

July 28, 2021

Board of Commissioners of Public Utilities
Prince Charles Building
120 Torbay Road, P.O. Box 21040
St. John's, NL A1A 5B2

Attention: Ms. Cheryl Blundon
Director of Corporate Services & Board Secretary

Dear Ms. Blundon:

Re: Application for Purchase of a Diesel Generating Unit – Ramea

Please find enclosed Newfoundland and Labrador Hydro's application for approval to purchase a diesel generating unit for use in the Ramea Diesel Generating Station. This project is required to meet peak demand and support the provision of reliable service for the residents of Ramea. The cost of this project is \$2,436,800.

Should you have any questions, please contact the undersigned.

Yours truly,

NEWFOUNDLAND AND LABRADOR HYDRO



Shirley A. Walsh
Senior Legal Counsel, Regulatory
SAW/sk

Encl.

ecc: **Board of Commissioners of Public Utilities**
Jacqui H. Glynn
PUB Official Email

Newfoundland Power
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Application for Purchase of a Diesel Generating Unit - Ramea

July 28, 2021



An application to the Board of Commissioners of Public Utilities

IN THE MATTER OF the *Electrical Power Control Act, 1994* RSNL 1994, Chapter E-5.1 (“*EPCA*”) and the *Public Utilities Act, RSNL 1990, Chapter P-47* (“*Act*”), and regulations thereunder;

IN THE MATTER OF an application by Newfoundland and Labrador Hydro (“*Hydro*”) for an Order approving the purchase of a diesel generating unit for use in Ramea pursuant to Section 41(3) of the *Act*.

To: The Board of Commissioners of Public Utilities (“Board”)

THE APPLICATION OF NEWFOUNDLAND AND LABRADOR HYDRO STATES THAT:

A. Background

1. Hydro is a corporation continued and existing under the *Hydro Corporation Act, 2007*, is a public utility within the meaning of the *Act*, and is subject to the provisions of the *EPCA*.

B. Application

2. Hydro has 23 diesel generating stations, 18 of which are prime power stations which are not interconnected to the grid and serve as the primary source of capacity and energy for isolated systems. The 18 prime power stations serve approximately 4,400 customers.
3. The Ramea Diesel Generating Station holds three 925 kW generating units, Unit 2047, Unit 2077, and Unit 2097, all of which are used to provide electrical service to the community. In addition to the Ramea Diesel Generating Station, the Ramea system is served by a 390 kW capacity wind farm owned and operated by Frontier Energy and a 300 kW capacity wind farm owned by Nalcor Energy. Wind generation provides approximately 500 MWh annually for the community.
4. Unit 2047, installed in 1997, was the most utilized unit in Ramea in 2020, running for 5,300 hours. It has undergone three overhauls in its lifetime with the most recent in 2018 at 60,039 hours. Its next planned overhaul was scheduled for 2026 once it had reached 90,000 hours. The

unit had historically operated reliability and its planned maintenance was up to date. There had not been any issues with the unit until May 15, 2021 when it experienced a catastrophic engine failure.

5. At the time of Unit 2047's failure, detailed in the supplemental report attached to this application as Schedule 1, the unit was the only one online. Its failure caused a brief outage to the town until service was restored using one of the other units.
6. The damage to Unit 2047 included a connecting rod being ejected through the side of the engine block. The Unit's engine is not repairable and a new engine is no longer available from Caterpillar. As a result, the full unit must be replaced.
7. Without all three generating units, during the winter peak loads could exceed the firm capacity of the Ramea Diesel Generating Station, resulting in outages to customers. The existing wind generation is an intermittent, variable generation source that cannot be adjusted to match demand on the system and cannot provide firm, reliable capacity. Therefore, Hydro requires sufficient diesel generation firm capacity on the isolated Ramea system in order to ensure sufficient capacity to meet demand.
8. In the short term, to mitigate the reliability risks, Hydro plans to install a retired engine from a unit that was replaced in Cartwright in 2021. However, this is a short-term solution as the engine has operated for more than 125,000 hours and it has been more than 30,000 hours since its last overhaul. As detailed in Schedule 1, this is an emergency solution only, allowing Hydro to continue to serve Ramea customers through the winter operating season while also carrying out planned maintenance on Units 2077 and 2097.
9. The supplemental report, attached as Schedule 1, describes the alternatives Hydro considered for the continued supply of power to Ramea. In addition to the possibility of deferral, the alternatives were to replace the generating unit with a new unit of various capacity, i.e., 500 kW, 725 kW, and two versions of a 925 kW unit. These options are evaluated in Schedule 1 to this application, with the conclusion being that the purchase of a new 500 kW generating unit at a cost of \$2,436,800 is the most appropriate and least-cost option.

10. Although a third unit is required in to supplement the existing two units in Ramea and provide reliable service, due to the declining load requirements of the community, a lower capacity unit is sufficient. The replacement of the disabled Unit 2047 with a 500 kW unit will ensure the provision of reliable service while also allowing for increased use of the existing wind generation in the instances where all three units are not required.

C. Hydro's Request

11. Hydro requests that the Board make an Order pursuant to Section 41(3) of the *Act* approving Hydro's acquisition of a 500 kW generating unit for use in the Ramea Diesel Generating Station to enable the continued supply of reliable power to Ramea.

D. Communications

12. Communications with respect to this application should be forwarded to Shirley A. Walsh, Senior Legal Counsel, Regulatory for Hydro.

DATED at St. John's in the Province of Newfoundland and Labrador this 28th day of July 2021.

NEWFOUNDLAND AND LABRADOR HYDRO



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Newfoundland and Labrador Hydro,
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Schedule 1

Ramea Diesel Engine Failure

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1.0 Introduction

Newfoundland and Labrador Hydro (“Hydro”) has 23 diesel generating stations, 18 of which are prime power stations serving a total of approximately 4,400 customers. Diesel generating stations are designed such that demand can be met in the event of failure of the largest generating unit provided all other units remain in service. The Ramea Diesel Generating Station has three generating units (“gensets”), Unit 2047 (925 kW), Unit 2077 (925 kW), and Unit 2097 (925 kW).

Unit 2047 experienced catastrophic engine failure on May 15, 2021 while operational when a connecting rod was ejected through the side of the engine block. At the time, it was the only unit online, resulting in a brief outage to the town until service was restored using Unit 2077. Unit 2047’s engine is not repairable and a new engine is no longer available from Caterpillar (“CAT”); therefore, a full genset replacement is required to replace Unit 2047.

Procurement of a replacement for Unit 2047 must begin in the fall of 2021 to meet the time frame for installation in advance of the 2022–2023 winter operating season. As such, Hydro is proposing this project as a 2021 supplementary capital budget application rather than including it within its 2022 Capital Budget Application as a Board Order would not be received in time.

2.0 Background

2.1 Existing System

There are three generating units in the Ramea Diesel Generating Station: Unit 2047 (925 kW), Unit 2077 (925 kW), and Unit 2097 (925 kW). Unit 2047 is a 4,160 V CAT Model 3512 that was installed in 1997; it had 71,013 operating hours at the time of failure. The unit had undergone three overhauls in its lifetime, with the most recent taking place in 2018 after 60,039 operating hours. Unit 2047 was planned for overhaul in 2026 once it reached 90,000 operating hours.

In addition to the Ramea Diesel Generating Station, the Ramea system is served by a 390 kW capacity wind farm owned and operated by Frontier Energy and a 300 kW capacity wind farm owned by Nalcor Energy. Wind generation provides approximately 500 MWh annually.

1 **2.2 Operating Experience and Maintenance History**

2 Unit 2047 had historically operated reliably and experienced no issues leading up to this unexpected
3 failure. This unit was the most utilized unit in Ramea in 2020, running for 5,300 hours in that year. The
4 unit consistently produced good oil sample results and planned maintenance was up to date. Unit 2047
5 operated for 10,974 hours since its last overhaul in 2018 without experiencing any issues until its
6 catastrophic failure.

7 **3.0 Justification**

8 **3.1 Operational Impact**

9 Unit 2047 is one of three identical units in the Ramea Diesel Generating Station. It operates for
10 approximately 3,600 hours annually on average making it the most utilized engine in the diesel
11 generating station. Without a third genset available, peak winter loads could exceed the firm capacity of
12 the Ramea Diesel Generating Station, potentially resulting in outages to customers.

13 To mitigate the reliability risks until a new genset can be procured, Hydro will install a retired engine
14 from Unit 2052 in Cartwright, which was replaced in July 2021. Hydro considers this engine a short-term
15 solution, as it has in excess of 125,000 hours and approximately 30,000 hours since its last overhaul; the
16 engine block is in poor condition and cannot be overhauled again. This engine will serve as emergency
17 use only and will allow Hydro to carry out planned maintenance on Units 2077 and 2097 during the
18 winter operating season without requiring outages to customers.

19 **3.2 Consideration of Renewable Energy**

20 In recent years, Hydro has considered the potential role of renewable energy resources in its isolated
21 systems. To date, renewable energy technologies, with the exception of hydro generation with reservoir
22 storage, present challenges that limit their viability as primary sources of capacity in isolated systems.
23 Renewable technologies such as wind generation are non-dispatchable¹ and therefore require
24 significant energy storage infrastructure to provide firm, reliable capacity. Energy storage technologies
25 have not yet matured to the point that they are a viable alternative for firm, reliable, least-cost provision
26 of power when compared to diesel generation. Therefore, Hydro requires sufficient diesel generation

¹ Non-dispatchable generation refers to intermittent, variable generation sources whereby the supply cannot be adjusted to match demand on the system, potentially leading to capacity shortfalls during periods of reduced renewable energy generation.

1 firm capacity on isolated diesel systems in order to ensure sufficient capacity to meet demand without
2 the use of renewable energy sources.

3 While renewable energy sources in their current state are not viable for the provision of firm capacity, in
4 certain circumstances, these sources can be used to provide energy on an isolated system, reducing the
5 energy required from diesel generation and thereby reducing operating costs such as diesel fuel
6 consumption.

7 **4.0 Analysis**

8 **4.1 Identification of Alternatives**

9 Hydro has identified the following alternatives:

- 10 • Alternative 1: Deferral; and
- 11 • Alternative 2: Diesel genset replacement.

12 **4.2 Evaluation of Alternatives**

13 **4.2.1 Alternative 1: Deferral**

14 Deferral of the replacement of the failed Unit 2047 is not considered a viable option. Along with the two
15 remaining units, Hydro requires a third unit at the Ramea Diesel Generating Station to provide sufficient
16 firm capacity to meet customer load during the winter operating season. While Hydro believes the
17 temporary use of the engine from Cartwright Unit 2052 acceptably mitigates the risks for the 2021–2022
18 winter operating season, that engine has exceeded the operating hours at which overhaul is required
19 and cannot be overhauled again. Replacement with a new unit is required to meet firm capacity for the
20 2022–2023 winter operating season and beyond.

21 **4.2.2 Alternative 2: Diesel Genset Replacement**

22 This alternative consists of the replacement of the failed Unit 2047 with a new genset, including the
23 necessary upgrades to the unit protection and control to enable automated operation and
24 accommodate the new unit.

25 **New Genset Sizing**

26 Ramea has a decreasing load profile, as presented in Table 1, which is considered when evaluating
27 replacement options. To determine the most cost-effective genset size to replace Unit 2047, Hydro

1 completed a cost-benefit analysis of units with capacities of 500 kW (1,800 rpm), 725 kW (1,800 rpm),
 2 925 (1,800 rpm), and 925 Kw (1,200 rpm).² Results of the analysis indicate that the least-cost option is to
 3 replace Unit 2047 with an 1,800 rpm unit having a capacity of approximately 500 kW. The results of this
 4 analysis are summarized Table 2.

Table 1: Ramea Diesel System Peak Load Forecast – 2021–2024

Year	Peak (kW)
2021	1147
2022	1145
2023	1143
2024	1141
2025	1139
2026	1138
2040	1114

Table 2: Cost-Benefit Analysis (\$) ³

Genset Size	Cumulative Net Present Value (“CPW”)	CPW Difference between Genset Sizes and the Least-Cost Option
500 kW	4,159,804	0
725 kW	4,428,982	269,179
925 kW (1200 rpm)	5,145,550	985,746
925 kW	5,203,746	1,043,943

5 Hydro’s analysis excluded the contribution of wind generation. In addition to the economic benefits
 6 identified in Table 2, it is also expected that reducing the size of the smallest diesel generation unit at
 7 the Ramea Diesel Generating Station will allow for increased renewable energy penetration from the
 8 existing wind farms in Ramea, as the 500 kW unit will be able to operate at a lower load, allowing more
 9 capacity for wind generation. Wind generation currently provides approximately 500 MWh of renewable
 10 energy production in Ramea each year. By replacing the 925 kW Unit 2047 with a 500 kW unit, the
 11 capacity for penetration of renewable energy is forecast to increase by up to 250 MWh per year,⁴
 12 providing further economic benefits resulting from the installation of a 500 kW unit.

² Available rotational speeds for those gensets.

³ CPW to the year 2021.

⁴ Based on existing wind farms.

1 5.0 Project Description

2 This project will replace Unit 2047 with a new 500 kW, 1,800 rpm diesel genset, which includes the
 3 design, procurement, and installation of a new genset, exhaust stack, radiator, aftercooler, switchgear
 4 with breaker, and all other equipment necessary to facilitate the proper function of the new unit.
 5 Upgrades to some existing protection and control equipment will be required including additions to the
 6 motor control centre’s PLC⁵ cabinet, modifications to the main PLC, HMI⁶ configuration, and
 7 modification/testing of PLC logic. Modifications to the existing cooling system and addition of fuel
 8 coolers will be necessary to accommodate the new diesel genset.

9 Hydro plans to install the new genset with manual operation in advance of the 2022–2023 winter
 10 operating season with additional modifications and commissioning of the control system in 2023 to
 11 enable automation.

Table 3: Project Estimate (\$000)

Project Cost	2021	2022	Beyond	Total
Material Supply	22.4	565.6	0.0	588.0
Labour	214.8	830.5	21.3	1,066.6
Consultant	13.4	52.4	0.0	65.8
Contract Work	0.0	0.0	0.0	0.0
Other Direct Costs	22.1	253.2	7.3	282.6
Interest and Escalation	13.5	147.6	86.8	247.9
Contingency	21.5	161.5	2.9	185.9
Total	307.7	2,010.8	118.3	2,436.8

⁵ Programmable logic controller (“PLC”).

⁶ Human-machine interface (“HMI”).

Activity	Start Date	End Date
Planning: Open work order and plan and develop detailed schedules	August 2021	October 2021
Engineering Site visit and design for P&C ⁷ upgrade	September 2021	March 2022
Procurement: All the required materials for P&C, mechanical supply contract develop and publish tender	October 2021	April 2022
Construction: Remove old genset and P&C equipment and install new equipment	May 2022	July 2022
Commissioning (Manual Mode): Run up the new genset without automation, confirm operation, and release to operations.	July 2022	September 2022
Construction and Commissioning (Automation): PLC/HMI programming, PLC I/O wiring, PLC I/O and logic testing, confirm operation, and release to operations.	August 2022	June 2023
Close Out: Close work order, complete all documentation and lessons learned	June 2023	July 2023

1 6.0 Conclusion

2 The engine of Unit 2047 failed on May 15, 2021 and cannot be repaired or replaced. Hydro’s analysis has
3 determined that the least-cost option is to replace the unit with a new unit rated for 500 kW. On a
4 short-term, emergency-use basis, Unit 2047 will be mated with a retired engine from Unit 2052 in
5 Cartwright until a new genset can be installed.

6 Hydro believes that replacing Unit 2047 with a 500 kW genset is required for reliability but also provides
7 an opportunity to increase efficiency of the diesel generating station. With Ramea’s declining loads, a
8 500 kW unit will operate roughly half the year resulting in fuel savings and lower operation and
9 maintenance costs; there will also be a related increase in the potential penetration of renewable
10 energy produced on the Ramea system, resulting in a reduction of diesel fuel requirements.

⁷ Protection and controls (“P&C”).



Appendix A

Photos



Photo A-1: Hole in Engine Block where the Connecting Rod was Ejected from the Engine



Photo A-2: Connecting Rod and Wrist Pin on the Floor after Knocking over Garbage Can from being Ejected from Engine



Photo A-3: Broken Pieces of Unit 2047 that were Collected, including Bent Connecting Rod, Wrist Pin, Bent Connecting Rod Bolts, Engine Block Pieces, and Piston Pieces



Photo A-4: Pieces of Engine Block Scattered on the Floor with Lube Oil that Spilled from the Engine



Photo A-5: Large Amount of Lube Oil Spilled onto the Floor due to the Failure; this was Contained Once Power was Restored



Affidavit

IN THE MATTER OF the *Electrical Power Control Act, 1994* RSNL 1994, Chapter E-5.1 ("*EPCA*") and the *Public Utilities Act, RSNL 1990, Chapter P-47* ("*Act*"), and regulations thereunder;

IN THE MATTER OF an application by Newfoundland and Labrador Hydro ("*Hydro*") for an Order approving the purchase of a diesel generating unit for use in Ramea pursuant to Section 41(3) of the *Act*.

AFFIDAVIT

I, Robert Collett, of St. John's in the Province of Newfoundland and Labrador, make oath and say as follows:

1. I am Vice President, Engineering & Technology for Newfoundland and Labrador Hydro, the applicant named in the attached application.
2. I have read and understand the foregoing application.
3. To the best of my knowledge, information, and belief, all of the matters, facts, and things set out in this application are true.

SWORN at St. John's in the)
Province of Newfoundland and)
Labrador this 28th day of July)
2021, before me:)



Barrister – Newfoundland and Labrador



Robert Collett, P. Eng.