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October 13, 2023

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

Attention: Jo-Anne Galarneau
Executive Director and Board Secretary

Re: *Reliability and Resource Adequacy Study Review* – Combustion Turbine Feasibility Study

At the technical conference on the *Reliability and Resource Adequacy Study Review* proceeding ("*RRA Study Review*") on May 1 and 2, 2023, Newfoundland and Labrador Hydro ("Hydro") provided an overview of all of the reports, studies, and analyses underway or planned for fulsome consideration of the next supply resource for the province. Following the technical conference, in correspondence dated May 5, 2023, the Board of Commissioners of Public Utilities ("Board") directed Hydro to file a number of updates regarding the studies and analyses ongoing within the *RRA Study Review*. In particular:

1) Hydro shall file by May 19, 2023 a comprehensive list of all reports, studies and analyses it has currently underway or planned with respect to the reliability of the LIL, potential alternative generation resources, the load forecast, and any other issues raised in the 2022 RRAS Update and the May 1-2, 2023 technical conference. This list shall include a description of the scope of each study, report and analysis, the consultant or group undertaking the work and the schedule for completion.

2) Hydro shall file with the Board a copy of each report, study or analysis listed in response to number 1 above as it is completed.[1]

On May 25, 2023, Hydro provided the Board with a list of all reports, studies, and analyses currently underway or planned to support future filings in relation to the *RRA Study Review*.[2]

Hydro has previously provided the Board and parties with an overview of the Combustion Turbine Study and noted that, as the Concept Design Study performed by Hatch Ltd. ("Hatch" contains substantial third-party commercially sensitive information, Hatch would be completing the redaction of this information and the redacted version would be provided once complete.

Enclosed with this correspondence is the redacted version of the Concept Design Study.

[1] "Newfoundland and Labrador Hydro - Reliability and Resource Adequacy Study Review - To Parties - Further Process," Board of Commissioners of Public Utilities, May 5, 2023, p. 2.
[2] "*Reliability and Resource Adequacy Study Review* – Listing of Planned Reports, Studies, and Analyses," Newfoundland and Labrador Hydro, May 25, 2023, Table 1 and att. 1.

Should you have any questions, please contact the undersigned.

Yours truly,

NEWFOUNDLAND AND LABRADOR HYDRO

Shirley A. Walsh
Senior Legal Counsel, Regulatory
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Encl.

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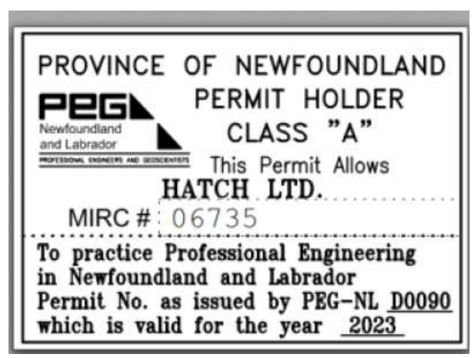
Newfoundland and Labrador Hydro
Concept Design Report

Final Report



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2023-09-28	2	Final Report	H. MacLean	S. DeYoung	K. Meghari
Date	**Rev.**	**Status**	**Prepared By**	**Checked By**	**Approved By**
HATCH					

IMPORTANT NOTICE TO READER

This report was prepared by Hatch Ltd. ("**Hatch**") for the sole and exclusive benefit of Newfoundland and Labrador Hydro (the "**Owner**") for the sole purpose of assisting the Owner to complete a conceptual design study (the "**Project**"), and must not be provided to, relied upon or used by any other party.

Any use of or reliance upon this report by another person is done at their sole risk and Hatch does not accept any responsibility or liability in connection with that person's use or reliance.

The use of this report by the Owner is subject to the terms of the relevant services agreement between Hatch and Owner.

This report is meant to be read as a whole, and sections should not be read or relied upon out of context. The report includes information provided by the Owner and by certain other parties on behalf of the Owner. Unless specifically stated otherwise, Hatch has not verified such information and does not accept any responsibility or liability in connection with such information.

This report contains the expression of the opinion of Hatch using its professional judgment and reasonable care, based upon information available at the time of preparation. The quality of the information, conclusions and estimates contained in this report is consistent with the intended level of accuracy as set out in this report, as well as the circumstances and constraints under which this report was prepared.

As this report is a conceptual study, all estimates and projections contained in this report are based on limited and incomplete data. Accordingly, while the work, results, estimates and projections in this report may be considered to be generally indicative of the nature and quality of the Project, they are not definitive. No representations or predictions are intended as to become the results of future work, and Hatch does not promise that the estimates and projections in this report will be sustained in future work.

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Acronyms

AACE	Association for the Advancement of Cost Engineering
AC CD	Atlantic Canada Conservation Data Centre
COD	Cost of Delivery
CT	Current Transformer
DECC	Department of the Environment and Climate Change
DFO	Fisheries and Oceans Canada
DLE	Dry-Low Emissions
EA	Environmental Act
EBS	Estimate Breakdown Structure
EPCM	Engineering Procurement Construction Management
eHGPI	Extended Hot Gas Path Inspection
FG	Fuel Gas
FWS	Fuel Water Separator
[redacted]	[redacted]
GHG	Greenhouse Gas
GIS	Geographical Information Systems
GTG	Gas Turbine Generator
HGPI	Hot Gas Path Inspection
HMI	Human Machine Interface
HRD	Holyrood
HRSG	Heat Recovery Steam Generator
IAA	Impact Assessment Act
IAAC	Impact Assessment Act Canada
IDC	Interest During Construction
ISO	International Organization for Standardization
LIL	Labrador Island Link
MCC	Motor Control Centre

[redacted]	[redacted]
MI	Minor Inspection
ML	Maritime Link
MO	Major Inspection
NFPA	National Fire Protection Association
NL	Newfoundland and Labrador
NLH	Newfoundland and Labrador Hydro
NLSO	Newfoundland and Labrador System Operator
NRCan	Natural Resources Canada
OEM	Original Equipment Manufacturer
PAO	Provincial Archaeological Office
PFD	Process Flow Diagram
POI	Point of Interconnection
RCIE	Rotor and Casing Inspection & Evaluation
SAC	Single Annular Combustor
SOD	System Operating Diagrams
SOP	Soldiers Pond
STG	Steam Turbine Generator
TCP	Turbine Control Panel
TGS	Thermal Generating Station
TIC	Total Installed Cost
TS	Terminal Station
WBS	Work Breakdown Structure
WRMD	Wildlife Rehabilitation Medical Database
WUL	Water Use License

1. Executive Summary

1.1 Emergency Power Plant on the Avalon Peninsula

The Holyrood Thermal Generation Station (Holyrood TGS) is to be decommissioned as part of Newfoundland and Labrador Hydro's transition to lower emission power generation. NLH is therefore considering the role of an emergency plant during and post-decommissioning of the Holyrood TGS. The emergency plant is expected to operate for approximately 6 consecutive weeks per year and be available to operate for the remainder. NLH has engaged Hatch to complete a concept design study examining the feasibility of an emergency plant consisting of gas turbines located on the Avalon Peninsula.

The study analyzed a staged approach for the plant capacity, with three (3) phases being evaluated as requested by NLH. To minimize the risk of stranded assets, NLH must consider CT's that can run on natural gas, diesel, biodiesel, and hydrogen blend fuels. The following phases were evaluated in this study.

- **Phase 1:** 150 MW output
- **Phase 2**: 300 MW output
- **Phase 3**: 450 MW output

As part of this study, Hatch assessed the potential site locations to determine which would be the most feasible. The concept design study for the emergency plant included the following:

- Combustion turbine technology review and selection
- Identification of possible power plant sites along the Avalon peninsula
- Investigate land purchase requirement for identified locations.
- Fuel and water supply and logistics
- Demineralized water treatment equipment
- Electrical interconnection requirements
- Environmental impact
- Noise impact
- Project schedule
- Capital cost.

The following sections summarize the various aspects of the emergency plant conceptual design study, including the site location, performance data, environmental assessment, fuel assessment, noise impact, project schedule, and cost estimate.

1.2 Site Location

The study considered various potential locations on the Avalon Peninsula. Six (6) sites were considered, five (5) of these sites are greenfield and one (1) of the sites is considered brownfield. These sites are listed in Table 1-1.

Table 1-1: Proposed Sites

Option	Site Name	Classification
A	Holyrood	Brownfield
B	Paddy's Pond	Greenfield
C	Sugarloaf Pond	Greenfield
D	Soldiers Pond	Greenfield
E	Bremigen's Pond	Greenfield
F	Petty Harbour Long Pond	Greenfield

A site assessment was performed to rank each location based on various criteria. The technical criteria considered were transmission availability and proximity, fuel supply and logistics, water availability, and noise constraints. These criteria were selected as they have a significant impact on the feasibility of a site and greatly aid in the site selection process.

After performing the site assessment, Holyrood TGS (Option A) and Soldiers Pond (Option D) were determined to be the top two sites based on the above criteria.

1.3 Combustion Turbine

Three (3) original equipment manufacturers (OEM) were contacted on specific gas turbine technologies that met the project requirements. A gas turbine specification was developed and issued to the OEMs for a budgetary price, equipment general arrangement drawings, performance data on natural gas and diesel, biofuel and hydrogen fuel capability and experience, and estimated delivery time. [redacted]

Aeroderivative gas turbines were considered due to their higher efficiency and industrial gas turbines were considered as they require the least number of units to deliver the required output. [redacted]

[redacted]

[redacted]

1.4 Power Plant Performance

Table 1-2 describes the gas turbine performances for the [redacted] aeroderivative gas turbine and the [redacted] industrial gas turbine based on information sent by [redacted]. These two technologies where selected as representative of aeroderivative gas turbines, and industrial frame gas turbines. This data was calculated for Scenario 1 (150MW) assuming that the gas turbines would be running on diesel fuel. The performance evaluation was done under the following site conditions:

- Temperature: 25°C
- Relative Humidity: 60%
- Elevation: 152 m

This plant will be operating as an emergency backup plant, with an expected operating time of approximately 6 weeks a year continuously. The performance data can be seen in Table 1-2 and Table 1-3 below.

Table 1-2: Performance Data

		[redacted]	
	Units	[redacted]	[redacted]
Model	-	[redacted]	[redacted]
Unit Output	MW	[redacted]	[redacted]
Heat Rate (LHV)	kJ/kWh	[redacted]	[redacted]
Efficiency	%	[redacted]	[redacted]
Water Injection per GT	t/h	[redacted]	[redacted]
Fuel Consumption	t/MWh	[redacted]	[redacted]

Table 1-3: Output, Fuel Consumption and Number of Units for Phase 1, 2 and 3

			[redacted]	
		Units	[redacted]	[redacted]
Model	-	-	[redacted]	[redacted]
Output	*Phase 1*	MW	[redacted]	[redacted]
	Phase 2	MW	[redacted]	[redacted]
	Phase 3	MW	[redacted]	[redacted]
Fuel Consumption	*Phase 1*	t/h	[redacted]	[redacted]
	Phase 2	t/h	[redacted]	[redacted]
	Phase 3	t/h	[redacted]	[redacted]
No. Units	*Phase 1*	-	[redacted]	[redacted]
	Phase 2	-	[redacted]	[redacted]
	Phase 3	-	[redacted]	[redacted]

[redacted]

[redacted]

1.5 Environmental Assessment

Environmental, regulatory, and social criteria were examined in tandem with technical criteria for the short-listed proposed sites. A Multi-Criteria Analysis was developed to rank the proposed site location. In summary, Option A: Holyrood TGS, performed the highest of all sites, with a score of 87%. Option D: Soldiers Pond', scored the second highest of all sites and the highest of all greenfield sites, with a 70% score.

Therefore, the two options further modelled and investigated for interconnection, fuel delivery, and noise impact for this study, were the brownfield site (Option A) at Holyrood TGS, and the preferred greenfield site (Option D) at Soldiers Pond. The scoring of each site and its preferred rank (1 being highest), is provided in Table 1-4.

Table 1-4: Summary of Site Selection Results

Option	Site Name	Classification	Score	Preferred Rank
A	Holyrood TGS	Brownfield	87%	1
B	Paddy's Pond	Greenfield	63%	3
C	Sugarloaf Pond	Greenfield	51%	4
D	Soldiers Pond	Greenfield	70%	2
E	Bremigen's Pond	Greenfield	51%	4
F	Petty Harbour Long Pond	Greenfield	41%	5

1.6 Fuel Assessment

1.6.1 *Combustion Turbine Fuel Capability*

The [redacted] aeroderivative gas turbine and [redacted] gas turbine can burn natural gas, diesel, biofuel, and hydrogen blends. They can burn [redacted] and [redacted] hydrogen by volume in its [redacted] annular combustor, respectively, while the [redacted] gas turbine can burn natural gas and diesel with limited experience burning biofuels such as ethanol. [redacted]

1.6.2 *Fuel Supply and Logistics*

The fuel analysis provides an overview of the fuel options in the Avalon Peninsula. The fuel supply landscape in Newfoundland and Labrador is dominated by diesel with limited supply of alternative fuels. The fluctuating demand for diesel fuel can pose several challenges in the fuel supply chain. The fuel consumption per day for the [redacted] and the [redacted] gas turbines for each phase are listed in Table 1-5.

Table 1-5: Daily Fuel Consumption

Turbine Type	Fuel Consumption (t/MWh)
[redacted]	[redacted]
[redacted]	[redacted]

When demand for diesel fuel surges in the region, the existing infrastructure will struggle to handle the increase volume which may lead to bottleneck and supply disruptions. The current fuel infrastructure for diesel is more dominant than other alternative fuels; procuring diesel is more convenient compared to other alternatives fuels but procuring diesel that is required for Phase 2 and Phase 3 poses a challenge for the truck delivery method.

The Holyrood site has the option for sea transportation of fuel where barges can deliver fuel to site and the site is well connected to a road network. If advance notification is provided, suppliers can anticipate the demand and supply large quantities of diesel fuel to NLH as required.

Hatch contacted multiple suppliers [redacted] Some suppliers are unable to provide large amounts of fuel without notice (20-45 days lead time), but some mentioned that they can deliver 6-8 million liters of fuel in a 10-day period with 2-3 days notice. Other suppliers mentioned that they can delivery approx. 600,000 liter per day via truck. If the weather does not allow for truck delivery, barge delivery will be required, but 600,00lb/day will still be achievable. Most suppliers can handle the demand required for all the three phases; however, more advance notice should be provided so that they can plan their supply chain. The suppliers have stated that they can provide 600,000 L/day in addition to what is already being supplied on the island.

Since it will require up to 10 days to receive fuel from the vendors, an initial volume of fuel is required on site to run the plant with no notice. To supply the plant with 10 days worth of fuel, the following quantities of fuel are required as an initial storage volume. Table 1-6 below shows the initial storage needed for 10 days, if 600,000 liters/day were delivered. All fuel quantities have been normalized to 150MW, 300MW and 450MW, respectively.

Table 1-6: Required Initial Fuel Storage Volumes

		Phase 1	Phase 2	Phase 3
[redacted]	Volume (ML)	5.0	15.5	26.0
[redacted]	Volume (ML)	7.0	19.5	32.0

1.7 Electrical Interconnection

Both Holyrood and Soldiers Pond sites provide an acceptable Point of Interconnection (POI) to NLH's 230kV transmission system. Holyrood's electrical layout will be slightly larger because two additional 230kV breaker bays are required. For this reason, the relative cost of the terminal station will be slightly higher.

Soldiers Pond will require the thermal uprating of TL 242 to [redacted] MVA from the winter rating of [redacted] MVA for the contingency of loss of TL 266. This location may require a tighter outage window of TL 266 when tying the line into the new terminal station as there may be an elevated risk of thermal overload of TL 218 should there be an unexpected outage of TL 242 during the tie in process. Further analysis during the FEED stage will be required to quantify this risk and propose mitigation strategies.

1.8 Noise Impact

The noise impact of the proposed combustion turbines on the surrounding environment was evaluated for the Holyrood and Soldiers Pond sites based on Nova Scotia's noise regulations as there were no specific requirements for Newfoundland and Labrador. Noise levels at the nearest sensitive receptors due to operation of both sites are predicted to be below the adopted guidelines from the Province of Nova Scotia for acceptable equivalent continuous sound levels for industrial zones[1] (Leq):

- Leq of 65 dBA between 0700 to 1900 hours
- Leq of 60 dBA between 1900 to 2300 hours
- Leq of 55 dBA between 2300 to 0700 hours.

The analysis is based on preliminary information and subject to refinement during the FEED study and detailed design phase. The considered noise criteria need to be verified with the corresponding regulatory authority (Department of Environment and Climate Change). For lower noise limits below 50 dBA, the location of the Holyrood site would need to be moved further away from the residential area to the north-west of the site. Soldiers Pond site noise impact at the nearest receptor is very low and it can satisfy noise limits down to 40 dBA.

1.9 Project Schedule

A level 2 preliminary project schedule was developed for two power plant output scenarios, 150 MW and 450 MW, corresponding to lowest and highest plant size. The estimated timeline for budgeting approval, environmental assessment, engineering procurement, construction, and management to commercial operating is approximately 6 and 8 years for the 150 MW and 450 MW, respectively. This project timeline is highly dependent on gas turbine generator availability from the OEM. The project schedule will differ depending on which OEM is selected, therefore, a project schedule was developed for both the [redacted] and the [redacted] gas turbines.

[1] guidelines-environmental-noise-measurement-assessment.pdf (novascotia.ca)

1.10 Capital Cost

This study includes an AACE Class 5 Cost Estimate with an accuracy of -30% and +50%. The capital cost of each scenario is broken down into direct, indirect, and contingency costs. The cost estimate does not include owner's costs. Owner's costs include but not limited to: Owner's project management team and consultants, Front-End Engineering and Design (FEED), owner's startup and commissioning crew, taxes, project financing, permitting and approvals, project escalation, insurance during construction (IDC), land acquisition, site survey and soil testing, predevelopment works, and contingency. The cost estimate was performed for the [redacted] and [redacted] gas turbines for three scenarios: 150MW, 300MW and 450MW output.

The equipment list with budgetary numbers received from OEMs was used to develop a Class 5 cost estimate shown in Table 1-7 and Table 1-8.

Table 1-7: Capital Cost for [redacted]

Breakdown of Activities	[redacted]		
	[redacted]	[redacted]	[redacted]
Direct cost	[redacted]	[redacted]	[redacted]
Indirect cost	[redacted]	[redacted]	[redacted]
Contingency (25%)	[redacted]	[redacted]	[redacted]
Capital Costs	[redacted]	[redacted]	[redacted]
$/KWh	[redacted]	[redacted]	[redacted]

Table 1-8: Capital Cost for [redacted]

Breakdown of Activities	[redacted]		
	[redacted]	[redacted]	[redacted]
Direct cost	[redacted]	[redacted]	[redacted]
Indirect cost	[redacted]	[redacted]	[redacted]
Contingency (25%)	[redacted]	[redacted]	[redacted]
Capital Costs	[redacted]	[redacted]	[redacted]
$/KWh	[redacted]	[redacted]	[redacted]

The CAPEX estimate excludes escalation, taxes, owner's costs, currency fluctuation, financing costs, camp costs, site dewatering costs, environmental approval costs, schedule acceleration/delay costs, development fee and approval cost of statutory authority and allowance for piled foundation.

The contingency estimate excludes potential scope changes, process escalation, currency fluctuation, allowance for force majeure and other project risks.

1.10.1 *Operating Cost Estimate*

The fixed operational costs include costs for operators of the facility, maintenance labour and materials and the administrative costs to provide the facility service, but exclude taxes and royalties, owner's administrative costs on the corporate level.

Non-fuel variable operating, and maintenance costs were estimated based on a back up duty mode of operation with approximately 870 hours of operation. Variable O&M costs include consumable commodities, such as water, lubricants, and chemicals. Also included is the average annual cost of the planned maintenance events for the CTs over the long-term maintenance cycle, based on the number of equivalent operating hours (EOH) the CT has run. Staffing is assumed to include 4 operators, 2 maintenance personnel and an allowance for administration/management staff.

Estimated Total Fixed O&M Cost: [redacted]

Estimated Total Non-Fuel Variable O&M Cost: [redacted]

The operating cost estimate above is based on Aeroderivative gas turbines technology, and it is for 150 MW power; for phase 2 and 3 power plants the total Fixed O&M cost will be lower than [redacted]

1.10.2 *Recommendations*

The Aeroderivative gas turbines are good candidates for the project given their fuel efficiency, and fuel flexibility. Aeroderivative gas turbines are reliable machines and are leaders in terms of fast start capabilities and efficiency. This study is representative and further investigation and review will be required at the FEED stage.

The recommended plant site is the Holyrood site as it already has an existing dock and road facility for both barge and truck delivery. Due to the large on-site fuel storage and transportation requirements for larger plant sizes we recommend building a 150 MW (nominal) power plant. A better alternative to a large plant size of 300MW or 450MW is to build a smaller gas turbine back up plant of 150 MW to support the first project phase; and further investigate the feasibility of larger plant sizes while considering renewable energy sources with battery storage or hydrogen for subsequent project phases.

2. Introduction

Newfoundland and Labrador Hydro engaged Hatch to perform a concept design study. The concept design study stems off NLH's system planning strategy to continuously improve its generation capacity to meet the current growing power demands in the province. NLH has also determined that the Holyrood Thermal Generating Station (Holyrood TGS) is not a long-term option to meet these growing power needs, hence the need to assess power supply alternatives.

The primary objective of the study is to develop a conceptual engineering study for an emergency plant, identify potential sites for the proposed combustion turbine along the Avalon Peninsula, situated on the southeastern part of the Island of Newfoundland. The identified site would be ranked based on the environmental and noise impact, fuel, and water availability along side the required electrical interconnection infrastructure.

Table 2-1 below shows list of examined sites and location.

Table 2-1: Proposed Site Locations

Site Option	Site Name	GPS Coordinates	Classification
A	Holyrood TGS	47.451236, -53.09741	Brownfield
B	Paddy's Pond	47.487436, -52.8996	Greenfield
C	Sugarloaf Pond	47.612844, -52.67908	Greenfield
D	Soldiers Pond	47.413802, -52.98254	Greenfield
E	Bremigen's Pond	47.521668, -52.84968	Greenfield
F	Petty Harbour Long Pond	47.506469, -52.71937	Greenfield

The study examined three (3) different power plant output phases; these are:

- **Phase 1:** 150MW Output
- **Phase 2:** 300MW Output
- **Phase 3:** 450MW Output

The combustion turbine was screened based on the equipment fast start capability, synchronous condensing capability, fuel flexibility and ability to be used as a back up generation and emergency plant. An AACE Class 5 estimate was developed for the three output scenarios.

Technical limitations of burning hydrogen, diesel, biofuels such as ethanol and biodiesel in the combustion turbine was reviewed along aside specific upgrades required for a turbine to burn more volume of hydrogen and biofuels.

The sourcing, transportation, and technical limitations of using diesel fuel was reviewed and discussed in the study report.

3. General Plant Description

3.1 Plant Description and Configuration

The combustion turbine generators will be arranged in a parallel configuration with sufficient spacing for equipment maintenance, including crane access and laydown area. Each gas turbine generator (GTG) will be a stand-alone generating unit which will include all necessary auxiliary equipment including exhaust stack, air cooled lube oil coolers, power augmentation and winterization package.

The generators are connected to the switchyard through a dedicated 13.8kV to 230kV step up transformer. Each 13.8kV to 230kV transformer may be connected to two generators.

The GTG package and plant auxiliary systems include the following:

- Black Start
- Synchronous condenser
- Exhaust stack with new doors
- Combustion turbine generator
- Start-up system and requirement
- Instrumentation
- Batteries/chargers
- Uninterruptible power supply (“ups”) systems
- Inlet/heating de-icing system
- Lube oil system
- Demineralized and raw water requirement
- Compressed air system
- Fuel System
- Gearbox (if required)
- Coupling(s) and coupling guards.
- Continuous emissions monitoring system
- Generator step-up transformer
- Fire Protection system
- Air cooled generator, open ventilated complete with generator enclosure

- Generator stator heater
- Turbine generator supervisory system
- Turbine control panels

3.1.1 *Operating Requirements*

The GTG will be designed for cyclic, part load, and base load operation. Each unit will be capable of frequent start-ups and shutdowns as well as occasional full load rejections. This plant will be operating as an emergency backup plant, with an expected operating time of approximately 6 weeks a year, continuously.

3.1.2 *Redundancy Design Philosophy*

Plant redundancy will be provided as follows:

- Each GTG system will be complete and capable of full load operation without support from the other units. Full system and component redundancy is not provided within a single GTG package. However, redundancy is provided within the GTG package for protection and control and as required to prevent equipment damage. Backup power for essential combustion turbine systems is provided by a battery powered DC system.
- Redundancy will be provided for all normally operating fuel system components, i.e., pumps, pressure regulating valves and filter/separators.
- Service and demineralization water pumps will be provided with 100% redundancy.
- Compressed air system will be provided with redundant air compressors and air dryers.

4. Design Basis

4.1 Mechanical

4.1.1 *Fuel System*

The basis for the design of the simple cycle combustion turbine is that the turbines need to have the capability of running on diesel fuel with a possibility of converting to either natural gas, biodiesel, ethanol, or hydrogen in the future.

The liquid fuel system includes the following major components:

- Manual isolation valve
- Fire safety valve with limit switches
- Duplex filter assembly
- Fuel boost pump
- Metering flow control valve
- Automatic shut-off valves
- Flow meter

- Flow divider valve
- Automatic drain vales
- Pressure and temperature instrumentation
- Fuel storage tanks.

4.1.2 *Combustion Turbine Generators*

The combustion turbine generators will operate in simple cycle mode with a fast start (10 minutes) and synchronous condenser capability. The turbine generators will be equipped with a winterization and power augmentation packages.

4.1.3 *Raw Water*

Raw water can be supplied from either municipal water mains or from adjacent water bodies. The raw water would be used for the demineralized plant and potable water services.

4.1.4 *Demineralized Water*

Demineralized water will be used for the following:

- The power augmentation system (Spray Intercooling)
- Compressor water wash.
- NOx abatement.

A demineralization plant will be built to supply demineralized water for plant use. Service water will be demineralized then pumped and stored in the demineralized water tank. The demineralized water will then be pumped to the combustion turbine.

The demineralized water system includes the following:

- Multimedia Inlet Filter
- Reverse Osmosis System
- Polishing demineralizer
- Demineralized water tank
- Demineralized Water Pumps.

The demineralized tank construction will be stainless steel and will be provided with insulation and immersion heaters to prevent freezing. The plant demineralized water pumps and service water pumps will be housed in a building. Table 4-1 shows the average required demineralized water quantity for each power plant option.

Table 4-1: Demineralized Water Requirements

Option	Demineralized Water Flow Rate (m^3/hour)
Phase 1 (150MW)	40
Phase 2 (300MW)	110
Phase 3 (450MW)	150

4.1.5 Compressed Air

The compressed air system will provide the plant with “Instrument Air” and “Service Air”. Both instrument and service air will go through series of filters and dryers.

Compressed air will be used for the following:

- GTG inlet air self-cleaning filter (air pulse type)
- GTG lube oil shut down cooling
- Miscellaneous Instrument Air Users
- Miscellaneous Service Air Users

The following equipment will be included:

- Compressors
- Air dryers
- Receivers

4.1.6 Glycol Cooling System

The Glycol Cooling System for the main lube oil system consists of a fin fan air cooled heat exchanger and a single glycol circulation pump with a three-way temperature control valve. The glycol cooler will be located outdoors, and the circulating pump and three-way control valve will be located in the Auxiliary Module Building dedicated for the lube oil storage and pump facility.

4.2 Electrical, Instrumentation and Control System

The power plant electrical system is designed to include a high and low voltage system, generator step-up transformers, lighting poles/panels, cathodic protection for outside tanks, and exhaust stack lightning protection.

The electrical, instrumentation, and control system for the combustion turbine includes the following:

- Air-conditioned control room for turbine/generator panels.
- 600 VAC and 120/208 VAC electrical power for gas turbine starting and accessories.

- Electrical power connections (power cable or duct) from the generator lineside cubicle to the plant facility electrical systems.
- Electrical control connection from the on-base terminal points to the turbine control panel, and from the generator control panel to plant facility electrical systems.
- Motor control centers (MCC) and auxiliary power transformers.
- Control cables between the turbine/generator panels and MCC.
- Power cables to and from the 24/125 VDC battery and charger systems.
- Generator protective relay panels.
- Automatic voltage regulator, power system stabilizer and vibration monitor

4.3 Civil and Structural

The structural design at all sites is based on a simple steel-frame building with concrete foundations and metal cladded exterior. Depending on the interior layout requirements, this can be accomplished using a stick-build or pre-engineered type of construction.

It is anticipated that the geotechnical conditions on site will allow for the foundations to be a spread footing type bearing on undisturbed native fill or bedrock without the need for a piled foundation. The foundations are expected to have an underside of footing that is below frost depth, which is assumed to be 1.5 metres below finished grade. The slab-on-grade will be designed to support standard occupancy load and any additional equipment may have either a thickened slab or separate foundation detail, depending on specific equipment isolation and loading requirements.

The environmental loading for the building (wind, snow, and seismic) will be based on the NBCC 2015 for St. John's, NL since all sites are close to the city. The structure is anticipated to be a post disaster building as it is essential to the provision of services in the event of a disaster. There will be one building per phase, which will include the gas turbine units and the water treatment equipment associated with that phase. The phase 3 option will therefor include three (3) separate buildings.

Other than the excavation and backfill requirements for installation of the foundations, it is assumed that none of the proposed sites require a significant amount of site grading or drainage detailing.

5. Technology Overview

5.1 Combustion Turbine Overview

The following three technologies were screened for the project to determine if the vendors could meet the specifications described above and in the GTG Specification sheet, shown in Appendix D.

[redacted]

All three vendors have experience in the design and supply of gas turbines.

[redacted]

5.1.1.1 Technology Overview

[redacted] Since this unit is aeroderivative, it can easily be used for an emergency plant application due to its fast start up and stop capabilities and excellent load following.

The technology has the following capabilities:

- Has a ramp up rate of [redacted] MW/minute with a minimum turn down load of [redacted] of full load.
- Meets various dispatch profiles with 5-minute start and can reach max power in less than [redacted] minutes.
- Has high fuel flexibility (ethane, propane, LPG) with a standard combustor.

[redacted]

[redacted]

Figure 5-1: [redacted]

5.1.1.2 *Configuration*

The gas turbine configuration includes a [redacted] fuel system, a turbine/synthetic lube oil (TLO) system, a hydraulic start system, a water injection for NOx system, [redacted], a water wash system, and a combustion exhaust system connection.

The generator configuration includes a generator excitation and regulation, line side and neutral side cubicles, a generator lube oil (GLO) system, and a generator cooling/ventilation system. [redacted] a gearbox in this configuration.

The ventilation & combustion air (VCA) system configuration includes an air filter house and inlet plenum, an air inlet chilling and anti-ice system, and a pulse filter system.

Also included is a control and monitoring system, a fire and gas detection system and a battery system.

5.1.1.3 *Combustor Technology*

[redacted] is fitted with a [redacted] Annular Combustor ([redacted]) or a Dry-Low Emissions (DLE) combustor. [redacted] This produces maximum output with low thermal stress. [redacted] This provides cleaner combustion, reduces NOx, and helps to eliminate the formation of high-carbon visible smoke. Available nozzle designs allow natural gas, or dual-fuel (distillate/natural) operation. The nozzles also permit NOx reduction with Water injection for NOx (Steam injection is no longer offered). [redacted]

5.1.1.4 *Water Injection*

Water Injection for the NOx System is an available option to reduce emissions [redacted]. The Water Injection for NOx System pumps de-mineralized water to the fuel nozzles via an engine mounted manifold. The water injection motor/pump assemblies, duplex filter assembly, and flow-control valve are located on [redacted]. The [redacted] aeroderivative gas turbine can achieve a [redacted] ppm NOx emissions target with water injection when running on natural gas and [redacted] PPM NOx when running on diesel fuel.

5.1.1.5 *Fuel Capability*

The [redacted] can run on the following fuels:

- Natural Gas
- Diesel
- Biodiesel
- Ethanol
- Hydrogen blend.

[redacted]

The [redacted] can burn [redacted] hydrogen by volume with notable upgrade in the gas turbine. Some of the required upgrades include:

- Fuel blending skid
- H2 and NG stop/control valves
- Flow meters, instrumentation, and controls
- Inert purge system
- Fuel piping material upgrade
- Optical fire protection system
- Gas sensor
- Ventilation system upgrade
- Hazardous gas detection system upgrade
- Software changes.

[redacted]

5.1.1.6 *Winterization*

[redacted] winterization for the package modules. This consists mainly of heat tracing, which includes a variable speed ventilation fans and controlled ventilation louvers. In addition to the package module, an air inlet heating system is also provided. This is achieved by installing an inlet heating coil that sits in front of the air filters to prevent them from clogging with ice/snow.

For equipment operating in hot or cold climates, [redacted] selecting the ambient thermal condition options to mitigate the site operating conditions. [redacted] will provide winterization of the gas turbine package [redacted].

These options may include, but are not limited to:

- Inlet air conditioning (heating or cooling).
- Air conditioning or heaters for some equipment.
- Heat tracing and insulation of applicable unit mounted piping.
- Enclosing and heating exposed instruments and equipment.
- Winterization enclosures for auxiliary skids.
- Variable Frequency Drives for ventilation fans.
- [redacted] special equipment may be required.

5.1.1.7 *Synchronous Condensing*

[redacted] synchronous condensing capabilities. The generator is a synchronous, two-pole, cylindrical rotor machine. It has open-air cooling and a static or brushless excitation system with permanent magnet generator. [redacted].

5.1.1.8 *Start-Up*

The [redacted] package has the unique ability to reach full power (simple-cycle) from a cold start within [redacted] minutes for special applications. The gas turbine load ramp rate would be [redacted] kW/sec, a total of [redacted] seconds to full load.

5.1.1.9 *Balance of Plant – Instrumentation and Controls*

The instrumentation and controls provided will ensure safe and efficient operation of the process over the complete range of operating conditions. The following balance of plant systems are required.

- Gas Turbine enclosure
- Lubricating Oil and Hydraulic Oil Systems
- Lube Oil Cooler: Shell & Tube Cooler
- Lube Oil Piping and Reservoir
- Multi-stage Static Air Filtration System
- Evaporative Cooling for improved performance Exhaust
- Exhaust Collector and Flange
- Turbine Control Panel (TCP)
- Generator Monitoring and Integrated Generator Protection System
- 24 V DC Battery and Charger System
- Human Machine Interface (HMI)

- Fire Protection System
- Vibration Monitor
- GTG Motor Control Center (CE).

[redacted]

5.1.2.1 *Technology Overview*

[redacted] supplies aero-derivative gas turbine packages that generate [redacted] to [redacted] MW, tailored and responsive aftermarket services, turnkey EPC expertise, and battery storage. Since this unit is aeroderivative, it can easily be used for an emergency plant application due to its fast start up and stop capabilities and excellent load following.

[redacted]

Figure 5-2: [redacted]

The [redacted] has the following features:

- Enables a start-up time of less than [redacted] minutes from cold start.
- A load change rate of [redacted] per minute.
- [redacted] MW Output.

5.1.2.2 *Configuration*

The [redacted] gas turbine can be coupled to an electric generator in either a [redacted] gas turbine configuration. [redacted] has quote the [redacted] gas turbine in a [redacted] gas turbine configuration, which has [redacted]

[redacted] electric generator is a two-pole, air-cooled synchronous type which includes a brushless exciter and permanent magnetic generator. This generator includes cylindrical rotors which are supported with end frame journal bearings.

5.1.2.3 *Combustor Technology*

The [redacted] gas turbine utilizes an [redacted] combustor and is furnished with [redacted] fuel nozzles for liquid distillate fuel, natural gas fuel, or dual fuel depending upon the fuel system specified by the customer. The combustion system can achieve [redacted] ppm NOx without a selective catalytic reducer (SCR) while running on diesel.

5.1.2.4 *Water Injection*

The [redacted] comes with a dry low NOx combustor technology that does not required water for NOx abatement to achieve [redacted] ppm NOx on diesel.

5.1.2.5 *Fuel Capability*

The [redacted] is designed to run on liquid fuel, diesel, and natural gas. [redacted] currently can burn [redacted] hydrogen by volume with a development cycle of attaining [redacted]. As of the time of this report, the [redacted] does not have the capability to burn any biofuel.

5.1.2.6 *Winterization*

The gas turbine enclosure and electric generator enclosure are designed for outdoor operation to protect the engine and related equipment from the weather and to reduce noise levels. The stated design temperature range is from [redacted] max. The enclosure is supplied with filtered ventilation air. For installation into a building, the inlet and exhaust stacks will need to be ducted. Sufficient access to the enclosure is provided with personnel doors and equipment removal doors or panels. Sufficient space within the enclosure is provided to allow for normal maintenance and removal of major components.

In cold weather applications, [redacted] provides a set of engineered systems which allows operations below [redacted]. By using heat tracing and an EG recirculation air damper, the equipment can operate at low temperatures and be resistant to icing.

5.1.2.7 *Synchronous Condensing Mode*

This mode allows the generator to operate as a synchronous motor for grid voltage stabilization at a leading or lagging power factor selected by the operator. This mode can be entered from normal operation or from shutdown condition. The synchronous motor can be operated in Voltage control or VAR control to enable support of transmission system requirements.

5.1.2.8 *Start-Up*

Start-up time of less than [redacted] minutes from cold start with outstanding system stability and a load change rate of [redacted] per minute.

5.1.2.9 *Balance of Plant – Instrumentation and Controls*

The following are the balance of plant systems required for the [redacted]:

- Gas Fuel System
- Liquid Fuel System
- Water Treatment System
- Compressed Air System
- Wastewater System
- Fire Protection System

- Auxiliary Electrical Systems
- Medium Voltage Electrical System
- High Voltage Switchyard/Transmission
- Civil/Structural Works.

[redacted]

5.1.3.1 *Technology Overview*

The [redacted] industrial gas turbine combines a simple robust design for high reliability and easy maintenance with high efficiency and low emissions. [redacted]

[redacted]

Figure 5-3: [redacted]

The technology has the following capabilities:

- Broad flexibility in fuels, operating conditions, maintenance concepts, package solutions and ratings to satisfy different market requirements.
- World-class reported fleet reliability of >99.5%.
- NOx emissions less than [redacted] PPMV at 15% O_2 on fuel oil (DLE system).
- [redacted] MW output at 25°C site condition.

5.1.3.2 *Configuration*

The gas turbine engine has a single shaft industrial type configuration with a modular design, and the compressor casing is [redacted]. [redacted] The gas turbine is designed with a single shaft rotor with a rotor speed of [redacted] rpm connected to the [redacted]

[redacted] This gas turbine has a DLE configuration with a [redacted] turbine design. The exhaust gas system is an insulated axial exhaust diffuser with support.

5.1.3.3 Combustor Technology

The [redacted] gas turbine comes with dual fuel dry low emission (DLE) system. The burners on the gas turbine fleet are dry (DLE), [redacted].

5.1.3.4 Water Injection

The [redacted] Energy standard DLE combustion system does not require water injection to meet the required low NOx emission levels. The unit us able to achieve [redacted] ppm NOx (Nitrogen Oxide) on natural gas and [redacted] ppm NOx on diesel no 2. The combustor consists of [redacted] DLE replaceable burners with on load fuel changeover capability.

5.1.3.5 Fuel Capability

The [redacted] offers gas only, liquid only (Diesel No.2) or dual fuel (gas/liquid) with on-load fuel-changeover capability. The engine, equipped with DLE burners, is capable to burn up to [redacted] vol% of hydrogen (H_2). The [redacted] can also burn LNG, syngas, blast furnace gas, biogas, ethane, propane, condensate, distillate oil, heavy and crude oils, biodiesel, alcohols, naphtha, or kerosene.

5.1.3.6 Winterization

The turbine generator package will require an anti-icing heater for temperatures below [redacted].

5.1.3.7 Synchronous Condensing

The water-cooled AC generator comes with synchronizing equipment. The reactive power of the [redacted] synchronous condenser can reach up to [redacted] MVA at full speed.

5.1.3.8 Start-up

Start-up time of less than [redacted] minutes.

5.1.3.9 Balance of Plant – Instrumentation and Controls

The following are a list of the balance of plant systems:

- Combustion Air Intake System
- Exhaust System
- Gas Fuel and Ignition System
- Lubricating Oil System
- Cooling Water System
- Water Cooled AC Generator
- Electric Start & Barring System
- Weatherproof Acoustic Enclosure
- Enclosure Ventilation System

- Electrical and control module
- Fire Extinguishing System.

[redacted]

5.1.4.1 *Technology Overview*

The [redacted] industrial gas turbine combines a simple robust design for high reliability and easy maintenance with high efficiency and low emissions. [redacted]

[redacted]

Figure 5-4: [redacted]

The technology has the following capabilities:

- Broad flexibility in fuels, operating conditions, maintenance concepts, package solutions and ratings to satisfy different market requirements.
- World-class reported fleet reliability of >99.5%.
- [redacted]MW output AT [redacted] site condition.

5.1.4.2 *Configuration*

The single-casing, single-shaft gas turbine has a common rotor shared by the compressor and turbine. The rotor is supported in two bearings outside the pressurized region. The pressure-retaining outer casing comprises a cylindrical center section. A fixed vane carrier, which functions as an outer casing and the front bearing pedestal, are connected at the compressor end. Vane carriers for the final [redacted] compressor stages and for the first turbine stage are inserted in the cylindrical, flexible but rigid center casing. Apart from the inlet casing, all other casing sections are split horizontally.

The intake air is routed through the front bearing housing, which contains the combined journal and thrust bearing. The speed transmitter and the hydraulic turning gear are mounted at the upstream end. The bearing assembly is supported by radial struts connected to the front support paws in the flow path. Air is taken in by an intake shaft located upstream of the compressor. The flow is routed between an inner cylinder and a conical outer shell which is what makes up the exhaust casing.

5.1.4.3 *Combustor Technology*

The [redacted] gas turbine comes with dual fuel dry low emission (DLE) system. The burners on the gas turbine fleet are dry (DLE), not requiring water injection.

5.1.4.4 *Water Injection*

For fuel oil operation, the [redacted] uses water injection to control NOX emissions. NO_X emissions on fuel oil at 15% O2 with water injection is ≤ [redacted] ppmvd.

5.1.4.5 *Fuel Capability*

The [redacted] offers gas only, liquid only (Diesel No.2) or dual fuel (gas/liquid) with on-load fuel-changeover capability. The engine, equipped with DLE burners, is capable to burn up to [redacted] vol% of hydrogen (H_2). The [redacted] can also burn LNG, syngas, blast furnace gas, biogas, ethane, propane, condensate, distillate oil, heavy and crude oils, biodiesel, alcohols, naphtha, or kerosene.

The potential modifications that would be required to burn [redacted] hydrogen gas include the following.

- Fuel blending with Natural Gas to be performed by Own.
- Fuel Gas (FG) piping to be converted (e.g., 316 stainless steel).
- Hydrogen rated FG valves.
- Combustion design and material changes for H2.
- Enclosure to Class 1, Div 2, group B.
- Hydrogen detection equipment for Enclosure.

5.1.4.6 *Winterization*

The turbine generator package will require an anti-icing heater for temperatures below [redacted].

5.1.4.7 *Synchronous Condensing*

Operational flexibility with a synchronous condenser option to provide grid support, with the gas turbine disconnected through an SSS-clutch. The reactive power of the [redacted] synchronous condenser can reach up to [redacted] MVA at full speed.

5.1.4.8 *Start-up*

Start-up time of less than [redacted] minutes with ramp rate of [redacted]MW/min.

5.1.4.9 *Balance of Plant – Instrumentation and Controls*

The following are a list of the balance of plant systems:

- Black start
- Combustion Air Intake System

- Exhaust System
- Gas Fuel and Ignition System
- Lubricating Oil System
- Cooling Water System
- Water Cooled AC Generator
- Electric Start and Barring System
- Weatherproof Acoustic Enclosure
- Enclosure Ventilation System
- Electrical and control module
- Fire Extinguishing System.

5.2 Turbine Technology Selection

[redacted]

[redacted]

[redacted]

5.3 Best Available Control Technology

[redacted] both confirmed the capability of the proposed units to achieve a NOx and CO target of 42 ppmvd and 10 ppmvd at 15% O_2 on diesel fuel respectively with water injection. To monitor these pollutants, a Continuous Emissions Monitoring (CEM)/ Data Acquisition historical storage (DAHS) system can be provided for the gas turbine package. The System utilizes an extractive sampling system that is capable of monitoring NOx, CO, CO_2, O_2, and NH_3. To further reduce the emission target, a Selective Catalytic Reduction (SCR) and Carbon Monoxide Reduction (COR) assembly can be installed. The assembly would consist of an expansion joint, ductwork, CO oxidation catalyst, NOx reduction catalyst, ammonia injection grid, ammonia injection skid, integral stack/silencer assembly, tempering or purge air fans, ammonia forwarding pump skid and required platforms.

5.4 Combustion Turbine Maintenance

5.4.1 Aeroderivative Gas Turbine

Aeroderivative gas turbines maintenance services typically consists of:

- Periodic inspections
  - Period inspection typically includes:
  - Borescope inspection of the engine. This is typically performed approximately every 4000 hour or annually, depending on whichever occurs first.
  - Annual package inspection and controls calibration.
- HGPI- Hot Gas Path Inspection

  Hot section and combustor rotable exchange. This is typically performed approximately at 30,000 fired hours on natural gas which could vary depending on the operation and condition of the engine. During this maintenance interval, the existing hot gas path section will be removed, refurbished, and replaced.
- Major Overhaul

  This is done at approximately 60,000 fired hours, during which the engine is removed and shipped to the nearest repair workshop for an overhaul. During the overhaul, there is a complete tear down and inspection of engine and rebuilding with new or refurbished components. [redacted]

5.4.2 Industrial Gas Turbine

Industrial gas turbine maintenance services are typically categorized into the following inspection programs.

- Minor Inspection (MI)
- Hot Gas Path Inspection (HGPI)

[redacted]

- Major Inspection (MO)
- Rotor and Casing Inspection &Evaluation (RCIE)

[redacted]

Table 5-1: [redacted] Recommended Maintenance Interval

Type of Outage	Equivalent Operating Hours	Starts
MI	11,000	500
HGPI	33,000	-
[redacted]	[redacted]	[redacted]
MO	66,000	3,000
RCIE	100,000	3,000

6. Power Plant Performance

The performance analysis was completed for:

[redacted]

Table 6-1 describes the gas turbine performances based on information sent by [redacted] This data was calculated for Scenario 1 (150MW) assuming that the gas turbines would be running on diesel fuel. The performance evaluation was done under the following site conditions:

- Temperature: 25°C
- Relative Humidity: 60%
- Elevation: 152 m.

This plant will be operating as an emergency plant, with an expected average operation time of 6 weeks a year. The performance data for the [redacted] and the [redacted] gas turbines can be seen in Table 6-1 below.

Table 6-1: Performance Data

OEM	Units	[redacted]	[redacted]
Model		[redacted]	[redacted]
No of units		[redacted]	[redacted]
Gross Output	*MW*	[redacted]	[redacted]
Heat Rate (LHV)	*kJ/kWh*	[redacted]	[redacted]
Efficiency	*%*	[redacted]	[redacted]
Water Injection per GT	*t/h*	[redacted]	[redacted]
Fuel Consumption (150MW)	*t/MWh*	[redacted]	[redacted]
Fuel Storage for 5 days (150MW)	*ML*	[redacted]	[redacted]

See Appendix L for a detailed summary of the estimated performances from the OEMs.

[redacted]

[redacted]

7. Site Selection

7.1 Site Location

Various potential locations were initially screened out from the site selection process due to being located within a public water supply shed. As seen in Figure 7-1, this excluded locations within 'protected' or 'potential' public water supply areas, including:

Protected Water Supply Areas of:

- Windsor Lake: WS-S-0693.
- Petty Harbour Long Pond: WS-S-0692.
- Western Barrens Pond:WS-S-0867.
- Bay Bulls Big Pond: WS-S-0691.

Potential Water Supply Areas of:

- Thomas Pond- St. John's.
- Pierre's Brook – St. John's.

Figure 7-1: Public Water Supply Areas Excluded from the Site Selection Process

Shortlisted sites included one brownfield site and five greenfield sites, all of which are located on the Avalon Peninsula, along the southeastern part of the island of Newfoundland. The sites short-listed for evaluation were:

- Option A: Holyrood TGS
- Option B: Paddy’s Pond
- Option C: Sugar Loaf
- Option D: Soldiers Pond
- Option E: Bremigen’s Pond, and
- Option F: Petty Harbour-Long Pond

Figure 7-2 below shows the location of all sites assessed.

Figure 7-2: Shortlisted Site Locations

7.2 Site Selection Methodology

For each Shortlisted site's location, data sets were collected according to various aspects for performance evaluation and ranking, according to three categories of criteria. These categories included 'Technical and Operational criteria', 'Environmental and Social Criteria', and 'Regulatory and Legal Criteria'. Specific criteria within each category are listed below:

1.) Technical and Operational Criteria:

- Land suitability and space
- Switchyard requirements and proximity to 230 kV lines
- Proximity to Nearest Transmission Station
- Fuel type
- Fuel storage
- Fuel supply and delivery
- Technical availability of water.

2.) Environmental and Social Criteria

- Protected Areas
- Rare flora and Fauna
- Flood Zone Watershed
- Wetlands Potentially Affected
- Quality of Life (Noise, aesthetics)
- Recreational conflicts
- Public Safety/Risk
- Archaeological Potential.

3.) Regulatory and Legal Criteria:

- Water Use and Water Rights
- Land Use Zoning and Jurisdiction
- Permitting, Delays and other obstacles.

7.2.1 Literature Review and Research

Suitable locations were georeferenced, with a 5 km radius applied around each site. Information was then collected via literature review coupled with the use of Geographical Information Systems (G.I.S.) to gather attributes on the three categories of criteria, within the 5 km radius. This approach was selected as it aligns with standard data search requests from the Atlantic Canada Conservation Data Centre (AC CDC). AC CDC Data searches were requested for each site (including the brownfield), which provided information on rare flora and fauna. Each data request Map received from the AC CDC, is provided in Appendix K.

Each site was evaluated based on their proximity to the nearest municipal boundary, or noted if it was within a municipality. Municipal boundaries were retrieved from the NL Department of Municipal and Provincial Affairs “Municipal plans and development regulations registered under the Urban and Rural Planning Act, 2000” webpage. Geospatial data was imported into GIS software, and the shortest line between features process was executed. Results were rounded to the nearest tenth of a kilometre and recorded. Additional information was collected from the NL ‘Land Use Atlas’ to retrieve information related zoning, crown lands, and other geospatial data. Additional zoning information was collected from the City of St. John’s Land Master Plan for Land Use, and collected from the St. John’s Map Viewer, online tool.

Information on public water supply areas, and water rights were retrieved from the Government of NL’s Water Use License Mapping Application and Water Resources Portal. The NL Water Resources Management Board was also consulted via email correspondence.

A proximity analysis was undertaken to measure the distance from each site to the closest wetland. Locations of wetlands was retrieved from Natural Resources Canada's (NRCan) CANVEC 50k dataset. Geospatial data was imported into GIS software and the shortest line between features process was executed. Results were rounded to the nearest tenth of a kilometre and recorded.

A proximity analysis was also undertaken to measure the distance from each site to the closest protected area. The locations of protected area boundaries were retrieved from the National Parks and National Park Reserves of Canada Legislative Boundaries web service, and the Newfoundland and Labrador Department of Municipal and Provincial Affairs GIS Data webpage. Geospatial data was imported into GIS software, and the shortest line between features process was executed. Results were rounded to the nearest kilometre and recorded under the NL *Historic Resources Act*, archaeological sites are protected, and high potential areas require an archaeological impact assessment. For each short-listed site, a 5 km buffer was established in GIS, exported as a shapefile, and provided to NL Provincial Archaeological Office for comments. The Provincial Archaeological authority indicated the archeological potential at each site. This information was recorded.

Regulatory and permitting requirements for development to proceed at the shortlisted Greenfield sites and the Brownfield site, were also investigated. Considerations for sizing of the powerplant (i.e., 150 MW, 300 MW, and 450 MW) at each location were taken into account, specifically as plant upsizing relates to the federal Physical Activities Regulations, pursuant to the federal *Impact Assessment Act* (IAA). As well, a review of the Newfoundland and Labrador *Environmental Protection Act*, and Environmental Assessment Regulations was undertaken to understand provincial EA triggers.

Technical inputs were further received from the various disciplines involved in the study including electrical, mechanical, and civil, to compliment the environmental, social, and regulatory research.

7.2.2 Characterization and Evaluation Workshop

A characterization and evaluation workshop was held on April 19, 2023, between representatives of NL Hydro, and Hatch, to conduct the preferred option evaluation collaboratively. Shortlisted sites were then characterized according to the identified technical, regulatory, environmental, and social aspects, risk, or constraints, with value weighting assigned to each criterion. Criteria Characterization and Weighting are depicted below in Table 7-1. Building off each criteria's characterization attribute, a criteria ranking was assigned, which can be seen in Table 7-2.

Table 7-1: Criteria Characterization and Weight

Category	Weight		Criteria	Characterization
Technical and Operational	10.00%	47%	Land Suitability/Space	Access, topo/contours (Slope %, cut and fill), space for 150MW versus 450MW facility
	10.00%		Switchyard Requirements and Proximity to 230kV Line	Terminal station upgrades, Located on the 230 kV ROW, within 10 km of ROW, >10 km, etc.
	5.00%		Proximity to Nearest Transmission Station	O km, <10 km, > 10 km, > 20 km
	2.00%		Fuel Type	Bunker C, Light Fuel Oil, Diesel, N. Gas, Hydrogen, Biodiesel
	5.00%		Fuel Storage	Refurbish existing, Use existing, Build New
	10.00%		Fuel Supply and Delivery	Marine Terminal, Road Transport
	5.00%		Technical Availability of Water	Proximity to surface water impoundment, City of St. John's Water line. Etc.
Environment and Social	4.00%	32%	Protected Areas	None within 5 km, some within 5 km, <1 km, etc.
	4.00%		Rare flora and Fauna	Rare plant & animals with special status within 5 km radius.
	4.00%		Flood Zone Watershed	Proximity to flood risk zone or watershed
	4.00%		Wetlands Potentially Affected	No wetlands affected, Wetlands present within 2 km, wetlands directly affected
	4.00%		Quality of Life (Noise, aesthetics)	Residential density, noise, and visual aesthetics
	4.00%		Recreational conflicts	Public access, and recreational use
	4.00%		Public Safety/Risk	Perceived and actual risk, traffic increase, fuel storage and proximity to high density residential.
	4.00%		Archaeological Potential	Lands claims and # of sites within 5 km
Regulatory and Legal	5.00%	21%	Water Use and Water Rights	Jurisdiction, Existing Water Rights or Water Use License
	8.00%		Land Use Zoning and Jurisdiction	Zoning and current land use
	8.00%		Permitting, Delays and other obstacles	Permitting and construction complexity, IAA vs EA

The ranking in Table 7-2 combines numerical representation, rank descriptions, as well as traffic light (colour coding) to assist in quantifying qualitative information on attributes for each site.

Table 7-2: Assigned Ranking and Characterization of Criteria

Symbol	Numeric Value	Descriptor
■	4	Preferred, or best option
●	3	Limited issues, suitable option
●	2	Some issues or Constraints
♦	1	Various Issues or Constraints
■	0	Block or impediment

7.3 Result and Discussion

7.3.1 Option A: Holyrood TGS

The Holyrood TGS as the proposed brownfield site, scored highest in cumulative ranking and quantitative scoring against all other proposed locations (87%). The Holyrood TGS property is located 9.93 km away from the nearest large town, Conception Bay South, and 31.36 km away from St. John's. The Holyrood TGS property is in an industrial area, with the nearest residential area 0.58 km away. It is located within the municipal boundaries of the town of Holyrood. Site Option A: Holyrood TGS, is depicted in Figure 7-3.

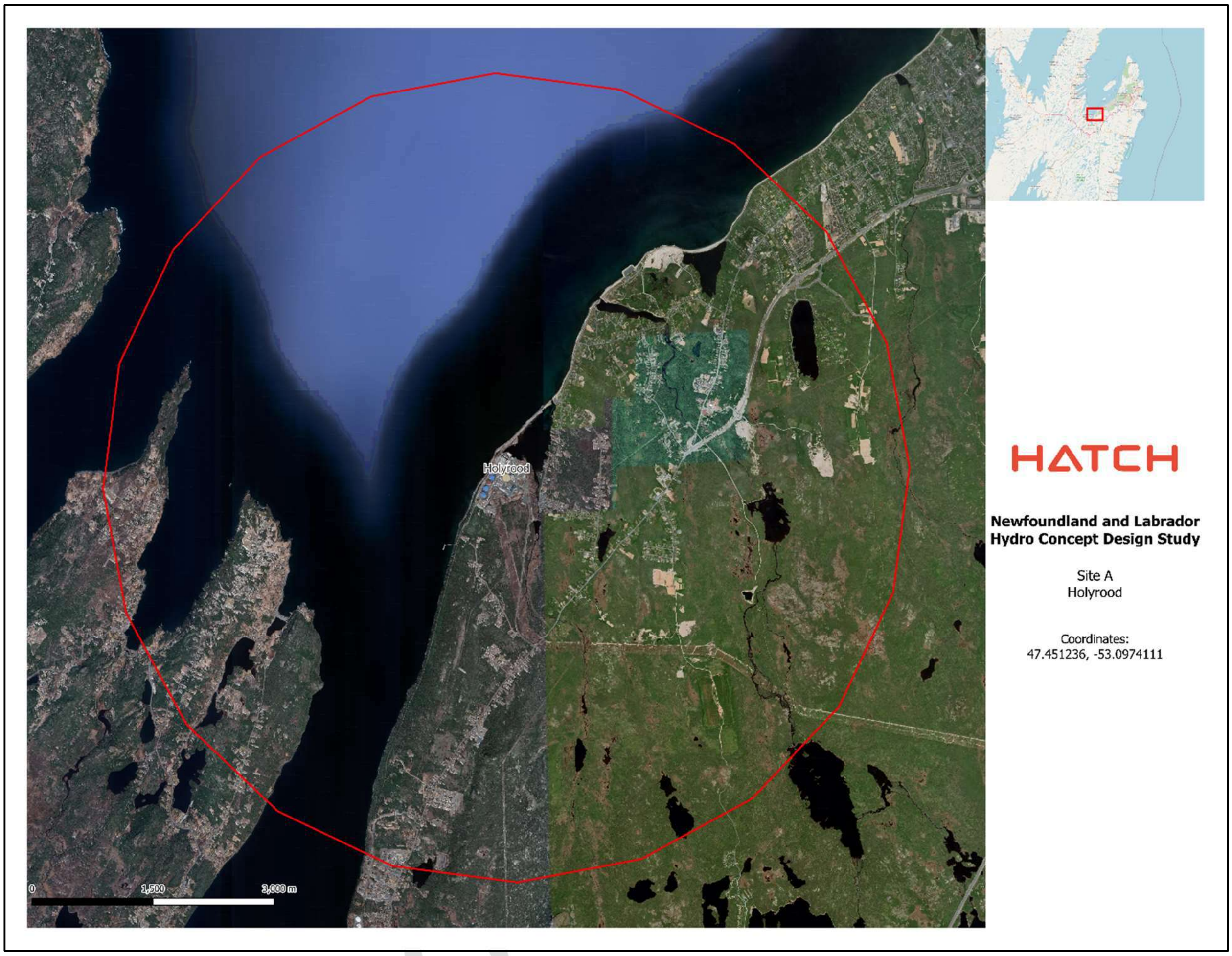


Figure 7-3: Site Option A – Holyrood TGS

7.3.1.1 *Option A: Technical and Operational Criteria Ranking*

Table 7-3: Holyrood TGS Technical and Operational Criteria Characterization

Criteria	Ranking	Comment
Land Suitability/Space	■	Adequate Space for 450 MW
Switchyard Requirements and Proximity to 230kV Line	●	New Terminal Station (Next to existing). 2 underground 230 kV cables brought to existing. Existing 230 kV tied to the new station
Proximity to Nearest Transmission Station	●	10.5 km
Fuel Type	●	Diesel
Fuel Storage	●	Potential to Refurbish Tanks 1-4, Existing Light Fuel Storage for 123 MW CT. New Tanks to be constructed
Fuel Supply and Delivery	■	Marine terminal. 5 days for commercial tanker to deliver, 5 days storage onsite, can increase number of vessels
Availability of Water	■	Intake in place at Quarry Brook, with ample Raw Water

7.3.1.2 Option A: Biophysical and Social Criteria Ranking

Table 7-4: Holyrood TGS Biophysical and Social Criteria Characterization

Criteria	Ranking	Comment
Protected Areas	●	Within a 5km radius there is Butter Pot Provincial Park's Area of Interest
Rare flora and Fauna	■	Option A has 17 rare plant records, none with special status in Newfoundland, 1 that is considered globally rare. There are 11 rare animal records, 4 of which are species with special status in Newfoundland
Flood Zone Watershed	■	~2.5km from a flood risk area
Wetlands Potentially Affected	■	Brownfield - No new wetlands affected by development
Quality of Life (Noise, aesthetics)	●	The existing thermal generator means that residents will not likely be affected by changing noise emissions, or aesthetics changes to the area. Extension of life for the area, may detract from future enjoyment.
Recreational conflicts	●	Public Access is restricted, however Newfoundland T'Railway traverses through portion of the Site. Recreational boating in Indian Pond, however no current conflicts due to duration the plant has been in operation
Public Safety/Risk	●	Option A affects less residential/publicly used land. The actual and perceived risk of accidents should be low in terms of public safety (less density)
Archaeological Potential	■	No known presence of indigenous lands. Archaeological impact assessment likely not required as the Holyrood TGS development is Brownfield

7.3.1.3 Option A: Regulatory and Legal Criteria Ranking

Table 7-5: Holyrood TGS Regulatory and Legal Criteria Characterization

Criteria	Ranking	Comment
Water Use and Water Rights	■	WUL 21-11600 is valid and in place for Quarry Brook, valid from 01-Jan-21 to 01-Jan-26. Max Annual Withdrawal not to exceed 450,000 m3 (1,233 m3/d). Town of Holyrood jurisdiction.
Land Use Zoning and Jurisdiction	■	Site designated as Industrial. The existing Holyrood TGS likely means that stakeholder concerns will be minimal
Permitting, Delays and other obstacles	●	Fewer permits required because it's a brownfield. Obstacles is the Decommissioning requirements (construction interface and complexity of the site). 150 MW Provincial EA >200 MW requires a Federal Impact Assessment, See Physical Activities Regulation (Section 30 and 31), however could be incrementally upsized, to avoid threshold for Federal IAA trigger.

7.3.2 Option B: Paddy's Pond

Paddy's Pond scored third in the overall ranking (62%). Paddy's Pond is located 7.92 km away from Mount Pearl and 16.30 km away from St. John's core. It is located within the municipal boundaries of St. John's. Paddy's Pond land use zoning is currently Agricultural/forestry, with the nearest residential area 5.20 km away. 'Site Option B: Paddy's Pond', is depicted in Figure 7-4.

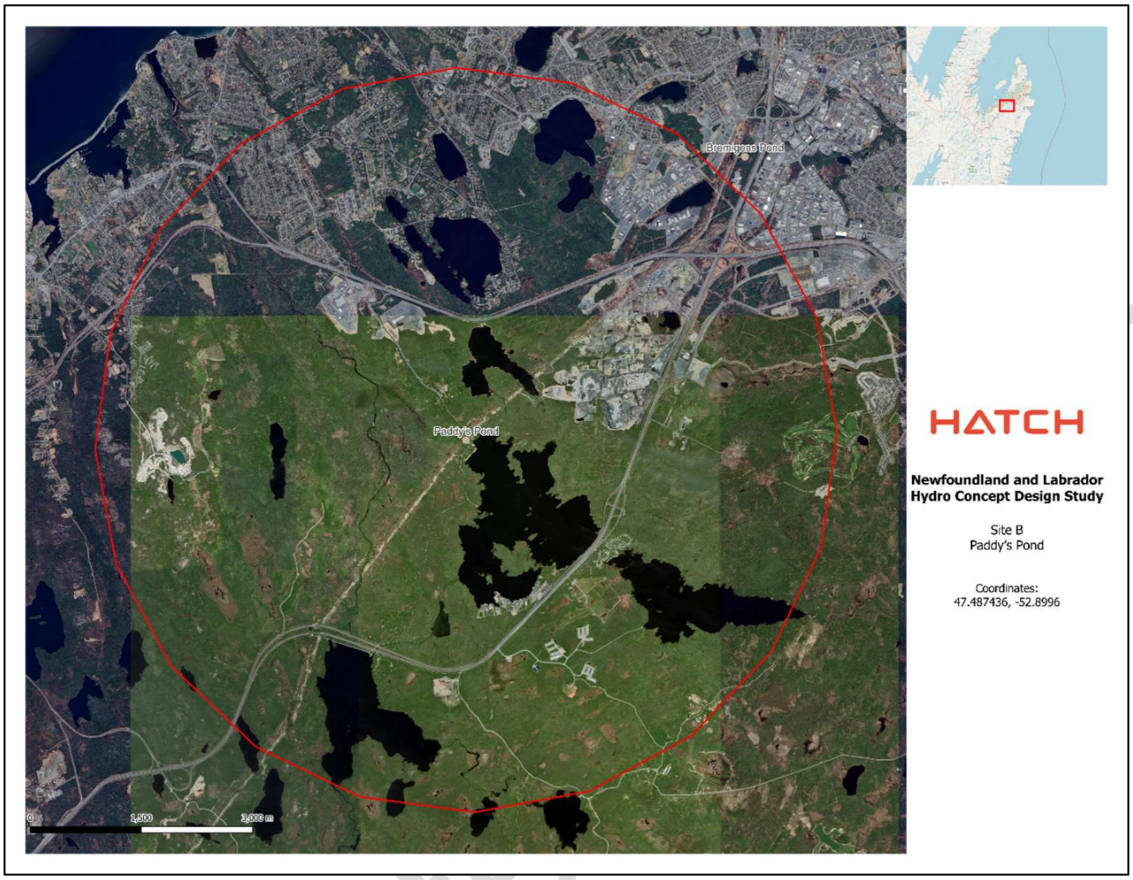


Figure 7-4: Site Option B - Paddy's Pond

7.3.2.1 Option B: Technical and Operational Criteria Ranking

Table 7-6: Paddy's Pond Technical and Operational Criteria Characterization

Criteria	Ranking	Comment
Land Suitability/Space		Adequate Space for 450 MW
Switchyard Requirements and Proximity to 230kV Line		Paddy's Pond Close to Transmission line
Proximity to Nearest Transmission Station		9 km
Fuel Type		Diesel
Fuel Storage		Build New
Fuel Supply and Delivery		Road Transport (100+: B-Trains Per Day for a 450 MW)
Availability of Water		New Intake to be constructed. Permit to Alter a body of water No water line/City Infrastructure in place

7.3.2.2 Option B: Biophysical and Social Criteria Ranking

Table 7-7: Paddy's Pond Biophysical and Social Criteria Characterization

Criteria	Ranking	Comment
Protected Areas	■	There are no protected areas within 5km of Paddy's Pond
Rare flora and Fauna	●	Option B has 3 rare plant records, none with special status in Newfoundland. There are 6 rare animal records, 3 of which are species with special status in Newfoundland
Flood Zone Watershed	■	~3.25km from a flood risk area
Wetlands Potentially Affected	●	Within a 2km radius of swamp, marsh, bog, and fen habitat
Quality of Life (Noise, aesthetics)	●	Unlikely that the noise will carry to the residential lots (to be assessed), visual aesthetics potentially affected for recreational users
Recreational conflicts	◆	Float Plane Base. Cochrane Pond Campground within 500m-1000m. Boat launch available and recreational fishing location. Presumed transmission line is used by ATVs and snowmobiles
Public Safety/Risk	●	Option B affects less residential/publicly used land. The actual and perceived risk of accidents should be low in terms of public safety (less density) Float Plane Base may require consideration
Archaeological Potential	●	No known presence of indigenous lands. Archaeological impact assessment required. 2 archaeological sites confirmed within 5 km of Option B

7.3.2.3 Option B: Regulatory and Legal Criteria Ranking

Table 7-8: Paddy's Pond Regulatory and Legal Criteria Characterization

Criteria	Ranking	Comment
Water Use and Water Rights	♦	WUL 10-030 in place for NF Power Inc., valid through to 2035. Copy unavailable online, but assumed non-exclusive rights are in place to generate from watershed, that includes Paddy's Pond. Unclear of permissible abstraction volume. Emailed WRMB for copy of WUL, but none provided. S (17) Water Resources Act could be invoked. Construction of Intake will require a Permit to Alter a body of water. City of St. John's jurisdiction.
Land Use Zoning and Jurisdiction	●	Site designated as agricultural. The combustion turbine development is likely to be perceived by surrounding stakeholders as a threat to the agricultural/forestry vocation of the sector
Permitting, Delays and other obstacles	●	May require more permits due to Aerodrome (float plane base) tree clearing permits, and proximity to a Trans Canada Highway. 150 MW Provincial EA >200 MW Federal Impact Assessment

7.3.3 *Option C: Sugar Loaf*

Sugar Loaf site scored 51 % in the numerical ranking, which was second least preferred of all sites (tied with Bremigen's Pond). The nearest large city is St. John; Sugarloaf Pond is located 5.80 km away from St. John's. Sugarloaf Pond is in an area classified as rural, and open space, adjacent to industrial space zoning (Robin Hood Bay Landfill). The nearest residential area is 0.47 km away. Site 'Option C: Sugar Loaf', is depicted in Figure 7-5.

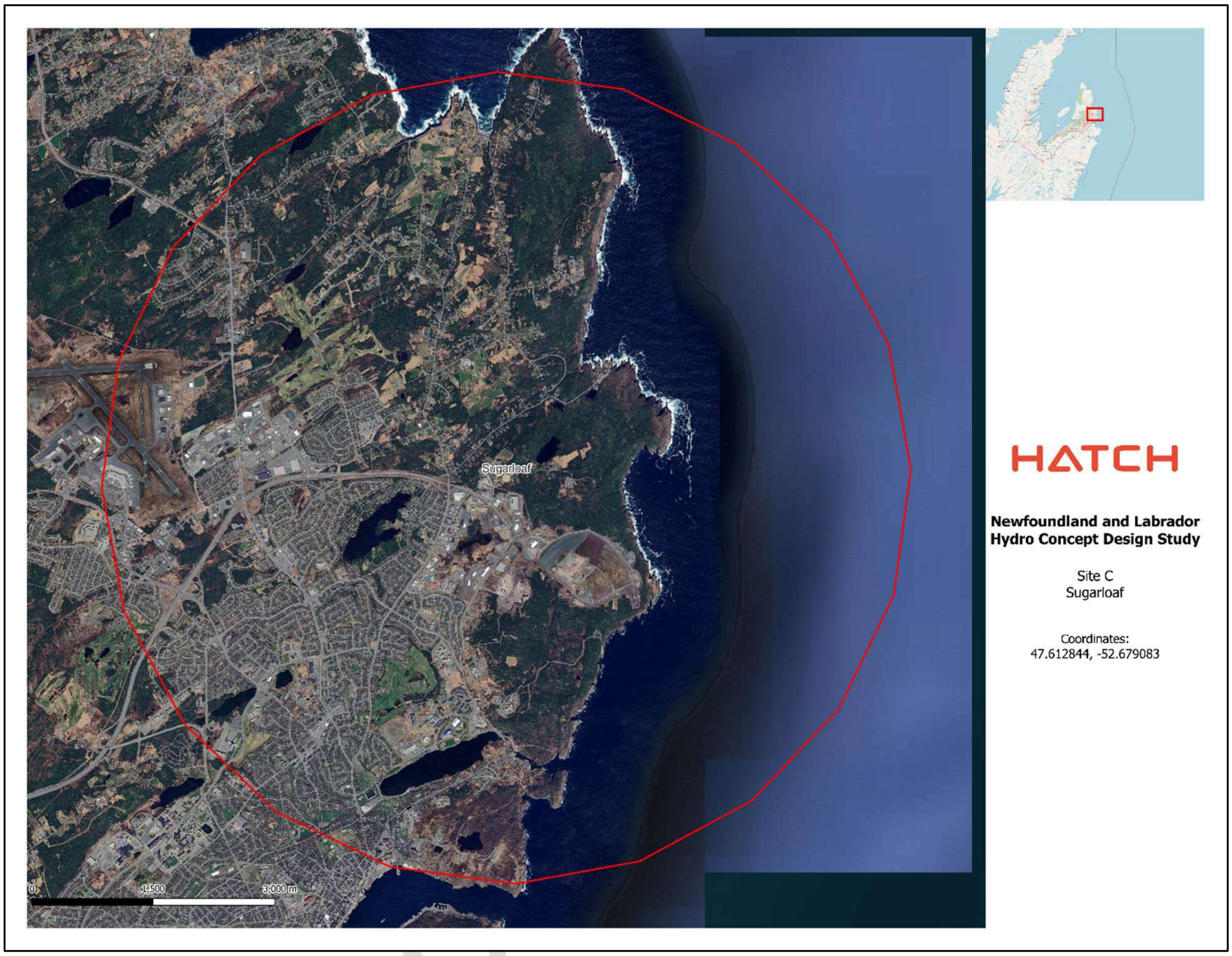


Figure 7-5: Site Option C – Sugar Loaf

7.3.3.1 Option C: Technical and Operational Criteria Ranking

Table 7-9: Sugar Loaf Technical and Operational Criteria Characterization

Criteria	Ranking	Comment
Land Suitability/Space	♦ (orange)	Inadequate Space for 300 – 450 MW, contours, at 44pprox. 13% slopes. Cut and fill requirements would be high
Switchyard Requirements and Proximity to 230Kv Line	♦ (orange)	7.8 KM and transmission line built through residential (through pippy park)
Proximity to Nearest Transmission Station	♦ (orange)	30 km
Fuel Type	● (yellow)	Diesel
Fuel Storage	● (yellow)	Build New
Fuel Supply and Delivery	● (yellow)	Road Transport (100+: B-Trains Per Day for a 450 MW)
Availability of Water	● (light green)	Could be supplied by City infrastructure or New Intake to be constructed

7.3.3.2 Option C: Biophysical and Social Criteria Ranking

Table 7-10: Sugar Loaf Biophysical and Social Criteria Characterization

Criteria	Ranking	Comment
Protected Areas	● (light green)	Within a 5km radius there is Signal Hill National Historic Site and Pippy Park
Rare flora and Fauna	● (yellow)	Option C has 13 rare plant records, none with special status in Newfoundland, 1 that is considered globally rare. There are 11 rare animal records, 4 of which are species with special status in Newfoundland
Flood Zone Watershed	■ (green)	~0.9km, ~1.5km and ~1.6km from a flood risk area. Elevated topo, limited flood risk
Wetlands Potentially Affected	● (yellow)	Within a 2km radius of swamp, marsh, bog, and fen habitat
Quality of Life (Noise, aesthetics)	● (yellow)	Unlikely that the noise will carry to the residential lots (to be assessed), some perceived issues with development (aesthetics)
Recreational conflicts	● (light green)	Location is within 500m - 1000m of the East Coast Trail (popular hiking and tourist attraction)
Public Safety/Risk	● (yellow)	Option B affects less residential/publicly used land, increased traffic near residential. Adjacent properties and business
Archaeological Potential	● (yellow)	No known presence of indigenous lands. Archaeological impact assessment required. 39 archaeological sites confirmed within 5 km of Option C

7.3.3.3 Option C: Regulatory and Legal Criteria Ranking

Table 7-11: Sugar Loaf Regulatory and Legal Criteria Characterization

Criteria	Ranking	Comment
Water Use and Water Rights	🟡	Sugar Loaf Pond feeds the MUN Ocean Sciences Centre - Logy Bay Research Facility Water Supply Dam. However, there is no WUL apparently tied to this dam. City of St. John's jurisdiction.
Land Use Zoning and Jurisdiction	🟢	Site designated as industrial commercial with some residential areas within a 2 km radius.
Permitting, Delays and other obstacles	🟡	Fewer permits may be required due to industrial land use designation, tree clearing likely not required, although Greenfield. 150 MW Provincial EA >200 MW Federal Impact Assessment

7.3.4 Option D: Soldiers Pond

Soldiers Pond scored second in the overall ranking and scored the highest out of all greenfield sites (70%). The nearest large town, Conception Bay South, is 13.7 km away, while St John’s is 32 km away. Soldiers Pond is in an industrial area located on Crown Lands Reserve (lands reserved for Nalcor) outside of the municipal boundaries of St. John’s, with the nearest residential area located 6 km away. Site ‘Option D: Soldiers Pond’ is depicted in Figure 7-6.

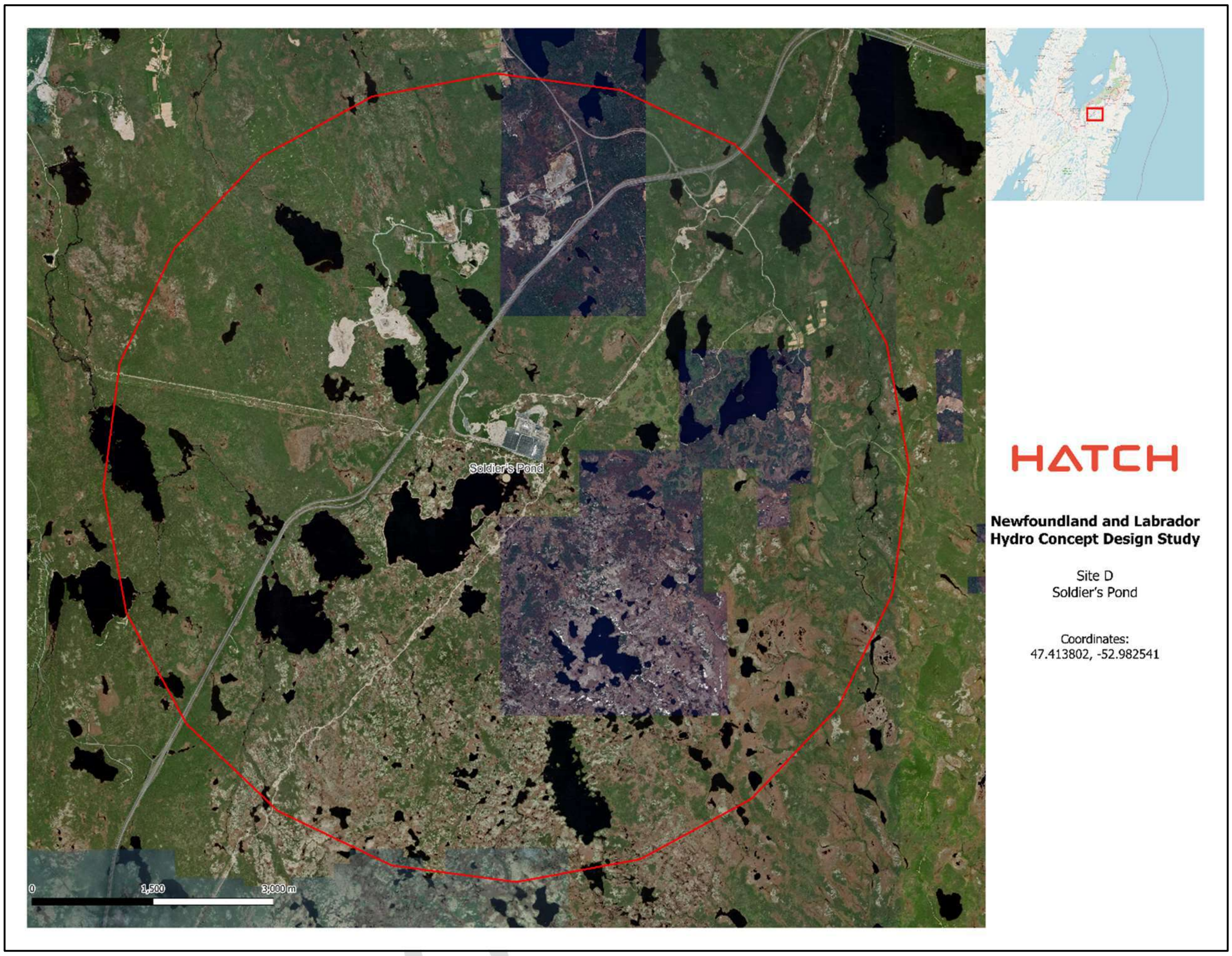


Figure 7-6: Site Option D - Soldiers Pond

7.3.4.1 Option D: Technical and Operational Criteria Ranking

Table 7-12: Soldiers Pond Technical and Operational Criteria Characterization

Criteria	Ranking	Comment
Land Suitability/Space	●	Site Alternate Option (D) Alternate location is 1 km NE of Soldiers Pond Substation, adequate space for 450 MW, some access road upgrades needed.
Switchyard Requirements and Proximity to 230kV Line	●	Directly adjacent to 230 kV transmission line
Proximity to Nearest Transmission Station	■	within 1 km
Fuel Type	●	Diesel
Fuel Storage	●	Build New
Fuel Supply and Delivery	●	Potential fuel pipeline approximately 10 km in length, extending from Holyrood TGS jetty to Proposed Site Configuration TCH Access Available
Availability of Water	●	New Intake to be constructed, Permit to Alter a body of water would be required

7.3.4.2

7.3.4.3 Option D: Biophysical and Social Criteria Ranking

Table 7-13: Soldiers Pond Biophysical and Social Criteria Characterization

Criteria	Ranking	Comment
Protected Areas	● (light green)	Within a 5km radius there is Butter Pot Provincial Park and its Area of Interest
Rare flora and Fauna	■ (green)	Option D has 0 rare plant records and 2 rare animal records found. These 2 rare animal records include 1 species with a special status in Newfoundland
Flood Zone Watershed	■ (green)	No flood risk areas within a 5km radius
Wetlands Potentially Affected	● (yellow)	Within a 2km radius of swamp, marsh, bog, and fen habitat
Quality of Life (Noise, aesthetics)	● (light green)	Site (D)(3) Unlikely that the noise will carry to the residential lots (to be assessed), some perceived issues with development (aesthetics - Camp Morris Town (Scouts) within 1.6 km)
Recreational conflicts	■ (green)	-Site option (D)(3) limited public access infrastructure and limited recreational opportunities, 1.6 km from Scouts Camp (Camp Morristown)
Public Safety/Risk	■ (green)	Option D Little to no public access or residential density
Archaeological Potential	● (light green)	No known presence of indigenous lands. Archaeological impact assessment required. 1 archaeological site confirmed within 5 km of Option D

7.3.4.4 Option D: Regulatory and Legal Criteria Ranking

Table 7-14: Soldiers Pond Regulatory and Legal Criteria Characterization

Criteria	Ranking	Comment
Water Use and Water Rights	◆ (orange)	WUL 22-12349 is valid and in place for Non-exclusive rights to NF Power for hydro generation (Seal Cove). Max Annual for Seal Cove Hydro = 120,000,000m3 (328,767 m3/d). WUL 19-10843 is valid and in place for Labrador Island Link Ltd Partnership (LCP). Max annual withdrawal 100 m3 (0.27m3/d) for firefighting purposes. Provincial Jurisdiction.
Land Use Zoning and Jurisdiction (City's master plan for land use)	● (light green)	-Site (D)(3) designated as Crown Reserve (9.E.22), adjacent to Nalcor Lands. Resource Development: Forestry: Discretionary General Industry.
Permitting, Delays and other obstacles	● (yellow)	May require several permits due to Greenfield, but outside of City Jurisdiction. 150 MW Provincial EA >200 MW Federal Impact Assessment

7.3.5 *Option E: Bremigen's Pond*

The Bremigen's Pond location, tied for fourth lowest score in the overall numerical ranking with 51% (tied with Sugar Loaf). Bremigen's Pond is located 10.15 km away from the nearest transmission substation, Oxen Pond Substation. It's located within the municipal boundaries of the town of Paradise, the nearest large city, Mount Pearl, is 3.91 km away, while St. John's is 12.15 km away. Bremigen's Pond is in an industrial area, with the nearest residential area 1.05 km away. Site 'Option E: Bremigen's Pond', is depicted in Figure 7-7.

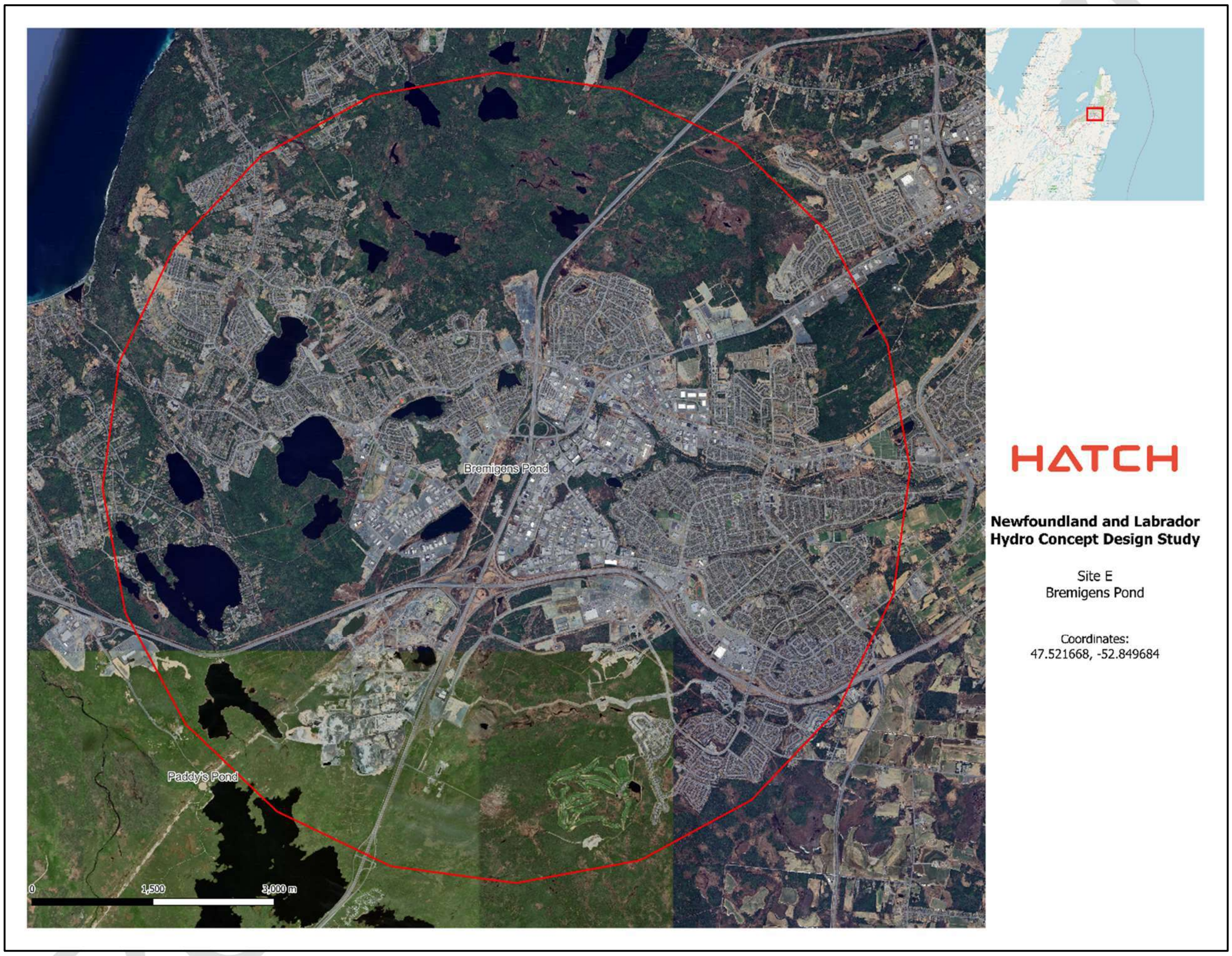


Figure 7-7: Site Option E - Bremigen's Pond

7.3.5.1 Option E: Technical and Operational Criteria Ranking

Table 7-15: Bremigen's Pond Technical and Operational Criteria Characterization

Criteria	Ranking	Comment
Land Suitability/Space	♦	Inadequate Space for 300 - 450 MW (Unless multiple property acquisitions
Switchyard Requirements and Proximity to 230kV Line	●	Directly adjacent to 230 kV transmission line
Proximity to Nearest Transmission Station	●	14 km
Fuel Type	●	Diesel
Fuel Storage	●	Build New
Fuel Supply and Delivery	●	Road Transport (100+: B-Trains Per Day for a 450 MW)
Availability of Water	●	Could be supplied by City infrastructure or new intake to be constructed

7.3.5.2 *Option E: Biophysical and Social Criteria Ranking*

Table 7-16: Bremigen's Pond Biophysical and Social Criteria Characterization

Criteria	Ranking	Comment
Protected Areas	■	There are no protected areas within 5km of Bremigen's Pond
Rare flora and Fauna	♦	Option E has 6 rare plant records, none with special status in Newfoundland. There are 40 rare animal records, 22 of which are for species with special status in Newfoundland
Flood Zone Watershed	♦	Within a flood risk zone
Wetlands Potentially Affected	●	Within a 2km radius of swamp, marsh, bog, and fen habitat
Quality of Life (Noise, aesthetics)	●	Unlikely that the noise will carry to the residential lots (to be assessed), some perceived issues with development (aesthetics)
Recreational conflicts	●	Limited public access infrastructure and limited recreational opportunities, close proximity to church and to florist
Public Safety/Risk	♦	Option E is closer to more residential/publicly used land, so the actual and perceived risk of accidents increases with a higher population density
Archaeological Potential	●	No known presence of indigenous lands. Archaeological impact assessment required. 1 archaeological site confirmed within 5 km of Option E

7.3.5.3 *Option E: Regulatory and Legal Criteria Ranking*

Table 7-17: Bremigen's Pond Regulatory and Legal Criteria Characterization

Criteria	Ranking	Comment
Water Use and Water Rights	●	Government of NL owns a water impoundment/dam at Bremign's Pond. "St. John's Region Water Control Structure". Head waters of Waterford River. Town of Paradise jurisdiction.
Land Use Zoning and Jurisdiction (City's master plan for land use)	●	Site designated as Open Space with some residential areas within a 2km radius. The development of the combustion turbine may be perceived by surrounding residents as a threat to the residential zoning
Permitting, Delays and other obstacles	♦	May require more permits due to Greenfield. 150 MW Provincial EA >200 MW Federal Impact Assessment

7.3.6 *Option F: Petty Harbour Long Pond*

The Petty Harbour Long Pond location scored the lowest in the overall numerical ranking with 41%. Petty Harbour Long Pond is located 13 km away from the nearest transmission substation, Oxen Pond Substation. The nearest large city, St John's, is 7.2 km away, while Mount Pearl is 8.7 km away. It falls within the municipal boundaries of the City of St. John's and is zoned rural. As well, the Petty Harbour Long Pond site, is also located within a protected watershed, which therefore makes it unsuitable for development. For completeness, it's ranking across all criteria have been included in the option analysis. Site 'Option F: Petty Harbour – Long Pond' is depicted in Figure 7-8.

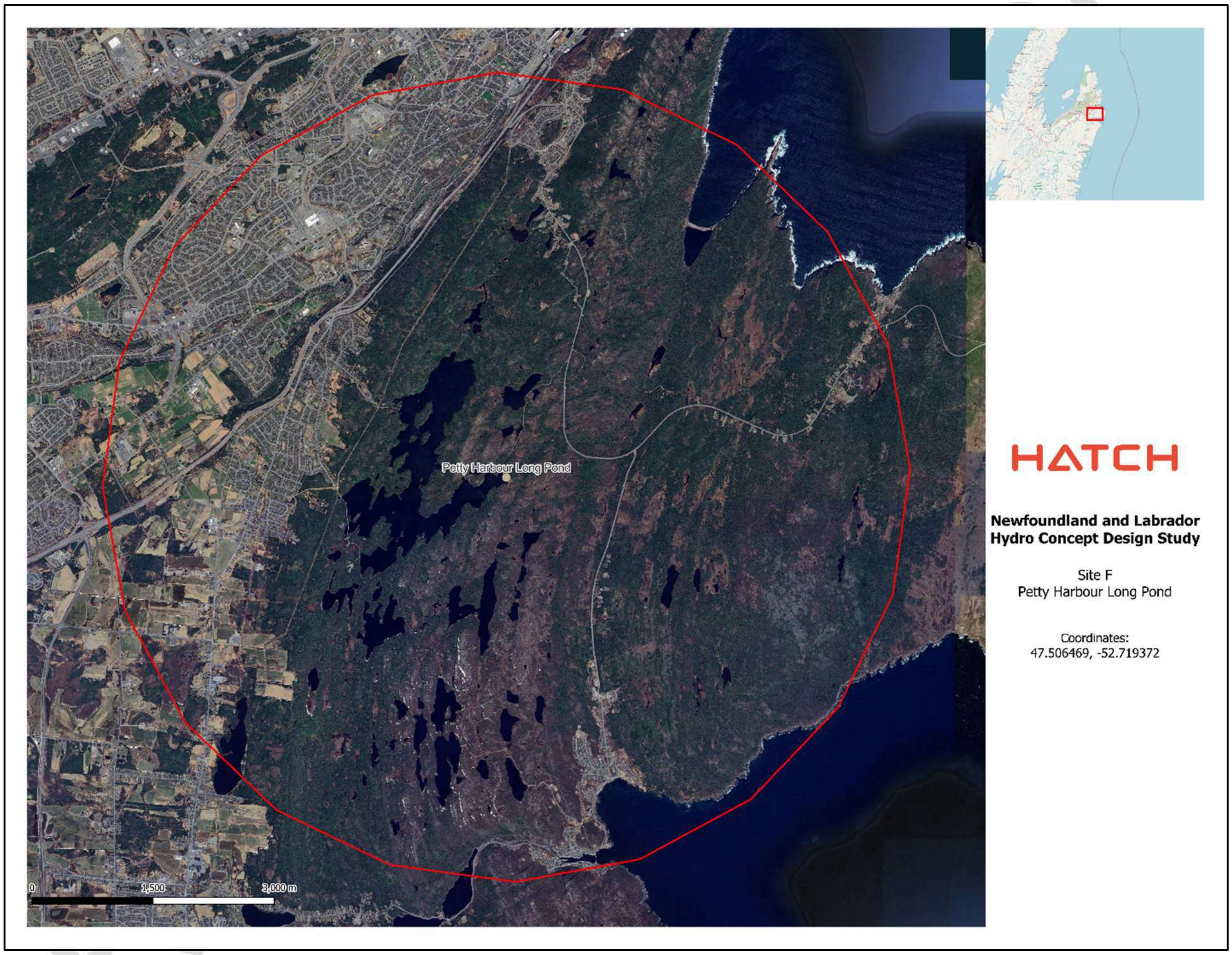


Figure 7-8: Option F - Petty Harbour – Long Pond

7.3.6.1 Option F: Technical and Operational Criteria Ranking

Table 7-18: Petty Harbour Long Pond Technical and Operational Criteria Characterization

Criteria	Ranking	Comment
Land Suitability/Space	♦	Locational is at a significant distance from existing road access. It also has grading constraints as well as potential water crossing to contend with for access.
Switchyard Requirements and Proximity to 230kV Line	■	>10 km new 230 needed
Proximity to Nearest Transmission Station	♦	21 km
Fuel Type	●	Diesel
Fuel Storage	●	Build New
Fuel Supply and Delivery	●	Road Transport (100+: B-Trains Per Day for a 450 MW)
Availability of Water	●	New Intake to be constructed, Permit to Alter a body of water would be required

7.3.6.2 Option F: Biophysical and Social Criteria Ranking

Table 7-19: Petty Harbour Long Pond Biophysical and Social Criteria Characterization

Criteria	Ranking	Comment
Protected Areas	🟩	There are no protected areas within 5km of Option F
Rare flora and Fauna	🟥	Option F has 7 rare plant records, none with special status in Newfoundland or are considered rare globally. There are 104 rare animal records found which include multiple species that are listed under COSEWIC and under the provincial Endangered Species Act. This makes this site not ideal for the proposed project
Flood Zone Watershed	🟩	~3.5km and ~4.7km from a flood risk area
Wetlands Potentially Affected	🟡	Within a 2km radius of swamp, marsh, bog, and fen habitat
Quality of Life (Noise, aesthetics)	🟡	Unlikely that the noise will carry to the residential lots (to be assessed), some perceived issues with development (aesthetics)
Recreational conflicts	🟡	Location is within 500m - 1000m of the East Coast Trail (popular hiking and tourist attraction). Perception that this is more pristine
Public Safety/Risk	🟢	Option F affects less residential/publicly used land, so the risk of accidents is likely to be lower
Archaeological Potential	🟢	No known presence of indigenous lands. Not assessed for archaeological impact as the site will not be used due to other excluding factors

7.3.6.3 Option F: Regulatory and Legal Criteria Ranking

Table 7-20: Petty Harbour Long Pond Regulatory and Legal Criteria Characterization

Criteria	Ranking	Comment
Water Use and Water Rights	🟥	Protected Water Supply (City of St. John's)
Land Use Zoning and Jurisdiction (City's master plan for land use)	🔶	Site designated as watershed/rural. The development of the combustion turbine may be perceived as a threat to the health of the watershed due to its proximity to residential land use just past the 2km radius
Permitting, Delays and other obstacles	🔶	May require more permits due to tree clearing permits, and due to Greenfield. 150 MW Provincial EA >200 MW Federal Impact Assessment

7.3.7 *Quantitative Scoring Results and Site Selection*

Qualitative rankings were converted to numerical values in accordance with Table 7-2. The predetermined weight per each criterion, could then be applied to determine option scoring as a percentage. Simplified quantitative scoring of the results is provided in Table 7-21. Additional information on numerical valuation and quantification is also provided in Appendix K.

In summary, Site 'Option A: Holyrood TGS' performed the highest of all sites, with a score of 87%. Site 'Option D: Soldiers Pond', scored the second highest of all sites, and the highest of all greenfield sites, with a 70% score.

Therefore, the two options further modelled and investigated for interconnection, fuel delivery, and noise within this study, are the brownfield (Option A) at Holyrood TGS, and the preferred greenfield (Option D) at Soldiers Pond.

Table 7-21: Quantitative Scoring and Option Performance for Site Selection

Category of Criteria	Weight per category	Options					
		Option A - HTGS	Option B - Paddys Pond	Option C - Sugar Loaf	Option D - Soldiers Pond East	Option E - Bremigens Pond	Option F - Petty Harbour Long Pond
		Scoring					
Technical and Operational	47%	40%	32%	19%	34%	25%	15%
Environment and Social	32%	28%	21%	20%	25%	16%	20%
Delays and Obstacles	21%	19%	9%	13%	11%	11%	6%
Grand total (out of 100):	100%	87%	62%	52%	70%	52%	41%

7.4 Site Selection Process - Assumptions and Limitations

The site assessment has been prepared subject to the following assumptions and limitations:

- AC CDC data reports are limited to information contained within recorded databases and reported to the centre. A data request should not be construed as confirmation of a species presence or absence from an area.
- Detailed field studies or surveys were not conducted as part of this study. The findings obtained from desktop studies and discussions with relevant stakeholders may not have captured all features and characteristics of each of the sites.

- Information on various criteria, was collected from public sources and external parties[3]. The accuracy of such information cannot be guaranteed. In addition, some of the data obtained may be outdated.
- This study has excluded direct contact with various, Federal, Provincial authorities and landowners.

7.5 Environmental Assessment, Permits and Approvals

7.5.1 Federal Impact Assessment Process

A review of the federal Physical Activities Regulations, pursuant to the federal Impact Assessment Act (IAA) was undertaken to determine whether the Project would trigger the federal impact assessment process.

Under the IAA, federal impact assessments are completed on designated projects, which are designated either by regulation, or the minister. The Physical Activities Regulations (commonly known as the project list) is the regulation that designates those projects. It provides clarity and certainty as to which projects are subject to the IAA and is required to properly implement the federal impact assessment process.

Sections 30 through 38 of the Physical Activities Regulations[4], concerning 'Oil, Gas and Other Fossil Fuels' prescribes designated energy projects with thresholds requiring a federal impact assessment. More specifically, regarding fossil fuel-fired power generating facilities, the following would require a federal impact assessment:

> *"30 The construction, operation, decommissioning and abandonment of a new fossil fuel-fired power generating facility with a production capacity of 200 MW or more", and;*
>
> *"31 The expansion of an existing fossil fuel-fired power generating facility, if the expansion would result in an increase in production capacity of 50% or more and a total production capacity of 200 MW or more".*

For all of the gas turbine options, a federal impact assessment will not be required for Phase 1 (150 MW) plant, as it is below the threshold prescribed in the Regulation, as well, the Project is not located on federal lands. However, a federal assessment will be required during Phase 2 and Phase 3 facility upgrades (I.e., step up from 150 MW to 300 MW /450 MW) as this would increase production capacity by 50% or more and have a total production capacity of 200 MW or more.

Federal assessments are generally conducted in conjunction with provincial counterparts, in matters triggering assessment within both jurisdictions legislated framework.

[3] See Section 3.2.1 'Literature Review and Research' for information on public data sources.
[4] Physical Activities Regulations (justice.gc.ca)

7.5.1.1 *Provincial Environmental Assessment Process*

The Newfoundland and Labrador Environmental *Assessment Regulations* list the designated undertakings that are required to be registered under the *Environmental Protection Act*. As currently defined, the Project is subject to the provincial EA process due to the following:

> *"34 (1) An undertaking that will be engaged in electric power generation and the provision of structures related to that power generation, including (e) diesel electric power generating plants with a capacity of more than one megawatt; and (f) gas turbine electric power generating plants with a capacity of more than one megawatt;"* [Requires Registration]

7.5.1.2 *Permitting Road Map*

The anticipated environmental approvals, permits and authorizations that may be required for the Project are outlined in Table 7-22. These requirements are applicable to both the Brownfield and Greenfield. However, this list is not exhaustive, and will require further refinement in future, as dictated by project schedule and sanctioning.

Table 7-22: Potential Environmental Approvals, Permits and Authorizations

Activity	Approval, Permit, or Authorization	Legislation	Regulatory Agency	Review Period
Federal - Government of Canada (not all inclusive)				
Project – General Phase 2/3 (300 MW-450MW)	Release from federal Impact Assessment	*Impact Assessment Act*	Impact Assessment Agency of Canada (IAAC)	3-5 years
Work in and near water	Fish and Fish Habitat Protection Program (Request for Review)	*Fisheries Act*	Fisheries and Oceans Canada (DFO)	30 days
	Fisheries Act Authorization	*Fisheries Act*	Fisheries and Oceans Canada (DFO)	60-90 days
If Project will likely result in harm of aquatic species at risk	Species at Risk Permit	*Species at Risk Act*	Environment and Climate Change Canada	90 days
Provincial - Government of Newfoundland and Labrador (not all inclusive)				
Project – General Phase 1 (150 MW)	Release from the *Environmental Protection Act*, Part X, Environmental Assessment	*Environmental Protection Act*	DECC, EA Division	45 days for Review, 60 days for EPR guidelines, 120 days for EIS guidelines
Project General Industrial Compliance	Certificate of Approval	*Environmental Protection Act (Section 83)*	DECC, Pollution Prevention Division	8-10 weeks

Activity	Approval, Permit, or Authorization	Legislation	Regulatory Agency	Review Period
Work within 15 m of a water body and work in water (e.g., culverts, bridges, fording)	Permit to Alter a Body of Water	*Water Resources Act*	DECC, Water Resources Management Division	4-6 weeks
Pipe Crossing/Water Intake	Permit to Alter a Body of Water (Schedule E)	*Water Resources Act*	DECC, Water Resources Management Division	4-6 weeks
Water withdrawal	Water Use Licence	*Water Resources Act*	DECC, Water Resources Management Division	4-6 weeks
Protection of Archaeological and Heritage Resources	Archaeological investigation permits	*Heritage Resources Act*	Department of Tourism, Culture, Arts and Recreation Provincial Archaeological office (PAO)	8-10 Weeks
Extracting borrow material	Quarry Permit	*Quarry Materials Regulations*	Department of Industry, Energy, and Technology, Mineral Lands Division	8-10 Weeks
Clearing timber (e.g., right of way, quarries, camp, laydown areas)	Commercial Cutting Permit	*Cutting of Timber Regulations*	Department of Fisheries, Forestry and Agriculture, Forest Management District Office	8-10 Weeks
Cutting during forest fire season	Operating Permit	*Forest Fire Regulations*	Department of Fisheries, Forestry and Agriculture, Forest Management District Office	8-10 Weeks
Stationary fuel tanks	Gasoline and Associated Products (GAP) Registration	*Storage and Handling of Gasoline and Associated Products Regulations*	Department of Digital Government and Service NL	8-10 Weeks
Used oil tanks (greater than 205 L)	Used Oil Storage Approval	*Used Oil and Used Glycol Control Regulations*	Department of Digital Government and Service NL	8-10 Weeks
Prime power diesel generators with	Certificate of Approval	*Air Pollution Control Regulations, 2022*	DECC, Pollution Prevention Division	8-10 Weeks

Activity	Approval, Permit, or Authorization	Legislation	Regulatory Agency	Review Period
capacity greater than 100 kW		Guidance Document – Approval of Diesel Generators		
Standby diesel generators with capacity greater than 100 kW and operate more than 500 hours per year	Certificate of Approval	*Air Pollution Control Regulations, 2022* Guidance Document – Approval of Diesel Generators	DECC, Pollution Prevention Division	8-10 Weeks
General Site – Wildlife	Permit to Destroy Problem Animals	NL *Wildlife Act*	Department of Fisheries, Forestry and Agriculture	8-10 Weeks

7.5.1.3 Raw and Demineralized Water – Permitting Requirements and Considerations

Raw and demineralized water requirements for the three plant size scenarios are included in Section 4.1.3. 'Raw Water' and Section 4.1.4 "Demineralized Water' of this report.

Applicable to all plant sizing scenarios, a volume of 1000 m^3 of raw water will be required on site to be used as demineralized water, with an additional volume of 1500 m^3 of raw water available for the fire water system. Auxiliary cooling water requirements were not considered in this study.

The following demineralized water flow rates will be required for the three plant size scenarios (note this is in addition to any requirements for existing Holyrood TGS and CT's located on the Holyrood property currently in operation).

Table 7-23: Demineralized Water Requirements

Option	Demineralized Water Flow Rate (m^3/hour)
Phase 1 (150MW)	40
Phase 2 (300MW)	110
Phase 3 (450MW)	150

Option A: Holyrood TGS

Raw water requirements for the concept plant located on the Property of Holyrood TGS (i.e., option A), are assumed to be able to extract water from the intake at Quarry Brook, which is currently permitted under Water Use License WUL-21-1160. This WUL gives NL Hydro non-exclusive rights to withdraw water required for thermal power generation, service fire water, domestic water, and CT operations, at the existing thermal plant. WUL-21-1160 has an annual withdrawal of 450,000 m^3.

As the existing Holyrood TGS, is currently scheduled to be decommissioned in 2030, with unit 3 operating as a synchronous condenser until 2045 or beyond, water withdrawal for the existing plant will presumably continue, primarily for firefighting and domestic water requirements.

Option D: Soldiers Pond

The Soldiers Pond location will require a new WUL or amendment to existing. Currently, two existing WULs are active or have non-exclusive rights at this location.

WUL 19-10843 is valid and in place for Labrador Island Link Ltd Partnership (LCP). Max annual withdrawal 100 m^3 (0.27m^3/d) for firefighting purposes. This could be amended to extend supplying raw water directly to the concept plant for its thermal generating needs. An amendment will require an Application for Water Use License, as required under Part 1 of the Water Resources Act, SNL 2002 c W-4.01. Water availability and allocation would be evaluated by the Water Resources Management Board (WRMB) once an application for a WUL is submitted.

An Application for Permit to Alter a Body of Water, as required under Section 48 of the Water Resources Act, SNL 2002 c W-4.01 would also be needed for the installation of an intake. Specifically, the application would be for 'Schedule E – Pipe Crossing/Water Intake'. Intake design would require adherence to the DFO 'Interim code of practice: End-of-pipe fish protection screens for small water intakes in freshwater' (2019).

Additional consideration must also be given to other non-exclusive WUL is in place for the broader watershed. WUL 22-12349 is valid and in place for non-exclusive rights to NF Power for hydro generation (at Seal Cove). The Maximum Annual withdrawal for Seal Cove Hydro is 120,000,000m3. The abstraction point is on the terminus of the permitted watershed at the intake structure located in White Hill Pond. There are various conditions related to maintaining water control structures throughout the watershed for NF Power associated with this WUL, as there are series of impoundments inclusive at Soldiers Pond itself, of dams classified in the ‘High’ and ‘Low’ Consequence category (based on the 2007, Canadian Dam Association guidelines). Further study on how water withdrawal could affect this WUL, inclusive of impoundments at the headwaters originating at Soldiers Pond, should be undertaken. Discussion with NF Power on shared use, could be beneficial to both parties. The permitted watershed, and various impoundments under WUL 22-12349 are depicted in Figure 7-9.

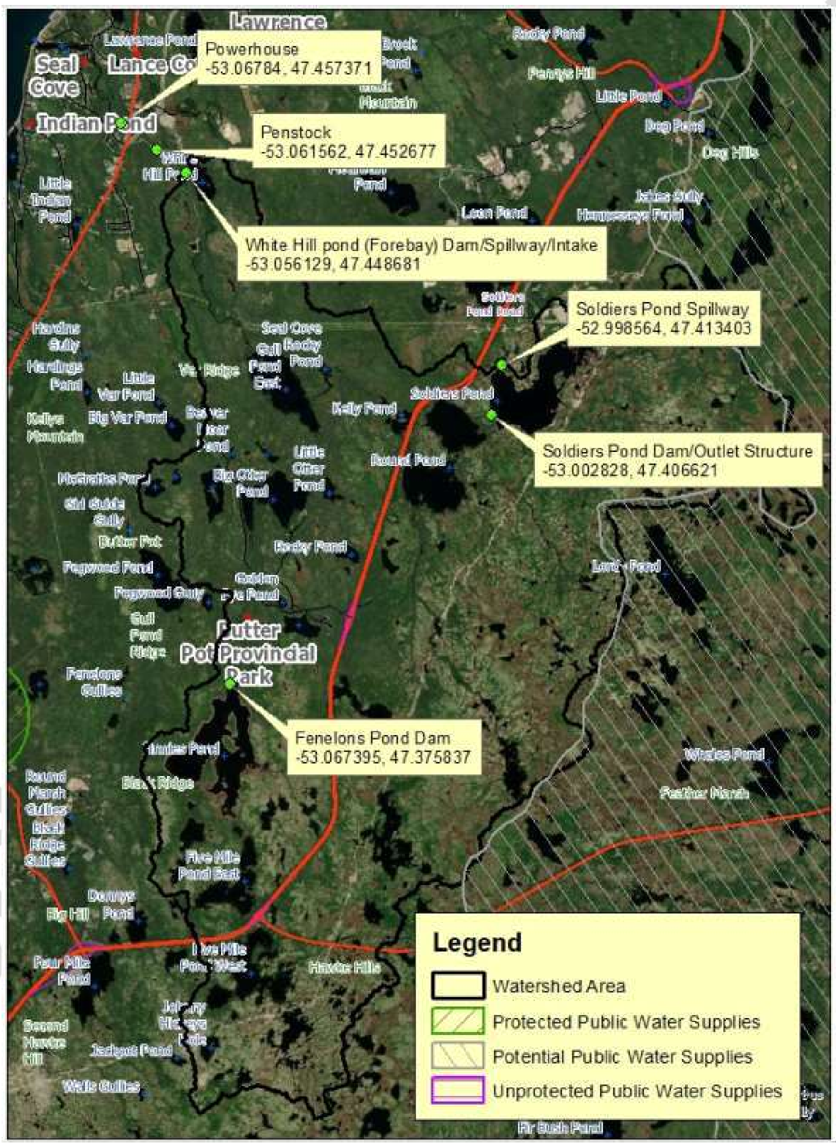


Figure 7-9: Water Impoundments Along the Watershed Permitted Under WUL 22-12349

8. Fuel Assessment and Transportation

A fuel assessment was carried out to analyze the fuel requirements and supply for the prospective site locations. The assessment covers the fuel consumption, capability of suppliers, storage needs at site, and transportation requirement.

8.1 Assessed Fuel Types

The design of the turbine, the intended use, and local fuel supply are only a few of the variables that affect fuel selection. Diesel fuel was primarily evaluated due to its availability with respect to other fuel types in the Avalon peninsula.

Due to its accessibility and high energy density, diesel fuel can be used to power gas turbines. Diesel fuel is frequently employed in backup or mobile power applications where there is a lack of natural gas infrastructure.

8.1.1 Natural Gas

There is currently no established natural gas supply chain in Newfoundland and Labrador. In 2021, 433Mft^3/day of natural gas was produced at offshore Newfoundland crude oil facilities, which was used to power the offshore facilities. This natural gas was also used to maintain reservoir pressure/increase oil by reinjecting it into the reservoir. There is currently no commercial production of natural gas liquids (NGLs) in Newfoundland and Labrador. To encourage natural gas development in the future, Newfoundland and Labrador is developing a natural gas framework.[5]

8.1.2 Liquid Hydrogen

Liquid Hydrogen is one of the primary options for transporting hydrogen over long distances. The primary advantage of transporting liquid hydrogen over gaseous hydrogen is its increased density. Gaseous hydrogen is liquefied when its temperature is cooled below -253°C at atmospheric pressure. At this temperature, the density of liquid hydrogen is about 800 times that of gaseous hydrogen at standard conditions and is approximately 1.7 times higher than compressed hydrogen at 800 bar. Hydrogen liquefaction is currently very energy intensive, and it typically consumes around 30% of its energy content. In North America there are currently liquefaction plants ranging in size from 6 to 80 tonnes per day of hydrogen, with most of these plants located in the U.S.

Liquid hydrogen has a very low heat of vaporisation so a small heat input will create a violent evolution of gas and splashing of liquid. Liquid hydrogen has a very low heat of vaporisation (related to a volume basis). At this temperature, gases within the liquid hydrogen can condense and solidify. These solid particles can plug valves and piping, which could restrict the flow and increase the pressure, which causes a potential explosion hazard. Liquid hydrogen and the cold "boil off' gas can also produce severe thermal burns upon skin contact. Some safety measures would have to be taken to transport liquid hydrogen.

[5] CER – Provincial and Territorial Energy Profiles – Newfoundland and Labrador (cer-rec.gc.ca)

8.1.3 Hydrogen

There is currently no established hydrogen supply chain in Newfoundland and Labrador. [redacted] Newfoundland and Labrador's proximity to natural gas reservoirs (blue or grey hydrogen production) and its renewable energy sources in hydropower and wind (green hydrogen production) show the large potential for hydrogen production in the province. However, the province is not currently projected to have a large domestic demand and most of the production being considered is for export markets.[6]

8.1.4 Transportation of Hydrogen

As there is currently no established hydrogen supply chain in Newfoundland and Labrador, different methods of importing hydrogen would need to be evaluated. Hydrogen has a high gravimetric energy density but a relatively low volumetric energy density. This directly relates to a higher storage and transportation cost. As a result, hydrogen is typically produced near its end user. However, as the forecasted global demand for hydrogen is expected to increase, a greater emphasis has been placed on transportation.

There has been a more pronounced interest in the hydrogen market in Newfoundland and Labrador in the last 6-12 months. As a result, the provincial government recently announced its plans to open crown land for wind power development. There is also interest in developing wind-to-hydrogen projects on the Island. Recently the Government of Canada and Germany signed a "joint declaration of intent" to establish a transatlantic Canada-Germany supply corridor and start exporting hydrogen by 2025[7]. At this moment it is anticipated that most of these potential projects would focus on export markets.

Liquid Hydrogen can be transported by vessel. The Suiso Frontier, built by Kawasaki Heavy Industries, is the world's first liquid hydrogen carrier ship. In January of last year, it completed its first shipment from Australia to Japan. The vessel can carry up to 1,250 m3 (90 tonnes) of compressed liquid hydrogen.[8] Highly insulated cryogenic tanker trucks can potentially carry up to 4,000 kg of liquid hydrogen and can be used for long distance transport.[9]

8.1.5 Biofuel and Ethanol

The production capacity of biofuel has grown significantly over the last decade. As of 2022, there are 19 operational biofuel production facilities in Canada - 14 as ethanol plants and 5

[6] Zen Clean Energy Solutions, "A Feasibility Study of Hydrogen Production, Storage, Distribution and Use in Newfoundland and Labrador," Zen Clean Energy Solutions, Newfoundland, 2021
[7] CBC News, "'Hydrogen alliance' formed as Canada, Germany sign agreement on exports," CBC News, 23 August 2022. [Online]. Available: https://www.cbc.ca/news/canada/newfoundland-labrador/canada-germany-hydrogen-partnership-nl-1.6559787. [Accessed 24 August 2022].
[8] New Atlas, "Kawasaki launches the world's first liquid hydrogen transport ship," 15 December 2019.
[9] IEA, "The Future of Hydrogen: Seizing today's opportunities," IEA, 2019.

as biodiesel [10]. All facilities are currently located in Central and Western Canada. In 2021, Canadian imports of ethanol from the U.S. increased by 8% year over year to 1.3 billion liters.[11] This was driven by higher Canadian fuel usage as well as an increased share of domestic supply being exported - the total production of ethanol within Canada was over 1.7 billion liters with 100 million liters being exported[12]. In 2022, imports from the U.S are expected to be 1.5 billion liters to support an upward trend in the average nationwide blend level [5]. Canada's biodiesel facilities are export-oriented with only a fraction of the production focused on the domestic market. Approximately 75 to 90% of Canada's biodiesel is exported, with almost all of it being shipped to the United States driven primarily by the tax credits/incentives and margins. Overall, the current supply in Canada is not enough to meet the demand required, therefore, there is a very low chance that there will be any availability for domestic supply to Newfoundland and Labrador in the near future. As the biofuel supply chain grows in Canada, provinces near Newfoundland and Labrador such as Ontario, Quebec, Nova Scotia, and New Brunswick may be of interest to NL Hydro to determine their ability to import.

Biofuel import to Newfoundland and Labrador can be accomplished through trucking, shipping, or piping depending on the location and amount required, in a similar manner to conventional fuels such as petroleum diesel.

The movement of refined products in Canada is largely regional due to infrastructure limitations (especially pipelines). The two broad geographic regions include:

Western Canada: Refineries in Alberta and Saskatchewan supply the demand in the Prairies, British Columbia (BC) and the Northern Territories (Yukon, NW Territories and Nunavut). BC has a couple of small refineries as well that supply part of the provincial demand. The Western Canadian provinces are connected by a network of refined petroleum product pipelines that start near Edmonton, transporting product west to the coast (Vancouver) and east into Winnipeg where it can then be railed or trucked to as far as Thunder Bay.

Eastern Canada: Refineries in Ontario and Quebec supply mainly the provincial demands while most of the production from the Atlantic refineries is exported mainly to the United States. There is a network of pipelines that carries refined products from facilities in Sarnia and Nanticoke towards the Toronto area, and another set of pipelines in Quebec that carry refined products west into the Toronto area.

Figure 8-1 shows the current product flow system for refined products in Canada for export, import and trades. This can potentially apply to biofuels as well when the market becomes more mature.

[10]: Ethanol Producer Magazine, "Canadian Ethanol Plants," Ethanol Producer Magazine, 06 June 2022. [Online]. Available: https://ethanolproducer.com/plants/listplants/Canada/Operational/All. [Accessed 17 August 2022].
[11] Biodiesel Magazine, "Canadian Biodiesel Plants," Biodiesel Magazine, 24 January 2022. [Online]. Available: https://biodieselmagazine.com/plants/listplants/Canada/existing/. [Accessed 16 August 2022].
[12] Global Agricultural Information Network, "Canada- Biofuels Annual 2022," Ottawa, 2022

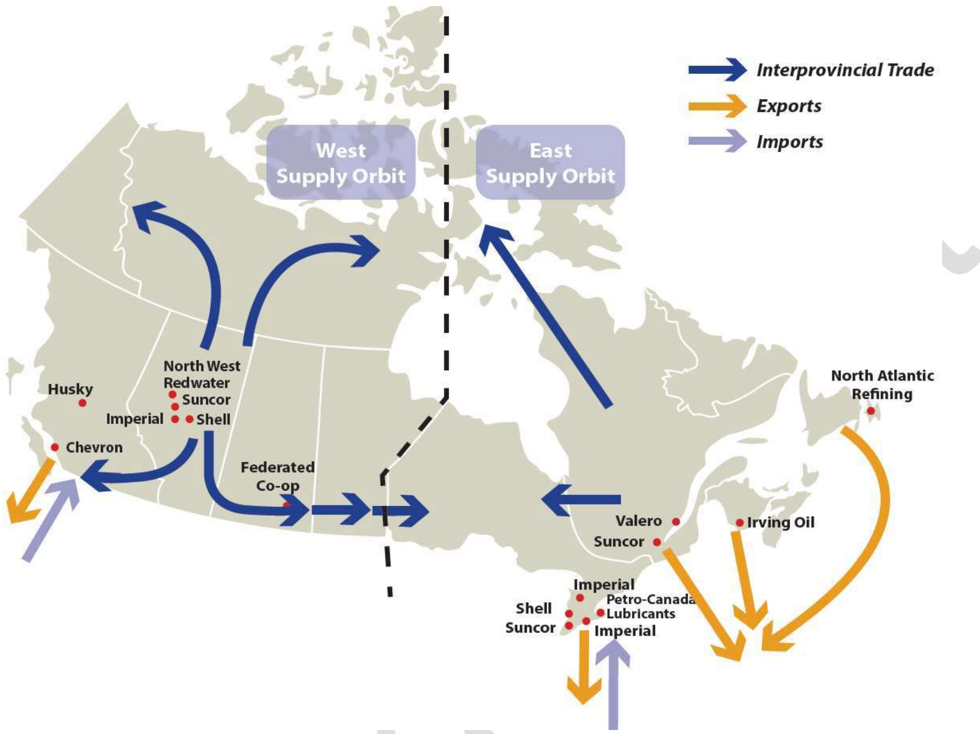


Figure 8-1: Refined Petroleum Product Flow in Canada (Canadian Fuels Association[2])

8.2 Diesel Fuel Consumption

The operating load of the plant, the storage tank capacity, and the daily delivery requirements should all be considered when evaluating fuel assessment for power plants. Table 8-1 below summarized the volume of diesel fuel required for the powerplant to operate at full plant capacity for a day. All fuel quantities have been normalized to 150MW, 300MW and 450MW for phase 1, 2 and 3, respectively.

Table 8-1: Fuel Consumption Summary

[redacted]	[redacted]	Required Units			Total MW			One Day Fuel Requirement (ML)		
Turbine Type	Fuel (t/MWh)	Phase 1	Phase 2	Phase 3	Phase 1	Phase 2	Phase 3	Phase 1	Phase 2	Phase 3
[redacted]	[redacted]	3	6	9	142	283	425	0.942	1.884	2.827
[redacted]	[redacted]	1	3	4	124	373	498	1.125	2.249	3.374

8.3 Potential Diesel Fuel Suppliers

To evaluate the available fuel supply for the proposed facilities, Hatch contacted multiple suppliers on the Avalon Peninsula. [redacted]

[redacted]

In order to guarantee the successful supply of fuel to the plant as shown in Table 8-1, the contacted suppliers confirmed an advanced notice is required for the fuel quantity requested. The average lead time to supply this quantity of fuel is 10-45 days.

While the requirement for advanced notification can reduce some logistical difficulties, proactive communication, and coordination between NLH and the suppliers will assist with reducing any delays and guarantee a steady supply of fuel that is in line with the operations' dynamic demand patterns. On the Avalon Peninsula, where diesel is the most common fuel type, the availability of diesel fuel exceeds the availability of other types of fuel, such as natural gas, hydrogen fuel and biofuel.

From the [redacted] suppliers contacted, most of them were able to partially meet the fuel demand with little to no advance notification. Some suppliers were only able to supply fuel by trucks (approx. 600,000 liter per day), whereas others indicated they have approximately 6-8 million liters available by barge and truck with 2-3 days notice within a 10-day period. These supplies are weather dependant. Hatch recommends initiating discussion with suppliers on the contractual terms during the FEED study.

8.4 Fuel Delivery

Bases on the location of the identified sites, fuel delivery by truck and barge were evaluated.

8.4.1 Truck Delivery

Fuel distribution by truck entails delivering fuel in tankers or other specialised trucks to various locations, including Industrial sites and businesses. The following are a few crucial characteristics of truck delivery:

- Trucks can travel to isolated locations, work sites, and locations with poor infrastructure. Based on demand, they provide a flexible and adaptable way to reach various regions.
- Fuel distributors can deliver smaller amounts of fuel to certain clients or geographic areas thanks to trucks. This is especially beneficial for home heating oil, remote petrol stations or urgent filling requirements.
- Truck deliveries can be planned in advance to guarantee a timely supply of fuel, minimizing customer inconvenience and downtime.

8.4.2 *Barge Delivery*

Large ships or barges are frequently used for barge delivery, which entails moving fuels via rivers, lakes, or coastal locations. Here are some crucial elements of delivery by barge:

- Barges are an excellent choice for bulk transportation. Since they can transport large amounts of fuel, fewer shipments are required.
- Barge delivery is advantageous when a waterway is near by, such rivers, lakes, or coastal areas. In places where long-distance travel is impractical or road access is limited, it enables efficient fuel supply.
- Barges can help with fuel transshipment, which is the movement of fuel between larger ships and storage facilities. They serve as an essential conduit between refineries, warehouses, and distribution centres.
- Barge transportation has potential environmental advantages over other modes of transportation, including lower fuel consumption and emissions per ton-mile of goods.

Considering the viability of truck and barge transportation, Table 8-2 provides an overview of the fuel supply options if the plant ran at 100% capacity. It is assumed that the capacity of fuel delivered by one truck is 40,000 liters and the capacity of fuel delivered by barge will be 5,000,000 liters. It is to be noted that one supplier confirmed they can provide 6,000,000 L via barge from Conception Bay south area within a 10-day notice. All fuel quantities have been normalized to 150MW, 300MW and 450MW, for phase 1, 2 and 3, respectively.

Table 8-2: Barge and Truck Requirements for Fuel Delivery to Sustain Plant Run for 10 Days

[redacted]	Barge Required for 10 Days			Trucks Required per Day			Trucks Required for 10 Days		
[redacted]	Phase 1	Phase 2	Phase 3	Phase 1	Phase 2	Phase 3	Phase 1	Phase 2	Phase 3
[redacted]	2	4	6	24	47	71	236	471	707
[redacted]	3	5	7	28	56	84	281	562	843

Due to the required number of trucks to keep the plant running, it is almost impractical to deliver diesel to a power plant via truck for anything larger than Phase 1.

Although this is an emergency plant, barge delivery is still viable for the Holyrood site as there is already existing barge infrastructure which can be used. There are therefore no additional capital costs that would go into this. The barge option is therefore more practical than truck delivery.

8.5 Preliminary Storage Volume

Fuel storage is important to guarantee sufficient fuel supply and reduce the risks associated with fuel delivery delays, supply variations, or unanticipated events. An initial storage volume was determined which could supply the plant without the need for delivery for a certain length of time, which in the case below is 10 days. This will allow the plant to run without notice and without immediate delivery for a short period of time. A large fuel storage capacity enables better disaster preparedness and contingency planning. The table below show the initial storage needed for 10 days, if 600,000 liters/day were received. All fuel quantities have been normalized to 150MW, 300MW and 450MW, for phase 1, 2 and 3, respectively.

Table 8-3: Required Initial Volume of Fuel for 10 Days of Storage with Daily Delivery - 600,000 Liter/Day

		Phase 1	Phase 2	Phase 3
[redacted]	Volume (ML)	5.0	15.5	26.0
[redacted]	Volume (ML)	7.0	19.5	32.0

8.5.1 Long-Term Fuel Storage Limitation

The shelf life for diesel is approx. 6-12 months on average. Generally, to prolong the life and maintain the quality of stored diesel fuel, it should be kept cool at around 21° Celsius and treated with biocides & stabilizers and should be maintained properly in accordance with NFPA 110. As per the Standard recommends that, “Tanks should be sized so that the fuel is consumed within the storage life, or provision should be made to replace stale fuel with fresh fuel,” NFPA 110, A-5-9, which means that fuels be periodically pumped out and used in other services and replaced with fresh fuel”. It should be noted that NLH might need to burn the volume of fuel that is being stored if it is not used after 12 months.

If the above conditions are not met adequately, four main threats to the quality of the diesel may arise:

- Hydrolysis - Diesel and biofuel degrades as a result of exposure to water, which results in a hydrolysis reaction. Due to a chemical reaction brought on by the contact with water, the fuel is broken down and becomes more prone to the growth of germs and fungi.
- Microbial growth - Microbial growth is a result of hydrolysis. Bacteria create acid that deteriorates fuel, clog tank filters from biomass buildup, restrict fluid flow, erode storage tanks, and harm engines. The Environmental Protection Agency (EPA) is mandating less sulphur in diesel to minimise air pollutants. However, less sulphur in diesel makes the fuel less stable and susceptible to microbial development.
- Oxidation - Diesel and biofuel oxidizes as soon as it leaves the refinery due to a chemical reaction in which oxygen is introduced to the fuel. When oxygen interacts with the chemicals in diesel, it produces high acid levels as well as undesirable gum, sludge, and

silt. While the generation of gum and sediment clogs filters, the high acidity erodes the tank. Heat and sunlight can also accelerate the oxidation process.

- Exposure to Metal Alloys - Contact with zinc, copper, brass, bronze, lead, and tin as these can cause accelerated aging. These metals will quickly react with biofuel and diesel fuel to form unstable compounds. Exposure to dust and dirt which contain trace elements can also cause accelerated aging.

8.5.2 *Recommended Measures for Long-Term Fuel Storage*

To guarantee clean, uncontaminated stored diesel and biofuel, a few measures should be taken.

- Fungicides/Biocides - Biocides will assist in halting the development of bacteria and fungi that can flourish at the water-diesel contact.
- Antioxidants – antioxidants will stop the oxidation process and reduce the formation of sediment and gum.
- Fuel treatment - Utilise fuel treatment that separates water from fuel and has demulsifying qualities. The Fuel Water Separator (FWS) filter is likely installed in tanks that are currently on the market, and demulsifying treatments improve the FWS's function.
- Reliable fuel supply – ensure the fuel supplied conforms with a recognized specification. Obtain assurance from the supplier that the fuel components are well refined and stable.
- Tank check - After rain, check the tank for any water that has accumulated. By routinely inspecting the tank, especially after rain to drain any standing water on the top of the tank, you can maintain its structural integrity. It is also important to keep the tank full to reduce the space for water to condense. Tanks should also have a low point where water can be drained.
- Fuel testing – Regularly sample and test the fuel in a laboratory. The fuel can also be visually inspected for evidence of haziness, sediment, and darkening.
- Tank cleaning – tanks should be drained and cleaned at least every 10 years. If there is a contamination problem, the tank should be cleaned more frequently.
- Regular turn-over – ensure the fuel is used within 12 months of initially being stored.
- Maintain temperature - Keep the tank at a cool temperature. A cool tank is essential for postponing oxidation; -6°C is optimal, but temperatures shouldn't exceed 29°C.
- Treat the fuel - By stabilising it and avoiding a chemical breakdown, additives like antioxidants and fuel stability treatments preserve the diesel fuel's quality.
- Filter the fuel – A filtration system should be implemented to remove any sediment and gums from the fuel. The filters should be checked frequently and changed at regular intervals.

- Avoid contact with metals - Ensure that the fuel is not in contact with any surfaces containing zinc, copper or compounds containing those metals (e.g., brass). If those metals are present, then a metal deactivator additive may need to be used to avoid fuel degradation.

8.6 Existing Demand on Fuel Network for NL Hydro

The above analysis and scenarios do not consider the existing infrastructure that NLH has. However, NLH has other units which would likely be running in addition to the proposed gas turbines which will rely on the same fuel supply network. Some of these units include:

Existing Holyrood Gas Turbine – Consumes approximately 969K L / Day at full load.

Hardwoods – Consumes approximately 400K L / Day at full load.

Stephenville Gas Turbine – Consumes approximately 400K L / Day at full load.

The suppliers have stated that they can provide 600,000 L/day in addition to what is already being supplied on the island. Hardwoods and Stephenville gas turbines are old assets and potentially due to be retired, when that happens, more fuel will be available on the island to supply phase1 project.

8.7 Summary for Fuel Assessment and Transportation

1) Fuel Consumption – Fuel delivery for the Phase 1 case is achievable based on the number trucks needed to deliver the fuel. If the fuel demand surpasses this, more resources will be needed to deliver the required fuel.

2) Transportation – Fuel delivery via truck would be challenging due to limited availability of trucks in the province. Fuel unloading time can be reduced by incorporating more than 1 truck offload area. Delivery via barge would be possible for a site that is in close proximity to a shoreline, therefore, the Holyrood site would be a preferred options amongst all other sites.

3) Storage of fuel - A storage tank is required to accommodate the variable fuel consumption of the emergency plant. A storage tank enables the plant to handle changes in demand and respond to unanticipated events like delays in fuel delivery or supply chain interruptions.

   Storing large quantity of fuel for a long duration can cause fuel degradation. Storing large quantities of fuel can incur additional cost for maintenance & monitoring of fuel storage.

4) Supplier - Setting up proper contractual terms with supplier for unplanned demand will help to shorten the lead time for fuel delivery. To meet the demand, multiple suppliers should be involved with fuel delivery.

5) Facility Location - Facility location plays an important role in the fuel delivery process. As the Holyrood site has the existing dock and road facility, it would be the preferred option due to unplanned demand of fuel, as suppliers can deliver fuel via both methods.

9. Electrical Interconnection

There are two primary areas or zones of electrical infrastructure in the Newfoundland and Labrador Interconnected System — the Island Interconnected System and the Labrador Interconnected System.

The Island Interconnected System is primarily supplied by large hydroelectric generation capability located off the Avalon Peninsula and the 230 kV bulk transmission system extending from Stephenville to St. John's. Currently, the two largest sources of generation on the Island are the Bay d'Espoir Hydroelectric Generating Facility[13] and the Holyrood TGS.[14] The Island Interconnected System is interconnected to the Labrador Interconnected System via the Labrador-Island Link ("LIL"), a 900 MW HVdc[15] transmission line designed to deliver power from the Muskrat Falls Hydroelectric Generating Facility in Labrador to the Soldiers Pond Terminal Station on the Avalon Peninsula. The Island Interconnected System also connects to the North American Grid via the Maritime Link. The Maritime Link is a 500 MW (+/- 200 kV) HVdc transmission line, as well as a 230 kV high-voltage alternating current ("HVac") transmission line and associated infrastructure, connecting Newfoundland and Labrador to Nova Scotia

The Electrical Interconnection portion of this study investigates the technical feasibility of replacing the Holyrood TGS 490MW of capacity with up to 450MW of combustion turbines at one of two possible sites.

Figure 9-1 below shows the eastern portion of the Provincial Generation and Transmission Grid for the Island portion of the province. Site selection guidelines dictated the proposed site location was to be near the 230kV system electrically downstream of Soldiers Pond Terminal Station.

As previously outlined, the Environmental review process identified the top two possible site locations as Holyrood and Soldiers Pond.

[13] A 613 MW hydraulic plant on the south coast of the Island.
[14] A 490 MW oil-fired thermal generating plant located on the Avalon Peninsula.
[15] High-voltage direct current ("HVdc").

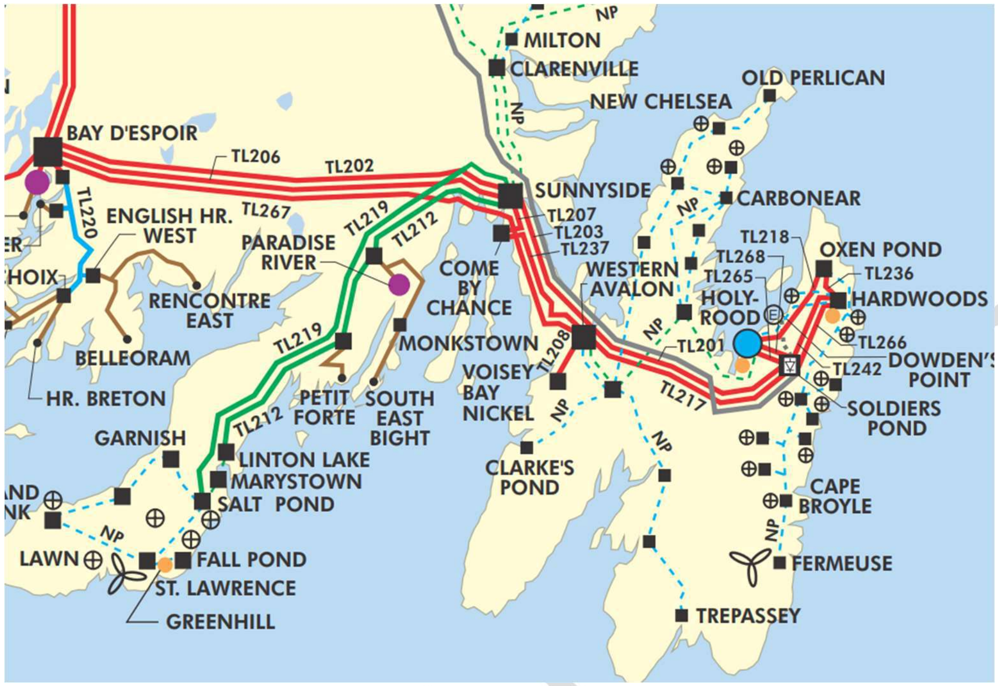


Figure 9-1: Eastern Portion of NLH Grid

9.1 Site Selection and 230kV Transmission Line Interconnection

The two sites selected for interconnection to the 230kV Transmission System are Holyrood, adjacent to the existing Holyrood TGS, and Soldiers Pond, approximately 1 km east of the existing Soldiers Pond Terminal Station. This section proposes each sites interconnection configuration for analysis.

9.1.1 Holyrood Site Interconnection

The proposed site for the combustion turbine plant would be approximately 150m to the east of the existing Holyrood TGS. The 230kV transmission line right of way from the existing Holyrood TGS has three transmission lines as follows:

1. TL265 – Steel Tower to Soldiers Pond Terminal Station with summer and winter ratings of [redacted] MVA respectively.
2. TL268 – Steel Tower to Soldiers Pond Terminal Station with summer and winter ratings of [redacted] MVA respectively.
3. TL218 – Wooden Pole to Oxen Pond Terminal Station with summer and winter ratings of [redacted] MVA respectively.

TL218 is the preferred 230kV point of interconnection as it is both physically adjacent to the new power plant site, thus minimizing transmission line outages of the other 230kV lines and provides a direct route to the most eastern 230kV terminal station in the St. John's area, Oxen Pond Terminal Station. This selection provides a level of security in the event of loss of the Soldiers Pond Terminal Station thus maintaining a level of power delivery to the St. John's area.

Figure 9-2 provides a high-level overview of the proposed site and interconnection points.

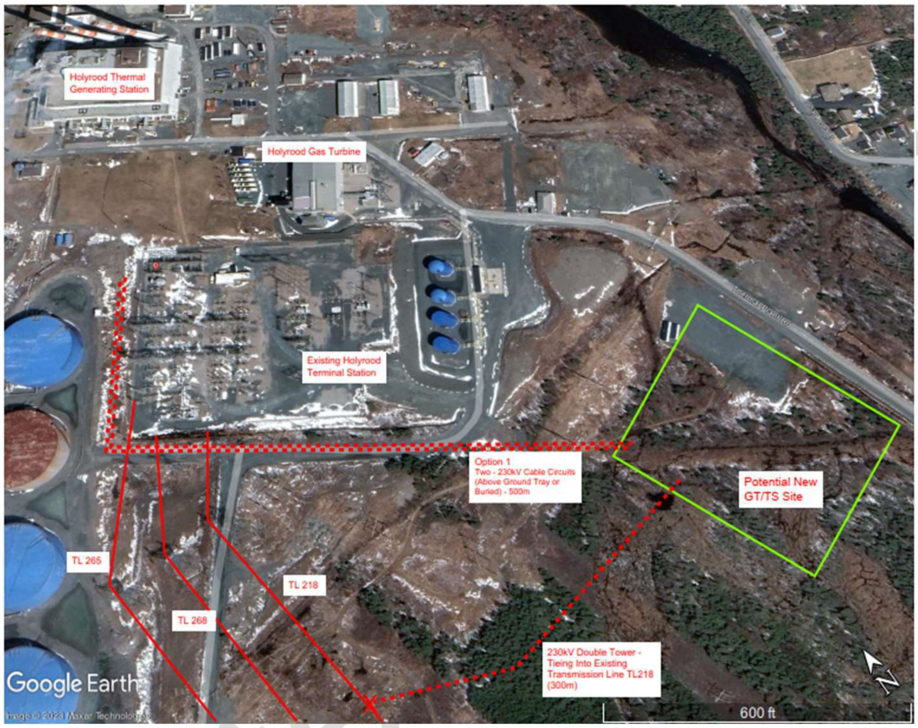


Figure 9-2: Holyrood Site 230kV Interconnection Proposal

The existing Holyrood TGS units 1, 2 and 3 are to be decommissioned in the 2030 timeframe, while Unit 3 will be permanently converted to a Synchronous Condenser mode of operation. As such, Units 1 and 2's 230kV breaker bays at the existing Terminal Station will be available as interconnection points for the new Combustion Turbine Power Plant. It is proposed that two 230kV underground cables be used to interconnect the new Power Plant to existing breaker bays for Units 1 and 2 as TL218 cannot support a full load of [redacted] MW without exceeding its summer and winter thermal rating. This will provide an alternate path of power to the 230kV transmission system thus maximizing flexibility during transmission line outages. Underground cable is preferred as there is heavy congestion in the area thus lack of Right of Way to the existing Holyrood TGS is an issue.

The decommissioning of the existing HGTP will be done in stages as outlined below:

1. Permanently convert Unit 3 to Synchronous Condenser operation.
2. Removal of Unit 1 from service
3. Removal of Unit 2 from service

TL218 tie into the new Power Plant can be performed while Unit 3 is permanently converted to Synchronous Condenser operation without affecting operation of the existing HGTP. The installation of the 230kV underground cables can be performed prior to Units 1 and 2 being decommissioned, whilst termination and commissioning can be performed as each Unit 1 and 2 comes out of service thus maintaining uninterrupted service to the existing Terminal Station.

Figure 9-3 below outlines the interconnection of the new power plant with the existing 230kV transmission line TL218 and the two new 230kV type "DD" wood pole structure requirements (see Appendix C1 for structure drawing).

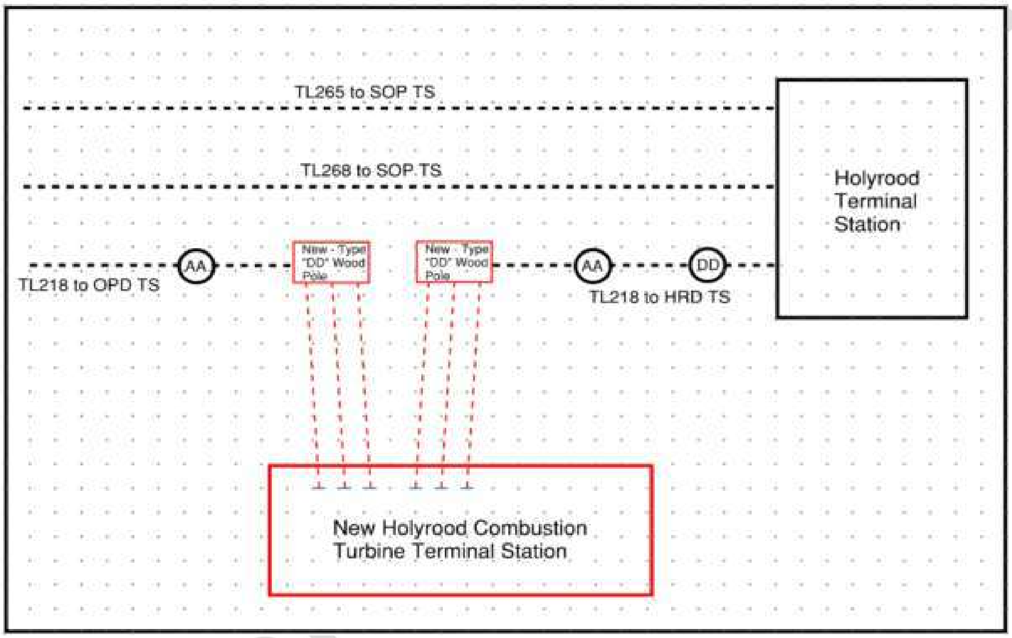


Figure 9-3: TL218 Interconnection to New CT Terminal Station

9.1.2 Soldiers Pond Site Interconnection

The proposed site for the Soldiers Pond Combustion Turbine Plant would be approximately 1km to the east of the existing Soldiers Pond Terminal Station. The 230kV transmission line right near the proposed site includes three transmission lines as follows:

i) TL218 – Wooden Pole Structures from Holyrood to Oxen Pond Terminal Station with summer and winter ratings of [redacted] and [redacted] MVA respectively

ii) TL242 – Steel Tower Structures from Soldiers Pond to Hardwoods Terminal Station with summer and winter ratings of [redacted] and [redacted] MVA respectively

iii) TL266 – Steel Tower Structures from Soldiers Pond to Hardwoods Terminal Station with summer and winter ratings of [redacted] and [redacted] MVA respectively

TL266 is the preferred 230kV point of interconnection as it is physically adjacent to the new power plant site, thus minimizing transmission line outages of the other 230kV lines. TL266 is a new transmission line with in-service date of 2018 and has a very high thermal capacity enabling it to carry the entire [redacted]MW during all ambient temperature ranges. Finally, TL266 has an overhead ground wire over its entire 16.5km length, thus no requirements of having to install up to 1.6km of overhead ground wire to meet NLH's transmission standards for terminating in terminal stations.

Figure 9-4 provides a high-level overview of the proposed site and interconnection points.

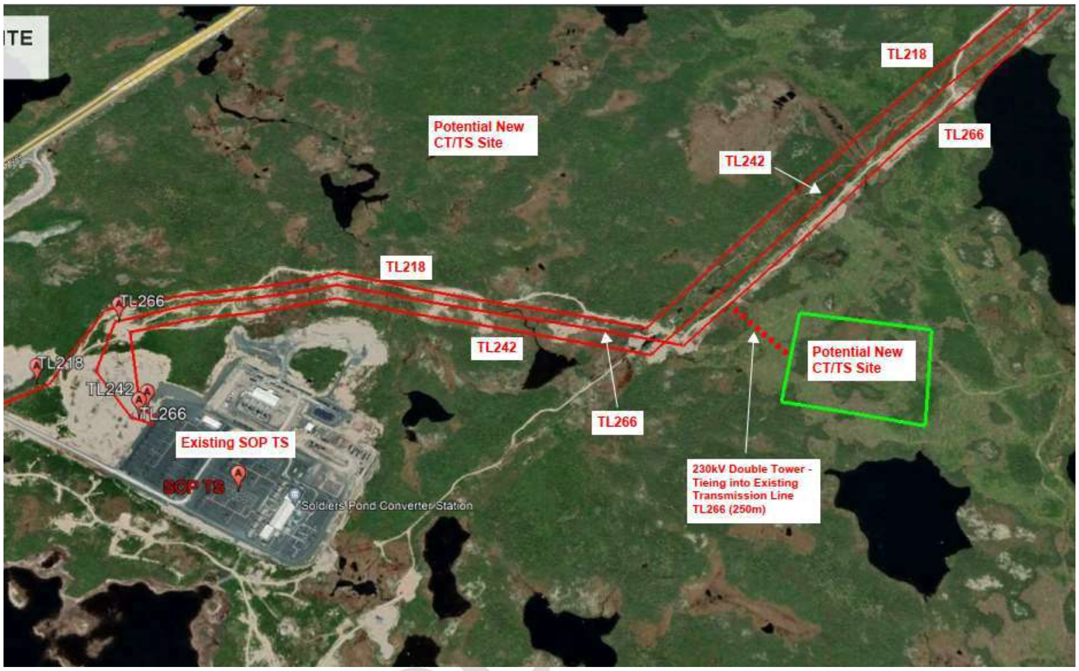


Figure 9-4: Soldiers Pond Site 230kV Interconnection Proposal

Figure 9-5 below outlines the interconnection of the new power plant with the existing 230kV transmission line TL266 and the four new 230kV type "C" steel pole structure requirements (see Appendix C2 for structure drawing).

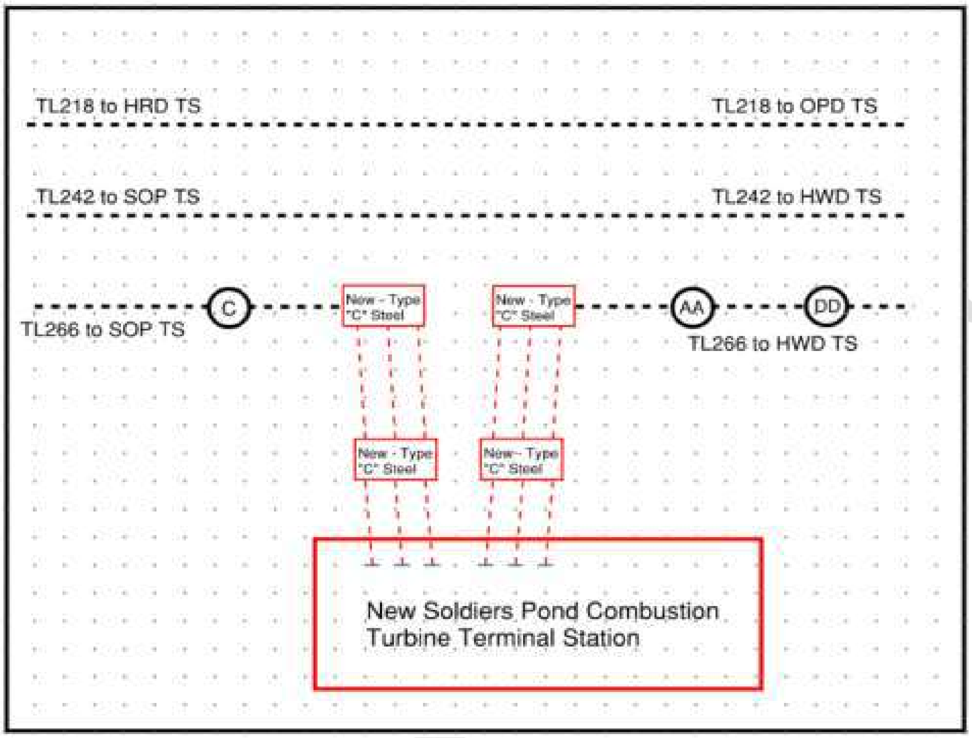


Figure 9-5: TL266 Interconnection to New CT Terminal Station

9.2 System Operating Diagrams and Terminal Station Footprint

Development of System Operating Diagrams (SOD) were done following the general guidelines of NLSO Standard TP-S-008 for Terminal Station Configurations. For the high-level conceptual design, it is assumed that the [redacted] (50 MW at ISO conditions) combustion turbine is used with up to nine (9) generating units for an estimated output of 450MW. The generating units will produce power at 13.8kV and to reduce the footprint of the terminal station it is recommended to have two generators feed one 13.8/230kV step-up transformer, thus a requirement of five step-up transformers. The transformers shall be rated at 13.8/230kV, 125MVA while the 230kV breakers shall have a continuous rating of 1200A and a short circuit interrupting capability of 31.5kA. A breaker and a third scheme are recommended to minimize the number of circuit breakers while maintaining an acceptable level of reliability. The following sections outline the Holyrood TGS and Soldiers Pond Terminal Station configurations.

9.2.1 Holyrood System Operating Diagram / Station Layout

The proposed System Operating Diagram for the Holyrood Combustion Turbine Terminal Station location and the high-level Terminal Station layout can be seen in Appendix C.

Appendix C1 shows the breaker and a third scheme in which there are three diameters[16] and room for a fourth diameter in the future if required. The SOD can be broken down into three Phases of the Plant size progression. Phase 1 involves installation of 3 x 50MW combustion turbines (150MW capacity) and termination into the first and second diameters. TL218 will be broken and re-terminated into the new Terminal Station.

Phase 2 involves expansion of generation by 150MW (300MW capacity), termination into the second and third diameters. As well, this phase would see the installation of a three phase 230kV underground cable to Holyrood TGS – Unit 1 breaker slot to coincide with de-commissioning of the 175MW Unit 1.

Phase 3 involves expansion of generation by 150MW (450MW capacity), termination into the third diameter. As well, this phase would see the installation of a three phase 230kV underground cable to Holyrood TGS – Unit 2 breaker slot to coincide with de-commissioning of the 175MW Unit 2.

9.2.2 Soldiers Pond System Operating Diagram / Station Layout

The proposed System Operating Diagram for the Soldiers Pond Combustion Turbine Terminal Station location and the high-level Terminal Station layout can be seen in Appendix C. This site only requires termination of one 230kV transmission line, TL266, versus multiple terminations at the Holyrood site. This can be attributed to the fact that TL 266 has a higher transmission capacity capability than TL 218, thus allowing full transmission of [redacted]MW of power in either direction on this line. Therefore, there are two less circuit breaker bays and no requirement of a fourth diameter as opposed to the Holyrood site. The FEED stage would be used to optimize the final breaker configuration and terminations.

The SOD can be broken down into three Phases of the Plant size progression. Phase 1 involves installation of 3 x 50MW combustion turbines (150MW capacity) and termination into the first diameter. TL266 will be broken and re-terminated into the new Terminal Station's first and second diameter.

Phase 2 involves expansion of generation by 150MW (300MW capacity) and termination into the second diameter. This sites expansion into the interconnected system is not dependent upon de-commissioning of the 175MW Units 1 or 2.

Phase 3 involves expansion of generation by 150MW (450MW capacity), termination into the second and third diameter.

[16] A diameter in relation to terminal station design is the arrangement of a set of circuit breakers and transmission elements in a specific row. For example, a breaker and a half diameter consists of three circuit breakers and two transmission elements, such that are one and a half breakers for each transmission element.

9.3 Transmission System Limitations – Infrastructure Requirements

A steady state power system analysis study was completed to determine transmission limitations resulting from the addition of up to 450MW of generation at both sites of Holyrood and Soldiers Pond. The study was completed using PSSE Version 33 and Newfoundland & Labrador Hydro's latest 2032-33 Peak and Light load models. The study followed the general NLSO Standard – Transmission Planning Criteria, TP-S-007, with the following criteria:

1. Pre-Contingency Criteria
   a. With all equipment in service under normal operation, power flow in all elements should be at or below normal rating and voltages shall be within acceptable limits.
2. Single Contingency (N-1) Criteria
   a. From normal system conditions, the Newfoundland and Labrador Interconnected System shall be able to withstand a single contingency.
3. Voltage Limits for Normal and Contingency Conditions (Steady State)
   a. Pre-contingency limits: For normal operations, all bus voltages shall be maintained between 95% and 105%.
   b. Post-contingency limits: For contingency or emergency situations, bus voltages shall be maintained between 90% and 110%.
4. MVA Limits

For planning purposes, the pre- and post-contingency MVA rating limits cannot be exceeded. When studying the post-contingency, there is flexibility in the system to reduce equipment loading by several operating changes such as:

a. Changes in generation dispatch.

b. Changes in system configuration (opening loops).

c. Non-firm export reductions.

d. Non-firm load reductions.

9.3.1 System Study Setup

Four main cases were developed for the system study upon which contingency analysis was then completed. The cases were prepared based on Newfoundland & Labrador Hydro's 2022 Fall Load forecast. Three of the cases were prepared based on 2032/33 Peak Load model while the fourth was based on the 2032/33 Light Load model with the Labrador Island Link (LIL) and Maritime Link (ML) dispatched as follows:

1. Peak Load with LIL at 900MW Export from Muskrat Falls and ML exporting 158MW.
2. Peak Load with LIL in Monopole mode, exporting 675MW from Muskrat Falls, and ML exporting 158MW.
3. Peak Load with LIL bipole outage, 0 MW from Muskrat Falls, and ML exporting 0MW.

Appendix C3 outlines the Generation Dispatch for all major units for each case outlined above and presents the technical assumptions associated with the modeling of the new Combustion Turbine Power Plant.

9.3.2 Single Contingencies

For this power system study, the contingencies studied were outages of all 230kV transmission lines East of Bay d'Espoir as well as loss of a synchronous condenser at Soldiers Pond. Table 9-1 below outlines the contingencies studied as well as the applicable thermal overload ratings of each transmission line.

Table 9-1: Contingencies Studied

Contingency			Transmission Line Rating (MVA)	
Transmission Line No.	From	To	Rate A [1]	Rate C [2]
TL 201	Western Avalon	Soldiers Pond	[redacted]	[redacted]
TL 202	Bay d' Espoir	Sunnyside	[redacted]	[redacted]
TL 203	Sunnyside	Western Avalon	[redacted]	[redacted]
TL 206	Bay d' Espoir	Sunnyside	[redacted]	[redacted]
TL 207	Sunnyside	Come-by-Chance	[redacted]	[redacted]
TL 217	Western Avalon	Soldiers Pond	[redacted]	[redacted]
TL 218	Holyrood	Oxen Pond	[redacted]	[redacted]
TL 218A[3]	Holyrood	New Holyrood CT TGS	[redacted]	[redacted]
TL 218B[4]	New Holyrood CT TGS	Oxen Pond	[redacted]	[redacted]
TL 236	Hardwoods	Oxen Pond	[redacted]	[redacted]
TL 237	Western Avalon	Come-by-Chance	[redacted]	[redacted]
TL 242	Soldiers Pond	Hardwoods	[redacted]	[redacted]
TL 265	Holyrood	Soldiers Pond	[redacted]	[redacted]
TL 266	Soldiers Pond	Hardwoods	[redacted]	[redacted]
TL 266A[5]	Soldiers Pond	New Soldiers Pond CT TGS	[redacted]	[redacted]
TL 266B[6]	New Soldiers Pond CT TGS	Hardwoods	[redacted]	[redacted]
TL 267	Bay d' Espoir	Western Avalon	[redacted]	[redacted]
TL 268	Holyrood	Soldiers Pond	[redacted]	[redacted]
SOP SC	Outage of Soldiers Pond Synchronous Condenser No. 2			

Notes:

1. Summer thermal rating of transmission lines are based on 30°C ambient and 50°C conductor temperature.
2. Winter thermal rating of transmission lines are based on 0°C ambient and 50°C conductor temperature.
3. The section of TL218 from the new HRD CT Terminal Station to the existing HRD TS, approximately 0.5 km.

4. The section of TL218 from the new HRD CT Terminal Station to the existing OPD TS, approximately 37 km.

5. The section of TL266 from the new SOP CT Terminal Station to the existing SOP TS, approximately 2.6 km.

6. The section of TL266 from the new SOP CT Terminal Station to the existing SOP TS, approximately 14.4 km.

9.3.3 Power Study Results

N-1 Contingency Analysis was performed on the four base cases outlined in section 9.3.1 for 450MW of generation installed at Holyrood and Soldiers Pond sites. The following section presents the results for each base case studied.

9.3.3.1 Peak Load

Table 9-2 outlines the overall results of the contingency analysis for the three Peak Load base cases. The only overload condition that cannot be mitigated without load shedding is the thermal overload of TL242 during an outage of TL266B for the Soldiers Pond Combustion Turbine site.

Table 9-2: 2032 Peak Load N-1 Continency Analysis Results with 450MW CT at SOP and HRD

LIL Loading at MFA	Combustion Turbine Location			
	Soldiers Pond		Holyrood	
	Contingency	Overload Condition	Contingency	Overload Condition
900 MW	TL 266B	TL 242 @ 107.3% [1]	N / A	N / A
675 MW (Monopole)	TL 266B	TL 242 @ 106.8% [1]	N / A	N / A
0 MW (Bipole Outage)	TL 266B	TL 242 @ 104.3% [1]	N / A	N / A
Note 1 – [redacted]				

Reducing the generation output from the Soldiers Pond site to 300 or 150MW does not alleviate the overload condition on TL 242 for TL 266B outage as can be seen in Table 9-3 and

Table **9-4**.

Table 9-3: 2032 Peak Load N-1 Continency Analysis Results with 300MW CT at SOP and HRD

LIL Loading at MFA	Combustion Turbine Location			
	Soldiers Pond		Holyrood	
	Contingency	Overload Condition	Contingency	Overload Condition
900 MW	TL 266B	TL 242 @ 107.0% [1]	N / A	N / A
675 MW (Monopole)	TL 266B	TL 242 @ 106.5% [1]	N / A	N / A

Table 9-4: Peak Load N-1 Continency Analysis Results with 150MW CT at SOP and HRD

LIL Loading at MFA	Combustion Turbine Location			
	Soldiers Pond		Holyrood	
	Contingency	Overload Condition	Contingency	Overload Condition
900 MW	TL 266B	TL 242 @ 106.8%	N / A	N / A
675 MW (Monopole)	TL 266B	TL 242 @ 104.9%	N / A	N / A

9.3.3.2 Light Load

For the Light Load base case, there were no transmission line overloads or voltage violations during any of the N-1 contingencies outlined for either Holyrood or Soldiers Pond locations.

There may be other light load scenarios and loading arrangements, not analyzed in this study, whereby overloading of TL 201 may arise when power flow is from east to west and there's an outage of TL 217. NLH is aware of this transmission constraint on the Avalon Peninsula and is actively studying these constraints. It is felt that both locations of Holyrood and Soldiers Pond are equally affected by this constraint and beyond the scope of work for this study.

9.4 Commissioning Coordination

The high-level coordination of commissioning activities for each site, as it relates to Electrical Interconnection are described in the following sections.

9.4.1 Holyrood Site

Coordination of interconnection to the 230kV transmission system would be accomplished in stages as outlined below:

1. Stage 1 - 150 MW of generation would be added via interconnection of TL 218. An outage of TL 218 would be required to tie into the new terminal station, and this can occur when the overall system load is less than 1000 MW which would prevent any

overloading issues due to N-1 contingencies on the 230kV system. The window for this outage typically would be from mid-June to late September which should be adequate for construction of wood pole structures and physical interconnection to the new terminal station. During this time frame, the changeover of Unit 3 at HGP to synchronous condenser mode will not be affected by an outage of TL 218.

2. Stage 2 – 150 MW of generation would be added via 230kV underground cable to existing Unit 1 breaker bay. This activity can be timed with the removal of Holyrood Thermal Generating Unit 1 from service, preferably between months of May to October when Unit 1 isn’t typically required for generation support.
3. Stage 3 – 150 MW of generation would be added via 230kV underground cable to existing Unit 2 breaker bay. This activity can be timed with the removal of Holyrood Thermal Generating Unit 2 from service, preferably between months of May to October when Unit 2 isn’t typically required for generation support.

9.4.2 Soldiers Pond Site

Coordination of interconnection to the 230kV transmission system would be accomplished in stages as outlined below:

1. Stage 1 - 150 MW of generation would be added via interconnection of TL 266. An outage of TL 266 would be required to tie into the new terminal station, and this can occur when the overall system load is less than 800 MW, which would still leave a potential overload condition on TL 218 with the loss of TL 242, using the summer transmission thermal rating. System load less than 800 MW typically has a small window of between mid-August to early September. There is an elevated risk of load shedding during the commissioning phase of the electrical interconnection using the Soldiers Pond site.
2. Stage 2 – Once TL 266 is in-service, an additional block of 150 MW of generation could be added via TL 266 with no transmission line outages and can be done before Holyrood Thermal units come offline.
3. Stage 3 – Once TL 266 is in-service, the final block of 150 MW of generation could be added via TL 266 with no transmission line outages and can be done before Holyrood Thermal units come offline.

9.5 Cost Comparison Considerations

Table 9-5 below outlines a high-level comparison of the differences between the two sites for consideration.

Table 9-5: High Level Cost Comparison of Differences

Item Description	Soldiers Pond Site	Holyrood Site
Civil Works – Station Size	19376m²	22144m²
	~ $ 5 M	~ $ 6 M
230kV Breaker / MOD – Assumed $1M each	10	12
	~ $ 10 M	~ $ 12M
230kV Underground Cable (Assumed $15 M / km for double run)	0	~ $ 7.5
TL 242 Thermal Uprating	~ $ 5 M	0
Total	$ 20 M	$ 25.5 M

As can be seen from the table above, the Soldiers Pond Terminal Station will be slightly lower in cost relative to the Holyrood Site.

9.6 Summary

Both Holyrood and Soldiers Pond sites provide an acceptable Point of Interconnection (POI) to NLH's 230kV transmission system.

The Holyrood site's electrical layout will be slightly larger because two additional 230kV breaker bays are required and thus the relative cost of the terminal station will be slightly higher.

Soldiers Pond location will require the thermal uprating of TL 242 to [redacted] MVA from the winter rating of [redacted] MVA for the contingency of loss of TL 266. This location may require a tighter outage window of TL 266 when tying the line into the new terminal station as there may be an elevated risk of thermal overload of TL 218 should there be an unexpected outage of TL 242 during the tie in process. Further analysis during the FEED stage will be required to quantify this risk and propose mitigation strategies.

10. Noise Assessment

The noise impact of the proposed new combustion turbine generator on the surrounding environment was assessed. The assessment is completed for Holyrood and Soldiers Pond only, as these sites score the highest in the environmental site selection exercise. The noise assessment provides preliminary evaluation of the sound levels of the noise emitted from the proposed new combustion turbines at the neighbouring communities of Holyrood and Soldiers Pond Site. The predicted noise levels are compared to the appropriate noise criteria to evaluate the need of noise mitigation. The assessment did not include the noise emissions from the existing activities on the Holyrood site.

10.1 Noise Criteria

There are no regulations in Newfoundland and Labrador regarding noise emissions. Due to insufficient support for the document, guidelines typically used by other municipal and provincial regulatory agencies were reviewed and noise guidelines for the Province of Nova Scotia have been adopted. The Province of Nova Scotia uses the following guidelines for acceptable equivalent continuous sound levels for industrial zones [17](Leq):

- Leq of 65 dBA between 0700 to 1900 hours;
- Leq of 60 dBA between 1900 to 2300 hours; and
- Leq of 55 dBA between 2300 to 0700 hours.

Leq is the equivalent continuous sound level and represents the average sound level over the period of measurement, which is typically one (1) hour. When a noise varies over time, the Leq is the equivalent continuous sound which would contain the same sound energy as the time varying noise. Leq is measured using dBA values. The "A" frequency weighting network is the most widely used and represents the response of the human ear to loudness.

Labrador City does have Municipal Noise Abatement By-Laws (Municipalities Newfoundland and Labrador, 2017). The by-law states the following limits for residential receptors:

- Leq of 55 dBA for daytime.
- Leq of 45 dBA for nighttime.

The Labrador City noise limits are not used in this study as Nova Scotia provincial guidelines are considered more applicable.

10.2 Methodology

The assessment was completed using the CadnaA software application developed by DataKustik. CadnaA models atmospheric sound propagation following the ISO 9613-2 standard. The model considers geometrical dispersion, atmospheric decay, ground absorption and ground topography.

[17] guidelines-environmental-noise-measurement-assessment.pdf (novascotia.ca)

The modeling was completed for the Holyrood Site. Four (4) CadnaA noise impact scenarios were modeled to estimate the effect of the new proposed combustion turbines on adjacent communities. Table 10-1 describes the four model scenarios.

Table 10-1: CadnaA Models for Holyrood Site

Model	Description
Phase 1	Modeling 150 MW combustion turbine power plant.
Phase 2	Modeling 300 MW combustion turbine power plant.
Phase 3	Modeling 450 MW combustion turbine power plant.
Phase 3 - Mitigated	Modeling 450 MW combustion turbine power. Five (5) m tall noise walls are modeled around the fin fan coolers of the nine units and seven (7) m tall noise walls are modelled around the five transformers in the terminal station.

Noise source sound power data was estimated based on a repository of Hatch sound data and predictive calculations based on the preliminary design. All sound powers are prorated to the design capacity. Noise sources included in the noise model are limited to the following:

- Exhaust stack
- Turbine Air intake filter
- Transformer
- Fin Fan cooler

The assessment for Soldiers Pond Site is based on the screening criteria for the closest noise sensitive receptors. Screening distances are calculated based on the results of the Cadna-A model for the Holyrood Site. The screening distance is the furthest distance from the new turbines for the noise level to drop to the nighttime limit of 55 dBA.

10.3 Assumptions

The following are main assumptions considered in the noise impact analysis:

1) Noise source sound power data was estimated based on a repository of Hatch sound data and predictive calculations.
2) The assessment did not include the noise emissions from the existing activities on the Holyrood site.
3) Noise criteria are taken from province of Nova Scotia noise limits for industrial zone.

10.4 Results

10.4.1 Holyrood Site

The nearest receptors to the Holyrood site are identified as shown in Figure 10-1. All identified noise sensitive receptors are classified as residential. Most receptors are localized on the north-east of the site.

Figure 10-1: Holyrood Site Noise Sensitive Receptors

Figure 10-2 shows the noise level contour plot for phase 3. All identified noise sensitive receptors are located outside the zone where the noise contour levels exceed 55 dBA. Noise levels at all noise sensitive receptors meet the acceptance criteria.

The numerical values of the sound levels at the noise sensitive receptors for Phase 1, Phase 2 and Phase 3 are listed in Table 10-2, Table 10-3, and Table 10-4, respectively. The noise levels increase by up to 3 dB from Phase 1 to Phase 2, which is representing the doubling of the emitted sound power with doubling the number of turbine units. The difference in the noise level between Phase 2 and Phase 3 is about 2 dB.

The maximum noise level for Phase 3 is 54 dBA at 154 Indian Pond Dr and 137 Indian Pond Dr. Although this value is below the 55 dBA nighttime limit, the overall site noise emission can exceed the noise limit if the existing noise emission is in similar order of magnitude. Noise levels of the proposed combustion turbines should be reduced further below the nighttime limit. This can be achieved by installing noise barriers around the fin fan coolers of all the units as well as the transformers in the terminal station. Table 10-5 lists the noise levels at the noise sensitive receptors for Phase 3 with five (5) m tall noise barriers installed around two sides of the fin fan coolers and seven (7) m tall noise barriers installed around the three sides of the transformers in the terminal station. The installations of the noise barriers reduce the maximum noise level by three (3) dB to 51 dBA. The difference between the maximum noise level and the nighttime noise limit is 4 dB, which is sufficient assuming the existing noise at the sensitive receptors is equivalent to or less than the proposed combustion turbine noise. To ensure that the noise emission from the proposed turbine will not result in noise limit exceedances, the existing noise is to be verified. For lower noise limits than 50 dBA, the location of the Holyrood site would need to be moved further away from the residential area to the north-west of the site.

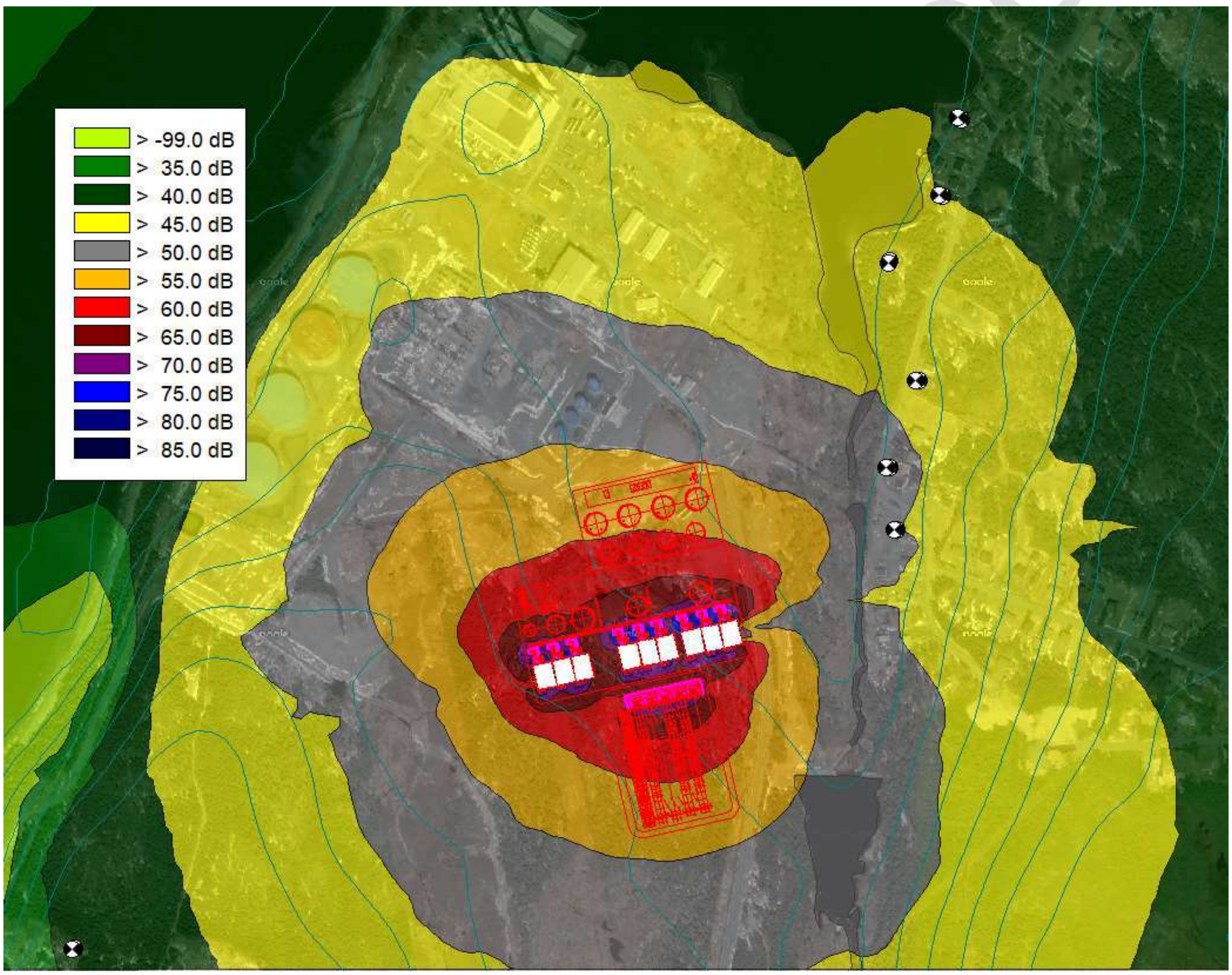


Figure 10-2: Holyrood Site Phase 3 Noise Contour Plot

Table 10-2: Phase 1 Holyrood Site Receptors Noise Levels

Phase 1 – 150MW						
Receptor	Noise Level		Limit		Coordinates	
	Day (dBA)	Night (dBA)	Day (dBA)	Night (dBA)	X (m)	Y (m)
Duffs Rd	40	40	65	55	341408.7	5256714
154 Indian Pond Dr	50	50	65	55	342319.9	5257178
137 Indian Pond Dr	49	49	65	55	342311.1	5257247
123 Indian Pond Dr	48	48	65	55	342343.5	5257344
110 Indian Pond Dr	47	47	65	55	342312.5	5257475
100 Indian Pond Dr	45	45	65	55	342369.2	5257550
90 Indian Pond Dr	44	44	65	55	342390.6	5257636

Table 10-3: Phase 2 Holyrood Site Receptors Noise Levels

Phase 2 – 300MW						
Receptor	Noise Level		Limit		Coordinates	
	Day (dBA)	Night (dBA)	Day (dBA)	Night (dBA)	X (m)	Y (m)
Duffs Rd	41	41	65	55	341408.7	5256714
154 Indian Pond Dr	52	52	65	55	342319.9	5257178
137 Indian Pond Dr	52	52	65	55	342311.1	5257247
123 Indian Pond Dr	50	50	65	55	342343.5	5257344
110 Indian Pond Dr	49	49	65	55	342312.5	5257475
100 Indian Pond Dr	47	47	65	55	342369.2	5257550
90 Indian Pond Dr	46	46	65	55	342390.6	5257636

Table 10-4: Phase 3 Holyrood Site Receptors Noise Levels

Phase 3 – 450MW						
Receptor	Noise Level		Limit		Coordinates	
	Day (dBA)	Night (dBA)	Day (dBA)	Night (dBA)	X (m)	Y (m)
Duffs Rd	41	41	65	55	341408.7	5256714
154 Indian Pond Dr	54	54	65	55	342319.9	5257178
137 Indian Pond Dr	54	54	65	55	342311.1	5257247
123 Indian Pond Dr	52	52	65	55	342343.5	5257344
110 Indian Pond Dr	51	51	65	55	342312.5	5257475
100 Indian Pond Dr	49	49	65	55	342369.2	5257550
90 Indian Pond Dr	48	48	65	55	342390.6	5257636

Table 10-5: Mitigated Phase 3 Holyrood Site Receptors Noise Levels

Phase 3 – Mitigated with 5m Tall Barrier Around Each Fin-Fan Cooler						
Receptor	Noise Level		Limit		Coordinates	
	Day (dBA)	Night (dBA)	Day (dBA)	Night (dBA)	X (m)	Y (m)
Duffs Rd	40	40	65	55	341408.7	5256714
154 Indian Pond Dr	50	50	65	55	342319.9	5257178
137 Indian Pond Dr	51	51	65	55	342311.1	5257247
123 Indian Pond Dr	49	49	65	55	342343.5	5257344
110 Indian Pond Dr	47	47	65	55	342312.5	5257475
100 Indian Pond Dr	45	45	65	55	342369.2	5257550
90 Indian Pond Dr	44	44	65	55	342390.6	5257636

10.4.2 Soldiers Pond Site

The nearest noise sensitive receptor to the Soldiers Pond site is Scouts Camp (Camp Morristown). The camp it is located 1.6 km away from the site. Potential exceedances of noise level will occur if this receptor falls within the nighttime noise screening distance for any of the three Phases of the project.

The noise screening distance for all the modeled cases are listed in Table 10-6. The screening distance is calculated from the Holyrood site models. The distance between camp Morristown and Soldiers Pond site is considerably longer than all the screening distances for all the phases. No noise level exceedance is expected at Soldiers Pond site. Soldiers Pond site noise impact at the nearest receptor is very low, due to the considerable distance between the site and the nearest receptor. This site can satisfy noise limits down to 40 dBA.

Table 10-6: Noise Screening Distance

Model	Screening Distance Based on 55 dBA
Phase 1	230 m
Phase 2	240 m
Phase 3	300 m
Phase 3 - Mitigated	235 m

Figure 10-3: Soldiers Pond Site Noise Sensitive Receptors

10.5 Summary and Recommendations

The noise impact of the proposed combustion turbines on the surrounding environment was evaluated for Holyrood site and Soldiers Pond site. The noise levels at the nearest sensitive receptors due to operation of both sites are predicted to be below the considered noise criteria. For lower noise limits than 50 dBA, the location of the Holyrood site would need to be moved further away from the residential area to the north-west of the site. Soldiers Pond site noise impact at the nearest receptor is very low that it can satisfy noise limits down to 40 dBA.

The analysis is based on preliminary information that is required to be refined during the detailed design. During the detailed design, the following is recommended:

1) Perform on site noise survey to determine the noise emission from existing activities at Holyrood site.
2) Optimize the location of the Holyrood site to move the site further away from the residential area to the north-west of the site.
3) Consider the installation of noise barriers around the fin fan coolers and the transformers in the terminal station to reduce the impact of the site on the nearest residential receptor even if the predicted noise levels are below the noise limits.
4) Consult the corresponding authorities on the appropriate noise criteria applicable to the project.

11. Preliminary Process Flow Diagram

Two (2) preliminary process flow diagrams (PFD) were developed for this study namely:

- Diesel Fuel PFD
- Biofuel (biodiesel) PFD

These PFDs were developed for the [redacted] gas turbine option. The preliminary PFDs are included in Appendix J.

12. Preliminary Plant Layout

Preliminary layout drawings were developed for the [redacted] gas turbine options. The preliminary layout includes the gas turbines, fuel tank farm, switch yard and a water treatment building, including raw water tanks, demineralized water tanks, fire water tanks, and water treatment equipment. The total square footage of the plant was estimated to be 398m (L) by 301m (W) for the [redacted] option and 335m (L) by 307m (W) for the [redacted] option for the 450MW plant. The layout drawings can be seen in Appendix A.

13. Level 2 Project Schedule

The proposed Level 2 schedule for project execution is included in Appendix H. The level 2 project schedules developed were for [redacted] for the following scenarios:

- **Scenario 1:** 150MW Output
- **Scenario 2**: 450MW Output

See Appendix H for a level 2 Gantt chart project schedule.

14. Capital Cost Estimate

This section describes the basis of the preparation of the capital cost estimate for the NLH Gas Turbine Screening Study for the power plant.

The target accuracy of the capital cost estimates is an AACE Class 5 Estimate with -30% and +50% accuracy.

The cost estimate was performed for the [redacted] gas turbines.

The capital cost estimate was compiled based on the following parameters:

- The Hatch Thermal Power Plant Factored estimate model was used to develop the costs by area and system. The Hatch Thermal Factored Model was developed from benchmark data for completed projects and definitive estimates.
- Refer to Appendix I for the equipment list. United States Dollar currency was converted to Canadian Dollar, based on the current exchange rates tabulated below:
  - The average labour rate for all works was established by Hatch.

Table 14-1: Foreign Currency Exchange Rates

Currency Code	Currency	Conversion Rate
Canada	Canadian Dollar	1.00 USD = 1.30 CAN

- Use of a defined Estimate Breakdown Structure (EBS) aligned to the project Work Breakdown Structure (WBS).
- An estimate base date of June 2023.
- All other costs are exclusive of escalation, taxes, and owner's costs.
- Estimates have been produced in accordance with Hatch Global Estimating Standards.

14.1 Basis of Estimate

Table 14-2 identifies the Basis of Estimate in summary form.

Table 14-2: Summary of Estimate Basis

Commodity	Estimate Basis
Plant and Equipment	
Major Equipment	Budget quotations based on specifications and data sheets. [redacted]
Minor Equipment	[redacted] Hatch Thermal Power Plant [redacted] Model
Bulk Materials & Site Works	
Site Preparation	[redacted] Hatch Thermal Power Plant [redacted] Model
Concrete	[redacted] Hatch Thermal Power Plant [redacted] Model
Structural Steelwork	[redacted] Hatch Thermal Power Plant [redacted] Model
Site Services Piping, and Valves	[redacted] Hatch Thermal Power Plant [redacted] Model
Tanks	Calculated based on volume of tank, ton of steel, fabrication cost, field erection, [redacted]
Buildings	Factored using building area and benchmark building costs from Hatch internal database
Electrical	[redacted] Hatch Thermal Power Plant [redacted] Model
Instrumentation	[redacted] Hatch Thermal Power Plant [redacted] Model
Control System	[redacted] Hatch Thermal Power Plant [redacted] Model
Installation	
Installation Labour	Personnel-hours calculated or based on historical benchmark data.
Vendor Representatives/Supervision	[redacted] Hatch Thermal Power Plant [redacted] Model
Contractor Distributables/ Preliminaries	Assessed and applied as a cost per personnel-hour to the unit labour rates by discipline.
Freight	
Freight	[redacted] Hatch Thermal Power Plant [redacted] Model
Spare Parts	
Commissioning Spares	[redacted] Hatch Thermal Power Plant [redacted] Model
Operations Spares	Owner's cost. No Spares Parts have been included in this estimate.

14.2 Capital Cost Estimate

14.2.1 Estimating Methodology

The approach to the estimate preparation was as follows:

- Define the scope of work.
- Structure and code the project into an agreed Estimate Breakdown Structure (EBS).
- Request pricing for Major Equipment.
- Calculate labour personnel-hour rates for construction work.
- Calculate the labour Productivity Adjustment.
- Establish foreign currency costs and exchange rates.
- Input Major Equipment costs into the Hatch Thermal Power Plant Factored Estimating Model.
- Adjust the model inputs to reflect the specific project scope.
- Determine the costs to carry out the EPCM.
- Establish an appropriate estimate base date.
- Establish appropriate contingency inline with the Hatch Project Life Cycle Process.
- Prepare estimate reports and summaries.
- Undertake estimate reviews.

14.2.2 Direct Costs

Direct costs are factored based on major equipment costs and include all the permanent equipment, materials and labour associated with the physical construction of the permanent process facility, and include:

- Land costs (by others).
- Purchase and installation of permanent plant, equipment, and materials.
- Construction labour.
- Contractor’s temporary construction facilities, power, and water.
- General construction plant and equipment.
- Contractor’s preambles overheads and profit.

14.2.3 Permanent Equipment

Estimates for major equipment are based on budget quotations derived from vendors using GTG specification data sheets. For minor equipment, costs were factored based on historical benchmark data. See Appendix D for GTG specification data sheet.

14.2.4 Bulk Materials

Bulk materials estimates were developed using the Hatch Factored Model Approach based on the pricing for major equipment.

14.2.5 Installation Costs

14.2.5.1 Direct Field Labour Costs

Direct field labour is the skilled and unskilled labour required to install the permanent plant, equipment, and bulk materials at the project site. Direct field installation personnel-hours are developed using estimated the Factored Model approach and benchmarked against completed projects.

14.2.5.2 Contractor Indirect Costs

Contractor's indirect costs are costs which are related to the contractor's direct costs, but which cannot easily be allocated to any particular part of them or are not part of the permanent works. For the purposes of this capital cost estimate, these costs are effectively direct costs, and will include the following:

- Contractor's mobilisation and demobilisation, including establishment and later removal and making good, of site offices, storage and other construction facilities, plant, and equipment.
- Contractor's manual indirect and non-productive labour, including time spent in inductions, training, toolbox meetings, clean-ups, bus drivers, crane, and truck operators and store men.
- Scaffolding, safety equipment, personal protection equipment.
- Special construction equipment and special temporary works.

14.2.6 Major and Heavy Lift Cranes

Major and heavy-lift cranes, which are project-specific and outside the scope of contractors' general cranage and plant, were identified and estimated as a direct cost. All general cranage is allocated within the all-in labour personnel-hour rates.

14.2.7 Construction Labor Rate and Productivity

14.2.7.1 Mechanical Installation Costs

In general, the mechanical installation cost includes:

- Equipment unloading and inspection.
- Storage and storage protection.
- Removal from storage and transport to point of installation.
- Assembly and setting of equipment, leveling, grouting, installation of drive guards, preliminary and final alignments, and balancing.
- First oil fill and cleaning of lube oil piping.
- Installation of on-board equipment.

- Installed integral controls and wiring to first junction box.
- Construction (mechanical completion) testing.
- Touch up painting and clean-up.

14.2.8 Indirect Costs

14.2.8.1 Basis of Estimate for Indirect Costs

During the next phase of the project a thorough study will be undertaken to determine and document the facilities and services required during the construction and commissioning phases.

14.2.8.2 Engineering, Procurement, Construction Management (EPCM) and Pre-Commissioning

The EPCM costs were calculated based on a percentage of the total installed cost (TIC) estimated for the project.

14.2.9 Owner Costs

The Owner's costs have not been included in the estimate.

14.2.10 Project Contingency

Contingency included in the capital cost estimate is an allowance for normal and expected items of work which must be performed within the defined scope of work covered by the estimate, but which could not be explicitly foreseen or described at the time the estimate was completed. The contingency amount is an integral part of the cost estimate. It does not cover potential scope changes, price escalation, currency fluctuations, allowances for force majeure, or other project risk factors or any of the other items that are excluded from the capital cost estimate.

Typical uncertainties applicable to contingency:

- Insufficient information due to incomplete engineering.
- Areas or systems with a reasonable probability of changes occurring during the detail design stage (considered "design development").
- Equipment or material costs obtained by ratio or update from historical costs or previous estimates.
- Labor productivity and costs.
- Project contingency does not cover scope changes or project exclusions. A contingency allowance of 25% is included.

14.2.11 Freight, Duties and Logistics

The freight budget, calculated as a percentage of total direct costs, covers the costs for the transportation of equipment and materials from the anticipated market to the plant site.

14.2.12 Spare Parts

Allowance to cover commissioning spares is calculated as a percentage of total direct cost.

14.2.13 *First Fills*

An allowance, calculated as a percentage of total direct costs, has been included to fill plant operating equipment and storage vessels with applicable consumables and fluids. This includes, but is not limited to, the first fills of materials listed below (i.e., materials that need to be replaced due to degradation or leakages rather than process consumption).

- Transformer oil.
- Hydraulic fluid.
- Lube oil and grease.

First fills do not include reagents and fuels.

14.3 Estimate Qualifications and Assumptions

The following qualifications and assumption apply to the capital cost estimate:

- The base date of the estimate is generally June 2023
- Taxes are excluded.
- Environmental Approval Process costs are excluded.
- Owner's Cost including operations support, site representatives and management costs.
- Financing costs are excluded.
- Camp Costs are excluded.
- Site De-watering costs are not included.
- Costs associated with escalation are excluded.
- Schedule acceleration costs are excluded; and
- Schedule delays and associated costs are excluded, such as those caused by:
  - Unexpected site conditions.
  - Unidentified ground conditions.
  - Labour disputes.
  - Lack of Labour Resources.
  - Weather Related conditions.
  - Force majeure.
- Permit applications.
  - Development fees and approval costs of Statutory Authorities are excluded.
  - Foreign currency changes from project exchange rates are excluded.

- No allowance for piled foundations has been included.

14.3.1 Indirect Cost Assumptions

The following project indirect costs are included in capital cost estimates:

- Construction power and water.
- Heavy Haul.
- Performance testing and stack emissions testing (where applicable).
- Preoperational testing, start-up, flushes, cleaning, and calibration.
- Start-up management.
- Initial fills and consumables.
- Construction/start-up technical service.
- Site surveys and studies.
- Engineering.
- Construction management.
- Construction testing.
- Operator training.
- Start-up spare parts.
- Performance and payment bond.
- Subcontractor Mark-ups.

14.3.2 Owner Costs

Owner costs are not included in the capital cost estimates. Typical Owner's costs include, but are not limited to the following:

- Project development.
- Owner's operations personnel prior to COD.
- Owner's legal costs.
- Owner construction/project management.
- Owner start-up engineering.
- Permitting and licensing fees.
- ECA Tax.
- Land.
- Fuel, water, chemicals, and power used during construction and start-up and testing.

- Initial fuel inventory.
- Site security.
- Operating spare parts.
- Permanent plant equipment and furnishings.
- Mobile Equipment (dozers, trucks, etc.).
- Builder's risk insurance and other insurances such as marine insurance etc.
- Owner's contingency.
- Transmission upgrades ([redacted]).
- Connection Fees
- Escalation through COD.
- Interest during construction (IDC)
- Financing fees.

Access road improvements, new access roads, erection of new bridges, modifications of existing bridges, relocation of existing electrical poles or circuits, or other work not directly associated with facility operation within the site boundaries are not considered or addressed in this report.

It is assumed that the labour force is local. Therefore, camp and per diems have not been included for construction labour.

No taxes, import duties, custom clearance, or any other tax associated with the construction of the facility have been included in the cost estimate.

14.4 Capital Cost Summary

Table 14-3 and Table 14-4 below is a summary of the capital cost for the [redacted] gas turbines.

Table 14-3: [redacted] Capital Cost Summary

Breakdown of Activities	[redacted]		
	[redacted]	[redacted]	[redacted]
Direct cost	[redacted]	[redacted]	[redacted]
Indirect cost	[redacted]	[redacted]	[redacted]
Contingency (25%)	[redacted]	[redacted]	[redacted]
Capital Costs	[redacted]	[redacted]	[redacted]
$/KWh	[redacted]	[redacted]	[redacted]

Table 14-4: [redacted] Capital Cost Summary

Breakdown of Activities	[redacted]		
	[redacted]	[redacted]	[redacted]
Direct cost	[redacted]	[redacted]	[redacted]
Indirect cost	[redacted]	[redacted]	[redacted]
Contingency (25%)	[redacted]	[redacted]	[redacted]
Capital Costs	[redacted]	[redacted]	[redacted]
$/KWh	[redacted]	[redacted]	[redacted]

See Appendix F for detailed cost estimate summary.

14.5 Operating Cost Estimate

The fixed operational costs include costs for operators of the facility, maintenance labour and materials and the administrative costs to provide the facility service, but exclude taxes and royalties, owner's administrative costs on the corporate level.

Non-fuel variable operating, and maintenance costs were estimated based on a back up duty mode of operation with approximately 870 hours of operation. Variable O&M costs include consumable commodities, such as water, lubricants, and chemicals. Also included is the average annual cost of the planned maintenance events for the CTs over the long-term maintenance cycle, based on the number of equivalent operating hours (EOH) the CT has run. Staffing is assumed to include 4 operators, 2 maintenance personnel and an allowance for administration/management staff.

Estimated Total Fixed O&M Cost: [redacted]

Estimated Total Non-Fuel Variable O&M Cost: [redacted]

The operating cost estimate above is based on Aeroderivative gas turbines technology, and it is for 150 MW power; for phase 2 and 3 power plants the total Fixed O&M cost will be lower than [redacted]

15. Gap Analysis

A pre-FEED gap analysis was performed to identify any additional requirements that need to be completed ahead of the FEED. The following table shows the gap analysis, which includes the required activity as well as the status of those activities.

Table 15-1: Gap Analysis

Discipline	Activity	% Complete
Site Selection	Brown field and greenfield site visit	100
	Geotechnical Boreholes and Test Pit Program	0
	Plume Dispersion Modelling	0
	Water Supply and Intake Alterations/Design	0
	EA Registration for Brownfield Site.	0
Combustion Turbine Screening	Vendor Screening	100
	Preliminary Heat and Mass Balance	100
	Preliminary Performance Evaluation	100
	Preliminary Layout	75
	GT Selection	75
	Vendor Site Visit	0
	Optimization	25
Social and Environmental Assessment	Water Supply Evaluation	75
	Permits and Approvals (Approval under Part XI of the NL Environmental Protection Act, Air Pollution Control Regulations 2022)	75
	Environmental Evaluation	50
	Ground Truthing (Confirm desktop assumptions for environmental and social criteria.)	0
	Geotechnical investigations	0
	Engagement and Consultation Roadmap	0
	First Nation Consultation	0
	Environmental Assessment (EA)	0
	Federal Impact Assessment (Consult Federal and Provincial Regulatory Agencies)	0

Discipline	Activity	% Complete
	Preparation and Submission of a Provincial EA Registration	0
Fuel Assessment	Supplier Screening	100
	Fuel Storage Requirements	75
	Fuel Transportation Requirements	75
	Fuel Costs Evaluation	75
	PFDs (Diesel and Biodiesel)	25
	Fuel Supply Chain Review	75
	Alternative Fuel Evaluation	25
	Consideration of existing demand	75
	Contractual considerations to meet supply needs	25
Electrical Interconnection	System Operating Diagram	50
	Site Electrical Characteristics	75
	Transmission System Limitations	75
	Terminal Layout and Footprint	50
	Functional Operability Requirements	0
	Interconnection Infrastructure Requirements	50
	Applicable Standards	100
Noise Impact Assessment	Noise Model	100
	Determine the noise criteria requirement in the permitting process	0
	Verify noise sound power level of the different equipment by obtaining noise data from Prospective Supplier	0
	Determine the noise emissions from the existing activities on the Holyrood site	0
	Develop noise mitigation strategy for the residential area to the east of Holyrood site	0
Other Deliverables	AACE Class 5 Cost Estimate	100
	Basis of Cost Estimate	100
	Level 2 Schedule	100
	FEED Recommendation	100

16. FEED Recommendation

16.1 Environmental Impact

The following recommendations were provided by the environmental study.

1) The highest-ranking sites are the Holyrood site (85%) and the Soldiers Pond (70%) site.
2) Additional ground truthing of the proposed greenfield site at Soldiers Pond should be undertaken, to confirm desktop assumptions for environmental and social criteria.
3) Geotechnical investigations, specifically at the greenfield site, should be undertaken to inform site suitability.
4) A facility of this size and nature, would most likely require an Approval under Part XI of the NL Environmental Protection Act, as it relates to determining compliance with the Air Pollution Control Regulations 2022, and specifically ‘Schedule A’. This typically requires Plume Dispersion Modelling.
5) Water availability should be further evaluated in close consultation with the Water Resources Management Board. This is typically undertaken by the WRMD through submission of an application for a Water Use Licence (WUL) but could be ascertained prior to submission upon special request. This applies to water availability under the Existing WUL for the Holyrood TGS facility (required increase) as well as water availability at Soldiers Pond location, in relation to the other existing WULs within the watershed.

16.2 Noise Assessment Recommendation

The following recommendations were provided by the noise assessment:

1) Perform on site noise survey to determine the noise emission from existing activities at Holyrood site.
2) Optimize the location of the Holyrood site to move the site further away from the residential area to the north-west of the site.
3) Consider the installation of noise barriers around the fin fan coolers and the transformers in the terminal station to reduce the impact of the site on the nearest residential receptor even if the predicted noise levels are below the noise limits.
4) Consult the corresponding authorities on the appropriate noise criteria applicable to the project.

16.3 Electrical Interconnection

The following recommendations were provided by the electrical interconnection study.

1) Both Holyrood and Soldiers Pond sites provide an acceptable Point of Interconnection (POI) to NLH’s 230kV transmission system.
2) The Holyrood site’s electrical layout will be slightly larger because two additional 230kV breaker bays are required and thus the relative cost of the terminal station will be slightly higher.

3) Detailed design is recommended to optimize the final breaker configurations and terminations.

4) The Soldiers Pond location will require the thermal uprating of TL 242 to [redacted] MVA from the winter rating of [redacted] MVA for the contingency of loss of TL 266. This location will require a tighter outage window for the outage of TL 266 to tie into the new terminal station and during this outage period the single contingency of loss of TL 242 will cause overload condition on TL 218. To reduce the overload, it may be required for load reduction in the St. John's area.

17. Hatch Recommendation

The [redacted] gas turbines are good candidate for the project given their fuel efficiency, and fuel flexibility.

The recommended plant site is the Holyrood site as it already has an existing dock and road facility for both barge and truck delivery. Due to the large on-site fuel storage and transportation requirements for larger plant sizes we recommend building a 150 MW (nominal) power plant. A better alternative to a large plant size of 300MW or 450MW is to build a smaller gas turbine back up plant of 150 MW to support the first project phase; and further investigate the feasibility of larger plant sizes while considering renewable energy sources with battery storage or hydrogen for subsequent project phases. The suppliers have stated that they can provide 600,000 L/day in addition to what is already being supplied on the island. Hardwoods and Stephenville gas turbines are old assets and potentially due to be retired, when that happens, more fuel will be available on the island to supply phase1 project.

In terms of fuel types, diesel is the main available option. There is a potential to use biofuel or hydrogen in the future, depending on the availability of these fuels locally. It is also recommended that NLH has a fuel storage tank on site with enough fuel for 10 days of full operation, which would be a volume of 5 million liters for the [redacted]. It is recommended that the fuel be treated with biocides, antioxidants, a demulsifying treatment, a fuel stability treatment, and should be equipped with a fuel water separator (FWS). The tank should be monitored, checked, and tested regularly and the fuel should not be left in the tank for more than 1 year. The tank should always be kept at a cool temperature. A temperature of -6°C is optimal, but temperatures shouldn't exceed 29°C.

17.1 Fuel Assessment

The following recommendations were provided by the fuel assessment study.

1) Fuel Consumption - Delivery of fuel consumed by 150 MW is still achievable based on the number trucks needed to deliver the fuel. If the fuel demand surpasses this, more resources will be needed for delivery process.

2) Transportation - Delivering fuel via truck would be challenging due to limited availability of trucks in the province. Delivery time at the client's storage tanks can be reduced by incorporating more than 1 truck offload area.

Delivery via barge would require a site that is near a shoreline. The Holyrood site would be a preferred site option for barge delivery. Large quantity of fuel can be delivered via barge at one time.

3) Storage of fuel - As the demand of fuel is not constant and a large quantity of fuel is needed each day to run the facility, it is essential to have a sizable storage tank to accommodate the variable fuel consumption and guarantee the facility's continuous functioning. The recommended storage volume is enough fuel to last for 10 days of full operation.

   Storing large quantity of fuel for a long duration can degrade fuel quality. As discussed above in section 8.5, fuel conditioners would help need to be added to help maintain the quality of diesel.

4) Supplier - Setting up proper contractual terms with supplier for unplanned demand will help to shorten the lead time for fuel delivery. To meet the demand, multiple suppliers should be involved to meet the demand and proper supply chain should be planned for uninterrupted fuel delivery.

   There is a potential to work with suppliers to overcome some of the mentioned limitations, depending on the contractual agreement that was set up between NLH and the suppliers.

   In terms of the transportation limitations, the suppliers will likely require a commitment from NLH to a certain quantity of fuel per year if they were to increase their fleet to compensate for NLH’s demand. This may require NLH to run the plant for a certain amount of time each year, even if it is not required. NLH will also be able to sell the electricity produced during this time to the grid. NLH could also purchase their own trucks to be used by the supplier so that truck availability isn’t an issue.

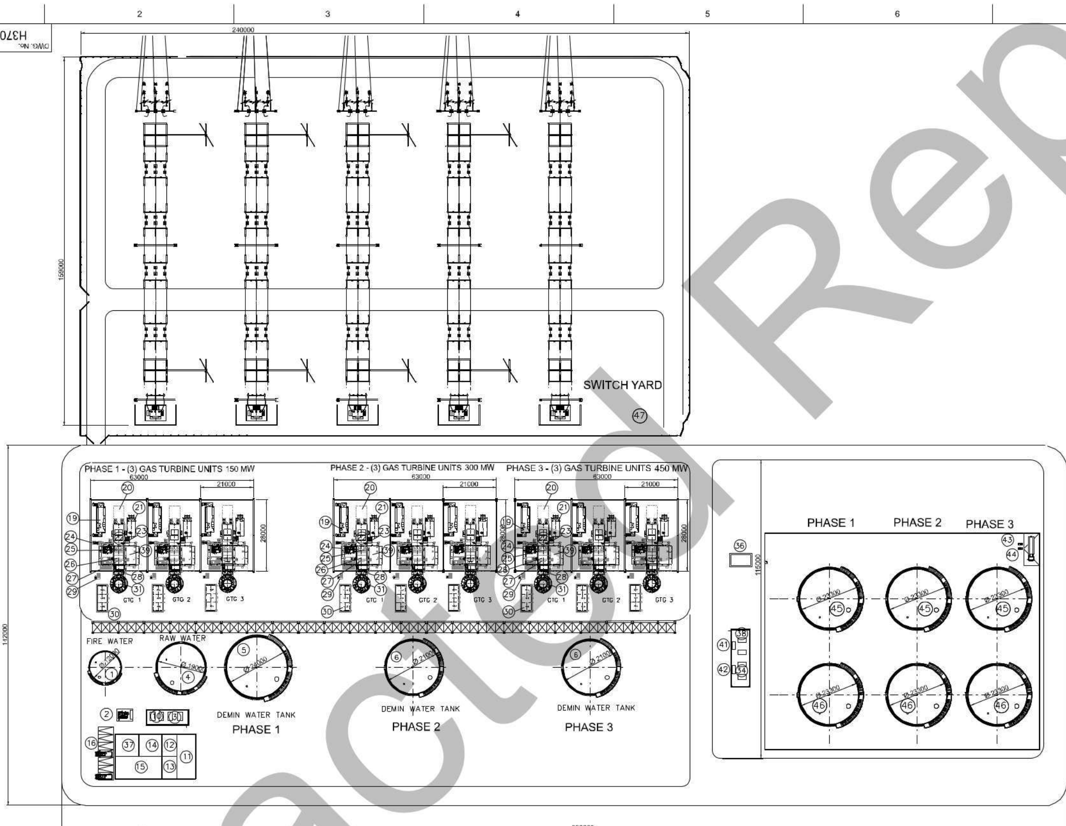
   In terms of fuel degradation, NLH could increase the storage tank size on the plant site so that the supplier can use this tank to also supply to other plants on the Avalon peninsula. By doing this, NLH will always have a sufficient fuel supply and the fuel will have constant turnover, which will eliminate the fuel degradation limitation.

5) Facility Location - Facility location plays an important role in supply for the fuel delivery process. As the Holyrood site has the existing dock and road facility, it would be the preferred option due to unplanned demand of fuel, as suppliers can deliver fuel via both methods.

Appendix A: Plant Layout

Appendix A1: [redacted] Plant Layout
Appendix A2: [redacted] Plant Layout

A.1 [redacted] Plant Layout



LAYOUT

ITEM LEGEND

ITEM	DESCRIPTION
1	FIRE WATER STORAGE
2	FIRE PUMP SKID
3	RAW WATER PUMP SKID
4	RAW WATER STORAGE
5	DEMIN WATER STORAGE 1
6	DEMIN WATER STORAGE 2
10	DEMIN WATER PUMP SKID
11	WATER TREATMENT PLANT
12	COMPRESSORS
13	BOP SWITCHGEAR
14	ADMIN
15	WORKSHOP AND STORE
16	PARKING
17	TRANSFORMER
18	AUXILIARY TRANSFORMER
19	MCC
20	GENERATOR REMOVAL AREA
21	11KV GENERATOR TERMINAL BUILDING
22	EXHAUST GENERATOR VENTILATION
23	CO2 FIRE CONTROL SKID
24	GEN FAN A
25	GEN FAN B
26	TURBINE COMBUSTION AIR
27	VBV DUCT
28	TURBINE FAN
29	SPRINT SKID
30	FINFAN COOLER
31	EXHAUST STACK
32	~~BIOFUEL TANK~~
33	~~BIOFUEL TANK~~
34	FUEL PUMP SKID
35	~~DIESEL TANK~~
36	BLACK START DIESEL GENERATOR
37	CONTROL ROOM
38	BIOFUEL PUMP SKID
39	TURBINE AND GEARBOX REMOVAL AREA
40	~~DIESEL TANK~~
41	COALESCING FILTERS AND HEATING SET
42	COALESCING FILTERS AND HEATING SET
43	FUEL UNLOADING PUMP
44	FUEL UNLOADING PUMP
45	BIOFEUL TANK
46	DIESEL TANK
47	SWITCH YARD

NOTES

1. DIMENSIONS IN MILLIMETERS.

NEWFOUNDLAND AND LABRADOR HYDRO POWER PLANT LAYOUT

HATCH

No.	DESCRIPTION	BY	CHK'D	DATE
D	ISSUED FOR INFORMATION ONLY- SWITCH YARD MODIFY	MR	HM	08MAY2023
C	ISSUED FOR INFORMATION ONLY- SWITCH YARD ADDED	MR	HM	05MAY2023
B	ISSUED FOR INFORMATION ONLY	MR	HM	28APR2023
A	ISSUED FOR INFORMATION ONLY	MR	HM	14APR2023

REVISIONS

ROLE	NAME	SIGNATURE	DATE
DRAFTSPERSON	M RAMOS	NR	05MAY23
DESIGNER	M RAMOS	NR	05MAY23
CHECKER	H MCLEAN		
DESIGN COORD.	O OWOLABI		
RESP. ENG.			
LEAD DISC. ENG.			
ENG. MANAGER	K MEGHARY		
PROJ. MANAGER			

DRAWING APPROVAL STATUS: Information

NEW FOUNDLAND AND LABRADOR HYDRO PROJECT

NLH POWER PLANT[redacted]PHASE 1,2 AND 3 PRELIMINARY GENERAL ARRANGEMENT PLAN

SCALE: NTS OR AS NOTED

DWG. No. H370910-3000-210-272-0001

REV D

SHEET SIZE: D

DRAWING No.	DRAWING TITLE

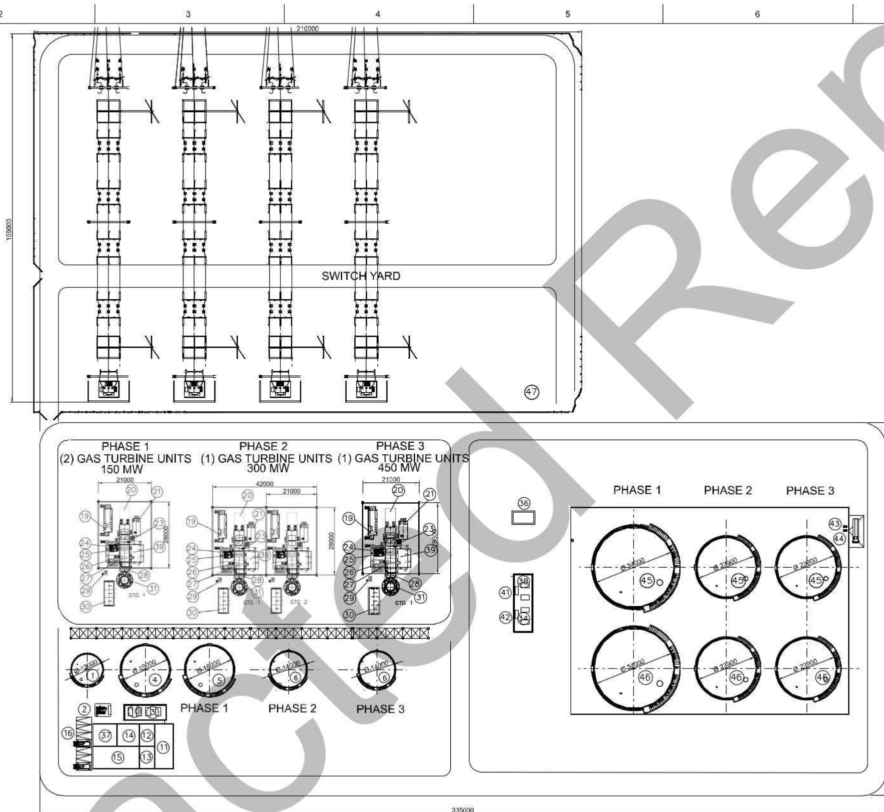
REFERENCE DRAWINGS

REG. PROFESSIONAL

DWG. No. H370910-3000-210-272-0001

A.2 [redacted] Plant Layout

DWG. No. H370910-3000-210-272-0002



LAYOUT

ITEM LEGEND

ITEM	DESCRIPTION
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12	COMPRESSORS
13	BOP SWITCHGEAR
14	ADMIN
15	WORKSHOP AND STORE
16	PARKING
17	TRANSFORMER
18	AUXILIARY TRANSFORMER
19	MCC
20	GENERATOR REMOVAL AREA
21	11KV GENERATOR TERMINAL BUILDING
22	EXHAUST GENERATOR VENTILATION
23	CO2 FIRE CONTROL SKID
24	GEN FAN A
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26	TURBINE COMBUSTION AIR
27	VBV DUCT
28	TURBINE FAN
29	SPRINT SKID
30	FINFAN COOLER
31	EXHAUST STACK
32	~~BIOFUEL TANK~~
33	~~BIOFUEL TANK~~
34	FUEL PUMP SKID
35	~~DIESEL TANK~~
36	BLACK START DIESEL GENERATOR
37	CONTROL ROOM
38	BIOFUEL PUMP SKID
39	TURBINE AND GEARBOX REMOVAL AREA
40	~~DIESEL TANK~~
41	COALESCING FILTERS AND HEATING SET
42	COALESCING FILTERS AND HEATING SET
43	FUEL UNLOADING PUMP
44	FUEL UNLOADING PUMP
45	BIOFUEL TANK
46	DIESEL TANK
47	SWITCH YARD

NOTES

1. DIMENSIONS IN MILLIMETERS.

NEWFOUNDLAND AND LABRADOR HYDRO POWER PLANT LAYOUT

No.	DESCRIPTION	BY	CHK'D	DATE
D	ISSUED FOR INFORMATION ONLY - SWITCH YARD MODIFY	MR	HM	08MAY2023
C	ISSUED FOR INFORMATION ONLY - SWITCH YARD ADDED	MR	HM	05MAY2023
B	ISSUED FOR INFORMATION ONLY	MR	HM	28APR2023
A	ISSUED FOR INFORMATION ONLY	MR	HM	14APR2023

REVISIONS

DRAWING No.	DRAWING TITLE

REFERENCE DRAWINGS

REG. PROFESSIONAL

HATCH

ROLE	NAME	SIGNATURE	DATE
DRAFTSPERSON	M RAMOS	NR	
DESIGNER	M RAMOS	NR	
CHECKER	H MCLEAN		
DESIGN COORD.	O OWOLABI		
RESP. ENG.			
LEAD DISC. ENG.			
ENG. MANAGER	K MEGHARY		
PROJ. MANAGER			

DRAWING APPROVAL STATUS: Information

NEW FOUNDLAND AND LABRADOR HYDRO PROJECT

NLH POWER PLANT [redacted] PHASE 1,2 AND 3 PRELIMINARY GENERAL ARRANGEMENT PLAN

SCALE: NTS OR AS NOTED

DWG. No. H370910-3000-210-272-0002

REV D

SHEET SIZE: D

$TIME$ $USERNAME$ $DATE$ $FILE$

Appendix B:
Heat and Mass Balance

PRELIMINARY ENERGY AND MASS BALANCE

Design assumptions:

Fuel: Diesel No 2, LHV = 18400 BTU/lb Natural Gas, LHV = 21512 BTU/lb

Site condition : 25C/75 RH/ 152m

Table 1: Diesel

OEM	**Units**	[redacted]		[redacted]		[redacted]
Model		[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
No of units		[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Gross Output	*MW*	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Heat Rate (LHV)	*kJ/kWh*	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Efficiency	*%*	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Water Injection per GT	*t/h*	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Fuel Consumption (150MW)	*t/MWh*	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Fuel Storage for 5 days (150MW)	*m3*	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]

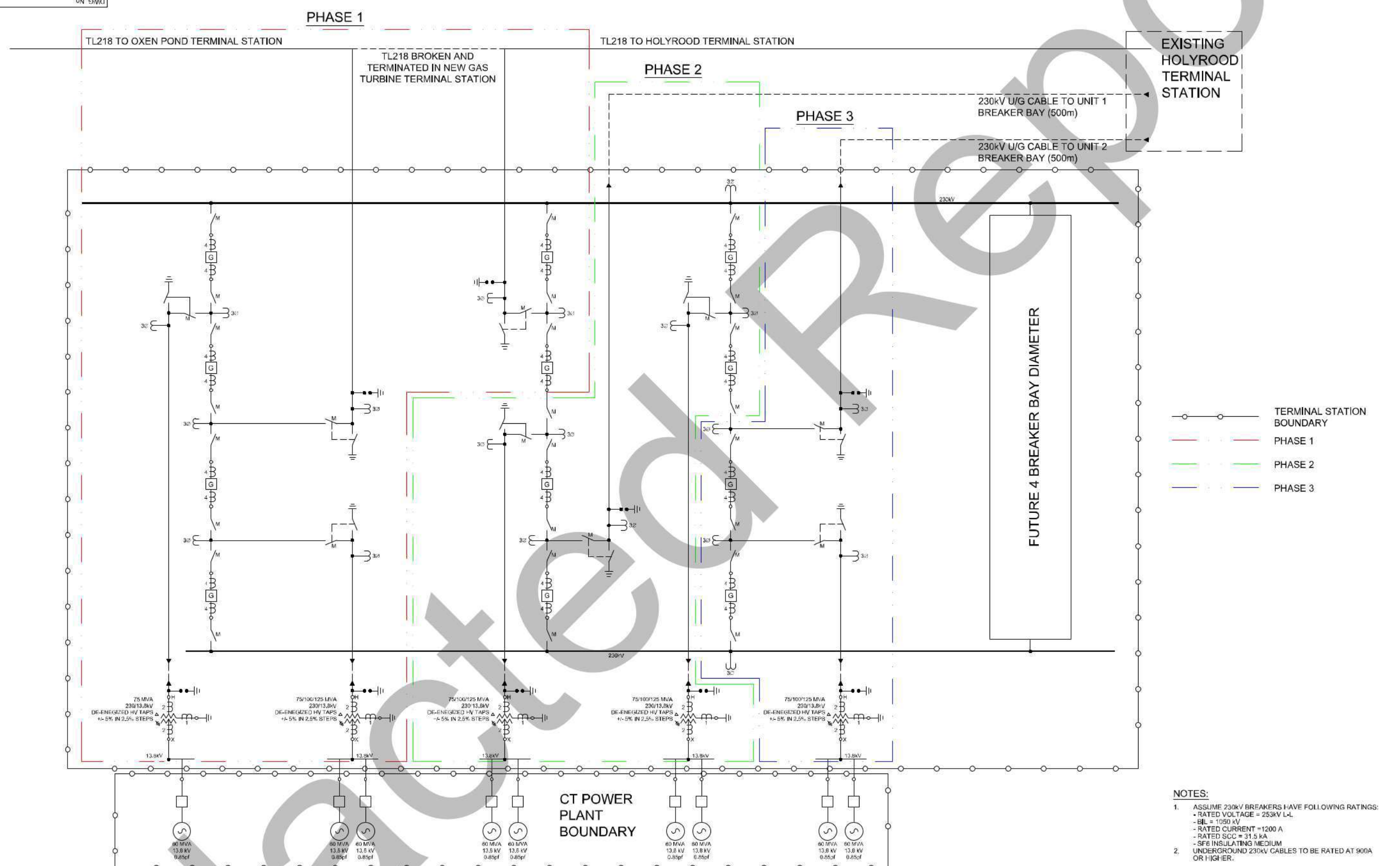
Table 2: Natural Gas

OEM	**Units**	[redacted]		[redacted]		[redacted]
Model		[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
No of units		[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Gross Output	*MW*	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Heat Rate (LHV)	*kJ/kWh*	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Efficiency	*%*	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]

Appendix C:
Electrical Appendices

Appendix C1: Holyrood CT Terminal Station SOD
Appendix C2: Holyrood CT Terminal Station Layout
Appendix C3: Soldiers Pond CT Terminal Station SOD
Appendix C4: Soldiers Pond CT Terminal Station Layout
Appendix C5: Type DD Wood Pole
Appendix C6: Type C Steel
Appendix C7: Power System Study

C.1 Holyrood CT Terminal Station SOD



NOTES:

1. ASSUME 230kV BREAKERS HAVE FOLLOWING RATINGS:
   - RATED VOLTAGE = 253kV L-L
   - BIL = 1050 kV
   - RATED CURRENT =1200 A
   - RATED SCC = 31.5 kA
   - SF6 INSULATING MEDIUM
2. UNDERGROUND 230kV CABLES TO BE RATED AT 900A OR HIGHER.

HATCH

ROLE	NAME	SIGNATURE	DATE
DRAFTSPERSON	M. TAI	NR	2023-05-23
DESIGNER		NR	
CHECKER			
DESIGN COORD.			
RESP. ENG.	J. FLYNN		2023-05-24
LEAD DISC. ENG.			
ENG. MANAGER			
PROJ. MANAGER	O. OWOLABI		2023-05-25

DRAWING APPROVAL STATUS:

NEWFOUNDLAND AND LABRADOR - HYDRO PROJECT

NLH POWER PLANT
HOLYROOD LOCATION - PHASE 1, 2 AND 3
SINGLE LINE DIAGRAM

SCALE NTS OR AS NOTED | DWG. No. H370910-3000-262-288-0001 | REV A

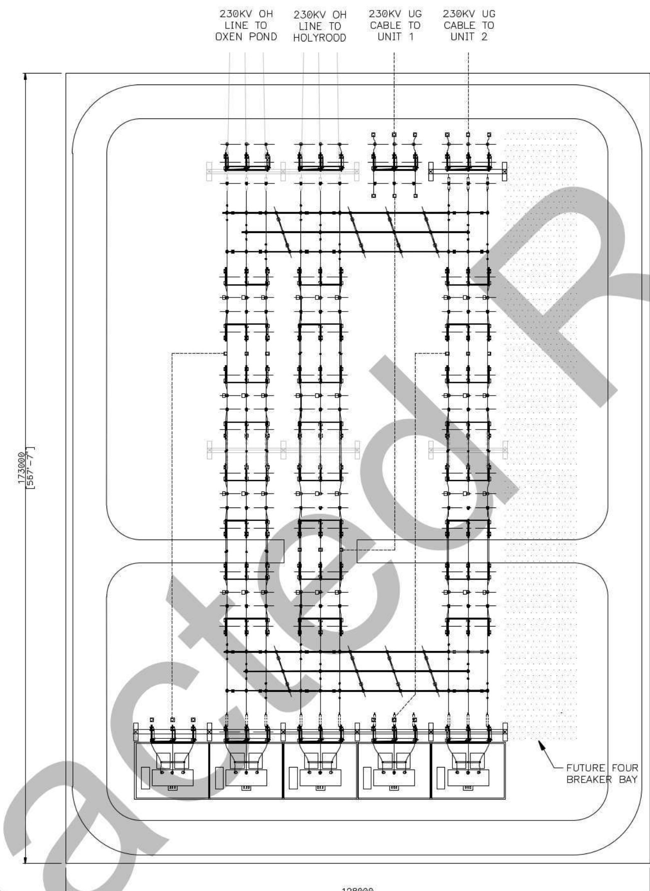
SHEET SIZE: A1

C.2 Holyrood CT Terminal Station Layout

H370910-3000-260-272-0001

NOTES:

1. BUILDINGS AND EQUIPMENT DIMENSIONS ARE ESTIMATED, FINAL DIMENSIONS TO BE CONFIRMED BY THE VENDORS



CT POWER PLANT

COORDINATES SYSTEM:
TBD

DRAWING No.	DRAWING TITLE
H370910-3000-262-288-0001	HOLYROOD LOCATION - PH. 1, 2 &3 - SINGLE LINE DIAGRAM

REFERENCE DRAWINGS

HATCH

ROLE	NAME	SIGNATURE	DATE
DRAFTSPERSON	S. TREPANIER	NR	2023-05-03
DESIGNER	S. TREPANIER	NR	2023-05-03
CHECKER	J. FLYNN		
DESIGN COORD.			
RESP. ENG.	J. FLYNN		
LEAD DISC. ENG.			
ENG. MANAGER			
PROJ. MANAGER			

DRAWING APPROVAL STATUS:

No.	DESCRIPTION	BY	CHK'D	DATE

REVISIONS

REG. PROFESSIONAL

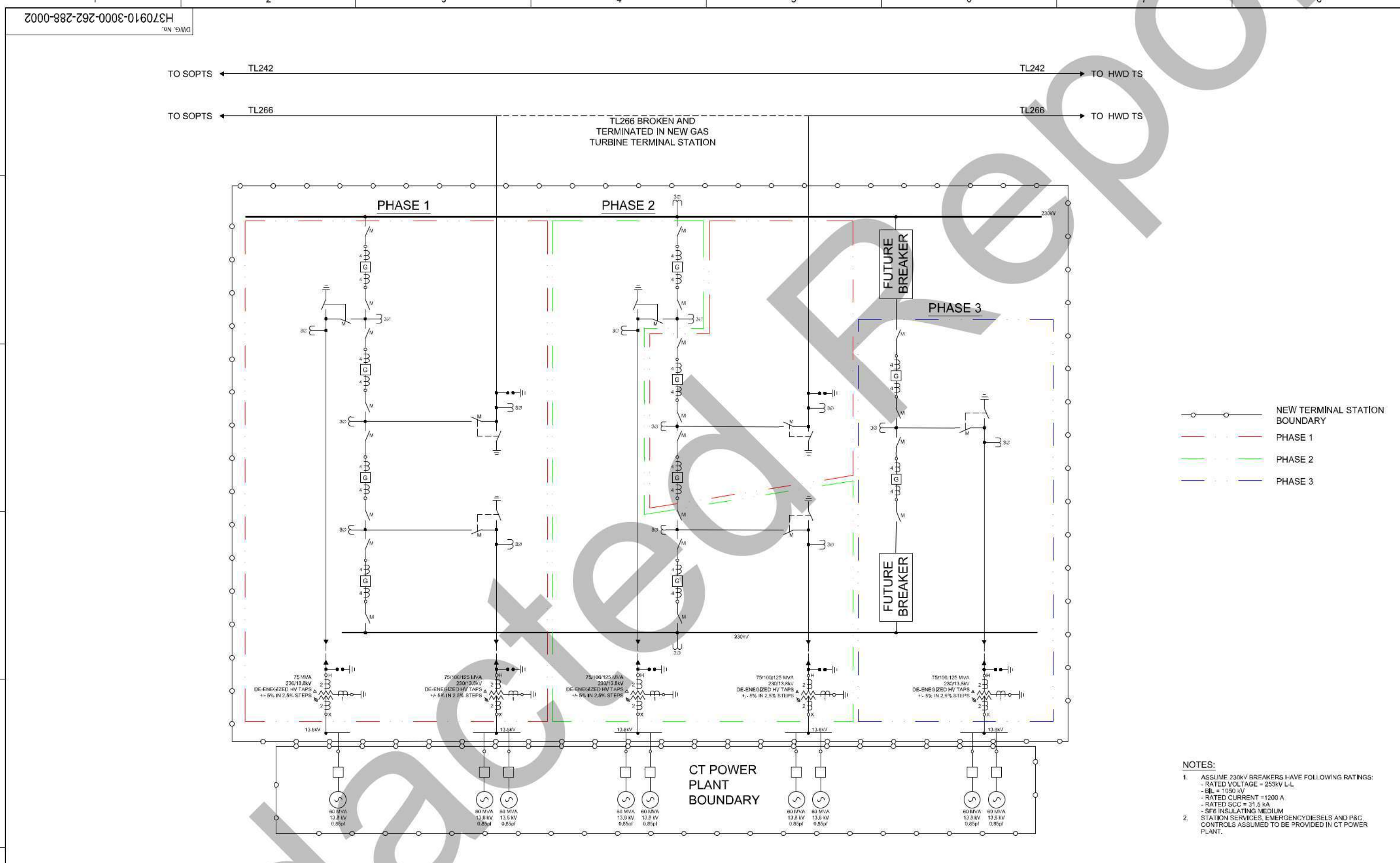
NEWFOUNSLAND AND LABRADOR HYDRO PROJECT

NLH POWER PLANT
HOLYROOD LOCATION - PH. 1, 2 & 3
GENERAL ARRANGEMENT

SCALE: NTS OR AS NOTED | DWG. No. H370910-3000-260-272-0001 | REV B

SHEET SIZE: A0

C.3 Soldiers Pond CT Terminal Station SOD



NOTES:

1. ASSUME 230kV BREAKERS HAVE FOLLOWING RATINGS:
   - RATED VOLTAGE = 253kV L-L
   - BIL = 1050 kV
   - RATED CURRENT =1200 A
   - RATED SCC = 31.5 kA
   - SF6 INSULATING MEDIUM
2. STATION SERVICES, EMERGENCYDIESELS AND P&C CONTROLS ASSUMED TO BE PROVIDED IN CT POWER PLANT.

HATCH

ROLE	NAME	SIGNATURE	DATE
DRAFTSPERSON	M. TAI	NR	2023-05-23
DESIGNER		NR	
CHECKER			
DESIGN COORD.			
RESP. ENG.	J. FLYNN		2023-05-24
LEAD DISC. ENG.			
ENG. MANAGER			
PROJ. MANAGER	O. OWOLABI		2023-05-25

DRAWING APPROVAL STATUS:

NEWFOUNDLAND AND LABRADOR - HYDRO PROJECT

NLH POWER PLANT
SOLDIERS POND LOCATION - PHASE 1, 2 AND 3
SINGLE LINE DIAGRAM

SCALE NTS OR AS NOTED | DWG. No. H370910-3000-262-288-0002 | REV A

DRAWING No. | DRAWING TITLE | REFERENCE DRAWINGS | REG. PROFESSIONAL | No. | DESCRIPTION | BY | CHK'D | DATE | REVISIONS

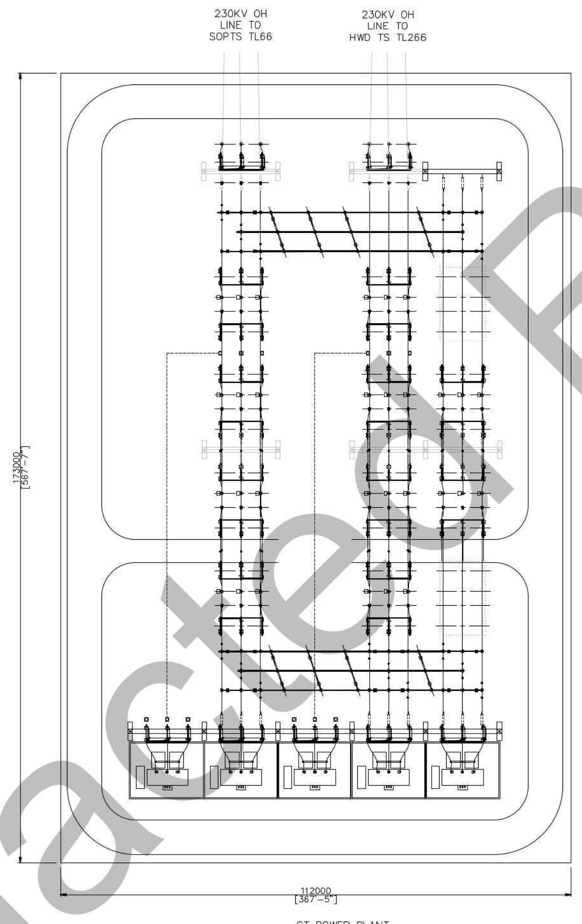
SHEET SIZE: A1

C.4 Soldiers Pond CT Terminal Station Layout

H370910-3000-260-272-0002
DWG. No.

NOTES:

1. BUILDINGS AND EQUIPMENT DIMENSIONS ARE ESTIMATED, FINAL DIMENSIONS TO BE CONFIRMED BY THE VENDORS



CT POWER PLANT

COORDINATES SYSTEM:
TBD

DRAWING No.	DRAWING TITLE
H370910-3000-262-288-0002	SOLDIER'S POND LOCATION - PH. 1, 2 &3 - SINGLE LINE DIAGRAM

REFERENCE DRAWINGS

REG. PROFESSIONAL

No.	DESCRIPTION	BY	CHK'D	DATE

REVISIONS

HATCH

ROLE	NAME	SIGNATURE	DATE
DRAFTSPERSON		NR	
DESIGNER		NR	
CHECKER			
DESIGN COORD.			
RESP. ENG.			
LEAD DISC. ENG.			
ENG. MANAGER			
PROJ. MANAGER			

DRAWING APPROVAL STATUS:

NEWFOUNDLAND AND LABRADOR - HYDRO PROJECT

NLH POWER PLANT
SOLDIER'S POND LOCATION - PHASE 1,2 AND 3
GENERAL LAYOUT

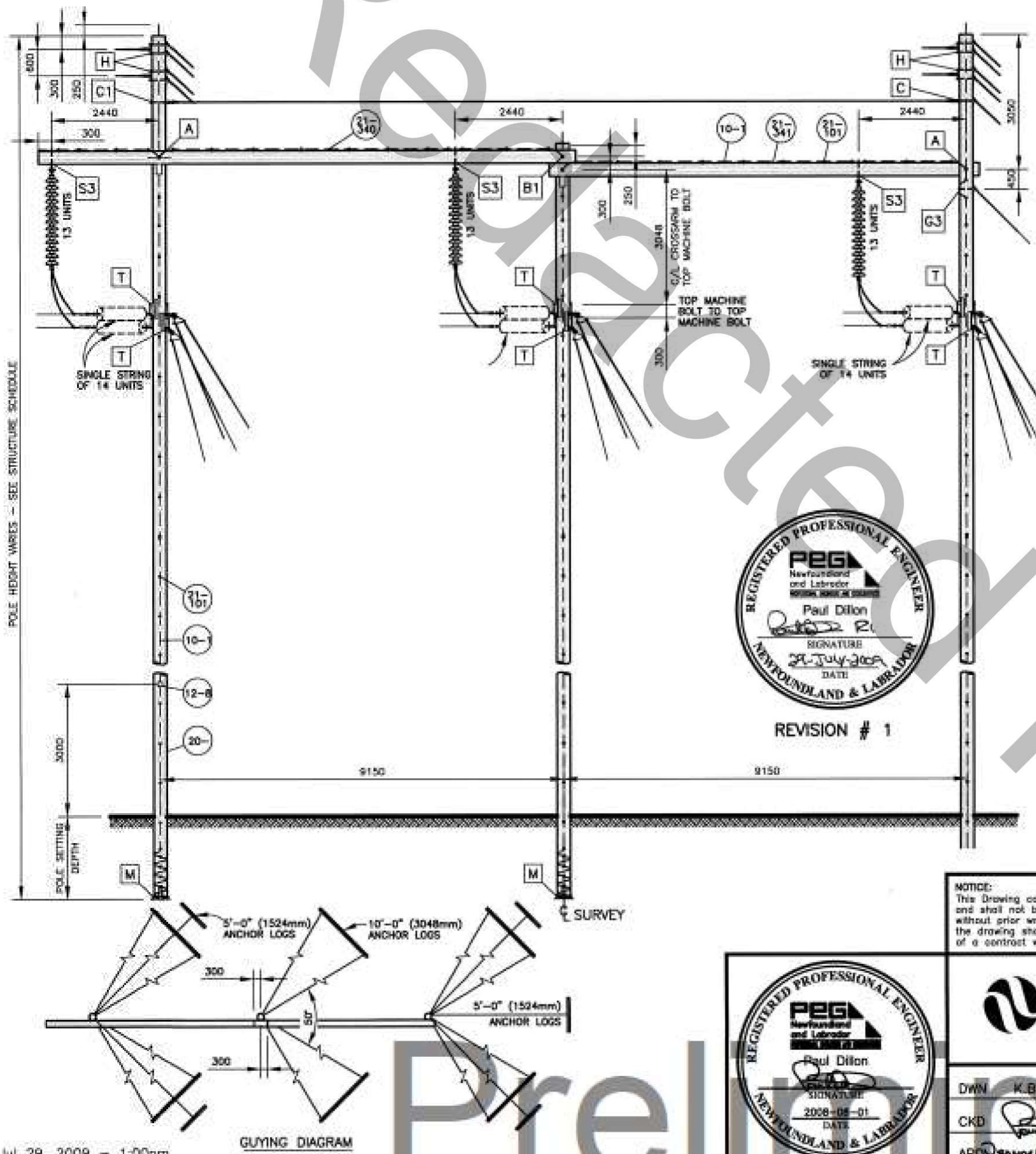
SCALE: NTS OR AS NOTED

DWG. No. H370910-3000-260-272-0002

REV A

SHEET SIZE: A0

C.5 Type DD Wood Pole



BM	JD Edwards	QTY	DESCRIPTION	DETAIL ITEM
1-4	37000009	AS REQ'D	GUY WIRE, GRADE 180, 5/8" (16mm)	C, C1, G3
2-4	24000124	48	GUY GRIPS FOR OHGW, GRADE 180, 5/8" (16mm)	C, C1, G3, T
3-X	-	SEE REMARKS	STOCKBRIDGE DAMPER (AS PER STRUCTURE LIST)	T
4-X	-	3	ALUMINUM SUSPENSION CLAMPS	S3
5-X	-	6	COMPRESSION DEADEND ASSEMBLY	J
6-1	76100014	39	SUSPENSION INSULATORS, 15,000 # M & E	S3
6-2	76100019	84	SUSPENSION INSULATORS, 25,000 # M & E	T
8-50A	24000129	10	GUY HOOK FOR 7/8" (22mm) BOLT	C, G3, H
8-50B	72100144	3	DEADEND GUYING ASSEMBLY	T
8-52	24000104	18	CLEVIS, THIMBLE	C, C1, H, T
8-110	72100313	4	TEE, GUYING - HEAVY DUTY	H
9-100	25100124	3	BOLT, SHOULDER EYE, 7/8" x 14" (22x356mm)	S3
9-100C	72100312	3	CLEVIS, Y-BALL	S3
9-100D	24000094	18	CLEVIS, WL Y-BALL, 36,000 lbs. LT	T
10-1	37100006	100	#5 STEEL POLE GROUNDING WIRE	M
10-6		3	CONNECTOR, #5 TO #5	
12-8	82200101	1	SMALL NUMBER SIGN	M
20-	-	3	WOOD POLES, CLASS & HEIGHT AS PER STRUCTURE LIST	M
21-25	25100115	8	BOLT, MACHINE, 7/8" x 18 (22x457mm)	H
21-40	24000186	8	WASHER, ROUND, 2-1/4" (57mm), for 7/8" (22mm #) BOLT	H
21-44	24000182	4	WASHER, CURVED, 3.5"x3.5"x3/8" (89x89x3/8mm) for 3/4" BOLT	C, C1, S3
21-45	24000183	10	WASHER, CURVED, 4"x4"x3/8" (102x102x10mm) for 7/8 BOLT	A, B1, C, C1, G3, S3
21-46	25100102	4	BOLT, MACHINE, 3/4" x 14" (19x356mm)	G3, M
21-48	24000142	6	POLE BEARING PLATES, VERTICAL	M
21-49	25100243	4	BOLT, DOUBLE ARMING, 7/8" (22mm #)	A, B1
21-90	25100234	24	SCREW, LAG, 5/8" x 5" (16x127mm)	M
21-100	24000120	3	SPAR ARM GAINS, SLOTTED FOR 7/8" (22mm #) BOLT	A, B1, C
21-101	24000039	200	GALVANIZED STAPLES 1-1/4" (32mm) LONG	M
21-174	25100120		BOLT, OVAL EYE, 3/4" x 14" (19x356mm)	C, C1, G3
21-176	24000230	6	CLEVIS, HOT LINE SOCKET, 36,000 lbs.	T
21-187	24000121	32	GRID GAIN, TEETH ONE SIDE, HOLE FOR 3/4" (19mm) BOLT	H, T
21-336	14000012	1	CROSSARM SPAR, 40'-0" (12192mm) CL4 DF OR SYP	
21-336	14000013	1	CROSSARM SPAR, 32'-0" (9754mm) CL4 DF OR SYP	
31-351	24000148	6	GUYING YOKE PLATE, 50,000#, 5/8" (16mm)	T
31-352	24000165	18	DEADEND SHACKLES, 50,000#, 7/8" (22mm)	T

NOTES :

1. FOR GENERAL NOTES, SEE A3-1-230TL (NOTES).DWG
2. ANCHOR MATERIAL IS NOT INCLUDED IN THE BILL OF MATERIALS FOR THIS STRUCTURE. MATERIAL IS TO BE ORDERED FOR THE FOLLOWING ANCHORS (OR EQUIVALENT): FIVE 5'-0" (1524mm) LOG ANCHORS AND SIX 10'-0" (3048mm) LOG ANCHORS

NO	DATE	REVISION	BY	CKD	APD
1	09-06-19	UPDATED BOM and TITLE BLOCK	K.B.R.		

REGISTERED PROFESSIONAL ENGINEER — PEG Newfoundland and Labrador — Paul Dillon — SIGNATURE — 2008-08-01 DATE — NEWFOUNDLAND & LABRADOR

newfoundland labrador hydro — a nalcor energy company

Newfoundland and Labrador Hydro

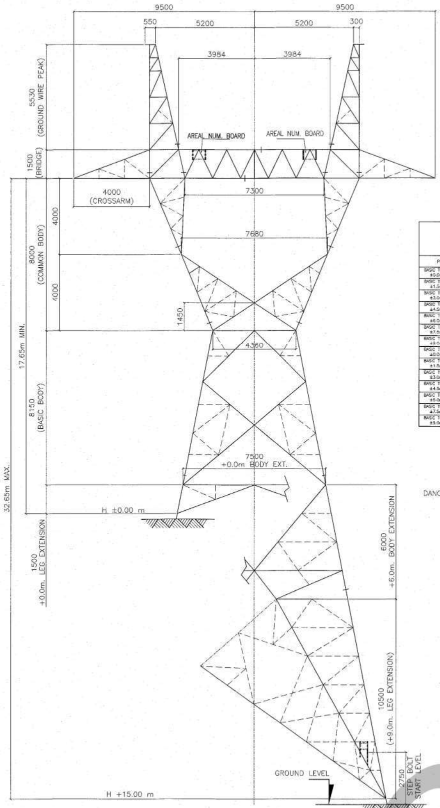
DWN K.B.Ricketts
CKD
APD

230kV WOOD POLE STRUCTURE TYPE "DD"

Scale 1 : 100
Date 08-05-29
A3- 1-230TL (DD)
REV. 1

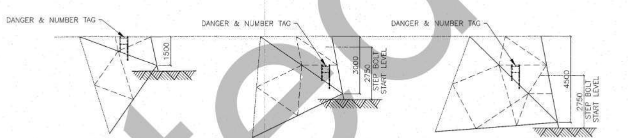
Jul 29, 2009 - 1:00pm

C.6 Type C Steel



TRANSVERSE ELEVATION
1:100

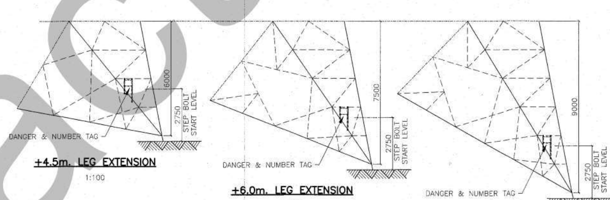
PARTS	GROUND WIRE PEAK	BRIDGE	CROSSARM	COMMON BODY	BASIC BODY	±0 M BODY EXTENSION	+6.0_BODY EXTENSION	LEG EXTENSION ±0.0 m	LEG EXTENSION ±1.5 m	LEG EXTENSION ±3.0 m	LEG EXTENSION ±4.5 m	LEG EXTENSION ±6.0 m	LEG EXTENSION ±7.5 m	LEG EXTENSION ±9.0 m	DANGER & NUMBER TAG	AERIAL NUMBER BOARD	TOTAL TOWER WEIGHT
PART WEIGHT	2232	4385	1122	5198	6314	992	6103	370	565	789	1027	1289	1533	1812	14	13	
BASIC TOWER +0.0m B.E. ±0.0m L.E. (4 LEG)	1	1	1	1	1	1		4							1		21736
BASIC TOWER +0.0m B.E. ±1.5m L.E. (4 LEG)	1	1	1	1	1	1			4						1		22514
BASIC TOWER +0.0m B.E. ±3.0m L.E. (4 LEG)	1	1	1	1	1	1				4					1		23412
BASIC TOWER +0.0m B.E. ±4.5m L.E. (4 LEG)	1	1	1	1	1	1					4				1		24364
BASIC TOWER +0.0m B.E. ±6.0m L.E. (4 LEG)	1	1	1	1	1	1						4			1		25408
BASIC TOWER +0.0m B.E. ±7.5m L.E. (4 LEG)	1	1	1	1	1	1							4		1		26387
BASIC TOWER +0.0m B.E. +9.0m L.E. (4 LEG)	1	1	1	1	1	1								4	1		27504
BASIC TOWER +6.0m B.E. ±0.0m L.E. (4 LEG)	1	1	1	1	1		1	4							1		26846
BASIC TOWER +6.0m B.E. ±1.5m L.E. (4 LEG)	1	1	1	1	1		1		4						1		27625
BASIC TOWER +6.0m B.E. ±3.0m L.E. (4 LEG)	1	1	1	1	1		1			4					1		28523
BASIC TOWER +6.0m B.E. ±4.5m L.E. (4 LEG)	1	1	1	1	1		1				4				1		29475
BASIC TOWER +6.0m B.E. ±6.0m L.E. (4 LEG)	1	1	1	1	1		1					4			1		30518
BASIC TOWER +6.0m B.E. ±7.5m L.E. (4 LEG)	1	1	1	1	1		1						4		1		31497
BASIC TOWER +6.0m B.E. ±9.0m L.E. (4 LEG)	1	1	1	1	1		1							4	1		32615



+0.0m. LEG EXTENSION
1:100

+1.5m. LEG EXTENSION
1:100

+3.0m. LEG EXTENSION
1:100



+4.5m. LEG EXTENSION
1:100

+6.0m. LEG EXTENSION
1:100

+7.5m. LEG EXTENSION
1:100

PROVINCE OF NEWFOUNDLAND AND LABRADOR
PEG PERMIT HOLDER
This Permit Allows
AVAL ENGINEERING INC.
08401
To practice Professional Engineering in Newfoundland and Labrador.
Permit No. as issued by PEGNL N0848
which is valid for the year 2016

DRAWING LIST

GENERAL NOTES:

1) ALL DIMENSIONS ARE IN MILLIMETERS.
2) ALL STEEL USED IN TOWER CONFORM TO CSA G40.21 STRUCTURAL QUALITY STEEL 350WT OR EQUIVALENT.
3) ALL BOLTS AND STEP BOLTS ARE AS PER ASTM A394 TYPE 1 & NUTS ARE AS PER ASTM A-563 GRADE DH.
4) ALL CONNECTION BOLT IN THIS TOWER ARE 5/8" & 3/4" SIZE AND STEP BOLT SIZE IS 3/4"
5) HOLES 11/16" (17.5mm) DIAMETER FOR 5/8" (15.9mm) DIAMETER BOLTS, EXCEPT AS NOTED
6) HOLES 13/16" (20.64mm) DIAMETER FOR 3/4" (19.05mm) DIAMETER BOLTS(STEP BOLT), EXCEPT AS NOTED
7) LOCK WASHER AS PER ASME STANDARD B18.21.1 ARE TO BE USED UNDER EACH NUT.
8) EACH BOLT TO HAVE ONE LOCK WASHER & ONE NUT. EXCEPT STEP BOLT HAVE TWO LOCK WASHER & TWO NUTS
9) SHEAR PLANES SHALL BE OUTSIDE THE THREADED PORTION OF THE BOLTS AND, THE BOLT PROTRUSION SHALL NOT BE LESS THAN ABOUT 3 FULL THREADS. BUT NOT MORE THAN 6/10" (15mm).
10) MINIMUM GUSSET PLATE THICKNESS IS 6mm.
11) ALL ITEMS TO BE PRE-FIXED WITH (ITEM NO. COMMON PREFIX FOR THE PARTICULAR TOWER)
MEMBER MARK LABELLING
DRAWING CODE GW/100 WILL BE MARKED AS SHOWN BELOW

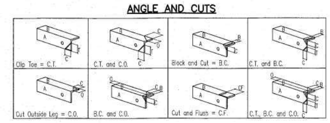
LINE
TOWER TYPE
TOWER LOCATION
MEMBER MARK NUMBER
T 267-C-GW-100

12) END DISTANCE, EDGE DISTANCE, BOLT SPACING & PLATE THICKNESS AS PER "BWT-SN-CD-6400-TL-DD-0003-01"
13) ALL STEEL ITEMS TO BE HOT DIP GALVANIZED AS PER ASTM A123 AND BOLTS AND WASHER AS PER ASTM A153
14) CF (cut and flush) OPERATION NOT TO BE DONE ON FORCE CARRYING MEMBERS.

TORQUE VALUES FOR BOLTS AND SCREWS

NOMINAL DIAMETER	BOLT GRADE	TORQUE VALUES	
5/8"	ASTM A394 TYPE 1	100 N.m	74 lb.ft
3/4"	ASTM A394 TYPE 1	160 N.m	118 lb.ft

ANGLE AND CUTS



ABBREVIATIONS

OPEN FLANGE
OP.FL.

CLOSE FLANGE
CL.FL.

ANGLE AND DISTANCE

L44x44...
L51x51...

UNLESS OTHERWISE NOTED CENTER OF THE ANGLE SHALL BE USED AS BOLT AXIS

STEP BOLT

228.6 Threaded part inside the angle as shown
80
19.05

BOLT SYMBOL

- All holes ø14.29 dia for 12.7 dia bolts
- All holes ø17.46 dia for 15.88 dia bolts
- All holes ø20.64 dia for 19.05 dia bolts
- All holes ø20.64 dia for 19.05 dia step bolts
- All holes ø23.81 dia for 22.23 dia bolts

***** DATUM REFERENCE: *ALL ELEVATIONS ARE IN METRES REFERENCED TO GEODETIC.* COORDINATE REFERENCE: *UTM 6° (UNIVERSAL TRANSVERSE MERCATOR) PROJECTION, NAD83, ZONE __ CENTRAL MERIDIAN 63° 00' W LONGITUDE.* *****

ISSUE	REV.	DATE	DISTRIBUTION & STATUS
5	C1	03-OCT-2016	ISSUED FOR CONSTRUCTION
4	B4	12-AUG-2016	ISSUED FOR COMMENTS
3	B3	05-AUG-2016	ISSUED FOR COMMENTS
2	B2	19-JULY-2016	ISSUED FOR COMMENTS
1	B1	17-JUN-2016	ISSUED FOR COMMENTS

ISSUE REGISTER

No.	REFERENCE DRAWING

No.	DATE	REVISION	MOD.	VER.	APP.
1	03-OCT-2016	ISSUED FOR PROTOTYPE	Y.O.	A.B.D.	C.A.

REVISION REGISTER

********* FOR INTERNAL USE ONLY *********
REVIEW CLASS: EQUIPMENT TAG NUMBER:
REVIEW DOES NOT CONSTITUTE APPROVAL OF DESIGN DETAILS, CALCULATIONS, TEST METHODS OR MATERIAL DEVELOPED AND/OR SELECTED BY THE CONTRACTOR, NOR DOES IT RELIEVE THE CONTRACTOR FROM FULL COMPLIANCE WITH CONTRACTUAL OR OTHER OBLIGATIONS.
✓ 1. REVIEWED AND ACCEPTED NO COMMENTS
☐ 2. REVIEWED - INCORPORATE COMMENTS, REVISE & RESUBMIT
☐ 3. REVIEWED - NOT ACCEPTED
☐ 4. INFORMATION ONLY
☐ 5. NOT REVIEWED
LEAD REVIEWER: Shahid Khan Date (dd-mmm-yyyy): 27-Oct-2016
NE-LCP MANAGEMENT: Date (dd-mmm-yyyy):
PROJECT MANAGER: Date (dd-mmm-yyyy):

PROFESSIONAL STAMP
Stamping responsibility is limited to steel quality, quantity & connection element check.
LICENSED PROFESSIONAL ENGINEER 08401 Chang Sun Eun SIGNATURE OCT 24/16 DATE NEWFOUNDLAND & LABRADOR

MITAŞ

DESIGNED	A. YAHIAOUI	APPROVED (Discipline Lead Engineer)
DRAWN	Y.OZDOGAN	APPROVED (Engineering Manager)
VERIFIED	A.B. DOGAN	
DATE	17-JUN-2016	SCALE AS NOTED
SUPPLIER DOC No.	MTG-410000420-C-01	

CLIENT: newfoundland labrador hydro, a nalcor energy company
PROJECT: BAY D'ESPOIR TO WESTERN AVALON TRANSMISSION LINE
TITLE: 230kV TOWER TYPE "C" GENERAL LAYOUT DETAIL DRAWING
NE DOC No.: BWT-MT-SD-6400-TL-D04-0012-01
Rev.: C1
FORMAT A1 (594x841)

C.7 Power System Study

Generation Dispatch

1. PEAK LOAD – LIL @ 900MW FROM MUSKRAT FALLS

Generator Identification	Dispatch (MW)	Generator Identification	Dispatch (MW)
Bay d'Epoir Unit 1	49.6	Cat Arm Unit 1	35
Bay d'Epoir Unit 2	0	Cat Arm Unit 2	35
Bay d'Epoir Unit 3	50.7	Paradise River	8
Bay d'Epoir Unit 4	0	Holyrood Diesels	8.5
Bay d'Epoir Unit 5	0	Holyrood Unit 1	Off
Bay d'Epoir Unit 6	50.7	Holyrood Unit 2	Off
Bay d'Epoir Unit 7	100	Holyrood Unit 3	Sync. Cond
Upper Salmon	50	Holyrood Unit 4	40
Granite Canal	23	New CT – HRD or SOP	450
Hinds Lake	50	ML Export	158
VALE Curtailable	27.2	Kruger Curtailable	0
Soldiers Pond SC #1	On	Soldiers Pond SC #3	Off
Soldiers Pond SC #2	On		

2. PEAK LOAD – LIL – MONOPOLE @ 675MW FROM MUSKRAT FALLS (R_{cmp} & R_{dc} = 31.44Ω)

Generator Identification	Dispatch (MW)	Generator Identification	Dispatch (MW)
Bay d'Epoir Unit 1	61.5	Cat Arm Unit 1	35
Bay d'Epoir Unit 2	64.2	Cat Arm Unit 2	35
Bay d'Epoir Unit 3	64.2	Paradise River	8
Bay d'Epoir Unit 4	64.2	Holyrood Diesels	8.5
Bay d'Epoir Unit 5	64.2	Holyrood Unit 1	Off
Bay d'Epoir Unit 6	64.2	Holyrood Unit 2	Off
Bay d'Epoir Unit 7	135	Holyrood Unit 3	Sync. Cond
Upper Salmon	50	Holyrood Unit 4	40
Granite Canal	23	New CT – HRD or SOP	450
Hinds Lake	50	ML Export	158
VALE Curtailable	27.2	Kruger Curtailable	0
Soldiers Pond SC #1	On	Soldiers Pond SC #3	Off
Soldiers Pond SC #2	On		

3. PEAK LOAD – LIL – BIPOLE OUTAGE – 0MW FROM MUSKRAT FALLS

Generator Identification	Dispatch (MW)	Generator Identification	Dispatch (MW)
Bay d'Epoir Unit 1	72.8	Cat Arm Unit 1	67
Bay d'Epoir Unit 2	75.9	Cat Arm Unit 2	67
Bay d'Epoir Unit 3	75.9	Paradise River	8
Bay d'Epoir Unit 4	75.9	Holyrood Diesels	8.5
Bay d'Epoir Unit 5	75.9	Holyrood Unit 1	Off
Bay d'Epoir Unit 6	75.9	Holyrood Unit 2	Off
Bay d'Epoir Unit 7	154.4	Holyrood Unit 3	Sync. Cond
Upper Salmon	84	Holyrood Unit 4	123.5
Granite Canal	40	New CT – HRD or SOP	450
Hinds Lake	75	ML Export	0
St. Anthony Diesels	9.7	Hawke's Bay Diesels	5
VALE Curtailable	27.2	Kruger Curtailable	90
Soldiers Pond SC #1	On	Soldiers Pond SC #3	Off
Soldiers Pond SC #2	On		

Note : With LIL out of service, all generation is at maximum capability

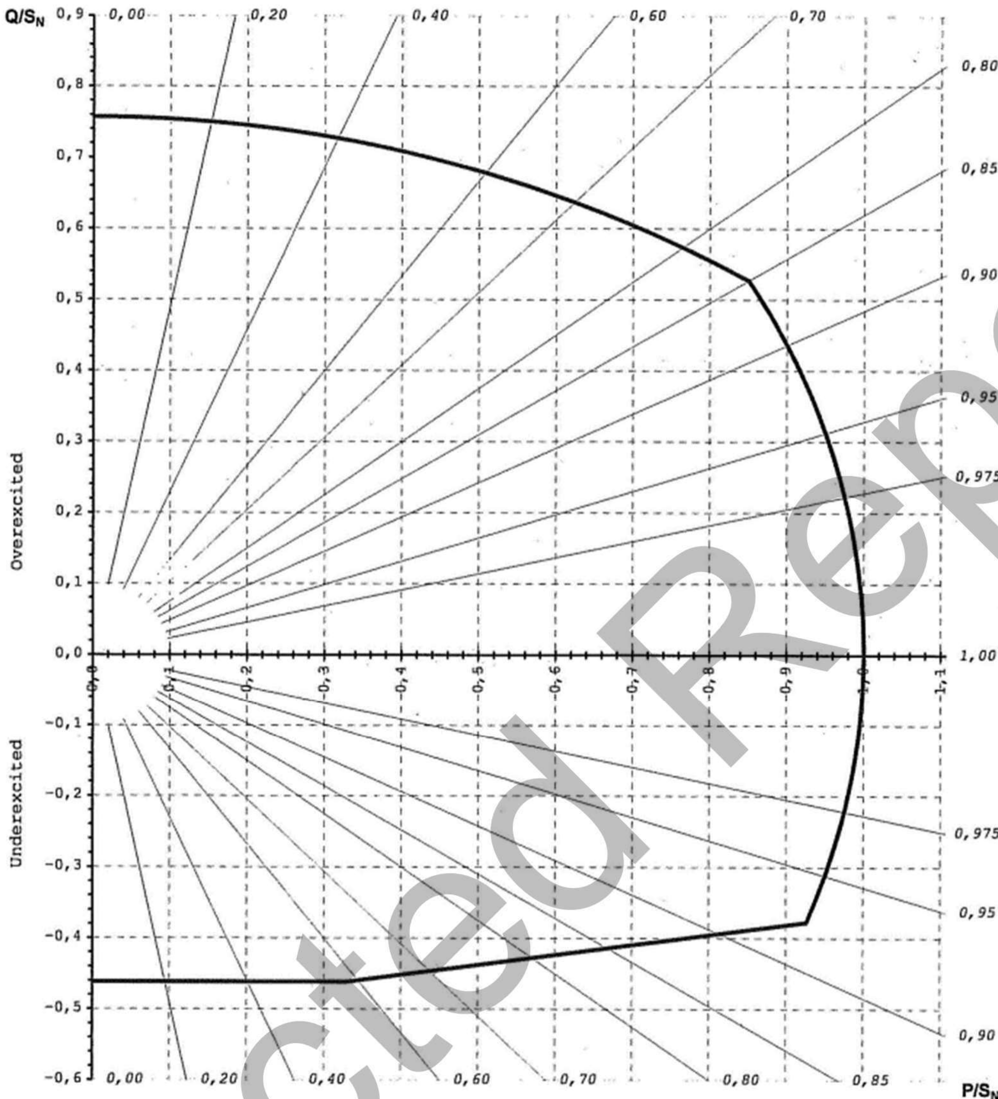
4. LIGHT LOAD – LIL - BIPOLE OUTAGE – 0MW FROM MUSKRAT FALLS

Generator Identification	Dispatch (MW)	Generator Identification	Dispatch (MW)
Bay d'Epoir Unit 1	30.4	Cat Arm Unit 1	35
Bay d'Epoir Unit 2	30.4	Cat Arm Unit 2	Sync. Cond
Bay d'Epoir Unit 3	30.4	Paradise River	8
Bay d'Epoir Unit 4	30.4	Holyrood Diesels	0
Bay d'Epoir Unit 5	0	Holyrood Unit 1	Off
Bay d'Epoir Unit 6	0	Holyrood Unit 2	Off
Bay d'Epoir Unit 7	Sync. Cond	Holyrood Unit 3	Sync. Cond
Upper Salmon	50	Holyrood Unit 4	0
Granite Canal	23	New CT – HRD or SOP	450
Hinds Lake	0	ML Export	158
VALE Curtailable	0	Kruger Curtailable	0
Soldiers Pond SC #1	On	Soldiers Pond SC #3	Off
Soldiers Pond SC #2	On		

Technical Study Assumptions

Table 1 provides the parameters used to assess the addition of up to 450MW of combustion turbines at either Holyrood or Soldiers Pond. Figure 1 provides the assumed capability curve for a 50MW generator.

Table 1 **Preliminary Combustion Turbine and Step Up Transformer Parameters**	
Generator	
kV	13.8
MW	50.0
Power Factor	0.85
MVA	58.82
X''_d per unit	0.132
X_l per unit	0.132
Step Up Transformer	
Windings	13.8 kV DELTA
	230 kV WYE-GND
MVA Rating	75 / 100 / 125
Z_1 (%)	10.0
Z_0 (%)	9.0
X / R	30.0



Appendix F: Reactive Capability Curve – Assumed for 50MW Unit

Appendix D:
GT Specification Sheet

Gas Turbine Generator – Specification Sheet

Introduction

This scope of work describes the minimum requirements for the design, fabrication, assembly and testing of aeroderivative gas turbine generator with a nominal output of 50-100MW with less than 10 min start up time with a capability to operate as a synchronous condenser.

The turbines shall be able to run on Diesel, Natural Gas, Biodiesel, and Hydrogen. Provide an estimated timeline for the gas turbine technology if there is a projected technology improvement to burn more hydrogen or biodiesel in the future.

Winterization and power augmentation packages should be included in proposal.

Scope of supply is as follows:

Combustion turbine generator
Start-up system and requirement
Instrumentation
Batteries/chargers
Uninterruptible power supply ("ups") systems
Inlet/heating de-icing system
Lube oil system
Demineralized and raw water requirement
Compressed air system
Specify unit start up time
Fuel System
Gearbox (if required)
Coupling(s) and coupling guards.
Continuous emissions monitoring system
Generator step-up transformer
Fire Protection system
Air cooled generator, open ventilated complete with generator enclosure
Generator stator heater
Turbine generator supervisory system
Turbine control panels

General Design Data for estimated performance

Site:	Newfoundland and Labrador
Location:	Indoors
Air Quality:	Good (no particulate)
Elevation:	88m
Ambient Temperature :	-26°C min/28°C max
Relative humidity:	60%

Fuel: Diesel, Natural Gas, Biodiesel, and Hydrogen

NOx Emissions Requirements:

Fuel Type	Compliance Limit (ppm)	Performance Target (ppm)
Diesel, Natural Gas, Biodiesel, and Hydrogen	Canadian Environmental Protection Act: guidelines, objectives, and codes of practice	38

Information Required with Quotation

The following information shall be supplied with the Quotation:

- Equipment Scope Description
- Vendor standard data sheet with performance and design data. Provide an estimated performance sweep from -26 to 28°C.
- Preliminary Equipment arrangement drawings, including dimensions (include 3D model drawings).
- Emission guarantees
- Weight of equipment
- Technology experience list for burning diesel, natural gas, biodiesel, and hydrogen.
- Manufacturing and delivery schedule
- Vendor shall include a priced list of recommended spare parts for start-up and initial operation of the equipment and a priced list of spare parts for two-years of normal operation in the proposal.

Appendix E:
Budgetary Proposals

Appendix E1: [redacted] Budgetary Proposal
Appendix E2: [redacted] Budgetary Proposal

E.1 [redacted] Budgetary Proposal

OMITTED IN REDACTED REPORT

E.2 [redacted] Budgetary Proposal

OMITTED IN REDACTED REPORT

Appendix F:
Cost Estimates

Appendix F1: [redacted] Simple Cycle Cost Estimate
Appendix F2: [redacted] Simple Cycle Cost Estimate

F.1 [redacted] Cost Estimate

OMITTED IN REDACTED REPORT

F.2 [redacted] Cost Estimate

OMITTED IN REDACTED REPORT

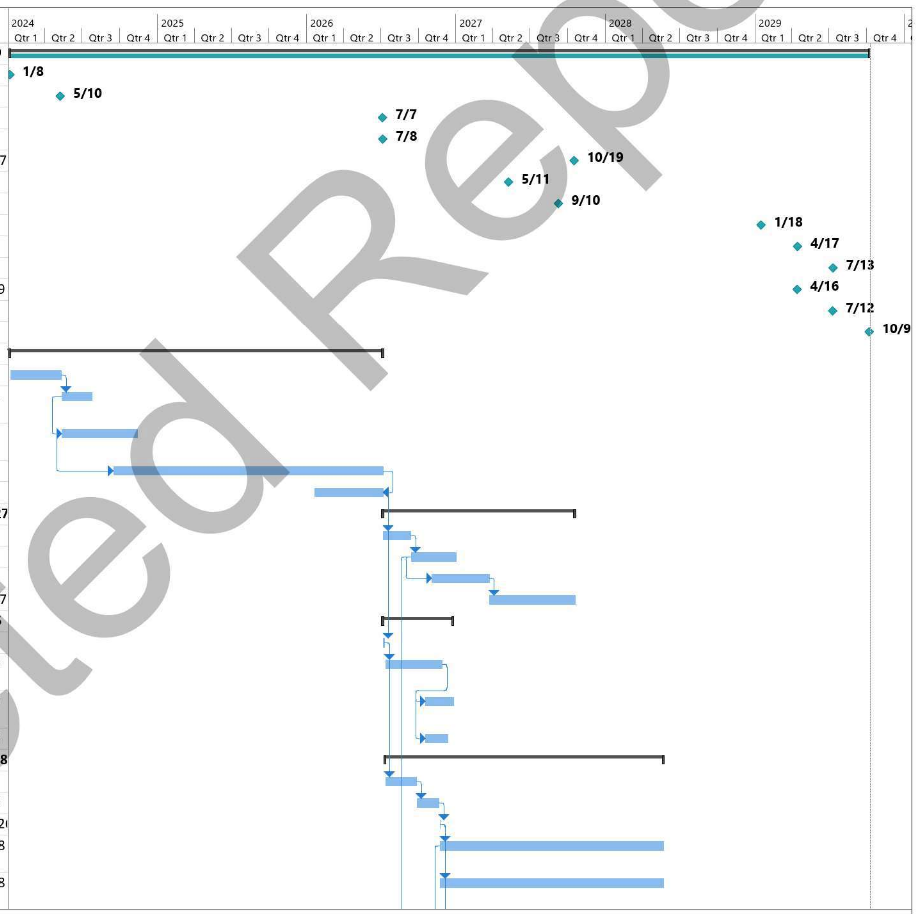
Appendix G:
Alternative Fuel Experience List

OMITTED IN REDACTED REPORT

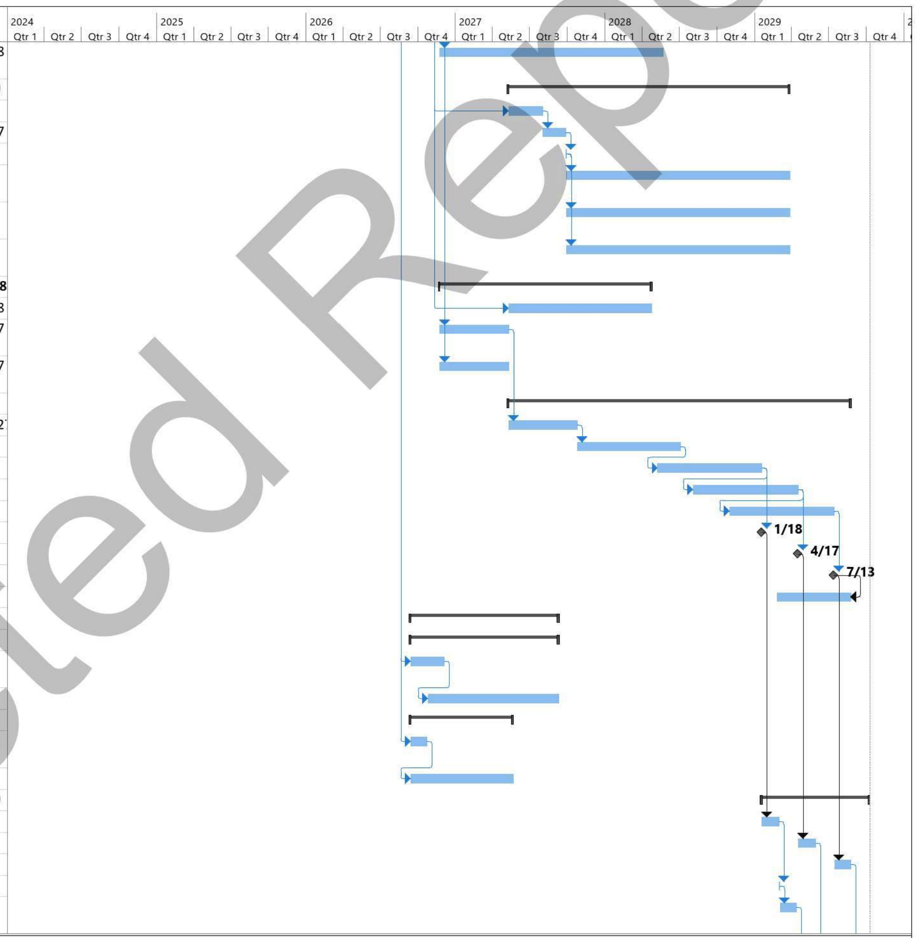
Appendix H: Schedules

H.1 [redacted] Phase 1 (150MW) Schedule

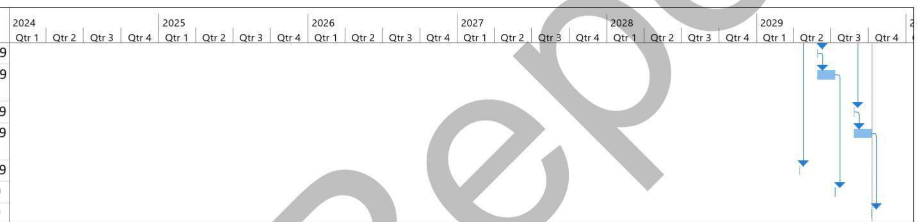
ID	Task Name	Duration	Start	Finish
1	**Key Milestones**	**1502 days**	**Mon 1/8/24**	**Tue 10/9/29**
2	NLH Budgeting and Approval Start	0 days	Mon 1/8/24	Mon 1/8/24
3	NLH Budgeting and Approval Complete	0 days	Fri 5/10/24	Fri 5/10/24
4	EPCM Contract Award	0 days	Tue 7/7/26	Tue 7/7/26
5	Preliminary Engineering Start	0 days	Wed 7/8/26	Wed 7/8/26
6	Enviromental Approval	0 days	Tue 10/19/27	Tue 10/19/27
7	Start of Construction (Per Owner RFP)	0 days	Tue 5/11/27	Tue 5/11/27
8	Site Utility Services Available	0 days	Fri 9/10/27	Fri 9/10/27
9	Mechanical Completion Unit #1	0 days	Thu 1/18/29	Thu 1/18/29
10	Mechanical Completion Unit #2	0 days	Tue 4/17/29	Tue 4/17/29
11	Mechanical Completion Unit #3	0 days	Fri 7/13/29	Fri 7/13/29
12	Commercial Operation Unit #1	0 days	Mon 4/16/29	Mon 4/16/29
13	Commercial Operation Unit #2	0 days	Thu 7/12/29	Thu 7/12/29
14	Commercial Operation Unit #3	0 days	Tue 10/9/29	Tue 10/9/29
15	**Project Development**	**652 days**	**Mon 1/8/24**	**Tue 7/7/26**
16	NLH Budgeting and Approval	90 days	Mon 1/8/24	Fri 5/10/24
17	Project Management - Risk, Strategy, Charter	54 days	Mon 5/13/24	Thu 7/25/24
18	FEED - Consultant Procurement, Design, Cost Estimate	133 days	Mon 5/13/24	Wed 11/13/24
19	NLH - PUB Report, Reviews, Package Prep	472 days	Mon 9/16/24	Tue 7/7/26
20	EPCM Contract Negotiations and Award	120 days	Wed 1/21/26	Tue 7/7/26
21	**Permitting / Approval Process**	**335 days**	**Wed 7/8/26**	**Tue 10/19/27**
22	Environmental Consultant Procurement	48 days	Wed 7/8/26	Fri 9/11/26
23	Emission/Noise modelling report	80 days	Mon 9/14/26	Fri 1/1/27
24	Enviromental Application Process	100 days	Wed 11/4/26	Tue 3/23/27
25	Enviromental Approval	150 days	Wed 3/24/27	Tue 10/19/27
26	**Preliminary Engineering**	**123 days**	**Wed 7/8/26**	**Fri 12/25/26**
27	Project Kick off meeting	3 days	Wed 7/8/26	Fri 7/10/26
28	Design Basis & Preliminary P&ID's Layout / SLDs	100 days	Mon 7/13/26	Fri 11/27/26
29	Preliminary Specs for Long Lead Equipment	50 days	Mon 10/19/26	Fri 12/25/26
30	Prepare Cost Estimate	40 days	Mon 10/19/26	Fri 12/11/26
31	**Gas Turbine Generator (GTG) Procurement**	**486 days**	**Mon 7/13/26**	**Mon 5/22/28**
32	Specifications and RFQ's	55 days	Mon 7/13/26	Fri 9/25/26
33	Bids, Evaluations & Clarifications	40 days	Mon 9/28/26	Fri 11/20/26
34	Supply Contract Award	1 day	Mon 11/23/26	Mon 11/23/2
35	GTG #1 Design / Manufacturing and Delivery on Site	390 days	Tue 11/24/26	Mon 5/22/28
36	GTG #2 Design / Manufacturing and Delivery on Site	390 days	Tue 11/24/26	Mon 5/22/28



ID	Task Name	Duration	Start	Finish
37	GTG #3 Design / Manufacturing and Delivery on Site	390 days	Tue 11/24/26	Mon 5/22/28
38	**GSU Transformers Procurement**	**491 days**	**Tue 5/11/27**	**Tue 3/27/29**
39	Specifications and RFQ's	60 days	Tue 5/11/27	Mon 8/2/27
40	Bids, Evaluations & Clarifications	40 days	Tue 8/3/27	Mon 9/27/27
41	Contract Award	1 day	Tue 9/28/27	Tue 9/28/27
42	GSU #1 Transformer Design / Manufacturing and Delivery on Site	390 days	Wed 9/29/27	Tue 3/27/29
43	GSU #2 Transformer Design / Manufacturing and Delivery on Site	390 days	Wed 9/29/27	Tue 3/27/29
44	GSU #3 Transformer Design / Manufacturing and Delivery on Site	390 days	Wed 9/29/27	Tue 3/27/29
45	**Detailed Engineering**	**370 days**	**Tue 11/24/26**	**Mon 4/24/28**
46	Detailed Engineering	250 days	Tue 5/11/27	Mon 4/24/28
47	Civil & Found. Works Contract Spec's/ Bid Process/ Award	120 days	Tue 11/24/26	Mon 5/10/27
48	Mech & Elec Installation Contract RFP/Bid Proces/Award	120 days	Tue 11/24/26	Mon 5/10/27
49	**Construction**	**599 days**	**Tue 5/11/27**	**Fri 8/24/29**
50	Site Grading / Roads / Drainage	120 days	Tue 5/11/27	Mon 10/25/2
51	Piling / Found. / Buildings	180 days	Tue 10/26/27	Mon 7/3/28
52	GTG #1 Installation Work Execution	183 days	Tue 5/9/28	Thu 1/18/29
53	GTG #2 Installation Work Execution	183 days	Fri 8/4/28	Tue 4/17/29
54	GTG #3 Installation Work Execution	183 days	Wed 11/1/28	Fri 7/13/29
55	Mechanical Completion Unit #1	0 days	Thu 1/18/29	Thu 1/18/29
56	Mechanical Completion Unit #2	0 days	Tue 4/17/29	Tue 4/17/29
57	Mechanical Completion Unit #3	0 days	Fri 7/13/29	Fri 7/13/29
58	As Builts, Turnover, etc…	130 days	Mon 2/26/29	Fri 8/24/29
59	**Serivices To Site**	**260 days**	**Mon 9/14/26**	**Fri 9/10/27**
60	**Transmission Line / HV Connection**	**260 days**	**Mon 9/14/26**	**Fri 9/10/27**
61	Preliminary Studies/Specs/Negotiations	60 days	Mon 9/14/26	Fri 12/4/26
62	Permitting Process & Approval	230 days	Mon 10/26/26	Fri 9/10/27
63	**Water Supply**	**180 days**	**Mon 9/14/26**	**Fri 5/21/27**
64	Preliminary Studies/Specs/Negotiations	30 days	Mon 9/14/26	Fri 10/23/26
65	Permitting Process & Approval	180 days	Mon 9/14/26	Fri 5/21/27
66	**Comissioning & Testing**	**188 days**	**Fri 1/19/29**	**Tue 10/9/29**
67	Check Out/PreComm Unit #1	30 days	Fri 1/19/29	Thu 3/1/29
68	Check Out/PreComm Unit #2	30 days	Wed 4/18/29	Tue 5/29/29
69	Check Out/PreComm Unit #3	30 days	Mon 7/16/29	Fri 8/24/29
70	First Fire - Unit #1	1 day	Fri 3/2/29	Fri 3/2/29
71	Startup/Testing Including Performance Unit #1	30 days	Mon 3/5/29	Fri 4/13/29

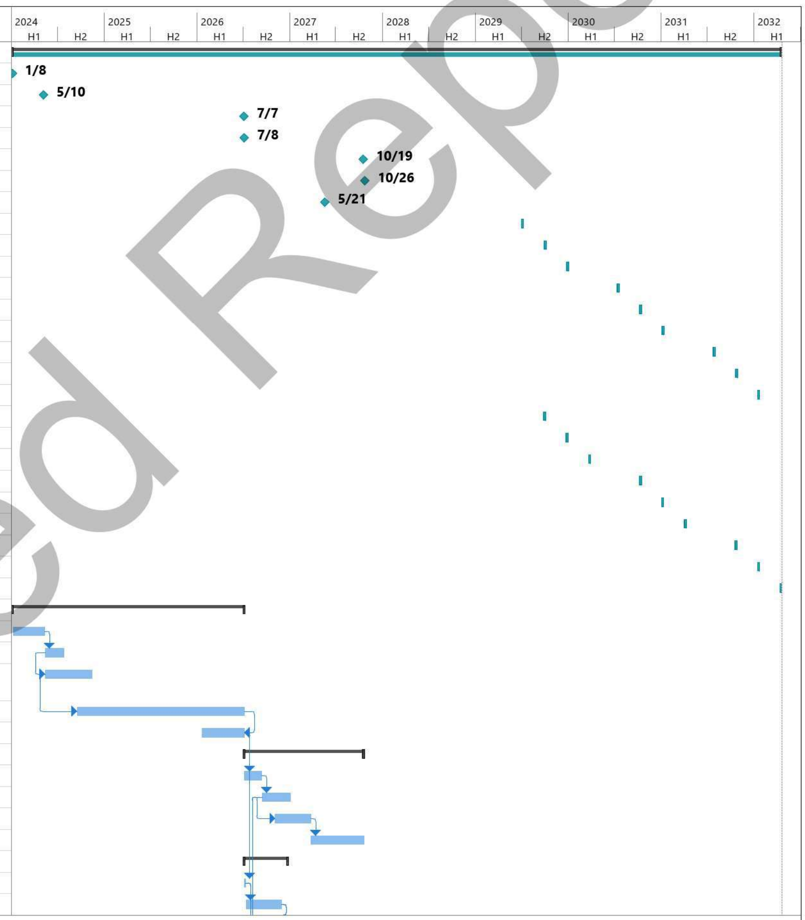


ID	Task Name	Duration	Start	Finish
72	First Fire - Unit #2	1 day	Wed 5/30/29	Wed 5/30/29
73	Startup/Testing Including Performance Unit #2	30 days	Thu 5/31/29	Wed 7/11/29
74	First Fire - Unit #3	1 day	Mon 8/27/29	Mon 8/27/29
75	Startup/Testing Including Performance Unit #3	30 days	Tue 8/28/29	Mon 10/8/29
76	Commercial Operation Unit #1	1 day	Mon 4/16/29	Mon 4/16/29
77	Commercial Operation Unit #2	1 day	Thu 7/12/29	Thu 7/12/29
78	Commercial Operation Unit #3	1 day	Tue 10/9/29	Tue 10/9/29

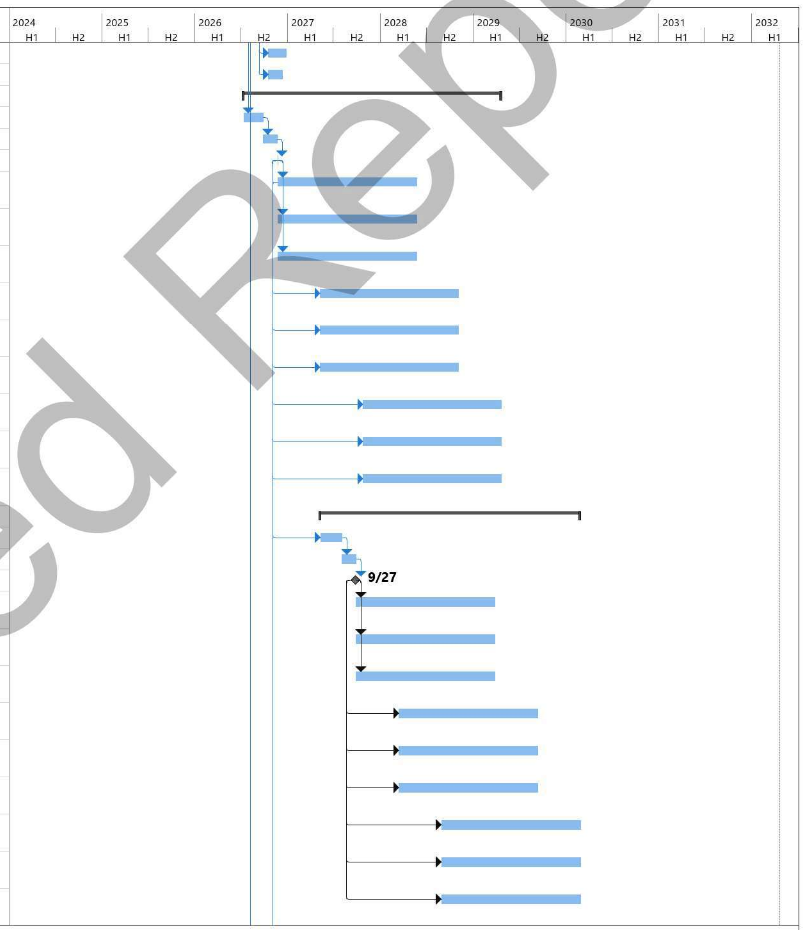


H.2 [redacted] Phase 3 (450MW) Schedule

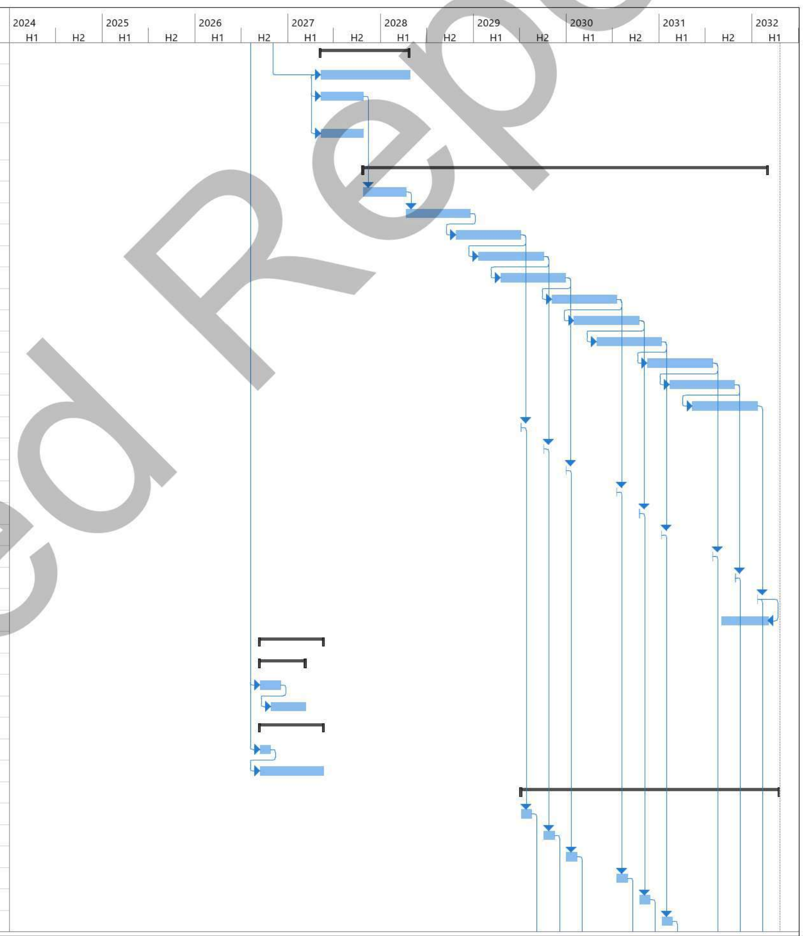
ID	Task Name	Duration	Start	Finish
1	**Key Milestones**	**2161 days**	**Mon 1/8/24**	Mon 4/19/32
2	NLH Budgeting and Approval Start	0 days	Mon 1/8/24	Mon 1/8/24
3	NLH Budgeting and Approval Complete	0 days	Fri 5/10/24	Fri 5/10/24
4	EPCM Contract Award	0 days	Tue 7/7/26	Tue 7/7/26
5	Preliminary Engineering Start	0 days	Wed 7/8/26	Wed 7/8/26
6	Enviromental Approval	0 days	Tue 10/19/27	Tue 10/19/27
7	Start of Construction (Per Owner RFP)	0 days	Tue 10/26/27	Tue 10/26/27
8	Site Utility Services Available	0 days	Fri 5/21/27	Fri 5/21/27
9	Mechanical Completion Unit #1	1 day	Fri 7/6/29	Fri 7/6/29
10	Mechanical Completion Unit #2	1 day	Wed 10/3/29	Wed 10/3/29
11	Mechanical Completion Unit #3	1 day	Mon 12/31/29	Mon 12/31/29
12	Mechanical Completion Unit #4	1 day	Thu 7/18/30	Thu 7/18/30
13	Mechanical Completion Unit #5	1 day	Tue 10/15/30	Tue 10/15/30
14	Mechanical Completion Unit #6	1 day	Fri 1/10/31	Fri 1/10/31
15	Mechanical Completion Unit #7	1 day	Wed 7/30/31	Wed 7/30/31
16	Mechanical Completion Unit #8	1 day	Mon 10/27/31	Mon 10/27/31
17	Mechanical Completion Unit #9	1 day	Thu 1/22/32	Thu 1/22/32
18	Commercial Operation Unit #1	1 day	Tue 10/2/29	Tue 10/2/29
19	Commercial Operation Unit #2	1 day	Fri 12/28/29	Fri 12/28/29
20	Commercial Operation Unit #3	1 day	Wed 3/27/30	Wed 3/27/30
21	Commercial Operation Unit #4	1 day	Mon 10/14/30	Mon 10/14/30
22	Commercial Operation Unit #5	1 day	Thu 1/9/31	Thu 1/9/31
23	Commercial Operation Unit #6	1 day	Tue 4/8/31	Tue 4/8/31
24	Commercial Operation Unit #7	1 day	Fri 10/24/31	Fri 10/24/31
25	Commercial Operation Unit #8	1 day	Wed 1/21/32	Wed 1/21/32
26	Commercial Operation Unit #9	1 day	Mon 4/19/32	Mon 4/19/32
27	**Project Development**	**652 days**	**Mon 1/8/24**	**Tue 7/7/26**
28	NLH Budgeting and Approval	90 days	Mon 1/8/24	Fri 5/10/24
29	Project Management - Risk, Strategy, Charter	54 days	Mon 5/13/24	Thu 7/25/24
30	FEED - Consultant Procurement, Design, Cost Estimate	133 days	Mon 5/13/24	Wed 11/13/24
31	NLH - PUB Report, Reviews, Package Prep	472 days	Mon 9/16/24	Tue 7/7/26
32	EPCM Contract Negotiations and Award	120 days	Wed 1/21/26	Tue 7/7/26
33	**Permitting / Approval Process**	**335 days**	**Wed 7/8/26**	**Tue 10/19/27**
34	Environmental Consultant Procurement	48 days	Wed 7/8/26	Fri 9/11/26
35	Emission/Noise modelling report	80 days	Mon 9/14/26	Fri 1/1/27
36	Enviromental Application Process	100 days	Wed 11/4/26	Tue 3/23/27
37	Enviromental Approval	150 days	Wed 3/24/27	Tue 10/19/27
38	**Preliminary Engineering**	**123 days**	**Wed 7/8/26**	**Fri 12/25/26**
39	Project Kick off meeting	3 days	Wed 7/8/26	Fri 7/10/26
40	Design Basis & Preliminary P&ID's Layout / SLDs	100 days	Mon 7/13/26	Fri 11/27/26



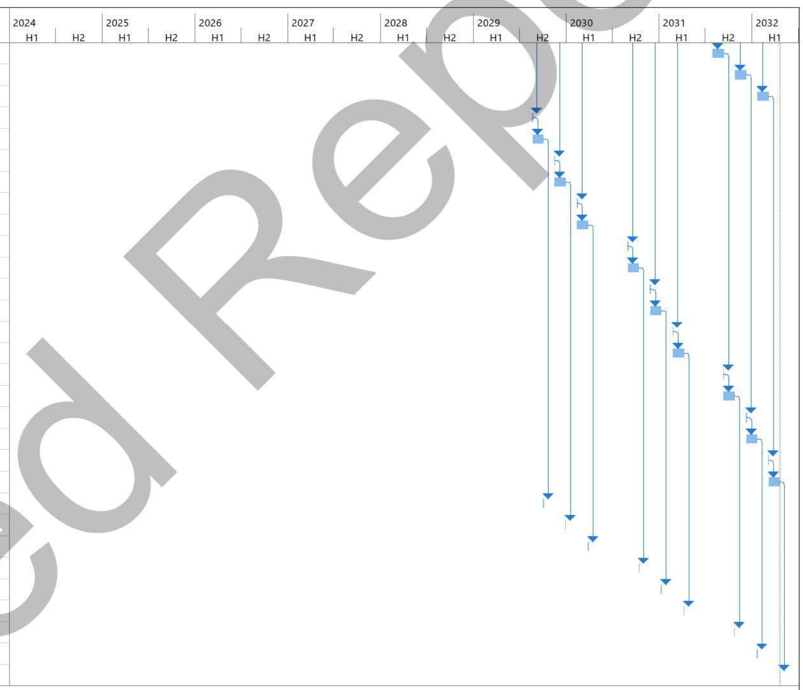
ID	Task Name	Duration	Start	Finish
41	Preliminary Specs for Long Lead Equipment	50 days	Mon 10/19/26	Fri 12/25/26
42	Prepare Cost Estimate	40 days	Mon 10/19/26	Fri 12/11/26
43	**Gas Turbine Generator (GTG) Procurement**	**725 days**	**Mon 7/13/26**	**Fri 4/20/29**
44	Specifications and RFQ's	55 days	Mon 7/13/26	Fri 9/25/26
45	Bids, Evaluations & Clarifications	40 days	Mon 9/28/26	Fri 11/20/26
46	Supply Contract Award	1 day	Mon 11/23/26	Mon 11/23/26
47	GTG #1 Design / Manufacturing and Delivery on Site	390 days	Tue 11/24/26	Mon 5/22/28
48	GTG #2 Design / Manufacturing and Delivery on Site	390 days	Tue 11/24/26	Mon 5/22/28
49	GTG #3 Design / Manufacturing and Delivery on Site	390 days	Tue 11/24/26	Mon 5/22/28
50	GTG #4 Design / Manufacturing and Delivery on Site	390 days	Mon 5/10/27	Fri 11/3/28
51	GTG #5 Design / Manufacturing and Delivery on Site	390 days	Mon 5/10/27	Fri 11/3/28
52	GTG #6 Design / Manufacturing and Delivery on Site	390 days	Mon 5/10/27	Fri 11/3/28
53	GTG #7 Design / Manufacturing and Delivery on Site	390 days	Mon 10/25/27	Fri 4/20/29
54	GTG #8 Design / Manufacturing and Delivery on Site	390 days	Mon 10/25/27	Fri 4/20/29
55	GTG #9 Design / Manufacturing and Delivery on Site	390 days	Mon 10/25/27	Fri 4/20/29
56	**GSU Transformers Procurement**	**730 days**	**Tue 5/11/27**	**Mon 2/25/30**
57	Specifications and RFQ's	60 days	Tue 5/11/27	Mon 8/2/27
58	Bids, Evaluations & Clarifications	40 days	Tue 8/3/27	Mon 9/27/27
59	Contract Award	0 days	Mon 9/27/27	Mon 9/27/27
60	GSU #1 Transformer Design / Manufacturing and Delivery on Site	390 days	Tue 9/28/27	Mon 3/26/29
61	GSU #2 Transformer Design / Manufacturing and Delivery on Site	390 days	Tue 9/28/27	Mon 3/26/29
62	GSU #3 Transformer Design / Manufacturing and Delivery on Site	390 days	Tue 9/28/27	Mon 3/26/29
63	GSU #4 Transformer Design / Manufacturing and Delivery on Site	390 days	Tue 3/14/28	Mon 9/10/29
64	GSU #5 Transformer Design / Manufacturing and Delivery on Site	390 days	Tue 3/14/28	Mon 9/10/29
65	GSU #6 Transformer Design / Manufacturing and Delivery on Site	390 days	Tue 3/14/28	Mon 9/10/29
66	GSU #7 Transformer Design / Manufacturing and Delivery on Site	390 days	Tue 8/29/28	Mon 2/25/30
67	GSU #8 Transformer Design / Manufacturing and Delivery on Site	390 days	Tue 8/29/28	Mon 2/25/30
68	GSU #9 Transformer Design / Manufacturing and Delivery on Site	390 days	Tue 8/29/28	Mon 2/25/30



ID	Task Name	Duration	Start	Finish
69	**Detailed Engineering**	**250 days**	**Tue 5/11/27**	**Mon 4/24/28**
70	Detailed Engineering	250 days	Tue 5/11/27	Mon 4/24/28
71	Civil & Found. Works Contract Spec's/ Bid Process/ Award	120 days	Tue 5/11/27	Mon 10/25/27
72	Mech & Elec Installation Contract RFP/Bid Proces/Award	120 days	Tue 5/11/27	Mon 10/25/27
73	**Construction**	**1138 days**	**Tue 10/26/27**	**Thu 3/4/32**
74	Site Grading / Roads / Drainage	120 days	Tue 10/26/27	Mon 4/10/28
75	Piling / Found. / Buildings	180 days	Tue 4/11/28	Mon 12/18/28
76	GTG #1 Installation Work Execution	183 days	Tue 10/24/28	Thu 7/5/29
77	GTG #2 Installation Work Execution	183 days	Fri 1/19/29	Tue 10/2/29
78	GTG #3 Installation Work Execution	183 days	Wed 4/18/29	Fri 12/28/29
79	GTG #4 Installation Work Execution	183 days	Mon 11/5/29	Wed 7/17/30
80	GTG #5 Installation Work Execution	183 days	Thu 1/31/30	Mon 10/14/30
81	GTG #6 Installation Work Execution	183 days	Tue 4/30/30	Thu 1/9/31
82	GTG #7 Installation Work Execution	183 days	Fri 11/15/30	Tue 7/29/31
83	GTG #8 Installation Work Execution	183 days	Wed 2/12/31	Fri 10/24/31
84	GTG #9 Installation Work Execution	183 days	Mon 5/12/31	Wed 1/21/32
85	Mechanical Completion Unit #1	1 day	Fri 7/6/29	Fri 7/6/29
86	Mechanical Completion Unit #2	1 day	Wed 10/3/29	Wed 10/3/29
87	Mechanical Completion Unit #3	1 day	Mon 12/31/29	Mon 12/31/29
88	Mechanical Completion Unit #4	1 day	Thu 7/18/30	Thu 7/18/30
89	Mechanical Completion Unit #5	1 day	Tue 10/15/30	Tue 10/15/30
90	Mechanical Completion Unit #6	1 day	Fri 1/10/31	Fri 1/10/31
91	Mechanical Completion Unit #7	1 day	Wed 7/30/31	Wed 7/30/31
92	Mechanical Completion Unit #8	1 day	Mon 10/27/31	Mon 10/27/31
93	Mechanical Completion Unit #9	1 day	Thu 1/22/32	Thu 1/22/32
94	As-Builts, Turnover, etc...	130 days	Fri 9/5/31	Thu 3/4/32
95	**Services To Site**	**180 days**	**Mon 9/14/26**	**Fri 5/21/27**
96	**Transmission Line / HV Connection**	**130 days**	**Mon 9/14/26**	**Fri 3/12/27**
97	Preliminary Studies/Specs/Negotiations	60 days	Mon 9/14/26	Fri 12/4/26
98	Permitting Process & Approval	100 days	Mon 10/26/26	Fri 3/12/27
99	**Water Supply**	**180 days**	**Mon 9/14/26**	**Fri 5/21/27**
100	Preliminary Studies/Specs/Negotiations	30 days	Mon 9/14/26	Fri 10/23/26
101	Permitting Process & Approval	180 days	Mon 9/14/26	Fri 5/21/27
102	**Comissioning & Testing**	**726 days**	**Mon 7/9/29**	**Mon 4/19/32**
103	Check Out/PreComm Unit #1	30 days	Mon 7/9/29	Fri 8/17/29
104	Check Out/PreComm Unit #2	30 days	Thu 10/4/29	Wed 11/14/29
105	Check Out/PreComm Unit #3	30 days	Tue 1/1/30	Mon 2/11/30
106	Check Out/PreComm Unit #4	30 days	Fri 7/19/30	Thu 8/29/30
107	Check Out/PreComm Unit #5	30 days	Wed 10/16/30	Tue 11/26/30
108	Check Out/PreComm Unit #6	30 days	Mon 1/13/31	Fri 2/21/31

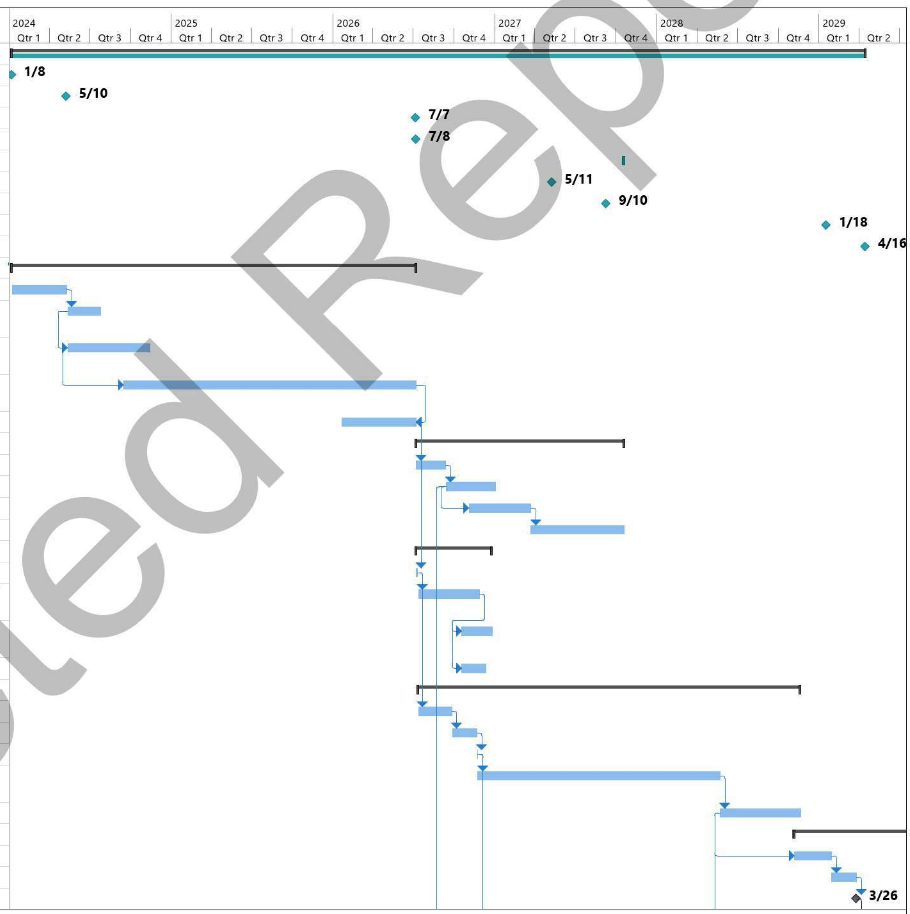


ID	Task Name	Duration	Start	Finish
109	Check Out/PreComm Unit #7	30 days	Thu 7/31/31	Wed 9/10/31
110	Check Out/PreComm Unit #8	30 days	Tue 10/28/31	Mon 12/8/31
111	Check Out/PreComm Unit #9	30 days	Fri 1/23/32	Thu 3/4/32
112	First Fire - Unit #1	1 day	Mon 8/20/29	Mon 8/20/29
113	Startup/Testing Including Performance Unit #1	30 days	Tue 8/21/29	Mon 10/1/29
114	First Fire - Unit #2	1 day	Thu 11/15/29	Thu 11/15/29
115	Startup/Testing Including Performance Unit #2	30 days	Fri 11/16/29	Thu 12/27/29
116	First Fire - Unit #3	1 day	Tue 2/12/30	Tue 2/12/30
117	Startup/Testing Including Performance Unit #3	30 days	Wed 2/13/30	Tue 3/26/30
118	First Fire - Unit #4	1 day	Fri 8/30/30	Fri 8/30/30
119	Startup/Testing Including Performance Unit #4	30 days	Mon 9/2/30	Fri 10/11/30
120	First Fire - Unit #5	1 day	Wed 11/27/30	Wed 11/27/30
121	Startup/Testing Including Performance Unit #5	30 days	Thu 11/28/30	Wed 1/8/31
122	First Fire - Unit #6	1 day	Mon 2/24/31	Mon 2/24/31
123	Startup/Testing Including Performance Unit #6	30 days	Tue 2/25/31	Mon 4/7/31
124	First Fire - Unit #7	1 day	Thu 9/11/31	Thu 9/11/31
125	Startup/Testing Including Performance Unit #7	30 days	Fri 9/12/31	Thu 10/23/31
126	First Fire - Unit #8	1 day	Tue 12/9/31	Tue 12/9/31
127	Startup/Testing Including Performance Unit #8	30 days	Wed 12/10/31	Tue 1/20/32
128	First Fire - Unit #9	1 day	Fri 3/5/32	Fri 3/5/32
129	Startup/Testing Including Performance Unit #9	30 days	Mon 3/8/32	Fri 4/16/32
130	Commercial Operation Unit #1	1 day	Tue 10/2/29	Tue 10/2/29
131	Commercial Operation Unit #2	1 day	Fri 12/28/29	Fri 12/28/29
132	Commercial Operation Unit #3	1 day	Wed 3/27/30	Wed 3/27/30
133	Commercial Operation Unit #4	1 day	Mon 10/14/30	Mon 10/14/30
134	Commercial Operation Unit #5	1 day	Thu 1/9/31	Thu 1/9/31
135	Commercial Operation Unit #6	1 day	Tue 4/8/31	Tue 4/8/31
136	Commercial Operation Unit #7	1 day	Fri 10/24/31	Fri 10/24/31
137	Commercial Operation Unit #8	1 day	Wed 1/21/32	Wed 1/21/32
138	Commercial Operation Unit #9	1 day	Mon 4/19/32	Mon 4/19/32

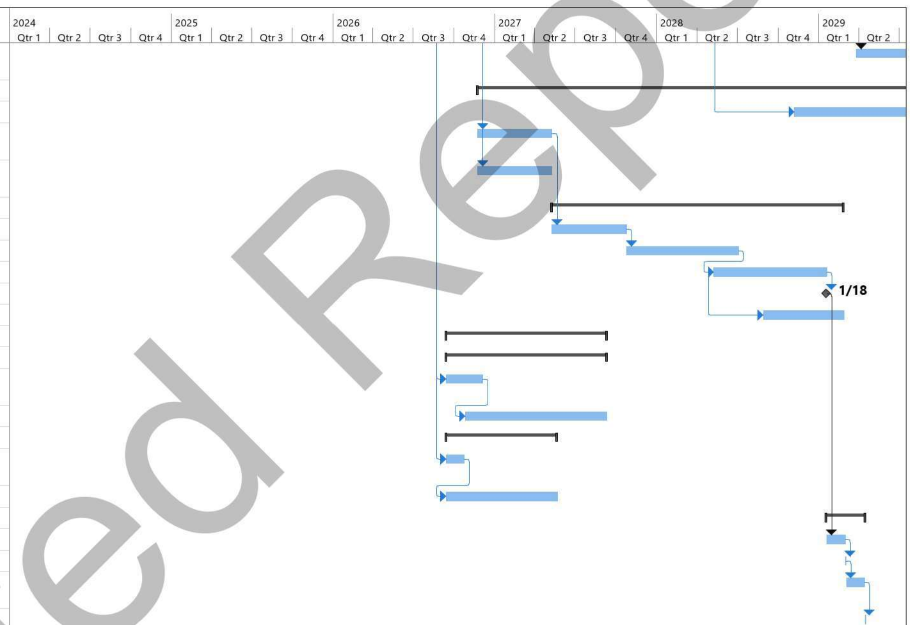


H.3 [redacted] Phase 1 (150MW) Schedule

ID	Task Name	Duration	Start	Finish
1	**Key Milestones**	**1376 days**	**Mon 1/8/24**	**Mon 4/16/29**
2	NLH Budgeting and Approval Start	0 days	Mon 1/8/24	Mon 1/8/24
3	NLH Budgeting and Approval Complete	0 days	Fri 5/10/24	Fri 5/10/24
4	EPCM Contract Award	0 days	Tue 7/7/26	Tue 7/7/26
5	Preliminary Engineering Start	0 days	Wed 7/8/26	Wed 7/8/26
6	Enviromental Approval	1 day	Tue 10/19/27	Tue 10/19/27
7	Start of Construction (Per Owner RFP)	0 days	Tue 5/11/27	Tue 5/11/27
8	Site Utility Services Available	0 days	Fri 9/10/27	Fri 9/10/27
9	Mechanical Completion Unit #1	0 days	Thu 1/18/29	Thu 1/18/29
10	Commercial Operation Unit #1	0 days	Mon 4/16/29	Mon 4/16/29
11	**Project Development**	**652 days**	**Mon 1/8/24**	**Tue 7/7/26**
12	NLH Budgeting and Approval	90 days	Mon 1/8/24	Fri 5/10/24
13	Project Management - Risk, Strategy, Charter	54 days	Mon 5/13/24	Thu 7/25/24
14	FEED - Consultant Procurement, Design, Cost Estimate	133 days	Mon 5/13/24	Wed 11/13/24
15	NLH - PUB Report, Reviews, Package Prep	472 days	Mon 9/16/24	Tue 7/7/26
16	EPCM Contract Negotiations and Award	120 days	Wed 1/21/26	Tue 7/7/26
17	**Permitting / Approval Process**	**335 days**	**Wed 7/8/26**	**Tue 10/19/27**
18	Environmental Consultant Procurement	48 days	Wed 7/8/26	Fri 9/11/26
19	Emission/Noise modelling report	80 days	Mon 9/14/26	Fri 1/1/27
20	Enviromental Application Process	100 days	Wed 11/4/26	Tue 3/23/27
21	Enviromental Approval	150 days	Wed 3/24/27	Tue 10/19/27
22	**Preliminary Engineering**	**123 days**	**Wed 7/8/26**	**Fri 12/25/26**
23	Project Kick off meeting	3 days	Wed 7/8/26	Fri 7/10/26
24	Design Basis & Preliminary P&ID's Layout / SLDs	100 days	Mon 7/13/26	Fri 11/27/26
25	Preliminary Specs for Long Lead Equipment	50 days	Mon 10/19/26	Fri 12/25/26
26	Prepare Cost Estimate	40 days	Mon 10/19/26	Fri 12/11/26
27	**Gas Turbine Generator (GTG) Procurement**	**616 days**	**Mon 7/13/26**	**Mon 11/20/28**
28	Specifications and RFQ's	55 days	Mon 7/13/26	Fri 9/25/26
29	Bids, Evaluations & Clarifications	40 days	Mon 9/28/26	Fri 11/20/26
30	Supply Contract Award	1 day	Mon 11/23/26	Mon 11/23/26
31	GTG #1 Design / Manufacturing and Delivery on Site	390 days	Tue 11/24/26	Mon 5/22/28
32	Add 6 months for Sync	130 days	Tue 5/23/28	Mon 11/20/28
33	**GSU Transformers Procurement**	**490 days**	**Tue 11/7/28**	**Mon 9/23/30**
34	Specifications and RFQ's	60 days	Tue 11/7/28	Mon 1/29/29
35	Bids, Evaluations & Clarifications	40 days	Tue 1/30/29	Mon 3/26/29
36	Contract Award	0 days	Mon 3/26/29	Mon 3/26/29

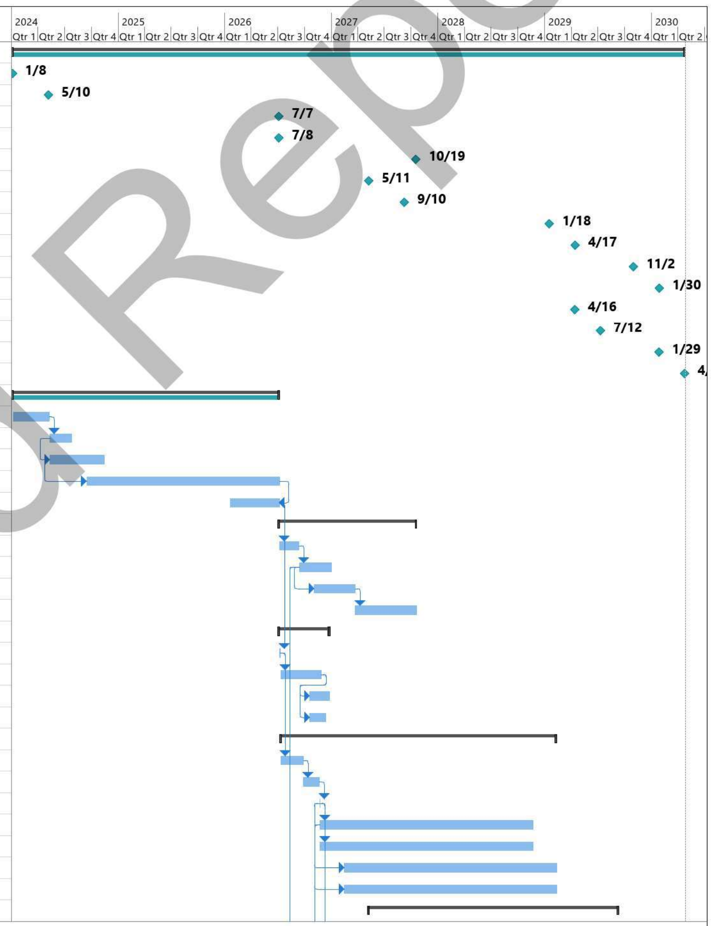


ID	Task Name	Duration	Start	Finish
37	GSU #1 Transformer Design / Manufacturing and Delivery on Site	390 days	Tue 3/27/29	Mon 9/23/30
38	**Detailed Engineering**	**760 days**	**Tue 11/24/26**	**Mon 10/22/29**
39	Detailed Engineering	250 days	Tue 11/7/28	Mon 10/22/29
40	Civil & Found. Works Contract Spec's/ Bid Process/ Award	120 days	Tue 11/24/26	Mon 5/10/27
41	Mech & Elec Installation Contract RFP/Bid Proces/Award	120 days	Tue 11/24/26	Mon 5/10/27
42	**Construction**	**470 days**	**Tue 5/11/27**	**Mon 2/26/29**
43	Site Grading / Roads / Drainage	120 days	Tue 5/11/27	Mon 10/25/27
44	Piling / Found. / Buildings	180 days	Tue 10/26/27	Mon 7/3/28
45	GTG #1 Installation Work Execution	183 days	Tue 5/9/28	Thu 1/18/29
46	Mechanical Completion Unit #1	0 days	Thu 1/18/29	Thu 1/18/29
47	As-Builts, Turnover, etc…	130 days	Tue 8/29/28	Mon 2/26/29
48	**Services To Site**	**260 days**	**Mon 9/14/26**	**Fri 9/10/27**
49	**Transmission Line / HV Connection**	**260 days**	**Mon 9/14/26**	**Fri 9/10/27**
50	Preliminary Studies/Specs/Negotiations	60 days	Mon 9/14/26	Fri 12/4/26
51	Permitting Process & Approval	230 days	Mon 10/26/26	Fri 9/10/27
52	**Water Supply**	**180 days**	**Mon 9/14/26**	**Fri 5/21/27**
53	Preliminary Studies/Specs/Negotiations	30 days	Mon 9/14/26	Fri 10/23/26
54	Permitting Process & Approval	180 days	Mon 9/14/26	Fri 5/21/27
55	**Comissioning & Testing**	**62 days**	**Fri 1/19/29**	**Mon 4/16/29**
56	Check Out/PreComm Unit #1	30 days	Fri 1/19/29	Thu 3/1/29
57	First Fire - Unit #1	1 day	Fri 3/2/29	Fri 3/2/29
58	Startup/Testing Including Performance Unit #1	30 days	Mon 3/5/29	Fri 4/13/29
59	Commercial Operation Unit #1	1 day	Mon 4/16/29	Mon 4/16/29

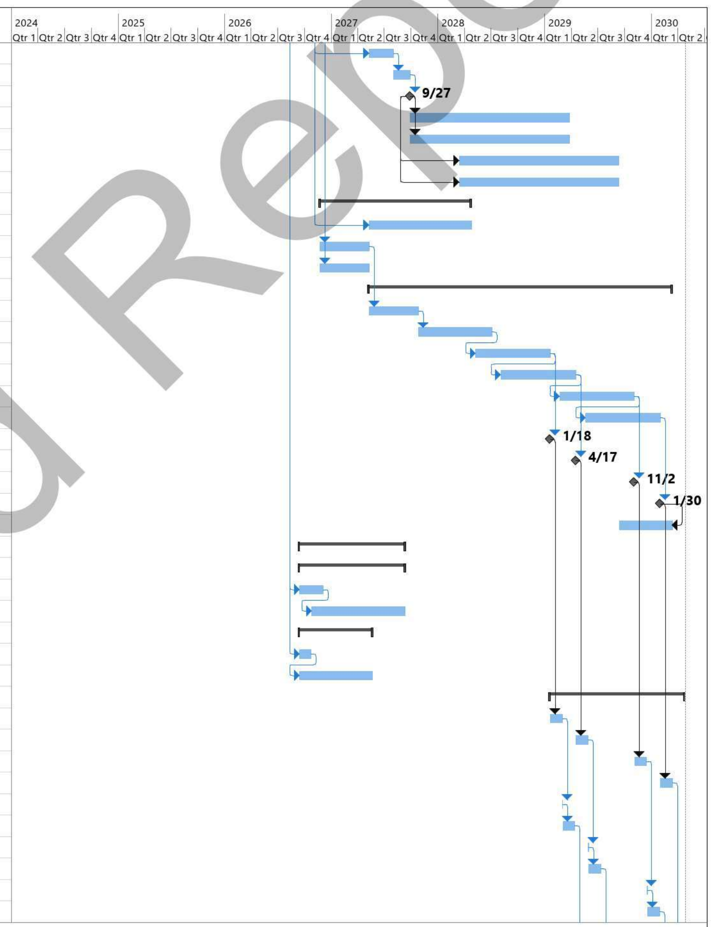


H.4 [redacted] Phase 3 (450MW) Schedule

ID	Task Name	Duration	Start	Finish
1	**Key Milestones**	**1645 days**	**Mon 1/8/24**	**Fri 4/26/30**
2	NLH Budgeting and Approval Start	0 days	Mon 1/8/24	Mon 1/8/24
3	NLH Budgeting and Approval Complete	0 days	Fri 5/10/24	Fri 5/10/24
4	EPCM Contract Award	0 days	Tue 7/7/26	Tue 7/7/26
5	Preliminary Engineering Start	0 days	Wed 7/8/26	Wed 7/8/26
6	Enviromental Approval	0 days	Tue 10/19/27	Tue 10/19/27
7	Start of Construction (Per Owner RFP)	0 days	Tue 5/11/27	Tue 5/11/27
8	Site Utility Services Available	0 days	Fri 9/10/27	Fri 9/10/27
9	Mechanical Completion Unit #1	0 days	Thu 1/18/29	Thu 1/18/29
10	Mechanical Completion Unit #2	0 days	Tue 4/17/29	Tue 4/17/29
11	Mechanical Completion Unit #3	0 days	Fri 11/2/29	Fri 11/2/29
12	Mechanical Completion Unit #4	0 days	Wed 1/30/30	Wed 1/30/30
13	Commercial Operation Unit #1	0 days	Mon 4/16/29	Mon 4/16/29
14	Commercial Operation Unit #2	0 days	Thu 7/12/29	Thu 7/12/29
15	Commercial Operation Unit #3	0 days	Tue 1/29/30	Tue 1/29/30
16	Commercial Operation Unit #4	0 days	Fri 4/26/30	Fri 4/26/30
17	**Project Development**	**652 days**	**Mon 1/8/24**	**Tue 7/7/26**
18	NLH Budgeting and Approval	90 days	Mon 1/8/24	Fri 5/10/24
19	Project Management - Risk, Strategy, Charter	54 days	Mon 5/13/24	Thu 7/25/24
20	FEED - Consultant Procurement, Design, Cost Estimate	133 days	Mon 5/13/24	Wed 11/13/24
21	NLH - PUB Report, Reviews, Package Prep	472 days	Mon 9/16/24	Tue 7/7/26
22	EPCM Contract Negotiations and Award	120 days	Wed 1/21/26	Tue 7/7/26
23	**Permitting / Approval Process**	**335 days**	**Wed 7/8/26**	**Tue 10/19/27**
24	Environmental Consultant Procurement	48 days	Wed 7/8/26	Fri 9/11/26
25	Emission/Noise modelling report	80 days	Mon 9/14/26	Fri 1/1/27
26	Enviromental Application Process	100 days	Wed 11/4/26	Tue 3/23/27
27	Enviromental Approval	150 days	Wed 3/24/27	Tue 10/19/27
28	**Preliminary Engineering**	**123 days**	**Wed 7/8/26**	**Fri 12/25/26**
29	Project Kick off meeting	3 days	Wed 7/8/26	Fri 7/10/26
30	Design Basis & Preliminary P&ID's Layout / SLDs	100 days	Mon 7/13/26	Fri 11/27/26
31	Preliminary Specs for Long Lead Equipment	50 days	Mon 10/19/2(	Fri 12/25/26
32	Prepare Cost Estimate	40 days	Mon 10/19/2(	Fri 12/11/26
33	**Gas Turbine Generator (GTG) Procurement**	**675 days**	**Mon 7/13/26**	**Fri 2/9/29**
34	Specifications and RFQ's	55 days	Mon 7/13/26	Fri 9/25/26
35	Bids, Evaluations & Clarifications	40 days	Mon 9/28/26	Fri 11/20/26
36	Supply Contract Award	1 day	Mon 11/23/2(	Mon 11/23/26
37	GTG #1 Design / Manufacturing and Delivery on Site	520 days	Tue 11/24/26	Mon 11/20/28
38	GTG #2 Design / Manufacturing and Delivery on Site	520 days	Tue 11/24/26	Mon 11/20/28
39	GTG #3 Design / Manufacturing and Delivery on Site	520 days	Mon 2/15/27	Fri 2/9/29
40	GTG #4 Design / Manufacturing and Delivery on Site	520 days	Mon 2/15/27	Fri 2/9/29
41	**GSU Transformers Procurement**	**610 days**	**Tue 5/11/27**	**Mon 9/10/29**



ID	Task Name	Duration	Start	Finish
42	Specifications and RFQ's	60 days	Tue 5/11/27	Mon 8/2/27
43	Bids, Evaluations & Clarifications	40 days	Tue 8/3/27	Mon 9/27/27
44	Contract Award	0 days	Mon 9/27/27	Mon 9/27/27
45	GSU #1 Transformer Design / Manufacturing and Delivery on Site	390 days	Tue 9/28/27	Mon 3/26/29
46	GSU #2 Transformer Design / Manufacturing and Delivery on Site	390 days	Tue 9/28/27	Mon 3/26/29
47	GSU #3 Transformer Design / Manufacturing and Delivery on Site	390 days	Tue 3/14/28	Mon 9/10/29
48	GSU #4 Transformer Design / Manufacturing and Delivery on Site	390 days	Tue 3/14/28	Mon 9/10/29
49	**Detailed Engineering**	**370 days**	**Tue 11/24/26**	**Mon 4/24/28**
50	Detailed Engineering	250 days	Tue 5/11/27	Mon 4/24/28
51	Civil & Found. Works Contract Spec's/ Bid Process/ Award	120 days	Tue 11/24/26	Mon 5/10/27
52	Mech & Elec Installation Contract RFP/Bid Proces/Award	120 days	Tue 11/24/26	Mon 5/10/27
53	**Construction**	**742 days**	**Tue 5/11/27**	**Wed 3/13/30**
54	Site Grading / Roads / Drainage	120 days	Tue 5/11/27	Mon 10/25/27
55	Piling / Found. / Buildings	180 days	Tue 10/26/27	Mon 7/3/28
56	GTG #1 Installation Work Execution	183 days	Tue 5/9/28	Thu 1/18/29
57	GTG #2 Installation Work Execution	183 days	Fri 8/4/28	Tue 4/17/29
58	GTG #3 Installation Work Execution	183 days	Wed 2/21/29	Fri 11/2/29
59	GTG #4 Installation Work Execution	183 days	Mon 5/21/29	Wed 1/30/30
60	Mechanical Completion Unit #1	0 days	Thu 1/18/29	Thu 1/18/29
61	Mechanical Completion Unit #2	0 days	Tue 4/17/29	Tue 4/17/29
62	Mechanical Completion Unit #3	0 days	Fri 11/2/29	Fri 11/2/29
63	Mechanical Completion Unit #4	0 days	Wed 1/30/30	Wed 1/30/30
64	As Builts, Turnover, etc...	130 days	Thu 9/13/29	Wed 3/13/30
65	**Services To Site**	**260 days**	**Mon 9/14/26**	**Fri 9/10/27**
66	**Transmission Line / HV Connection**	**260 days**	**Mon 9/14/26**	**Fri 9/10/27**
67	Preliminary Studies/Specs/Negotiations	60 days	Mon 9/14/26	Fri 12/4/26
68	Permitting Process & Approval	230 days	Mon 10/26/2	Fri 9/10/27
69	**Water Supply**	**180 days**	**Mon 9/14/26**	**Fri 5/21/27**
70	Preliminary Studies/Specs/Negotiations	30 days	Mon 9/14/26	Fri 10/23/26
71	Permitting Process & Approval	180 days	Mon 9/14/26	Fri 5/21/27
72	**Comissioning & Testing**	**331 days**	**Fri 1/19/29**	**Fri 4/26/30**
73	Check Out/PreComm Unit #1	30 days	Fri 1/19/29	Thu 3/1/29
74	Check Out/PreComm Unit #2	30 days	Wed 4/18/29	Tue 5/29/29
75	Check Out/PreComm Unit #3	30 days	Mon 11/5/29	Fri 12/14/29
76	Check Out/PreComm Unit #4	30 days	Thu 1/31/30	Wed 3/13/30
77	First Fire - Unit #1	1 day	Fri 3/2/29	Fri 3/2/29
78	Startup/Testing Including Performance Unit #1	30 days	Mon 3/5/29	Fri 4/13/29
79	First Fire - Unit #2	1 day	Wed 5/30/29	Wed 5/30/29
80	Startup/Testing Including Performance Unit #2	30 days	Thu 5/31/29	Wed 7/11/29
81	First Fire - Unit #3	1 day	Mon 12/17/2	Mon 12/17/29
82	Startup/Testing Including Performance Unit #3	30 days	Tue 12/18/29	Mon 1/28/30



ID	Task Name	Duration	Start	Finish
83	First Fire - Unit #4	1 day	Thu 3/14/30	Thu 3/14/30
84	Startup/Testing Including Performance Unit #4	30 days	Fri 3/15/30	Thu 4/25/30
85	Commercial Operation Unit #1	1 day	Mon 4/16/29	Mon 4/16/29
86	Commercial Operation Unit #2	1 day	Thu 7/12/29	Thu 7/12/29
87	Commercial Operation Unit #3	1 day	Tue 1/29/30	Tue 1/29/30
88	Commercial Operation Unit #4	1 day	Fri 4/26/30	Fri 4/26/30

Appendix I:
Equipment Lists

Appendix I1: [redacted] (300MW) Equipment List
Appendix I2: [redacted] (300MW) Equipment List

I.1 [redacted] (300MW) Equipment List

HATCH

Equipment List

Originator:	Date Submitted:	Project No.:	Revision:
Hatch	6/26/2023	H-370910	A
Client:	**Project Name:**		**Discipline:**
Newfoundland and Labrador Hydro	Concept Design Study	[redacted] (300 MW)	Thermal Power
Document Number:	**Hatch Responsible Project Manager:**		Ope Owolabi
H-370910-00000-200-216-001			
	Client Representative:		Ryan Cooper

WBS #	Description	Description of sub-components	Quantity	Duty % /Volume	Notes
Equipment List:					
10	**Gas Turbine Generator**	Gas Turbine Generator with Exhaust Door	6		
		Gas Turbine Fuel Module	6		
		Generator Breaker Enclosure			
		GT Electrical and Control Compartment	6		
		Exhaust Frame Blower	12		
		GT Coolling Water Module	6		
		Lube Oil Demister	6		
	Gas Turbine Firefighting Skid	Gas Turbine Firefighting Skid	3		
	Gas Turbine Wash Pakage	Gas Turbine Water Was Skid	3		
20	**Common Services Equipment and Systems**				
21	**Plant Water Systems (Common)**				
	Service Water System	Service Water Storage Tank	1	4000	volume required in m3 for 2 days storage
		Service Water Pumps	4		
		Strainers	4		
		Piping/Hoses	lot		
	2-Stage Reverse Osmosis(RO)	2 parallel trains		100	
		First Stage RO pumps	3	100	
		First Stage Membrane Units	3	100	
		Break Tank	1	100	
		Energy recovery devices	3	100	
		Caustic Soda Tote and Pump	2	100	
		Second Stage RO Pumps	3	100	
		Second Stage Membrane Units	3	100	
		RO Product Water Tank	1		
		RO Reject to CW Weir	lot		
		Piping Valves, etc.	lot		
		Clean-in-Place Skid (for membrane cleaning)	lot		
	DI Water	RO Product Water Pumps	3	100	
		Electrodeionization (EDI) Units	3	100	
		DI Water Tank	2	4000	volume required in m3 for 2 days storage
	Waste Water System	Wastewater Collection Sumps			
		Wastewater Collection Sump Pumps			
		Fuel Storage Sump			
		Fuel Storage Sump Pump			
		Dirty Water Sump			
		Dirty Water Sump Pump			
		Piping Systems			
		Oily Water Seperator			
		Waste Water Catch Basin			
		Sanitary Sewage System			
23	Compressed Air, Gas & Vacuum Systems				
	Plant Air & Instrument Air System	Air Compressors	6	100	Each sized for one unit
		Instrument Air Dryers	3	100	One per unit
		Service Air Receiver (per Unit)	3	100	Vertical
		Instrument Air Receiver (per Unit)	3	50	Vertical
		Piping & Valves	lot		
24	Lubricating Oil Storage/treatment	Oil Cleaning Unit (per Unit)	1		
25	Emergency Diesel Generators	Emergency Diesel Generators	1		
26	Fire Protection Systems	Water Storage (Fire Water Tank)	1	1000	volume required in m3 for 2 hours storage
		Main Pump - electric	1	100	
		Emergency/backup Pump -diesel	1	100	
		Jockey Pump - electric	1	Maintain pressure	
		Water Ring Main System	lot		
		Dry Deluge Spray System	lot		
		Valved Fire Water Connections	lot		
		Yard Hydrant & Hose Station	lot		
		Wet System Sprinklers	lot		
		Portable Dry Chemical Extinguishers	lot		
		CO_2 systems	lot		
30	**Fuel Supply and Storage**				
31	Diesel Handling & Storage (Common)	Diesel Storage Tanks	2		include tank size
		Fuel Metering	1		
		Interconnecting piping and piping to gas turbine	lot		
		Fuel Supply to Diesel Generator			
		Fuel forwarding Pumps	2		
		Oil separator	2		
		Fuel heaters			
		Fuel offloading pump	2		
32	Biofuel	Biofuel Storage Tank	2		
		Fuel Metering	1		
		Interconnecting piping and piping to gas turbine	lot		
		Fuel Pumps	2		
		Fuel offloading pump	2		
40	**Miscellaneous Equipment & Systems**				
41	Workshop Equipment and Tools		lot		
	Laboratory and Test Equipment		lot		
50	**Environmental (Emissions) Control Systems (per Unit)**				
	Continuous Emission Monitoring (Unit)	One system for each flue	1		
60	**Electrical Power Systems**				
61	240-kV Main Power Output System (per Unit)	Main 11/240-kV Power Transformer (TP at HV Terminals	6		
		Generator Isolated-phase Bus System	lot		
		Generator Circuit Breakers	6		
		Metering and Protection	lot		
		Grounding System	lot		
62	Auxiliary Power Supply system	11/4.16 kV Unit Auxiliary Transformer	6		
63	Unit/Station Power Supply system	4.16/0.6-kV Unit/Station Services Transformer	6		
		4.16 kV MV switchgear	lot		
		600 V switchgear	lot		
		600 V MCC's	lot		
64	Auxiliary AC Power Distribution (Common)	Emergency Diesel Generator	2		
65	UPS Supply and Distribution (per Unit)	110-V, 1 ph, 50 Hz Power Distribution	lot		
	DC Supply (Common)	125 VDC Supply and Distribution System	6		
66	Cabling Systems	Power, Control and Instrumentation	lot		
67	Building and Outdoor Electrical Services				
	Grounding grid	Will be tied into existing plant grid.	lot		
70	**Instrumentation and Control**				
71	Central Control System, incl. DCS		lot		
72	Power generation & Auxiliaries I&C		lot		
73	Common Sevices and equipment I&C		lot		

I.2 [redacted] (300MW) Equipment List

HATCH

Equipment List

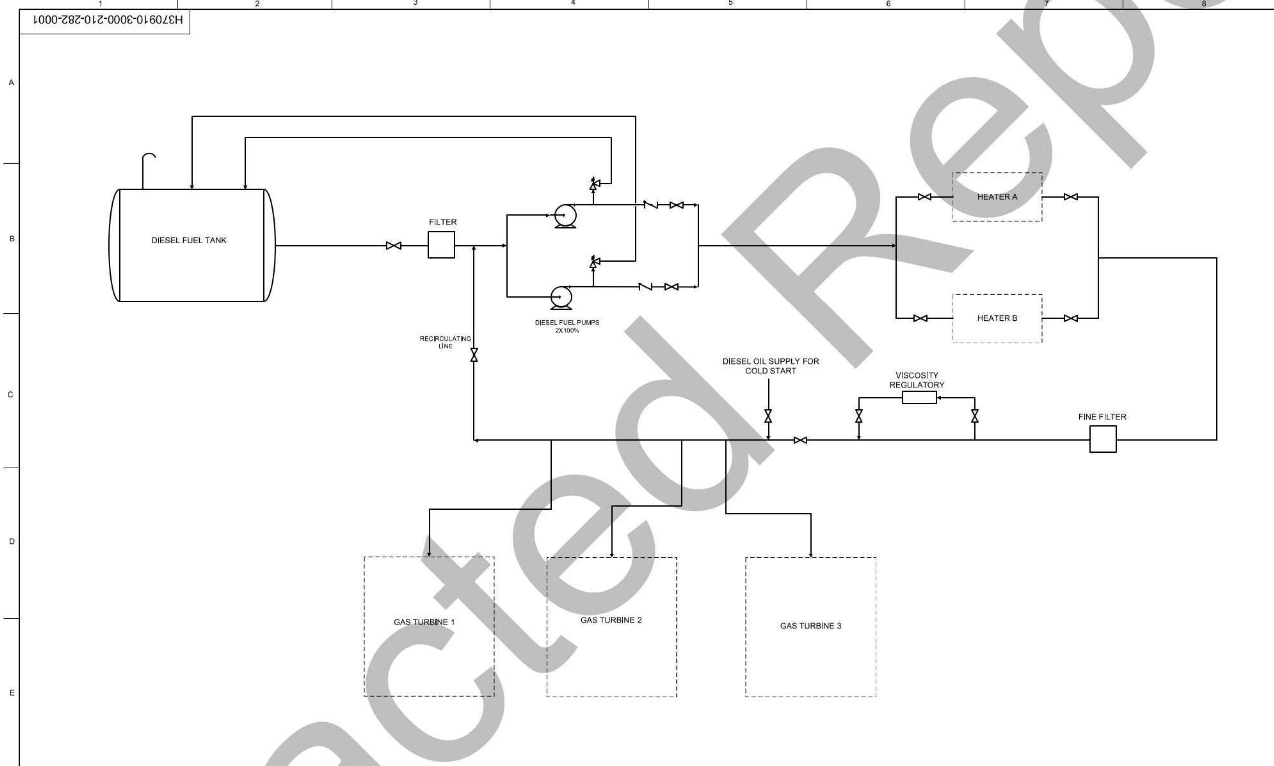
Originator:	Date Submitted:	Project No.:	Revision:
Hatch	6/26/2023	H-370910	A
Client:	**Project Name:**		**Discipline:**
Newfoundland and Labrador Hydro	Concept Design Study	[redacted](300MW)	Thermal Power
Document Number:	**Hatch Responsible Project Manager:**		Ope Owolabi
H-370910-00000-200-216-002			
	Client Representative:		Ryan Cooper

WBS #	Description	Description of sub-components	Quantity	Duty % /Volume	Notes
Equipment List:					
10	**Gas Turbine Generator**	Gas Turbine Generator with Exhaust Door	3		
		Gas Turbine Fuel Module	3		
		Generator Breaker Enclosure	3		
		GT Electrical and Control Compartment	3		
		Exhaust Frame Blower	6		
		GT Coolling Water Module	3		
		Lube Oil Demister	3		
	Gas Turbine Firefighting Skid	Gas Turbine Firefighting Skid	1		
	Gas Turbine Wash Pakage	Gas Turbine Water Was Skid	1		
20	**Common Services Equipment and Systems**				
21	**Plant Water Systems (Common)**				
	Service Water System	Service Water Storage Tank	1	4000	volume required in m3 for 2 days storage
		Service Water Pumps	2	100	
		Strainers	2	100	
		Piping/Hoses	lot		
	2-Stage Reverse Osmosis(RO)	2 parallel trains		100	
		First Stage RO pumps	2	100	
		First Stage Membrane Units	2	100	
		Break Tank	1	100	
		Energy recovery devices	2	100	
		Caustic Soda Tote and Pump	1	100	
		Second Stage RO Pumps	2	100	
		Second Stage Membrane Units	2	100	
		RO Product Water Tank	1	100	
		RO Reject to CW Weir	lot		
		Piping Valves, etc.	lot		
		Clean-in-Place Skid (for membrane cleaning)	lot		
	DI Water	RO Product Water Pumps	2	100	
		Electrodeionization (EDI) Units	2	100	
		DI Water Tank	2	4000	volume required in m3 for 2 days storage
	Waste Water System	Wastewater Collection Sumps			
		Wastewater Collection Sump Pumps			
		Fuel Storage Sump			
		Fuel Storage Sump Pump			
		Dirty Water Sump			
		Dirty Water Sump Pump			
		Piping Systems			
		Oily Water Seperator			
		Waste Water Catch Basin			
		Sanitary Sewage System			
23	Compressed Air, Gas & Vacuum Systems				
	Plant Air & Instrument Air System	Air Compressors	4	100	Each sized for one unit
		Instrument Air Dryers	2	100	one per unit
		Service Air Receiver (per Unit)	2	100	vertical
		Instrument Air Receiver (per Unit)	2	50	vertical
		Piping & Valves	lot		
24	Lubricating Oil Storage/treatment	Oil Cleaning Unit (per Unit)	1		
25	Emergency Diesel Generators	Emergency Diesel Generators	1		
26	Fire Protection Systems	Water Storage (Fire Water Tank)	1	1000	volume required in m3 for 2 days storage
		Main Pump - electric	1	100	
		Emergency/backup Pump -diesel	1	100	
		Jockey Pump - electric	1	maintain pressure	
		Water Ring Main System	Lot		
		Dry Deluge Spray System	Lot		
		Valved Fire Water Connections	Lot		
		Yard Hydrant & Hose Station	Lot		
		Wet System Sprinklers	Lot		
		Portable Dry Chemical Extinguishers	Lot		
		CO2 systems	Lot		
30	**Fuel Supply and Storage**				
31	Diesel Handling & Storage (Common)	Diesel Storage Tanks	2		
		Fuel Metering	1		
		Fuel heaters	1		
		Interconnecting piping and piping to gas turbine	lot		
		Fuel Supply to Diesel Generator		100	
		Fuel Forwarding Pumps	2	100	
		Oil separator	2	100	
		Fuel Offloading Pumps	2	100	
32	Biofuel	Biofuel Storage Tank	2	100	
		Fuel Metering	1	100	
		Interconnecting piping and piping to gas turbine	lot		
		Fuel Pumps	2	100	
		Fuel offloading Pumps	2	100	
40	**Miscellaneous Equipment & Systems**				
41	Workshop Equipment and Tools		lot		
	Laboratory and Test Equipment		lot		
50	**Environmental (Emissions) Control Systems (per Unit)**				
	Continuous Emission Monitoring (Unit)	One system for each flue	1		
60	**Electrical Power Systems**				
61	240-kV Main Power Output System (per Unit)	Main 11/240-kV Power Transformer (TP at HV	2		
		Generator Isolated-phase Bus System	lot		
		Generator Circuit Breakers	2		
		Metering and Protection	lot		
		Grounding System	lot		
62	Auxiliary Power Supply system	11/4.16 kV Unit Auxiliary Transformer	2		
63	Unit/Station Power Supply system	4.16/0.6-kV Unit/Station Services Transformer	6		
		4.16 kV MV switchgear	lot		
		600 V switchgear	lot		
		600 V MCC's	lot		
64	Auxiliary AC Power Distribution (Common)	Emergency Diesel Generator	2		
65	UPS Supply and Distribution (per Unit)	110-V, 1 ph, 50 Hz Power Distribution	lot		
	DC Supply (Common)	125 VDC Supply and Distribution System	2		
66	Cabling Systems	Power, Control and Instrumentation	lot		
67	Building and Outdoor Electrical Services				
	Grounding grid	Will be tied into existing plant grid.	lot		
70	**Instrumentation and Control**				
71	Central Control System, incl. DCS				
72	Power generation & Auxiliaries I&C				
73	Common Sevices and equipment I&C				

Appendix J:
Process Flow Diagrams

Appendix J1: Diesel Fuel PFD
Appendix J2: Biofuel PFD

J.1 Diesel Fuel PFD



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DESIGNER	F. OROJLOU	FO	21/06/2023
CHECKER	O. OWOLABI	OO	21/06/2023
DESIGN COORD.	O. OWOLABI	OO	21/06/2023
RESP. ENG.	G. COOPER	GC	21/06/2023
LEAD DISC. ENG.	G. COOPER	GC	21/06/2023
ENG. MANAGER	K.MEGHARI	KM	21/06/2023
PROJ. MANAGER	K.MEGHARI	KM	21/06/2023

DRAWING APPROVAL STATUS: FOR CLIENT REVIEW

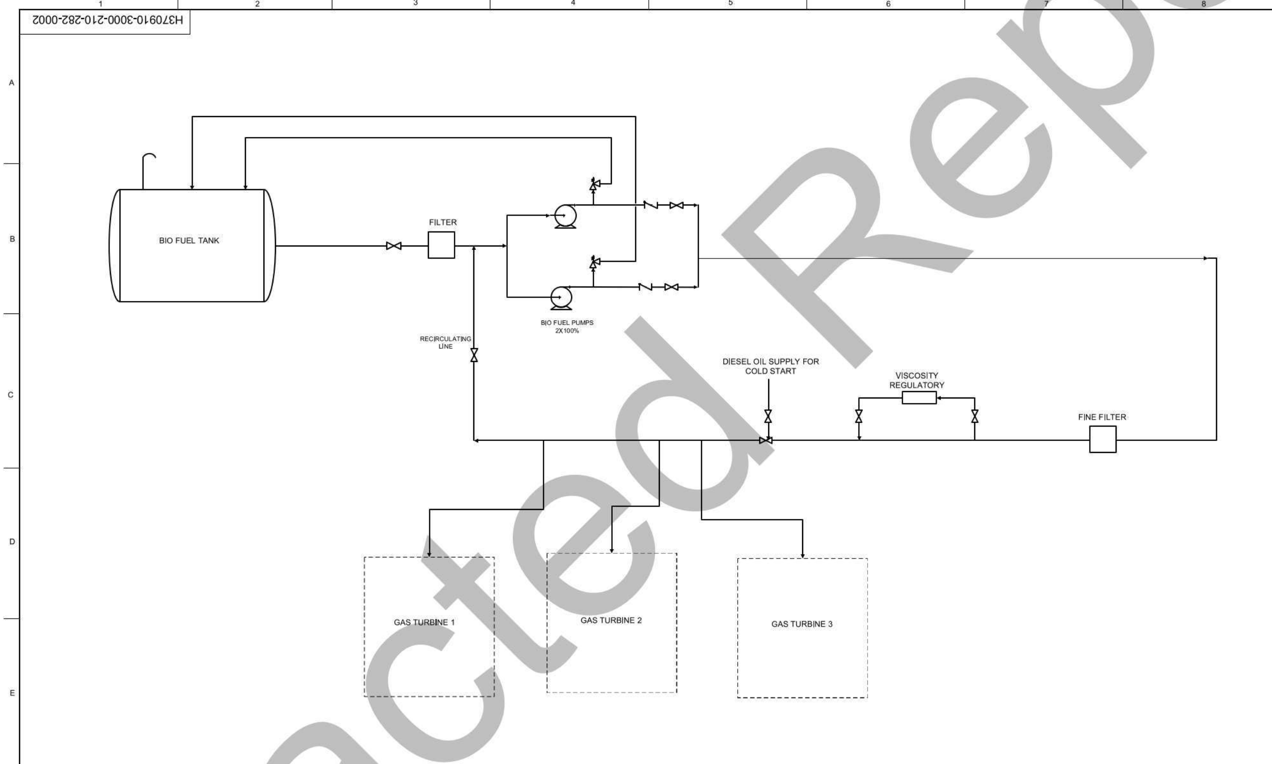
NEWFOUNDLAND AND LABRADOR HYDRO

CONCEPT DESIGN STUDY
PROCESS FLOW DIAGRAM
DIESEL FUEL

SCALE	DWG. No.	REV
NTS OR AS NOTED	H370910-3000-210-282-0001	A

SHEET SIZE: A3

J.2 Biofuel PFD



DRAWING No.	DRAWING TITLE
REFERENCE DRAWINGS	

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No.	DESCRIPTION	BY	CHK'D	DATE
A	CLIENT REVIEW	FO	OO	21/06/2023

REVISIONS

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CHECKER	O. OWOLABI	OO	21/06/2023
DESIGN COORD.	O. OWOLABI	OO	21/06/2023
RESP. ENG.	G. COOPER	GC	21/06/2023
LEAD DISC. ENG.	G. COOPER	04	21/06/2023
ENG. MANAGER	K.MEGHARI	KM	21/06/2023
PROJ. MANAGER	K.MEGHARI	KM	21/06/2023

DRAWING APPROVAL STATUS: FOR CLIENT REVIEW

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NEWFOUNDLAND AND LABRADOR HYDRO

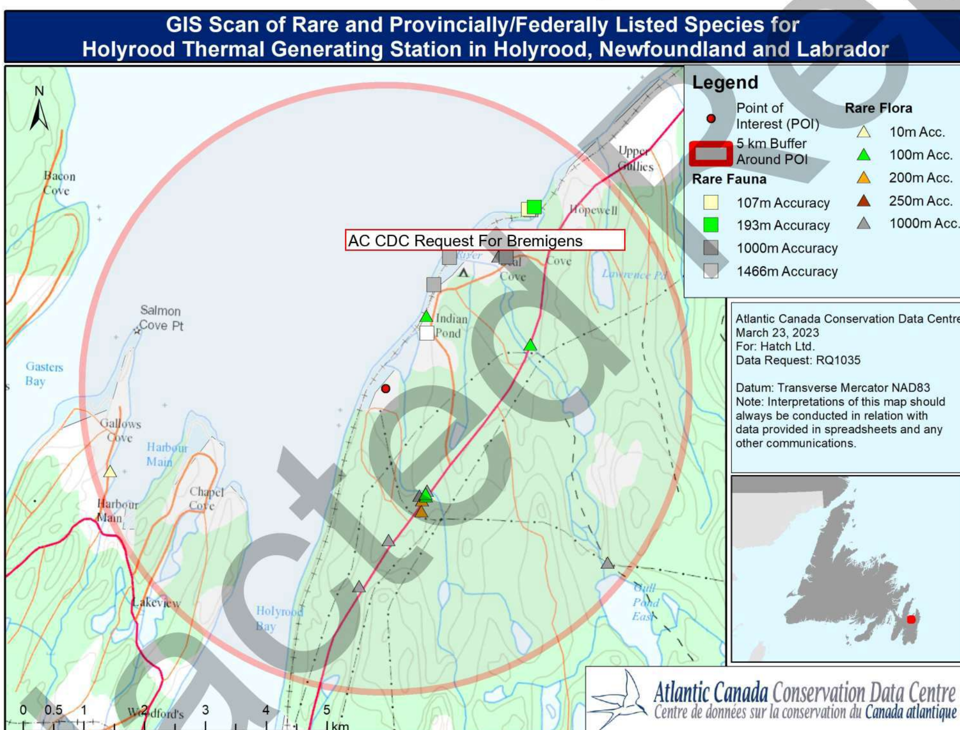
CONCEPT DESIGN STUDY
PROCESS FLOW DIAGRAM
BIO FUEL

SCALE NTS OR AS NOTED | DWG. No. H370910-3000-210-282-0002 | REV A

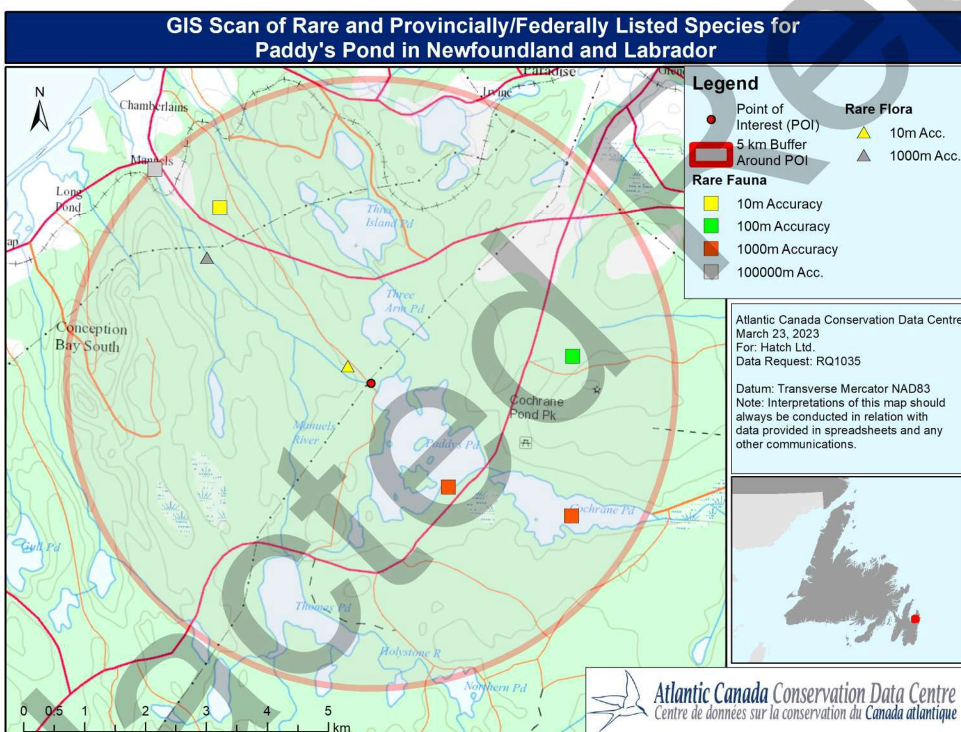
SHEET SIZE: A3

Appendix K:
Site Evaluation and Characterization Workshop

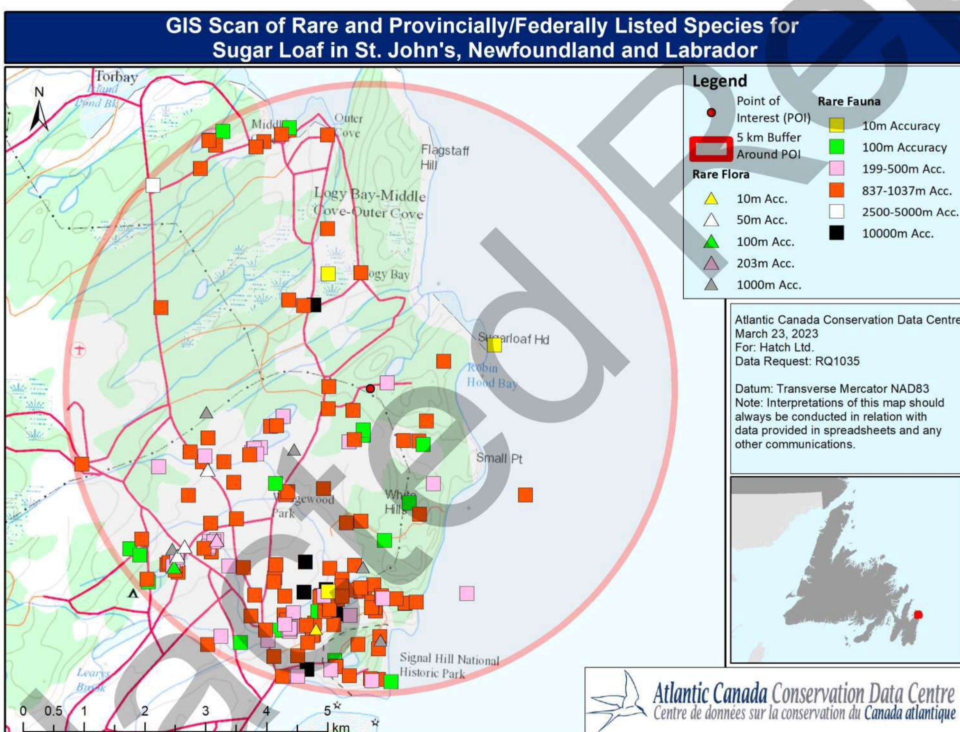
AC CDC Request for Holyrood Pond



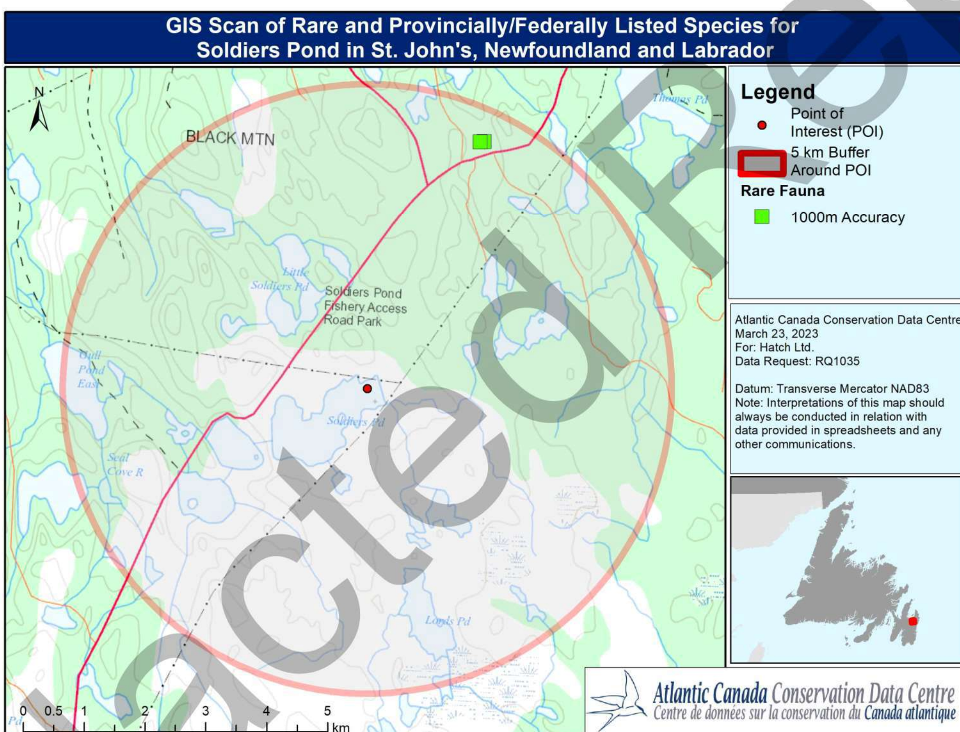
AC CDC Request for Paddy's Pond



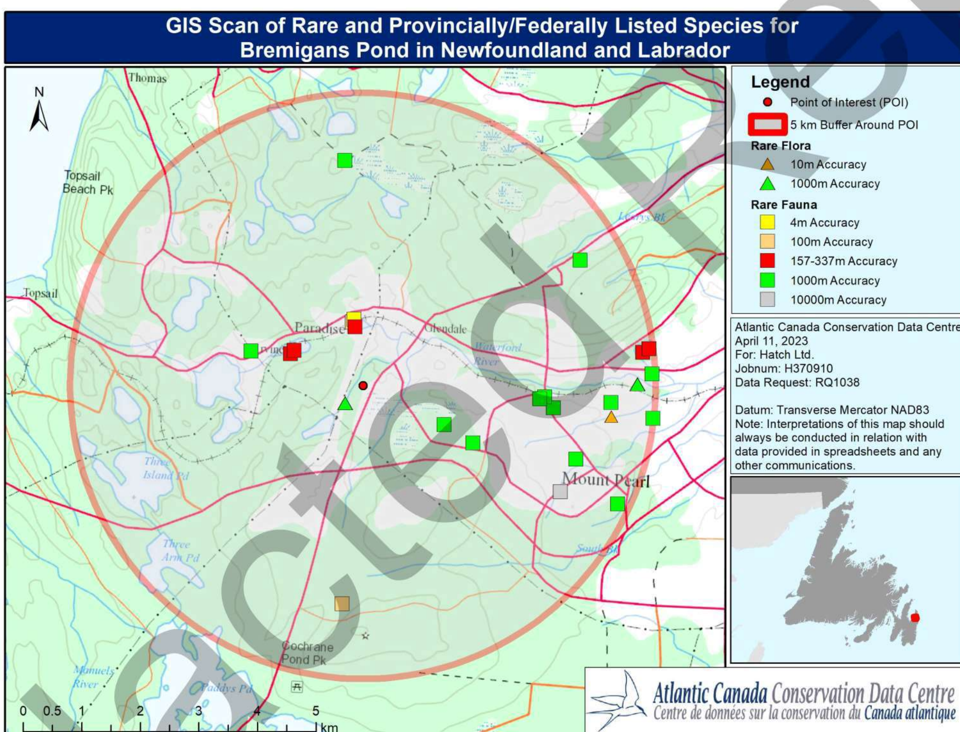
AC CDC Request for Sugar Loaf



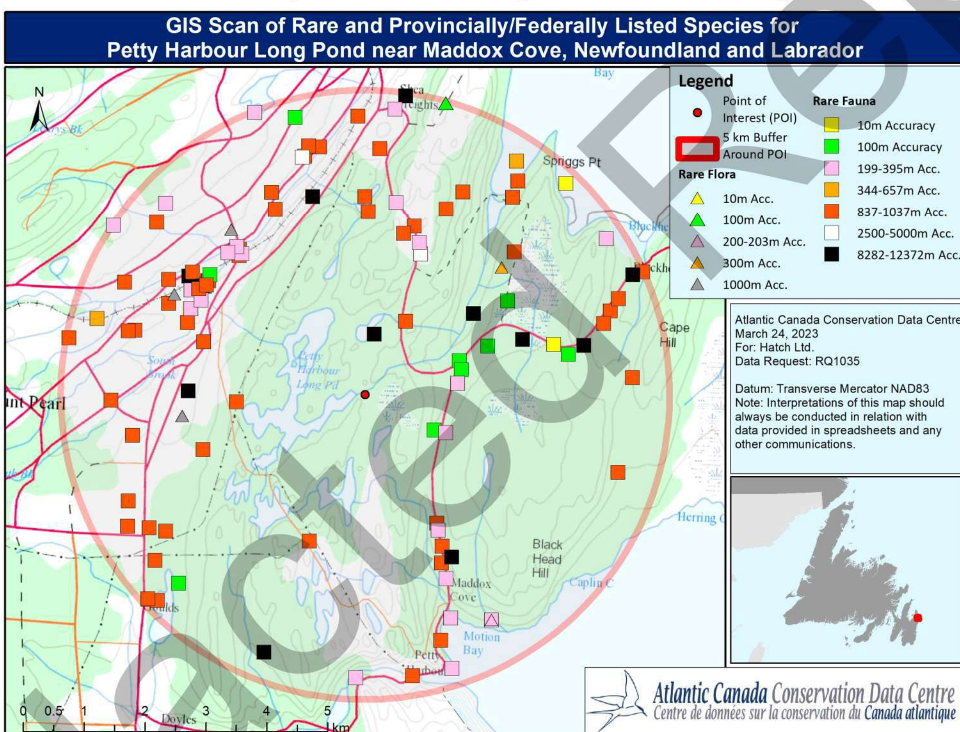
AC CDC Request for Soldiers Pond



AC CDC Request for Bremigens Pond



AC CDC Request for Petty Harbour Long Pond



Numerical Value of Criteria Ranking Breakdown

Category		Criteria	Weight per Criterion	Options						Scoring					
			(%)	Option A - HTGS	Option B - Paddys Pond	Option C - Sugar Loaf	Option D - Soldiers Pond East	Option E - Bremigens Pond	Option F - Petty Harbour Long Pond	Option A - HTGS	Option B - Paddys Pond	Option C - Sugar Loaf	Option D - Soldiers Pond East	Option E - Bremigens Pond	Option F - Petty Harbour Long Pond
Technical and Operational	1	**Land Suitability/Space**	10.0%	4	4	1	3	1	1	10%	10%	3%	8%	3%	3%
	2	**Switchyard Requirements and Proximity to 230kV Line**	10.0%	3	3	1	3	3	0	8%	8%	3%	8%	8%	0%
	3	**Proximity to Soldiers Pond**	5.0%	2	3	1	4	2	1	3%	4%	1%	5%	3%	1%
	4	**Fuel Type**	2.0%	2	2	2	2	2	2	1%	1%	1%	1%	1%	1%
	5	**Fuel Storage**	5.0%	3	2	2	2	2	2	4%	3%	3%	3%	3%	3%
	6	**Fuel Supply and Delivery**	10.0%	4	2	2	3	2	2	10%	5%	5%	8%	5%	5%
	7	**Technical Availability of Water**	5.0%	4	2	3	2	3	2	5%	3%	4%	3%	4%	3%
Environment and Social	8	Protected Areas	4.0%	3	4	3	3	4	4	3%	4%	3%	3%	4%	4%
	9	Rare flora and Fauna	4.0%	4	2	2	4	1	0	4%	2%	2%	4%	1%	0%
	10	Flood Zone Watershed	4.0%	4	4	4	4	1	4	4%	4%	4%	4%	1%	4%
	11	Wetlands Potentiallty Affected	4.0%	4	2	2	2	2	2	4%	2%	2%	2%	2%	2%
	12	Quality of Life (Noise, aesthetics)	4.0%	3	2	2	2	2	2	3%	2%	2%	2%	2%	2%
	13	Recreational conflicts	4.0%	3	1	3	3	2	2	3%	1%	3%	3%	2%	2%
	14	PublicSafety/Risk	4.0%	3	3	2	4	1	3	3%	3%	2%	4%	1%	3%
	15	Archaeological Potential	4.0%	4	3	2	3	3	3	4%	3%	2%	3%	3%	3%
Delays and Obstacles	19	Water Use and Water Rights	5.0%	4	1	2	1	2	0	5%	1%	3%	1%	3%	0%
	21	Land Use Zoning and Jurisdiction	8.0%	4	2	3	3	2	1	8%	4%	6%	6%	4%	2%
	22	Permitting, Delays and other obstacles	8.0%	3	2	2	2	2	2	6%	4%	4%	4%	4%	4%
		Grand total (out of 100):	**100%**							**87%**	**63%**	**51%**	**70%**	**51%**	**41%**

Site Selection Criteria Characterizations

Selection criteria - Multi-criteria analysis			Option A - Holyrood Thermal Generating Station	Option B - Paddys Pond	Option C - Sugar Loaf	Option D - Soldiers Pond East	Option E - Bremigens Pond	Option F - Petty Harbour Long Pond
Technical and Operational Criteria	Land Suitability and Space (elevation/topo)	Land Suitability and Space (150 MW (approximate area= 200mX130m)	Adequate Space for 450 MW ↑	Adequate Space for 450 MW ↑	Inadequate Space for 300 - 450 MW, contours, at approx. 13% slopes. Cut and fill requirements would be high ♦	Site Alternate Option (D)(3) Alternate location is 1 km NE of Soldiers Pond Substation, adeqaute space for 450 MW, some access road upgrades needed. ●	Inadequate Space for 300 - 450 MW (Unless multiple property aquisitons) ♦	Locational is at a significant distance from existing road access. It also has grading constraints as well as potential water crossing to contend with for access. ♦
	Transmission	New Transmission or Switch yard	New Terminal Station (Next to existing). 2 underground 230 kV cables brought to exisiting. Existing 230 kV tied to the new station ●	Paddy's Pond Close to Transmission line ●	7.8 KM and transmission line built through residential (through pippy park) ♦	On line ●	On line ●	>10 km new 230 needed ■
	Proximty to SOP	SOP	10.5 km ●	9 km ●	30 km ♦	within 1 km ↑.	14 km ●	21 km ♦
	Fuel Supply and Delivery	Fuel Type	Diesel ●	Diesel ●	Diesel ●	Diesel ●	Diesel ●	Diesel ●
		Storage	Potential to Refurbish Tanks 1-4, Exisiting Light Fuel Storage for 123 MW CT. New Tanks to be constructed ●	Build New ●	Build New ●	Build New ●	Build New ●	Build New ●
		Supply and Delivery	Marine terminal. 5 days for commercial tanker to deliver, 5 days storage onsite, can increase number of vessels ↑	Road Transport (100+: B-Trains Per Day for a 450 MW) ●	Road Transport (100+: B-Trains Per Day for a 450 MW) ●	Potential fuel pipeline approximatley 10 km in length, extending from HTGS jetty to Proposed Site Configuration TCH Access Available ●	Road Transport (100+: B-Trains Per Day for a 450 MW) ●	Road Transport (100+: B-Trains Per Day for a 450 MW) ●
	Tech. Water	Technical Water Availability	Intake in place at Quarry Creek , with ample Raw Water ↑	New Intake to be constructed. Permit to Alter a body of water No water line/City Infrasructure in place ●	Could be supplied by City infrasture or New Intake to be constructed ●	New Intake to be constructed, Permit to Alter a body of water would be required ●	Could be supplied by City infrasture or New Intake to be constructed ●	New Intake to be constructed, Permit to Alter a body of water would be required ●
Biophysical Environment	Biological environment	Protected areas	Within a 5km radius there is Butter Pot Provincial Park's Area of Interest ●	There are no protected areas within 5km of Paddy's Pond ↑	Within a 5km radius there is Signal Hill National Historic Site and Pippy Park ●	Within a 5km radius there is Butter Pot Provincial Park and its Area of Interest ●	There are no protected areas within 5km of Bremigan's Pond ↑	There are no protected areas within 5km of Option F ↑
		Uniqueness (fauna and flora with status)	Option A has 17 rare plant records, none with special status in Newfoundland, 1 that is considered globally rare. There are 11 rare animal records, 4 of which are species with special status in Newfoundland ↑	Option B has 3 rare plant records, none with special status in Newfoundland. There are 6 rare animal records, 3 of which are species with special status in Newfoundland ●	Option C has 13 rare plant records, none with special status in Newfoundland, 1 that is considered globally rare. There are 11 rare animal records, 4 of which are species with special status in Newfoundland ●	Option D has 0 rare plant records and 2 rare animal records found. These 2 rare animal records include 1 species with a special status in Newfoundland ↑	Option E has 6 rare plant records, none with special status in Newfoundland. There are 40 rare animal records, 22 of which are for species with special status in Newfoundland ♦	Option F has 7 rare plant records, none with special status in Newfoundland or are considered rare globally. There are 104 rare animal records found which include multiple species that are listed under COSEWIC and under the provincial Endangered Species Act. This makes this site not ideal for the proposed project ■
		Areas of natural constraints (e.g. flood risk areas, landslides)	~2.5km from a flood risk area ↑	~3.25km from a flood risk area ↑	~0.9km, ~1.5km and ~1.6km from a flood risk area. Elevated topo, limited flood risk ↑	No flood risk areas within a 5km radius ↑	Within a flood risk zone ♦	~3.5km and ~4.7km from a flood risk area ↑
		Wetlands (marshes, swamp, bog)	Brownfield - No new wetlands affected by development ●	Within a 2km radius of swamp, marsh, bog, and fen habitat ●	Within a 2km radius of swamp, marsh, bog, and fen habitat ●	Within a 2km radius of swamp, marsh, bog, and fen habitat ●	Within a 2km radius of swamp, marsh, bog, and fen habitat ●	Within a 2km radius of swamp, marsh, bog, and fen habitat ●
Social and Heritage	Quality of life (noise emission, and visual. Proximity to the built environment)	Impacts on residents' quality of life (Proximity to the built/human environment)	The existing thermal generator means that residents will not likely be affected by changing noise emissions, or aesthetics changes to the area. Extension of life for the area, may detract from future enjoyment. ●	Unlikely that the noise will carry to the residential lots (to be assessed), visual aesthetics potentially affected for recreational users ●	Unlikely that the noise will carry to the residential lots (to be assessed), some perceived issues with development (aesthetics) ●	Unlikely that the noise will carry to the residential lots (to be assessed), some perceived issues with development (aesthetics - Camp Morris Town (Scouts) within 1.6 km) ●	Unlikely that the noise will carry to the residential lots (to be assessed) , some perceived issues with development (aesthetics) ●	Unlikely that the noise will carry to the residential lots (to be assessed), some perceived issues with development (aesthetics) ●
	Recreational conflict	Recreational uses and public safety	Public Access is restricted, however Newfoundland T'Railway traverses through portion of the Site. Recreational boating in Indian Pond, however no current conflicts due to duration the plant has been in operation ●	Float Plane Base. Cochrane Pond Camp ground within 500m-1000m. Boat launch available and recreational fishing location. Persumed transmission line is used by ATVs and snowmobiles ♦	Location is within 500m - 1000m of the East Coast Trail (popular hiking and tourist attraction) ●	Limited public access infrastructure and limited recreational opportunites, 1.6 km from Scouts Camp (Camp Morristown) ●	Limited public access infrastructure and limited recreational opportunites, close proximity to church and to florist ●	Location is within 500m - 1000m of the East Coast Trail (popular hiking and tourist attraction). Perception that this is more prestine ●
	Public safety	Risks and consequences of accidents	Option A affects less residential/publicly used land. The actual and perceived risk of accidents should be low in terms of public safety (less density) ●	Option B affects less residential/publicly used land. The actual and perceived risk of accidents should be low in terms of public safety (less density) Float Plane Base may require consideration ●	Option B affects less residential/publicly used land, increased traffic near residential. Adjacent properties and business ●	Option D Little to no public access or residential density ↑	Option E is closer to more residential/publicly used land so the actual and perceived risk of accidents increases with a higher population density ♦	Option F affects less residential/publicly used land, so the risk of accidents is likely to be lower ●

Selection criteria - Multi-criteria analysis			Option A - Holyrood Thermal Generating Station	Option B - Paddys Pond	Option C - Sugar Loaf	Option D - Soldiers Pond East	Option E - Bremigens Pond	Option F - Petty Harbour Long Pond
	Archaeological potential	lands claimed by First Nations in the area. Archaeological sites	No known presence of indigenous lands. Archaeological impact assessment likely not required as the Thermal Generating Station development is Brownfield ↑	No known presence of indigenous lands. Archaeological impact assessment required. 2 archaeological sites confirmed within 5 km of Option B ●	No known presence of indigenous lands. Archaeological impact assessment required. 39 archaeological sites confirmed within 5 km of Option C ●	No known presence of indigenous lands. Archaeological impact assessment required. 1 archaeological site confirmed within 5 km of Option D ●	No known presence of indigenous lands. Archaeological impact assessment required. 1 archaeological site confirmed within 5 km of Option E ●	No known presence of indigenous lands. Not assessed for archaeological impact as the site will not be used due to other excluding factors ●
Regulatory and Legal	Water	Water Use and Water Rights	WUL 21-11600 is valid and in place for Quarry Brook, valid from 01-Jan-21 to 01-Jan-26. Maximum Annual Withdrawal not to exceed 450,000 m3 (1,233 m3/d). Town of Holyrood jurisdiction. ↑	WUL 10-030 in place for NF Power Inc., valid through to 2035. Copy unavailable online, but assumed non-exclsuive rights are in place to generate from watershed, that includes Paddy's Pond. Unclear of permissable abstraction volume. Emailed WRMB, however copy was not provided. S (17) Water Resources Act could be invoked. Construction of Intake will require a Permit to Alter a body of water. City of St. John's jurisdiction. ♦	Sugar Loaf Pond feeds the MUN Ocean Sciences Centre - Logy Bay Research Facility Water Supply Dam. However, there is no WUL apparently tied to this dam. City of St. John's jurisdiction. ●	WUL 22-12349 is valid and in place for Non-exclsuive rights to NF Power for Hydrogeneration (Seal Cove). Max Annual for Seal Cove Hydro = 120,000,000m3 (328,767 m3/d). WUL 19-10843 is valid and in place for Labrador Island Link Ltd Partnership (LCP). Max annual withdrawal 100 m3 (0.27m3/d) for fire fighting purposes. Provincial Jurisdiction. ♦	Government of NL owns a water impoundment/dam at Bremigans Pond. "St. John's Region Water Control Structure". Head waters of Waterford River. Town of Paradise jurisdiction. ●	Protected Water Supply (City of St. John's) ■
	Zoning	Land Use Zoning and Jurisdiction (City's master plan for land use)	Site designated as Industrial. The existing HTGS likely means that stakeholder concerns will be minimal ↑	Site designated as agricultural. The combustion turbine development is likely to be perceived by surrounding stakeholders as a threat to the agricultural/forestry vocation of the sector ●	Site designated as industrial commercial with some residential areas within a 2km radius. ●	Site designated as Crown Reserve (9.E.22), adjacent to Nalcor Lands. Resource Development: Forestry: Discretionary General Industry ●	Site designated as Open Space with some residential areas within a 2km radius. The development of the combustion turbine may be perceived by surrounding residents as a threat to the residential zoning ●	Site designated as watershed/rural. The development of the combustion turbine may be perceived as a threat to the health of the watershed due to its proximity to residential land use just past the 2km radius ♦
	Permitting and delays	Permitting, Delays and other obstacles	Fewer permits required because it's a brownfield. Obstacles is the Decommissioning requirements (construction interface and complexity of the site). 150 MW Provincial EA >200 MW requies a Federal Impact Assessment, See Physical Activites Regulation (Section 30 and 31), however could be incrementally upsized, to avoid threshold for Federal IAA trigger. ●	May require more permits due to Aerodrome (float plane base) tree clearing permits, and proximity to a Trans Canada Highway. 150 MW Provincial EA >200 MW Federal Impact Assessment ●	Fewer permits may be required due to industrial land use designation, tree clearning likely not required, although Greenfield. 150 MW Provincial EA >200 MW Federal Impact Assessment ●	May require several permits due to Greenfield, but outside of City Jurisdiction. 150 MW Provincial EA >200 MW Federal Impact Assessment ●	May require more permits due to Greenfield. 150 MW Provincial EA >200 MW Federal Impact Assessment ●	May require more permits due to tree clearing permits, and due to Greenfield. 150 MW Provincial EA >200 MW Federal Impact Assessment ●

Appendix L:
Gas Turbine Performance Data

L.1 [redacted] Diesel Performance Data

OMITTED IN REDACTED REPORT

L.2 [redacted] Natural Gas Performance Data

OMITTED IN REDACTED REPORT

L.3 [redacted] Hydrogen Performance Data

OMITTED IN REDACTED REPORT

L.4 [redacted] Biodiesel Performance Data

OMITTED IN REDACTED REPORT

L.5 [redacted] Diesel Performance Data

OMITTED IN REDACTED REPORT

L.6 [redacted] Natural Gas Performance Data

OMITTED IN REDACTED REPORT

L.7 [redacted] Hydrogen Performance Data

OMITTED IN REDACTED REPORT

Appendix M: [redacted] Inspection Types and Intervals

OMITTED IN REDACTED REPORT