Attachment 1

150 MW Combustion Turbine Plant FEED Study

Hatch Ltd.

Newfoundland and Labrador Hydro
Newfoundland and Labrador, Canada

FEED Report

For

Newfoundland and Labrador Hydro
150 MW Combustion Turbine Plant FEED Study

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Newfoundland and Labrador Hydro
150 MW Combustion Turbine Plant FEED Study

FEED Report

[redacted]

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Date	**Rev.**	**Status**	**Prepared By**	**Checked By**	**Approved By**

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Executive Summary

Introduction

Newfoundland and Labrador Hydro (NLH) has identified the need for additional generation capacity to meet the province's growing electrical demand. The solutions must provide cost-conscious, reliable service, and include provisions for increasing its generation capacity in the future. Multiple power generation alternatives were considered by NLH and the feasibility of various options were assessed. It was also concluded that the Holyrood Thermal Generating Station (HTGS) was not capable of fulfilling the needs of the province long-term.

Upon review of potential solutions, NLH has chosen to progress with the Front-End Engineering Design (FEED) for a 150 MW combustion turbine power plant located at the HTGS site and forms the basis for this report.

Design Basis

The design basis established by NLH was utilized to execute the FEED study. The NLH requirements for the design include:

- The power plant nominal capacity shall be 150 MW and shall be designed to allow for the expansion to 300 MW in the future.
- The power plant is to be used for backup generation and to provide peaking power.
- The plant shall operate primarily on No. 2 diesel fuel. Considerations shall be made to alternate the fuel type in the future.
- Combustion turbines must be a proven technology, capable of fast start, and the ability to operate as a synchronous condenser.

Combustion Turbine Technology Selection

A technical specification was developed and issued to original equipment manufacturers (OEM) for budgetary and firm pricing. The specification outlined the need for a packaged combustion turbine-generator system with a nominal plant capacity of 150 MW that meets all project requirements.

Budgetary proposals were received from [redacted] per technical definition established by Hatch. Through the completion of a technology comparison, vendor proposals were analyzed and evaluated based on unit reliability, output capacity, fast startup, and redundancy as the main selection criteria. As a result, the [redacted] was concluded to be the most suitable for NLH's application and circumstances. In addition to meeting the main selection criteria, [redacted]

Plant Design

The FEED report summarizes all work done throughout the study. This includes work from all disciplines, including mechanical/process, piping, electrical, I&C, civil, structural, and environmental. All deliverables are in line with the Contractor Document Register, and the deliverable document numbers are referenced and listed in Appendix A. The completion of the design allowed for a Class 3 CAPEX cost estimate with an accuracy of -22.5% to +24.8% to be developed.

Mechanical/Process

The mechanical/process work included preliminary design for the fuel system, demineralized water system, service water system, fire water system, wastewater system, domestic water and sewer, instrument air system, and glycol heating and cooling systems. Completion of the design involved system modeling and design calculations to achieve preliminary sizing of equipment. Equipment specifications and data sheets were prepared. OEMs and vendors were contacted to receive budgetary quotes on the main mechanical equipment.

Piping

Piping design was based upon the services and flowrates provided on the PFDs. Pipelines were sized based on velocity and acceptable pressure drop. Piping tie-ins were established after review of existing drawings and conducting a site visit. P&IDs were developed in coordination with mechanical and instrumentation teams. The pipeline layout was based on the overall site plan and combustion turbine building GA drawings. Each pipeline was assigned a unique piping line number and compiled in a piping line list and MTO. The MTO for piping included all pipe, fittings, valves, speciality items, pipe supports and necessary allowances.

Electrical

The electrical work includes preliminary design of the generating plant, switchyard and transmission line TL218 modifications. Single line diagrams were developed with the electrical equipment required for the generating plant and switchyard. Preliminary design was completed for the combustion turbine and auxiliaries. This included selection of the exciter, automatic voltage regulator, synchronization systems, and UPS and battery systems. Redundancy was included in the station service supply using 2 x 2 MW black start diesel generators and a supply from NLH's 138 kV B8 bus. Switchyard sections and layouts were developed for electrical equipment including protection and control requirements for the 230 kV and 138 kV sections. Modifications to transmission line TL218 includes termination into the new switchyard, with an extension to tie into the existing Holyrood Terminal station, as well as the replacement of wood pole structures 2 to 13 with steel structures to meet the requirement for overhead shield wire. Additionally, design includes re-routing of NF Power lines 38L and 39L around the project site footprint (work to be completed by NF Power).

Instrumentation and Controls

The I&C work included a conceptual design of the overall control system architecture for the CTG and all BOP systems for the new 150 MW Power Plant. Instrument, I/O and cable lists were developed using the P&IDs and site layouts developed as part of the FEED. A preliminary functional description was also developed as a guideline for the BOP control system.

Civil

The civil preliminary design and 3 model for the site development and drainage was initially based on open-source LiDAR (existing ground) data and the recommendation from the Geotechnical Investigation. Topographical survey data was later used to confirm material quantities, that were produced from the model. Removal of unsuitable material, such as root mat and organics were reflected in the siteworks design, subsequently, the remaining 'other material' within the site footprint was considered during the determination of final site grades. Efforts were made to create a balanced site, in terms of earthworks, while still ensuring proper site drainage, and a functional site layout / grading design in coordination with the proposed building and infrastructure required on site. In general, stormwater runoff is conveyed overland, utilizing grading slopes and is directed towards ditching. The site ditching daylights at a natural water course / ditch and ties into the existing pre-condition conveyance. Cut-off ditching is proposed along the south and west sides of the site to redirect the stormwater from upstream and connect to the original downstream outlet, north of the site. This rerouting protects the site from excess stormwater, erosion and mitigation of upsizing underground proposed stormwater infrastructure that is required on site. Underground infrastructure, such as culverts, are placed at access roads that connect the site to Thermal Road. There are two site access points along Thermal Road.

Structural

The structural requirements for the project were based on the mechanical system and equipment general arrangements and included preliminary engineering for the powerhouse, generator foundations, tank foundations, pipe racks and cable tray supports, fuel unloading pad, substation foundations and other buildings on site. Structural sizing for steel framing and foundations were based on either preliminary calculation or historical sizes for similar structures/projects, adjusted for difference in site-specific loading and bearing capacities. Loads used for analysis were based on environmental loading for Holyrood, NL obtained from Environment Canada and preliminary loading for the combustion turbine generator provided by GE. Sizing of building and equipment foundations were based on bearing capacities provided in the initial geotechnical investigation report.

Environmental

The environmental work included a social and environmental review of the HTGS property to inform design criteria via identifying various attributes of the site. The capacity for Quarry Brook to provide sufficient service water, firewater, domestic water, and power generation was also evaluated and assessed to determine the ability of continued water use at the existing Holyrood facilities, as well as for the proposed development. An initial Community Noise Impact Assessment was completed, outlining assumed and expected noise levels and constraints to inform potential required updates to the NLH Noise Management Plan. Confirmatory noise assessments and acoustic modeling should be considered for future implementation.

Plant Layout and Model

A three-dimensional CAD model of the 150 MW simple cycle plant was prepared, with input from Civil Engineering, Structural Engineering, Mechanical Engineering, Piping Engineering, and Electrical Engineering. The model details the combustion turbine, the main mechanical and electrical systems, and the associated piping, structural, and civil components. General arrangement drawings from vendors and OEMs were used to develop the power plant layout and the 3D model. From the completed model, the plot plan and various deliverables were created.

Project Schedule

A Level 3 project schedule was prepared for the completion of the 150 MW combustion turbine power plant, subject to assumptions on NLH plans for engaging an EPCM provider. Equipment delivery periods in the project schedule are based on the delivery times quoted by the vendors and OEMs and the Hatch in-house database for similar projects. The construction and installation periods were generated from the in-house database taking into account the site location, access to site, and availability of experienced local contractors and skilled trade's personnel. The project timeline is expected to be highly dependent on OEM lead times for the combustion turbine/generator package. Projected completion date of the project was identified as November 2029, subject to quantified risk assessment. Key milestones were identified and are listed in the table below.

Table 1: Key Milestones

Avalon Combustion Turbine Project - HRD	
Key Milestones	**Complete**
EPCM contract award	[redacted]
NF Power 38L Relocated	
PUB Approval	
Environmental Approval	
NF Power 39L Relocated	
Combustion Turbine Generator Package contract award	
Start of Construction	
Engineering Substantially Complete	
Construction Complete	
Start of Stage 4 Commissioning	
Commercial Operation Date (COD)	

Cost Estimate

A Class 3 Cost Estimate was developed to an accuracy of -22.8% to +25.7% for [redacted] confidence interval. Inputs from all disciplines throughout the FEED study were used to populate the estimate. The developed MTOs and budget quotations received for major equipment provided the main components of the direct costs calculation. Installation and labour costs are also factored into the direct costs. The indirect costs include the engineering, procurement, construction management (EPCM) and pre-commissioning costs for the project. Contingency added in the capital cost estimate allows for expected variations in the cost and/or quantity for labour, material and equipment, for the given scope of work and for the economic climate existing at the time the estimate was made. A summary of the cost estimate is presented in the table below.

Table 2: Cost Estimate

Description	Cost
Direct Costs	[redacted]
Indirect Costs	
Contingency	
Owner's Costs	
TOTAL COST:	

1. Introduction

1.1 General

Newfoundland and Labrador Hydro (NLH) have identified the need for additional generation capacity to meet the province's growing electrical demand. The solution must provide cost-conscious, reliable service, and include provisions for increasing its generation capacity in the future. It was concluded that the Holyrood Thermal Generating Station (HTGS) was not capable of fulfilling the needs of the province long-term. Multiple power generation alternatives were considered by NLH and the feasibility of the options assessed.

In a 2023 report, Hatch completed the conceptual engineering for a combustion turbine power plant with three output options, 150 MW, 300 MW, and 450 MW. A fuel assessment was completed along with a site identification study, environmental assessment, project schedule, Class 5 cost estimate, and final recommendation.

NLH has chosen to progress with the Front-End Engineering Design (FEED) for a 150 MW combustion turbine power plant. The 150 MW combustion turbine is to be located at the HTGS site. The power plant civil works will be designed with the capability of expanding to 300 MW in the future. The combustion turbine generators (CTG) will operate primarily on light fuel oil (No. 2 Distillate Diesel Fuel) but shall be convertible or retrofittable to operate on natural gas, hydrogen/natural gas blends, and/or biofuels.

Table 1-1: Abbreviations and Acronyms

Abbreviation	Description
AACE	Association for the Advancement of Cost Engineering
AVR	Automatic Voltage Regulation
BACT	Best Available Control Technology
BOP	Balance of Plant
CAD	Computer-Aided Design
CanSIS	Canadian Soil Information Service
CAPEX	Capital Expenditure
COD	Commercial Operation Date
CT	Combustion Turbine
CTG	Combustion Turbine Generator
DCS	Distributed Control System
EA	Environmental Assessment
EDI	Electrodeionization
EPC	Engineering Procurement and Construction
EPCM	Engineering Procurement and Construction Management
FEED	Front-End Engineering Design
GA	General Arrangement
GE	General Electric
GSU	Generator Step Up
GT	Gas Turbine
HDPE	High-Density Polyethylene
HSS	Hollow Structural Section

Abbreviation	Description
HTGS	Holyrood Thermal Generating Station
HV	High Voltage
I&C	Instrumentation and Controls
I/O	Inputs/Outputs
kV	Kilovolts
LiDAR	Light Detection and Ranging
LO	Lube Oil
LV	Low Voltage
MCC	Motor Control Center
MHI	Mitsubishi Heavy Industries
MTO	Material Take Offs
MV	Medium Voltage
MVA	Megavolt Ampere
MW	Megawatts
NDE	Non-Destructive Evaluation
NLH	Newfoundland and Labrador Hydro
NOx	Nitrogen Oxides
O&M	Operations and Maintenance
OEM	Original Equipment Manufacturer
P&ID	Piping & Instrumentation Diagram
PC	Personal Computer
PVC	Polyvinyl Chloride
PEP	Project Execution Plan
PFD	Process Flow Diagram
QGIS	Quantum Geographic Information Software
QRA	Quantitative Risk Assessment
RO	Reverse Osmosis
SCS	Soil Conservation Service
SLD	Single Line Diagram
[redacted]	
SWMM	Storm Water Management Model
TEWAC	Total Enclosed Water-Air Cooled
V	Volts
VDR	Vendor Data Requirement

1.2 Site Description

The HTGS is located near the community of Holyrood, in Conception Bay. It is approximately 10 km away from the municipality of Conception Bay South, and approximately 32 km away from the city of St. John’s. The site is situated in an industrial planning zone, as per the Land Use Zoning Map in the Holyrood Development Regulations, with the nearest residential area 0.58 km away. The approximate coordinates of the generating station are 47.27074 N, 53.54160 W.

The climatic conditions for the site applied in the FEED are provided in the table below.

Table 1-2: Climatic Conditions

	Temperature (°C)	Relative Humidity (%)	Wet Bulb Temperature (°C)
Average	5.42	83.17	4.181
High	21	83	18.99
Low	-8	82	-8.613
ISO	15	60	10.83

Notes:
Summer (June-August) & Winter (December-February) conditions were calculated using the monthly average lows and highs.

The site is an average elevation of 15 m above sea level.

1.3 Project Objectives

This report details the FEED for a 150 MW simple cycle power plant. The work done in this phase will facilitate the detailed design phase of the project. Objectives of the FEED study include development of a design to generate a Class 3 CAPEX Estimate and a Level 3 Execution Schedule. In addition, Hatch completed a constructability review, a project execution plan, a contracting strategy, a risk review and a quantitative risk assessment.

1.4 Report Overview

This FEED report summarizes the preliminary design and deliverables generated for the 150 MW simple cycle power plant. These include the following:

- Design Basis
- CT Technology Comparison
- Best Available Control Technology (BACT)
- Discipline Preliminary Engineering Design (Process, Mechanical, Piping, Electrical, I&C, Civil, Structural, and Environmental)
- Overall Plant Layout and Model
- Class 3 CAPEX Estimate
- Level 3 Execution Schedule
- Constructability Review
- Risk Review.

Front End Execution Planning (FEEP) deliverables were also generated and are presented separately. These include:

- Contracting Strategy Report
- Project Execution Plan.

2. Design Basis

Based on the project requirements outlined by NLH, a design basis was established. The FEED study was executed based on the following project requirements:

- The power plant nominal capacity shall be 150 MW and shall be designed to allow for the expansion to 300 MW in the future (civil design only).
- The power plant is to be used for backup generation and to provide peaking power.
- The plant shall operate primarily on No. 2 diesel fuel. Considerations shall be made to alternate the fuel type to biofuels, natural gas and natural gas/hydrogen blend fuels in the future.
- Each combustion turbine engine package at the plant shall be approximately 50 MW.
- Combustion turbines must be a proven technology, capable of fast start, and have the ability to operate as a synchronous condenser.

Refer to Appendix A, Item-1 for additional detail, including discipline specific assumptions and design bases. A list of the systems included in the FEED study and the scope for each discipline is outlined in the following sections.

2.1 Mechanical/Process

Mechanical systems required to support the operation of the combustion turbine were identified. The systems listed below were considered in the scope of the project:

- Combustion turbine generator packages
- Fuel unloading, storage and distribution
- Glycol system for inlet heating and combustion turbine generator cooling
- Emissions control technology
- Utilities, including:
  - Service (raw and fire) water supply and distribution
  - Demineralized water production and distribution
  - Wastewater system
  - Compressed air system
  - Domestic water supply and sanitary sewer.

2.2 Piping

Piping design was performed for the following systems during the FEED study:

- Fuel System:

   - Fuel Pump House
   - Fuel Unloading from Trucks
   - Fuel Offloading from Jetty
   - Fuel Storage
   - Fuel Distribution.
- Demineralized water system:
   - Demineralized water storage
   - Demineralized water distribution.
- Service (raw) water system:
   - Raw water storage
   - Raw water distribution.
- Fire water distribution
- Instrument and service air distribution.

2.3 Electrical, Instrumentation and Controls

The following Electrical, Instrumentation and Controls work were included in the FEED study.

- Electrical interconnection and terminal station/transmission line
- High Voltage (HV) Switchgear and Power Distribution
- Medium Voltage (MV) and Low Voltage (LV) and Power Distribution
- Motor Control Centers (MCCs) and grouping of loads
- Auxiliary power
- UPS and Battery Systems
- Configuration and sizing of the generator step up (GSU) and auxiliary transformers
- Black start capabilities utilizing 2 x 2MW Diesel generators
- Control system/Distributed Controlled System (DCS) and networking
- Field instrumentation.

2.4 Civil

The following civil engineering work was included in the FEED study:

- General site layout and coordination with all project disciplines.

- Preliminary site grading, including but not limited to:
  - Access Roads
  - Site Pads
  - Ditching
  - Transitional sloping
  - Provision for Future Buildings / Equipment.
- Preliminary drainage analysis and calculations for the site pads, including preliminary sizing of ditching, culverts and underground storm sewer infrastructure.
- Road layout (horizontal and vertical alignment).
  - Site Access
  - Parking
  - Maintenance Roads
  - Jetty Pipeline Access Road
  - Fuel Delivery Road.
- Potential construction laydown areas were provided between the edge of the site access road and the existing Thermal Road. A well graded pad was provided after the removal of the organics as per the Geotechnical Investigation recommendations. These areas can also house temporary facilities as required.
- Fuel storage containment preliminary sizing and berm design and liner selection.
- Preliminary 3D Open Road Civil model for site layout.
- Civil Quantities for earthworks and other associated civil work for site development including security fencing.

2.5 Structural

The following structures and foundations were included in the FEED study.

- Power Plant Building and Foundations
- Combustion Turbine Generator Foundations
- Raw Water Pumphouse and Foundations
- Fuel Storage Tank Foundations
- Water Storage Tank Foundations
- Terminal Station Gantry, Equipment Supports and Foundations

- Terminal Station Building and Foundations
- Fuel Unloading Building and Foundations
- Pipe Racks and Pipe Supports
- Cable Tray Supports.

2.6 Environmental

A social and environmental review of the HTGS property, and more specifically the greenfield portion, was performed as part of the FEED study, to inform design criteria via identifying various attributes of the site, including but not limited to:

- Commercial and recreational use of the area
- Existing land-use and zoning
- Wetlands potentially affected
- Indigenous rights and land use
- Potential for archaeological resources
- Flora and fauna
- Potential for Species at Risk
- Proximity to protected areas
- Required Regulatory Authorizations and Approvals.

Capacity for Quarry Brook to provide sufficient service water, firewater, domestic water, and power generation was also evaluated and assessed to determine the ability of continued water use at the existing Holyrood facilities, as well as for the proposed development. Refer to Appendix A, Item-17 for additional detail.

3. Combustion Turbine Technology Selection

3.1 General

Hatch Ltd. (Hatch) performed a technology review of available combustion turbine technologies. The goal was to support selection of an Original Equipment Manufacturer (OEM) to supply a Combustion Turbine (CT) engine package to meet the NLH plant requirements.

A technical specification was prepared outlining the need for a packaged combustion turbine-generator system with a total nominal plant capacity of 150 MW. The specification was issued to OEMs for budgetary pricing, equipment general arrangement drawings, performance data and experience on associated fuels, and estimated delivery time.

Technical and budgetary proposals were received from [redacted]. The proposals were reviewed, and a recommendation was made for the most suitable technology for a 150 MW nominal plant capacity. The technologies offered by each vendor are outlined below.

[redacted]

3.2 Combustion Turbine Selection Criteria

The criteria used to select the combustion turbine technology included the following:

- OEM Operating Experience
- Net/Gross Power Output
- Heat Rate
- Synchronous Condenser Capabilities
- Dual Fuel Capabilities – Natural Gas, Diesel, Biofuels, and Hydrogen
- Maintenance Schedule and Strategy Options
- Operation and Maintenance (O&M) Costs
- Nitrogen Oxides (NOx) Emissions
- Layout
- Procurement and Delivery Schedule
- Redundancy
- Aeroderivative or industrial frame engine packages

- Capability of fast start generation up to rated load in not more than ten minutes
- Fuel flexibility that could allow NLH to adapt to Canada's Clean Electricity Regulations. CTGs will initially run on diesel fuel with options to transition to either renewable diesel, natural gas, or natural gas/hydrogen blend fuels, as these fuel sources become more readily available
- Best available control technology (BACT) for emission control
- Power augmentation packages (if required to satisfy required nominal output capacity requirements).

3.3 Technology Recommendation

Through a CT technology comparison, OEM proposals were analyzed and evaluated based on unit reliability, output capacity, fast startup, and redundancy as some of the main selection criteria. A brief summary of the technical proposals and their compliance with the project requirements is presented in the following paragraphs. Refer to Appendix A, Item-3 for more details on the combustion turbine technology comparison.

[redacted]

[redacted]

[redacted]

As a result, the [redacted] combustion turbine was identified to be the most suitable for NLH's application and circumstances. In addition to meeting the main selection criteria, [redacted]

4. Plant Design

4.1 Mechanical and Process

The following deliverables were performed for the mechanical design.

- Process Flow Diagrams (PFDs)
- PFD Basis and Assumptions
- Heat and Mass Balance & GT Pro Model
- Fuel and Water Tank Sizing Calculations
- Equipment specifications, including datasheet, scope of work, index and Vendor Data Requirement (VDR).
  - Combustion Turbine
  - Demin Water Plant
  - Tanks.
- Mechanical Equipment List
- Fuel Unloading Options Memorandum
- Combustion Turbine Technology Comparison.

4.1.1 Combustion Turbine and Auxiliaries

Hatch prepared a specification for the combustion turbine which outlined the criteria described in Section 3.2. The specification, along with the datasheet, the Scope of Work, the index and the VDR, were sent to vendors for budgetary and firm quotes. Refer to Appendix A, Item-2 for more details on the combustion turbine specification.

A combustion turbine technology comparison was performed to support combustion turbine technology selection for the purposes of FEED, and to confirm which offerings met the criteria described in Section 3.2. [redacted] Refer to Appendix A, Item-3 for more details on the combustion turbine technology comparison.

[redacted]

[redacted]

4.1.2 Fuel System

The fuel system consists of diesel fuel unloading and distribution pumps (2x100%), fuel filters, fuel heaters (2x100%), fuel storage tanks (2x100%) and Black Start Fuel Day Tank (1x100%).

Hatch performed preliminary modeling to estimate the fuel flow rates required to run the CTs and vendor data was used to validate these flow rates. Refer to Appendix A, Item-8 for additional details about the flow rates, the GT pro model and the heat and mass balance. Hatch also performed preliminary fuel tank sizing calculations to determine the fuel tank volume and dimensions, assuming a storage duration of 5 days, with 100% redundancy (total storage duration of 10 days). Refer to Appendix A, Item-9 for more details on the tank sizing calculations. The tank volume and dimensions were then added to a specification for the diesel fuel tank. The specification, along with the datasheet, the Scope of Work, the index and the VDR were sent to vendors for budgetary quotes. Refer to Appendix A, Item-12 for the tank specification document details.

A process flow diagram was prepared for the fuel system as well as the basis and assumptions used to determine the flow rates. Refer to Appendix A, Item-10 and Item-11 for a list of PFD document numbers and the PFD basis.

4.1.2.1 Fuel Unloading

Hatch prepared a fuel unloading options memorandum, which explored truck delivery and marine offloading, utilizing the existing jetty. Potential suppliers for delivery of fuel to this location were also identified in the fuel unloading memo. Contractual conditions need to be discussed further in the future phases of the project. Refer to Appendix A, Item-13 for more details.

4.1.3 Demineralized Water System

The demineralized water system consists of a demineralization water package including filtration, a reverse osmosis (RO) system with electrodeionization (EDI), demineralized water pumps (2x100%) and demineralized water tanks (2x50%). The demineralized water is used for the wash skid, NOx abatement, SPRINT system, and auxiliary cooling water makeup. Demineralized water may also be used to supply the potable water system.

Hatch performed preliminary GT pro modeling to estimate the demineralized water flow rates required for NOx and [redacted], and vendor data was used to validate these flows. Hatch also performed preliminary demineralized water tank sizing calculations to determine the demineralized water tank volume and dimensions. The tank volume and dimensions were then added to a specification for the demineralized water tank, assuming a storage duration of 24 hours. The specification, along with the datasheet, the Scope of Work, the index and the VDR, were sent to vendors for budgetary quotes. Refer to Appendix A, Item-12 for more details on the tank specification.

Hatch prepared a specification for the demineralized water package along with the datasheet, the Scope of Work, the index and the VDR. These documents were sent to vendors for budgetary quotes. Refer to Appendix A, Item-4 for more details on the demineralized water plant specification.

A process flow diagram was prepared for the demineralized water system as well as the basis and assumptions used to determine the flow rates. Refer to Appendix A, Item-10 and Item-11 for a list of PFD document numbers and the PFD basis.

4.1.4 Service Water System

The service water system consists of service water supply pumps (2x100%), service water distribution pumps (2x100%), and a service water tank. Hatch also performed preliminary service water tank sizing calculations to determine the tank volume and dimensions assuming a storage duration of 4 hours. A common service water and fire water tank was assumed.

A process flow diagram was prepared for the service water system as well as the basis and assumptions used to determine the flow rates. Refer to Appendix A, Item-10 and Item-11 for a list of PFD document numbers and the PFD basis.

4.1.5 Wastewater System

The wastewater system consists of oily water separators for the powerplant building and the tank farm, wastewater pumps (2x100%), stormwater discharge and a wastewater discharge.

Combustion Turbine Building sanitary drains will collect in a buried septic holding tank located outside the building. The FEED design includes provision for tie into the existing sewer network and sewage treatment plant. Further analysis of available system capacity is required in the next phase.

A process flow diagram was prepared for the wastewater system as well as the basis and assumptions used to determine the flow rates. Refer to Appendix A, Item-10 and Item-11 for a list of PFD document numbers and the PFD basis.

4.1.6 Fire Water System

The fire water system will tie into the existing firewater system at the Holyrood site. The service water tank was also sized to provide an extra reserve of fire water to be used as a secondary source. Hatch performed preliminary service water tank sizing calculations to determine the tank volume and dimensions, assuming a storage duration of 2 hours. The tank volume and dimensions were then added to a specification for the service/fire water tank. The specification, along with the datasheet, the Scope of Work, the index and the VDR, were sent to vendors for budgetary quotes. Refer to Appendix A, Item-12 for more details on the tank specification.

A process flow diagram was prepared for the fire water system as well as the basis and assumptions used to determine the flow rates. Refer to Appendix A, Item-10 and Item-11 for a list of PFD document numbers and the PFD basis.

4.1.7 Instrument Air System

The instrument air system consists of air compressors (2x100%), air dryers (2x100%) and air receiver tanks (2x100%).

A process flow diagram was prepared for the instrument air system as well as the basis and assumptions used to determine the flow rates. Refer to Appendix A, Item-10 and Item-11 for a list of PFD document numbers and the PFD basis.

4.1.8 Glycol System

The glycol system consists of a glycol expansion tank, glycol pumps (2x100%), fin fan coolers, and electric glycol heaters which feed the [redacted]. The CT package includes an anti-icing system, the TEWAC (totally enclosed water air cooling) system and the Lube Oil (LO) system.

4.1.8.1 Inlet Air Heating

The [redacted] includes an anti-icing system, which prevents the air inlet from freezing. Heated glycol is supplied to the anti-icing system when operating at temperatures lower than 4.4°C. Preliminary calculations were performed to determine the electric heater duty required to heat the glycol prior to being sent to the anti-icing system, which was calculated to be 5.3 MW for all [redacted] combustion turbine anti-icing systems.

4.1.8.2 *Generator Cooling*

The [redacted] includes a TEWAC system, which is used to cool the generator. The [redacted] quote indicated that 990 kW of heat rejection is required for generator cooling. The generator will be cooled by a closed glycol loop, which will be circulated through a fin fan cooler to remove the heat collected from the generator. Preliminary calculations were performed to estimate the size of the fin fan cooler based on the heat rejection requirement provided by GE.

4.1.8.3 *Lube Oil Cooling*

The [redacted] includes a plate and frame LO cooler which is used to cool both the generator lube oil and the turbine lube oil. The [redacted] quote indicated that a total heat rejection of 964 kW is required for both lube oil systems. The lube oil will be cooled by a closed glycol loop, which will be circulated through a fin fan cooler to remove the heat collected by the LO cooler. Preliminary calculations were performed to estimate the size of the fin fan cooler based on the requirement [redacted]. One common fin fan cooler and closed loop glycol system was assumed for both the generator and lube oil cooling.

4.2 Piping

The following deliverables were performed for the piping design.

- Piping & Instrumentation Diagrams (P&IDs)
- Piping Design Criteria
- Piping Line Class Index
- Line Sizing Calculation and Hydraulic Calculations
- Piping Line List
- Piping Valve List
- Conceptual General Arrangements for Piping Tie-Ins
- Piping Material take Off (MTO).

4.2.1 *Piping & Instrumentation Diagrams*

P&IDs were prepared for most systems listed in Section 0. The fuel system includes P&IDs for the fuel pumphouse, fuel storage, and fuel distribution. The demineralized water system includes P&IDs for demineralized water storage and demineralized water distribution. The service water system includes P&IDs for service water storage and service water distribution. P&IDs were also prepared for the fire water system, and the instrument and service air system. Refer to Appendix A, Item-14 for a list of P&ID document numbers.

4.2.2 *Piping Design Criteria and Pipe Class Index*

A piping design criteria document was generated to establish a set of design codes, guidelines and standards to produce safe, efficient and reliable piping systems. Refer to

Appendix A, Item-21 for more details on the piping design criteria. The Pipe Class Index provided the typical piping materials and design conditions to be used for each piping service. Piping materials include carbon steel, stainless steel, Polyvinyl Chloride (PVC) and High-density polyethylene (HDPE). Material selection will be similar to the previously installed 120 MW facility at the Holyrood site. Refer to Appendix A, Item-25 for more details on the pipe class index.

4.2.3 Line Sizing & Hydraulic Calculations

Line sizing was based upon recommended fluid velocities and acceptable pipeline friction loss. Each piping line number was checked for an acceptable velocity range. Flowrates and fluid properties were provided in project PFDs. Hydraulic calculations were performed for more critical streams using flow modelling software. These streams include fuel oil offloading from vessel, raw water from Quarry brook, fuel unloading from trucks, fuel distribution to turbines, and fire water supply. Elevations for calculation input was determined by existing site conditions and new civil design for the CT building. Overall pipeline lengths were determined from site plans and layouts. Refer to Appendix A, Item-23 for a list of hydraulic calculation document numbers.

4.2.4 Piping Lists – Piping Line List and Manual Valve List

A piping line list and a manual valve list were produced from P&IDs. Each pipeline and valve were given a unique number and tracked in a list. The piping line list provides all characteristics of each line including material, diameter, pressure, temperature, design code, Non-Destructive Evaluation (NDE), testing, cleaning, heat trace, insulation and painting. The valve list provides a total quantity of each valve type and its associated line number and P&ID. Refer to Appendix A, Item-33 for more details on the piping lists.

4.2.5 Conceptual Arrangements for Piping Tie-Ins

Conceptual tie-in drawings were provided for Fuel at Jetty, Raw Water at Quarry Brook and Fire Water Main. Each tie-in location was observed during a site visit. All available previous drawings from the Holyrood site were reviewed and considered during development of tie-in locations. Refer to Appendix A, Item-27 for more details on the piping tie-ins.

4.2.6 Piping MTO

A piping MTO was generated which provides the total quantities of piping for each line number. This was based on modelled piping, site plan layouts, conceptual designs and allowances. This MTO includes all pipe, fittings, pipe supports, valves, specialty items, insulation, bolt up and vendor package integration. A complexity factor is applied to each pipeline based on the number of welds and fittings. This complexity factor assists with determining unit rates in the cost estimate. Refer to Appendix A, Item-31 for a list of MTOs prepared for different disciplines.

4.3 Electrical

The following deliverables were developed as part of the electrical design.

- Single Line Diagrams (SLDs)
- Switchyard Section Drawings
- Terminal Station Layout
- Generating Plant Electrical Room Layout
- Electrical Cable List
- Electrical Load List
- Electrical MTO
- 13.8 kV Switchgear Datasheet.

4.3.1 Single Line Diagrams

SLDs were prepared for the overall plant operation, Protection and Controls, Combustion Turbine A, B and C 600 V unit auxiliary board, and Combustion Turbine A, B and C balance of plant 600 V auxiliary station board.

4.3.2 Generating Plant

Power generation will be achieved by three 13.8 kV generating units for Phase 1. Provisions for three additional generating units were considered for a potential Phase 2. Phase 1 will provide three 50 megavolt ampere (MVA) combustion turbine-driven generators as outlined in Plant design section, Combustion Turbine and Auxiliaries. The new combustion turbine plant will operate as a peaking and emergency plant, capable of providing rated active power output with start time of less than 10 minutes. Each generating unit is rated 50 MVA and will be capable to operate as a synchronous condenser individually, and independent of the operation mode of the other units. The plant will have a fully autonomous black start capacity.

Generator voltage will be at 13.8 kV with individual step-up transformers (GSUs). Isolated Phase Bus ducts will be used for the connection of the generating units to 13.8 kV switchgear, generating units to excitation transformers, and 13.8 kV switchgear to the GSUs.

The electrical room will be air-conditioned with redundant air conditioning systems. The protection and controls panels will be placed in the electrical room with the 13.8 kV switchgear and 600 V load centres will be placed outside of the electrical room.

4.3.2.1 Exciter and Synchronization

The excitation system, and synchronization systems are assumed to be ABB Megatrol. The exciter will be ABB Unitrol 6000 series, with automatic voltage regulator and power system stabilization features. The exciter will be furnished with two fully redundant control channels, two fully redundant rectifying bridges and one field breaker. The synchronizing relay will be ABB Synchrotact.

4.3.2.2 13.8 kV Switchgear

Each generating unit will have its own 13.8 kV switchgear containing the equipment necessary for interruption, grounding, and protection of the generator output and will be rated for 40 kA symmetrical interrupting capacity. Circuit breakers will be included for each generator, and its interrupting chamber will be SF6 insulated. The circuit breakers will be fully specified after a Transitory Recovery Voltage study. The station service buses, and their circuit breakers will be mounted on a switchgear. ION 9000 series meters capable of connection to Owner's metering network will be used. The switchgear will be metal-clad with provisions to evacuate arc gases in a safe way.

4.3.2.3 600 V MCCs and Load centers

Each generating unit will have its own load center with any common loads on their own loading center. Each 600 V load centre will have at least two supply sources separated by a tiebreaker and will each have a main breaker which will be fully specified after a Transitory Recovery Voltage study. The station service buses, and their circuit breakers will be mounted on a switchgear. ION 9000 series meters capable of connection to Owner's metering network will be used. The switchgear will be fully metal-clad with provisions to evacuate arc gases in a safe way.

Battery banks will be segregated from the electrical room in their own room with adequate ventilation and explosion rating. The powerhouse will have its own DC supply.

4.3.2.4 Station Service Redundancy

The station service buses will be divided in two by a tie-breaker circuit breaker. Each station service bus will be fed by at least one of the generating units and at least one station service transformer. The secondary station service buses will have a feeder line from the Holyrood Terminal Station Bus B8, and two black start/emergency station diesel generators. These diesels were sized such to allow black start of the combustion turbine power plant, and to provide all station service power of the plant. Estimated Station Service power, including black start, is 3 MW.

4.3.2.5 Transformers

Hatch prepared a datasheet for the step-down transformers, including the 138-13.8 kV step-down transformer, 13.8-4.16 kV step-down transformer, and the 13.8-0.6 kV step-down transformer. Hatch also prepared datasheet for the 230 – 13.8 kV step-up transformer, as well as a datasheet for the current transformer. These datasheets were sent to vendors for budgetary quotes.

4.3.3 Switchyard

4.3.3.1 230 kV Switchyard

Section drawings were prepared for the 230 kV Switchyard General Layout, 230 kV Switchyard Sections, and 230 kV Switchyard Sections and Isometric.

All the latest NLH Terminal Station Engineering Standards were followed. The Holyrood area and site are be considered “Extra Heavy Contamination” according to IEEE Std. C57.19.100 for the purposes of determining creepage for the 230 kV apparatus, including bushings. Refer NLH Terminal Engineering Standard TS26-001-RS for additional details.

The switchyard was arranged with two operating buses connected by breaker-and-a-third diameters with enough space for a large boom truck to access at least one side of each diameter and each bus.

The 230 kV yard will contain the following transformers:

- 3 x GSUs for Phase 1
- Provision of space for Phase 2 GSUs.

All grounding will be as per NLH Terminal Engineering Standards and in accordance with IEEE Standard 80.

The auxiliary DC systems of the switchyard was designed according to NLH Terminal Station Engineering Standards. The protection systems 1 and 2 will be fed from fully independent DC supply systems. All motorized switchyard equipment will be fed from the same voltage sources as the protection systems.

4.3.3.2 *Power Transformers*

All the requirements of the latest NLH Terminal Station Engineering Standard TS24-001 – Outdoor Power Transformers will be met and must be built with the same vector orientation or group as existing GSUs. All mineral oil-filled transformers will be equipped with online DGA gas analyser GE Kellman 9000 and equipped with secondary oil containment systems.

4.3.3.3 *Revenue Metering*

Measurement Canada approved Instrument Transformers, will be installed at:

- The output of each generating unit
- At the take-off of each incoming station service line
- At the take-off of the transmission line.

4.3.3.4 *Protection and Relaying*

Protection relays will be specified such as to act as I/O boards and bay controllers, with minimal direct hardwiring to RTU. Two fully redundant protection system to be supplied and fully segregate protection network will be utilized. The two protection system cables may utilize the same raceways, provided a physical metallic barrier is installed between them.

All relays are Schweitzer. Models 400G and 700G + 2664S for generator protections, 352 for breaker failure per bay, 487B for bus differential, 387, 487E, and 787 for transformer protection, 421 and 411L for transmission line protection. Panel layout and wiring will follow NLH P&C Engineering Standards.

4.3.4 Transmission Line

NLH Transmission Line TL218 will be terminated in the new CT switchyard and continue to Oxen Pond Terminal station. The section of TL218 from the CT switchyard to the Holyrood Terminal Station will be renamed as a transmission line or a Holyrood Terminal Station 230 kV bus extension.

Transmission lineTL218 existing structures will be replaced to extend the overhead ground wire from the new CT switchyard.

All the latest NLH Transmission Engineering Standards will be followed.

4.4 Instrumentation and Controls

The following deliverables were performed for the I&C design.

- Network Architecture
- Instrument Index
- I/O List
- Instrumentation Cable List
- Instrumentation MTO
- Functional Description.

4.4.1 Network Architecture

Hatch prepared a conceptual Network Architecture of the control system for the new Combustion Turbine Power Plant. The architecture reflects a diagrammatic representation of the plant and how each area(s) of equipment or system's components are interconnected/interfaced, the datalink between these systems and how they all communicate to the main control system of the plant or DCS to provide monitoring and control in all plant areas.

The network architecture also shows the combustion turbine generator packages and associated protection and monitoring systems, as packaged equipment and the datalink to the plant's DCS.

Refer to Appendix A, Item-29 for more details on the conceptual network architecture.

4.4.2 Instrument Index

Hatch utilized the P&IDs developed for FEED to generate and quantify all Balance of Plant (BOP) instrumentation required for the project. The data obtained from the instrument index was used for providing inputs to preparing the class 3 estimate.

Refer to Appendix A, Item-41 for more details on the instrument index.

4.4.3 *Input/Output (I/O) List*

Hatch utilized the P&IDs developed for FEED to generate and quantify all BOP Inputs and Outputs (I/Os) required for the control system. The I/O count for the BOP system, together with the estimated I/Os for each of the combustion turbine generators were used to estimate the size of control system (DCS) required for the plant. The total I/Os are estimated at 12,230.

Refer to Appendix A, Item-36 for more details on the BOP I/Os.

4.4.4 *Instrument Cable List*

An instrument cable list was prepared through extraction of measurements from the Site Layout Plan developed for this FEED. The measurements taken were approximate based on the placement of equipment cabinets and instruments in the field, back to the marshalling cabinets in the control building.

Refer to Appendix A, Item-30 for more details on the instrument cable list.

4.4.5 *Instrumentation MTO*

An Instrumentation MTO was prepared through a combination of information extracted from the Instrument Cable List, P&IDs and Network Architecture documents. The MTO includes:

- Instrumentation – Transmitters, Switches, On/Off Valves, Control Valves
- Instrument Cabling
- Junction Boxes and Marshalling Cabinets
- Network and Communications Equipment
- DCS/Controls Equipment/Software and Programming.

Refer to Appendix A, Item-31 for more details on the instrumentation MTO.

4.4.6 *Functional Description*

Hatch prepared a Functional Description document describing the functionality of the equipment, instrumentation and controls for the Balance of Plant (BOP) systems of the Newfoundland and Labrador Hydro Combustion Turbine Power Plant.

The Functional Description is intended to be used as a guideline for the control system design, software development acceptance testing, commissioning and site testing.

Refer to Appendix A, Item-32 for more details on the I&C BOP functional description.

4.5 Civil

The following deliverables were prepared for the Civil design.

- General Civil Layout Plan
- Side Wide Civil Layout Sections (1/2)

- Side Wide Civil Layout Sections (2/2)
- Ground Works MTO.

4.5.1 Site Development

Bentley's OpenRoads Roadway Design software, Version 23.00.00.129 was used to complete the 3D modeling of the proposed site. The existing surface was based on open-source Light Detection and Ranging (LiDAR) data. Later, topographical survey data was used to confirm the material qualities taken from the 3D model. The LiDAR data was analyzed in combination with the Hatch document H373262-0000-2A0-230-0001 – Geotechnical Investigation at Holyrood Thermal Generating Facility Final Report, Rev.0. in order to optimize site grading and cut and fill quantities.

The Geotechnical Investigation provided 33 test pits within the site limits which detail thicknesses of root mat, organics, and other materials on site. To quantify the subsurface thicknesses throughout the site, areas outside of the test pit locations required estimated depths based on the information provided in the investigation. The process by which these thicknesses were estimated is further described in the estimate plan. Refer to Appendix A, Item-42 for the estimate plan document details. In an attempt to balance the site earthworks volumes, finished grade elevations were set as close as possible to the base of organics elevations while still maintaining positive drainage.

Access roads throughout the main site were designed as either asphalt or gravel roads. The Geotechnical Investigation does not include a proposed asphalt structure recommendation, therefore a standard granular road cross section (50 mm asphalt, 75 mm of Class A Granular and 75 mm of Class B Granular) was used. The remainder of the site was designed with a gravel finish.

4.5.2 Geotechnical Investigation and Foundation

The recommendations from Hatch document H373262-0000-2A0-230-0001 – Geotechnical Investigation at Holyrood Thermal Generating Facility Final Report, Rev.0, was taken under advisement during the design of the site. The following items are examples of topics that affect site development; this is not an exhaustive list:

- Definition of significant wetland to be avoided
- Delineation of water bodies and buffers
- Native material coefficient of friction / recommended sloping angles
- Unsuitable material removal from site
    - Bog / Peat Removal
    - Clearing, Grubbing, and topsoil stripping.
- Bearing pressure

- Compaction requirements
- Pavement structure requirements.

4.5.3 Drainage

Newfoundland & Labrador Hydro requested that climate change be incorporated into the stormwater design for the project. The Town of Holyrood does not specify in their Development Regulations the requirement of climate change impacts on design storms for stormwater calculations. Therefore, in conjunction with Environment Canada Intensity Duration Frequency data and the report: *Projected Impacts of Climate Change for the Province of Newfoundland & Labrador: 2018 Update prepared by Memorial University of Newfoundland* was referenced for the appropriate climate change scenario to be incorporated for stormwater design. As the drainage infrastructure was designed for the 100-year rainfall event, Hatch proceeded with the data projected to year 2100 from this report.

The Stormwater Model PC SWMM (Personal Computer Storm Water Management Model); Version 7.6.3620 uses the Green and Ampt Infiltration Method with an SCS runoff method for this particular project. The stormwater catchments were delineated with the LiDAR contour information, in lieu of topographic information, and land cover description will be extracted from the Geotechnical Investigation, site visit information, and satellite imagery. These are a few high-level model inputs required to determine the peak flows within the site.

As mentioned, the stormwater catchment areas for the proposed site were based on the open-source LiDAR. This data was imported into Quantum Geographic Information Software (QGIS) to assist in delineating the catchment areas. Following the delineation, the catchment areas were then imported into the advanced stormwater modelling software, PC SWMM, in which the model set up was determined based on the site-specific conditions. Soil parameter inputs for the soil cover were based on the Canadian Soil Information Service (CanSIS). PC SWMM calculates the flow upstream of the site, contributing to the proposed cut-off ditch, as well as within the limits of site work, subsequently used to size the drainage infrastructure for the preliminary design, including, but not limited to:

- Site Ditching
- Culverts
- Storm Sewers
- Manholes
- Catch Basins.

In addition, an oil grit separator is proposed downstream of the fuel tank containment area onsite to ensure all stormwater within said area is treated prior to release. This stormwater infrastructure was sized as per the manufacturer’s proprietary software, with inputs based on site requirements and environmental guidelines.

All stormwater sewers and culverts were assumed to be dual wall HDPE pipes. Ditching was assumed to be finished with either Class I riprap, or topsoil and hydroseed, dependent on the peak flow velocity through the ditch.

4.5.4 Civil Drawings

Three civil drawings were prepared to illustrate the expected grading and stormwater design. These drawings include a General Civil Layout Plan and two Side Wide Civil Layout Sections. Drawing details are listed in Appendix A, Item-18.

4.5.5 Civil MTO

A Ground Works MTO was prepared through a combination of information extracted from the OpenRoads Civil model and manual calculations. Refer to Appendix A, Item-31 for the MTO document details. The MTO's will generally include, but are not limited to, the following:

- Clearing and Grubbing
- Mass earthworks such as:
  - Root mat removal
  - Organics removal
  - New granular materials (Fill).
- Asphalt
- Underground utility infrastructure
- Liner for secondary containment of fuel tanks
- Other civil infrastructure on site.

4.6 Structural

The following deliverables were completed as part of the structural scope.

- Structural Design Criteria
- Structural and Concrete 3D Models
- Structural MTOs
  - Structural Steel MTO
  - Concrete MTO
  - Architectural MTO.
- Tank Foundation General Arrangement Drawing.

4.6.1 Structural MTOs

Structural MTOs were prepared for structural steel, concrete, and architectural materials. Refer to Appendix A, Item-31 for the MTO document details. MTOs include only quantities for the current phase of the project (150 MW). Quantities for future expansion of the powerhouse, tank farm and substation to provide an additional generating capacity are not included. Refer to the estimate plan for how structural quantities were developed.

4.6.2 Structural Design Criteria

A structural design criteria was developed to establish the project guidelines for structural design codes and parameters, minimum loads, and material requirements for all buildings, structures and foundations associated with the project. Structural design criteria document details are outlined in Appendix A, Item-37.

4.6.3 Powerhouse

The powerhouse is modelled as a steel frame structure with metal cladding and membrane roofing, and anticipated to be stick-built construction. The main engine hall is single storey with long-span roof trusses to minimize interior columns. The building framing on the east side has sufficient load capacity for future building expansion.

The west end of the powerhouse has a 2-storey area for administrative offices, control room, kitchen, washrooms, maintenance shop, electrical room, compressor room and water treatment area. Detailed floor plans will be developed during final design and space allocation for shower/locker areas and sleeping quarters can be designated. The west end of the building has two single-storey annexes, one for black start engines and one to house the demineralized water tanks.

The southern portion of the main engine hall allowed for a 10-tonne overhead crane, running east-west. A 10-tonne crane in the black start engine annex was also included.

Powerhouse building foundations are constructed of spread footings supporting the building columns, foundation walls around the building perimeter, and an interior slab-on-grade. Based on preliminary analysis, genset foundations can be supported on rectangular concrete mat footings. During final design, genset foundations should be verified using final geotechnical borehole data and combustion turbine vendor loading data to ensure steel piles are not required below the gensets.

4.6.4 Tanks

Foundation requirements for the two (2) fuel tanks, the raw/fire water tank, and the two (2) demineralized water tanks were assessed during this study. Due to high bearing pressures under the tanks, spread footings would need to be much larger than the tank footprints and would impact equipment and site layout. Steel piles were therefore used in lieu of large spread footings. For analysis, 300 mm diameter driven steel HSS piles were considered, supporting a concrete pile cap at the base of the tank. Since the geotechnical investigation did not include boreholes, pile capacity data was limited. A pile length of 15 m was assumed based on pile capacities for similar projects. As recommended by the Geotechnical Report, a borehole program should be undertaken to confirm geotechnical recommendations prior to final design.

A Tank Foundation General Arrangement Drawing was prepared and drawing details are listed in Appendix A, Item-38.

4.6.5 Pipe Racks & Supports

The main pipe racks, located between the powerhouse and fuel tank farm, support fuel, water and glycol lines, as well as cable tray. Pipe racks are considered to be modular steel units supported on concrete spread footings. Within the tank farm, smaller steel pipe supports are supported on shallow concrete pads or sleepers. Any movement from frost action in this area will be accommodated by flexible piping connections.

For the fuel pipeline between the jetty and tank farm, pipe supports are anticipated to match existing. These typically consist of steel T-post piles, with anchor points supported on concrete foundations. Pipe supports required on the existing jetty will consist of small steel supports connected to existing steel and concrete.

4.6.6 Substation

The substation control building is considered to be a metal clad, pre-engineered steel building. The building is supported on concrete spread footings at the columns, with a perimeter foundation wall and interior slab-on-grade.

Electrical equipment in the substation, such circuit breakers, insulators and the gantry structures, are supported on spread footings. The pad mount transformers are supported on concrete slabs with an integral oil-containment area.

Substation gantry structures, equipment and buswork support structures and transmission line towers were included in the electrical estimate.

4.6.7 Miscellaneous Equipment

Powerhouse exhaust stacks and fin fan coolers are supported on spread footings, with steel support structures provided by respective vendors.

The three (3) 13.8/230 kV transformers, located south of the powerhouse, are supported on concrete slabs with integral oil-containment. Concrete fire walls are required between the transformers, as well as between the transformers and powerhouse.

At the fuel offloading area, a concrete pad and trench is provided to capture any spillage from off-loading and pipe it to oily water separator.

4.6.8 Other Buildings

Pumphouse buildings for fuel off-loading, raw water (near Quarry Brook) and the raw water tank are assumed to be modular steel construction. Raw water pumphouses are supported on slabs-on-grade, while the fuel-off loading pumphouse is located near the sloped berm and is supported on spread footings.

4.7 Environmental

The following deliverables were performed for the environmental portion of the design.

- Community Noise Assessment
- Water Supply Analysis & Environmental Review Report
- BACT Memo.

4.7.1 Community Noise Assessment

A Community Noise Assessment Report was prepared which describes the noise impact of the 150 MW simple cycle plant on the surrounding communities. Refer to Appendix A, Item-15 for the Community Noise Assessment Report document details.

4.7.2 Water Supply Analysis & Environmental Review Report

A Water Supply Analysis and Environmental Review Report was prepared which includes a social and environmental review of the HTGS property, including biophysical and social attributes, regulatory authorizations and approvals, and water supply. The document details are outlined in Appendix A, Item-17.

4.7.3 Best Available Control Technology (BACT) Memorandum

A BACT Memorandum was prepared which reviews the best control technology that is available for the [redacted] gas turbine options that were considered in the Combustion Turbine Technology Comparison. Refer to Appendix A, Item-16 for the document details.

5. Overall Plant Layout and Model

A three-dimensional CAD model of the 150 MW simple cycle plant was prepared, with input from Civil Engineering, Structural Engineering, Mechanical Engineering, Piping Engineering, and Electrical Engineering. These inputs include vendor data, sizing from in-house data and calculations. This model includes all components described in Section 4 of this report. From the model, the following deliverables were produced.

- Overall Site Plot Plan
- Combustion Turbine General Arrangement
- Fuel Storage Mechanical GA Plan
- Tie-in Point GAs
  - Quarry Brook
  - Fire Water
  - Wharf Unloading Fuel.
- General Civil Layout Plan and Section
- Tank Foundations GA
- Switchyard General Layout and Sections.

6. Constructability Review

A constructability report was prepared to align engineering and construction for the 150 MW simple cycle plant. This report addresses constructability issues associated with the project to ensure the smooth transition of the project from Front End Engineering Design (FEED) to Detailed Design and Project Execution phases. The constructability report was prepared through a workshop between NLH and Hatch.

Refer to Appendix A, Item-39 for the constructability report document details.

7. Supplemental FEED Deliverables

The design work from all disciplines was used to develop a Class 3 cost estimate, a level 3 project schedule and a risk and assumptions register. These FEED deliverables will support an application to the Public Utilities Board and an investment decision by NLH for proceeding with the next phase of design.

7.1 Project Schedule

A Level 3 project schedule was developed as part of the FEED study for the engineering, procurement, construction and commissioning of the 150 MW combustion turbine power plant. Equipment delivery periods in the project schedule are based on the delivery times quoted by the vendors and OEMs and the Hatch in-house database for similar projects. The construction and installation periods were generated from the in-house database taking into account the site location, access to site, and availability of experienced local contractors and skilled trade's personnel. The project timeline is highly dependant on delivery of the combustion turbine packages and transformers from the OEM. Projected completion date is identified as [redacted] 2029, subject to assumptions made. Key milestones are shown in the table below.

Refer to Appendix A, Item-5 for more detail on the project schedule and basis of schedule.

Table 7-1: Key Milestones

Avalon Combustion Turbine Project - HRD	
Key Milestones	**Complete**
EPCM contract award	[redacted]
NF Power 38L Relocated	
PUB Approval	
Environmental Approval	
NF Power 39L Relocated	
Combustion Turbine Generator Package contract award	
Start of Construction	
Engineering Substantially Complete	
Construction Complete	
Start of Stage 4 Commissioning	
Commercial Operation Date (COD)	

7.2 Cost Estimate

A Class 3 cost estimate was developed as part of the FEED study to an accuracy of -22.8% to +25.7% for [redacted] confidence interval. Inputs from all disciplines throughout the FEED study were used to populate the estimate, including developed MTOs and budget quotations received for major equipment.

The capital cost estimate consists of four major cost groupings: Direct Costs, Indirect Costs, Contingency and Owner's Costs.

- Direct costs are the costs of all equipment and bulk materials, together with construction and installation costs for all permanent facilities. Installation and labour costs are also factored into the direct costs.
- Indirect costs are made-up of factors and allowance. The factors and allowances are developed based on historical information from similar projects, adjusted to account for site specific factors. The indirect costs include the engineering, procurement, construction management (EPCM) and pre-commissioning costs for the project.
- A Quantitative Risk Analysis (QRA) was completed for Newfoundland and Labrador Hydro as part of the 150 MW Combustion Turbine FEED Study to assess the project schedule and capital costs risk profiles, following a parametric quantitative risk model. This model outlines the cost of contingency established at the P_{Mean} value for expected variations in the cost and/or quantity for labour, material and equipment, for the given scope of work and for the economic climate existing at the time the estimate was made.
- Estimates of owner's cost was developed by the client and provided to the Hatch management team for insertion into the final estimate.

A breakdown of the cost estimate can be seen in the table below.

Refer to Appendix A, Item-6 for more detail on the cost estimate and the basis of estimate.

Table 7-2: Cost Estimate Summary

Description	Cost
Site Development	[redacted]
Concrete	[redacted]
Roadworks, Drainage & Paving	[redacted]
Earthworks	[redacted]
Architectural	[redacted]
Control and Instrumentation	[redacted]
Electrical Equipment	[redacted]
Mechanical Equipment	[redacted]
Mechanical Platework & Tanks	[redacted]
Pipework & Fittings	[redacted]
Insulation	[redacted]
Cable Ladder, Tray & Conduit	[redacted]
Structural Steel	[redacted]
Wire and Cable	[redacted]
	[redacted]
Total Direct Costs	[redacted]
Indirect Costs	[redacted]
Contingency	[redacted]
Owner's Costs	[redacted]
TOTAL COST:	[redacted]

A Class 5 CAPEX estimate as also developed for a 50 MW incremental size increase. Refer to Appendix A, Item-6.

The O&M and Life Cycle cost was also estimated and provided. Refer to Appendix A, Item-6.

7.3 Risk and Assumptions

A risk and assumptions register was prepared which outlined all assumptions made throughout the FEED study, as well as the risks associated with these assumptions. These risks include risks to project cost, schedule, revenue, performance, environment, community, etc. Each risk was evaluated and given an initial rating, a mitigation plan and a rating after the mitigation plan is implemented.

A quantitative risk assessment (QRA) was developed through a series of workshops between Hatch and NLH.

Refer to document Appendix A, Item-42 for more details on the risk and assumptions register, and Appendix A, Item-35 for more details on the QRA.

8. FEEP Deliverables

A FEEP study was also performed to establish the framework for the FEED study. The FEEP deliverables included a contracting strategy and a project execution plan (PEP).

8.1 Contracting Strategy

A Contracting Strategy was prepared during the FEEP study. The contracting strategy reviews potential project delivery models to be used for the 150 MW simple cycle plant, including EPCM, EPC, and integrated EPC. The recommendation provided by Hatch in the contracting strategy was to adopt the EPCM project delivery model as this approach is aligned with the following key requirements identified for the Avalon CTG Project:

- A high degree of project definition with supporting cost estimates prior to regulatory Project Approval.
- Cost and schedule predictability within a defined level of confidence.
- Technology design maturity and performance.
- Project constraints including regulatory approvals, schedule for long-lead equipment, operational factors related to the existing Holyrood plant and potential resource demand from other regional projects.
- Alignment with contracting resources availability and capability.
- Appropriate degree of Owner oversight and management.

Refer to Appendix A, Item-43 for more details on the contracting strategy.

8.2 Project Execution Plan

A Project Execution Plan (PEP) was prepared for the 150 MW simple cycle plant. This PEP established the implementation of all project activities, their interdependencies and their interfaces with construction, commissioning and operation.

Refer to Appendix A, Item-7 for the PEP document details.

9. Gap Analysis

As part of the pre-FEED 2023 Concept Design Report, a gap analysis was prepared to establish the additional deliverables that need to be completed ahead of the FEED. For this FEED Study, the 2023 gap analysis was refreshed and further developed to identify gaps outstanding for project execution following FEED study completion. Refer to Table 9-1.

Table 9-1: Gap Analysis

Discipline	Activity	% Complete
Site Selection	Brown field and greenfield site visit	[redacted]
	Geotechnical Boreholes and Test Pit Program	[redacted]
	Plume Dispersion Modelling	[redacted]
	Water Supply and Intake Alterations/Design	[redacted]
Gas Turbine Screening	Vendor Screening	[redacted]
	Preliminary Heat and Mass Balance	[redacted]
	Preliminary Performance Evaluation	[redacted]
	Preliminary Layout	[redacted]
	GT Selection	[redacted]
	Vendor Site Visit	[redacted]
	Optimization	[redacted]
Social and Environmental Assessment	Water Supply Evaluation	[redacted]
	Roadmap for Permits and Approvals (Approval under Part XI of the NL Environmental Protection Act, Air Pollution Control Regulations 2022, etc)	[redacted]
	Environmental Evaluation	[redacted]
	Ground Truthing (Confirm desktop assumptions for environmental and social criteria.)	[redacted]
	Geotechnical investigations	[redacted]
	Engagement and Consultation Roadmap	[redacted]
	First Nation and Community Consultation	[redacted]
	Environmental Assessment (EA)	[redacted]
	Preparation and Submission of a Provincial EA Registration	[redacted]
Fuel Assessment	Supplier Screening	[redacted]
	Fuel Storage Requirements	[redacted]
	Fuel Transportation Requirements	[redacted]

Discipline	Activity	% Complete
	Fuel Costs Evaluation	[redacted]
	PFDs (Diesel)	[redacted]
	Fuel Supply Chain Review	[redacted]
	Alternative Fuel Evaluation	[redacted]
	Consideration of existing demand	[redacted]
	Contractual considerations to meet supply needs	[redacted]
Electrical Interconnection	Overall Plant Single Line Diagram	[redacted]
	Site Electrical Characteristics	[redacted]
	Transmission System Limitations	[redacted]
	Terminal Layout and Footprint	[redacted]
	Functional Operability Requirements	[redacted]
	Interconnection Infrastructure Requirements	[redacted]
	Applicable Standards	[redacted]
Noise Impact Assessment	Noise Model	[redacted]
	Determine the noise criteria requirement in the permitting process	[redacted]
	Verify noise sound power level of the different equipment by obtaining noise data from Prospective Supplier	[redacted]
	Determine the noise emissions from the existing activities on the Holyrood site	[redacted]
	Develop noise mitigation strategy for the residential area to the east of Holyrood site	[redacted]
Other Deliverables	AACE Class 3 Cost Estimate	[redacted]
	Basis of Cost Estimate	[redacted]
	Level 3 Schedule	[redacted]
	FEED Recommendation	[redacted]

10. Conclusion and Recommendations

The FEED report summarized all work completed throughout the FEED study, including a CT technology comparison, discipline design work, an overall plant playout and model, constructability review, a project execution schedule, CAPEX estimate, and a project risk assessment. Project planning deliverables were also completed as part of the FEEP, including a contracting strategy and project execution plan.

The following areas of the design remain outstanding after the completion of the FEED study. As a next step, Hatch recommends completing/finalizing the following items following the completion of the FEED study.

- Engine Selection
- Geotechnical review
- Environmental assessment
- Long lead item procurement.

Appendix A:
List of Reference Documents

No.	Document Title	Hatch Document No.	NLH Document Number	Revision
Item-1	Design Basis Document	H373979-0000-100-610-0001	HRDCT2-HAT-49100-EN-BOD-0001-01	0
Item-2	Combustion Turbine Specification, Datasheet, Scope of Work, Index, and VDR	H373979-BM001-240-242-0001 H373979-BM001-240-206-0001 H373979-BM001-240-248-0001 H373979-BM001-240-216-0001 H373979-BM001-240-212-0001	HRDCT2-HAT-49100-EN-SPC-0001-01 HRDCT2-HAT-49100-EN-DAS-0001-01 HRDCT2-HAT-49100-EN-DEG-0001-01 HRDCT2-HAT-49100-EN-IDX-0001-01 HRDCT2-HAT-49100-EN-DAT-0001-01	0
Item-3	Combustion Turbine Technology Comparison	H373979-0000-240-249-0004	HRDCT2-HAT-49100-ME-TEN-0001-01	0
Item-4	Demin Plant Specification, Datasheet, Scope of Work, Index, and VDR	H373979-BM003-240-242-0001 H373979-BM003-240-206-0001 H373979-BM003-240-248-0001 H373979-BM003-240-216-0001 H373979-BM003-240-212-0001	HRDCT2-HAT-49326-EN-SPC-0001-01 HRDCT2-HAT-49326-EN-DAS-0002-01 HRDCT2-HAT-49326-EN-DEG-0001-01 HRDCT2-HAT-49326-EN-IDX-0001-01 HRDCT2-HAT-49326-EN-DAT-0001-01	0
Item-5	Execution Schedule Basis of Execution Schedule	H373979-0000-400-076-0001 H373979-0000-610-610-0001	HRDCT2-HAT-49100-CS-SCH-0001-01 HRDCT2-HAT-49100-PM-SCH-0002-01	0 0
Item-6	Class 3 CAPEX Cost Estimate Basis of CAPEX Estimate Class 5 CAPEX Estimate for Incremental 50MW Size Increase O&M and Life Cycle Estimate	H373979-0000-620-622-0001 H373979-0000-100-610-0001 H373979-0000-100-622-0002 H373979-0000-100-016-0001	HRDCT2-HAT-49100-EP-EST-0004-01 HRDCT2-HAT-49100-EN-BOD-0001-01 HRDCT2-HAT-49100-EP-EST-0003-01 HRDCT2-HAT-49100-EP-EST-0002-01	1 0 0 0
Item-7	Project Execution Plan	H373979-0000-100-120-0001	HRDCT2-HAT-49100-PM-PLN-0001-01	0
Item-8	Heat and Mass Balance Memo	H373979-0000-240-249-0003	HRDCT2-HAT-49100-EN-HMB-0001-01	0
Item-9	Tank Sizing Calculations	H373979-0000-240-202-0001	HRDCT2-HAT-49100-FS-CAL-0001-01	0
Item-10	Diesel Fuel System PFD Demin Water PFD Service, Fire and Waste Water PFD Instrument Air PFD	H373979-0000-210-282-0001 H373979-0000-210-282-0002 H373979-0000-210-282-0003 H373979-0000-210-282-0004	HRDCT2-HAT-49314-PI-PFD-0001-01 HRDCT2-HAT-49326-PI-PFD-0001-01 HRDCT2-HAT-49327-PI-PFD-0001-01 HRDCT2-HAT-49322-PI-PFD-0001-01	0 0 0 0

No.	Document Title	Hatch Document No.	NLH Document Number	Revision
Item-11	PFD Stream Tables Basis and Assumptions	H373979-0000-240-249-0005	HRDCT2-HAT-49327-EV-TEN-0003-01	0
Item-12	Tank(s) Specification, Datasheet, Scope of Work, Index, and VDR	H373979-BM002-240-242-0001 H373979-BM002-240-206-0001 H373979-BM002-240-206-0002 H373979-BM002-240-206-0003 H373979-BM002-240-248-0001 H373979-BM002-240-216-0001 H373979-BM002-240-212-0001	HRDCT2-HAT-49314-EN-SPC-0001-01 HRDCT2-HAT-49327-EN-DAS-0001-01 HRDCT2-HAT-49326-EN-DAS-0001-01 HRDCT2-HAT-49314-EN-DAS-0001-01 HRDCT2-HAT-49314-EN-DEG-0001-01 HRDCT2-HAT-49314-EN-IDX-0001-01 HRDCT2-HAT-49314-EN-DAT-0001-01	0
Item-13	Fuel Unloading Options Memo	H373979-0000-240-249-0002	HRDCT2-HAT-49100-FS-TEN-0001-01	1
Item-14	Legend Sheet Fuel Pump House P&ID Fuel Storage P&ID Fuel Distribution P&ID Raw Water Storage P&ID Demin Water Storage P&ID Raw Water Distribution P&ID Demin Water Distribution P&ID Fire Water Distribution P&ID Instrument and Service Air P&ID	H373979-0000-250-276-0001 H373979-0000-250-276-0002 H373979-0000-250-276-0003 H373979-0000-250-276-0004 H373979-0000-250-276-0005 H373979-0000-250-276-0006 H373979-0000-250-276-0007 H373979-0000-250-276-0008 H373979-0000-250-276-0009 H373979-0000-250-276-0010	HRDCT2-HAT-49100-PI-PID-0001-01 HRDCT2-HAT-49327-PI-PID-0004-01 HRDCT2-HAT-49314-PI-PID-0001-01 HRDCT2-HAT-49314-PI-PID-0002-01 HRDCT2-HAT-49327-PI-PID-0001-01 HRDCT2-HAT-49326-PI-PID-0002-01 HRDCT2-HAT-49327-PI-PID-0003-01 HRDCT2-HAT-49326-PI-PID-0001-01 HRDCT2-HAT-49327-PI-PID-0002-01 HRDCT2-HAT-49322-PI-PID-0001-01	0 0 0 0 0 0 0 0 0 0
Item-15	Community Noise Assessment Report	H373979-0000-245-066-0001	HRDCT2-HAT-49100-EV-TEN-0001-01	0
Item-16	BACT Memo	H373979-0000-210-249-0002	HRDCT2-HAT-49100-EV-LTR-0001-01	1
Item-17	Water Supply Analysis and Environmental Review Report	H373979-0000-840-030-0001	HRDCT2-HAT-49100-EV-TEN-0002-01	0
Item-18	General Civil Layout Plan Side Wide Civil Layout Sections (1/2) Side Wide Civil Layout Sections (2/2)	H373979-0000-220-272-0001 H373979-0000-220-272-0002 H373979-0000-220-272-0003	HRDCT2-HAT-15000-CV-DAL-0001-01 HRDCT2-HAT-15000-CV-DSE-0001-01 HRDCT2-HAT-15000-CV-DSE-0001-02	0 0 0
Item-19	Electrical Load List	H373979-0000-260-216-0002	HRDCT2-HAT-49890-EL-LST-0001-01	0

No.	Document Title	Hatch Document No.	NLH Document Number	Revision
Item-20	Mechanical Equipment List	H373979-0000-240-216-0002	HRDCT2-HAT-49100-ME-LST-0001-01	0
Item-21	Piping Design Criteria	H373979-0000-250-210-0002	HRDCT2-HAT-22000-PI-CRT-0001-01	1
Item-22	Piping Material Class Index	H373979-0000-250-216-0001	HRDCT2-HAT-22000-PI-IDX-0001-01	1
Item-23	Hydraulic Calculations (fuel oil offloading from vessel, raw water from Quarry brook, fuel unloading from trucks, fuel distribution to turbines, and fire water supply	H373979-0000-250-202-0002 H373979-0000-250-202-0003 H373979-0000-250-202-0004 H373979-0000-250-202-0005 H373979-0000-250-202-0006	HRDCT2-HAT-49314-EN-CAL-0003-01 HRDCT2-HAT-49327-EN-CAL-0001-01 HRDCT2-HAT-49314-EN-CAL-0002-01 HRDCT2-HAT-49314-EN-CAL-0001-01 HRDCT2-HAT-49327-EN-CAL-0002-01	0
Item-24	Overall Site Plot Plan	H363979-0000-203-270-0001	HRDCT2-HAT-49100-PP-DAL-0001-01	0
Item-25	Combustion Turbine Building GA	H373979-0000-203-270-0002 H373979-0000-240-270-0001	HRDCT2-HAT-49100-PP-DAL-0002-01 HRDCT2-HAT-49100-FS-DAL-0001-01	0 0
Item-26	Fuel Storage Mechanical GA Plan	H373979-0000-240-270-0001	HRDCT2-HAT-49100-FS-DAL-0001-01	
Item-27	Tie-in Point GAs (Wharf Unloading Fuel, Quarry Brook, and Fire Water)	H373979-0000-250-260-0001 H373979-0000-250-260-0002 H373979-0000-250-260-0003	HRDCT2-HAT-49314-PI-DGA-0001-01 HRDCT2-HAT-49327-PI-DGA-0001-01 HRDCT2-HAT-49327-PI-DGA-0002-01	0
Item-28	13.8 kV Station Service Switchgear Datasheet	H373979-0000-260-206-0013	HRDCT2-HAT-49890-EL-SPC-0001-01	0
Item-29	Network Architecture	H373979-0000-270-256-0001	HRDCT2-HAT-49900-TE-DBD-0001-01	0
Item-30	Instrument Cable List	H373979-0000-270-216-0001	HRDCT2-HAT-49900-PT-LST-0002-01	0
Item-31	MTOs (Instrumentation, civil, structural, piping, electrical)	H373979-0000-270-222-0002 H373979-0000-220-222-0001 H373979-0000-230-222-0001 H373979-0000-230-222-0002 H373979-0000-230-222-0003 H373979-0000-250-222-0003 H373979-0000-260-222-0001 H373979-0000-260-222-0002	HRDCT2-HAT-49900-PT-MTO-0001-01 HRDCT2-HAT-49100-ST-MTO-0002-01 HRDCT2-HAT-49100-ST-MTO-0001-01 HRDCT2-HAT-49100-ST-MTO-0003-01 HRDCT2-HAT-49100-AR-MTO-0001-01 HRDCT2-HAT-49100-PI-MTO-0001-01 HRDCT2-HAT-49890-EL-MTO-0001-01 HRDCT2-HAT-51300-EL-MTO-0001-01	0 1 0 0 0 0 0 1

No.	Document Title	Hatch Document No.	NLH Document Number	Revision
Item-32	Instrumentation Function Description	H373979-0000-270-208-0002	HRDCT2-HAT-49900-PM-SPC-0001-01	1
Item-33	Piping Line List Manual Valve List	H373979-0000-250-216-0002 H373979-0000-250-216-0004	HRDCT2-HE-49100-PI-LST-0001-01 HRDCT2-HAT-49100-PI-LST-0002-01	0 0
Item-34	Single Line Diagrams	H373979-0000-260-288-0001 H373979-0000-260-288-0002 H373979-0000-260-288-0003	HRDCT2-HAT-49890-EL-DSL-0001-01 HRDCT2-HAT-49890-EL-DSL-0005-01 HRDCT2-HAT-49890-EL-DSL-0005-02	0 1 1
Item-35	QRA	H373979-0000-120-066-0001	HRDCT2-HAT-49100-PC-EST-0001-01	1
Item-36	Input/Output (I/O) List	H373979-0000-270-216-0002	HRDCT2-HAT-49900-PT-DIO-0001	1
Item-37	Structural Design Criteria	H373979-0000-230-210-0001	HRDCT2-HAT-20000-ST-CRT-0001-01	1
Item-38	Tank Foundation GA	H373979-0000-230-270-0001	HRDCT2-HAT-49314-ME-DGA-0001-01	0
Item-39	Constructability 0Report	H373979-0000-400-066-0001	HRDCT2-HAT-49100-CS-TEN-0001-01	0
Item-40	230 kV Switchyard General Layout 230 kV Switchyard Sections 230 kV Switchyard Sections and Isometric	H373979-0000-260-270-0001 H373979-0000-260-270-0002 H373979-0000-260-270-0003	HRDCT2-HAT-49100-EL-DAL-0001-01 HRDCT2-HAT-49890-EL-DSL-0002-01 HRDCT2-HAT-49890-EL-DSL-0002-02	0
Item-41	Instrument Index	H373979-0000-270-216-0003	HRDCT2-HAT-49900-PT-IDX-0001-01	1
Item-42	Risk and Assumptions Register	H373979-0000-120-131-0001	HRDCT2-HAT-49100-RI-REG-0001-01	0
Item-43	Contracting Strategy Report	H373979-0000-100-066-0001	HRDCT2-HAT-49100-PM-CTR-0001-01	0
Item-44	Project Wide Sanitary Drainage GA	H373979-0000-240-272-0001	HRDCT2-HAT-79100-CV-DAL-0001-01	0

HATCH

80 Hebron Way, Suite 100
St. John's, Newfoundland and Labrador, Canada A1A 0L9
Tel: +1 (709) 754 6933