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
Plant Total		210.4	140,387	-	-	-	-	-	1.239	0.002	0.072	0.001	97.9

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 CO₂e 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 ¹ (g/KWh)					Total Annual Emissions (tonnes)				
				NO2	SO2	CO	PM2.5	GHG (CO ₂ eq)	NO2	SO2	CO	PM2.5	GHG (CO ₂ 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
Plant Total		365.3	832,956	-	-	-	-	-	7.350	0.012	0.430	0.000	581.0
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
Plant Total		627.5	899,806	-	-	-	-	-	7.940	0.013	0.464	0.000	627.6
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
Plant Total		57.8	33,495	-	-	-	-	-	0.296	0.000	0.017	0.000	23.4
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
Plant Total		210.4	140,387	-	-	-	-	-	1.239	0.002	0.072	0.001	97.9

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 CO₂e 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 ¹ (g/kWh)					Total Annual Emissions (tonnes)				
				NO2	SO2	CO	PM2.5	GHG (CO ₂ eq)	NO2	SO2	CO	PM2.5	GHG (CO ₂ 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
Plant Total		421.8	978,376	-	-	-	-	-	8.6332	0.0137	0.5048	0.4866	682.4
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
Plant Total		230.5	337,847	-	-	-	-	-	2.9812	0.0047	0.1743	0.1743	235.6
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
Plant Total		46.5	26,250	-	-	-	-	-	0.2316	0.0004	0.0135	0.0135	18.3
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
Plant Total		268.0	194,566	-	-	-	-	-	1.7169	0.0027	0.1004	0.1004	135.7

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 CO₂e 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 ¹ (g/kWh)						Total Annual Emissions (tonnes)					
				NO ₂	SO ₂	CO	PM _{2.5}	VOC	GHG (CO ₂ eq)	NO ₂	SO ₂	CO	PM _{2.5}	VOC	GHG (CO ₂ eq)
Whitehorse	WD1 ²								-						
	WD2 ²								-						
	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
Plant Total		1,680	4,978,200	-	-	-	-	-	-	21.254	0.034	14.091	0.296	2.959	2,671
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
Plant Total		129	190,708	-	-	-	-	-	-	1.6828	0.0027	0.0984	0.0256	-	133
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
Plant Total		37	21,700	-	-	-	-	-	-	0.1915	0.0003	0.0112	0.0029	-	15
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
Plant Total		1,227	934,700	-	-	-	-	-	-	8.2478	0.0131	0.4823	0.1252	-	652

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 CO₂e per GWh (or 0.0006975 g/kWh). Natural gas GHG emissions are approximately 451 tonnes of CO₂e per GWh (or 0.000451 g/kWh). Nitrous Oxide emissions in the combustion of natural gas are negligible (i.e., 1.47x10⁻¹⁷ 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 ¹ (g/kWh)						Total Annual Emissions (tonnes)					
				NO ₂	SO ₂	CO	PM _{2.5}	VOC	GHG (CO ₂ eq)	NO ₂	SO ₂	CO	PM _{2.5}	VOC	GHG (CO ₂ eq)
Whitehorse	WD1 ²														
	WD2 ²														
	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
Plant Total		4,223	13,704,114	-	-	-	-	-	-	52.187	0.083	42.002	0.713	8.969	7,129
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
Plant Total		217	280,708	-	-	-	-	-	-	2.4770	0.0039	0.1448	0.0376	-	196
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
Plant Total		58	38,745	-	-	-	-	-	-	0.3419	0.0005	0.0200	0.0052	-	27
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
Plant Total		564	450,603	-	-	-	-	-	-	3.9761	0.0063	0.2325	0.0604	-	314

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 CO₂e per GWh (or 0.0006975 g/kWh). Natural gas GHG emissions are approximately 451 tonnes of CO₂e per GWh (or 0.000451 g/kWh). Nitrous Oxide emissions in the combustion of natural gas are negligible (i.e., 1.47x10⁻¹⁷ 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 ¹ (g/kWh)						Total Annual Emissions (tonnes)					
				NO ₂	SO ₂	CO	PM _{2.5}	VOC	GHG (CO ₂ eq)	NO ₂	SO ₂	CO	PM _{2.5}	VOC	GHG (CO ₂ 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
Plant Total		9,771	35,889,519	-	-	-	-	-	-	106.562	0.171	125.300	1.374	21.825	17,606
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
Plant Total		184	302,000	-	-	-	-		-	2.6648	0.0042	0.1558	0.0405		211
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
Plant Total		132	86,520	-	-	-	-	-	-	0.7635	0.0012	0.0446	0.0116	-	60
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
Plant Total		1,543	1,266,789	-	-	-	-	-	-	11.1781	0.0177	0.6537	0.1697	-	884

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 CO₂e per GWh (or 697.5 g/kWh). Natural gas GHG emissions are approximately 451 tonnes of CO₂e per GWh (or 451 g/kWh). Nitrous Oxide emissions in the combustion of natural gas are negligible (i.e., 1.47x10⁻¹⁷ 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 ¹ (g/kWh)						Total Annual Emissions (tonnes)					
				NO ₂	SO ₂	CO	PM _{2.5}	VOC	GHG (CO ₂ eq)	NO ₂	SO ₂	CO	PM _{2.5}	VOC	GHG (CO ₂ 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
Plant Total		17,120	67,518,529	-	-	-	-	-	-	143.24	0.231	264.81	1.65	27.95	31,098.8
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
Plant Total		525	805,688	-	-	-	-	-	-	7.1094	0.0113	0.4157	0.1080		562
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
Plant Total		121	104,166	-	-	-	-	-	-	0.9192	0.0015	0.0537	0.0140	-	73
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
Plant Total		895	709,392	-	-	-	-	-	-	6.2597	0.0099	0.3660	0.0951	-	495

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 CO2e per GWh (or 697.5 g/kWh). Natural gas GHG emissions are approximately 451 tonnes of CO2e per GWh (or 451 g/kWh). Nitrous Oxide emissions in the combustion of natural gas are negligible (i.e., 1.47x10⁻¹⁷ g/kWh)



REPORT

Greenhouse Gas Mitigation Assessment

Proposed Grid Scale Battery Energy Storage System

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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 tCO₂e in the year 2030**.
- The Project would result in a cumulative reduction in GHG emissions of **8,150 tCO₂e 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 tCO₂e**.

The cost of the federal contribution per CO₂e reduction for the 2030 calendar year is **\$14,700/tonne CO₂e**, and the total capital and operational cost of the project per total CO₂e reduced over the Project lifetime is **\$1,739/tonne CO₂e**.

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 (CO₂), methane (CH₄), and nitrous oxide (N₂O) were quantified.

Emission factors for CO₂, CH₄ and N₂O 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 CH₄ 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.x/sx*, 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)² 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 CO₂, CH₄ and N₂O. Other key units in the assessment include:

- Carbon dioxide equivalents (CO₂e): Baseline and Project GHG emissions were converted to units of CO₂e 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 CO₂, CH₄, and N₂O were taken from Table A6-4 in the ECCC NIR 1990-2017 (ECCC 2019b). Parameters for a sample CO₂ emission calculation for grid diesel combustion for the year 2019 are shown in Table 1.

Table 1: Parameters for a Sample CO₂ 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 ₂ 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 ⁶	—

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

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

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

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

Table 2: Diesel Generation Emission Factor

Value	CO ₂	CH ₄	N ₂ O
Diesel Emission Factor ^(a) (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 CO₂ and 2-12 for CH₄ and N₂O were used. The forecasted annual LNG power in GWh provided by YEC were converted to a natural gas fuel input value in m³/year using the high heat value for natural gas. Emission factors for CO₂, CH₄, and N₂O 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 CO₂ emission calculation for grid LNG combustion for the year 2019 are provided in Table 3.

Table 3: Parameters for CO₂ 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 ³	0.038	WCI Table 20-1 (WCI 2011)
EF	CO ₂ Emission Factor	g/m ³	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) ² Consultants Inc. 2014)
UC1	Unit Conversion	GJ/GWh	3,600	—
UC2	Unit Conversion	g/tonne	10 ⁶	—

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

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

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

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 ₂	CH ₄	N ₂ O
Natural gas Emission Factor ^(b) (g/m ³)	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 CO₂ and Equation 2-16 for CH₄ and N₂O, 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 CO₂ emissions calculation for diesel combustion in a pickup truck for 2019 to 22 are provided in Table 5.

Table 5: Parameters for a Sample CO₂ 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 ₂ Emission Factor	g/L	2,681	ECCC NIR Part 2, Table A6-4 (ECCC 2019b)
ρ	Diesel Density	kg/m ³	870	—
SF	Scaling Factor	m ² /m ²	0.994	Scaling factor based on physical footprint of the BESS
UC1	Unit Conversion	Lb/kg	2.24	—
UC2	Unit Conversion	L/m ³	1,000	—
UC2	Unit Conversion	tonne/kg	10 ⁻⁶	—

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

$$\begin{aligned} \text{Construction CO}_2 \text{ Emissions (tonnes)} &= 1 \text{ pickup} \times \frac{8 \text{ hours}}{\text{day}} \times \frac{5 \text{ days}}{\text{period}} \times 0.30 \times 397 \text{ hp} \times 0.59 \times \frac{0.367 \text{ lb}}{\text{hp} \cdot \text{h}} \times \frac{\text{kg}}{2.24 \text{ lb}} \times \frac{\text{m}^3}{870 \text{ kg}} \times \frac{1,000 \text{ L}}{\text{m}^3} \\ &\times \frac{2,681 \text{ g CO}_2}{\text{L}} \times \frac{1 \text{ tonne}}{10^6 \text{ g}} \times \frac{0.994 \text{ m}^2}{\text{m}^2} \end{aligned}$$

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

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 CO₂, CH₄, and N₂O) used in the Project case for on-road emissions are summarized in Table 6.

Table 6: On-Road Emission Factors, Project Case

Value	CO ₂	CH ₄	N ₂ O
EF ^(a) (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 CO₂, CH₄, and N₂O) used in the Project case off-road emissions are summarized in Table 7.

Table 7: Off-Road Emission Factors, Project Case

Value	CO ₂	CH ₄	N ₂ O
EF ^(a) (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 ₂ e] ¹
	CO ₂	CH ₄	N ₂ O	
2019 to 2043	616,587	149	22	626,858
Year 2030	42,321	10	2	43,025

t = tonne; CO₂ = carbon dioxide; CH₄ = methane, N₂O = nitrous oxide; CO₂e = carbon dioxide equivalents.

¹ 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 ₂ e] ¹
	CO ₂	CH ₄	N ₂ O	
2019 to 2043	597,156	146	20	606,736
Year 2030	41,244	10	1	41,903

t = tonne; CO₂ = carbon dioxide; CH₄ = methane, N₂O = nitrous oxide; CO₂e = carbon dioxide equivalents.

¹ 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 CO₂e 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 ₂ e)	Total Baseline Emissions (B) (t CO ₂ e)	Total Net Change (A-B) (t CO ₂ 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
12	2030	41,903	43,025	-1,122
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
Total		606,736	626,858	-20,123

Based on this analysis:

- The Project would result in a reduction in GHG emissions of **1,122 tCO₂e in the year 2030**.
- The Project would result in a cumulative reduction in GHG emissions of **8,150 tCO₂e to the year 2030 (between 2019 and 2030)**.
 - Project emissions, cumulative to 2030 are **416,242 tCO₂e**.
 - Baseline emissions, cumulative to 2030 are **424,392 tCO₂e**.
- 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 tCO₂e**.

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 CO₂e reduction for the 2030 calendar year is \$14,700/tonne CO₂e, 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 CO₂e reduced over the Project lifetime is \$1,739/tonne CO₂e 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 tCO₂e in the year 2030**.
- The Project would result in a cumulative reduction in GHG emissions of **8,150 tCO₂e 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 tCO₂e**.

The cost of the federal contribution per CO₂e reduction for the 2030 calendar year is **\$14,700/tonne CO₂e**, and the total capital and operational cost of the Project per total CO₂e reduced over the Project lifetime is **\$1,739/tonne CO₂e**.

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

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

- **10 MW/40 MWh:** The extent of the outage would be reduced with the battery picking up 10 MW of the lost WH4 generation. With insufficient generation available after the loss of WH4 the under frequency protection would trip 3-4 feeders. Restoration duration would be reduced by approximately 60%. Additional generation would be added to the system to offload the battery. The battery would be used in conjunction with the hydro/diesel generation to restore the system load.
- **13 MW/40 MWh:** The extent of the outage would be significantly reduced with the battery picking up 13 MW of the lost WH4 generation. The under frequency protection would have been limited to 2-3 feeders trips. Restoration duration would be reduced by approximately 75%. Additional generation would be added to the system to offload the battery. The battery would be used in conjunction with the hydro/diesel generation to restore the system load.
- **20 MW/40 MWh:** It is plausible that this event would have been avoided with a BESS capacity of 20 MW, the loss of WH4 output would have been absorbed by the battery. Additional hydro/diesel generation would have been placed on line to offload the battery.

(c)

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

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

Both projects were completed in early Q2 2017. Both projects improved the reliability and 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

TOPIC: Planning Costs

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

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

QUESTION:

- a) Have YEC planning costs been finalized? If not, what is the current forecast of the total planning costs?
- b) Please distinguish between the amounts of planning costs that are included in line 1 of Table 3-4 and the owner's costs for final planning prior to the "final 'go' decision".
- c) Please provide a full breakdown of all the costs included in owner's costs.
- d) The battery is 72% of the total project cost. How has the decreasing cost of the technology factored into decisions around sizing versus achieving savings on the project?

ANSWER:

(a)

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

(b)

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

- Refine the cost estimates and engineering design of the energy storage option 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 Please see Table 1 below.

Table 1: BESS Owner's Cost Breakdown

Element	Cost (\$000's)
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
TOTAL:	\$ 2,382

(d)

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):

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

(f)

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

1. **N-1 use** – Net recharging cost of \$1.7k (assumed average throughput of 56 MWh with diesel recharging – net added cost due to BESS is 15% added losses, or 8.4 MWh per year, at assumed diesel fuel price of \$0.2051/kWh). The diesel cost for the balance of the recharging would be incurred without BESS, assuming diesel thermal generation is available to supply electricity during the N-1 event.
2. **Operating reserve use** – Net recharging cost of \$3.7k (assumed average throughput of 120 MWh, with this table conservatively assuming 15% losses to be charged by diesel, with diesel assumed to be otherwise being required for the operating reserve). Operating reserve is likely often to be recharged by hydro at an incremental cost of \$0.7k per year (120 MWh plus 15% losses at incremental hydro cost of \$0.005/kWh).
3. **Peak Shifting use** – Net recharging cost is included in column G net savings for this use; the 244 MWh/year of throughput is assumed (with 15% losses added) to be recharged 75% with LNG and 25% with hydro. Also see page B-112, Table 11-7 and Table 12-1 of the Hatch Feasibility Study report (Appendix B of the Application) which estimates recharging costs based on peak shifting use based on YEC's cost to generate as assumed in the Hatch report.

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

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

(g)

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

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

TOPIC: New Diesels

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

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

QUESTION:

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

ANSWER:

(a)

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

Application for an Energy Project Certificate
and an Energy Operation Certificate regarding
the Battery Energy Storage System Project

Yukon Energy Corporation
YUB-YEC-1-30

		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)	Non-Industrial Load	Electric Vehicle Load	Industrial load
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.

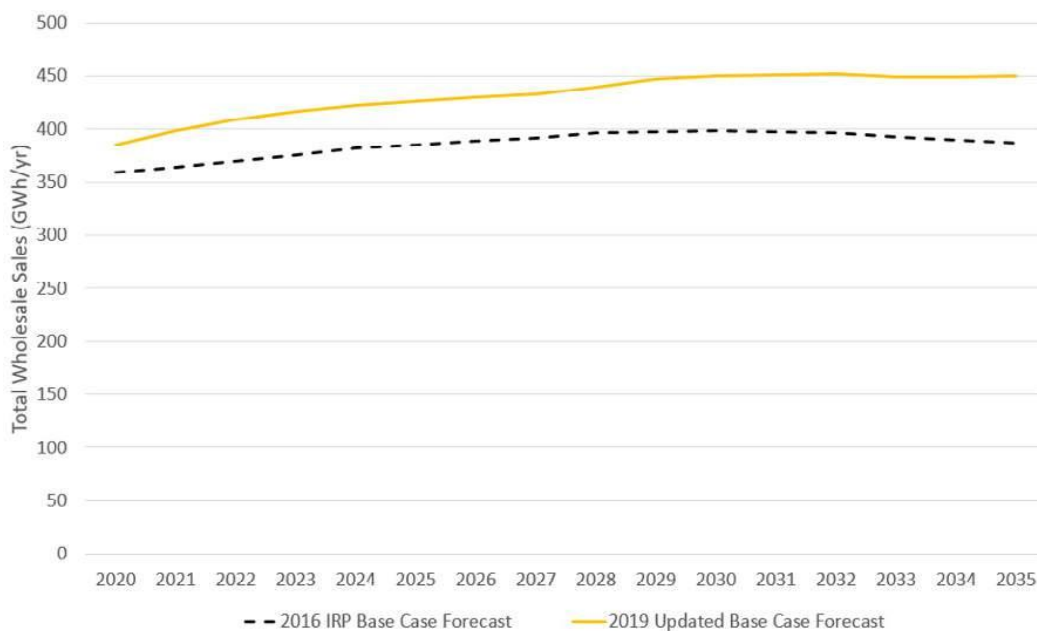
The YIS energy forecast comprises two major elements, wholesale load and industrial (i.e. mining) load, which are combined to produce the total energy forecast. To show how the load forecasts have changed over time, the previous forecast values from the 2016 IRP are included in each of the following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



4.3.1 Annual Energy Forecast

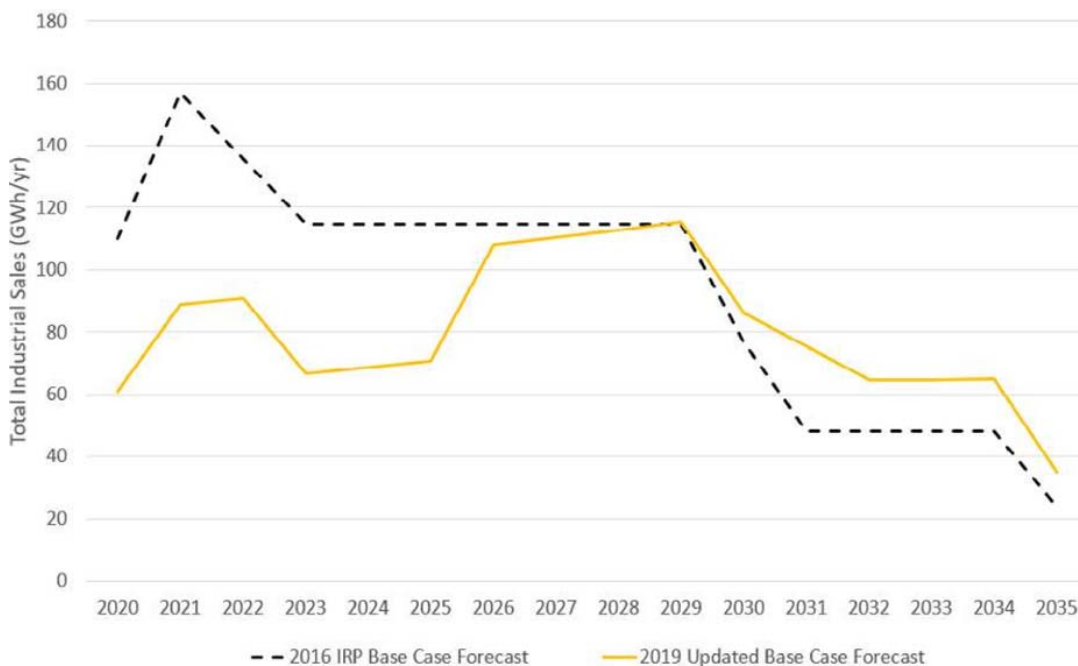
The annual wholesale energy forecast, which includes the incremental Yukon Energy Policy Action loads for the Base Case scenario relative to the 2016 IRP Base Case forecast, is shown in Figure 5. The updated 2019 energy forecast is higher than the 2016 forecast for the entire planning period, including 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



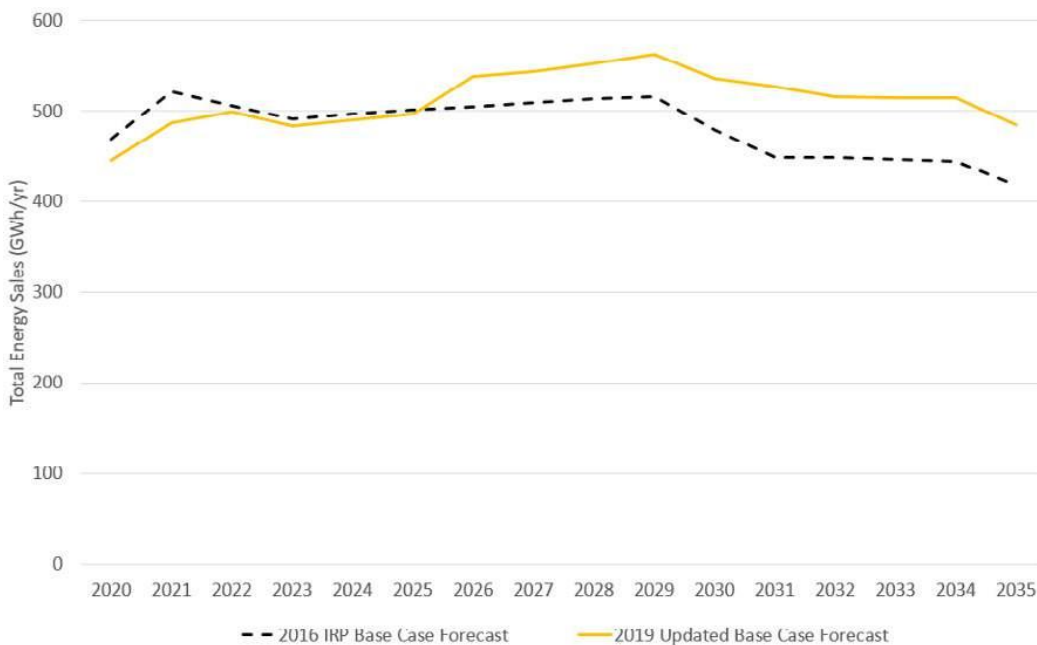
The annual industrial forecast for the Base Case scenario relative to the 2016 IRP Base Case forecast is shown in Figure 6. It should be noted that the 2019 industrial forecast also includes an additional 35 GWh/year load from year 2026 onwards for the assumed electrification of cruise ships in Skagway 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.

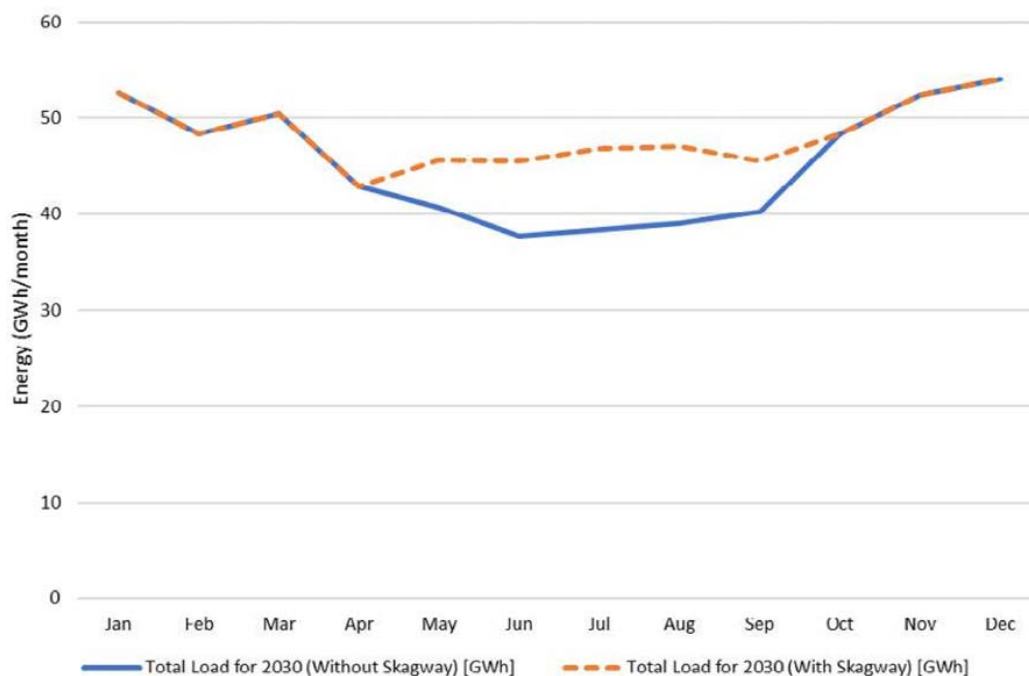
Figure 7: Base Case – Total Energy Forecast Relative to 2016 IRP Base Case Forecast



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.

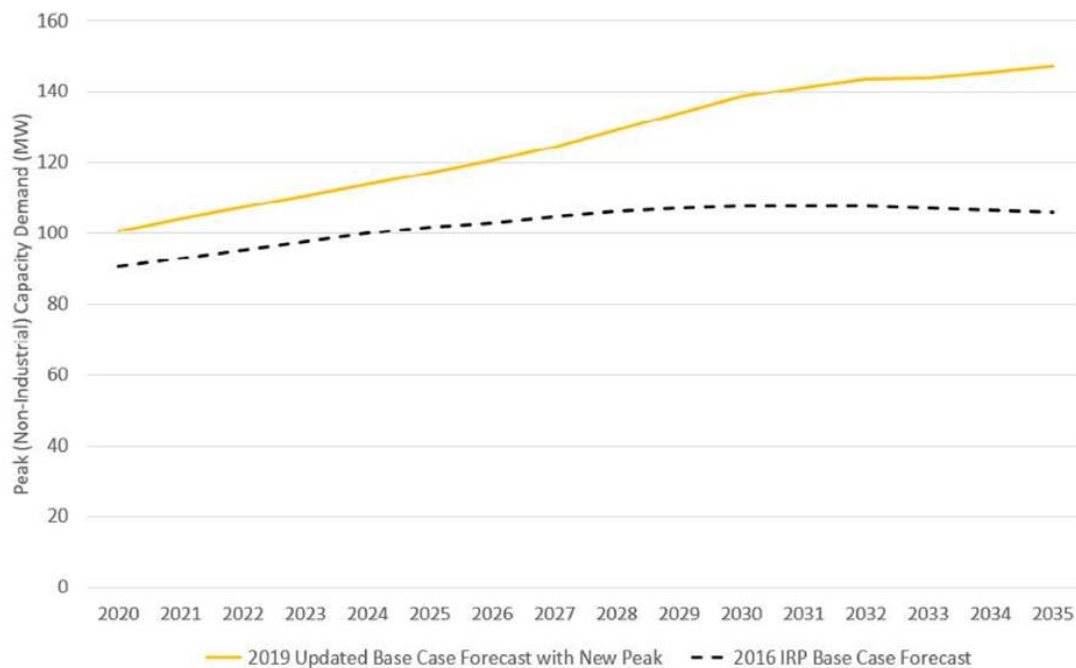
It should be noted that including Skagway in the Base Case does not impact the non-industrial peak capacity demand forecast. Skagway is assumed to add approximately 35 GWh of summer energy per year from year 2026 onwards, but it does not impact the peak capacity demand which occurs in the winter.



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



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

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

QUOTE: Application, PDF page 22:

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

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

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

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.

TOPIC: NAV Canada Land Use Assessment

REFERENCE: Application, Tab 3.4, PDF page 26

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

QUESTION:

- a) The project is expected to require a NAV Canada land use assessment and a Transport Canada aeronautical obstruction clearance. When will the processes for these permits be initiated?
- b) What is the process undertaken by NAV Canada and Transport Canada?
- c) What is the projected timeline for these assessments?
- d) As the proposed location for the BESS is near the end of a runway adjacent to the Whitehorse airport, are additional requirements to the project or the property necessary to satisfy any NAV Canada concerns? What costs are likely to be associated with such changes? Please explain.

ANSWER:

(a)

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

(b)

NAV Canada and Transport Canada assess a proposal to establish the impact of the proposed physical structure(s) on the air navigation system and installations. This includes 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.

TOPIC: Demand-Side Management (DSM)

REFERENCE: Application, Tab 4.1.3, PDF page 30

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

QUESTION:

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

ANSWER:

(a)

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

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

TOPIC: BESS Project Reliability

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

QUESTION:

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

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

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

ANSWER:

(a) to (c)

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

Primary Use Case

The primary use case of the BESS project is related to the provision of N-1 dependable 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 contingency¹. 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 jurisdictions².

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

² 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

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

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

Frequency Regulation

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

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

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

Voltage Control

Maintaining acceptable voltage levels on the power system is also key to system reliability. Voltage deviations outside of acceptable ranges can wear or damage equipment, trigger outages, or compromise safety. The acceptable voltage ranges employed by YEC are 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

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

Blackstart and Outage Restoration Capability

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

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

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

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.”

13 **QUESTION:**

- 15 a) Please provide a summary of the review conducted by YEC on energy storage
16 technologies in its 2016 Resource Plan.
- 18 b) Please explain the drawbacks of connecting other energy storage technologies on
19 to the Yukon Integrated System.

21 **ANSWER:**

23 **(a)**

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.

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).

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.

TOPIC: Dependable Capacity

REFERENCE: Application, Tab 4.2.2, PDF page 40

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

QUESTION:

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

ANSWER:

(a)

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

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

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

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

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

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."

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.

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"?

ANSWER:

(a)

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

(b)

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

- Total Annual Costs PV of \$27.75 million. Excluding net recharging costs for secondary uses, total annual PV costs with only N-1 use are \$26.49 million over the 20-year life.
- BESS annual savings from avoided diesel rental costs (related to N-1 use) are \$22.65 million PV over the 20-year life.
- Net PV impact of ratepayer savings from only N-1 use is an added PV cost of \$3.84 million over the 20-year life.

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

(c)

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

TOPIC: BESS Inverter to 20 MW

REFERENCE: Application, Tab 4.2.2, PDF page 40

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

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

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

QUESTION:

- a) During a peak winter load scenario and an N-1 event (loss of Aishihik transmission line), is there any excess hydro available to recharge the BESS? Please explain.
- b) In the event of an N-1 event (loss of Aishihik transmission line), at a rated capacity of 7.2 MW, how long can the BESS supply energy? Please explain.
- c) How long is the blackstart process for LNG? Please explain.
- d) How long is the blackstart process for diesel? Please explain.

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 ($40 \text{ MWh}/20 \text{ MW} = 2 \text{ hours}$); 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.

TOPIC: 20 MW Thermal Plant not Pursued

REFERENCE: Application, Tab 4.1.3, PDF page 30

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

QUESTION:

- a) Please provide further information on the 20 MW thermal plant. For example, what would be the fuel source of combustion and where would this plant be located?
- b) Please provide further detail as to why YEC decided not to pursue the thermal plant in the near term.
- c) Please indicate whether YEC has considered constructing this plant at a future date. Under what circumstances would YEC be required to construct and operate a thermal plant?

ANSWER:

(a) to (c)

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

TOPIC: Reasonable Alternatives to the BESS Project

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

QUOTE: Application, PDF page 66:

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

Application, PDF page 33:

“4.2.1 Alternatives to the Project

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

QUESTION:

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

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

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

ANSWER:

(a)

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

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

- **Rented diesel alternative:** Both assessments assume rented diesels are the most cost-effective alternative to the BESS to reduce the N-1 dependable capacity shortfall.
- **Capital and Operating Costs:** For the 20 MW/ 40 MWh BESS size option selected for the Project and assessed in Table 4-3 of the Application, Capex and Opex are both increased (2020\$) for Table 4-3 compared to Hatch (\$31.698 million capex vs. \$28.88 million in Hatch before the \$16.5 million grant to reduce these

costs, \$629k annual Opex vs. \$574k in Hatch report); Table 4-3 assumes 7.2 MW of dependable capacity provided vs 7.0 MW assumed in Hatch report. See response to YUB-YEC-1-53 for more detailed explanation of factors explaining differences in Table 4-3 compared to Hatch for capex and opex costs.

- **Levelized Cost of Capacity (LCOC):** Hatch estimates LCOC (2020\$) at \$199/kW per yr for the 20 MW/ 40 MWh BESS at the selected KDFN site based only on the above net capex and annual opex costs; on the same basis, the Application costs result in an estimated LCOC of \$226/kW per yr for the BESS Project.¹ These LCOC comparators to rented diesels both highlighted that BESS feasibility required cost savings from secondary uses beyond the primary N-1 dependable capacity use.
- **NPV (with Savings):** Hatch estimates NPV (2020\$ with savings for BESS compared to rented diesel units over the 20 year life) at \$49.252 million for the 20 MW/ 40 MWh BESS at the selected KDFN site based on the 20 year cash flow with the above net capital and annual opex costs and annual savings of \$0.956 million for diesel rentals and \$3.802 million for operating reserve and peak shifting BESS uses²; the Application Table 4-3 estimates NPV with savings for BESS compared to rented diesel units at \$12.676 million – this materially lower NPV mainly reflects the reduction of estimated thermal displacement (reduced by two-thirds to reflect water storage savings impacts with existing operations) as well as updated thermal fuel prices and corrected incremental hydro generation costs.
- **Internal Rate of Return (IRR):** The Hatch Report included the IRR comparator regarding BESS savings return compared to rented diesels. Hatch estimates IRR (2020\$) at 34% based on the same cash flow used for the NPC with savings estimate; based on Table 4-3 annual cash flows excluding capital costs and the initial net capex of \$15.812 million (2022\$), the IRR is 11% for the Project. The materially lower IRR for the Application analysis reflects the same adjustments noted above for the lower NPV with savings.

¹ 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.

² 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.

Table 4.3 from Application - 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	
	A	B	C	D=A+B+C	E	F	G	H=E+F+G	I=H-D
\$000									
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
NPV	\$16,318	\$10,147	\$1,286	\$27,751	\$22,647	\$17,612	\$167	\$40,426	\$12,676

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 notes³, for example, estimated LCOC for a 12.5 MW new diesel at Takhini at approximately \$186/kW-year (2022\$) versus estimated LCOC for

³ Application, footnote 30 (corrected to show 12.5 MW vs 12.5 kW).

1 rented diesels (2022\$) at \$211.kW-yr,⁴ 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.

⁴ 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.

YEC will continue to communicate with the public about how each concern has been mitigated and/or addressed as further engineering and procurement advances and more detailed information is available on the particular resolution of each concern.

Table 1: Approach to Addressing Stakeholder Concerns

Concern	How it will be addressed by YEC
Potential noise pollution	- Noise modeling for each site has been conducted. - As a result of the public feedback, noise mitigation measures, where appropriate, will be considered as engineering advances. - Options include selecting batteries that are designed to be quiet, installing noise baffles and orienting the HVAC systems away from homes.
Potential light pollution	- This concern will be addressed in the lighting system design, which will be conducted as engineering advances. - YEC will select lighting that provides appropriate security but does not create unnecessary light pollution.
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	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. - YEC will select a vendor with a proven and reliable battery system, and use qualified technicians to do the installation and startup. - 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: - Install a fire suppression system and alarms in each battery container. - Check and maintain the fire suppression system routinely as recommended by the vendor. - Use fire-retardant packing/module containers to ensure that if a fire does occur, it is isolated to a single pack of battery cells.

Concern	How it will be addressed by YEC
	- o Use containers with pressure relief valves which, in the event of a fire, allow gas to escape and prevent a container explosion. - o Space the containers apart to prevent a fire from spreading from one container to another. - o Develop a comprehensive fire and emergency response plan and commit to providing the required training to local firefighters and emergency response staff.
Health impacts of radiation, electromagnetism, and gases	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. 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.
Contamination of agricultural land close to the project	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.



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
	Total	43

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 First 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;
- Quite 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



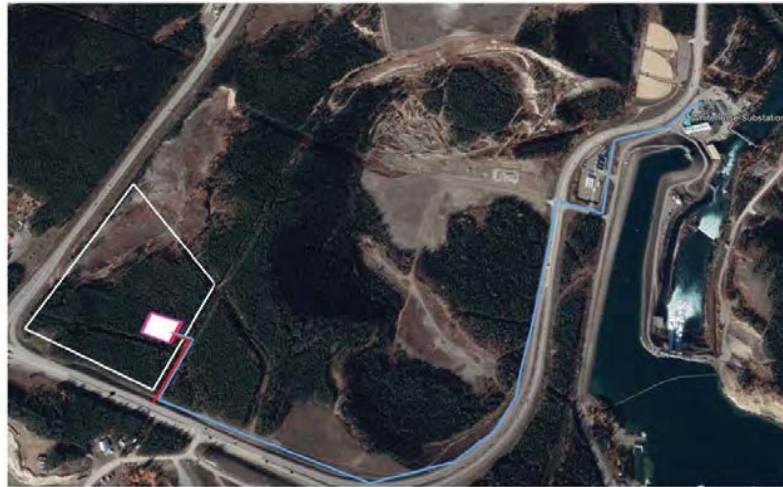
SITE B

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
	Total	43

Virtual Meeting #1

September 8, 2020

Attendees: 7 members of the community

On September 8th 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 10th 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 15th, 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 16th, 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 17th, 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: - Representative of the Department of Environment, Environmental Protection and Assessment - Representatives from the Highways and Public Works, Transportation Planning Branch	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 .

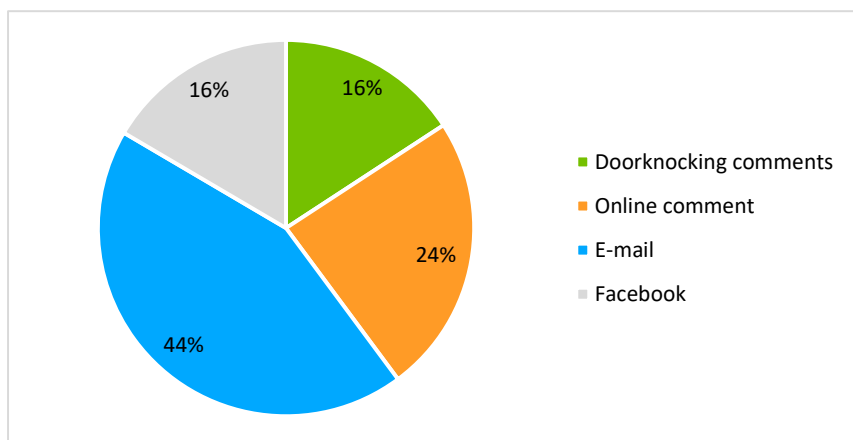


Figure 4 Comments Received by Feedback Method

Most of the comments (96) received were related to the proposed Site A North Klondike Highway. This is shown in Figure 5.

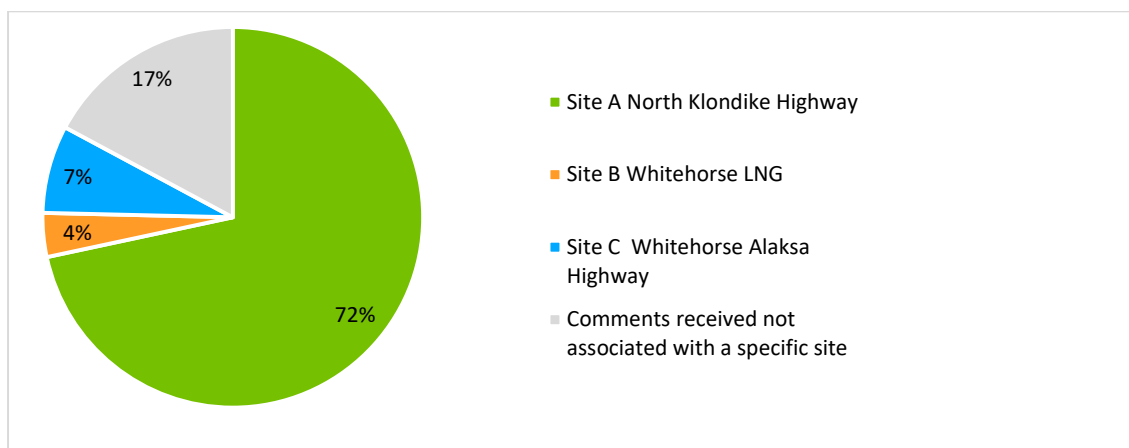


Figure 5 Comments Received by Specific Site

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 (ie. 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.

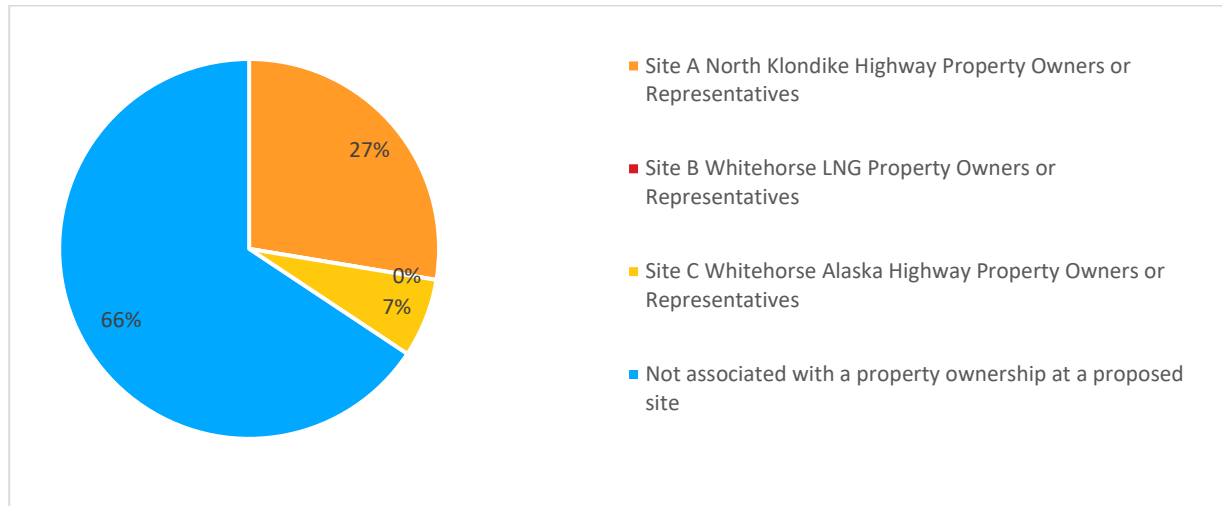


Figure 6 Comments Received from all Feedback Methods by Respondent Category

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.

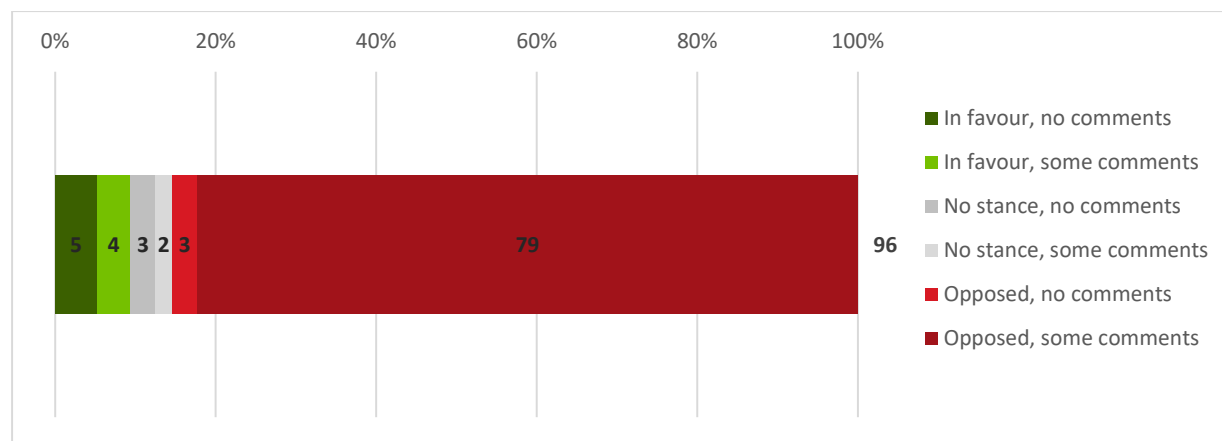


Figure 7 Site A Feedback Summary, From All Feedback Sources

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.

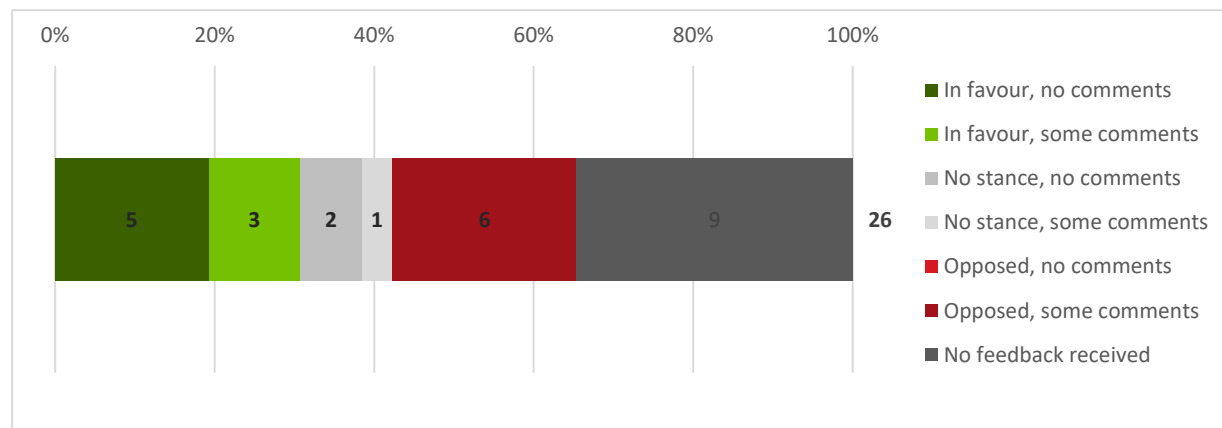


Figure 8 Site A Feedback Summary, From Property Owners or Representatives

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

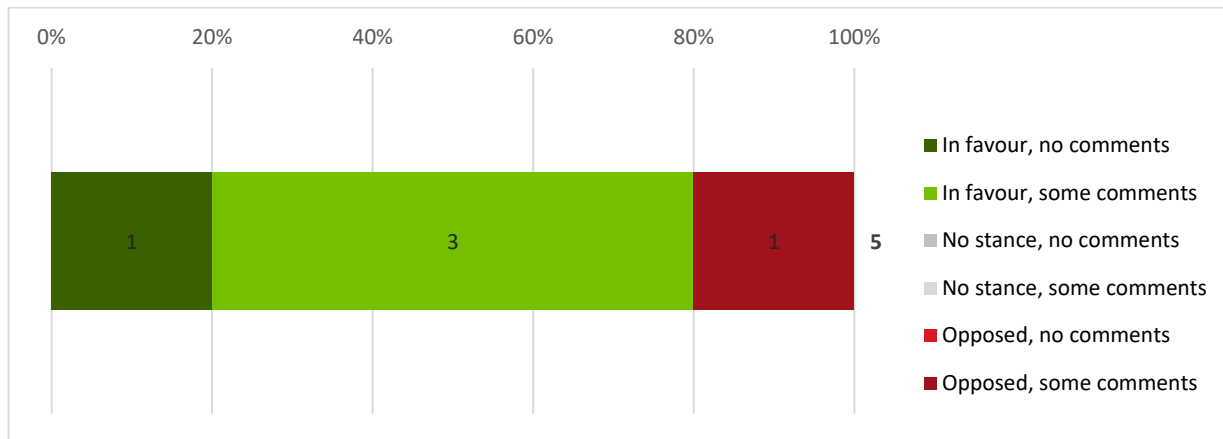


Figure 9 Site B Feedback Summary, From All Sources

Comments From Property Owners or Representatives

Although three property owners were associated with Site B, no feedback was received from these owners or businesses.

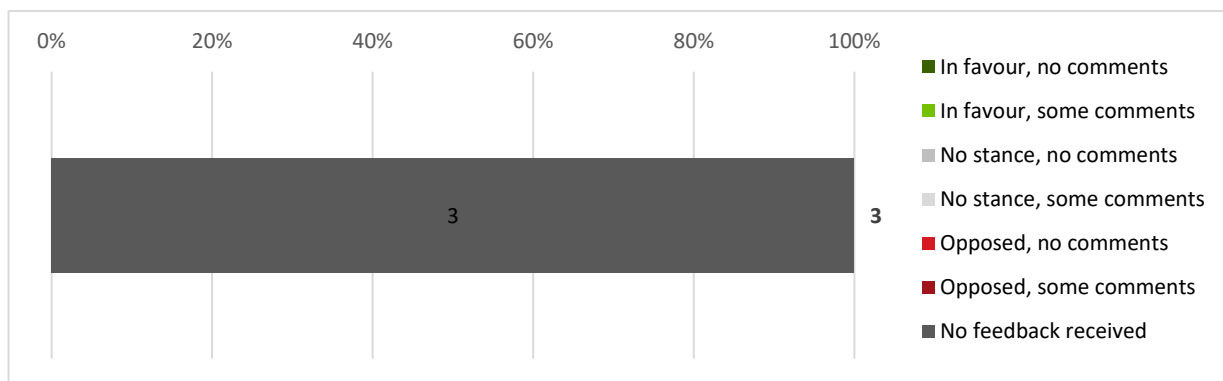


Figure 10 Site B Feedback Summary, From Property Owners or Representatives

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.

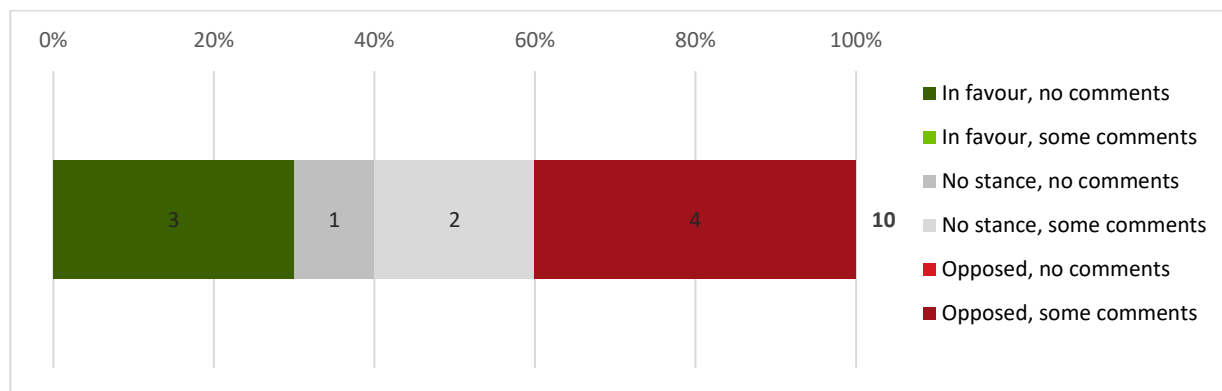


Figure 11 Site C Feedback Summary, From All Sources

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.

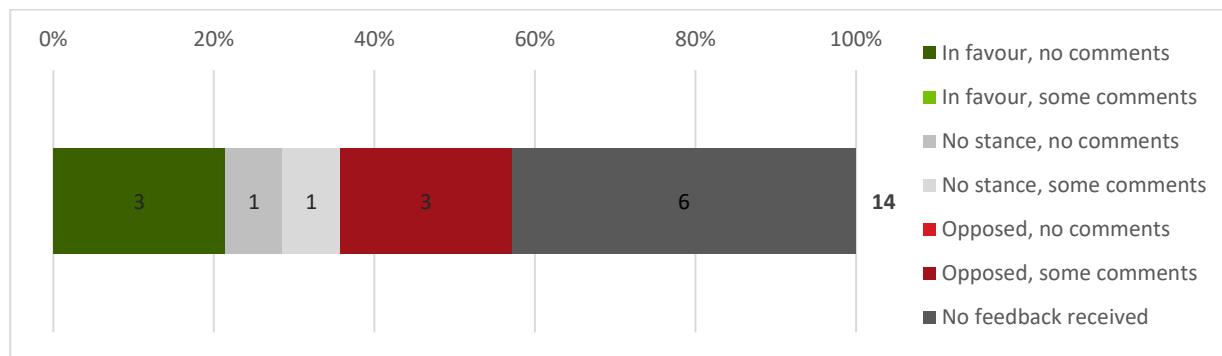


Figure 12 Site C Feedback Summary, From Property Owners or Representatives

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;
- Quite 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.



Photo courtesy of Tuglio Energy Corp.

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.

Complete the online comment form
available on our website,
yukonenergy.ca/battery.



VIRTUAL COMMUNITY MEETINGS

Tuesday, September 8

7–9 pm

Thursday, September 10

5:30–7:30 pm

Email yecbatteryfeedback@stantec.com or
visit 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 or communications@yec.yk.ca

website: 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 dbs 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 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 pack will come in \$1,060 per Mwh.¹

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.

¹ 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.² Are they also safe to operate at extreme winter conditions?³ 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

² Yukon Energy 2016 20 Year Resource Plan, p. 18

³ 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.⁴

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?

⁴ Yukon Energy web on Mayo B

September 18, 2020

Yukon Energy Corporation
#2 Miles Canyon Road
Box 5920, Whitehorse, Yukon
Y1A 6S7

Stephanie Cunha, Manager, Communications
Via email: stephanie.cunha@yec.yk.ca
cc: 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_{2,eq} 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	Battery infrastructure should be screened from view.	Screening
2	Just giver'	Support or opposition
3	- No problems with the proposed site. - Designed home to be able to add a solar array in the future.	Support or opposition
4	- Questions: What size will it be? What % will my rates increase. - Generally the resident supports this project. - Would like to see a more stable grid with fewer power outages. - YEC needs to plan new sources of energy as demand continues to grow. - Concern about the environmental impacts of building this type of battery.	Environmental impact Parking lot: energy rates
5	- Does not want access to the area's quadding trails to be cut off by this project. - Definitely support for this project and this location is fine. - Would like to see projects that lead to more stable power and fewer outages.	Loss of site from recreational purposes
6	Feels that her home is far enough away that there wont be any issues.	Support or opposition
7	- Does not want to have the battery so close to her home and her garden/vegetable growing business. - Do not want to see this type of infrastructure at the entrance to the community. - Concern that the battery may cause emissions or gases that will impact vegetable production. - Would not want to see or hear the battery. - Concern about environmental impacts of living so close to the battery. - Paragliders use this site as well; should reach out to their association. - Would prefer the site near LNG generators.	Screening Screening: aesthetics from roadway Health impacts to surrounding residents Noise Environmental impact Loss of site from recreational purposes
8	No issues with the proposed project.	Support or opposition
9	- Prefer a battery at this location over LNG or diesel generator. - Wife will likely have questions.	General.
10	- Questions: - How much noise? - What are the benefits? - What are the timelines. - Would like the site to be screened if the project goes ahead. - Appreciate that YEC is door knocking in the area	Noise Screening
11	No issues with the proposed site.	Support or opposition

	Door-Knocking Comments	Themes Used for Graphing Purposes
12	• Do not want to see the battery from the road; need to consider the aesthetics at this site. • 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. • Need to consider aviation safety; the area is so close to the airport that there may be impacts. • People who live in the area use that site for recreation; trails and tobogganing hill. • If the battery catches on fire how will the toxic fumes be managed? • Various property owners along Metropolit Land have expansion plans and the battery may not be compatible with these plans. • 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. • Proposed site is not flat. • North Klondike Highway site may be better because of lower taxes. • Want to know if there is a plan to add more batteries in the future. • Will the batteries have magnetic properties that could impact airplane navigation? • Want to know where batteries will be made. • Would feel more comfortable if YEC had completed research into impacts; for example will radiation or gases be emitted? • Concern that batteries are dangerous; long term impacts and potential risks are not know or well understood. • Yukon Gardens uses lots of power to heat greenhouses; would like to have access to agriculture rates or off-peak rates.	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
13	• Access quadding trails in the area. • Question about the noise that would be produced. • No concerns.	Loss of site from recreational purposes Noise
14	• No in favour of this project at this site; many concerns and questions. • Concern that real estate values will go down and that insurance premiums will go up • Battery are not safe. • Volunteer fire department is not equipped to deal with a battery accident, explosion or fire. • Concern that a fire would block the highway or other local roads and resident will not be able to get out. • 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. • Moved to the Yukon to get away from this sort of project. • Do not see battery storage as a sustainable option. • YEC needs to commit to letting people know what they decide to do on this site. • YEC needs to provide clear and timely answers to residents' questions. • 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. • Want time to learn, understand and provide timely input. • Need to know what will happen if bullets hit the battery or there is a lighting strike.	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
15	• Very disappointed that Yukon Energy would consider this site. • Do not support the battery project in this location. • Resident is very sensitive to lights and sounds.	Light Noise Health impacts to

	Door-Knocking Comments	Themes Used for Graphing Purposes
	• They have just finished building a recording studio and have received YG funding for this project; noise could be a big problem for recording. • This is not a good location for the battery; would be bad for well being of those who live here. • Concern about the risk of a fire and/or explosion. • Would consider moving if this project goes ahead; would not want to live so close to the battery. • Should consider some kind of financial compensation for residents if the project goes ahead at this location.	surrounding residents Fear of emergency situation Additional information: financial compensation for those impacted Reduction in quality of life

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	Hello, 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.	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
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.	Health impacts to surrounding residents Fear of emergency situation
12	I oppose this venture behind my family's land.Relocate to an isolated region. Thank you.	Support or opposition
13	1. Any Engagement with home owners / community prior? 2. Enviromental Study? 3. Stewardship of the project? 4. No Transparency to families? Thank you	Process: engagement timeline Environmental impact Decision-making criteria
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	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.	Support or opposition
17	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.	Noise Light Screening Loss of view Property values Fear of emergency situation Environmental impact Additional information: end-of-life for battery
18	Hello, 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. 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. 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 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! Additionally, this will negatively impact me as this development will effectively devalue my investment and greatly reduce my ability to enjoy my property. The two locations within the city of Whitehorse are clearly more suited to this development as there are little to no social impacts. 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.	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	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. 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. 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)? 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 (en.wikipedia.org/wiki/Methanol_economy and //en.wikipedia.org/wiki/Dimethyl_ether) which can be made from biomass (such as wood from our abundant burt-over areas). Could YE form partnerships with development companies to create what for them would be demonstration-sized projects but for us would be real-world?	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	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!! 1. It's at the end of a runway!!! 2. You have two main power sources in a river valley, in front of a dam, in an earthquake zone!!!! 3. If either the LNG or the batteries do have a catastrophic failure one would probably take out the other!!!! Option 2 - 1. Again, at the end of a runway/flight path 2. At least it's higher! 3. Still too close for my liking Option 3 1. No airport,	Fear of emergency situation; Support or opposition

	Online Form Comments	Themes Used for Graphing Purposes
	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	
23	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.	Property values Reduced quality of life
24	Hello Minister Pillai, 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. 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. We are opposed for several reasons. 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. 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. 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? 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. 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. 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. 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. We believe this is a band aid solution to Yukon's energy problem and that the	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

	Online Form Comments	Themes Used for Graphing Purposes
	Government has failed to develop a long term plan to meet the requirements of Yukoner's. 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. 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. 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. 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 move this through so quickly? 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. Will the minister commit to taking Site A Takhini off the table for the battery project? 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. Regards, [Redacted]	
25	Really don't appreciate get 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'm do not 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 be have too 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 step out of our front door to see northern light. This will have 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. I am not opposed to battery storage but I am very upset with it being in my back yard. 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.	Process: engagement timeline

	Online Form Comments	Themes Used for Graphing Purposes
26-32	I am writing you today to express that I am opposed to the Yukon Energy Grid-Scale Battery project at the Takhini Substation. There are many reasons I am writing to you today and they include: 1. The noise level and how it affects those around it, including the mental health of residents in the area 2. The lighting and how it will greatly alter the way of life in this location by removing northern lights viewing and stargazing 3. Unknown gases and fumes that may come from the units 4. Potential for leaks and ground contamination 5. The risk of explosion and lives it would take if this occurred 6. The risk of fire from internal and external sources, such as a wildfire 7. The risk of vandalism and how this is a large issue in this neighbourhood 8. The size and how it will affect our view 9. How it will affect resale for properties in this area 10. How the local fire station is clearly unable to save structures in the immediate area in event of a catastrophic event 11. The increase in the cost of insurance to residents 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. 13. Potential that potential home buyers will not want to purchase in this area anymore as the attractive factor would be removed. 14. Loss of current way of life 15. No positives for people in the direct area only loss 16. Various safety concerns as a whole Please consider the other 2 locations for this project as I feel this is not an appropriate area for such a large battery.	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

Appendix F E-MAILS

	E-Mail Comments	Themes Use for Graphing Purposes
1	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 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 an 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	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

	E-Mail Comments	Themes Use for Graphing Purposes
	faster rate. Wiping out my entire property and all of its structures (13 on my property alone, not counting other neighbours) 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. 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. 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. 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. 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. 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. Sincerely,	
2	Hello Zoe, 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.	Noise Light Reduced quality of life Fear of emergency situation

	E-Mail Comments	Themes Use for Graphing Purposes
	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 subsubstation option will have the greatest socio-economic impacts and therefore should not be the selected location for the battery storage facility. Thank you for your consideration,	Fear of emergency situation: emergency response Property values Screening Additional information: durability of battery in extreme situations
3	Hello Minister Pillai, 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. 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. We are opposed for several reasons. 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. 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. 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?	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

	E-Mail Comments	Themes Use for Graphing Purposes
	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. 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. 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. 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. 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. 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. 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. 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. 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 move this through so quickly? 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. Will the minister commit to taking Site A Takhini off the table for the battery project? 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. Regards,	
4	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.	Fear of emergency situation Fear of emergency situation: emergency

	E-Mail Comments	Themes Use for Graphing Purposes
	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: 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. 2. We are dependent on a volunteer fire department which has limited access to a continuous source of pressurized water to fight fires. 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. 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. 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. 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. Very truly yours,	response Property values: insurance rates Property values
5	Hello, I am writing to you today to express that I am opposed to the Yukon Energy Grid-Scale Battery project at the Takhini Substation. I live directly across the highway from the current Substation and proposed Battery project. There are many reasons I am writing to you today and they include: The noise level and how it affects those around it, including the mental health of residents in the area. The lighting and how it will greatly alter the way of life in this location by removing northern lights viewing and stargazing The size and how it will affect our view How it will affect resale for properties in this area How the local fire station is clearly unable to save structures in the immediate area in event of a catastrophic event Potential that potential home buyers will not want to purchase in this area anymore as the attractive factor would be removed. Loss of current way of life There is absolutely nothing positive for anyone that lives in the area.	Noise Light

	E-Mail Comments	Themes Use for Graphing Purposes
	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,	
6	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,	Noise Light Reduced quality of life Fear of emergency situation Fear of emergency situation: emergency response Property values Screening
7	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.	Fear of emergency situation Light Noise Decision-making criteria Process: engagement timeline Property values Reduction in quality of life

	E-Mail Comments	Themes Use for Graphing Purposes
	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. 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. 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.	
8	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	Noise Light Environmental impact
9	Hello All, 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. 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. 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. 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. The two locations within the city of Whitehorse are clearly more suited to this development as there are little to no social impacts. 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. Regards,	Process: engagement timeline Noise Light Property values Decision-making criteria
10	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. 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. 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. When your representatives were at my home educating and discussing the location for this facility, the topic that these batteries were quite flammable never	Decision-making criteria Property values Fear of emergency situation Fear of emergency situation: emergency response - containment of fumes Health of surrounding residents

	E-Mail Comments	Themes Use for Graphing Purposes
	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! Please reply that you have received this message. Regards	
11	Hello, 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	Screening: aesthetics from the roadway
12	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 something went wrong like leaks ,explosions, abanonment. In short i am against the klondike hwy proposed location of this grid scale battery	Light Noise Reduction in quality of life Screening Property values Fear of emergency situation Environmental impact Additional information: end-of-life for battery
13	Dear Zoe Morrison, 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. 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. 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. 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	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

	E-Mail Comments	Themes Use for Graphing Purposes
	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. 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. 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. 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. Regards,	
14	Hello Zoe, 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. 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. 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. 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. 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. 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	Property values Noise Light Process: engagement timeline Decision-making criteria

	E-Mail Comments	Themes Use for Graphing Purposes
	effort is not being made for option 3 where you have multiple residences under 300 m from the facility. 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. Thank you for your time,	
15	Hello, I just wanted to bring my concerns forward in regards to putting this battery storage out near Takhini subdivision, site A. 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. The other two options are great as they are not near subdivisions and are closed to what are already industrialized areas in Whitehorse. Please consider not putting this battery site at Site A as there are much better options for this. Thank you,	Noise Light Fear of emergency situation Reduced quality of life
16-58	Hello, I am writing you today to express that I am opposed to the Yukon Energy Grid-Scale Battery project at the Takhini Substation. There are many reasons I am writing to you today and they include: 1. The noise level and how it affects those around it, including the mental health of residents in the area 2. The lighting and how it will greatly alter the way of life in this location by removing northern lights viewing and stargazing 3. Unknown gases and fumes that may come from the units 4. Potential for leaks and ground contamination 5. The risk of explosion and lives it would take if this occurred 6. The risk of fire from internal and external sources, such as a wildfire 7. The risk of vandalism and how this is a large issue in this neighbourhood 8. The size and how it will affect our view 9. How it will affect resale for properties in this area 10. How the local fire station is clearly unable to save structures in the immediate area in event of a catastrophic event 11. The increase in the cost of insurance to residents 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. 13. Potential that potential home buyers will not want to purchase in this area anymore as the attractive factor would be removed. 14. Loss of current way of life 15. No positives for people in the direct area only loss 16. Various safety concerns as a whole	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

	E-Mail Comments	Themes Use for Graphing Purposes
	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
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...	Additional information: end-of-life for battery
Re: Solar panels... Yup they should brand SMN as "nuclear batteries"	Misc. comment
Re: Solar panels... Small modular nuclear would be amazing, too bad there is negative stigma around nuclear right now, nuclear needs a rebirth	Misc. comment
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 ...	Misc. comment
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	Misc. comment
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 they all somehow know better than you about renewable falsehoods. Consensus is a powerful drug.	Misc. comment
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."	Misc. comment
I'm wondering how green is getting all the material for these green products? No one seems to tell us of the chemicals used or how it's disposed of. In the end, no one will give a cost to the consumer	Additional information: connection between batteries and sustainability
Re: I'm wondering... Batteries & 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 China but that's believe in the 'pooping end of the pool'. Most of the mercury pollution in North America comes from dirty coal burning in China.	Additional information: connection between batteries and sustainability Environmental impact
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 another thing!	Misc. comment

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
Re: And how often... 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!	Misc. comment
Make a contract with Tesla????	Misc. comment
Costs more to set up than its worth	Decision-making criteria
Re: Costs more to... could you back up your claim with some evidence?	Misc. comment
Re: Costs more to... Look at every single time a feel good energy program is put on by any government any where how cost effective they are	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

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.

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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.

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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) 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

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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.

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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.

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- 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.

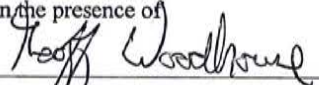
30. Counterparts

- 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.

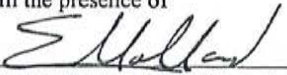
GOVERNMENT OF YUKON
as represented by the
President and CEO, Yukon Development Corp.

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

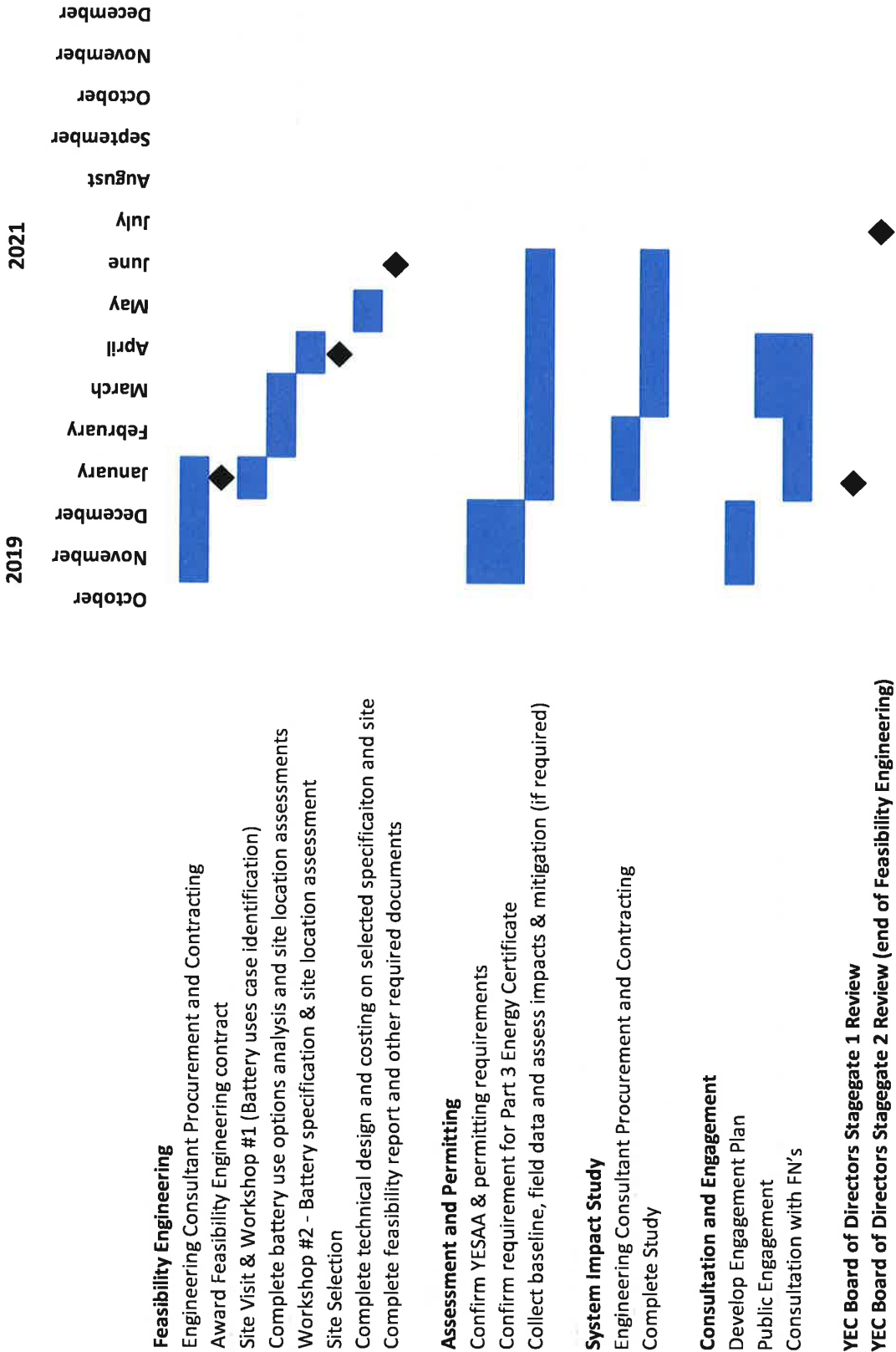
A1.0 Deliverables

- The acquisition and installation of a 40 MWh battery storage system with 8 MW capacity

A2.0 Work Plan

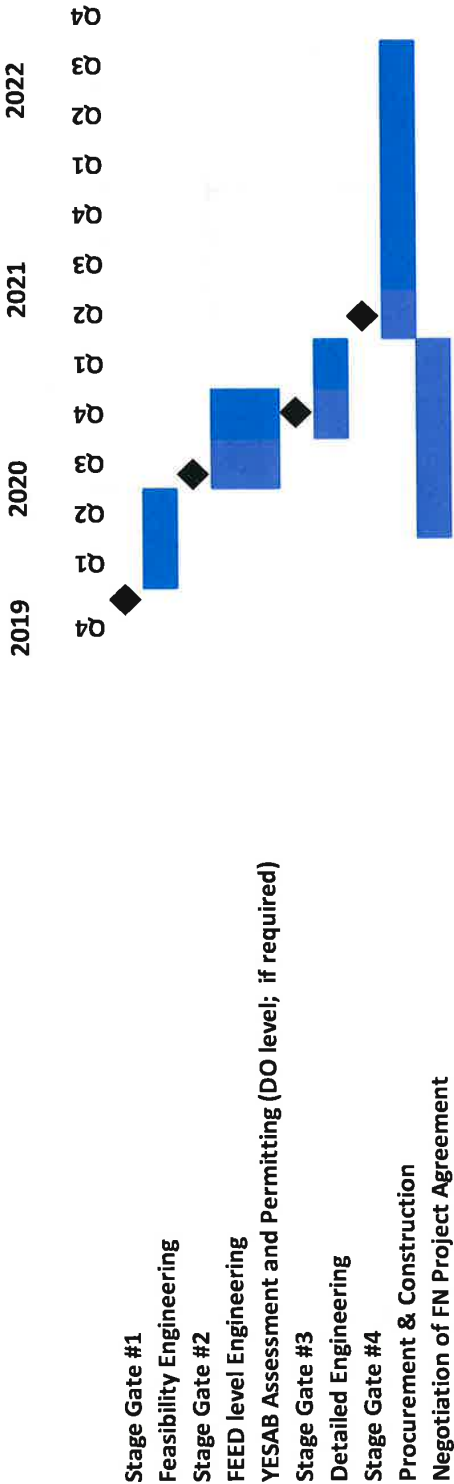
- A2.1 The Recipient shall carry out the Project in accordance with the work plan and deliverables as described in Schedule A as initially approved in writing by YG and attached to Schedule A as an appendix.

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
Total	25,000,000

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;

Name/Position

Signature

Date

I certify on behalf of YG that this report is acceptable to YG;

Name/Position

Signature

Date

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
Project Expenses Claimed		
Total Approved Eligible Expenditures		[Fund amount]
Remaining Eligible Expenditures		
Ineligible Costs		
Total Project Cost – Eligible & Ineligible		

Calculation of Current Claim

Total Expenses Submitted for Payment	
Total Payment This Claim	

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. 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 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].

TOPIC: Improved Efficiency of Hydro Turbines

REFERENCE: Application, Tab 4.2.3, PDF page 42

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

QUESTION:

- a) Please explain how the BESS project allows YEC to operate its hydro-turbines more efficiently.
- b) Regardless of the BESS project, does YEC strive to operate its hydro-turbines as efficiently as possible? Please explain.
- c) How does/will YEC measure this higher efficiency? Please explain.
- d) What is the difference in hydro unit efficiencies between summer and winter months? Please explain.

ANSWER:

(a)

The BESS will allow YEC to keep the hydro units at their respective optimum operating point while the load varies, rather than the hydro units being required to load-follow. Load-following, or the provision of operating reserve, requires the unit to operate at a less than optimum operating point. Please see also the response to YUB-YEC-1-20(d).

(b)

The system control center (SCC) monitors the hydro units in real time. SCADA displays kW's per cubic meter second flow information to the operator. This information is utilized 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.

TOPIC: Economic Benefits of Other Secondary use Cases for the Battery Energy Storage System Project

REFERENCE: Application, Tab 4.2.3, PDF page 42

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

QUESTION:

- a) Please explain why the economic benefits from these secondary use cases cannot be estimated.
- b) Please explain if YEC forecasted the reduction of grid outages with the Battery Energy Storage System Project installed and, if applicable, provide this forecasted number for the next ten years.

ANSWER:

(a)

The events are relatively infrequent and will vary year to year and are therefore difficult to quantify accurately. The impact of a shorter outage or less frequent outages on customer satisfaction is significant though not easily represented in a monetary value as it represents a customer reliability benefit.

(b)

YEC forecasts planned outages, but not forecast forced grid outages. However, YEC does expect a reduction in unplanned outages and a decrease in the duration and extent of 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.

TOPIC: Table Calculations

REFERENCE: Application, Tab 4.2.3, PDF page 43, Table 4-3

QUESTION:

- a) Please provide Table 4-3 in Excel format with formulae intact.
- b) Please provide the detailed calculations for the values in each column for rows Year 1, Year 4, Year 10, Year 16 and Year 20.
- c) Does Table 4-3 include the modest overbuild or capacity augmentation at year ten? Please explain.
- d) If Table 4-3 does not include the modest overbuild or capacity augmentation at year ten, then please provide a revised Table 4-3 which includes the modest overbuild or capacity augmentation at year ten.
- e) The savings outlined in Table 4-3 describe: avoided rental diesels, operating reserve use, and annual peak shifting. Are these savings firm forecasts resulting from BESS's intended use? Please explain.

ANSWER:

(a)

Please see YUB-YEC-1-52 Attachment 1 for the version of Table 4-3 in MS Excel format with formulae intact.

(b)

Please see YUB-YEC-1-52 Attachment 1 for the version of Table 4-3 in MS Excel format 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

benefit among the identified additional use cases with benefits of BESS use for operating reserve noted to be two-fold:

- A direct reduction in diesel and natural gas genset operation hours and energy generation; and
- Improved efficiency of the hydro-turbines by operating them at their most efficient output more frequently, leading to more energy production with the same amount of water flow.

The Hatch Report (see Appendix B of the Application) estimated that when the 20 MW/40 MWh BESS is used as operating reserve it could save up to 1,837 MWh of diesel and 17,043 MWh of LNG, or \$3.374 million, based on 2021 GRA fuel prices. However, as noted in Section 3.1.2.2. of the Application, these estimates may not be fully realized due to water storage savings with the existing operations, and that net thermal generation reduction from BESS operating reserve use is approximately one-third of these estimates, i.e., the operating reserve annual net fuel cost saving is reduced to approximately \$1.125 million (2022\$). Please see YUB-YEC-1-52 Attachment 1 for the version of Table 4-3 in MS Excel format with formulae intact that shows the details of the calculations of operating reserve benefits. Please also see YUB-YEC-1-51 for details on BESS savings from operating reserve use.

Unlike the dependable capacity benefits, the benefits from operating reserve cannot be described as “firm” forecasts as these are not firmly measurable and fluctuate on daily basis based on grid loads and generation outputs.

- **Secondary Use – Diesel Peak Shifting:** The estimated net cost savings from BESS diesel peak shifting based on 2019 operations and indicate relatively small net economic benefits approximating \$10,600/year (2022\$) after consideration of LNG and hydro operating costs for recharging of BESS. These benefits also cannot be described as “firm” forecasts as these are not firmly measurable and fluctuate on daily basis based on grid loads and generation outputs.

Assumptions

Capital net of grant (\$000) - 2020\$	\$15,198			
Capital net of grant (\$000) - 2022\$	\$15,812			
Project Life	20	years		
Weighted Average Cost of Capital	4.79%		MW.h	Benefits -MW.h
Inflation	2%		Annual Diesel Savings OR	1,837 612
Diesel rental	\$169 \$000/MW		Annual LNG Savings OR	17,043 5,681
Dependable Capacity	7.2 MW		Total thermal savings	18,880 6,293
Diesel Rental Inflation	4%			
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	
	A	B	C	D=A+B+C	E	F	G	H=E+F+G	I=H-D
\$000									
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
NPV	\$16,318	\$10,147	\$1,286	\$27,751	\$22,647	\$17,612	\$167	\$40,426	\$12,676

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.

(e)

Table 12-2 in Appendix B provides a summary of assessments for a location at the TKC site and 12-4 for the location in KDFN land near Takhini Substation. These sites were not selected for the Project, therefore, the information from these tables is not used in the Application.

The following explains variances between Table 12-3 of Hatch Report [Appendix B] and Table 4-3 of the Application:

- **Capital costs:** Table 12-3 of Appendix B shows the capital cost for a 20 MW/40 MWh battery at \$28.880 million (2020\$). As noted in note #1 to Table 3-4 of the Application the preliminary cost estimates included in Hatch Report [Appendix B] do not include Planning Costs and Owner's Costs. Including these costs, the total Project cost would be \$31.698 million (2020\$) before grants, or \$15.198 million after grants as shown in YUB-YEC-52 Attachment 1 [detailed calculations for Table 4-3].
- **O&M costs:** Table 12-3 of Appendix B shows the O&M cost for a 20 MW/40 MWh battery at \$0.574 million (2020\$) – escalated to 2022\$ at 2%/year inflation rate this would be \$0.597 million (2022\$). This O&M expense estimate, however, does not include annual lease costs for the selected site. Table 4-3 shows total annual O&M at \$0.652 million (2022\$) – this includes annual lease cost at \$0.055 million, or \$0.597 million when exclude lease costs which is the same as annual costs from the Hatch Report [Appendix B] escalated to 2022\$.
- **Levelized Cost of Capital (LCOC):** Hatch estimates LCOC (2020\$) at \$199/kW per yr for the 20 MW/ 40 MWh BESS at the selected KDFN site based only on the above Hatch net capex and annual opex costs; on the same basis using Table 4-3 capex and opex costs, the Application costs result in an estimated LCOC of \$226/kW per yr for the BESS Project.¹

¹ 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.

- **NPV (with Savings):** Hatch estimates NPV (2020\$ with savings over the 20 year life) at \$49.252 million for the 20 MW/ 40 MWh BESS at the selected KDFN site based on the 20 year cash flow with the above net capital and annual opex costs and annual savings of \$0.956 million for diesel rentals and \$3.802 million for operating reserve and peak shifting BESS uses²; the Application Table 4-3 estimates NPV with savings at \$12.676 million – this materially lower NPV mainly reflects the reduction of estimated operating use thermal displacement (reduced by two-thirds to reflect water storage savings impacts with existing operations) as well as updated thermal fuel prices and corrected incremental hydro generation costs.
- **Internal Rate of Return (IRR):** Hatch estimates IRR (2020\$) at 34% based on the same cash flow used for the NPV with savings estimate; based on Table 4-3 annual cash flows excluding capital costs and the initial net capex of \$15.812 million (2022\$), the IRR is 11% for the Project. The materially lower IRR for the Application analysis reflects the same adjustments noted above for the lower NPV with savings.

The project economics in the Application do not include LCOE as the Project is not intended to be an energy project. The primary focus of the Project is providing N-1 dependable capacity to replace rented diesel units as well as providing other system benefits.

Please see YUB-YEC-52 Attachment 1 for more detail on the calculations and assumptions for Table 4-3 of the Application.

² 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.

TOPIC: Owner's Engineer with Experience

REFERENCE: Application, Tab 4.3, PDF page 43

QUOTE: "These risks are generally being addressed through an early vendor selection process, assisted by an owner's engineer with experience procuring battery vendors..."

QUESTION:

- a) Has YEC selected an owner's engineer for this project?
- b) If the answer to (a) is yes, then what experience do they have in similarly sized installations in cold climates and in managing costs of a BESS project?
- c) Are the owner's engineer's costs included in the BESS capital costs?

ANSWER:

(a)

Yes. YEC has selected an Owners Engineer for this project.

(b)

The consultant's experience and qualifications are outlined in Attachment 1 to this response. Managing costs is not the responsibility of the Owners Engineer. The Project Manager will be responsible for Managing Project costs.

(c)

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 Kodsí PhD, PEng, PE – Power System Studies Lead



Dr Kodsí 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. Kodsí 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. Kodsí 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.

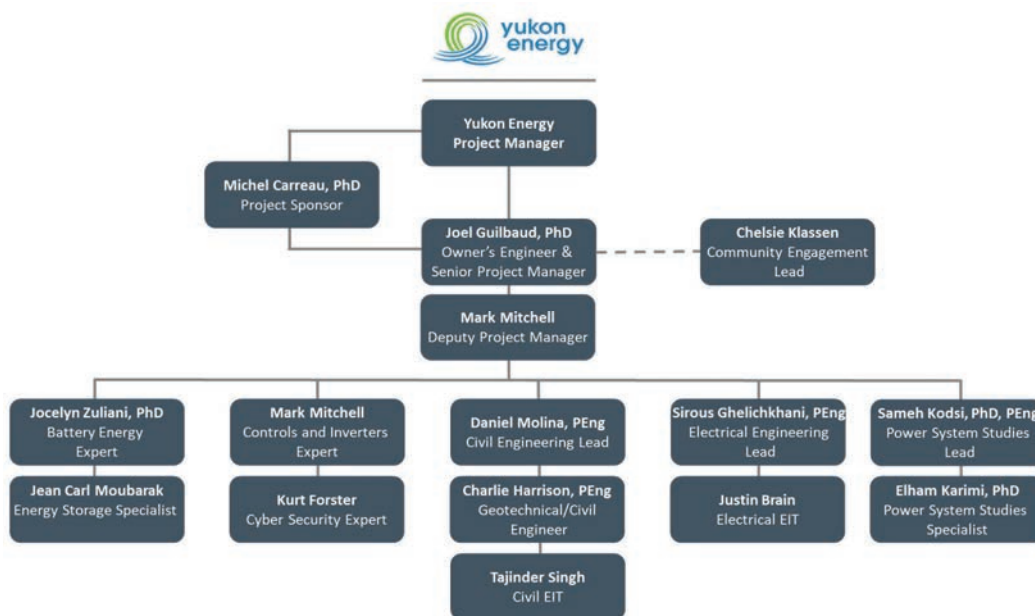


Figure 1: Project Organization Chart

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; +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; +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; +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; +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.

TOPIC: Conventional Construction Technologies and Applicable Construction and Design Practices

REFERENCE: Application, Tab 6.2, PDF page 48

QUOTE: “The Project will be built using conventional construction technologies suited for northern climate conditions and following all applicable construction and design practices for works of this nature, including building and electrical codes and adhering to industry best practices.”

QUESTION:

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

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

ANSWER:

(a)

Conventional construction methodologies that will be utilized during this project include: typical civil works (grading, application of soils and crushed stone, packing), ground grid design and installation (crushed stone, fence and equipment grounding), fencing installation as per safety standards (correct height and gaps under the fence), cable trench installation, piles driven for steel structures required for electrical equipment (disconnect switches, breakers, buss works, t-line connection), concrete pad for transformer complete with an oil containment system and control building installation.

(b)

Construction practices are standard (please see response to YUB-YEC-1-56(a)).

The BESS will be designed to meet the following standards, which are industry best practices:

- 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

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

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

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 o Uncertainty regarding ability for BESS to deliver blackstart services from
- 18 that distance.
- 19 o 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.



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Engineering Report
Engineering Management
Utility Battery Feasibility Study Final Report - Phase 1

Appendix C

Noise Assessment Study

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Appendix C

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Project Report

July 10, 2020

Yukon Energy Utility Battery Feasibility Study

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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 m².

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 ⁽¹⁾	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	None Facility will be continuously operating during the daytime and nighttime
Class A1 Adjustment Seasonal adjustment for wintertime complaints	None Not to be used for design purposes
Class A2 Adjustment Ambient sound level adjustment	None No data suggesting higher ambient levels. Requires authority approval.
Class B Adjustment	None

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Adjustment to account for duration of activity	Facility will operate for more than 60 days continuously
Applicable PSL	Basic Sound Level + 0 dB

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 receptor 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
Layout A - 10 MW / 40 MWh						
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
Layout B - 13 MW / 40 MWh						
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
Layout C - 20 MW / 40 MWh						
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 6-1 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
Layout A - 10 MW / 40 MWh						
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
Layout B - 13 MW / 40 MWh						
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
Layout C - 20 MW / 40 MWh						
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
Layout A - 10 MW / 40 MWh						
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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Layout B - 13 MW / 40 MWh						
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*
Layout C - 20 MW / 40 MWh						
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 ¹	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 ¹	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

¹ 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 ¹	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 ¹	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

¹ 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



(a)



(b)

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 100m²
- ♦ 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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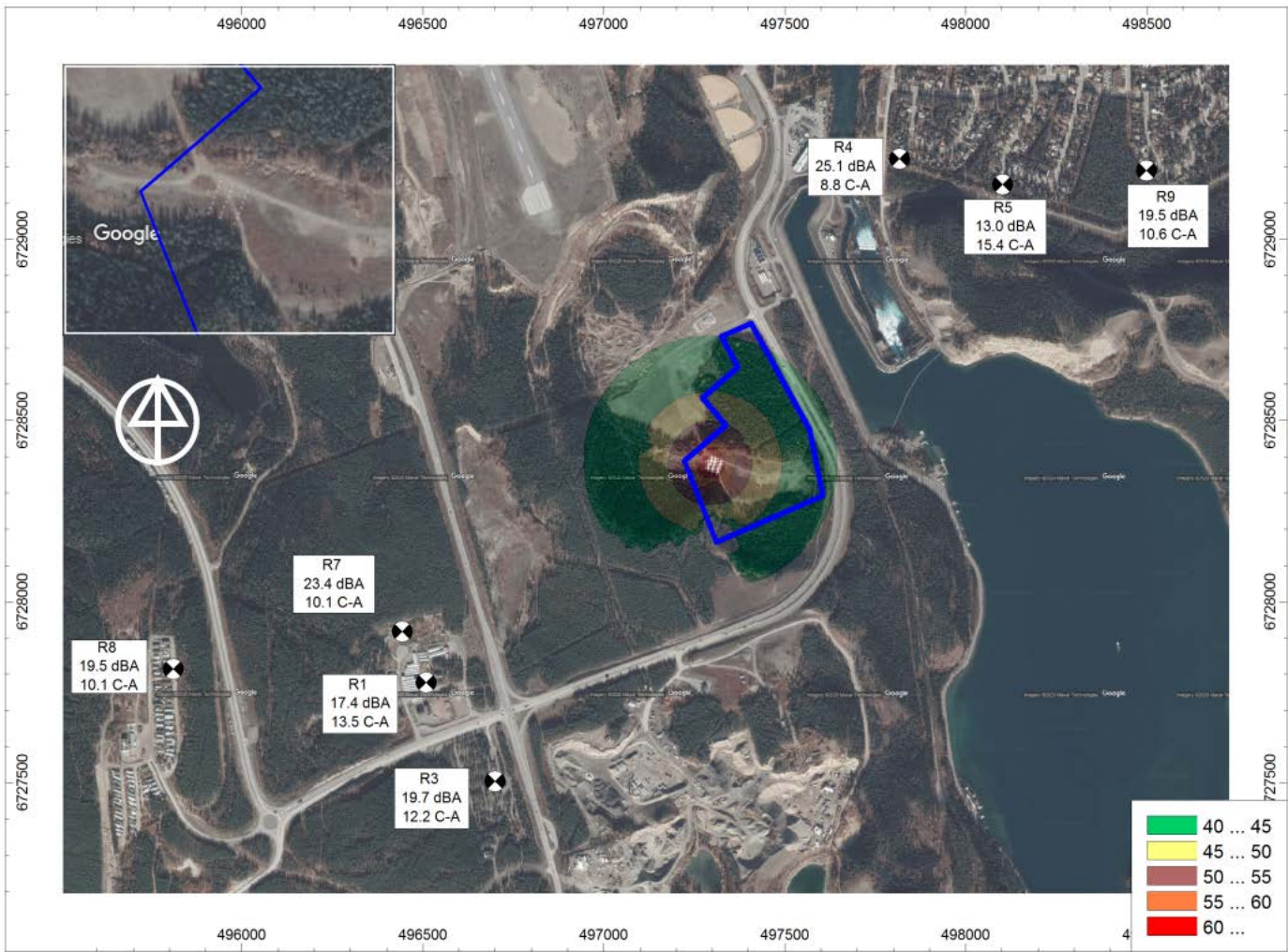
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Attachment(s)/Enclosure

Appendix A

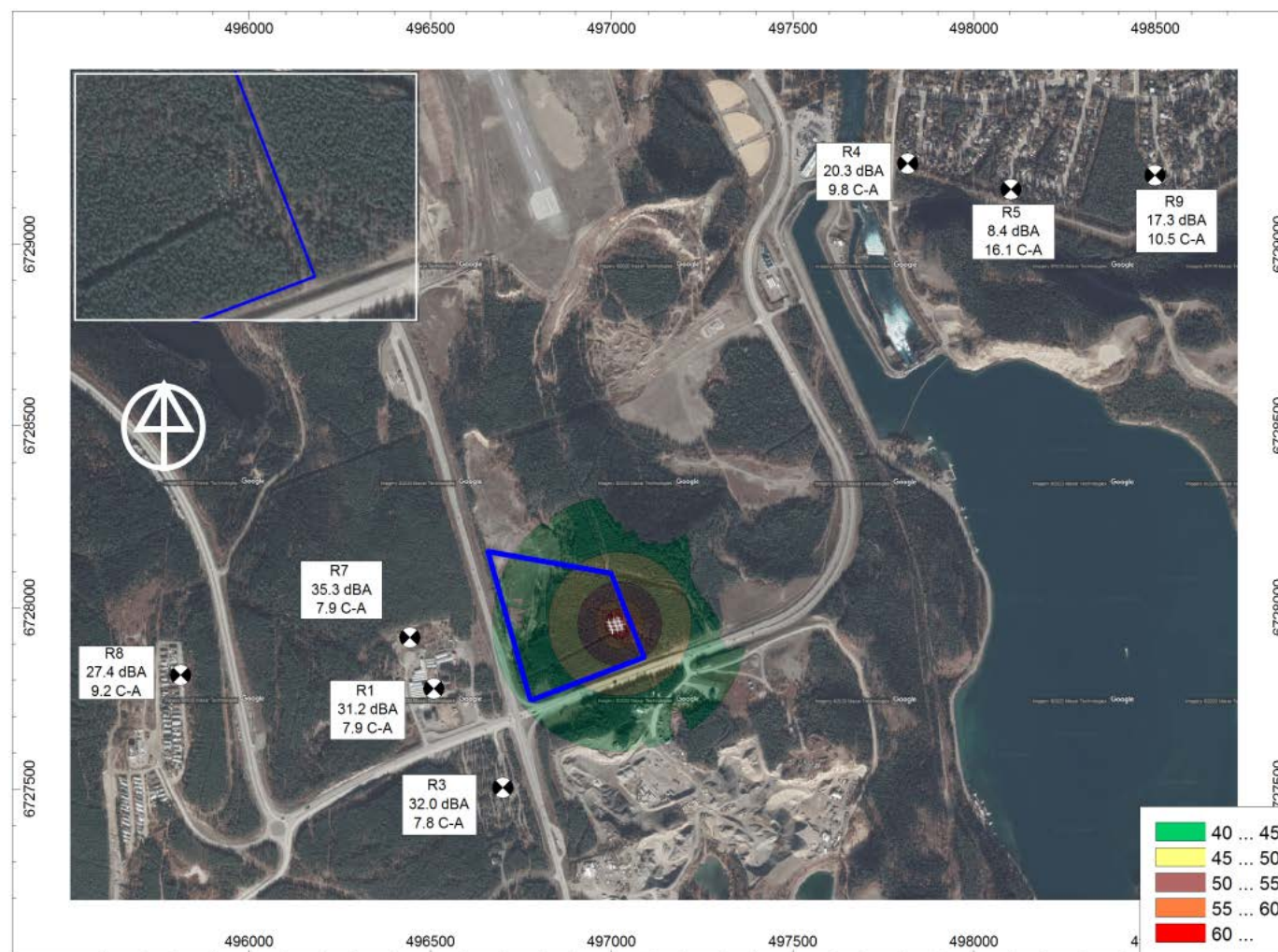
Noise Contour Plots

Layout A – 10 MW

TKC Site Near Whitehorse

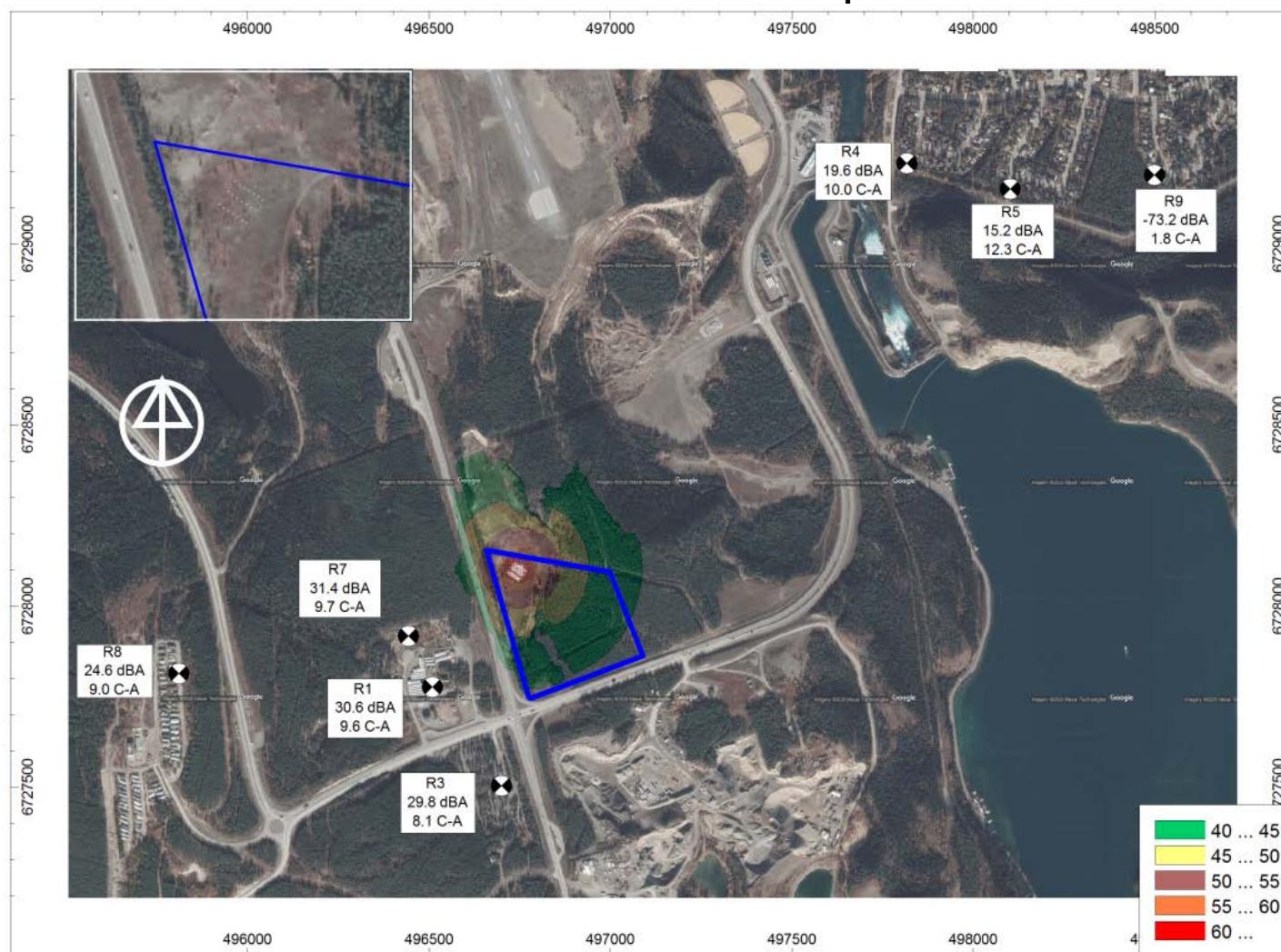


KDFN Site Near Whitehorse – Option 1

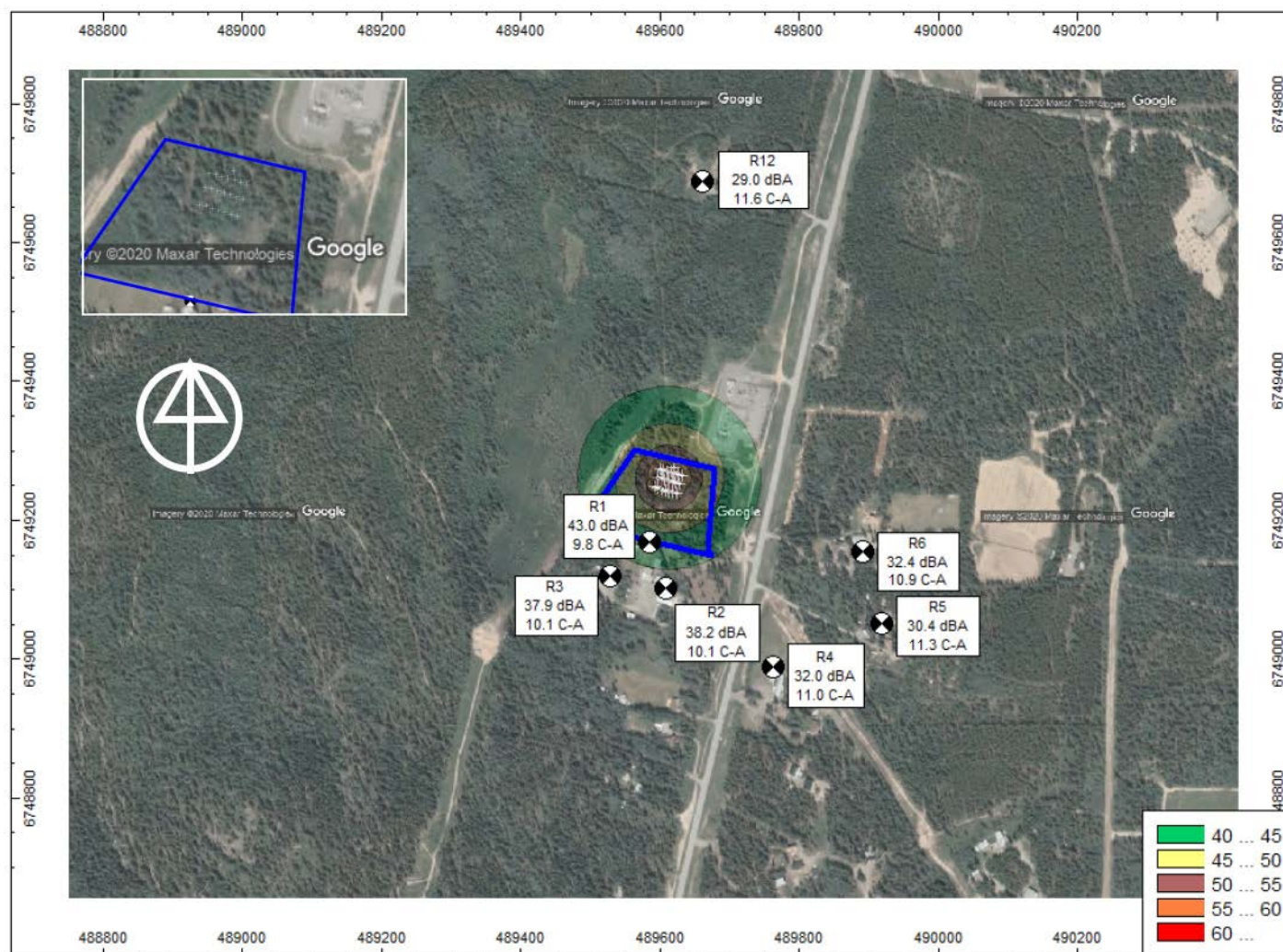


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Page A-2

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 LpA 68.0 dBA Based on NEMA TR1-1993 (R2000), Table 0-2, immersed power transformers
Estimated surface area 49.3 m² 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 ³
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]	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]	C3 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

Cutter-Hammer

Substation Transformers

15.0-5

Standard Features — Liquid-Filled Transformer

- ① Cover — welded to tank.
- ② Cooling tubes (Radiators).
- ③ Note: Radiator position and number of radiators will 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 (not connected), located in ANSI Segment 4.

Note: HV and LV bushings may be covered or uncovered for safety reasons.

- ⑧ Z-Bar flange.
- ⑨ Lifting lugs — two for lifting cover only.
- ⑩ Lifting hooks — four for lifting complete unit.
- ⑪ Ground pad — two total.
- ⑫ Drain valve — for connection lower filter press connection and complete drain with sampler.
- ⑬ Base (may be flat or formed).
- ⑭ Central cabinet for alarm lead termination.
- ⑮ Diagram instruction nameplate with warning nomenclature.
- ⑯ De-aerated tap changer with outlock provisions.
- ⑰ Liquid temperature indicator with maximum indicating band.
- ⑱ Upper valve for upper filter press connection.
- ⑲ Magnetic liquid level gauge.
- ⑳ Vacuum pressure gauge with air test and Suddens valve.

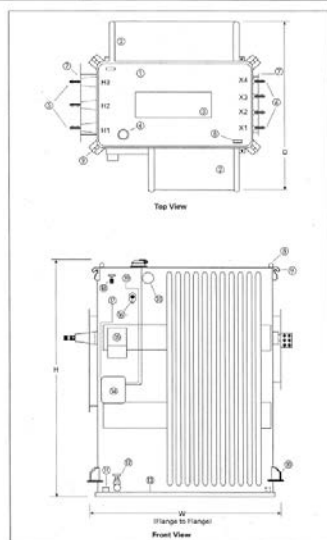


Figure 15.0-1, Liquid-Filled Primary Unit Substation Transformer with Well-Mounted HV and LV Bushings

Note: See Pages 15.0-6 and 15.0-7 for dimensions and weights.

Cutter-Hammer

Substation Transformers

15.0-7

Layout Dimensions

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 15.0-5, 65°C Rise, Oil-Filled HV 34500V, 250 BIL, LV 2400V, 45 BIL

kVA Rating	Weight (Lbs.)	Oil (Lbs.)	Dimensions in inches (mm)
			Height Width Depth
750	7000 (3178)	300 (1348)	115 (2921.0) 67 (1701.8) 66 (1676.4)
1000	7700 (3500)	350 (1524)	115 (2921.0) 67 (1701.8) 79 (2006.6)
1500	9800 (4446)	450 (2032)	115 (2921.0) 67 (1701.8) 88 (2238.2)
2000	11,300 (5130)	500 (2270)	115 (2921.0) 67 (1701.8) 112 (2844.8)
2500	12,800 (5804)	550 (2484)	115 (2921.0) 67 (1701.8) 132 (3352.8)
3000	13,700 (6247)	600 (2714)	115 (2921.0) 67 (1701.8) 132 (3352.8)
3750	16,200 (7388)	700 (3174)	115 (2921.0) 67 (1701.8) 136 (3454.4)
4500	19,700 (8940)	850 (3841)	115 (2921.0) 67 (1701.8) 138 (3505.2)
5500	25,200 (11,430)	1050 (4763)	115 (2921.0) 67 (1701.8) 138 (3505.2)
10,000	39,200 (17,838)	1400 (6350)	115 (2921.0) 67 (1701.8) 140 (3556.0)

Table 15.0-6, 65°C Rise, Oil-Filled HV 34500V, 250 BIL, LV 2400V, 45 BIL

kVA Rating	Weight (Lbs.)	Oil (Lbs.)	Dimensions in inches (mm)
			Height Width Depth
750	7200 (3262)	340 (1524)	115 (2921.0) 67 (1701.8) 67 (1701.8)
1000	8040 (3650)	380 (1701)	115 (2921.0) 67 (1701.8) 80 (2032.0)
1500	9800 (4446)	450 (2032)	115 (2921.0) 67 (1701.8) 84 (2133.6)
2000	11,700 (5312)	500 (2270)	115 (2921.0) 67 (1701.8) 116 (2948.8)
2500	13,100 (5954)	550 (2484)	115 (2921.0) 67 (1701.8) 136 (3454.4)
3000	14,400 (6530)	600 (2714)	115 (2921.0) 67 (1701.8) 136 (3454.4)
3750	16,200 (7388)	700 (3174)	115 (2921.0) 67 (1701.8) 136 (3454.4)
4500	19,700 (8940)	850 (3841)	115 (2921.0) 67 (1701.8) 138 (3505.2)
5500	25,200 (11,430)	1050 (4763)	115 (2921.0) 67 (1701.8) 138 (3505.2)
10,000	39,200 (17,838)	1400 (6350)	115 (2921.0) 67 (1701.8) 140 (3556.0)

Table 15.0-8, 65°C Rise, Oil-Filled HV 13800V, 95 BIL, LV 13800V, 95 BIL

kVA Rating	Weight (Lbs.)	Oil (Lbs.)	Dimensions in inches (mm)
			Height Width Depth
750	3110 (1408)	260 (1170)	115 (2921.0) 72 (1828.8) 70 (1778.0)
1000	3270 (1484)	280 (1270)	115 (2921.0) 72 (1828.8) 80 (2032.0)
1500	3700 (1680)	320 (1460)	115 (2921.0) 72 (1828.8) 90 (2286.0)
2000	4200 (1905)	360 (1626)	115 (2921.0) 72 (1828.8) 100 (2539.6)
2500	4700 (2130)	400 (1814)	115 (2921.0) 72 (1828.8) 110 (2793.2)
3000	5200 (2355)	440 (1991)	115 (2921.0) 72 (1828.8) 120 (3046.8)
3750	5900 (2675)	500 (2270)	115 (2921.0) 72 (1828.8) 130 (3299.6)
4500	6700 (3055)	560 (2526)	115 (2921.0) 72 (1828.8) 140 (3553.2)
5500	7600 (3425)	620 (2791)	115 (2921.0) 72 (1828.8) 150 (3806.8)
10,000	12,600 (5714)	1050 (4763)	115 (2921.0) 72 (1828.8) 150 (3806.8)

Notes: 1. Dimensions are APPROXIMATE. Refer to the transformer's outline drawing for actual dimensions for construction.

Table 15.0-9, 65°C Rise, Silicone-R-Temp/ROTTEMP-Filled HV 34500V, 45 BIL, LV 2400V, 45 BIL

kVA Rating	Weight (Lbs.)	Oil (Lbs.)	Dimensions in inches (mm)
			Height Width Depth
750	4900 (2228)	160 (726)	87 (2209.8) 68 (1727.2) 76 (1929.6)
1000	5300 (2400)	180 (816)	87 (2209.8) 68 (1727.2) 82 (2083.2)
1500	7000 (3178)	220 (989)	87 (2209.8) 68 (1727.2) 116 (2948.8)
2000	8270 (3740)	260 (1170)	87 (2209.8) 68 (1727.2) 127 (3217.2)
2500	9300 (4220)	300 (1360)	87 (2209.8) 68 (1727.2) 138 (3505.2)
3000	10,300 (4699)	340 (1550)	87 (2209.8) 68 (1727.2) 138 (3505.2)
3750	12,300 (5590)	400 (1814)	87 (2209.8) 68 (1727.2) 138 (3505.2)
4500	14,300 (6480)	460 (2079)	87 (2209.8) 68 (1727.2) 138 (3505.2)
5500	16,300 (7388)	520 (2343)	87 (2209.8) 68 (1727.2) 138 (3505.2)
10,000	26,300 (11,923)	800 (3630)	87 (2209.8) 68 (1727.2) 140 (3556.0)

Table 15.0-11, 65°C Rise, Silicone-R-Temp/ROTTEMP-Filled HV 13800V, 95 BIL, LV 13800V, 95 BIL

kVA Rating	Weight (Lbs.)	Oil (Lbs.)	Dimensions in inches (mm)
			Height Width Depth
750	5010 (2275)	160 (726)	87 (2209.8) 68 (1727.2) 76 (1929.6)
1000	5300 (2400)	180 (816)	87 (2209.8) 68 (1727.2) 82 (2083.2)
1500	7200 (3262)	220 (989)	87 (2209.8) 68 (1727.2) 116 (2948.8)
2000	8270 (3740)	260 (1170)	87 (2209.8) 68 (1727.2) 127 (3217.2)
2500	9300 (4220)	300 (1360)	87 (2209.8) 68 (1727.2) 138 (3505.2)
3000	10,300 (4699)	340 (1550)	87 (2209.8) 68 (1727.2) 138 (3505.2)
3750	12,300 (5590)	400 (1814)	87 (2209.8) 68 (1727.2) 138 (3505.2)
4500	14,300 (6480)	460 (2079)	87 (2209.8) 68 (1727.2) 138 (3505.2)
5500	16,300 (7388)	520 (2343)	87 (2209.8) 68 (1727.2) 138 (3505.2)
10,000	26,300 (11,923)	800 (3630)	87 (2209.8) 68 (1727.2) 140 (3556.0)

Table 15.0-12, 65°C Rise, Silicone-R-Temp/ROTTEMP-Filled HV 13800V, 95 BIL, LV 13800V, 95 BIL

kVA Rating	Weight (Lbs.)	Oil (Lbs.)	Dimensions in inches (mm)
			Height Width Depth
750	5300 (2400)	180 (816)	87 (2209.8) 68 (1727.2) 76 (1929.6)
1000	5700 (2585)	200 (907)	87 (2209.8) 68 (1727.2) 82 (2083.2)
1500	7800 (3536)	240 (1088)	87 (2209.8) 68 (1727.2) 116 (2948.8)
2000	9000 (4082)	280 (1269)	87 (2209.8) 68 (1727.2) 127 (3217.2)
2500	10,200 (4628)	320 (1450)	87 (2209.8) 68 (1727.2) 138 (3505.2)
3000	11,400 (5174)	360 (1631)	87 (2209.8) 68 (1727.2) 138 (3505.2)
3750	13,600 (6154)	420 (1905)	87 (2209.8) 68 (1727.2) 138 (3505.2)
4500	15,800 (7134)	480 (2179)	87 (2209.8) 68 (1727.2) 138 (3505.2)
5500	18,000 (8114)	540 (2453)	87 (2209.8) 68 (1727.2) 138 (3505.2)
10,000	28,000 (12,700)	840 (3806)	87 (2209.8) 68 (1727.2) 140 (3556.0)

Notes: 1. Dimensions are APPROXIMATE. Refer to the transformer's outline drawing for actual dimensions for construction.



Yukon Energy - Utility Battery Feasibility Study
Siting Noise Impact Study

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 m² 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 m³
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	C3 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

January 2003
Rev. No. 001

Substation Transformers

15.0-5

General Description

Standard Features —

Liquid-Filled Transformer

① Cover — welded to tank.

② Cooling tubes (Radiators).

Note: Radiator position and number of radiators will vary based on design.

③ Bolted handhole on cover.

④ Automatic resealing mechanical pressure relief device.

⑤ HV bushing, three total, located in ANSI Segment 2.

⑥ LV bushing, four total (two connected), located in ANSI Segment 4.

Note: HV and LV bushings may be cover mounted or right/left orientation may be reversed.

⑦ Z-Bar flange.

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 valves — for combination lower filter 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 nameplate.

⑯ On emergent tap changer with padlock provisions.

⑰ Liquid temperature indicator with maximum indicating band.

⑱ Upper valve for upper filter press connection.

⑲ Magnetic liquid level gauge.

⑳ Vacuum pressure gauge with air test and Soperdine valves.

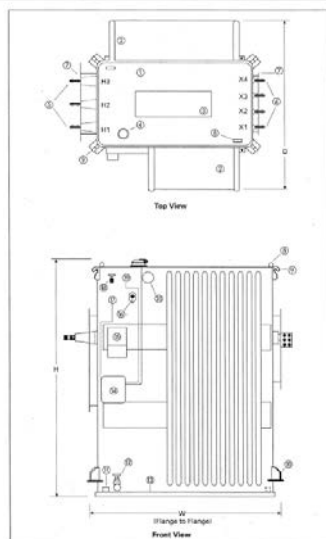


Figure 15.0-1. Liquid-Filled Primary Unit Substation Transformer with Wall Mounted HV and LV Bushings

Note: See Pages 15.0-6 and 15.0-7 for dimensions and weights.

E.T.N | Cutler-Hammer

January 2003
Rev. No. 001

Substation Transformers

15.0-7

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 34000, 200 BIL, LV 2400V, 45 BIL

HV 344000, 200 BBL HV 2400P, 45 BBL					
KVA Rating	Weight Lbs. (kg)	Gallons Liquid	Dimensions in Inches (mm)		
			Height	Width	Depth
750	7000 (3178)	320 (1249)	115 (2921.0)	67 (1701.8)	66 (1676.2)
1000	7700 (3500)	350 (1325)	115 (2921.0)	67 (1701.8)	66 (1676.2)
1500	8600 (3898)	380 (1438)	115 (2921.0)	69 (1752.6)	86 (2184.6)
2000	11,300 (5130)	410 (1552)	115 (2921.0)	71 (1803.4)	112 (2848.4)
2500	12,800 (5804)	450 (1702)	115 (2921.0)	71 (1803.4)	122 (3098.2)
3000	13,700 (6247)	460 (1740)	115 (2921.0)	71 (1803.4)	130 (3302)
3750	16,000 (7273)	520 (1968)	115 (2921.0)	86 (2184.6)	136 (3454)
5000	19,700 (8960)	600 (2284)	117 (2971.8)	103 (2643.0)	138 (3505)
7500	25,270 (11514)	1070 (4049)	126 (3243.6)	124 (3149.6)	66 (1676.2)

Table 15.0-8. 65°C Rise, Oil-Filled HV 34000, 200 BIL, LV 4100V, 60 BIL

VVA 34000, 380 HPL				
VVA 11500, 60 HPL				
VVA Rating	Weight (Lbs.)	Gallons (U.S.) Liquid	Dimensions in Inches (mm)	
			Height	Width Depth
750	7230 (3230)	340 (1287)	115 (2921)	67 (1727) 67 (1701)
1000	8040 (3650)	380 (1363)	115 (2921)	67 (1727) 67 (1701)
1500	8920 (4048)	390 (1476)	115 (2921)	67 (1752) 67 (1701)
2000	11,700 (5312)	430 (1628)	115 (2921)	71 (1803) 116 (2948)
2500	13,100 (5948)	460 (1740)	115 (2921)	73 (1854) 124 (3149)
3000	14,400 (6538)	500 (1892)	115 (2921)	76 (1930) 126 (3251)
3750	16,210 (7398)	540 (2044)	115 (2921)	77 (1955) 126 (3251)
5000	20,400 (9250)	610 (2284)	124 (3149)	95 (2413) 139 (3526)
7500	21,470 (14,287)	1190 (4402)	126 (3243)	136 (3454) 139 (3526)
10,000	26,290 (118,571)	1790 (6450)	126 (3243)	136 (3454) 145 (3683)

Table 15.0-9. 65°C Rise, Oil-Filled HV 34000, 200 BIL, LV 13800V, 95 BIL

VVA 13800, 95 RH					
VVA Rating	Weight Lbs. (kg)	Gallons (Liters) Liquid	Dimensions in inches (mm)		
			Height	Width	Depth
750	9110 (4136)	410 (1552)	115 (2921)	67 (1701)	66 (1676)
1000	9710 (4424)	450 (1702)	115 (2921)	67 (1701)	66 (1676)
1500	10,700 (4855)	470 (1779)	115 (2921)	67 (1701)	66 (1676)
2000	13,000 (5914)	510 (1928)	115 (2921)	67 (1701)	66 (1676)
2500	14,900 (6755)	550 (2080)	115 (2921)	67 (1701)	66 (1676)
3000	16,500 (7522)	590 (2232)	115 (2921)	67 (1701)	66 (1676)
3750	18,500 (8390)	640 (2424)	115 (2921)	77 (1955)	66 (1676)
5000	20,400 (9250)	710 (2687)	122 (3098)	67 (1701)	66 (1676)
7500	22,220 (10,082)	1060 (3992)	123 (3175)	67 (1701)	66 (1676)
10,000	26,290 (118,571)	1560 (5844)	124 (3149)	67 (1701)	66 (1676)
12,500	30,290 (137,838)	2160 (7928)	125 (3191)	67 (1701)	66 (1676)

Note: 1. Dimensions are APPROXIMATE. Refer to the transformer's outline drawing for actual dimensions for construction.

Table 15.0-10. 65°C Rise, Silicone/B-Temp/60TEMP-Filled HV 34000, 200 BIL, LV 2400V, 45 BIL

Silicones for Vibration/BIOTEMP Fixed					
HV 6900, 75 SIL					
LV 2400, 45 BIL					
VVA Rating	Weight Lbs. (kg)	Gallons (Liters) Liquid	Dimensions in Inches (mm)		
			Height	Width	Depth
750	4600 (2238)	160 (606)	67 (2209.8)	61 (2159.2)	76 (1626)
1000	5900 (2697)	180 (816)	67 (2209.8)	52 (2132.8)	82 (2236)
1500	7500 (3418)	220 (833)	67 (2209.8)	49 (1996.6)	86 (2236)
2000	9200 (4180)	250 (946)	67 (2209.8)	62 (2154.8)	107 (2717)
2500	10,700 (4855)	290 (1100)	67 (2209.8)	62 (2154.8)	119 (3024)
3000	12,300 (5579)	340 (1287)	67 (2209.8)	63 (2160.1)	121 (3073)
3750	14,540 (6601)	380 (1438)	67 (2209.8)	67 (1701.8)	123 (3098)
5000	18,220 (8283)	500 (1893)	68 (2489.2)	67 (1701.8)	123 (3098)

Table 15.0-11. 65°C Rise, Silicone/B-Temp/60TEMP-Filled HV 34000, 200 BIL, LV 4100V, 60 BIL

VVA 12000, 95 MIL					
VVA Rating	Weight (Lbs. (kg))	Gallons (Liters) Liquid	Dimensions in Inches (mm)		
			Height	Width	Depth
750	500 (227.5)	160 (606)	87 (2209.8)	48 (1219.2)	52 (1320.8)
1000	6090 (2765)	190 (681)	87 (2209.8)	53 (1346.2)	52 (1320.8)
1500	7730 (3509)	220 (832)	87 (2209.8)	56 (1397.8)	51 (1295.4)
2000	9270 (4208)	250 (946)	87 (2209.8)	59 (1496.6)	51 (1295.4)
2500	10710 (4867)	280 (1058)	87 (2209.8)	61 (1549.4)	51 (1295.4)
3000	12,300 (5583)	310 (1173)	87 (2209.8)	65 (1651.5)	51 (1295.4)
3750	14,380 (6529)	390 (1476)	87 (2209.8)	68 (1752.5)	51 (1295.4)
5000	18,300 (8300)	500 (1893)	97 (2483.8)	68 (1727.3)	52 (1309.8)
7500	22,300 (10,114)	610 (2284)	107 (2713.8)	67 (1701.3)	52 (1309.8)
10,000	26,390 (11,987)	710 (2687)	115 (2921.3)	67 (1701.3)	52 (1309.8)

Table 15.0-12. 65°C Rise, Silicone/B-Temp/60TEMP-Filled HV 34000, 200 BIL, LV 13800V, 95 BIL

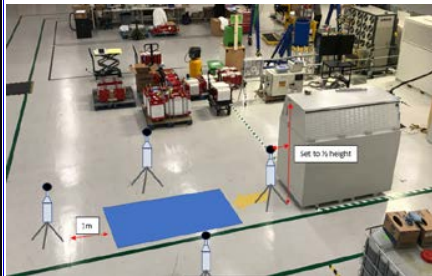
HY 141690, 95 GIL					
HY 141690, 95 GIL					
VVA Rating	Weight Lbs. (kg)	Gallons (Liters) Liquid	Dimensions in Inches (mm)		
			Height	Width	Depth
750	5340 (2424)	110 (417)	67 (2098)	45 (1142.6)	79 (2006)
1000	5820 (2652)	110 (417)	67 (2098)	45 (1142.6)	82 (2082)
1500	6470 (2942)	120 (454)	67 (2098)	50 (1270.2)	116 (2946)
2000	8032 (3778)	250 (946)	67 (2098)	63 (1600.8)	118 (2992)
2500	11100 (5040)	250 (946)	67 (2098)	64 (1625.6)	119 (3022)
3000	12,470 (5662)	310 (1173)	67 (2098)	66 (1676.4)	115 (2921)
3750	15,380 (6982)	360 (1363)	67 (2098)	68 (1727.2)	121 (3073)
5000	21,130 (9632)	420 (1588)	67 (2098)	69 (1752.2)	122 (3098)
7500	23,690 (10,744)	570 (2147)	66 (2489.2)	111 (987.9)	131 (3327)

Note: 1. Dimensions are APPROXIMATE. Refer to the transformer's outline drawing for actual dimensions for construction.

Yukon Energy - Utility Battery Feasibility Study
Siting Noise Impact Study

Estimated Frequency Spectra for Batteries

		Octave Band (dB)										OVL (dBA)	Notes
Battery Supplier	Metric	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)	
Calculations:													
Step 1: Select Saft Container battery - convert Lp to Lw													
Saft (20' container)	Lw (Sound Power)										79	216 Area Envelope of 216 m2 surrounding 20' container	
Step 2: Obtain a sample spectrum													
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			
Step 3: Shift Sample Spectrum to achieve overall LwA of Saft 20' Container													
Spectral Shift	dB										6	Spectral shift to LwA= 79.4 dBA	
Saft Container Lw Spectrum		81	80	74	85	77	70	63	57	49	79	Final Lw Spectra to use in Model	



Avalon 232 AFB3 DC Flow Battery Battery Acoustic Test Setup

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**

3 **REFERENCE: Application, Appendix B: Hatch Report, PDF pages 87 and 137**

5 **QUOTE: Application, PDF 137:**

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.”

20 **Application, PDF page 87:**

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.”

31 **QUESTION:**

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

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

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.

TOPIC: Primary Use Case: N-1 Capacity Reserve

REFERENCE: Application, Appendix B: Hatch Report, PDF page 94

QUOTE: “For the BESS to contribute to the capacity reserve, it needs to be able to reduce the peak demand during the day, and then be recharged overnight.”

QUESTION:

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

ANSWER:

(a)

Please refer to Table 6-1 (page 38) in the Hatch Report provided as Appendix B to the Application. The minimum recharging power is shown for each scenario. In all cases, the BESS can be recharged overnight at less than the firm capacity and within the allocated period. Accordingly, it is extremely likely, and expected, that the BESS can reduce peak 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

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

15 b) Are BESS savings strictly based on the alternative use of thermal generation to
16 provide operating reserve? Please explain.
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

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**

3 **REFERENCE:** **Application, Appendix B: Hatch Report, PDF page 137**

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.”

9 **QUESTION:**

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

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.

17 **ANSWER:**

19 **(a)**

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.

24 **(b)**

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.

TOPIC: Cost of Energy Used from the BESS

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

QUESTION:

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

ANSWER:

(a)

The full cost of energy used from the BESS is included in the economic analysis in section 4.3.2 and summarized in Table 4-3 of the Application. This analysis is a net present value calculation based on total net cost including the incremental cost of energy driven recharging the battery under various use scenarios.

Table 4-3 includes annual BESS capital costs, operating costs, and net recharging costs – as well as annual BESS savings for avoided diesel rental costs and displaced thermal fuel costs (diesel and LNG) from operating reserve use and peak shifting.

As highlighted in Table 4-3, the estimated benefits (savings) provided by the BESS relate almost entirely to two uses, each of which involve minimal BESS energy charging and discharging over each year:

1. **N-1 dependable capacity use**, which enables avoided diesel rental costs – the significant cost savings from this use involve the BESS simply being available when an N-1 event occurs (which is very infrequent, normally one event in 10 years), at which time recharging is likely to involve diesel generation. This use therefore involves minimal BESS energy charging and discharging over each year.

2. **Operating reserve use**, which enables avoided thermal generation costs – the significant cost savings from this use involve the BESS being available when an unplanned event occurs where generation trips or is insufficient (which is infrequent, estimated normally at one 30 minute event per month), at which time recharging is expected to involve hydro generation. The majority of this use case provision is expected to be met simply by the BESS being available on the system. This use therefore involves minimal BESS energy charging and discharging over each year.

3. **Peak shifting** is the third BESS use addressed in Table 4-3. The relatively small net cost savings from this use involve the BESS using LNG generation (75%) and hydro generation (25%) to displace diesel generation.

In summary, the impact of energy charging and discharging over each year is minor relative to the overall BESS economic feasibility.

In response to the specific focus of the question regarding use of hydro generation to recharge the BESS, relevant net ratepayer cost impacts are noted as follows:

- Hydro generation capital and most hydro generation operating costs are not affected by incremental generation required for the BESS. Short-term incremental costs related to added hydro generation for BESS recharging are estimated by YEC at 0.5 cents per kWh. [BESS operating reserve use is also expected to enhance the efficiency of hydro generation – but this benefit will be ignored for the purpose of responding to this question.]
- The 0.5 cents per kWh incremental hydro generation cost for BESS recharging would be augmented by efficiency losses related to BESS operation (15%) plus any related line losses required to move the hydro generation to the BESS (likely to be minimal [e.g., 1%] but could be higher [say 10%]), increasing the incremental hydro cost from 0.5 cents/kWh to between 0.58 cents/ kWh and 0.63 cents/ kWh.
- Table 4-3 includes incremental hydro generation costs and related efficiency losses related to BESS recharging; however, no attempt has been made in Table 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.