IN THE MATTER OF YUKON ENERGY CORPORATION APPLICATION UNDER PART 3 OF THE PUBLIC UTILITIES ACT FOR AN ENERGY PROJECT CERTIFICATE AND AN ENERGY OPERATION CERTIFICATE REGARDING THE BATTERY ENERGY STORAGE PROJECT

FINAL SUBMISSION

YUKON ENERGY CORPORATION

May 13, 2021

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YUKON ENERGY CORPORATION FINAL SUBMISSION

PREFACE

On December 17, 2020, the Commissioner in Executive Council designated the Battery Energy Storage Project (the Project) as a regulated project under Part 3 of the Public Utilities Act pursuant to OIC 2020/180; and on February 2, 2021, the Minister of Justice issued a letter to the Yukon Utilities Board (Board) referring the Battery Energy Storage System (BESS) Project of Yukon Energy Corporation (YEC) for review under Part 3 of the Public Utilities Act (the Act). The Minister attached terms of reference to review the Project and report back to the Minister by no later than May 17, 2021. The timing for the Board's report was extended to June 30, 2021.

The proposed BESS Project will provide 40 MWh of useful energy storage and 20 MW of inverter and transformer capacity. The containerized lithium ion battery energy storage system will be located on leased Kwanlin Dun First Nation (KDFN) settlement land situated near the interconnection of Robert Service Way and the Alaska Highway, on overlapping Traditional Territory of KDFN and Ta'an Kwach'an Council (TKC). The Project will include a 34.5 kV transmission line connecting the battery to Yukon Energy's transmission system at the Whitehorse Rapids facility.

The Board is to provide a report and recommendations on the potential benefits, costs, risks and customer impacts that influence whether the BESS Project should proceed as proposed by YEC, and any terms and conditions that the Board considers should apply.

In summary Part 3 of the terms of reference require the Board to address the necessity for the BESS Project, and its timing and design, with particular regard to:

- The public need for the BESS Project under various reasonable electric load forecasts, and the effect of the Project on customer rates and service reliability.

- The capability of existing and currently committed and expected generation and transmission facilities to meet the forecast load requirements and YEC's capacity planning criteria, and the effect of the BESS Project on this capability.

- The risks for the BESS Project and their potential impacts on rates for customers and on the reliability of electricity service provided to customers.

- What, if any, reasonable alternatives exist to the BESS Project, or alternative ways of undertaking the BESS Project.

- Impacts on YEC and ratepayers of the debenture investment opportunity that YEC is providing to TKC and KDFN.

- Whether it is prudent to build the BESS Project as proposed at this time.

Yukon Energy's submission is organized according to the above six subsections of part 3 of the Board's terms of reference. First, however, Yukon Energy addresses important context issues raised by the Board during the proceeding with regard to the current stage of Project development.

CONTEXT

Discussion at the oral hearing reviewed in detail the public need for the BESS, near term requirements, and the effect of the Project on rates for customers and reliability of electricity service to customers. Discussion at the oral hearing also reviewed potential concerns relating to existing Project cost information (e.g., +/- 30% class 4 cost estimate and the status and cost of final design, permitting and procurement).

To provide context for the Board's review – key factors relating to the Project's current stage of development are described below:

1. **Assessment based on current information:** Although uncertainties are to be expected at the time of a Part 3 review, it is important to note that the Board's review and recommendations must be based on currently available information. However, assuming the Project is built, the Board will have an opportunity to fully review final costs and the prudence of those costs when the Project is brought into rates.

   The issue was discussed by Mr. Hall at pages 347-49 of the transcript:

   > "And so what we've presented is, you know, a package of information based on the best available data we have, and we've presented, in our view, a business case that makes compelling sense for ratepayers. So I would postulate that that's the basis on which you make your recommendation to the government. I don't think anyone is expecting you to look into the future. And then I think we've pointed out several times that ultimately, as our regulator, when we come to bring the net ratepayer costs and apply to put them into rates, you have another opportunity to – to assess prudency based on actual costs."

2. **YEC Stagegate decisions still to be made for the Project:** YEC is following a stagegate decision process which manages Project risk and divides the Project into key decision making stages[1]. In this fashion the Project moves through initial design, environmental assessment, permitting and procurement, and then construction. YEC currently has approval from its board to complete the YESAB application and permitting, and to finalize battery procurement and the site construction contracts. Once this stage is

[1] The process was described by Mr. Hall at pages 290-92 of the transcript.

completed YEC will seek approval of its board to proceed to construction – presently expected to occur in August 2021.

At that time, YEC's board will review an updated budget based on RFP results along with the outcome of this Part 3 proceeding and initial permitting. YEC's board will then make a final investment decision. However, as noted by Mr. Hall "if there's a massive change in cost such that the project is no longer economic and no longer confers a benefit to ratepayers, our board will have an opportunity to cease further work at that time, at that stage gate decision point."

3. **Application provides conservative estimate of Project benefits:** As discussed on numerous occasions during the hearing, YEC has conservatively estimated the benefits of the Project. In addition, each of the benefits has been tested under a range of scenarios[2].

   This approach to the Application was noted by Mr. Mollard at page 348-49 of the transcript:

   > "we've estimated the benefits from this project fairly conservatively, we've sort of downgraded what could be the upside from this project quite a bit, and we've also provided some sensitivity analysis that the economics hold up over a pretty broad range. Based on the numbers, I think we had in one IR we said we could go up to 40 percent and it's still a benefit. So I would suggest that based on that we have proven economics at the level of the project costs as we've estimated them today, and we can take some pretty serious hits and it's still a good project."

1.0 PUBLIC NEED FOR THE BESS AND CUSTOMER BENEFITS

Part 3(a) of the terms of reference require the Board to review and report on "the public need for the BESS Project under various reasonable electric load forecasts, including near term requirements related to industrial and non-industrial loads, and the effect of the Project on the rates of customers and the reliability of electricity service provided to customers."

Public Need

The primary need for the BESS Project is to help meet Yukon Energy's dependable capacity requirements under the N-1 criterion for the Yukon Integrated System (YIS). As reviewed in section 2, forecasts related to non-industrial peak loads drive the requirement to permanently address the growing N-1 dependable capacity shortfall. Inability to supply the non-industrial peak winter demand presents an acute risk to both human health and safety, and public and private infrastructure.

[2] See for example Application pages 12-13 which notes the conservative assumptions used to calculate operating reserve use and thermal generation reduction benefits related to the Project, and the response to JM-YEC-1-33 and YUB-YEC-1-55 which assess Project benefits as outlined in Table 4-3 under a range of scenarios.

Section 4 of the Application (Project Justification) provides a detailed description of this public need for the Project under various reasonable electric load forecasts.

Section 4.2 of the Application notes that, under a "status quo" or "do nothing" alternative, YEC would continue in the near term to rely on rented diesel units. This requirement increases each year as non-industrial load growth increases peak load at the same time as dependable capacity is reduced with the planned diesel retirements.

Aside from added costs, reliance on rented diesel units can create risks relating to availability, acceptable performance levels and the ability of the system to accommodate non-permanent rental units. YEC must find a permanent solution to address these issues and the BESS helps by replacing four rented diesel units (7.2 MW) by the winter 2022/23.

As noted by Mr. Hall:

> "…the function of this project to add 7 megawatts of dependable capacity to our system, and that happens as of the time that the unit is available and commissioned. So that is certainly near term. And it allows us for that winter to, you know, eliminate or avoid the need to rent four mobile diesel generators. So, again, that talks about a very specific near-term benefit, which will then accrue every year after that in terms of avoiding that need to rent those four diesel units. So I think the near-term requirement in terms of the capacity gap we have, and also the ability of the project starting in Year 1 to help address that problem has been addressed very clearly." [3]
>
> …"[t]he N-1 criteria defines a need that we have to meet. Namely, that we have a capacity shortfall, and as I outlined in my opening oral statements today, we meet that need through mobile rental generators, but as the utility, we're always looking for permanent solutions that are more reliable or can confer a ratepayer benefit."[4]

Ratepayer cost saving benefits

The Project will reduce ratepayer costs compared to rented diesels or any other option to provide the same required dependable capacity, with the following unique features contributing to ratepayer savings:

- A $16.5 million federal grant, which reduces the estimated capital cost (2020$) to $15.2 million;
- Displacement of diesel rental costs (or similar fixed capital and non-fuel O&M costs for any other thermal option considered);
- Operating reserve use savings from the battery displacing thermal generation driven by the current requirements to use hydro for operating reserve [5]; and

[3] Transcript page 116, lines 5-22.

[4] Transcript page 154.

[5] Operating reserve use was discussed in detail at transcript pages 48-52 (operating reserve use and ratepayer benefits and basis for 2/3 reduction from Hatch report calculation in Application); page 154-55 (weighting operating reserve and

- Fuel cost savings from battery use for diesel peak-shifting.

The annual ratepayer costs and savings from the BESS compared to the diesel rental option are reviewed in detail over the Project's 20-year life in Table 4-3 of the Application (provided as Table 1 below). Net ratepayer savings occur each year with BESS, with $12.7 million net present value (NPV) ratepayer savings over the BESS 20-year life.

Table 1: Annual Ratepayer Impacts from BESS (20 MW/ 40 MWh)
[Table 4-3 from the Application]

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

During the oral hearing it was noted that effects on rates of customers are addressed at the overall revenue requirement impact level (changes to overall customer rates) and not at the level of specific customer rates or bills.

N-1); page 252-54 (explanation regarding how operating reserve works); page 256 (how operating reserve provides thermal savings benefits); 257-58 (data used to calculate operating reserve clarified by YEC and Hatch); page 260-63 (differences in total operating reserve benefits in Hatch report and in Application explained).

In that regard Mr. Mollard noted[6]:

> "So what this table is fundamentally trying to show is ultimately what does it mean to ratepayers from these two alternative approaches: our baseline approach being rental diesels and the option to install the BESS Project".

Mr. Mollard clarified that Table 4-3 is:

> "not providing what the effect of doing this project will be on an individual ratepayer's bill, but this gives the same answer in the sense that it provides the board with the effect on an annual basis of what the revenue requirement, which becomes rates, is for the company. And so at the end of the day we show that executing on this project provides a net benefit to ratepayers of some $12.7 million."

The ratepayer savings estimate in Table 1 excludes any additional thermal fuel cost saving benefits from improved hydro unit efficiency, non-fuel thermal O&M cost savings, or updated thermal fuel prices. Further, to demonstrate the robustness of the Project sensitivities were provided in response to JM-YEC-1-33 using different fuel costs (March 2021) and capital costs (plus or minus 30% of estimated Project costs). In each case ratepayer benefits were demonstrated.[7]

It is also important to note that the estimated ratepayer savings do not include any customer or YEC savings resulting from other secondary BESS uses not included in Table 1 (e.g., improved reliability benefits).

Electricity service reliability benefits to customers

Reliability benefits of implementing the BESS compared to diesel options are reviewed at transcript pages 356-57 where YEC witnesses describe the reliability advantages provided to YEC and customers by the battery as compared to reliance on diesel units.[8] These reliability benefits from BESS will reduce the impact of outages on customers, improve overall reliability of service, and enhance the capability of the YIS to integrate new Independent Power Producer (IPP) renewable generation that is currently planned to be connected in the next few years.

The Application at Section 3.1.2.2 and YEC's Opening Statement (Exhibit B-5, page 4) review BESS ability to provide added benefits beyond N-1 dependable capacity, including increasing renewable energy by providing operating reserve, enhanced blackstart capability, diesel peak shifting, and load shedding reduction/ frequency regulation that can assist integration of future additional intermittent renewables currently planned with the SOP.[9]

[6] Transcript, pages 294-295.

[7] Additional discussion of the ratepayer benefits as outlined in Table 4-3 was provided at transcript pages 240 (which confirmed the net annual ratepayer saving commencing the first year of the Project).

[8] See also YUB-YEC-1-36 which reviews different reliability features and how a diesel unit would compare to BESS.

[9] Transcript page 62-63 (integration of wind); page 113-14 (voltage regulation); page 123 (reliability compared to diesel rentals); page 163-65 (positive impact of BESS on power quality); page 179-80 (enhanced blackstart capability); page 38-47, and 145-46 (peak shifting).

For example, the 20 MW BESS Project inverter size significantly increases the size of the load segments that can be picked up during the blackstart process, which reduces the time required for grid restoration (see YUB-YEC-1-2). The 20 MW sizing can also cover the loss of Whitehorse Hydro Unit #4 (preventing critical grid outages) and will provide greater operational flexibility to accommodate future changes in the configuration and operational needs of the grid as more intermittent renewable resource options come online.

2.0 CAPABILITY OF EXISTING FACILITIES & EFFECT OF BESS

Part 3(b) of the terms of reference require the Board to review and report on the "capability of existing and currently committed and expected generation and transmission facilities including thermal generation facilities to provide reliable electric power generation to meet the forecast load requirements and YEC's capacity planning criteria, and the effect of the BESS Project on this capability."[10]

The BESS uses outlined in the Application to enhance the supply of reliable electric power generation include added dependable capacity to meet the N-1 capacity planning criterion, operating reserve use to reduce thermal generation, and several additional secondary uses that provide reliability benefits. Existing system capabilities and effects of the BESS are reviewed below for each of these uses, confirming how the Project provides benefits through reducing ratepayer costs and improving reliability of electricity service.

N-1 Capacity Planning Criterion

The Application outlines the current material and growing dependable capacity gap under the N-1 capacity planning criterion; as well as YEC's current plans to address that shortfall using both renewable and thermal capacity over a 20 year planning period (to 2041-42).[11]

Section 4.1.1 of the Application reviews the existing YIS grid context and the requirement for YEC to plan its system to meet the long-standing N-1 single contingency dependable capacity planning criterion initially established by YEC in 2005. Under the N-1 criterion the YIS must have enough dependable capacity to supply the forecast non-industrial peak winter demand under the largest single contingency.[12] Inability to supply the non-industrial peak winter demand --

[10] Mr. Hall at Transcript page 121, lines 7-18 helped to define this requirement as follows: "Mr. Chair, in terms of looking at the wording of this clause (b), particularly, the final sentence around the effect of the BESS Project on this capability, my interpretation of that is that, when they talk about capability, it's the capability in general of our existing and, you know, committed assets to provide reliable power generation. So it's not -- it's about everything together, how do we meet the future load. And, again, we've argued and presented clearly that the battery is a key part of that portfolio to close that capacity gap, that, if anything, is expected to increase over time."

[11] Application Section 3.1.1 (Existing Facilities and Project Components) provides details of the existing YIS facilities. Section 4.1 (Yukon Grid Context) reviews the Yukon grid context (Section 4.1.1), evolving grid load conditions (Section 4.1.2), and forecast new grid capacity required for the YIS (Section 4.1.3). Table 4-1 and Figure 4-1 (at page 28 of the Application) provide the 2021-2030 forecast non-industrial peak load and the forecast dependable capacity excluding mobile rented diesel units. This includes planned implementation of the renewable capacity supply options as illustrated in Table 4-1 and Figure 4-2.

[12] The current N-1 or largest single contingency is the loss of the 37 MW Aishihik Generation Station, either through an outage of the generating station itself or an outage of the L171 transmission line that interconnects generating station.

expected to occur during a period of the coldest winter temperatures -- presents an acute risk to both human health and safety, and public and private infrastructure.[13]

The current N-1 is loss of the 37 MW Aishihik Generating Station. Although an N-1 event is not expected to occur frequently – say once per decade – an isolated grid like the YIS must carry sufficient dependable capacity to adequately supply non-industrial loads during such an event.

In describing the BESS Project effects on the existing capability of the system, the following was noted by Mr. Hall:[14]

> "…it's important to note that the battery brings – adds capacity at all times of year, not just during the winter, but that when we look at our planning, the winter period is where our needs become most acute. And so if we look at the ability to meet system peaks, those peaks occur during the winter. So we have a winter peaking system because it's a cold weather environment, so the winter is the period where the system is most pushed to meet its -- the needs of Yukoners."

The N-1 capacity planning criterion focuses only on non-industrial load because all major industrial customers maintain sufficient on-site generation for their own emergency purposes.[15]

Existing and Forecast Facility Capabilities re: N-1 Capacity Requirements

The renewable and thermal capacity options identified in the Application are all needed to remove reliance on rented diesels in order to address the currently existing and ongoing forecast capacity shortfall. This is reviewed in Table 4-1 and Figure 4-1 of the Application (copied below as Figure 1 and Table 2).

Table 2 and Figure 1 show that YEC has a material and growing shortfall in its installed dependable capacity relative to the N-1 capacity requirement. This growing shortfall reflects ongoing growth in non-industrial winter peak demand, including continued growth in electric space heating and forecast emerging Electric Vehicle (EV) peak demand load. Until new permanent resource solutions can be implemented, rented diesels are being relied on to meet this growing N-1 dependable capacity shortfall.

YEC's 2021 GRA shows this forecast N-1 capacity shortfall at 26.4 MW for 2021/22, requiring 15 diesel rental units (plus two spares). Without new resources, YEC's 10-Year Renewable Electricity Plan forecast shows this shortfall increasing to 47.39 MW in 2025/26 and 69.0 MW in 2030/31.

[13] The importance of the N-1 criterion was also explained during the oral hearing at Transcript Page 123, lines 7-12, "the N-1 speaks to the capability of the system to meet peak load during the coldest winter days if we lose our largest generator, which is the Aishihik facility or the transmission that connects it to Whitehorse. So that's what's called the 'N-1 planning criterion."

[14] Page 122, lines 1-18.

[15] As reviewed in section 2.4 of YEC's 2021 GRA, YEC's capacity planning criteria includes provision not to exceed a Loss of Load Expectation (LOLE) of 2 hours per year. The LOLE criterion includes industrial loads as part of the assessment. The N-1 criterion to date has been the criterion setting requirements for new dependable capacity on the YIS.

Figure 1: Non-Industrial Peak & Dependable Capacity under N-1 Capacity Planning Criterion: 2021/22-2041/42 Winter [Figure 4-1 from the Application]

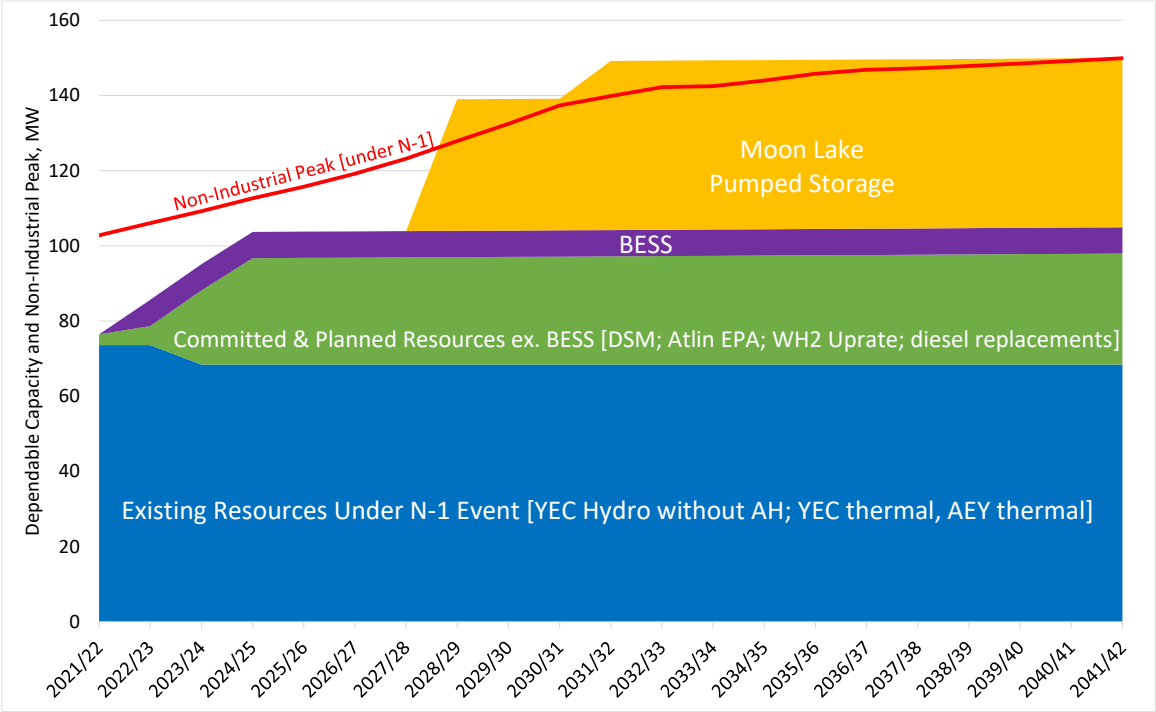

Table 2: Forecast Non-Industrial Peak and Dependable Capacity under N-1 Capacity Planning Criterion: 2021/22-2030/31 Winter (kW) [Table 4-1 from the Application]

	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	2028/29	2029/30	2030/31
Non-industrial Peak	**104,102**	**107,372**	**110,546**	**113,952**	**117,030**	**120,515**	**124,517**	**129,214**	**133,769**	**138,676**
Non-industrial Peak	*103,284*	*106,277*	*109,078*	*111,985*	*114,393*	*116,982*	*119,783*	*122,870*	*125,268*	*127,285*
EV Peak	*818*	*1,096*	*1,468*	*1,968*	*2,637*	*3,533*	*4,734*	*6,344*	*8,501*	*11,391*
Existing Resource Dependable Capacity	**112,100**	**112,100**	**106,900**	**106,900**	**106,900**	**106,900**	**106,900**	**106,900**	**106,900**	**106,900**
YEC Hydro	*70,500*	*70,500*	*70,500*	*70,500*	*70,500*	*70,500*	*70,500*	*70,500*	*70,500*	*70,500*
YEC Thermal	*36,050*	*36,050*	*30,850*	*30,850*	*30,850*	*30,850*	*30,850*	*30,850*	*30,850*	*30,850*
AEY Thermal	*5,550*	*5,550*	*5,550*	*5,550*	*5,550*	*5,550*	*5,550*	*5,550*	*5,550*	*5,550*
N-1 Event [Lost of AH GS or L171]	**-37,195**	**-37,194**	**-37,193**	**-37,192**	**-37,191**	**-37,190**	**-37,189**	**-37,188**	**-37,187**	**-37,186**
Loss of AH GS	*-37,000*	*-37,000*	*-37,000*	*-37,000*	*-37,000*	*-37,000*	*-37,000*	*-37,000*	*-37,000*	*-37,000*
Loss of AEY Haines Junction diesel	*-1,500*	*-1,500*	*-1,500*	*-1,500*	*-1,500*	*-1,500*	*-1,500*	*-1,500*	*-1,500*	*-1,500*
Haines Junction peak	*1,305*	*1,306*	*1,307*	*1,308*	*1,309*	*1,310*	*1,311*	*1,312*	*1,313*	*1,314*
Capacity Shortfall/Surplus under N-1	**-29,197**	**-32,466**	**-40,839**	**-44,244**	**-47,321**	**-50,805**	**-54,806**	**-59,502**	**-64,056**	**-68,962**
Committed and Planned Supply Options	**2,843**	**12,047**	**26,752**	**35,318**	**35,385**	**35,452**	**35,521**	**70,589**	**70,659**	**70,729**
Diesel Replacements	*0*	*0*	*12,500*	*12,500*	*12,500*	*12,500*	*12,500*	*12,500*	*12,500*	*12,500*
Whitehorse #2 Uprate	*638*	*638*	*638*	*638*	*638*	*638*	*638*	*638*	*638*	*638*
BESS	*0*	*7,000*	*7,000*	*7,000*	*7,000*	*7,000*	*7,000*	*7,000*	*7,000*	*7,000*
Atlin Hydro EPA	*0*	*0*	*0*	*8,500*	*8,500*	*8,500*	*8,500*	*8,500*	*8,500*	*8,500*
DSM	*2,205*	*4,409*	*6,614*	*6,680*	*6,747*	*6,814*	*6,883*	*6,951*	*7,021*	*7,091*
Moon Lake Pump Storage Phase 1	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*35,000*	*35,000*	*35,000*
Capacity Shortfall/Surplus under N-1	**-26,355**	**-20,419**	**-14,087**	**-8,926**	**-11,936**	**-15,352**	**-19,285**	**11,087**	**6,603**	**1,767**

Existing and Forecast Facility Capabilities re: Operating Reserve

Operating reserve accommodates variations in the load and will in many instances cover the loss of a generator. This is an essential requirement for reliable operation of the YIS. With the existing facilities, operating reserve is achieved by operating a hydro generator below its maximum capacity, to allow its output to be increased quickly, if required. In order to secure this operating reserve with existing facilities, thermal generation is typically required to supply ongoing load requirements not supplied by the hydro generators that are operating below maximum capacity.[16]

The benefits of the BESS being used for operating reserve when excess water is available are two-fold relative to existing or future thermal generation options:

- A direct reduction in diesel and LNG 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.

Table 1 of this submission demonstrates that BESS will provide economic benefits beyond displacing the need for four rented diesels. The use of BESS for operating reserve is conservatively estimated to provide NPV ratepayer cost savings of $17.6 million over the 20-year BESS Project life. This estimate is conservative because it only assumes one-third of the Hatch report estimated thermal fuel generation and it does not include any non-fuel O&M cost savings or any benefits for improved hydro unit efficiency. It also uses lower fuel prices from mid-2020.

BESS use for operating reserve is completely compatible with BESS helping to meet the N-1 dependable capacity criterion:

- Both require BESS to retain storage for use in an outage event involving different time periods[17]; and
- Both have minimal impact on battery life.[18]

The use of BESS for operating reserve was discussed in detail in the transcript and in answer to various IRs:

- In the transcript at the following pages:
  - Pages 48-52 (ratepayer benefits and basis for 2/3 reduction from Hatch report calculation in Application);
  - Pages 154-55 (operating reserve and N-1);

[16] Application Section 3.1.2.2, pages 10-13, reviews existing operating reserve and BESS effects with operating reserve use. Existing operating reserve is also addressed in YUB-YEC-1-2(c), YUB-YEC-1-36, JM-YEC-1-13 and YUB-YEC-1-20(a to c). BESS use for operating reserve is also addressed in YUB-YEC-1-66(a to c), YUB-YEC-1-51(b), YUB-YEC-1-49.

[17] Prime requirement for N-1 dependable capacity is for an N-1 event during the coldest period of winter – a time when BESS use for operating reserve has minimal benefit to provide net thermal generation reduction.

[18] See Table 3-1 in Application. Estimate of one 30 minute operating reserve event per month, and one two week N-1 event every 10 years.

- Pages 252-54 (how operating reserve works);
- Page 256 (how operating reserve provides thermal savings benefits);
- Pages 257-58 (data used to calculate operating reserve);
- Pages 260-63 (differences in operating reserve benefits estimated by Hatch and YEC)

- In the following IRs:
  - YUB-YEC-1-51 (BESS operating reserve use cost savings);
  - YUB-YEC-1-65(a) (BESS impact in high water years);
  - YUB-YEC-1-20(d)(BESS hydro efficiency improvement benefits);
  - JM-YEC-1-20 and JM-YEC-1-33 (updated diesel and LNG fuel prices);
  - JM-YEC-1-32 (estimates of the variable non-fuel O&M savings per kWh of diesel generation avoided).

Existing and Forecast Facility Capabilities re: Other Reliability Requirements

The analysis of existing and forecast facilities to provide reliable generation to meet forecast load requirements must also include an analysis of the system's capabilities to deal with blackstart events and renewable generation integration along with its ability to regulate frequency and to prevent "load shedding events".

The BESS offers distinctive reliability features compared with existing generation facilities. As reviewed in YEC's Opening Statement (Exhibit B-5), BESS will provide added reliability benefits for customers well beyond the ratepayer cost savings.

> Other reliability benefits provided by BESS include rapid blackstart and outage restoration capability, grid reliability and ancillary services (including frequency regulation, coverage of large generation unit outages, prevention of "load shedding" events, and renewable integration), load loss stabilization, and reactive power support. Rented or permanent thermal generation options to provide N-1 capacity reserve cannot provide these same additional benefits. Although YEC cannot easily quantify the additional ratepayer cost savings related to these added reliability benefits, they will reduce the impact of outages on customers, improve overall reliability of service, and enhance the capability of the YIS to integrate new Independent Power Producer (IPP) renewable generation that is currently planned to be connected in the next few years.

Existing and Forecast Facility Capabilities re: Reduction of Fossil Fuel Generation

In response to recent Federal and Territorial policies mandating reduction in greenhouse gas emissions, Yukon Energy is placing a high priority on new projects such as the BESS that can address the YIS dependable capacity requirements without increasing its reliance on new fossil fuel thermal generation or rented diesel units.

Further, in addition to being consistent with government policy the proposed BESS Project also complements Yukon Energy's 10-year plan to reduce where feasible reliance on fossil fuel generation through renewable IPP energy generation and uprates to existing hydro units, as well as the development of the Atlin Hydro, and Moon Lake Pumped Storage projects.

3.0 RISKS FOR THE BESS PROJECT & IMPACTS ON RATES AND RELIABILITY

Part 3(c) of the terms of reference require the Board to review and report on "the risks for the BESS Project and their potential impacts on rates for customers and on the reliability of electricity service provided to customers."

It is important to recognize the Project's current stage of development when assessing Project risks and uncertainties. Today's assessment must be based on existing information, taking into account that YEC's stagegate final decisions on the Project are still to be made.

BESS Project risks have been discussed mainly with regard to technical factors (e.g., the battery technology risk in northern climate), regulatory approvals and timelines, ratepayer cost (mainly in relation to Project capital cost risks), and BESS operating capabilities.

The following discussion outlines how each of these risk areas is effectively being managed.

3.1 TECHNICAL RISKS

The Board previously raised concern regarding the operating experience of batteries in northern climates (Board Order 2018-10). The evidence provided in the Application, IR responses and in YEC panel's testimony confirms that there is extensive operating experience in northern climates and minimal risk related to implementation of this technology in Yukon.

- Application Section 4.2.2 (page 32) notes the BESS Project will use similar technology currently in use in Northern Quebec, the Northwest Territories, and Alaska. The evidence demonstrates that lithium ion is a proven, safe technology for use in northern climates.

- Extensive discussion regarding northern operating experience was provided during the oral hearing. Specifically at page 77 (examples provided from Quebec and NWT); pages 140-142 ("different functions, depending on the needs of the local grid");[19] and at page 318 (describing Hatch's extensive experience with northern battery projects).[20]

- On the specific issue of battery sizing related to northern climate experience, Ms. Zuliani of Hatch at pages 358-59 indicated that due to the nature of the technology being used, the size of the system does not impact its ability to operate in the arctic, "we would note

[19] Transcript page 141 "So the Quaqtaq project is 600 kilowatts/600 kilowatt-hours; the Raglan Mine project is 3 megawatts/1.5 megawatt-hours; the Colville Lake project is 200 kilowatts; the Kotzebue project is 1.2 megawatts/950 kilowatt-hours; and the Cordova project is 1 megawatt/1 megawatt-hour."

[20] Ms. Zuliani notes "But, I mean, Hatch has worked on the Raglan Mine project. We're currently working on the Inuvik microgrid. We're working with a remote mine in the Northwest Territories on a battery project and a remote First Nation as well looking to develop a battery project, all in the Northern Quebec and the territories. As well we're working with Hydro-Quebec, as they explore development of batteries in the Nunavut region for some of the remote First Nations there."

that the technology is relatively similar, as they are containerized systems, so we expect a similar design in the system at 1 megawatt scale as is the 20 megawatt scale."[21]

- 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.[22] Further, implementation risks will be reduced by the use of containers with insulated walls and roof, and typically with HVAC systems on container walls to control climate within the container, rather than a designed building.[23]

No specific technical risks about the selected BESS lithium ion technology have been raised beyond seeking confirmation of operating experience in Canada's northern climate.

The BESS as planned will provide useful capacity of 40 MWh for 20 years.[24] Based on the proposed BESS uses, Hatch concluded that there is not significant risk of accelerated battery degradation, and that it is reasonable that the BESS will have a lifespan of 20 years with a modest initial overbuild or capacity augmentation.[25] Based on the proposed battery uses, cycle related capacity fade over 20 years for the BESS is estimated at between only 7-8% (typical use) and 13-15% (worst case use) - and the prime economic benefit uses (N-1 events, operating reserve and peak shifting) account for only 13% (typical use) and 24% (worst case use) of estimated annual throughput for the BESS.[26] The costs presented in the Application provide for a 20% initial overbuild, i.e., 48 MWh initial installed capacity. Through its procurement process, YEC will work with vendors to assess options for ensuring end-of-life capacity.

Operating costs for the BESS Project also include provision for preventive maintenance, based on qualified vendor site visits and an allocation for parts.[27]

At the hearing questions were raised regarding frequency control and power quality effects of the BESS while operating on the grid. Ms. Milojevic confirmed that the BESS is expected to improve any potential power quality issues on the grid given the services it provides.[28]

[21] Ms. Zuliani notes, "So, in my experience and in my opinion, these are quite similar in that they are the same basic technology. We have lithium ion batteries in modules in racks in a steel container which is insulated and has a heating system and cooling system. Whether we have 10 containers or one container they're all based on the operating principle, the same working principle, and the same design. So having a larger system does not necessarily change the ability to operate in the Arctic compared to these other examples."

[22] Application, Section 4.2.2 (page 32).

[23] See Hatch Report, section 4 for more detailed review of technical design and risk management related to lithium ion batteries and section 10 regarding modular containerized installation versus building installation.

[24] Application, page 5.

[25] Application Appendix B (Hatch Report), Section 8.1, pages B.1 pages B-74.83-85.

[26] Application, Section 3.1.2 and Table 3-1.

[27] See Application, pages 16-17 and Table 3-5; Ms. Zuliani describes annual operating and maintenance costs at transcript page 249, "So, again, this is based on Hatch's internal information based on other projects and from vendors. Typically with these projects vendors do engage in a site preventative maintenance visit once or twice a year. As allocated -- explained in the note, we did allocate a cost for technicians to come to site, as well as an allocation for parts. Batteries tend to be a relatively low maintenance item, there's not a lot of replacement parts."

[28] Transcript pages 163 to 165.

3.2 REGULATORY RISKS

Due to the nature of the Project YEC does not anticipate material design modifications resulting from the regulatory approvals and review process for this specific Project. No special added costs are expected to comply with approvals and permits required for the Project to proceed. Further, the key terms for the lease agreement with KDFN have been resolved.

More specifically, the Project will be located on a greenfield site on land zoned for utility use and within an existing environmental and socio-economic setting that has seen commercial and industrial development activities over a sustained period of time. Most of the proposed 1.7 km transmission line connecting the Project to YEC's LNG plant will follow a pre-existing trail and cutline.

A public engagement process was undertaken by YEC (as detailed in YUB-YEC-1-46(a) Attachment 1) in September 2020 and identified public concerns were taken into consideration in site selection and will also inform Project engineering and design, where appropriate. See discussion provided in the Application at Section 3.4 (Summary of Environmental and Socio-economic Impacts); Section 5.0 (Consultation); Section 5.1 (YESAB Process); and Section 6.2 (Conditions Affecting Approvals).

The YESAA Project Proposal was filed with the Whitehorse Designated Office April 29, 2021.[29]

The low risk related to regulatory and permitting requirements was reviewed in response to UCG-YEC-1-13 (notes the risk related to the YESAA assessment is low due to the nature of assessable activities).[30] YUB-YEC-1-9(a) reviewed the transmission connection to Whitehorse Rapids facility, and notes that route selection was expected to minimize permitting requirements and costs for the route as it prioritized use of existing rights of way, minimizing disturbance and visual impact.

YUB-YEC-1-33 also reviewed the NavCanada and Transport Canada assessment processes and notes that review timelines and permitting requirements are well understood and any cost impacts related to required mitigation are expected to be minimal and within current cost estimate.[31] Discussion during the oral hearing also noted both assessments are fairly low risk as they are mainly concerned with potential obstruction of the flight path, given the proximity of the site to the Whitehorse airport. This is not a material concern given the BESS' footprint and size. Undertaking #9 provided additional information regarding battery projects located near airports.

YUB-YEC-1-59 provides the noise assessment and indicates no noise controls are required for the selected Whitehorse site.

[29] Transcript Page 58, lines 4-5; page 170, lines 22-24. YEC noted it expects a decision from YESAB in July 2021 and there were no expected changes to the costs or timing of the Project as described in the Application to the recommendation from the YESAB being delayed a month.

[30] The assessable activities relate to minor land use and construction activities; and the transmission line is short and largely along existing easements or ROWs.

[31] The status of the NavCanada process was also discussed at Transcript pages 222-24. Ms. Milojevic confirmed, "both applications for the NAV Canada and Transport Canada land use assessments were submitted in March of this year. So we expect those to be concluded likely this month, based on the normal timing."

3.3 CAPITAL COST RISKS

Application Section 3.1.3 (pages 16-18) reviewed Project capital, noting a preliminary estimated total capital cost of $31.7 million (2020$, +/-30% accuracy). The Project includes $16.5 million funding from the Federal government's Investing in Canada Infrastructure Program ("ICIP"), which will reduce what is required to be recovered in rates. The net capital cost for YEC is estimated at $15.2 million.

The capital cost estimates provided by Hatch were a Class 4 cost estimate[32] and include a 15% contingency [except for planning and owner's costs, which were developed by YEC]. Ms. Zuliani reviewed the basis for the Hatch cost estimate at Transcript pages 241-43, noting it was:

> "derived based on our benchmark pricing of batteries of similar projects, with allocations for project-specific considerations like cold weather, transportation, and allocation for installation, and allocation for other electrical components and communication components within the BESS. The other CapEx is based on engineering costs as well as site preparation costs, which were derived based on estimates from our civil engineering team."

Ms. Zuliani noted that the benchmarks are based on either public information or Hatch's in-house data bases developed through their projects.

Hatch noted its confidence with the cost estimate provided during the oral hearing:[33]

> MS. ZULIANI: Yes. So, I mean, as Ms. Milojevic explained, they're based on the level of engineering. As you do more engineering, you get more certain on your costs because you have more details of your project more firmly defined. So, at the highest level, we have our Class 5 estimate which is options or scoping level study and, typically, plus/minus 50 percent; Class 4 estimate, which is where this project sits, is we've done a basic engineering phase, defined the project, and based our costs based on site specific considerations, benchmarks, and any other information, as we pointed out, based on past projects and discussions with vendors of major components. So, in that sense, we are confident, given the level of engineering, that this cost is within the range outlined here based on the information we have today.

Section 3.1.3 of the Application provides details of the Project costs and Table 3-4 provides a summary of preliminary estimated Project capital costs of $31.7 million (2020$, +/-30% accuracy).

[32] The explanation of a class cost estimate was provided by Ms. Milojevic during the Oral hearing at transcript pages 315 and 316: "Mr. Chair, that would have been the level -- based on the level of engineering that Hatch conducted to estimate the costs. And so we'll often see something called "Class 5 cost estimates," which are plus or minus 50 percent. Then you have Class 4, Class 3. And that's used often in engineering projects. So the current level of engineering that's been conducted gives a confidence of plus or minus 30 percent to the estimate…the minus 30 percent in this case recognizes the rapidly dropping prices in this particular market given that the battery system itself is such a large portion of the project costs. But, yes, so it is exactly that, an engineering classification system around certainty of estimates."

[33] Transcript page 353-54.

Sensitivities were reviewed in the responses to YUB-YEC-1-55(d) through (g) and JM-YEC-1-33 and demonstrate net benefits to ratepayers over the Project life over a range of scenarios.[34] More specifically, with 30% higher capital costs the present value savings would be $2.466 million; with 30% higher O&M costs the present value savings would be $9.632 million; and with 30% higher recharging costs the present value savings would be $12.290 million. In fact, the Project would still break even with a 42.5% increase in capital costs assuming the most recent actual fuel prices.

When assessing capital cost risks, it is important to emphasize that the battery price has the greatest impact on the Project economics as it accounts (with contingency included) for about 72% of the total Project capital cost. Ms. Milojevic confirmed that the outstanding RFP in the second phase procurement addresses between 70 and 80% of Project capital costs.[35] Mr. Hall noted at page 209 of the transcript:

> "what's going to happen here over the next two, three, months is we're going to get results back from the RFP process for the battery, which will confirm a substantial part of the capital cost. And then we would take that information and package the project up for our board of directors to make a final investment decision."

Mr. Hall also noted at page 218-19 of the transcript that the nature of the Project is relatively simple with a lower construction risk which materially reduces the cost risk compared to other major projects such as a hydro facility:

> "There's very minimal site work required. We're not excavating a whole lot. We're not blasting. It's basically clearing land and pouring some fairly limited foundation work. And then you're installing containerized modules that get shipped up from the supplier. So the amount of site work required is much lower." Further, YEC "wanted to avoid having to build a building to house this battery, which again would have introduced risk, and really wanted to simplify the way this project will be executed."

Discussion during the oral hearing also noted "the rapidly dropping prices in this particular market".[36] COVID-related supply risks that may impact Project cost were also reviewed and it was noted by Mr. Hall that while "there may be some inflation drivers on certain components of the battery … batteries overall in general are getting cheaper, as more production is brought online.[37]"

[34] Transcript, page 125, lines 1-13 Mr. Hall also notes "we've also presented and discussed analyses which then evaluated the ratepayer benefits at the bookends of that risk range, and demonstrated that, even in that plus 30 percent capital cost scenario, there was still a net benefit to ratepayers. So that's one of the -- probably the principal financial risk at this time. You know, obviously, there are technical risks associated with a battery, and those, you know, are addressed in a number of different ways through a competitive procurement process where the features of various suppliers, technology can be evaluated from a technical perspective."

[35] Transcript, pages 344-45. Based on Table 3-4 in the Application, the battery system plus the power conversion system together, with 15% contingency, account for 85.6% of total Project capital cost.

[36] Ms. Milojevic, Transcript page 316-317.

[37] See transcript page 224-25. Ms. Zuliani at page at page 345 also confirmed that Hatch does not have anything to note in the last six months in terms of major price differences from what seen in the Application.

All of this evidence highlights the extent to which capital cost risks will be addressed and resolved prior to YEC's board of director's final stagegate decision to proceed with the Project. The Application has described the process YEC is using to address and resolve procurement.[38]

In summary, the Project's capital cost risks will be largely resolved prior to the final stagegate decision by YEC's board of directors expected in August 2021 – and the evidence confirms that the Project by its nature has a low level of capital cost risk once that stage has been reached.

4.0 ALTERNATIVES TO THE BESS PROJECT

Part 3(d) of the Terms of Reference require the Board to review and report on "what, if any, reasonable alternatives exist to the BESS Project, or alternative ways of undertaking the BESS Project with its selected technology might be advisable given reasonable load assumptions and risk assessments."

The evidence provided on alternatives to the Project and alternative ways of undertaking the Project is reviewed below.[39]

4.1 ALTERNATIVES TO THE PROJECT

The Project provides 7 MW of dependable N-1 capacity at less cost to ratepayers, at a sooner date, and with a wider range of reliability benefits than other available options.

Yukon Energy is placing a high priority on new projects that can address the YIS dependable capacity requirements reviewed in Section 2 of this submission without reliance on new fossil fuel thermal generation or rented mobile diesel units. There are, however, in the near term no feasible renewable resource alternatives to the Project.[40]

Aside from the Atlin Hydro and Moon Lake pumped storage projects, temporary rental diesels or a permanent new thermal development remain the only feasible alternatives that would provide dependable capacity required to address the N-1 dependable capacity shortfall. The BESS Project's operating reserve use benefits enable it to provide material ratepayer cost savings relative to both the diesel rental and permanent thermal alternatives.

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[38] YUB-YEC-1-55 (b) and (c) notes YEC's risk management of capital costs as described in section 4.3 of the Application includes an early vendor selection process, assisted by an owner's engineer with experience procuring battery vendors, 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, taking into consideration the Whitehorse climate conditions and Yukon Energy's specific requirements.

[39] Project alternatives are reviewed in Section 4.2 of the Application (Need for and Alternatives to the Project). Section 4.2 provides an overview of alternatives to the Project reviewed by YEC (Section 4.2.1); and alternative ways of undertaking the Project and the preferred alternative (Section 4.2.2). Section 4.2.2 provides an assessment of the energy storage options reviewed (page 32-33), installation options considered (page 33), Project site options considered (page 34) and BESS size options considered (page 34-36). The assessment of Project economics compared to the alternatives is provided in Section 4.2.3 (Project Economics).

[40] See Table 2 in this submission. No dependable capacity will be provided by the expected IPP purchases under the Standing Offer Program as these are intermittent rather than dispatchable renewables; and enhanced storage projects displace thermal energy generation with no added dependable capacity.

The following are specifically noted from the Application and the proceeding:

- **Maintaining the current status quo is not a viable option**: Maintaining the status quo would mean that YEC would continue to rely on rented diesel units with increases each year in both the number of rental units and in rental costs per unit. This is not a feasible alternative and permanent solutions are needed.[41]

- **No Available Renewable Options can provide required Capacity within the relevant near-term time period**: The 10-Year Renewable Electricity Plan (provided as UCG-YEC-1-10(a) Attachment) examined a wide range of near-term resource supply options to address forecast energy and capacity shortfalls. As noted in the Application (page 29-30), many of these options do not provide dependable capacity and would not displace what the BESS can provide. The BESS Project is the only available near-term renewable option to displace four rental diesel units. The two dependable capacity hydro renewable projects identified for development within ten years are each subject to securing material federal grant funding and - even if they are developed - they will not remove the ongoing need for the other dependable capacity projects such as the BESS Project.

- **A 20 MW New Thermal Plant is not a Viable Option**: Ongoing Yukon Energy review and consultation on 20 MW plant options indicated a wide range of concerns regarding development of a new large greenfield diesel plant. See response to YUB-YEC-1-92 (c) as well as Mr. Hall's review during the oral hearing of the decision not to proceed with the 20 MW diesel plant option.[42]

During the oral hearing, Mr. Mollard highlighted how any alternative must be analyzed with regard to the providing required N-1 dependable capacity. He indicated:

> "the business case we prepared is a lifecycle business case. The N-1 is a one-in-10-year event. So it's really important to keep in mind, you have to look at the costs of the alternatives, where they're spending most of their time just sitting there not doing anything, as well as other use cases, which we presented in that table when we talk about the operating reserve, used savings, and the peak shifting uses. So it's not just the N-1 that justifies the project."[43]

In relation to alternatives -- see also the discussion at pages 354-57 of the transcript where Ms. Milojevic confirms the N-1 requirement is anticipated to occur once every 10 years; clarifies that

[41] See discussion in Application at page 29.

[42] Transcript, pages 205-207. Mr. Hall noted public and First Nation feedback that was adverse to the project, and the start of strategy formulation around renewable options ("..if you've got a plan that going to deliver a large step increase in capacity from, say, Moon Lake, that really erodes the justification of building a 20 MW diesel plant.") Mr. Hall also noted that YEC can always re-evaluate plans and bring back options onto the table if circumstances change, i.e., "…if we were simply not able to secure the required amount of federal funding for Moon Lake, for example, then we may well have no real other option but to reconsider a 20MW diesel plant….But right now Plan A, and the plan we're working on, is to pursue that federal funding and be successful with that endeavor, and if we're able to then start planning work on Moon." (page 207).

[43] Transcript page 330.

while there is a shortfall of capacity on the system, there is not an energy constraint; and outlines the number of other system benefits provided by the BESS that are not readily provided by diesel engines.

Finally, when comparing BESS to other possible alternatives, Table 4-3 in the Application confirms that the BESS Project provides lower costs to ratepayers than the rented diesel option (see Table 1 in this submission for details). YEC's response to Undertaking #7 confirms doing an apples-to-apples comparison of the BESS Project with new diesel indicates that the overall ratepayer benefit from the BESS Project would increase from $12.68 million NPV to $17.50 million NPV (see Table 1 in the response to Undertaking #7).

4.2 ALTERNATIVE WAYS OF UNDERTAKING THE PROJECT

Alternative ways of undertaking the BESS include different technologies, installation options, and sites as well as different sizes for the Project. Each of these was reviewed in Section 4.2.2 of the Application relative to the preferred option for the Project. The specified need to meet near term forecast requirements for reliable and flexible new capacity on the YIS is best met through the BESS as proposed in the Application.

4.2.1 Technology Selected/ Operation Details

Yukon Energy completed a comprehensive review of the available energy storage technologies for the 2016 Resource Plan (see Transgrid study provided as Undertaking #2). In its Feasibility Study, Hatch provided an updated assessment of the capabilities and limitations of available energy storage technologies. This updated work indicated lithium ion batteries are the best energy storage option for the YIS context (low cycling, adequate duration, with reliable and quick response required for a northern climate location). Other energy storage technologies considered were not able to meet the Yukon grid's needs because of the calculated power, energy, and discharge time characteristics required (as well as the maturity, cost and environmental and socio-economic attributes of the technologies).[44]

It is important to note that a preferred lithium ion battery chemistry will be selected based on the vendor offering that aligns best with YEC's needs. This approach was taken in an effort not to restrict the vendor pool, and in recognition of the rapid pace of development of battery technology.

The general benefits and limitations of the different chemistries are outlined in Section 4.1 and Section 8.2 of the Hatch Report (Appendix B to the Application). In addition, YUB-YEC-1-13 (d) Attachment 1 provides more information on the benefits and limitations of each chemistry type.

4.2.2 Installation Options

Two installation options were considered. The Application at page 33 notes the advantages and disadvantages of a containerized option versus a building option and indicates that the selected container option can be assembled at the vendor's factory, which reduces the on-site installation

[44]See Application page 33, YUB-YEC-1-38(b) and UCG YEC-1-15(c)

and commissioning time, reduces the risk during installation and commissioning, and is less costly than the building option.

4.2.3 Project Scale

The Hatch Report reviewed different energy capacity and power capability sizing options for BESS (see Application Pages 34-35, and Table 4-2). YEC selected the 20 MW/40 MWh option because it allows the Project to deliver 7 MW of N-1 dependable capacity in combination with the other reliability benefits while providing a net cost saving benefit to ratepayers (see Table 1 in this submission).

These attributes are described in YEC's Opening Statement (Exhibit B-5) as follows:

> The proposed BESS Project size has taken into consideration the added reliability benefits from these secondary uses. For example, the 20 MW BESS Project inverter size significantly increases 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 sizing can also cover the loss of Whitehorse Hydro Unit #4, preventing critical grid outages. The proposed sizing also provides greater operational flexibility to accommodate future changes in the configuration and operational needs of the grid as more intermittent renewable resource options come online.

4.2.4 Site Options

As the Project would be located on overlapping Traditional Territory of KDFN and 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 [see discussion in YUB-YEC-1-26(g)]. Parameters for site selection were reviewed in discussion at Transcript pages 213-16. This discussion noted that the key parameters for site selection were proximity to YEC substations[45] and locations where settlement land was available (in order to create an opportunity for a land lease with the affected First Nations).[46] Both parameters needed to be met. Siting the Project on First Nation land did not limit the site options available.[47]

Site options are reviewed at page 34 of the Application.

While three locations were considered, there was strong public opposition to the Takhini substation site.[48] It also had noise issues (due to proximity of residents),[49] more challenging

[45] Mr. Hall notes at page 216, "proximity to a substation, that's a pure economic driver, right? I mean, it just makes economic sense to be close to a substation. And technical sense in terms if you look at the hardware required to connect to the grid. It's much more convenient to do it through a substation."

[46] Mr. Hall notes at page 216, "in terms of the -- looking for First Nation settlement land, that was a very deliberate strategy of our board and of the company, to make economic opportunities available to First Nations through our new project." The basis and approach for the land lease was discussed in detail by Mr. Hall and Mr. Mollard at transcript pages 305-15.

[47] Transcript page 311.

[48] The majority of public comments focused on the Takhini site and indicated strong opposition to developing the project at this location. See Application, Section 5.0; and response to YUB-YEC-1-46(a) which provides the What We Heard Report (site specific comments provided in Section 3.3 of the report), and reviews stakeholder comments on site selection.

access conditions and had limited flexibility as to container output. KDFN withdrew the Takhini site from consideration and did not provide a lease offer for the KDFN site – effectively eliminating it from consideration [see response to YUB-YEC-1-59(d) and Mr. Hall at transcript page 248].

To the extent possible, YEC used a competitive process for site selection. A benchmarking process is being implemented to simulate a competitive process to get comparable data to prove out that the lease would be at a rate equivalent to the market,[50] and competitive bids were provided by both TKC and KDFN.[51] Mr. Mollard noted:

> "to the extent that the Board is being asked to assess the impact on ratepayers, the settlement land question, from our perspective, is not a factor because we are using market-based rates. So ratepayers would be indifferent because they would pay the same whether it was on settlement land or not."

Mr. Mollard also noted that the Board would have an opportunity to review final costs when the Project is brought before the Board for a prudency review prior to being put into rates.[52]

YUB-YEC-1-8 outlines why the KDFN site was selected as the preferred site. In summary:

- The terms of the commercial lease offer resulted in a net present value of 45% savings in lease costs.
- The offer provided specific details on the path to project development. KDFN is an experienced proponent and has executed similar land deals in the past.
- There is greater certainty regarding ability to appropriately zone the property.
- The offer included a provision to share the benefits of the lease with TKC, and enabled an optimized benefits package for both First Nations whose Traditional Territories the Project is located on.

YUB-YEC-1-8 (a) and (b) reviews the prudence of the site size (1.5 ha)[53], and JM-YEC-1-5 clarifies the parcel size and that the 1.5 ha area is a portion (15%) of the KDFN parcel.

[49] See response to YUB-YEC-1-59(a) which provides the Noise Assessment.

[50] See discussion at Transcript pages 307-09.

[51] Transcript page 311. The process for determining the land lease is reviewed at transcript pages 305-15.

[52] See transcript page 309, "the Board is not abdicating its future responsibility to assess the prudency of the project. So when we get this – if we're allowed to proceed and we get this built, we come back to you with those final project costs, including these lease costs, and we are required to provide evidence to satisfy you that this is a prudent expenditure. And the Board has the jurisdiction at that point to approve or deny the collection of those costs in rates."

[53] See YUB-YEC-1-8. Only 0.35 ha is required for the containers and inverter equipment, but additional space is required to enable road access; to appropriately space the containers for safety purposes; to ensure appropriately spacing between the equipment and any future potential development; and to enable clearing that provides adequate clearance between the BESS and the forested area, to prevent fire spread in the event of a wildfire.

YUB-YEC-1-26 reviews issues related to property taxes - and notes City of Whitehorse has authority to apply property taxes to land within its municipal boundaries. YEC formally requested that the City consider a reduced tax rate. Mr. Hall confirmed during the oral hearing that YEC had organized interested parties and appeared before City council and made two rounds of submissions requesting a reduction in the City taxes but was not successful.[54]

5.0 DEBENTURE INVESTMENT OPPORTUNITY

Part 3(e) of the Terms of Reference require the Board to review and report on "impacts on YEC and ratepayers of the debenture investment opportunity that YEC is providing to TKC and KDFN in recognition of the BESS Project's location on the overlapping Traditional Territory of TKC and KDFN and the benefits of TKC and KDFN support for this Project's development at this time."

First Nations' support for the Project is important given its location and YEC's desire to provide economic benefits to First Nations. See discussion at Transcript page 133-135 wherein Mr. Hall discussed the First Nation issues:

> "Mr. Chair, I think it's important in answering the question just to recognize the general environment that we are operating in with respect to Indigenous rights, and a real effort on behalf of, not only the federal government, but the territorial government as well, to uplift Indigenous communities and, really, what that flows down to is a very deliberate strategy on behalf of our board of directors to make economic benefit opportunities available to the relevant First Nations associated with the major projects that we undertake. So, it's a very strategic initiative on our part.
>
> ….
>
> "So -- and then more broadly than that, I think as a corporation, as a Crown corporation, we do have an objective of contributing and helping with that general economic betterment of Indigenous communities, and so that is of benefit financially we believe in the long term."

Mr Hall also reviewed the context for this arrangement provided by Chapter 22 of the Final Agreement.[55]

Pages 18-19 of the Application provide details of the First Nation Debenture investment opportunity including the estimated investment opportunity for KDFN and TKC. Additional details were provided in the response to YUB-YEC-1-7 and during the oral hearing see transcript pages 132-35, 267-83; and 324-25. Undertaking #5 notes that the key terms for the First Nation debenture investment opportunity related to the Project, as included in the term sheet, are provided in pages 18 and 19 of the Application.

[54] See Transcript pages 54-55.

[55] See Transcript pages 281-82, "So there's precedent through final agreements in Yukon that speak directly to this kind of investment. As we outlined in the application, in this particular case, you know, our view was that obligation wasn't necessarily there because of the nature of the project; but, you know, for the reasons I outlined and spoke to yesterday, our Board made a decision to offer the -- an investment nonetheless. But in terms of the nature and trigger for this kind of investment, there's good precedent with our corporation in this jurisdiction, let alone other jurisdictions."

The BESS Project is the first time when Yukon Energy - rather than Yukon Development Corporation - is providing a debenture investment opportunity in a YEC project.[56] However, the proposed debenture investment closely follows the precedents used by YDC for previous Yukon Energy projects, e.g., Mayo B and the Whitehorse LNG project.[57]

Although the proposed debenture investment is a loan, the return will be based on YEC's actual return on equity. The debenture's return will be included as part of YEC's equity return when setting rates (without any change in the 40% equity share assumed in the capital structure when setting rates).[58]

As noted by Mr. Mollard there will be no impact to ratepayers:

> "From our perspective, we believe the way we've structured this debenture as a benefit to the First Nations, ratepayers will be indifferent. We don't -- we don't feel that engaging in this debenture agreement will harm or benefit ratepayers, just specific to that instrument." (page 125)
> ….
>
> "So if the Board sees through to bless this arrangement and say, yes, you can proceed on this basis, while the numbers may change, it won't affect my overall costs and it won't affect ratepayers. Because effectively what we've committed to do is saying that whatever that debenture principal amount becomes, I will adjust my equity slice with my shareholder to ensure that I'm at 40 percent value.
>
> As the Board previously directed, we must stay 60/40. So I'm just substituting a KDFN dollar for a YDC dollar, or vice versa. So that will keep me whole and that will keep ratepayers whole." (page 275)

Finally, Mr. Mollard confirmed that while the agreement with KDFN and TKC has not been finalized, "the items remaining to be negotiated will not affect the treatment of the note".[59] He also noted that there will be an opportunity for the Board to review Project costs including the debenture costs prior to those costs being included in rates:[60]

6.0 PRUDENCE OF BUILDING BESS AT THIS TIME

Part 3(f) of the Terms of Reference require the Board to review and report on "whether it is prudent to build the BESS Project as proposed at this time."

[56] Mr. Hall discussed the rationale for YEC entering into the debenture arrangement with KDFN and TKC at Transcript page 270-71.
[57] Similarities and differences from other First Nation instruments were reviewed at Transcript page 271-72; and page 285.
[58] This was reviewed in detail by Mr. Mollard at transcript pages 267-79.
[59] Page 274 lines 24-25 and page 275, line 1.
[60] Page 276, lines 13-22.

Mr. Hall provided the following response when asked why YEC sees that it is reasonable to proceed with the Project now rather than a year from now or two years from now:[61]

> MR. HALL: Andrew Hall. Mr. Chair, I think a couple of reasons. Firstly, we've secured the government funding already, it's available, you know, it's ready to be drawn down, the time is right from that perspective. There wouldn't be any reason to delay spending on government funding that's already been announced and allocated. Secondly, I think we've demonstrated that the need exists today. So if you think about the primary benefit of this battery in terms of avoiding us renting four diesel units, we're renting today, so that need is current.
>
> And, secondly, you know, we've presented a ratepayer benefit calculation, and those benefits accrue from year 1. So, really, from a -- if you think about it, you know, flowing those benefits to ratepayers, they start in year 1 and, therefore, again, I would say there's no point in really delaying because you get those benefits starting in year 1.

In summary, as outlined in this submission, in order to meet the growing electricity peak demand of the Yukon grid and comply with emerging clean policy development, a diverse portfolio of new resources is needed. The battery Project, as one component of this portfolio, will contribute to meeting YEC's growing dependable capacity requirements, directly reduce Yukon Energy's reliance on thermal generation, provide cost savings for ratepayers, and increase the reliability of electricity service provided to customers. The debenture investment opportunity provided to TKC and KDFN related to the BESS Project will not have any impact on ratepayers.

This assessment is based on the best available information at this time. A final investment decision will be made after Yukon Energy has completed the regulatory review process and after Project capital costs are materially refined based the procurement process described in the Application.

Based on all of the above, it is prudent to build the BESS Project today as proposed by YEC.

ALL OF WHICH IS RESPECTFULLY SUBMITTED

P. John Landry, Q.C.
Counsel for Yukon Energy Corporation

May 13, 2021

[61] Transcript, pages 136-137.