FINAL

Terra Nova Energy Centre
Project Registration

Submitted to:
Newfoundland and Labrador
Department of Environment and Climate Change
Government of Newfoundland and Labrador
Confederation Building
P.O. Box 8700
St. John's, NL
A1B 4J6

Submitted by:
EnviroPower Renewable Development Inc. and
Synergy World Power Newfoundland Ltd.

13472 Point Pleasant Drive
Chantilly, VA 20151 USA

5 January 2022
Wood Project #: ME2090901

EXECUTIVE SUMMARY

Synergy World Power Newfoundland, Ltd., (SWPNL) a company yet to be established, will own and operate the Terra Nova Energy Centre (the Project) in Lewisporte. Originally developed by EnviroPower Renewable Development, Inc., (EPRD) and using EPRD technology, TNEC will be one of the largest and most comprehensive facilities in the hemisphere for the sustainable conversion of biomass and plastic solid waste to renewable energy and clean ultra-low sulfur liquid and gas phase hydrocarbon fuels. TNEC will be comprised of a gasification waste to energy combined heat and power (CHP) plant, and a hydrothermal liquefaction (HTL) plant to make liquid fuels from waste plastic. The CHP plant will generate renewable thermal energy from more than 550,000 tonnes/year of dry biomass diverted from landfills, resulting in a net reduction in greenhouse gas equivalent emissions compared to landfill placement. Both CHP and HTL technologies will eventually be deployed in multiple units.

Thermal energy from the CHP plant will produce steam for generating up to 36 MW of renewable electrical power as well as hot water for space heating for nearby Public Private Partnership (PPP) greenhouses used to grow fresh produce. The HTL plant will convert up to 250,000 metric tons per year of waste plastics into clean ultra-low sulfur liquid fuel and fuel gas. The TNEC will include a new bulk cargo port and fuel jetty on Burnt Bay, as well as an area for construction of greenhouses, an area for future businesses spun off from the TNEC, or from port activities, and a publicly financed and operated indoor pool that will be heated by hot water from the CHP plant.

Given the nature of the planned Project, it is subject to environmental assessment registration under the Newfoundland and Labrador Environmental Protection Act, 2002. Submission of this Registration/Project Description will initiate the provincial assessment processes, informing the government of SWPNL's intention to develop this Project. It is also intended to provide regulators with sufficient information regarding the proposed undertaking, the existing baseline conditions, and the potential effects of the Project to allow a determination regarding the nature of the environmental assessment process required for the Project to proceed to development.

This Project is anticipated to generate between 100 and 200 full time equivalent (FTE) positions during construction depending on the phase. At peak employment during operation, it is anticipated that SWPNL will employ between 180 to 230 full time people, on four crews, covering weekdays and weekends for a 24/7 operation. In addition to employment benefits, this Project represents a direct benefit to the province through corporate and other taxes over the life of the Project. In addition, further indirect benefits to the province would result from services required for the Project and its employees, including construction, supply and technical services, security and catering services and the potential for spinoff businesses. Overall, this Project development and operation is consistent with the provincial government's goal of diversifying the economy.

SWPNL will develop specific protocols as part of an overall Environmental Management System to facilitate the execution of the site development in an environmentally responsible and safe manner. As SWPNL moves forward with the Project, it will also develop a Diversity, Gender and Inclusion policy that encompasses all aspects of its business, including the Board of Directors, employees, contractors, and suppliers.

This new policy will provide the foundation for a future Diversity, Gender and Inclusion Plan that will be implemented for the development and operation of the Project. SWPNL also understands that consultation with all stakeholders who may have an interest in, or be affected by the Project, is key to operating within a sustainable development framework. SWPNL has initiated stakeholder consultation. However, this Registration Document has helped to identify potential issues and stakeholders with which SWPNL will conduct a stakeholder engagement program as part of the Project planning and regulatory stage of Project development.

Based on the existing information collected to date and Project activities and infrastructure, it is anticipated that should an Environmental Impact Statement be required, it will likely be based on relevant aspects of the atmospheric environment, freshwater environment, terrestrial environment, marine environment, and human environment.

The following table indicates how the specific requirements for a Project Description under the provincial assessment process have been addressed.

Table of Concordance with Provincial Project Registration Guidelines

Guidance		**Project Description Section(s)**
Name of Undertaking		1.1
Proponent	Name of Corporate Body	1.3
	Address	1.3
	Chief Executive Officer	1.3
	Principal Contact for Environmental Assessment	1.3
The Undertaking	Name of the Undertaking	1.1
	Purpose/Rationale/Need for the Undertaking	2.1
Description of the Undertaking	Geographical Location	2.0
	Physical Features	2.3
	Construction	2.4, 4.2.4, 6.0, 6.1.6
	Operation	2.5, 6.2.5
	Occupations	3.1.1
	Project Related Documents	8.0 and Appendices
Approval of the Undertaking		1.5, 2.10
Schedule		2.7
Funding		1.4

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

Abbreviations

A/C	Air-Conditioning
AGRU	Acid Gas Removal Unit
APC	Air Pollution Control
APCS	Air Pollution Control System
ASTM	American Society for Testing and Materials
BACT	Best Available Control Technology
BFW	Boiler Feed Water
BTU	British Thermal Unit
C	Celsius
CAC	Criteria Air Contaminants
CAD	Canadian Dollar
CCELC	Canada Committee on Ecological Land Classification
Cd	Cadmium
CEMP	Construction Environmental Management Plan
CEMS	Continuous Emissions Monitoring System
CH4	Methane
CHP	Combined Heat and Power
cm	Centimeter
CN	Canadian National
CNWA	Canadian Navigable Waters Act
CNWM	Central Newfoundland Waste Management
CO	Carbon Monoxide
CO_2	Carbon Dioxide
COA	Certificate of Approval
CTO	Chief Technical Officer
D/F	Dioxins and Furans
DFO	Fisheries and Oceans Canada
DWT	Dead Weight Tonnage
E&IS	Environment & Infrastructure Services
EA	Environmental Assessment
ECCC	Environment and Climate Change Canada
EERP	Environmental Emergency Response Plan

ELC	Ecological Land Classification
EMS	Environmental Management System
EPA	Environmental Protection Act
EPC	Engineering, Procurement, Construction
EPP	Environmental Protection Plan
EPR	EnviroPower Renewable, Inc.
EPRD	EnviroPower Renewable Development, Inc.
ES	Environmental Statement
ESP	Electrostatic Precipitator
ESA	Endangered Species Act
EU	European Union
F	Fahrenheit
FAME	Fatty Acid Methyl Ester
FAQ	Frequently Asked Question
FGD	Flue-gas Desulfurization
FMD	Forest Management District
FNI	Federation of Newfoundland Indians
FTE	Full Time Equivalent
GH	Greenhouse
GHG	Greenhouse Gas
GHGe	Greenhouse Gas Equivalents
GJ	Gigajoules
GJ/kL	Gigajoules per Kilolitre
GM	General Manager
H&MB	Heat and Mass Balance
Ha	Hectares
HAP	Hazardous Air Pollutant
HCl	Hydrochloric Acid
HF	Hydrogen Fluoride
Hg	Mercury
HHV	(higher) Heating Value
HQ	Headquarters
hr(s)	Hour(s)

HRSG	Heat Recovery Steam Generator
HTL	Hydrothermal Liquefaction
HV	High Voltage
Hz	Hertz
IAA	Impact Assessment Agency of Canada
IAPP	International Air Pollution Prevention
IMO	International Marine Organization
Kg	Kilogram
km	Kilometre
kt	Kilotonnes
kV	Kilovolt
L	Liter
LCA	Life Cycle Assessment
LiDAR	Light Detection and Ranging
LMAA	Lewisporte Marina Administrative Authority
LoNOx	Low Nitrogen Oxide(s)
m	Metre
M	Million
m^3	Cubic Metre
MAMKA	Mi'kmaq Alsumk Moiwimskik Koqoey Association
MARPOL	Marine Pollution
Max	Maximum
MBCA	Migratory Birds Convention Act
MBR	Membrane Bio-Reactor
MCC	Motor Control Centre
MCF	Mi'kmaq Commercial Fisheries Inc.
MCIQ	Marine Contractors Inc Qalipu
MFN	Miawpukek First Nation
Min	Minimum
MJ	Megajoules
mm	Millimeter
MRF	Materials Recovery Facility
MSW	Municipal Solid Waste

MVA	Mega Volt-Amp
MW	Megawatt
N2O	Nitrous Oxide
NAPS	National Air Pollution Surveillance Program (Canada)
NDA	Non-disclosure Agreement
NGO	Non-Governmental Organization
NL	Newfoundland and Labrador
NOC	National Occupation Codes
NO_2	Nitrogen Dioxide
NOx	Nitrogen Oxide(s)
O_3	Ozone
PAH	Polycyclic Aromatic Hydrocarbons
PAO	Provincial Archaeology Office
Pb	Lead
PCDD	Polychlorinated di-benzo p-dioxins
PCDF	Polychlorinated di-benzo Furans
PESO	Paid, Earned, Shared and Owned
PET	Polyethylene Terephthalate
$PM_{2.5}$	Particulate Matter less than 2.5 Microns
PM_{10}	Particulate Matter less than 10 Microns
ppb	Parts per Billion
ppm	Parts per Million
PPP	Public Private Partnership
PSD	Potential for Significant Deterioration
PTLF	Plastics to Liquid Fuel
PVC	Polyvinyl Chloride
QA	Quality Assurance
QC	Quebec
QDC	Qalipu Development Corporation
QFN	Qalipu First Nation
QPSS	Qalipu Project Support Services
RO	Reverse Osmosis
RORO	Roll-on Roll-off

SARA	Species at Risk Act
SCADA	Supervisory Control and Data Acquisition System
SCR	Selective Catalytic Reduction
SMS	Safety Management System
SO_2	Sulfur Dioxide
SOP	Standard Operating Procedure
SOPEP	Shipboard Oil Pollution Emergency Plan
SOx	Sulfur oxides
SRF	Solid Recovered Fuel
SWP	Synergy World Power
SWPNL	Synergy World Power Newfoundland Ltd.
t	Tonnes
TC	Transport Canada
TCLP	USEPA Toxicity Characteristic Leaching Procedure
t/d	Tonnes per day
TEQ	Dioxin and Dioxin-Like Compounds Toxic Equivalency
TNEC	Terra Nova Energy Centre
TPD	Tons per Day
TPM	Total Particulate Matter
UK	United Kingdom
ULSD	Ultralow Sulfur Diesel
UN	United Nations
US	United States
USEPA	United States Environmental Protection Agency
V	Volt
VA	Virginia
VOC	Volatile Organic Compound
WSI	Written Scheme of Investigation
WTE	Waste to Energy

1.0 INTRODUCTION

Synergy World Power Newfoundland, Ltd., a Canadian company yet to be established, will own and operate the Terra Nova Energy Centre (TNEC), or the Project, to be located in Lewisporte, Newfoundland. Originally developed by EnviroPower Renewable Development, Inc. (EPRD), TNEC will be one of the largest and most comprehensive facilities in the hemisphere for the sustainable conversion of biomass and plastic solid waste to renewable energy and clean ultra-low sulfur liquid and gas phase hydrocarbon fuels. TNEC will be comprised of a gasification waste to energy combined heat and power (CHP) plant and a hydrothermal liquefaction (HTL) plant to make liquid fuels from waste plastic. The CHP plant will generate renewable thermal energy from more than 550,000 tonnes/year of dry biomass diverted from landfills, resulting in a net reduction in greenhouse gas equivalent emissions compared to landfill placement. HTL and CHP technologies will eventually be deployed in multiple units.

Thermal energy from the CHP plant will produce steam for generating up to 36 MW (net to the grid) of renewable electrical power as well as hot water for space heating for nearby Public Private Partnership greenhouses used to grow fresh produce. The HTL plant will convert up to 250,000 metric tons per year of waste plastics into clean ultra-low sulfur, low carbon intensity, liquid fuels and fuel gas. The TNEC design will include a new bulk cargo port and fuel jetty on Burnt Bay, as well as an area for construction of greenhouses, and a publicly financed and operated indoor pool that will be heated by hot water from the CHP plant.

1.1 Name of the Undertaking

TNEC will be a major industrial and commercial enterprise located on approximately 163 Hectares of land on the south shore of Burnt Bay in Lewisporte, Newfoundland. The primary focus of the Project is the environmentally responsible conversion of waste plastics to fuels and conversion of biomass to renewable energy in the form of hot water for greenhouses and steam for generating electricity. Hot water from the TNEC gasification thermal energy plant will be provided to the agricultural industry at low cost to help achieve the Provincial mandate of increasing local production of the fruit and vegetables consumed in Newfoundland and Labrador to 20%.

TNEC will earn revenue by thermally processing solid recovered fuel (SRF) from Canada and Europe to produce clean ultra-low sulfur hydrocarbon fuels such as diesel and home heating oil by hydrothermal liquefaction. Gasification of SRF will provide thermal energy for heating greenhouses, as well as renewable electrical power for the agricultural greenhouse project and for sale to Newfoundland and Labrador (NL) Hydro to help stabilize the local power grid.

The Project will include major infrastructure improvements for Lewisporte and Burnt Bay, including a new bulk cargo port and marine fuel jetty on the south side of the Bay. This dock will be capable of handling bulk cargo carriers of up to a maximum of 24,000 dead weight tonnage (DWT). The TNEC CHP plant in Phase I will provide up to 36 MW of renewable baseload power for stabilization of the local power grid. The Project will bring investment of approximately one billion dollars (CAD) into the Canadian economy for initial construction. In operation, the project will provide between approximately 180 and 220 new jobs in Phase I. The number of jobs during construction will vary with phase and will be determined later.

1.2 Purpose of the Environmental Assessment Registration and Project Description

The purpose of the present environmental assessment registration document is to comply with the provisions of the NL *Environmental Protection Act (NL EPA, Part 10)*, which requires that an adequate description of any undertaking that could potentially result in a significant effect on the natural, social, or economic environment must be presented for examination through the provincial environmental assessment (EA) process. The TNEC project study area is indicated in Figure 1-1 in Section 1.4.

This document was prepared by Wood Environmental & Infrastructure Services (E&IS) technical staff in cooperation with Synergy World Power Ltd, and EnviroPower Renewable, Development, Inc. Synergy World Power Newfoundland, Ltd. will be established upon regulatory approval and financing of the Project.

1.3 The Proponent

EnviroPower Renewable Development, Inc. (EPRD) is the Project proponent. As described above, SWPNL is the yet to be formed company that will own and operate the TNEC. EPRD is led by seasoned energy professionals with executive management experience in the operation of electric utility companies and in the design, development, construction, and operation of waste to energy power plants. The team also includes established and experienced Canadian staff who will fill key management positions in SWPNL.

The SWPNL project team of scientists, engineers, local industrial professionals, and executive management has broad experience in infrastructure development, including conventional power plants and energy from waste facilities as well as a strong track record in construction and land development, as well as energy, utility, and environment related technical innovation.

EPRD is a Virginia, USA based renewable energy and liquid fuels project development company, incorporated in 2020. It is a subsidiary of EnviroPower Renewable, Inc., a private company that was incorporated in 2013 and has been operating under the current management team for the past three (3) years. The technical team has been involved with the company since inception. Contact information is shown in Table 1-1 and additional corporate information on EPRD can be found at https://eprenewable.com/.

Table 1-1: Contacts for EnviroPower Renewable Development Inc.

Title	Name
Chief Executive Officer	Mr. Keith Hulbert
Chief Technical Officer & Principal Contact for the Purposes of the EA	Dr. Bary Wilson, PhD

EPRD is a Delaware Corporation with a registered address of 13472 Point Pleasant Drive, Chantilly VA 20151 USA. Additional information on the TNEC Project can be found at www.SynergyWorldPower.com. Work on the TNEC project in Newfoundland and Labrador began in 2019 and has been focused on assessing the technical requirements, financial feasibility and capital costs of the potential project. EPRD's CEO has previous management experience in Labrador and the Project team includes two Canadian members with construction, waste management and real estate experience from the Lewisporte area.

1.3.1 Experience with Similar Projects

Synergy World Power's parent company team has many years of experience designing, constructing and operating facilities in other parts of the world that share components with this proposed Project (Table 1-2). Work in Newfoundland and Labrador began in 2019 and has been focused on assessing the technical requirements, financial feasibility and capital costs of the potential project. The EPRD team includes three Canada-based members who are deeply familiar with the local area. The TNEC project will be built out in two phases, the first of which is described in detail in this document and the second of which will be comprised of additional CHP and HTL capacity as warranted by future availability of feedstock and product market demand.

Table 1-2: Similar Projects Undertaken by EnviroPower Renewable Team

Project	Location	Technology	Details
Deeside Energy from Waste Facility	North Wales, UK	MRF, AD Plant and Gasification facility	Provided planning and multi-disciplinary design. 10 Mwe Gasification technology by Eqteq Spain. Owner – Logik Developments Manchester UK
Baddesley 10 MWe Biomass Facility	Warwick, UK	10 MWe RDF Incineration facility	Provided early development of complete facility. Owner – Equitix/GIB £61M
Haybridge Energy from Waste Plant	Somerset, UK	5 MWe Pyrolysis CHP plant	Provided early development of facility. Owner – Aeternis Energy
Brenig Wind Farm, 30 Turbine	North Wales, UK	60 MWe wind energy development	Provided planning, foundations, haul roads and grid connections. Owner – Germania Wind Energy Germany
Orthios Eco Park	Holyhead, North Wales, UK	RDF Incineration & Plastics to Fuel and Hydroponics	Provided various civil design to 300 MW Eco Park. Owner – Orthios Energy UK
Javelin Park	Gloucester, UK	190,000 tonnes p/a MSW	Gifford Consulting – early planning and design engineering services for £500M

Project	Location	Technology	Details
			EfW facility. Owner – Gloucester County Council/Urbaser
McIntosh Unit #5 501 Westinghouse Gas Turbine (now Siemens)	Lakeland, Florida, US	230MW Gas Turbine	Modified – EPC construction completion, commissioning and operations. Owner – Lakeland Electric
McIntosh Unit #3 Repowering	Lakeland, Florida, US	365MWe life extending conversion to modify away from waste and coal co-firing to coal only	Provided plan, design, conversion, commissioning, and operations. Owner – Lakeland Electric & Orlando Utilities
Winston Peaking Station	Lakeland, Florida, US	50MW quick start dual fuel source peaking and black-start generating station.	Design, construct, commission and operate. Owner – Lakeland Electric
Franklin County Combined Cycle	Franklin County, TN, US	500MW combined cycle	Owner - TVA
Fairless Combined Cycle Plant	Virginia, US	1000MW combined cycle	Owner – Dominion Energy
DeBary Peaking Station and Natural Gas Fired Station	Volusia County, Florida, US	730MW Natural Gas Fired Station	Permitting, liaison in public hearings, transmission and substation construction.
Rugeley B Power Station-FGD Plant	Staffordshire, UK	1000MW Coal-fired power plant	r.c. slip-formed silos and foundations and infrastructure for the FGD plant. Owner – International Power/GDF Suez
Atherstone Renewable Energy Park	Warwickshire, UK	Renewable Energy Park, Anaerobic Digestion, Biomass	Design, construction strategy and implementation. Owner – Merevale Estates/Park Top Ltd.
Duqm, Oman Integrated Waste Management System	Duqm Governorate of Oman	Integrated Waste Management System design including WTE gasification plant,	Complete Project Plan including needs assessment, waste characterization, EIA, landfill design, WTE gasification plant preliminary design. Owner: Omani Government. (Be'ah)

1.4 Project Financing

Although sustainability grant funding to assist with local infrastructure design, permitting and other regulatory costs would accelerate development, this Project is not dependant on public funding. Once registered and permitted, the Project will be financed by private investment. During the operations phase, the project will derive income from a variety of sources such as tipping fees, carbon credits, sale of recovered materials, sale of electrical energy, heated water, fuel and solid-state by-products as described in Section 3.1.4.

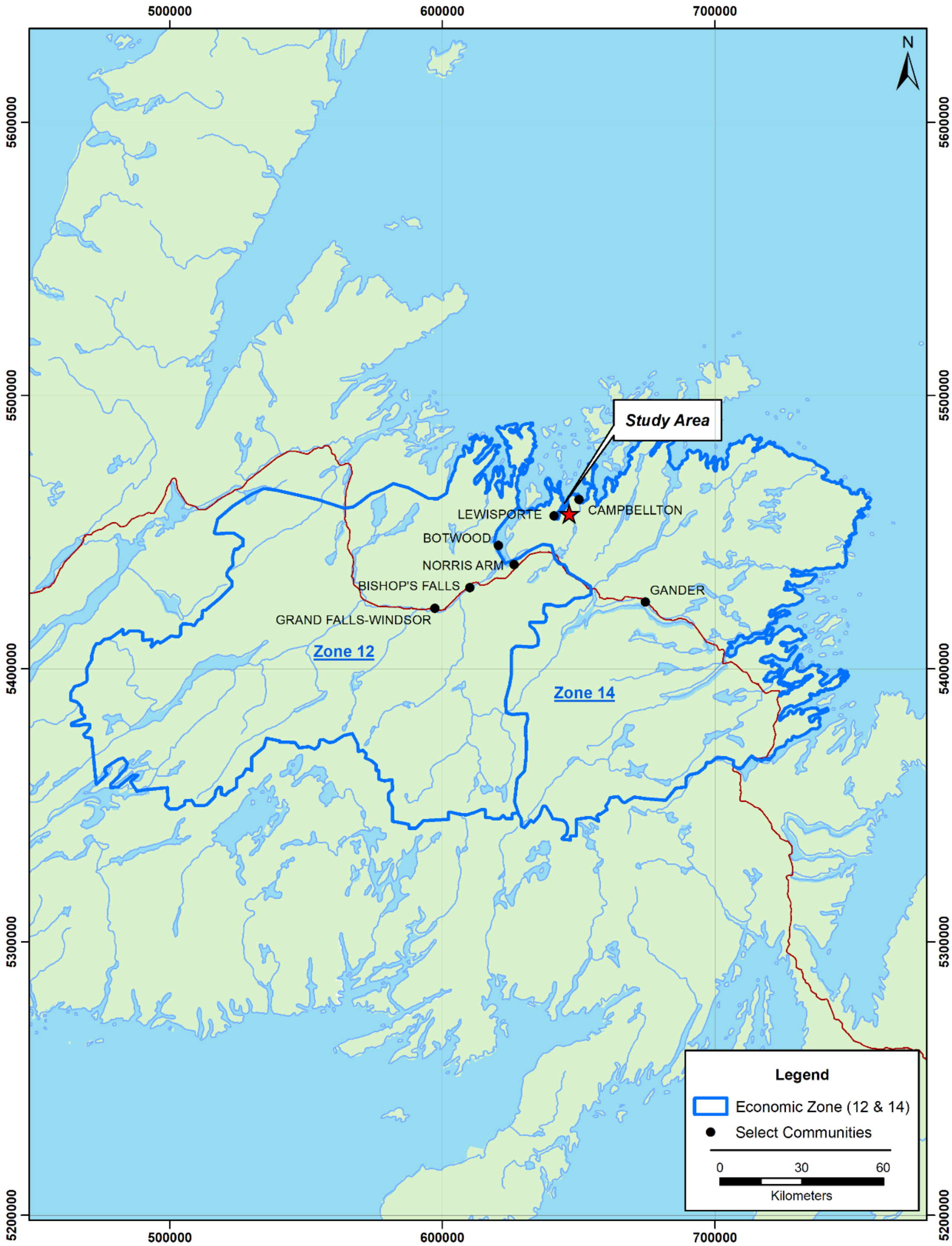


Figure 1-1 Location of the Terra Nova Energy Project

2.0 THE UNDERTAKING

The TNEC will be located along Route 340 relative to Burnt Bay and Lewisporte as shown in Figure 2-1. A rendered oblique view of the Project is shown in Figure 2-2. Locations of specific Project components may change during final engineering design. Changes may be due to topography, future engagement by regulators, local refuse derived fuel suppliers, and the off-takers for the electrical and thermal energy products, as well as for the aggregate by-product.

-

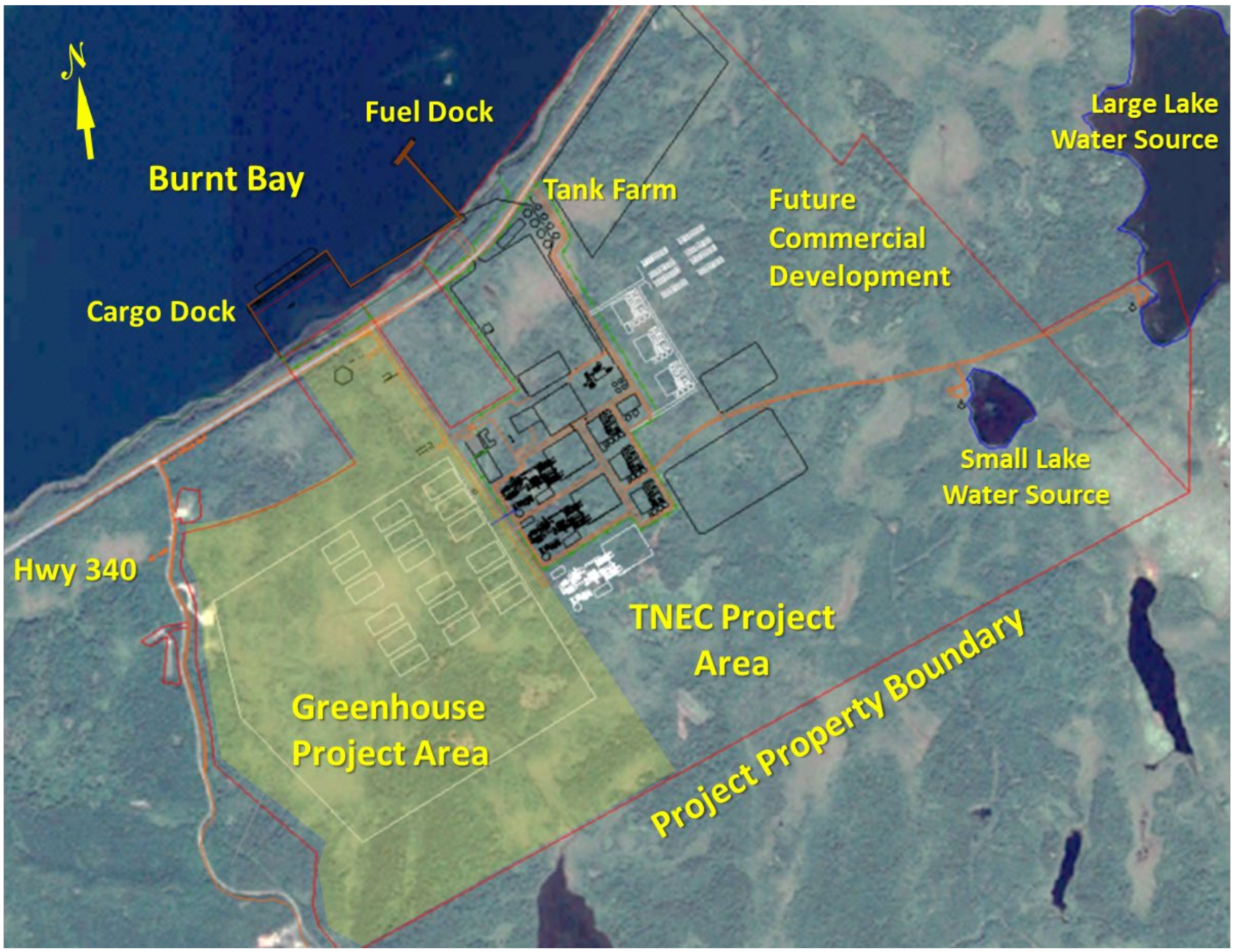


Figure 2-1 TNEC Location along Route 340 relative to Burnt Bay and Lewisporte

The area in which the agricultural greenhouses will be developed, on the western end of the property, is indicated by the yellow shading in Figure 2-1. This greenhouse development will be organized as a Public Private Partnership (PPP), administered by the Town of Lewisporte and supplied with thermal and electrical energy from the TNEC Project CHP plant.

An important objective of the Greenhouse PPP will be to increase the production of fresh produce in the province, helping it meet the mandated objective that 20% of the fresh produce consumed in the province should be locally grown. More information on this Greenhouse PPP undertaking can be found in Appendix A. An area east of the main TNEC Project, as shown in Figure 2-3 is designated for future commercial and industrial businesses related to the TNEC or port activities and will include commodity cargo holding areas and a worker housing camp.

A swimming pool and a visitor centre, open to the public, will be constructed on the west side of the main access road (Figure 2-2). The Project footprint will be approximately 54 hectares and will remain within the designated Project development area boundaries.

2.1 Purpose, Rationale and Need

The purpose of the Project is to bring a new, environmentally friendly, and socially beneficial industry to the Lewisporte area that will provide jobs and sustainable economic growth to central Newfoundland. Approximately 200 well-paying jobs will be created and hundreds of millions of dollars from outside Canada will be invested in new transportation, energy, agriculture, and marine infrastructure. Development of both phases of the Project will result in approximately a billion dollars (CAD) in plant and infrastructure improvements ranging, from approximately 100 million in new dock and port facilities to a public swimming pool, a visitors' centre, and corporate support for the Dietrac Technical Institute in Lewisporte.

Unbridled production of biomass and fossil carbon derived wastes poses an increasing threat to the global environment, as well as to human health and safety. Environmentally responsible management of solid waste is widely recognized as critically important in creating sustainable economic development. Advanced thermal processes for the clean conversion of waste plastic to ultra-low sulfur diesel motor and heating fuels, and the generation of renewable thermal and electrical energy from waste biomass, are important tools for achieving the economic and environmental sustainability goals of Newfoundland and Labrador.

While the Lewisporte Grand Falls-Windsor area of Newfoundland is rich in land, timber, marine and human resources, investment in major project infrastructure has been well below that justified by the opportunity in the area. Sources for revenue from outside the region are needed for further development and modernization, especially if it is to be truly sustainable. In addition to establishing a new corporate citizen, development of this Project will generate substantial employment, expenditures, and associated benefits to the province.

SWPNL will be paid to import clean, dry solid recovered fuel (SRF) from Europe and will use this material, along with SRF from Canada, as feedstock to make ultralow sulfur diesel (ULSD) fuel, heating oil, and other fuel products, while generating thermal energy that can be used for space heating in greenhouses and to generate renewable baseload electrical power to improve the NL power grid resiliency and stability by providing locally generated baseload renewable power.

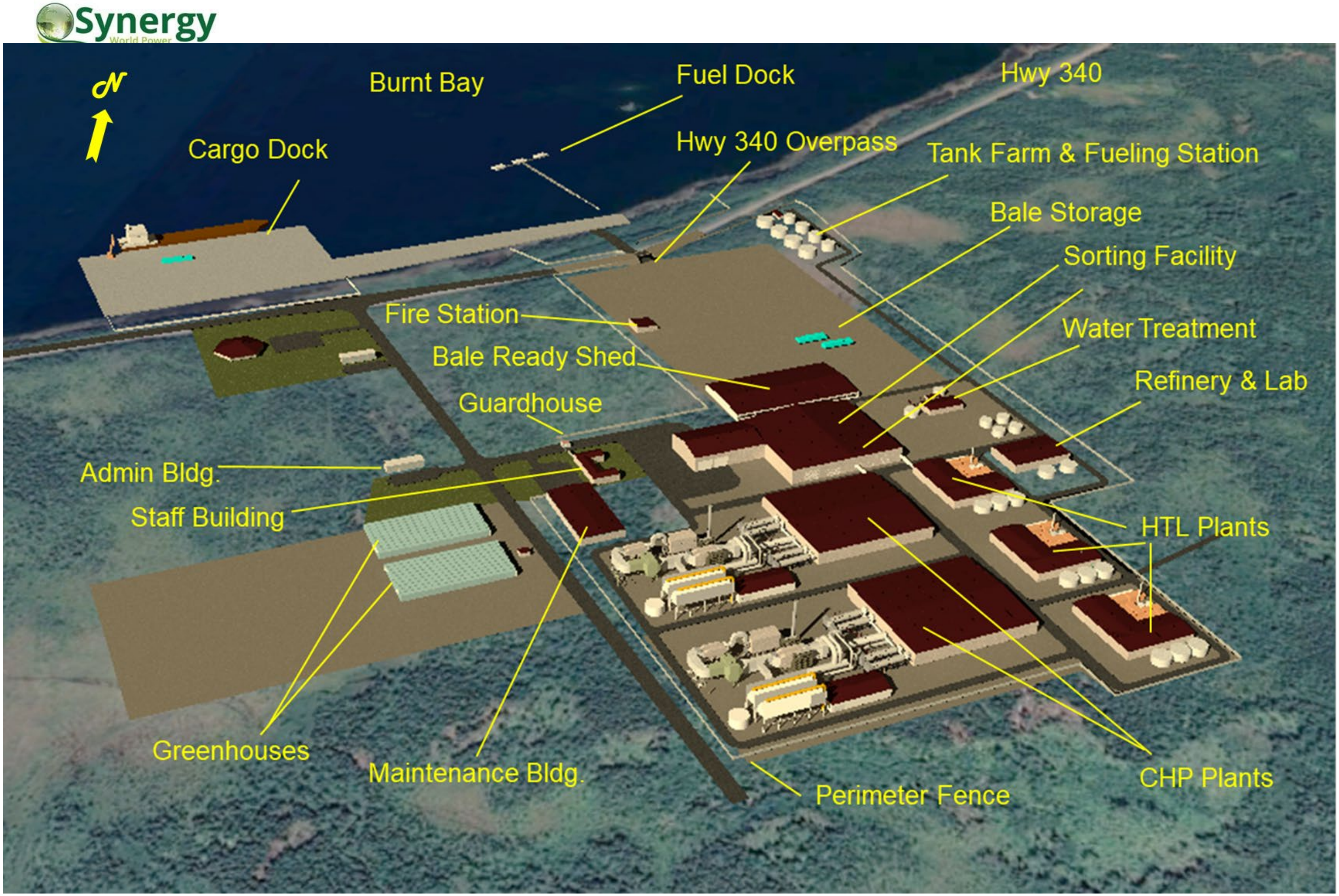


Figure 2-2 View of the TNEC Facility Looking North Towards Burnt Bay

In addition to direct employment, the Project represents a benefit to the province through economic diversity including the development of an environmentally beneficial industry based on new green technologies. Further benefits to the province will accrue from the Project due to the indirect services required for the Project and its employees, including construction, housing, materials supply and technical services, security and catering services. There is also the potential for spinoff businesses, especially in the energy, agricultural produce, and hydrocarbon fuel supply sectors.

The Project host town of Lewisporte, as well as nearby towns such as Grand Falls-Windsor and Bishops Falls, have been actively supporting the Project because of the potential for increased economic diversity and the environmental benefits it represents to the region and beyond. Likewise, the Town of Lewisporte, the Provincial Department of Agriculture, the Provincial Federation of Agriculture and local agriculturalists have all expressed an interest in the opportunities of increased crop production and diversity represented by the Greenhouse PPP component of the project.

Several local and regional suppliers and contractors have expressed strong interest in the Project, as have the proponents of a potential data centre project near Grand Falls-Windsor. Skilled petroleum industry and thermal power plant operation and maintenance personnel are available from within the Province as well as from elsewhere in Canada.

2.2 Project Planning and Alternatives

Given the nature of the feedstock for the Project, as provided both from Europe and Atlantic Canada, there are alternatives for both the siting of the Project, as described in Appendix B, and the thermal conversion technologies to be used, as discussed below.

The Lewisporte area of Newfoundland, with its abundance of virgin land, undeveloped sheltered coastline, and Atlantic seaport, is located as close to Europe as any in the Western Hemisphere. The area around Lewisporte is an ideal location for a new industry that produces fuel oil as well as thermal and electrical energy from refuse derived fuels.

Project planning took into consideration the international and Canadian economic and environmental benefits when siting the Project in Lewisporte. The area offers a sheltered and largely ice-free ocean inlet and seaport, as well as an ideal shoreline location for the construction of a port dedicated to the Project.

The Dietrac Technical Institute located in Lewisporte is prepared to conduct the skills training needed for the electrical, mechanical and computer skills that will be required at the TNEC site. The neighbouring Town of Grand Falls-Windsor is being considered for a data centre complex, which would be an off-take customer for renewable electrical energy potentially generated by the plant.

Compared to more developed port areas such as St. John’s, the Lewisporte area has more available land, while still offering adequate port facilities for oceangoing vessels, as well as other infrastructure such as roads and nearby fuel tankage, that supports the Project.

Construction of a deep-water port with a quay and roll-on roll-off dock facility at Lewisporte will provide bulk commodity products from Central Newfoundland with improved access to off Island markets. In addition to recovered low carbon intensity hydrocarbon fuels from the TNEC refinery, and aggregate for construction or cement products, the port will offer improved opportunities for export of timber, mineral, and agricultural products.

Thermal waste conversion technologies for power generation considered for this project included incineration, pyrolysis, and fluidized bed gasification (both air-fed and oxygen-blown). The environmental performance and reliability records for these technologies, especially air emissions, were considered. Conventional air fed gasification in robust and reliable rotary kilns was selected due mainly to its superior environmental performance.

The patented and patent pending EPRD LoNOx rotary kiln gasification technology has been reviewed and approved for use as advanced conversion technology in the UK, as well as by jurisdictions in Nevada, California, and New Jersey, in the US. A leading international manufacturer of the rotary kiln equipment that will be used in the project has agreed to manufacture, install, commission and wrap the rotary kiln gasifiers, as well as the reformer and LoNOx burner and associated equipment.

Cover pages of the patents related to the LoNox rotary kiln gasification technology are included in Appendix I. Two patents protect the LoNox design of the rotary kiln gasifier, and the third protects the elements of the design that enable the gasifier to produce the bottom ash as an inert inorganic aggregate. Each of the patents was originally filed as a PCT and provides protection in Canada, the UK, and elsewhere outside the US.

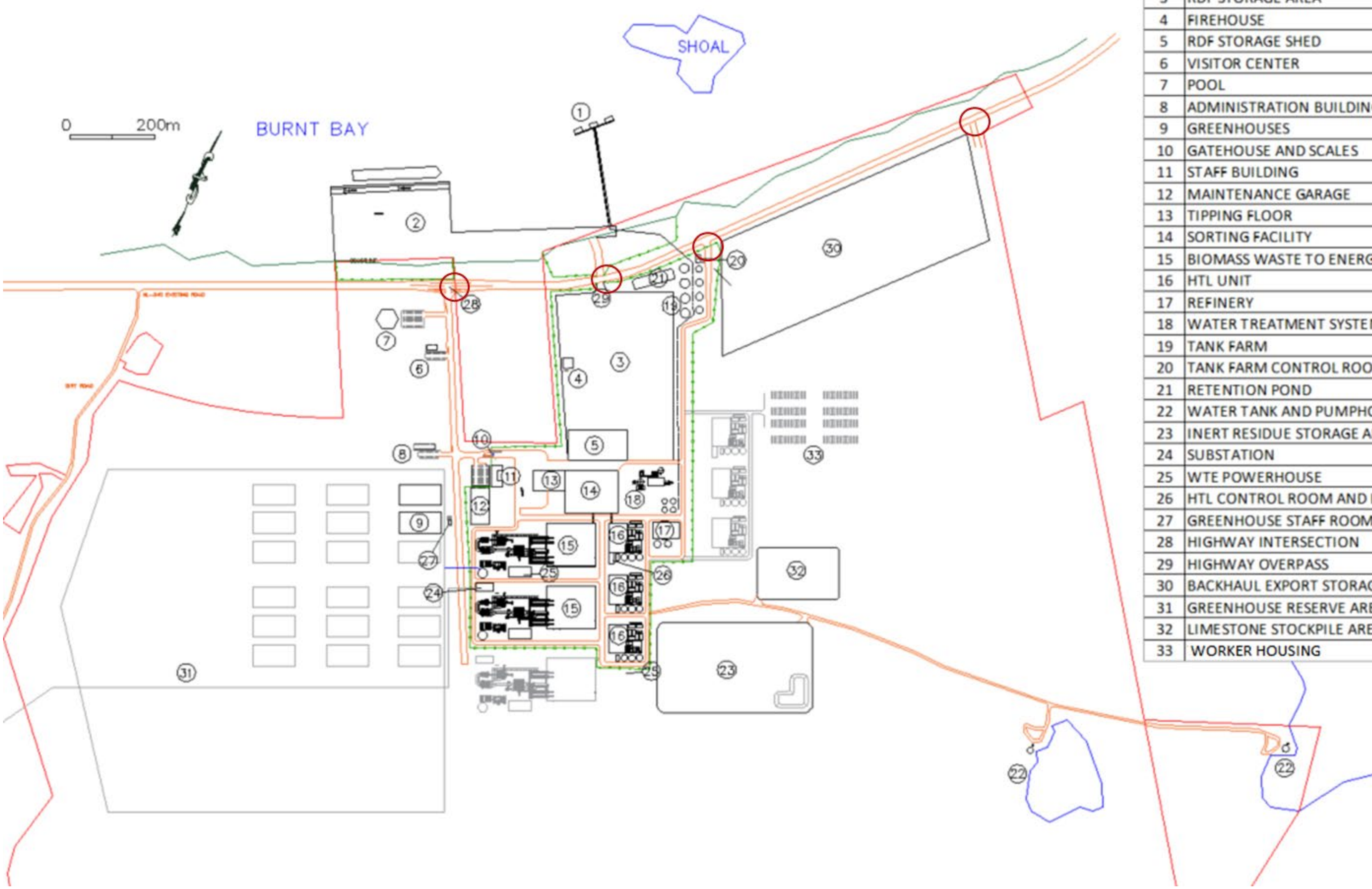
Power generation will be by conventional steam Rankine cycle technology with the steam turbines manufactured and wrapped by one of three candidate manufacturers. More detailed information on the gasification and hydrothermal liquefaction technologies selected for TNEC can be found in Section 2.5 below as well in in Appendices D, E and F.

2.3 Project Components and Layout

TNEC Project components are listed below along with short descriptions of their construction and function. The main plant will be constructed on an approximate 54-hectare site on the south side of Burnt Bay bordering Route 340. A new seaport will be constructed on Burnt Bay for the import of SRF feedstock from Europe and the export of liquid fuels and aggregate produced by TNEC, as well as other commercial and commodity goods produced in Central Newfoundland. A 138 kV intertie line will be constructed from the CHP plant substation to connect to the planned 138 kV Newfoundland Power line extending from Lewisporte in the direction of Boyd's Cove.

The overall TNEC layout is illustrated in Figures 2-1 and 2-2 above. Figure 2-3 is a plan view layout of the Project with the major components identified, along with ingress and egress locations along Route 340 circled in red. The area to be used for agricultural greenhouse PPP is located to the west of the main access road, as shown. The public swimming pool and visitors center are also to the west and accessed from the main entrance road and outside the TNEC secure area.

Synergy World Power



	DESCRIPTION
1	LIQUID FUEL DOCK
2	DOCK FACILITY
3	RDF STORAGE AREA
4	FIREHOUSE
5	RDF STORAGE SHED
6	VISITOR CENTER
7	POOL
8	ADMINISTRATION BUILDING
9	GREENHOUSES
10	GATEHOUSE AND SCALES
11	STAFF BUILDING
12	MAINTENANCE GARAGE
13	TIPPING FLOOR
14	SORTING FACILITY
15	BIOMASS WASTE TO ENERGY
16	HTL UNIT
17	REFINERY
18	WATER TREATMENT SYSTEM
19	TANK FARM
20	TANK FARM CONTROL ROOM
21	RETENTION POND
22	WATER TANK AND PUMPHOUSE
23	INERT RESIDUE STORAGE AREA
24	SUBSTATION
25	WTE POWERHOUSE
26	HTL CONTROL ROOM AND LAB
27	GREENHOUSE STAFF ROOM
28	HIGHWAY INTERSECTION
29	HIGHWAY OVERPASS
30	BACKHAUL EXPORT STORAGE AREA
31	GREENHOUSE RESERVE AREA
32	LIMESTONE STOCKPILE AREA
33	WORKER HOUSING

Figure 2-3 Layout of the TNEC Project Including Primary Fresh Water Source for the Project and Access Points Circled in Red

2.3.1 Main Plant Buildings

Materials Sorting Facility: The sorting facility will be used to separate plastic from biomass and the minor amount of metals and inert materials that will be in the SRF. Mechanical sorting equipment will include two single stream sorting systems, each with a 50 ton/hour capacity. The Sorting Facility will be housed in a steel frame building and the plant layout will be designed to provide room for expansion of the sorting and fuel prep lines. Equipment to be used in the Materials Sorting Facility is described in Appendix G. In this document the Materials Sorting Facility may also be referred to as the fuel prep facility, as it provides separated biomass plastic for the CHP and HTL plants, respectively.

Tipping Floor: A tipping floor adjacent to the Material Sorting Facility will allow for SRF to be supplied to TNEC by truck. The building will be designed to accommodate a lift for unloading haul trucks, if needed. The tipping floor area will also have cribs for storage of recovered metals. These cribs or bunkers will allow ready loading into bulk bags or dump trucks for transport from the Facility. The tipping floor area will be designed with a deluge fire suppression system and infra red sensing surveillance camera indicate possible hot spots from overheated motors, or heavy mobile equipment.

Hydrothermal Liquefaction (HTL) Plastics to Liquid Fuels Plant: The approximate 950 t/d capacity plastics to oil and fuel distillation plant will consist of 50 to 150 t/d modules, as well as an approximate 100 t/d dedicated line for processing of Polyethylene Terephthalate (PET). These units will be built and brought online sequentially depending on the amount and types of waste plastic reliably available to TNEC. Oil product from the HTL Plants will be stored in a settling tank prior to distillation and filtration in the refinery. The primary product will be ultralow sulfur #2 diesel fuel. Gas phase fuel from the HTL Process will be used for onsite power generation. Naphtha will be sold as gasoline blending stock or used for onsite fuel. Heavy end distillates and residual will be sold as marine bunker fuel. The Air Pollution Cleanup System and other environmental considerations for the HTL plant are discussed in Section 2.8.2. with a process flow block diagram shown in Appendix F.

Biomass Gasification Combined Heat and Power (CHP) Plant: Incoming biomass will be converted to renewable thermal and electrical energy in a gasification power plant. The gasification CHP plant will generate baseload power for use by TNEC components, and for electrical power loads such as the greenhouses associated with the Project. Baseload power from the CHP plant will be available to the grid via a 138 kV intertie. Figure 2-4 below shows a block diagram of an EPR CHP gasification plant. Extraction steam from one of the turbine generators will be used to supply hot water for heating the greenhouses.

The CHP plant will consist of a thermal island (compactor and ram feeder system, rotary kilns, reformer, LoNOx burner system, heat recovery steam generators, flue gas recycle system and air pollution control units), and a power island. The power island will include a condensing steam turbine rated at 50 MWe (nameplate) with an output voltage of 13.8 kV. The power island also includes an air-cooled condenser, boiler water make-up and treatment system, and a substation with high side output voltage of 138 kV.

Air permits granted for EPRD gasification power plants of this design include a synthetic minor stationary source permit from Clark County Nevada, and a permit to construct or modify and air contaminant source issued pursuant to the Tennessee Air Quality Act from Tennessee as shown in Appendix D. Also in Appendix D are a California Energy Commission pre-certification as a renewable electrical power source and a Sustainalytics Green Bond eligibility second opinion.

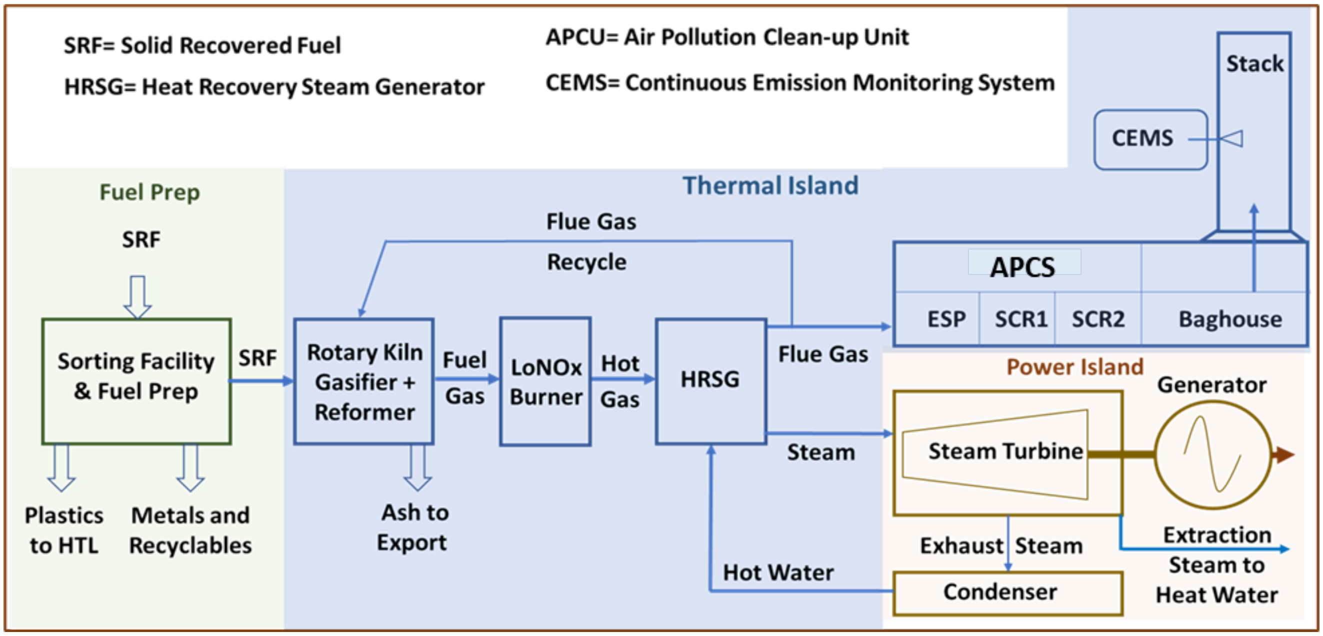


Figure 2-4 Block Diagram of an EPR LoNOx Gasification Combined Heat and Power Plant

The powerhouse will be designed to accommodate a total of three steam turbines. An additional 50 MW condensing steam turbine will be added to the powerhouse in Phase II, fired by the second gasification unit.

A smaller back pressure turbine, primarily for production of steam and hot water for heating of the greenhouses and large bay buildings onsite, will be installed in the powerhouse in Phase I. It will generate 5 MW thermal at a pressure of approximately 3 bar and a temperature approximately 95°C. Thermal energy produced by the plant in the form of hot water will be available for heating of local greenhouses under the greenhouse PPP.

The gasification power plant in CHP mode will supply an average of 36 MW to the grid and support up to approximately 40 acres of agricultural land covered by greenhouses. More heat can be produced as additional greenhouse acreage is developed.

The Air Pollution Cleanup System and other environmental considerations for this portion of the plant are discussed in Section 2.8.2., and process flow block diagrams for the APC systems are in Appendix F.

Laboratory: An analytical laboratory equipped to support fuel blending and quality control, as well as environmental compliance measurements, will be constructed in the refinery complex. This laboratory will be of poured concrete foundation and steel-clad construction, with well insulated walls and with added ventilation equipment as required by regulation for the types of test work conducted. The laboratory will be plumbed for water and sewage and will include fume hoods and with separate vents to the exterior. This building will be heated and air-conditioned using heat pumps. This laboratory will be located in the HTL conversion and refinery complex as shown in Figure 2-2.

2.3.2 Other Buildings

Administration Building: Executive and general administration offices will be in a separate building near the entrance to the Project site and outside the perimeter security fence. The Administration Building is expected to be of poured concrete foundation and concrete block construction with a stone facing. It will house a reception area, executive offices, conference rooms, a small food preparation area, a records and archives area, administrative staff offices and the Facility Central Monitoring and Control Centre. This building will be heated and air-conditioned using heat pumps.

Staff Building: The staff building will be located behind the security fence adjacent to the main employee parking area. An adjacent entry way through the security fence will allow badged employees to enter the staff building proper. Visitors will be directed to a reception area where they will be signed in with proper identification and shown a video with general rules of conduct and safety while on the premises. Appropriate safety gear such as protective eyewear, a hard hat and safety vest will be issued. Visitors will remain in this area to be picked up by a plant authorized escort.

The staff building will be the main personnel entrance to the plant. It will include changing rooms, lockers, bathroom, and shower facilities for all staff with workstations inside the secure area of the plant. The staff building will also include offices for supervisors, a lunchroom that also serves as a safety training area and a cafeteria and food service area. This building will be heated and air-conditioned using a heat pump system.

Maintenance Workshop and Warehouse Complex: The maintenance workshop will be located for ease of access and proximity of common services and infrastructure. The building will consist of sufficient servicing and maintenance bays and equipped with overhead cranes to service the mobile equipment fleet. A portion of the building will serve as a warehouse for spare parts and stock piping, steel, and other materiel. The building will have a poured concrete foundation and steel-clad construction, including in floor sumps for catchment of sediments and hydrocarbons from maintenance activities.

Oil/water separation units will be incorporated into the design where required. This building will be heated with hot water and will not have central air-conditioning (A/C). Offices in the complex will have wall mounted A/C as required. The building will be plumbed for bathroom facilities. The main work bay areas will be heated by a hot water radiator system.

Gatehouse, Weighbridge and Security HQ: A gatehouse and weighbridge monitoring building will be constructed adjacent to the plant site main entrance where employees and visitors will be required to check in and out. Security staff operations will be in the Staff Building near the gatehouse and main entrance to the facility. The easternmost exit gate from TNEC onto Route 340 will be controlled and monitored from the Security HQ, as will perimeter fence security cameras. The site will have a video monitored site perimeter security fence with an interior perimeter roadway for access to all points along the fence. Access control to tank farm perimeter road from Route 340 the worker housing and new industry area east of the TNEC, as shown in Figure 2-3, is yet to be determined.

Visitors Centre: The Visitors Centre will have exhibits and video presentations describing the operation of the plant and its benefits to the local environment and economy. There will be an adjoining kitchenette serving of food and public comfort facilities. The Visitors Centre will be hosted by appointment and may also be available for public functions by appointment. This building will be heated and air-conditioned using heat pumps.

Fire Station and Emergency Response: The fire station will be located to allow ready access to the areas where large quantities of flammable materials are used or stored. The fire station will be equipped with a pumper truck and an ambulance. A crew cross trained to man the fire and emergency response equipment will be onsite at all times. The Fire Station also serve as the primary health and safety emergency station where the site ambulance and other emergency response equipment will be positioned. The fire station engine bay will be heated with a hot water radiator system. Personnel areas will have a heat pump system for heat and A/C.

2.3.3 Storage Areas

Sintered Aggregate Temporary Storage Area: An engineered gravel pad will be constructed with drainage to a settling pond for storage of the gasification bottom ash that can be used for road grit or construction or architectural fill. This sintered ash aggregate will be used locally for block making, as construction fill, or exported back to the EU in bulk bags for cement products or aggregate. Storm water runoff from this storage area will be directed to a settling pond and water quality monitored before release to surface waters in accordance with Canadian environmental regulations.

Bulk Feedstock Storage Area and Ready Sheds: This area will include a gravel surfaced outdoor bulk bale storage area with adequate drainage to prevent flooding during rainstorms or from snowmelt. An SRF material ready shed for thawing and drying bulk fuel before sorting will be constructed next to the bulk bale storage area. These steel frame sheds will be enclosed on three sides and have fire control hydrants installed.

HTL Oil Refinery and Tank Farm: The refinery unit will consist of a filtration unit, settling tanks a distillation tower and product blending tanks (Figure 2-16). Distillates from the refinery will be stored in blending tanks until used in a final product formulation, which will then be stored in approximate 10,000 m^3 tanks prior to shipment. Since the HTL oil will come from mixed plastics, it will be important to have the capability to refine by distillation as well as to filter the fuel product before storage.

The tank farm will consist of larger storage tanks for diesel fuel and heating oils, naphtha, and heavy fuel or bunker oil. Distillation bottoms will be recycled into the process or blended for bunker fuel. Tank farm storage capacity has not been precisely determined but will not exceed 150,000 m^3. Aqueous ammonia and other reagents will be stored near their point of use elsewhere on the site (see Section 2.5.7).

2.3.4 Fuel Storage and Fueling Stations

Fuel Storage and Fueling Stations: Diesel fuel will be stored on site area for mobile equipment refueling. Diesel fuel storage and supply during construction will be provided by a fuel supplier. When the HTL refinery is on-line, a 5,000 m^3 fuel storage tank, offloading pumps, dispensing pumps, associated piping, and electronic fuel control/tracking system will be installed near the tank farm and will be supplied with HTL diesel from the storage tank area. A sump pump will be provided to remove precipitation from the bermed fuel catchment area.

2.3.5 Facility Microgrid

Facility Microgrid: Primary facility power will be provided by the steam turbine generator at the gasification CHP plant. Auxiliary power will be provided by two 5 MW reciprocating engine driven gensets used primarily for house power for the HTL units, refinery, and tank farm. These will operate on fuel gas by-product from the HTL units. Thermal energy from the exhaust of these reciprocating engines will be used for process heat by the HTL units. The two gas and naphtha-fired 5 MW piston engine gensets will also be connected to the microgrid through the generator substation. The Facility microgrid is described in more detail in Section 2.4.3 and Figure 2-21. The Air Pollution Cleanup System and other environmental considerations for this portion of the plant are discussed in Section 2.8.2.

Emergency Power Generation and Black Start Capability: As a component of the TNEC microgrid, the gasification CHP system will have Black Start capability using electricity from battery cranked gas fired reciprocating engine powered genset when isolated from the grid. For a more detailed description of the facility microgrid, see Section 2.5.5 and Figure 2-21.

2.3.6 Site Security

Site Security and Visual Impact: A security fence with electronic monitoring and an interior perimeter road will surround the TNEC site. The security perimeter will be monitored from the Security HQ in the Staff Building. Main access to the Project secure area will be through the main gate located along the main access road that intersects with Route 340 as shown in Figure 2-1. The port facility and dock will be accessed solely by means of the underpass from the secure area south of Route 340. A buffer zone of original trees and purpose planted trees other vegetation will be preserved along Route 340 to reduce the visual impact of the Project from the highway. Visual impact will be negligible due to the higher elevation of the Project compared to the level of Route 340.

2.3.7 Roads and Bridges

Highway 340 Interchange and Overpass: An overpass along Route 340 will allow access to the port facility from the main plant area. An interchange just west of the overpass approach will allow truck traffic to safely leave Route 340 and queue up, if needed, along the plant access road before entering the guardhouse and main plant area. Access to the port will be through the main gate and guardhouse.

The proposed underpass will be installed under Route 340 and can be constructed for concrete or corrugated steel coated to last over 75 years. There are no off ramps and only access will come from the TNEC secured yard. With an 8 meter drop off on ocean side of Route 340 there will on be an approximate 1-2 metre rise in the highway. A Newfoundland company located in Bishops Falls can supply the steel model.

2.3.8 Transmission Lines

138 kV Interconnect Line: A 138 kV feed-in line will be built connecting the TNEC generator substation to the 138 kV Newfoundland Power line planned to extend from Lewisporte in the direction of Boyd's Cove, allowing the splice in connection to be made on or near TNEC property. In operation the powerhouse will be under Newfoundland Power dispatch control by means of a SCADA system.

2.3.9 Marine Facilities

Bulk Cargo Port: A new cargo port for bagged SRF feedstock import will be built along the south shore of Burnt Bay for unloading of oceangoing vessels up to a maximum of 24,000 DWT. The dock will be constructed using partially driven rock socket reinforced tubular piles and backfilled with rock removed from the plant site. A suspended pre-cast/in-situ reinforced concrete deck will be constructed and installed. Rock for backfill of the dock structure will come from excavation of the main site in preparation for final grading and installation of the building foundations and pads. Berthing fenders will be installed. Dock dimensions will be approximately 180 meters by 280 meters, with a water depth at dockside of a minimum 13 meters. Elevation and plan view drawings of the dock are shown in Section 2.5.4.

Marine Fuel Terminal: Fuel produced by the HTL plant will be stored in approximate 10,000 m^3 storage tanks ready for loading onto tanker trucks for distribution or onto bulk tanker ships for transport to other markets in North America. Tanker ships for transport of liquid fuel products will be mainly in the 5,000 to 13,000 DWT capacity range and will in no case exceed 24,000 DWT.

TBD: Upgrade for Existing Lewisporte Dock and Onshore Infrastructure: The existing dock facility in Lewisporte will be upgraded for use by the Project to handle imports while the new bulk cargo port with shoreline dock and equipment for the unloading and loading of wrapped or bagged bulk cargo in being built.

2.3.10 Site Services

Water Management System: A water treatment management system will supply potable water for the site, as well as demineralized water for boiler feed water makeup. Water for this plant will be pumped from a pond on the property. This pond will provide feed for making potable water, raw water for washdown, and water for landscape and greenhouse irrigation.

Water Treatment Plant: A water treatment plant will process make-up water, pumped from a pond on the property, to provide the essential functions of potable drinking water as well as personnel sanitation, demineralized water for boiler feed water make-up, and, if necessary, the additional water required for ash temperature and dust control. Potable water supply and demineralized feed water will be produced from the pond water in a conventional reverse osmosis (RO) system and stored in a potable water tank. RO rejects will be stored and utilized as part of the ash temperature and dust control requirements. Demineralized water produced will be produced in a deionizer, stored and utilized for make-up of blow down, steam leakage and process steam consumptions.

Wastewater Treatment Plant: A membrane bio-reactor (MBR) based wastewater treatment plant will produce re-use quality effluent for a portion of the ash temperature and dust control requirements, facility wash down, toilet flushing, and for landscape and greenhouse irrigation functions, from all personnel and facility sanitary functions wastewater and any leachate generated. Wastewater purged in a slip stream from the water circulation loop of the HTL process will be treated by a sequence of treatments starting with activated carbon dosing, followed by dissolved air flotation, activated carbon filtration and ozonation polishing. Sludges produced will be disposed in the gasification process and vent gasses will be fed into the HTL's low NOx burner system.

Stormwater Pond and Sanitary Effluent System: Sewage generated within the Project site will be collected via an underground sanitary sewer network to a common location, where it will be treated in a septic tank system before release to a drain field. The plant site stormwater pond is located to the southeast side, and down-gradient, of the plant area. This pond will manage all plant site stormwater runoff prior to release.

Fire Suppression System: A fire suppression system with an underground pressurized pipeline loop and hydrants will be installed on the site. The plant will have a fire house and emergency response centre with firefighting and emergency response equipment including a fire control pumper truck and a trained crew capable of controlling and extinguishing fires on the site proper as well as in the dock area. Water deluge systems will be installed for the refinery, tank farm, bale storage area, sorting facility, tipping floor and SRF holding areas in the HTL and CHP plants.

Air Quality Monitoring Station: An air quality monitoring station, capable of determining levels of the pollutants listed below, will be considered at a suitable location near Route 340 at the west end of the TNEC project property nearest the Town of Lewisporte main business district. This station would be operated by TNEC and will make near real time data available to the public over the internet. Data from the station would be accessible through a link in the company website.

2.3.11 Other

Spent Reagent to Landfill: Dust and spent reagent from baghouse shake down and the electrostatic precipitator (ESP) will be wetted to prevent fugitive dust and sent to the Norris Arm Landfill for disposal.

Future Growth Potential: This document describes Phase I and Phase II of the TNEC Project as well as the initial development of heated agricultural greenhouses for production of fresh produce and other crops. The land grant from the Crown and the Town of Lewisporte provides space for future expansion of both the land area under greenhouses and the TNEC, as well as the development of associated follow-on industries that can take advantage of the thermal energy power land and new cargo port facility described in this document. As shown in Figure 2-3, this area will also be use for an onsite construction and worker's camp as described below. Phase II will comprise additional NTL and CHP units as appropriate in response to market demand and feedstock availability.

Construction Camp and On-site Worker Housing: A construction project camp with living quarters and services for approximately 200 workers will be acquired and set up on the site east of the main TNEC plant as shown in Figure 2-3. Infrastructure and utilities for the workers camp will be the responsibility of TNEC.

2.4 Construction

Construction work will be done by a qualified Engineering, Procurement and Construction (EPC) firm under contract. The EPC will be ultimately responsible for the final engineering design of the entire facility, as well as civil work, procurement, construction and installation and commissioning of the equipment. The selected EPC will use qualified subcontractors as needed and will guarantee the performance of the entire plant when completed. The anticipated Project schedule, including construction, is detailed in Section 2.7.

As a part of the Project planning and engineering design process, SWPNL will commission a LiDAR survey of the area in which the construction will be carried out, including the main site, shoreline port area, and 138kV interconnect power line route. The LiDAR survey will be flown by a drone and will produce a digital 3D topographical model of the land on which the construction will take place.

The 3D model will provide elevation data allowing cross sections needed to estimate the amount of rock, gravel and soil involved in the excavation, leveling and other earthworks required for site preparation. Descriptions and quantities of vegetation to be removed will be made by ground level surveys, as well as satellite imagery and visual spectrum images obtained from the drone overflight.

SWPNL will develop specific protocols as part of an overall Environmental Management System (EMS) to facilitate the execution of the site development in an environmentally responsible and safe manner.

In addition, SWPNL will develop an Environmental Protection Plan (EPP) specific to the construction phase that will outline best management practices for all construction activities. The EPP will be reviewed and approved by government regulators prior to the start of any site-specific construction activities.

2.4.1 Construction Activities Overview

Construction activities will include:

Site preparation includes cutting and clearing of vegetation and removal of organic materials and overburden over the areas to be developed. Site preparation will also include the development of construction stage water and erosion control (e.g., ditching, sedimentation ponds, etc.), arrangements for construction power from the Newfoundland Power line running adjacent to the site, and construction access roads.

Site Excavation and Earthworks for infrastructure development areas includes excavation, preparation of excavation bases, placement of structural fill, and grading to facilitate infrastructure construction. For the construction of the building and equipment pads, earthworks include stripping and stockpiling of organic and overburden materials and development of the grit Storage area with drainage. Excavation also includes the blasting and grubbing of material on the property to the south of Route 340 and the use of material excavated from this area as backfill for the new dock to be built on the south shore of Burnt Bay (see Figures 2-1 and 2-3).

Construction of off-site Infrastructure: placement of concrete foundations, and construction of buildings and infrastructure as required for the Project.

Installation of utilities: construction and connection of power, water, sanitary sewer and fuel supply infrastructure.

Major equipment installation: Further details on specific construction and development activities are provided below.

Vegetation Removal: In preparation for earthworks, site development, and infrastructure construction, vegetation removal will be completed over development areas in accordance with the cutting permits issued. Vegetation removal will be planned as per the regulations pertaining to bird breeding seasons, and where/if the schedule requires vegetation clearing during bird breeding seasons, experienced environmental monitors will inspect clearing areas ahead of the work to avoid disturbance of nests. Selection and planting of appropriate types of trees on the site for landscaping purposes will be done with the oversight of a qualified environmental monitor. Vegetation removal along the power line right of way will be carried out by crews experienced in the selective trimming and removal of trees and brush.

Earthworks: The Project will require earthworks development to support infrastructure, such as the roads, the new dock, buildings, the CHP and HTL process plants, bale storage pads, and greenhouse pads and water system development. Based on available mapping information, it is known that the surface elevations across the site vary from approximately 15 to 75 meters above sea level and the soil conditions vary from boggy areas, thin to thick till layers, and bedrock outcrops. It is assumed that building foundations will be constructed on dense, natural glacial tills, bedrock, and/or structural fill. In general, the foundations throughout the Project will require a soil cover of 1,800 mm, or equivalent, for frost protection. Surficial organic materials will be removed from the footprint of the Project structures before placing foundations or structural fills.

Building foundations and equipment pads and foundations will be prepared and placed on natural, dense glacial till, bedrock, or compacted, engineered structural fill. Structural fill is expected to be sourced from or through cut and fill civil earthworks at the site.

Concrete: Concrete will be required for building footings and foundations, rotary kiln plinths, process equipment pads, and other site construction and development features and is expected to be primarily batched on site. Coarse aggregates are expected to be crushed from material excavated onsite to allow leveling and grading or from site rock quarries. Fine aggregates (sand) are expected to be sourced from local quarries in the area. Some pre-cast of larger building footings may be poured off-site and transported to the site, if the schedule requires.

Fuel Supply During Construction and Operations: Fuel required for construction equipment will be provided by the contractor(s). Temporary storage and fueling locations and procedures will conform to applicable regulatory criteria. During operations mobile equipment will refuel from onsite produced diesel fuel. The refueling station will be located on the tank farm property and will be protected by a deluge water system.

Construction Power: Site power during construction will be provided from a Newfoundland Power 14.4 kV power line on wooden poles running along Route 340 adjacent to the plant site. A temporary hook-up will consist of a three-phase line mounted on wooden poles to a central location on the site with a transformer tapped to provide 460 V, 240 V and 120 V, at 60 Hz.

2.4.2 Dock Construction

Plan and elevation view drawings for the dock at TNEC are shown in Figures 2-5 and 2-6. The proposed reinforced concrete quay, which will have a berthing face of 280 metres and width of 60 metres, will be supported on 1,200 diameter tubular steel piles at 10 metre centres. Prior to confirming the design of the berthing quay an extensive geotechnical investigation will be carried out to determine the diameter, wall thickness and length of the piles. Should driving depths be limited due to the hardness of the strata, rock socketing will be carried out using pile top drilling rig techniques.

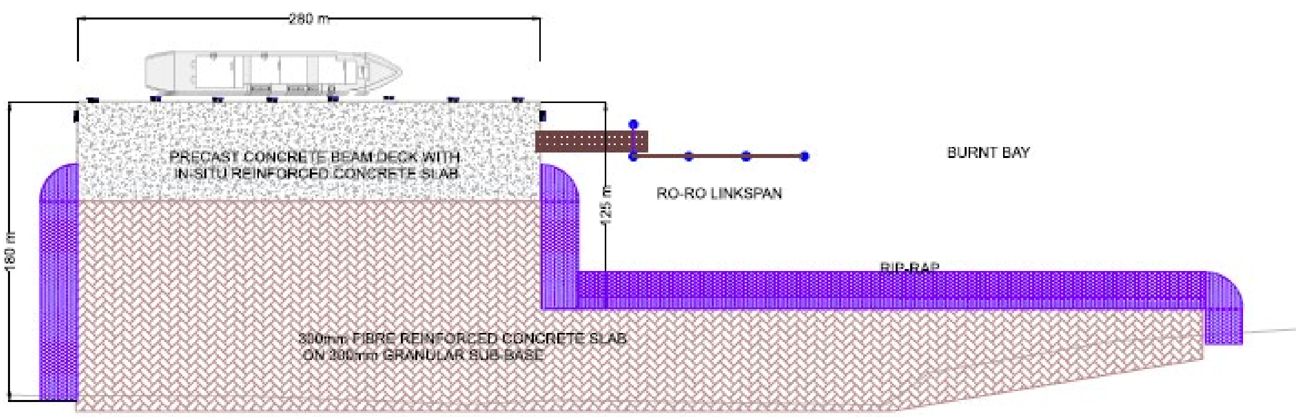


Figure 2-5 Plan of Berthing Quay, RORO and Dock

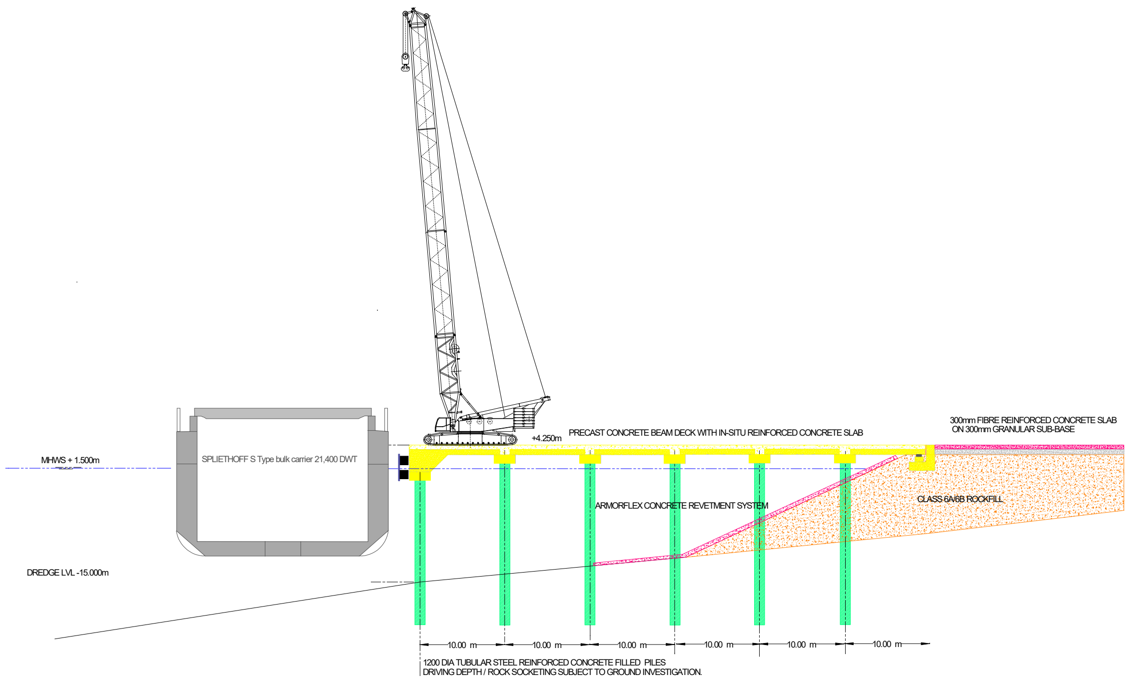


Figure 2-6 Sectional Elevation of Proposed Quay Construction Sequence

The berthing quay deck construction will consist of pre-cast beams and planks with an in-situ concrete slab to complete the quay. The front wall will predominantly act as a one-way spanning slab, spanning between the main transverse beams. It will be designed to transmit berthing loads to the main transverse beams in the deck and to the upper concrete slab. Deep reinforced concrete U-beams run transversely from the front wall which will allow reinforcement cages to be placed prior to placing concrete to complete the beams. The upper deck slab will consist of pre-cast planks to form the deck soffit with reinforcement and in-situ concrete cast to provide a homogeneous structural element. This will allow work to be carried out as rapidly as possible. Mooring bollards and fenders will be fitted on completion.

The main dock will be constructed using rockfill locally won from the main site, with a 300 mm fibre reinforced concrete service slab laid to falls to allow the surface to drain. The dock surface will be paved with reinforced concrete that can withstand the high loading associated with the movement of heavy equipment used for loading and unloading ships.

Once the geotechnical investigations are completed, and the pile design confirmed, work will commence by constructing a rock bund out into Burnt Bay up to the line of the bank seat foundations for the berthing quay deck. This will allow plant, equipment and resources to access the berthing quay construction area.

Following completion of the access bund, a jack-up barge with service crane, pile top drilling rig and hydraulic impact hammer will be mobilised with attendant flat top barges. Examples are shown in Figures 2-7 and 2-8. It is envisaged that a large jack-up barge with appropriate pile gates will install the tubular steel piles and drill rock sockets, as necessary.

Figure 2-7 Pile Top Drilling Rig

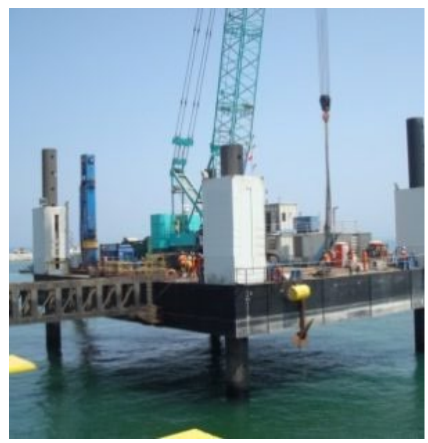


Figure 2-8 Coastal Jack-Up Barge

Once pitched, the piles may be driven to depth using a hydraulic impact hammer or if the geological conditions dictate, pile top drilling will be carried out to allow the tubes to be advanced prior to socketing and concreting. The steel casings are essentially sacrificial in that the reinforced concrete internal pile is designed to carry the full dead and imposed loads. Pile installation is illustrated in Figure 2-9.

Precast concrete "doughnut" units will be placed on top of the completed piles to act as landing points for the precast U-beams. The precast units provide the platform from which to complete the quay superstructure with reinforcement and in-situ concrete. Concrete will be pumped from the access bund/main dock service area.

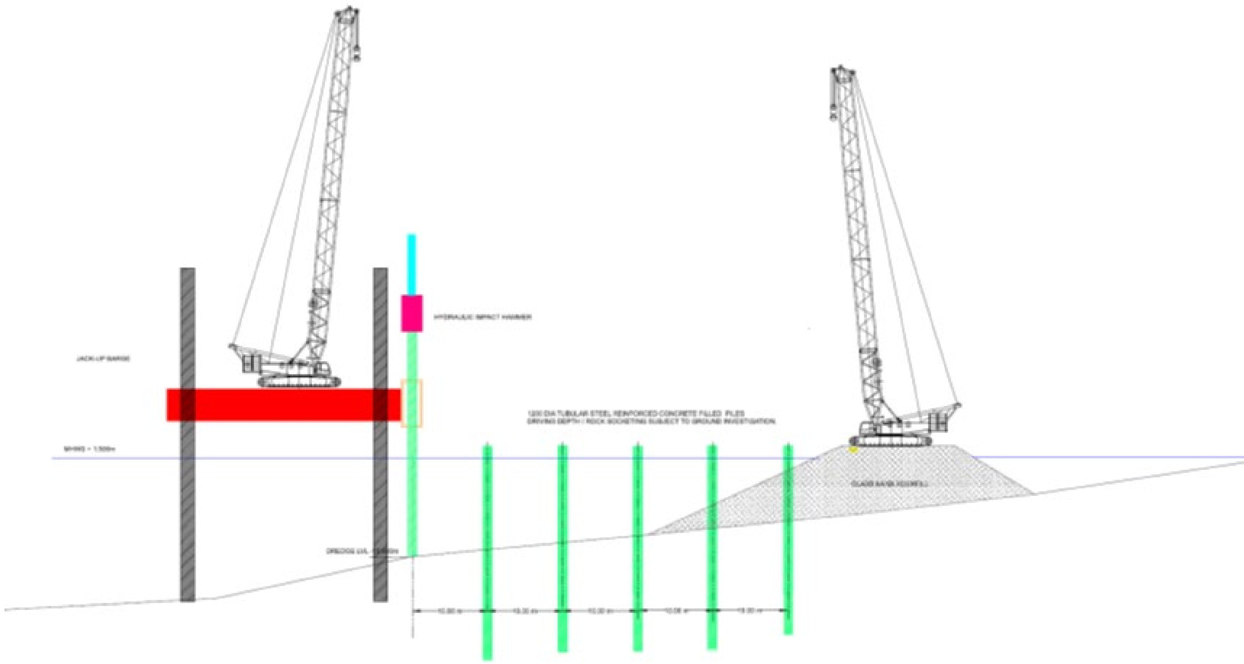


Figure 2-9 Pile Installation Sketch

2.5 Operations

2.5.1 Project Technology

Figure 2-10 on the following page shows an overall process flow block diagram for the TNEC. This material and product stream flow overview is followed by more detailed descriptions of the gasification CHP and HTL technologies to be used. Air, water, and solid-state terrestrial emissions to the Norris Arm landfill from the TNEC are described below. As shown in Figure 2-10 imported SRF in plastic bales and non putrescible biomass and plastic waste delivered by truck from Canada will be mechanically separated (Appendix G) into mainly biomass and plastic fractions with metals and inert metals removed. The biomass fraction will be used as feedstock for the CHP gasification plants, while the plastic will be converted to ULSD, low carbon intensity liquid and gas phase fuels by HTL. HTL processing will be carried out in modular units of between 50 and 150 t/d capacity each.

Hydrothermal Liquefaction (HTL): Proprietary technology for hydrothermal liquefaction (HTL) of plastics waste to liquid fuels is being developed combining best practices in high pressure food processing with well established petroleum refining systems and adapted use for the waste plastics recovered from the SRF. In the HTL conversion process, the main conversion reactions take place in superheated high-pressure water, resulting in a cleaner and generally higher energy fuel than can be obtained from conventional pyrolysis of plastics.

Waste to Energy (WTE): Proprietary LoNOx rotary kiln gasification technology from EPR is the best available for a low emission biomass to energy conversion and will be used for the gasification CHP waste to energy power plant to produce both steam for heating and baseload electrical power. Electricity from the CHP plants will be produced by conventional steam turbine generators. Extraction steam generated by one of the turbines will be routed to a heat exchanger to produce hot water for heating greenhouses on the Lewisporte owned agricultural land as shown in Figure 2-2.

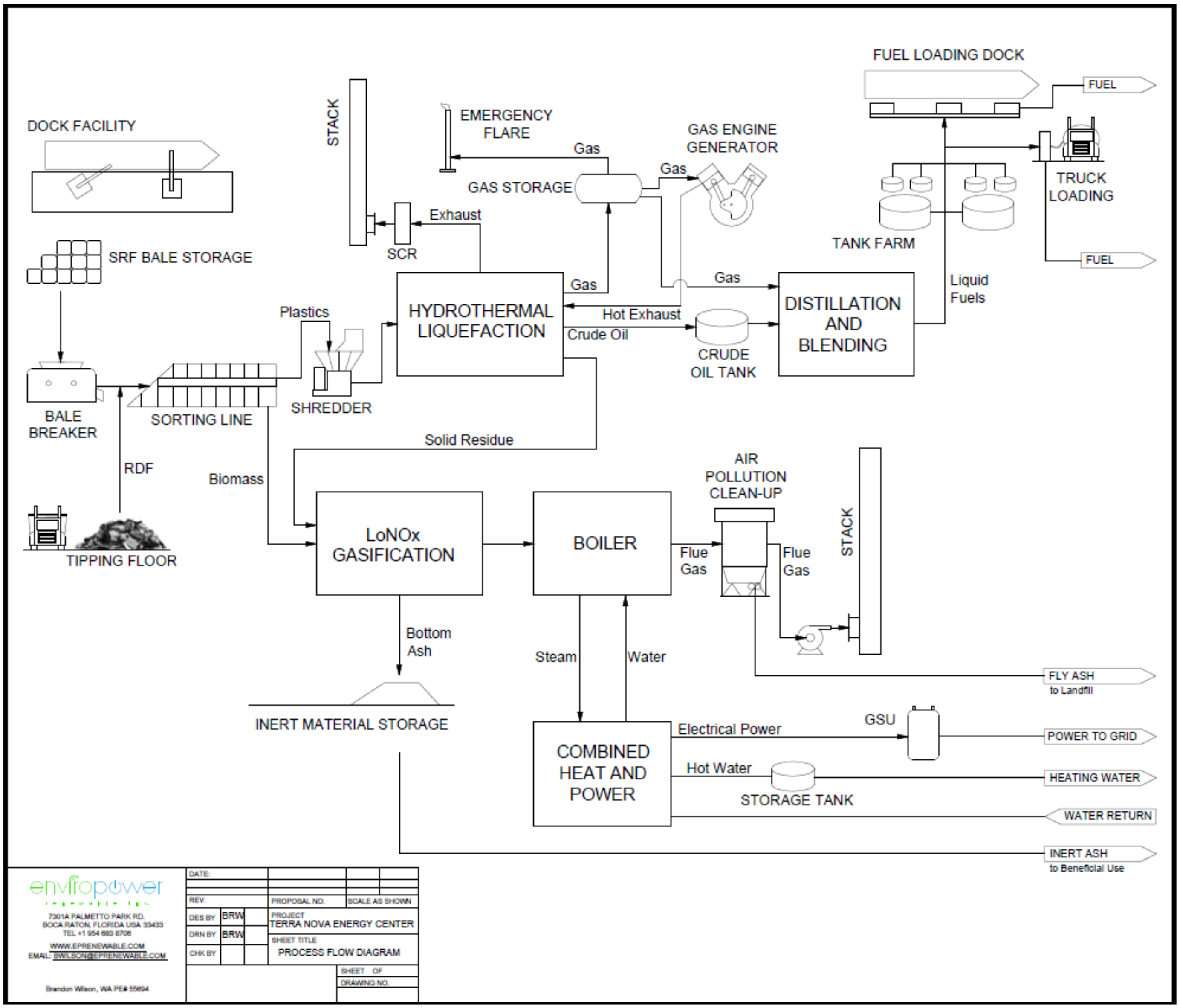


Figure 2-10 Block Diagram Overview of TNEC Technical Operations

Multi-fuel reciprocating engines used in the HTL units will also serve as additional generating sources for the TNEC microgrid and may eventually be used to generate peaking power for the grid. Figure 2-10 above shows a block diagram of the integrated biomass gasification and HTL processing of plastics to create liquid and gas fuel. The Air Pollution Cleanup System and other environmental considerations for this portion of the plant are discussed in Section 2.8.2 and Appendix F.

Hydrothermal Liquefaction for Conversion of Mixed Plastic Waste to Low Carbon Intensity Fuel

Withdrawal of China and other Asia-Pacific countries from the waste recycling market has resulted in large accumulations of both plastic and cellulosic carbon wastes at material recovery facilities and landfills in many western countries. In North America, attention has turned to the development of environmentally responsible waste to energy technologies to convert these combustible wastes to renewable electrical power or clean hydrocarbon fuels. Due to their relatively high calorific value, non-recyclable plastics are best utilized by conversion to distillate fuels using processes such as hydrothermal liquefaction (HTL). This process can convert both plastic and biomass to ultra-low sulfur diesel fuels, naphtha, and fuel gas.

TNEC will be using a proprietary HTL process for its plastics to fuel systems. Similar HTL technologies have been deployed in commercial applications, including a plant that processed 300 wet tons per day of turkey waste for ConAgra. This plant produced approximately 11 million liters of EPA certified alternative diesel fuel per year. When using waste plastic as a feedstock, EPR's proprietary HTL process can produce ASTM D 975 ultra-low sulfur diesel (ULSD) and ASTM 396 ultra-low sulfur fuel oils.

The HTL refinery will allow for changes in fuel product specifications as required by seasonal changes and by end-user. Products with boiling pint ranges from naphtha to marine bunker fuels can be produced from the HTL oil. All products will qualify as ultra-low sulphur and low carbon intensity fuels according to the Canadian Clean Fuels Standard.

2.5.2 Feedstock Materials

Incoming TNEC feedstocks from Europe for gasification (mainly biomass) and HTL conversion (mainly plastic polymers) will be supplied in accordance with the EU Waste Framework Directive (Figure 2-11). The Waste Framework Directive lays down basic waste management principles. It requires that waste be managed:

- Without endangering human health and harming the environment
- Without risk to water, air, soil, plants, or animals
- Without causing a nuisance through noise or odors
- Without adversely affecting the countryside or places of special interest

The EU Waste Framework Directive recognized the following hierarchy shown in Figure 2-11 below for non-waste, reusable material recycled material and recovered material as preferable to disposal in a landfill. SRF is considered recovered material under this system.

At the next level, content of the SRF imported to TNEC will be controlled by a written contract according to detailed specification sheets. The contract will include penalties and recourse for out of specification materials in the SRF. It should be noted that the production of SRF in the UK and certain other western European countries is an intermediate industry in and of itself and the suppliers with whom SWPNL will contract are credit rated and bondable. With regard to SRF from the EU:

- Hazardous waste is not allowed, and there will be none in the SRF.
- Out of spec waste will be returned according to the agreement (contract).
- Fuel will be ready to process depending on whether pre-shredded or not.
- No sorting will be required. Plastic will be mechanically separated from the biomass with the biomass being gasified, the plastic used as an HTL feedstock

Figure 2-11 EU Waste Hierarchy

The main onsite quality control will take place at several points along the automated sorting line that will separate plastic from biomass. At these points, human operators overwatch the sorting process and can manually remove any mis-sorted or out of spec materials. Figure 2-12 on the following page illustrates the preparation and shipping process for baled SRF.

For Feedstock coming in from the Norris Arm Materials Recovery Facility (MRF) or from other sources in Canada, any materials in the SRF that do not conform to the specifications will be handled in several ways. Depending on contractual arrangements, any out of spec materials in Feedstock material from Canada will be removed stored temporarily and then returned to the supplier. Alternatively, the supplier may pay for out of spec materials to be disposed of in the Norris Arm regional landfill. Anticipated handling procedures include:

- Specifically: inert materials (excess glass, soil, rocks ceramics, concrete, etc.) will be stored in the inert grit storage area, sent to the Norris Arm landfill, or shipped back to the supplier at the supplier's cost.
- Excess moisture SRF or SRF shipments that are below the required calorific value. These will be mixed with other drier or higher calorific value materials and gasified. The supplier will be advised of the variance and will create and designate a higher calorific value shipment to bring the average calorific value of the SRF above the minimum when calculated on a monthly or quarterly basis.
- Hazardous materials in the SRF: Hazardous materials, as defined by the Waste Framework Directive are strictly prohibited and SWPNL does not anticipate inclusion of these in sorted and shredded SRF. Hazardous materials such as pesticides solvents household cleaning (caustic or acidic chemicals) chemicals will not be in the imported SRF.
- If smaller items such as small batteries, are found in the SRF they will be separated and stored onsite and either shipped back to the supplier or safely disposed of in the Norris Arm landfill under an arrangement to be determined.

Figure 2-12 Preparation, Transport and Storage of SRF

Feedstock materials coming in from the Norris Arm MRF, or elsewhere in Canada, will have been sorted to SWPNL SRF specifications (although not necessarily pre-sized). No run of the dump shipments will be solicited accepted or allowed at TNEC.

Typical Contractual Description of SRF

The SRF shall be made from non-hazardous municipal and commercial waste that is produced by one or more Materials Recovery Facility (MRF). Typical waste municipal composition is shown in Table 2-1. The MRFs are equipped with plant and machinery and facilities for automated and manual sorting of waste including screens, magnets, eddy currents, ballistic separators, crushing and cutting, optical sorting, pneumatic sorting and handpicking, in different combinations.

During the sorting process, all relevant recyclables are removed from the incoming waste, including recyclable paper, plastic, wood, metals, glass and inert material. Organic and biodegradable material and fines (small particle size fractions) are also removed from the waste stream. The residual SRF then includes non-recyclable materials suited for energy recovery, including non-recyclable paper and light plastics (bags), wood and textile, which is baled and wrapped for safe transportation. Typical specification of this material is as follows:

- Fraction size: 0.3m x 0.3m x 0.3m
- Calorific value: 12-16 MJ/Kg HHV, as received
- Moisture: <30%
- Inert Material: <5%
- EWC Waste Code: 19 12 10

Table 2-1: Typical Composition of Feedstock Waste by Material

Waste Component	Percentage
Plastic	15-25%
Paper/Cardboard	30-50%
Fabrics	5-15%
Wood	5-15%
Metals	0-2%
Inert Material	3-5%
Moisture	20-30%
Hazardous Material	0%

Feedstock for Both the CHP Gasification Power Plant and HTL Plant

Combined Heat and Power Plant:

The Solid Recovered Fuel (SRF) for the CHP Plant will primarily (750,000 tonnes per year) be shipped to Newfoundland in Bulk Carriers from UK and European sources. Typical composition is shown below in Table 2-2. This fuel will be a pre-sorted clean waste to a designed specification for our plant. The specification defines calorific value, moisture content and its form and quantity. The fuel comprises largely of biomass (wood/paper/cardboard) in the order of 50%, light plastics in the form of polyethylene bags in the order of 25-30%, textiles, composites approximately in the order of 20%. There will be no putrescible or hazardous material. Moisture content will typically be 30% or less.

The fuel will be shredded to a size suitable for the rotary kiln and will then be baled and wrapped in typically one (1) tonne bales ready for shipping. The fuel may include a very small quantity of glass or metal that has eluded the sorting process. Any unacceptable loads of fuel will be sent back on returning ships to the supplier so there is a real incentive, on their part, to avoid this and in practice rarely occurs.

2.5.3 HTL Plant

TNEC will be using the HTL depolymerization process, which has been commercially proven at the 300 TPD scale two decades ago, including recent innovations that combine best practices in high pressure food processing with well established petroleum refining systems and adapted for use with the waste plastics recovered from the SRF for conversion to liquid fuels. EPR plans to have a 50 TPD commercial scale treatment module operating in the USA well prior to “notice to proceed” for the HTL modular systems to be built on the TNEC site.

The Plastics for this plant will also largely (where they cannot be obtained locally) be shipped in from UK and Europe in 1 tonne plastic wrapped bales for use in the plant.

EPRD is developing HTL for the conversion of mixed plastic wastes to liquid fuels. HTL was selected over conventional pyrolysis because HTL process equipment is simple, relatively inexpensive compared to conventional pyrolysis, and more readily maintained.

HTL processes use superheated water at high pressures in a simple, well controlled system to convert carbonaceous waste to liquid fuel. HTL conversion of mixed plastics (fossil carbon) to fuel oil has been well demonstrated in the scientific literature. Because HTL processes operate in a chemically reducing environment, HTL generally produces a better-quality fuel oil from a wider variety of waste plastic feedstocks than can be obtained from conventional pyrolysis processes.

Due to their relatively high calorific value, non-recyclable plastics are best utilized by conversion to fuels using processes such as hydrothermal liquefaction (HTL). This process can convert both plastic and biomass to ultra-low sulfur diesel fuel oils, and methane fuel gas.

Quality Control of the Feedstock

All feedstock for the plant originating from Western Europe or the UK will be covered by the EU Waste Framework Directive https://www.gov.uk/guidance/importing-and-exporting-waste.

These regulations apply from the point of loading the feedstock until it has been fully recovered or disposed of at the destination facility. Failure to follow these regulations, may constitute a criminal offence and result in prosecution, financial penalties and imprisonment.

The controls that apply to your shipment will depend on the:

- treatment planned for the material when it reaches its destination
- country of destination and the transport route
- material type

HTL Process Description

HTL processes use superheated water at high pressures in a simple, well controlled system to convert carbonaceous waste, in this case waste plastic, to liquid fuel. At temperatures well above the standard boiling point of water, and pressures above a few hundred psi, the properties of water change, making it a good solvent for organic materials. This superheated water conversion requires substantially less thermal energy than steam extraction because the water is held in the liquid phase by the high pressure, thus avoiding the need for the additional energy required to evaporate the water.

HTL conversion of mixed plastics (fossil carbon) to fuel oil has been well demonstrated in the scientific literature, as has hydrothermal conversion of biomass (cellulosic carbon), as well as unseparated municipal solid in general waste (plastic plus biomass). HTL fuel from plastics waste is not fatty acid methyl ester ("FAME") bio-diesel, which is often restricted as a blending stock.

HTL fuel oil yields depend on the feedstock. One metric ton of mixed plastic produces nominally 600 liters of a #2 diesel fuel, while the same amount of dry biomass yields about 160 liters of fuel, and a metric ton of food waste (mostly water) yields approximately 40 liters of fuel. Addition of a catalyst can increase conversion and alter the gas phase to liquid phase product ratio.

Production of non-condensable gases (used as generator fuel) also varies according to feedstock in proportion to the liquid fuel yield. Solid fuel yield is inversely proportional to the amount of available hydrogen in the feedstock or reactor environment. HTL allows process conditions to be controlled so that most of the hydrocarbon product leaves the process as a diesel base stock fuel oil.

The product fuel meets ASTM D 975 specifications for a motor fuel, and/or ASTM D 396 specification for a fuel oil. Heavy ends (90% over above 673°F) can be recycled to extinction in the process, if needed.

Prior to refining, these products do not have the additives that may be needed for motor fuel use in specific jurisdictions. Additives required for motor diesel such as oxygenates from biodiesel, may be added as required. Oil from HTL of plastics would reduce GHG emissions by up to 14% compared to conventional diesel from petroleum crude. The refined liquid fuels from the HTL Plant will be low carbon intensity fuels and meet the Canadian national clean fuel standard criteria.

Figure 2-13 shows a simplified process flow block diagram of the HTL process. The use of superheated high-pressure water as a reaction medium means that many of the unwanted elements such as sulfur, chlorine, nitrogen, and oxygen will be dissolved and remain in the water when the oil and water phases are separated.

Not shown in the diagram is the recycle of heavy end oils back through the water reactor to continue the cracking process, resulting in lighter oils. Using water as a reaction medium also allows the use of dead leg devices to remove any insoluble particles from the reaction mixture based on their density.

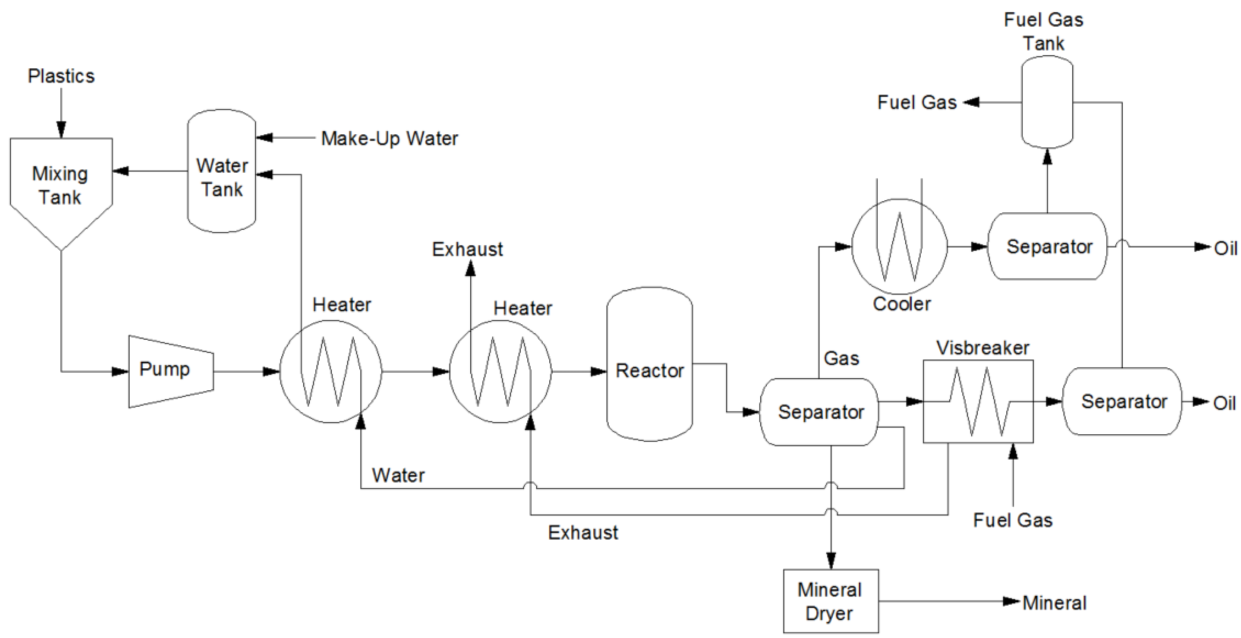


Figure 2-13 High Level Hydrothermal Liquefaction (HTL) Process Flow Diagram

Finally, in continuous flow operation, the recycle water picks up components from the fuel that can greatly improve its solvent and reactant properties as the process continues. Properly prepared HTL products can be sold as “drop in” fuels that are blended with petroleum derived fuels, or to which the needed additives are blended. Even though these fuels might sell into the market at a slight discount, generating ultra-low sulfur fuels from plastics has substantial economic and environmental advantages over simply gasifying or incinerating plastics to generate electrical energy.

Figure 2-14 below depicts the effect of heat on the chemical structure of polyethylene, a common component of plastic waste. Heat energy causes weakening of the bonds that link the polymer carbon backbone. These bonds eventually break at random sites along the polymer chain, releasing smaller hydrocarbons such as cetane, a major component of diesel fuel.

Diesel oil obtained from distillation of raw HTL oils can be sold as a "drop in" fuel blended with petroleum derived diesel. Gas phase products of distillation can be used for heat and power onsite. Heavier distillation cuts can be sold as boiler fuel of marine bunker fuel. Producing ultra-low sulfur fuel oil from plastics has substantial economic and environmental advantages over simply gasifying or incinerating plastics to generate electrical energy.

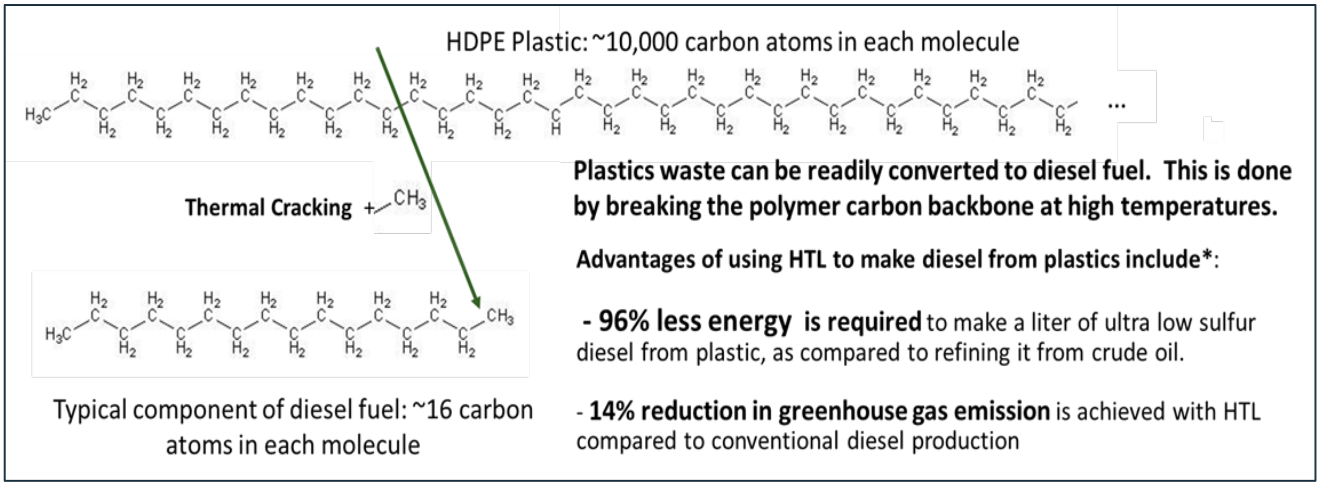


Figure 2-14 Graphic showing the thermal cleavage of carbon-carbon bonds along the polyethylene polymer chain to produce diesel fuel components, and other HTL process information

Advantages of the HTL process, as compared to conventional pyrolysis, include the fact that the reactions take place in a hydrogen-rich (chemically reducing) environment, resulting in a more energy rich liquid fuel. The use of superheated high-pressure water as a reaction medium means that many of the unwanted elements such as sulfur, chlorine, nitrogen, will be dissolved and remain in the water when the oil and water phases are separated.

Operational components of the HTL process are as follows. Plastics are separated from biomass in the incoming SRF stream, cleaned and shredded to 50 mm minus. The plastics are then processed by HTL as described above, yielding a non-condensable fuel gas, a light oil, a heavy oil, and carbonaceous mineral matter. The two liquid oil fractions are combined and distilled to produce primarily ultra low sulfur naphtha, diesel fuel oil, and heavy fuel oil or bunker fuel. The range of distillation cuts available from the HTL oil are shown in Figure 2-15.

The liquid fuels obtained from the HTL processing of waste plastics are ultra-low sulphur, low carbon intensity fuels. They are comprised of hydrocarbons without oxygenates and can be used as drop in fuels for most applications. They are not fatty acid methyl ester (FAME) bio-fuels. They contain no ester moieties. Compared to their petroleum derived counterparts they differ only in their relative proportion of various unsaturated hydrocarbons.

Referring to Figure 2-15, the < 85 °F (30 °C) cut is designated here as fuel gas. The naphtha cut (30 °C to 85 °C) can be sold as a solvent, a bending component for gasoline, or burned onsite to generate electrical power. The HTL process will be controlled to favor ASTM D 975 compliant diesel oil (232 °C to 343 °C) over the lighter kerosene. The cut between approximately 232 °C and 343 °C can be sold as an ultra low sulfur drop in fuel. This same general cut meeting ASTM D 396 specifications oil will be sold as home heating fuel. The heavy gas fuel oil (343 °C to 565 °C) is sold as ultra low sulfur marine bunker fuel, and the residual fuel oil is mainly recycled to extinction in the process.

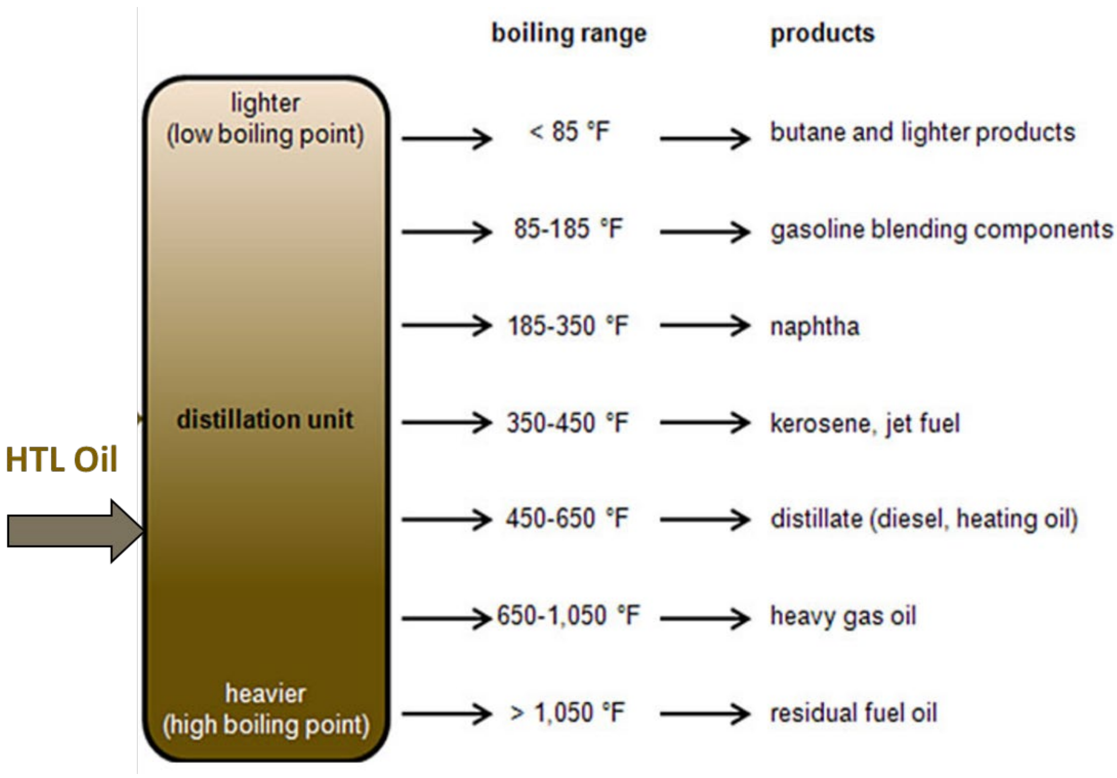


Figure 2-15 Boiling point ranges of distillations products from HTL oil

The tank farm for storage of the liquid fuels will consist of six site-built 14.6 m x 12.2 m (48′ x 40′) steel tanks, 3 of which will store diesel oil. Bunker fuel, home heating or furnace oil, and naphtha will each be stored in a single 2,000 m^3 tank, as shown. The blending and pump control station will be capable of delivering these liquid products to tanker ships at the fuel dock or to tanker trucks at the fuel rack.

Figure 2-16 below shows the process flow diagram for the HTL plant and refinery comprised of HTL process plant shown on Figure 2-13 with surge tanks, a distillation tower, settling tanks, filtration system and a blending and pump station. The tank farm basic design is also shown in Figure 2-16.

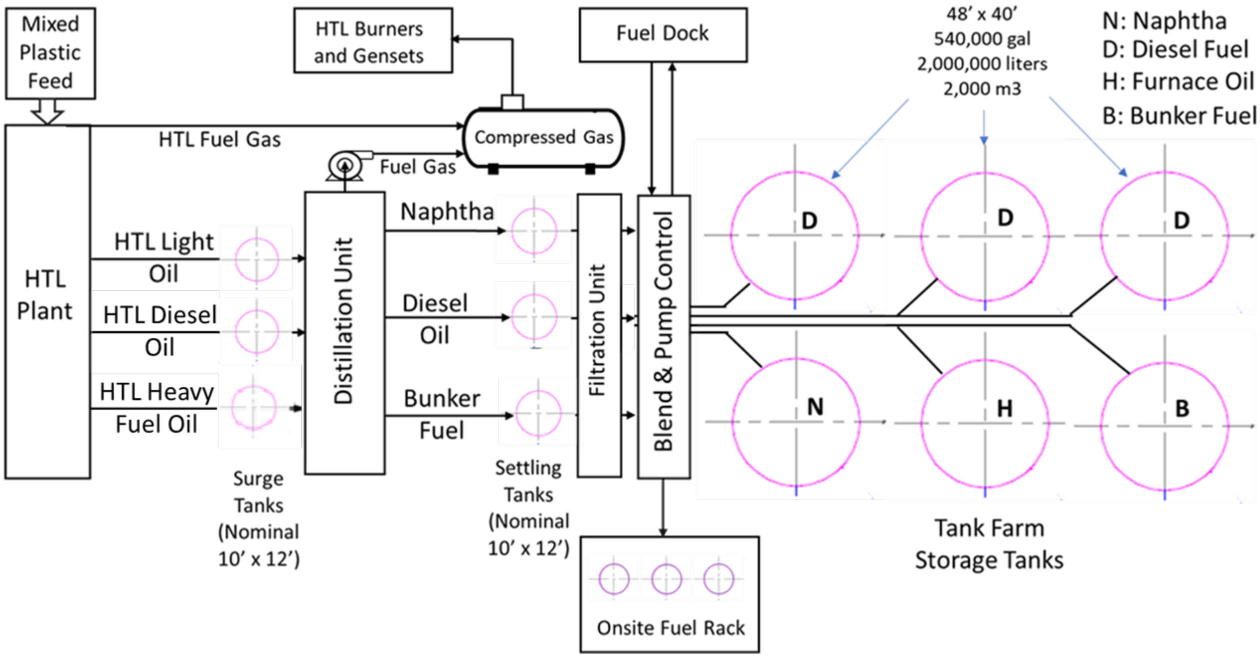


Figure 2-16 Process Flow Diagram for the HTL Plant, Refinery, Tank Farm, Fuel Dock and Fuel Rack

The tank farm will be designed, constructed, and serviced by a local company that has experience in tank farm design and construction as well as petroleum product handling in the near shore and marine environment of the Lewisporte area. The tank farm will have storage capacity for up to one month's worth of production for each fuel except for naphtha the excess of which, if any, will be used onsite for generation of electrical power.

It will be bermed as required with spill containment and deluge fire control systems appropriate for the type and amount of hydrocarbon fuels being stored. The design and construction of the tank farm, and indeed the entire HTL conversion component of the TNEC, will be designed, built and operated in compliance with industry best practices and standards using local petroleum industry consultants and in compliance with American Petroleum Institute (API) issued "Recommended Practice (RP) 754: "Process Safety Performance Indicators for the Refining and Petrochemical Industries", as well as applicable Canadian legislation and best practices guidelines.

Gasification

Gasification is a clean thermal treatment technology, ideal for smaller waste to energy plants producing from 10 to 100 MW. This technology is environmentally friendlier and less expensive than incineration and lends itself well to distributed generation electrical grid structures. Gasification is a process wherein carbonaceous materials are dissociated at high temperatures in an oxygen-starved thermal reactor to form a fuel gas comprised mainly of carbon dioxide, carbon monoxide, hydrogen, methane, and water vapor. If the thermal reactor is air fed (as opposed to oxygen fed only), the fuel gas also contains nitrogen.

When using the steam Rankine cycle for generation of electricity, the hot fuel gas is combusted to generate steam in a heat recovery boiler, also designated as an HRSG (heat recovery steam boiler). The steam is then used to drive a turbine generator. In smaller plants (ca. 10 MW or less) this low heating value fuel gas is sometimes cleaned and cooled and used to fire reciprocating engine gensets. However low heating value gas fired reciprocators are substantially less reliable than steam turbines and generate significantly more NOx, CO, and VOCs than a boiler. At the 50 MW scale, gas engines are also more expensive than a Rankine cycle system.

Figure 2-17 is a line drawing of an EPR waste to energy gasification plant thermal island. The EPR design uses rotary kilns as gasification reactors along with a patented flue gas recycle system to substantially reduce NOx emissions. Table 2-2 shows typical specifications for imported SRF.

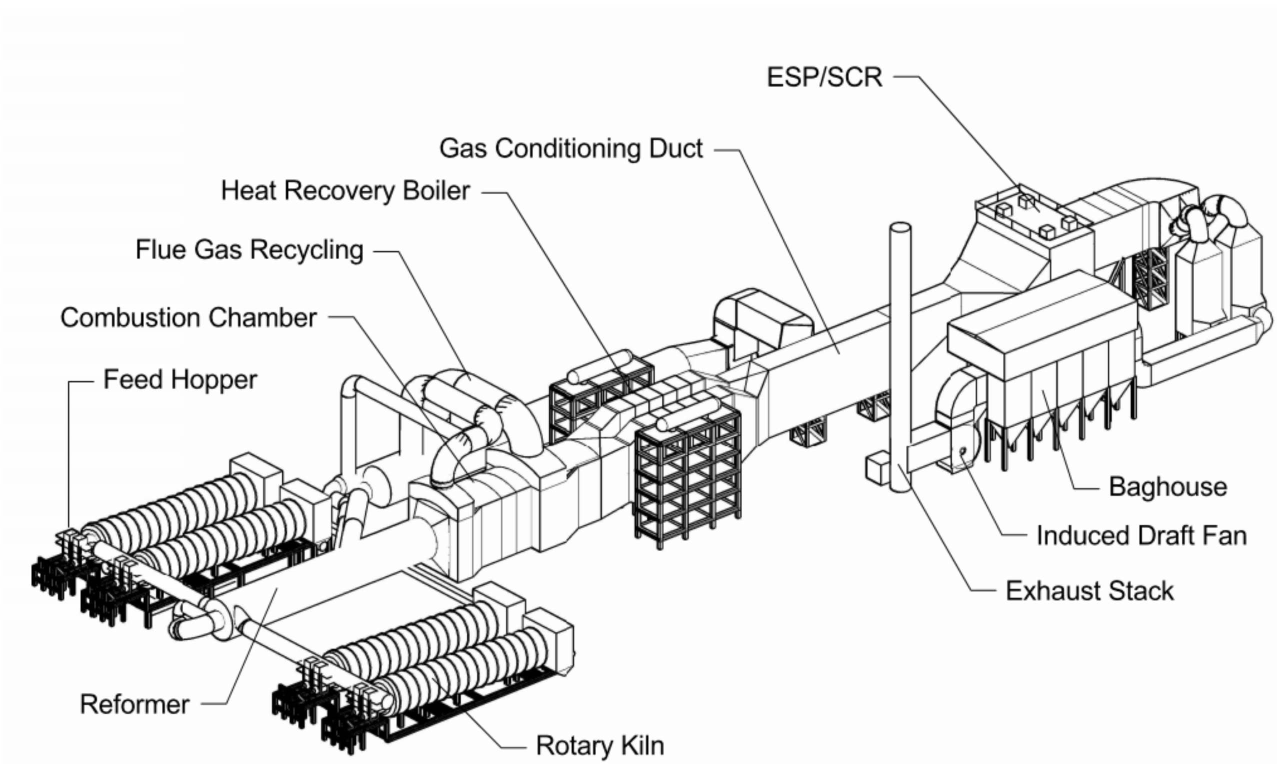


Figure 2-17 Oblique View of the Thermal Island of a Gasification Power Plant

Table 2-2: Typical SRF Feedstock Composition (Andusia Recovered Fuels)

SRF Specification	Units	Min	Max	Comments
Combustion Limitations				
Lower Heating Value (as received)	MJ/kg	10	14	Design 12 MJ/kg
Each Dimension	mm		500	All
Sum of Any Two Dimensions (i.e., length + width)	mm		725	All
Rods (length x diameter)	mm		500 x 50	Not more than 5% of as delivered weight; All
Foils/sheets (length x width)	mm		400 x 400	All
Tapes (length)	mm		500	All
Ash content (dry)	% wt/wt		20	Per tonne
Metal content	% (dry)		4	Per tonne
Glass content	% (dry)		5	Per tonne
Earth Soil	% (dry)		5	Per tonne
Dust Percentage Grain Size <1mm	% (dry)		10	Residue at the 1mm filter 90% material; Per tonne
Dust Percentage Grain Size <0.5mm	% (dry)		5	Residue at the 0.5mm filter 95% material; Per tonne
Ceramics, stones, porcelain, sand, metals	% (dry)		1	Per tonne
Metallic aluminium (foils, composite films)	% (dry)		0.80	Per tonne
Moisture content	% wt/wt		40	Per tonne
Abatement Limitations				
Sulphur content (dry)	% wt/wt		1.0	Daily average
Chlorine content (dry)	% wt/wt		1	Daily average
Mercury (Hg) (as received)	mg/MJ		0.06	Daily average
Cadmium (Cd) (as received)	mg/MJ		5	Daily average
Sum of heavy metals (HM) (as received)	mg/MJ		100	Daily average

Since waste to energy plants are paid to take in fuel, thermodynamic efficiency need not be the top priority in plant design. In EPR plant designs the main emphasis is on reliability, safety, and lowest possible environmental impact. As shown below, air emissions from a 100 MW plant (designed for another site, comprised of two 50 MW units and processing some 3,000 tons per day) are low enough that it was permitted as a minor source.

Project Component Control and Monitoring System

Comprehensive Operations Management System Software: The TNEC operations management system will be based on a commercial off the shelf software package that provides key functions to help optimize operations and reduce or eliminate operational errors and risk of errors. The system will be integrated with control and monitoring systems provided by the manufacturer of the various process units and will integrate overall process management at the central site control room. Primary functions will include:

> **Comprehensive Operations Monitoring** for comprehensive limit management, across the entire organization. From planning and scheduling limits, to equipment, maintenance, safety and alarm limits. All managed from one location.
>
> **Operations Logbook**: An advanced electronic logbook which automates much of an operator's daily shift log processes. Importing process data, alarm information, critical limit deviations, safety bypasses and standing alarms, all without operator intervention, securing the shift handover process in-line with operating best practices.
>
> **Electrical and Thermal Energy Supply Control Room:** This Consolidated Control Centre will allow operators to oversee the feedstock flow to the HTL and CHP plants and have the capability to adjust fuel flows and monitor (and override if necessary) the automatic system controlling the gasification CHP plant. Operator actions and authorities in the control room are done according to SOPs developed by engineers and equipment manufacturers. Energy sources and loads on the site microgrid are monitored. The site common bus will be overhead power lines onsite operating at 13.8 kV.
>
> These will provide power to various buildings and equipment as well as the 138 kV tie in line to the Newfoundland Power grid. Pole mounted transformers will step down the voltage at each location and supply power to local switchgear, MCC and equipment on that leg. A high-level single line of the microgrid is shown below in Figure 2-21. Power flow to the Newfoundland Power grid will be monitored from this control room as will steam turbine and HTL reciprocating engine genset power output. These sources will normally operate under automated control.
>
> **Electrical and Thermal Energy Supply Control Room:** This Consolidated Control Centre will allow operators to oversee the feedstock flow to the HTL and CHP plants and have the capability to adjust fuel flows and monitor (and override if necessary) the automatic system controlling the gasification CHP plant. Operator actions and authorities in the control room are done according to SOPs developed by engineers and equipment manufacturers. Energy sources and loads on the site microgrid are monitored. The site common bus will be power lines onsite operating at 13.8 kV.

These will provide power to various buildings and equipment as well as the 138 kV tie in line to the Newfoundland Power grid. Pole mounted transformers will step down the voltage at each location and supply power to local switchgear, MCC and equipment on that leg. A high-level single line of the microgrid is shown below in Figure 2-21.

Power flow to the Newfoundland Power grid will be monitored from this control room as will steam turbine and HTL reciprocating engine genset power output. These sources will normally operate under automated control. Figure 2-18 below describes the main components of the Project equipment and operations monitoring and control.

Sorting Facility and Bale Storage Area Control: Controls for the Sorting Facility and Bale Storage Area will consist of the motor control centre for the sorting equipment and video cameras monitoring the function of automatic system at critical locations. Plan and elevation views of the primary mechanical sorting equipment to be installed n the sorting facility is shown in Appendix G.

A primary task of the Sorting Facility control centre will be early detection of over temperature events in motors or bearings as well as detection of hot spots of fire in loose materials delivered by truck. Weights of materials exiting the facility as biomass and as plastics will be monitored and records kept for system performance analysis. The Shift Supervisor will be responsible for operation of the Sorting Facility. Area video feeds will be available to the TNEC Operations Central Monitoring.

HTL, Refinery and Tank Farm Control: The HTL units will convert waste plastics into clean, ultralow sulfur, wide boiling point range oil. This HTL oil will be further refined by distillation and filtration to produce diesel fuel, home heating oil and industrial or marine distillate fuel oils. After distillation filtration and re-blending as needed, these fuel products will be stored in the tanks for sale or distribution. The tank farm will supply a marine fuel dock for loading product onto tankers for transport to customers in Atlantic Canada and the Northeastern US.

Both the analytical laboratory and the control room for the HTL plants, refinery and tank farm will be located near the refinery and blending facility to the east of the HTL plants. This control room will be responsible for the functions listed in Figure 2-18 on the following page and will be staffed at all times during operations.

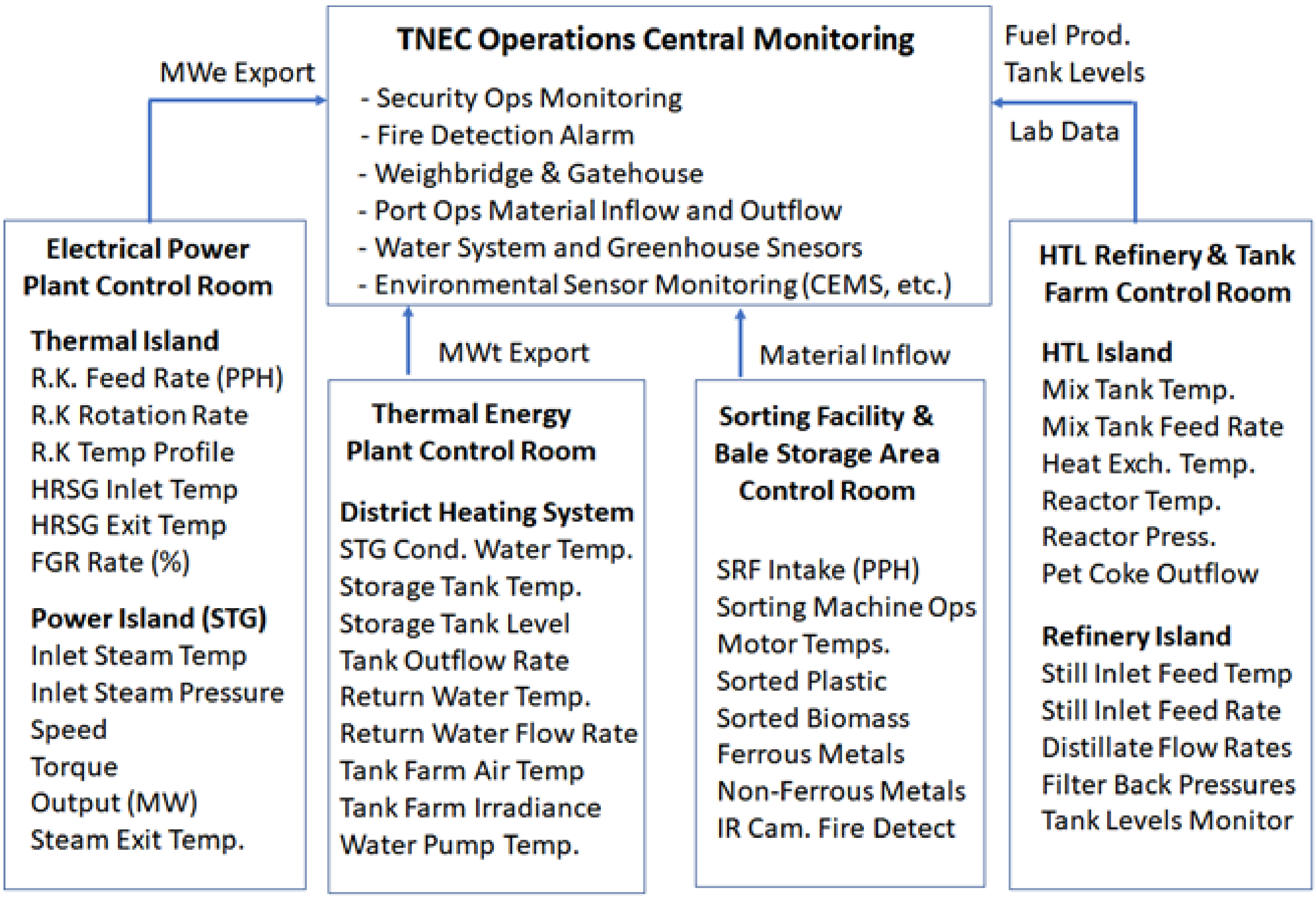


Figure 2-18 Project Component Control and Monitoring System

2.5.4 Facility Fresh Water Intake and Distribution

The following describes freshwater supply sources. Drinking water will be treated at the site.

Raw Water Supply System

Two lakes located on the property, shown in Figure 2-3, will be used as the source of fresh water. The smaller of these two lakes will be used as the primary source. Additional water will be pumped from the larger lake to the smaller lake, or directly into the fresh water supply system, when needed.

Fresh water will be supplied by the raw water pumps to an atmospheric vented freshwater tank. Raw water will be used for all purposes requiring clean water with low dissolved solids, primarily as follows:

- Fire suppression for the SRF storage areas sorting facility as well as the CHP and HTL feedstock storage areas and the general fire loop hydrant system for the plant overall
- Deluge fire control system for the tank farm.

- Boiler make up water for the CHP plant
- Reagent make-up water for the HTL plant
- Feed for the potable water plant
- Raw water will be treated and stored in the potable water storage tank for use in safety showers and other similar applications

Pond Size and Inflow Estimates: Two ponds on the TNEC site have been identified as water sources for the project. While a detailed survey of the water resource of the site has not yet been undertaken, rough calculations can be made from the available information for nearby basins. Both water source ponds are in the eastern part of the property. The first is a 3-hectare pond, with a second 42-hectare pond about 800 meters to the northeast. Both ponds have a fairly small drainage areas that are largely contained on the site.

Flow rates into the ponds were estimated using the drainage area and the average local precipitation rate. The fraction of precipitation that drains into the ponds was roughly estimated by reviewing data from the nearest well monitored river, the Exploit River. In the Exploit Basin, 80% of all annual precipitation flows through the Exploit River into the Bay of Exploits. As a similar climate and ground cover exist throughout the region, this percentage was used to estimate the flow rates of water into the ponds. The resulting flow rates are shown in the Table 2-3 below.

Table 2-3: Drainage Area Flow Rates and Capacities for Pond 1 and Pond 2

Parameter	Pond 1	Pond 2
Drainage Area (*ha)	41	274
Annual Average Flow (m3/d)	996	6,674
Total Annual Average Flow Rate (m3/d)	7,670	
Estimated TNEC Water Usage (m3/d)	1,082	

The estimated water usage from the ponds for the site is 1,082 m^3/d. As both ponds drain through short streams into Burnt Bay, without other users, the two ponds together will offer a sufficient water supply. Flow rates in area streams are highest in April and lowest in August, when flow rates may be a fraction of the annual average. By a conservative estimate, the two ponds store at least 900,000 m^3 of water. This supplies a more than sufficient buffer for low water flows during the summer months.

Figure 2-19 shows a process flow diagram for the preliminary design of the TNEC fresh water supply system with the potable water, raw water washdown, and raw water fire suppression loops indicated. The water system block diagram in Figure 2-20 provides further detail.

Access Road and Pipeline from to 3 Hectare Lake

The route of an access road from the main Project site to a pond (located at 49° 15′ 06.7″ N by 54° 58′ 57.7″ W) is shown in Figure 2-3. Tank level and pipe flow rates as well as controls valves will be monitored and controlled by means of a wireless link with local power provided by a solar cell and battery arrangement. The route for the gravel surfaced access road is indicated on the drawing in Figure 2-3 but may be altered if ground level surveys indicate a better route. Operation of the water system including pumps tank levels and will be monitored from the central facility control room.

As shown in Figure 2-19, the larger lake, access to which is at the far east end of the property as shown in Figure 2-3, will serve as a secondary source of water for the TNEC.

Fire Water Supply System

Fire water will be piped to the main facilities via underground fire water ring mains with hydrants placed where needed. In addition, buildings will be equipped with hose cabinets and supplemented with hand-held fire extinguishers of two types: general purpose extinguishers for inside plant areas, and dry type extinguishers for inside electrical and control rooms. Ancillary buildings will be provided with automatic wet sprinkler systems throughout the buildings

Potable Water Supply

The potable water treatment plant will be designed to NL drinking water guidelines. The plant is expected to include multimedia filtration for reduction of turbidity, followed by ultraviolet disinfection for primary disinfection, and the addition of sodium hypochlorite for secondary disinfection. Treatment residuals from the potable water treatment plant (e.g., multimedia filtration backwash) will be sent to the wastewater treatment plant for ultimate disposal.

Treated potable water from the water treatment plant will be stored in the plant potable water tank and the safety shower water tank. Treated potable water from the plant potable water tank will be distributed via the plant potable water pump in a piping ring main to serve potable water users in the facilities.

Treated potable water from the safety shower water tank will be distributed via the safety shower water pumps to drinking fountains, eye wash stations, and safety showers. Potable water piping in the plant area will either be buried below the frost line, routed through heated buildings, or heat traced and insulated. Manual drain points will be included to allow emptying of pipelines, should conditions dictate.

A sketch of the provisional design of the water supply and distribution is shown in Figure 2-19. Figure 2-20 is a general process flow diagram of the sources and uses of water and was used to estimated quantities of the various water streams. Table 2-4 and Table 2-5 list the estimated maximum quantities of water needed for various uses on the TNEC site.

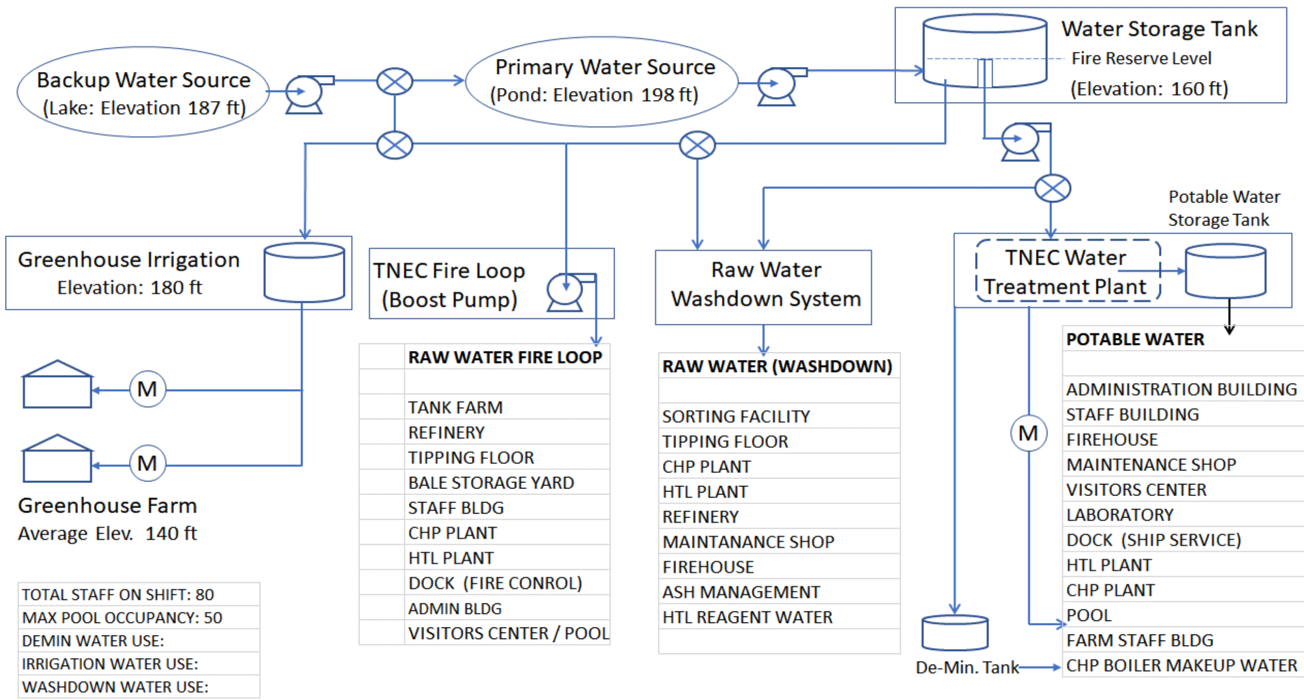


Figure 2-19 Overview of the Provisional TNEC Water System Design

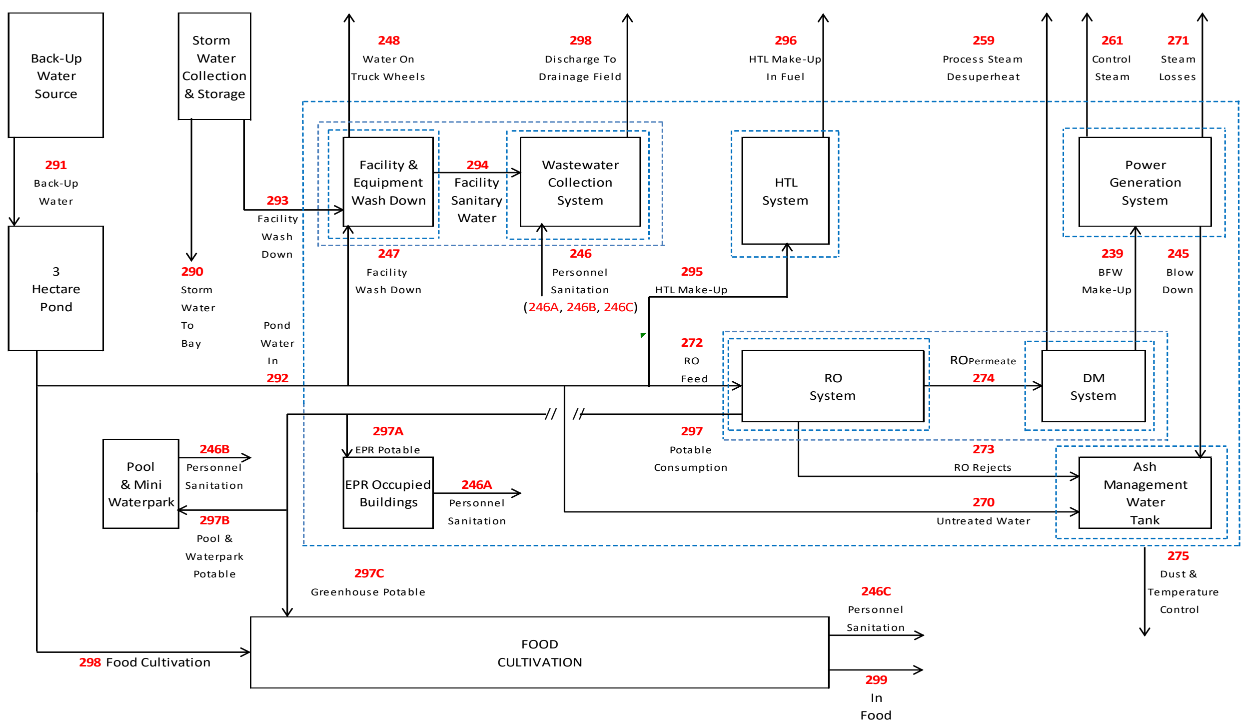


Figure 2-20 Water System Diagram (Image can be magnified for easier viewing)

Table 2-4: TNEC Water Management System Planning – Pond Water Usage Estimation Summary

Category	Use Function	Water Usage Rates					
A	**Production/Processing**	**Daily Usage GPD**	**Daily Usage (L/Day)**	**Daily Usage (m^3/Day)**	**Usage Rate (LPM)**	**Usage Rate (m^3/hr)**	**Usage Rate (GPM)**
A.1	**WtE System (By Use or Loss)**						
	Ash Management Water Use						
	RO Rejects to Ash Mgmt	6,577	24,895	25	17	1.04	5
	Blow Down to Ash Mgmt	22,123	83,737	84	58	3.49	15
	Pond Water for Ash Mgmt	14,263	53,986	54	37	2.25	10
	Total Dust Management	42,964	162,617	163	113	7	30
	Steam Losses to Atmosphere						
	Steam Losses (Vents, etc.)	11,062	41,868	42	29	1.74	8
	Process Control Steam	3,250	12,301	12	9	0.51	2
	DeSuperHeated Water	637	2,412	2	2	0.10	0
	Total Losses to Atmosphere	14,949	56,581	57	39	2	10
A.2	**HTL System Uses**						
	HTL Process Water Make-Up	5,947	22,508	23	16	0.94	4
	APCS Scrubber Make-Up	N.A.					
	De-NOx Demin Water	N.A.					
	HTL System Total Use	5,947	22,508	23	16	1	4
A.3	**GH Cultivation**						
	Crop*	215,278	814,828	815	566	33.95	149
	GH Cultivation Total	215,278	814,828	815	566	33.95	149
A.4	**Pool/Water Park Make-Up Water**	0	0	0	0	0.00	0
A	**Production/Processing Total**	279,137	1,056,534	1,057	734	44	194

Source: *UMA, 2021

Table 2-5: TNEC Site Pond Water Usage

Category	Use Function	Design Parameters			Usage Estimates			
B	**Personal Sanitation**	**Daily #**	**Per Capita Use (L/Day)**	**Per Capita Use (M^3/Day)**	**Daily Use (L/Day)**	**Daily Use (m^3/Day)**	**Daily Use (GPD)**	**Use (GPM)**
B.1	Dock Facility							
	Employees	12	114	0.114	1,363	1.36	360	0.25
	Guests/Visitors	12	57	0.057	681	0.68	180	0.13
B.2	Firehouse							
	Employees	1	114	0.114	114	0.11	30	0.02
	Guests/Visitors	1	57	0.057	57	0.06	15	0.01
B.3	Visitor Centre							
	Employees	1	114	0.114	114	0.11	30	0.02
	Guests/Visitors	20	57	0.057	1,136	1.14	300	0.21
B.4	Pool – Water Park							
	Employees	4	114	0.114	454	0.45	120	0.08
	Guests/Visitors	40	57	0.057	2,271	2.27	600	0.42
B.5	Administration Building							
	Employees	27	114	0.114	3,066	3.07	810	0.56
	Guests/Visitors	10	57	0.057	568	0.57	150	0.10
B.6	Greenhouses							
	Employees	10	114	0.114	1,136	1.14	300	0.21
	Guests/Visitors	2	57	0.057	114	0.11	30	0.02
B.7	Gatehouse & Scales/Guards							
	Employees	9	114	0.114	1,022	1.02	270	0.19
	Guests/Visitors		57	0.057	0	0.00	0	0.00
B.8	Staff Building							
	Employees	120	114	0.114	13,626	13.63	3,600	2.50
	Guests/Visitors		57	0.057	0	0.00	0	0.00
B	**Personnel Total**				25,719	25.7	6,795	4.72
	Total Use of Pond Water			285,932 GPD				
				1,082 m^3/day				

2.5.5 Site Power Plant, Substations and Power Distribution

Facility Microgrid Repeat: In operation, the Project will establish a microgrid with a 40 MW (nameplate) turbine generator driven by steam from the thermal island (see Figure 2-4) of the CHP biomass gasification WTE plant. Microgrid sources will include a 40 MW condensing turbine and a 5 MW thermal and 1.7 MWe back pressure steam turbine as power sources. Two 5 MW piston engine gensets installed in the HTL plants will be connected to a separate bay in the microgrid substation (Figure 2-21).

These sources will have an output voltage of 13.8 kV at 60 Hz. The generator substation step-up transformer, rated at no less than 70 MVA for future expansion, will step up the 13.8 kV low side voltage to 138 kV for connection to the Newfoundland Power grid. A 138 kV interconnect line will be constructed to connect the generator substation to the nearest Newfoundland Power line. The main generator substation will be constructed with extra bays for future connection of an additional generation sources.

A 13.8 kV common bus originating at the generator substation will comprise the backbone of a microgrid system that will provide for onsite electrical distribution. The onsite system will supply power to the various Project buildings and equipment by means of pole mounted transformers or substations with multiple tap transformers equipment in the plant operating at 600 V, 440 V, and 240 V three phase. Electrical lighting transformers and building single phase power outlets will operate at 120 V.

The 5 MW reciprocating engine gensets installed in the two 500 t/d HTL plants will be operating in combined heat and power mode. Thermal energy from the engine exhaust at approximately 500 ºC will preheat the reagent water used in the HTL process. Electrical power generated by these two 5 MW units should offset most of the parasitic load of the plant. That is, they will be the primary source of house power for the Project, except for the greenhouses. Power for the greenhouses will be provided by the CHP power plant by way of a revenue meter that will allow monthly charges for greenhouse power. Distribution transformers at the plant various substations will be fed from the plant main 13.8 kV line with stepdown transformers to 600, 440, 240 or 120 kV as required.

As shown in Figure 2-21, legs on the microgrid will include:

- Sorting Facility and Bale Storage
- HTL Plant, Laboratory and Refinery
- CHP Gasification WTE Plant and Control Room
- Tank Farm, Fire and Port
- Admin and Staff Buildings
- Greenhouse Farm, Visitors Centre & Water Park

2.5.6 Power Station Black Start Capability and 138 kV Feed-in Line

The Project CHP plant will have Black Start capability. At start up, the Project substation will not be connected to the 138 kV interconnect line. Startup electrical power will be provided by one of the two battery-cranked 5 MW generators located at the HTL plants. The thermal island of the CHP plant will be preheated with a burner using diesel fuel, or fuel gas to a temperature at which SRF feedstock can be introduced for gasification. Start-up power will operate the lighting, control system, burner system, thermal island servos and blowers and provide for kiln rotation. After off-line start-up, all generators will sync with the Newfoundland Power phase grid prior to coming on-line.

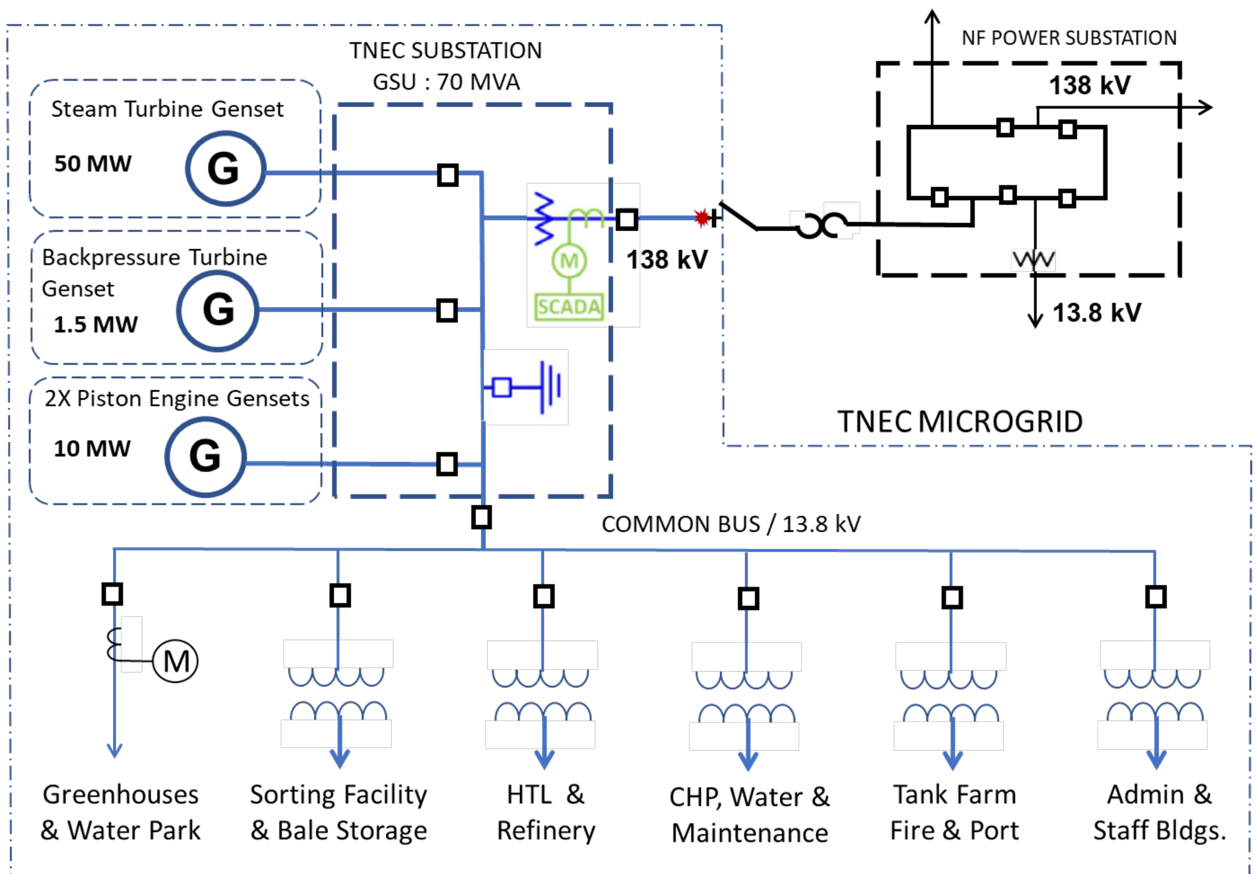


Figure 2-21 One Line Diagram of the TNEC Microgrid (change of ownership marked in red)

138 kV Grid Interconnect Feed-in Line: The proposed route for connection of the TNEC power station to the Newfoundland Power grid will be a 138kV feeder line from the TNEC substation to the nearest point along the 138 kV transmission line planned to run from Lewisporte to Gander Bay. According to recent information from Newfoundland Power, a 138 kV line is to be constructed on a right of way running adjacent to Route 340 through, or directly adjacent to, the TNEC Project property.

If that line along Route 340 is installed, then the connection to the TNEC powerhouse would be a direct splice into the new 138 kV power line.

The short feeder line from the TNEC powerhouse to the 138 kV line be paid for by SWPNL and constructed by Newfoundland Power technicians. Design and construction of the generator substation will be approved in advance by Newfoundland Power. Connection to the generator substation will be made by Newfoundland Power after inspection, testing and approval of the SCADA system and metering system.

Prior to entering commercial service, ownership of the 138 kV intertie line will be transferred to Newfoundland Power, who will then be responsible for maintenance of the 138 kV intertie line. The point of transfer of ownership will main high side switch at the generator substation.

2.5.7 Staffing Plan and Organizational Structure

A provisional TNEC organizational chart is shown in Figure 2-22. Senior plant management includes the Operations General Manager (GM), Chief Engineer, Finance Manager, Environmental Health and Safety Manager, and Regulatory Compliance Manager, who serves as the Environmental Compliance Officer. Each of these operation managers will have an assigned operations crews and maintenance teams. Maintenance specialists including welders, and electronics and IT techs may have responsibilities on more than one maintenance team.

At the operational level, direct reports to the Operations GM include the Port Operations Manager, CHP Plant Manager and the HTL Plant Manager. The Finance and EH&S managers are direct reports to their corporate officers with a dotted line to the TNEC plant General Manager. Experience and educational qualifications for key members of the staff are listed in Table 3-3 and described in more detail the Plant Operations Plan, the table of contents of which is shown in Appendix C. This document includes position descriptions, along with requisite education, skill sets and relevant experience. Table 2-6 lists staff positions as grouped by skill level and experience. TNEC will operate in compliance with labor laws of the Province of Newfoundland and Labrador and the Canadian Federal Government.

The TNEC Plant will be in operation 24 hours per day 365 day per year. Multiple staff will be required to fill some of the positions shown for the appropriate shift coverage. The financial and administrative functions will be the responsibility of the Operations General Manager but will initially report to EPRD Corporate to assist in establishing the appropriate systems to support the TNEC plant.

This approach will allow the General Manager and the Chief Engineer to provide undivided attention on the Safety, Operations and Technical aspects of the TNEC to assimilate to steady performance as a baseload electrical energy thermal energy and liquid fuels refinery plant. Once the plant achieves a commercial status the General Manager will have the full local authority for operational and technical functions.

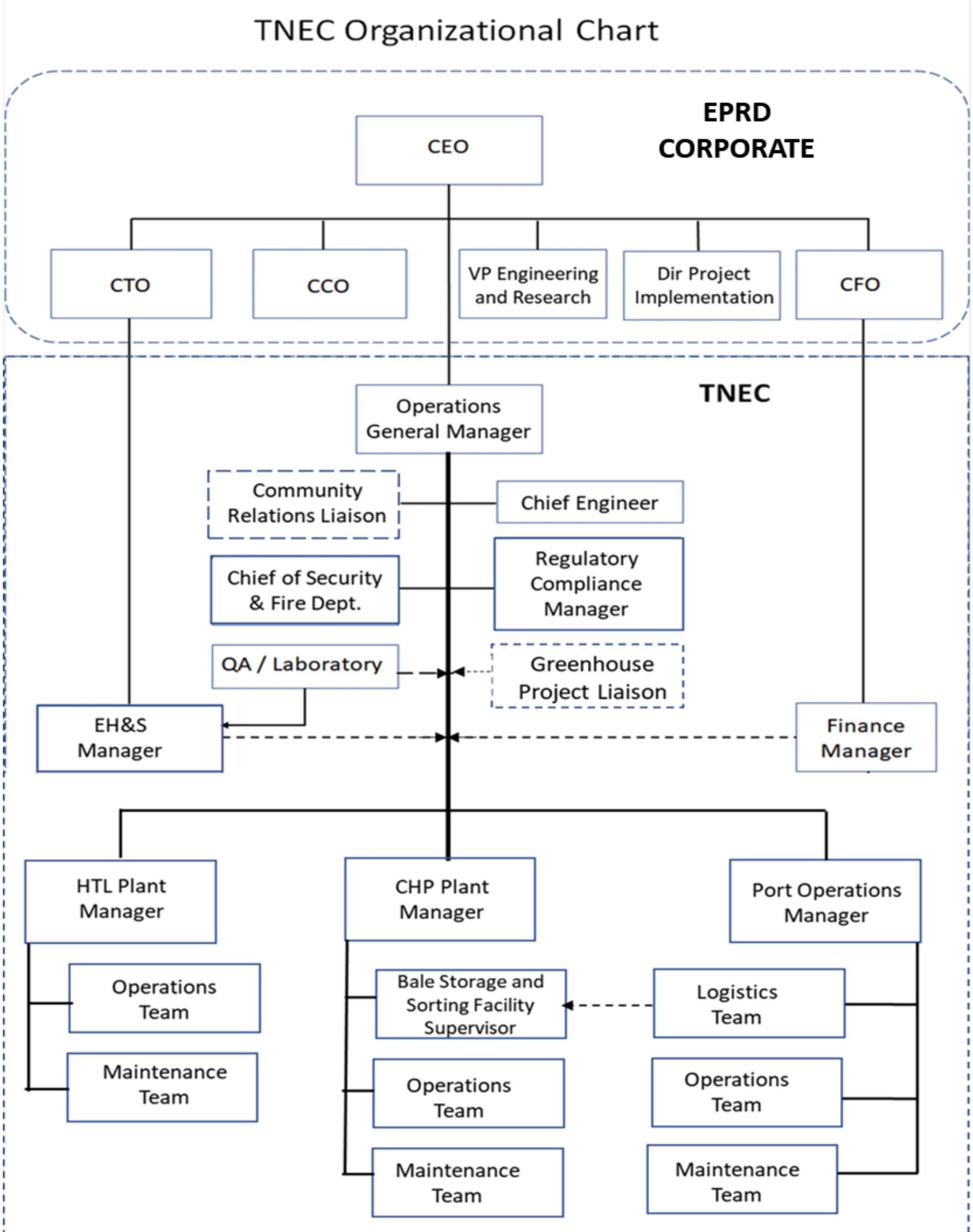


Figure 2-22 TNEC Organizational Chart

Table 2-6: Average TNEC Employment FTEs

New Hire Position Title/Description	Number of Positions	Average Hours Worked per Week
Plant Management	7	40
Administrative Staff	21	40
Licensed Operators and Techs	23	40
Skilled Labor and Trades	74	40
Fuel Handlers	40	20-40
Dock Workers	18	20-40
Guard Force	13	40
Total	196	

The operations and maintenance plans for the TNEC set forth the staffing positions and staff training requirements for the facility. A description of how standard operating procedures and applicable Canadian and international health and safety guidelines will be developed and implemented. In addition to the provisional Operations Plan, operations and standard operation and maintenance procedures for the HTL plant and refinery as well as the CHP plants will be developed based on the commercial operating history of these plants and the relevant operations used in petroleum refineries such as distillation, coking processes and tank farm operations and maintenance.

2.5.8 Special Purpose Chemicals and Reagents Used and Stored Onsite

Chemical Reagents: Several chemical reagents will be used and stored onsite at TNEC. These may include powdered limestone, sodium bicarbonate, aqueous ammonia, and activated carbon. Limestone will be sourced from a local quarry and crushed onsite before transport to TNEC for final grinding and use. These reagents will be unloaded from trucks and stored in their respective silos or tank in the water treatment and chemical storage area south of the sorting facility and gasification CHP plant.

Lime: TNEC will use approximately 30 tonnes of lime per day for acid gas removal. This material will come from a quarry located in Newfoundland. Hydrated lime, a calcium-based reagent, is preferable due to its availability in Newfoundland. The lime will arrive by truck and be pneumatically unloaded into a storage silo. The storage capacity in the silo will be 200 tonnes. Immediately before use, the lime will be pulverized and pneumatically conveyed to two injection points on each gasification line.

At the injection points, the lime passes through a distribution manifold which channels the powder through several lances which release the lime into the flue gas stream. The lime is entrained in the flow, where it reacts with SOx, HCl and to a lesser extent NOx. The product compounds and unreacted reagent are removed in the ESP or Baghouse. The removed material is conveyed pneumatically to the fly ash silo where it is stored until removal to a landfill. EPR also has the option of using sodium bicarbonate, a sodium-based reagent, for acid gas removal. Sodium bicarbonate is more expensive but requires less material per unit of acid gas removal due to its higher purity.

Activated Carbon: TNEC will use approximately 0.5 tons of activated carbon per day. Activated carbon adsorbs heavy metals and other hazardous air pollutants (HAPs) from the flue gas before release. The activated carbon will be handled in a similar way to the lime, being pneumatically conveyed and pulverized before use. The storage silo will hold up to 50 tons. The activated carbon has a single injection point on each gasification line, being injected immediately after the flue gas exits the economizer. The activated carbon is entrained in the flue gas and is removed in the baghouse. The fly ash removed from the baghouse, together with the acid gas removal product, will be stored in the fly ash silo prior to transport to the Norris Arm landfill.

Ammonia: TNEC will use up to approximately 4 tons of aqueous ammonia per day. Ammonia use will be minimized by optimal operation of the reformer. That is, by allowing no more ammonia to exist the reformer than can help offset NOx formation in the burner. The SCR operates on catalytic reduction to sustain air permit compliance. Ammonia will be delivered and used in the form of a 19% aqueous ammonia solution. Ammonia offloaded from trucks will be stored in a 100 m^3 aqueous ammonia tank.

For use it will be piped to one injection point on each gasification line, directly between the ESP and SCR units. An ammonia mist evaporates into the hot flue gas, then reacts on the catalyst beds to reduce NOx compounds to diatomic nitrogen and water vapor. There are no solid by products from this reaction, only a small amount of ammonia "slip"; unreacted ammonia that remains in the flue gas. Small amounts of ammonia are also used to condition the boiler feed water (BFW) in the deaerators. This raises the pH of water in the boiler, preventing oxidation and promoting the formation of stable iron oxide compounds.

2.5.9 Marine Operations

Current Operations at Lewisporte Port: Lewisporte is a Public Harbour controlled by Transport Canada. The Harbour Master monitors all commercial marine traffic that enters and departs Lewisporte Harbour, documents the details, forwards them to Transport Canada where they issue invoices to the ship owners. A fee is charged for entering the port.

The Harbour Master is responsible for monitoring the harbour zone for any potential navigation hazards, land encroachment, pollution, or other activities such as commercial diving, etc. This information is reported to Transport Canada if there are any issues of concern. Most commercial shipping traffic sends the Harbour Master a pre arrival notice a week or so before arrival.

Project Marine Operations

The Port serving TNEC will have first class marine facilities constructed primarily for the import of baled SRF feedstock materials to provide heat and power for the energy centre and also to export HTL derived fuel oils and sintered aggregate by-product. Storage tanks of nominal 10,000 m^3 capacity will be provided for the HTL product liquids. The Port will have a new dock office to replace the existing one. Fuel tankage and marine fuel jetty and surface road transfer equipment for fuel to tanker ships and and tanker trucks is shown in Figure 2-16.

By arrangement, the dock facilities can be available to Lewisporte and local companies for import and export of goods and materials as vessels would otherwise be potentially going to Europe empty. TNEC shipping line partners have indicated interested to discuss any opportunities to deliver good to other parts of Canada, US, Europe and beyond.

Commercial Marine Port Operations

Commercial Marine Operations of Ports requires a specific focus and safety regime, which will require a dedicated professional team. Careful planning and precise execution are the key ingredients to a safe, yet efficient, working port environment.

TNEC management will consult with specialists who will partner with TNEC to provide:

- Transport Canada certified marine labor for commercial marine operations,
- Marine project management to reduce overall costs and increase productivity ensuring safety in compliance with all applicable regulations and industry best practice.
- Health, Safety & Environment will be delivered to the highest standard.
- Training will be provided for a wide variety of options to suit all operational needs.

Bulk Cargo Vessels

Bulk cargo vessels will be hired for the transportation of feedstock for TNEC as well as for transport of materials and equipment to be used in construction where they cannot be obtained locally. The type of bulk carrier shipping that lends itself to TNEC import requirements are Spliethoff Type 'S' side loading vessels (Figure 2-23). Spliethoff is a Dutch flagged ocean-transport company operating out of Amsterdam www.spliethoff.com.

Given that SWPNL wishes to restrict the size of vessel at the dockside to less than 25,000 DWT, Spliethoff has been identified as suitable transport company with regular services to Canada from Europe. The Spliethoff Type 'S' ships range in capacity from approximately 20,000 to 25,000 DWT. The Spliethoff Type 'S' vessels typically have a max length of 173 meters and a draught of 10.74 meters allowing easy access to the proposed dock. These ships have a novel side loading facility with 5 side-loaders and covered working areas utilising clamped forklifts and elevators to deck areas.

Figure 2-23 Spliethoff Type 'S' Vessel

Deliveries of Solid Recovered Fuel (SRF)

Feedstock: It is expected that the main quantities of SRF feedstock will arrive by ship from Europe and elsewhere in dry cargo vessels which operate typically 20,000-25,000 DWT fully loaded. All materials will be baled and sealed (Figure 2-12).

The dock at TNEC will therefore require a minimum depth of approximately 13 metres. The fuel jetty to be constructed will extend out into Burnt Bay to accommodate this water depth. Maintenance dredging will be required from time to time to maintain this berth depth. Such vessels are provided with five on board side-loaders and the recovered fuel will arrive sealed in plastic bales.

Although the side loading vessels can be loaded and unloaded with forklifts (Figure 2-12), the plan is to provide fully capable tracked dockside crane facilities whereby bulk cargo in bales or bulk sacks can be transferred from ship to quayside and vice versa. A conveyor system will be constructed from the dock straight to the TNEC bale storage area. This conveyor system will traverse Route 340 and be primarily used to take the baled fuel to the plant. Equipment and materials for the construction of the TNEC project will also arrive by ship and stored temporarily on the quayside for dispersal to the project site.

Frequency of Baled Recovered Fuel deliveries: SWPNL estimates that the TNEC will initially require 750,000 tonnes per annum of solid recovered fuel (wrapped in bales) and sourced mainly from Europe and Canada. The trip from Europe, for example, will take approximately 14 days (www.sea-distances.org). Assuming a single vessel will take generally 20,000 – 24,000 tonnes, this would indicate a maximum of 30/40 trips for a single vessel annually to deliver the 750,000 tonnes. It is anticipated that three vessels per month will continuously servicing the facility and would potentially add a fourth to facilitate parts and equipment when required. Vessels will not return empty but will take on cargoes for the return journey to Europe.

Tanker Vessels for Transport of Liquid Fuels: HTL crude oil, middle distillate ultralow sulfur diesel fuels and furnace oil, as well as naphtha when available will be transported by overland truck and coastal tankers with capacity in the 5,000 to 13,000 DWT range. The fuel dock will be capable of loading cargo or bunker fuel for vessels up of up to a maximum of 24,000 DWT. The tanker vessels will be the same as, or similar to, those currently used by Woodward in Burnt Bay will take on cargo at the fuel dock.

Cargo shipped from the new TNEC port may include sintered bottom ash, to be shipped in bulk bags. Other local minerals, timber, or agricultural products may eventually be sought for backhaul export but are not yet specified and not a part of the present registration application.

It is intended that diesel fuel will be transported as tanker cargo, mainly to other ports in Atlantic Canada. It is also intended that bulk carrier vessels will be able to take on bunker oil from the fuel dock at the port.

TNEC will not use tankers greater than 25,000 DWT. TNEC tankers will be similar to those used by Woodward for petroleum product transport in Burnt Bay. The Woodward fleet includes petroleum tankers with capacities in the range of 13,000 DWT or less.

Bunkering Operations and Bunker Planning: The term "bunkering" as used here, is defined as the transfer between ships or between ship and terminal facility, of a substance consisting wholly or mainly of oil for consumption by the engines of the ship receiving the substance. A bunker station is shown in Figure 2-24. Safe bunkering facilities will be provided to enable ships to take on fresh fuel oil, potable water and discharge dirty water from bunker tanks or bilges. This service will be provided with the highest regard to Health and Safety. Bunkering on a ship can be of fuel oil, sludge, diesel oil, cargo etc. Bunkering of fuel or diesel oil requires utmost care and alertness to prevent any kind of fire accident or oil spill.

In due course, the port will be able to import/ export a range of products produced at the TNEC site. The port will be available, by arrangement, for use by local external commercial organisations. There is always potential for human error and hence the potential for spills. Bunkering related oil spills are generally due to operational lapses and can be prevented if all necessary precautions are taken.

Figure 2-24 Bunker Station

In addition to the UN International Marine Organization (IMO) regulations, individual-states and/or ports have their own regulatory regimes covering bunkering operations. At the same time, many owners have their own specific requirements, instructions and procedures related to such operations, which are laid out in the ship`s Safety Management System (SMS) and the Shipboard Oil Pollution Emergency Plan (SOPEP). The causes and circumstances of bunker spills from vessels are varied but can have a significant effect on the maritime environment. Operations responsible for bunker spills can be classified into the following categories:

- Engine room bilges and fuel tanks ballast
- Bunker operations
- Tanker cargo operations (loading/discharging)

- Tank cleaning and ballasting operations on tankers
- Vessel collision/tanker accidents

*Note: accidental oil spills contribute to 5-10% of all oil pollution.

Many spills are the result of carelessness or negligence, either on the part of those supplying the bunkers, or those on board the vessel receiving them. Even a technical problem, such as the failure of an alarm to go off, may well be the result of human error.

Bunkering Planning: Due to the above spillage causes, bunkering operations should, and will, be carefully planned and executed in accordance with international MARPOL regulations. Pollution caused when heavy bunker oil is spilt can be difficult to clean-up. Ships' bunkers normally consist of heavy fuel oils, which in general are highly viscous and persistent and therefore a relatively small quantity of highly persistent bunker fuel, can be disproportionately damaging and costly to remove in comparison. Therefore, it is important to understand and organize every step of the operation while being pro-active in the management. This is essential and will be set forth in TNEC SOP manuals.

Personnel involved in the bunkering operation on board should have no other concurrent tasks and should remain at their workstations during topping-off. This is particularly important when bunkers are being loaded concurrent with cargo operations, to avoid conflicts of interest for operational personnel. Spillages often occur when staff are distracted by another task.

It is necessary that a bunker plan is produced, which should be detailed and carefully considered. The procedures should ensure that the risks associated with the operation have been assessed and that controls are in place to mitigate these risks. The procedures should also address contingency arrangements in the event of a spill.

2.6 Closure and Decommissioning

The conventional end of service life process for a thermal power plant starts with planned retirement, during which the last of the onsite fuel is consumed by the plant, prior to final shutdown. The operating permits are surrendered, and the plant is decommissioned. Machinery or other components may be sold for reuse elsewhere, while the steel and other recoverable materials are cut up and sold for scrap.

Once removal of the buildings and equipment is complete, the site is remediated to remove any residual hazardous materials. Concrete masonry and other inert materials are placed in a construction and demolition landfill or repurposed for road or waterway riprap as the property is prepared for re-development. The TNEC will have an engineered inert materials landfill onsite that will be suitable for placement of any non-recyclable inert material generated during remediation.

Design service life for both the HTL and WTE (CHP) components of the TNEC Facility is 30 years. SWPNL management will maintain a capital reserve for replacement of major components on a periodic basis which will be equivalent to a complete plant overhaul in 20 years. The capital reserve will be sufficient for two complete refurbishment cycles with residual capital for final retirement and decommissioning sometime after between 50 and 60 years of service.

Plans call for the thermal energy in the form of steam or hot water from the TNEC biomass WTE plant will be used for space heating in greenhouses. These will be built in the area immediately west of the TNEC facility as indicated by the yellow shading in Figure 2-2.

Use of this land for agriculture is likely to be commercially viable on a longer-term basis than 50 or 60 years. Therefore, it is likely that the normal life cycle for the CHP thermal plant will be altered by eventual installation of a second WTE gasification unit so that at least one of the two units can be available to provide thermal energy to the greenhouses on a near continuous basis.

The HTL units will be comprised mainly of high-pressure vessels and pipes carrying plastic derived organic fluids suspended in superheated water. These units will be maintained on component replacement schedule similar to that for the WTE gasification systems. After retirement, they will be decommissioned by conventional means. The capital accrual or set aside will be used for retirement and decommissioning, followed by remediation and re-development of the site. It is likely that the two types of units on the site will be retired and decommissioned at separate times, since the HTL and WTE units have different functions and different uses in the community.

Provincial regulations for registration, operation and abandonment of above-ground storage tanks used for gasoline or associated products are set forth in Newfoundland and Labrador Regulation 58/0 (O.C. 2003-225). The regulations stipulate that riveted tanks may not be re-used and must be thoroughly cleaned prior to being cut up for scrap during decommissioning. The scrap may be placed in a scrap yard or landfill.

2.7 Project Schedule

The anticipated Project schedule is shown in detail in Table 2-7. The projected date for initiation of construction activities is May 2022.

Table 2-7: Project Schedule

Activity/Milestone	Month - Year
Project Registration Application	11 – 2021
Establish Newfoundland SPV	05 – 2022
Regulatory Approval for Project	05 – 2022
Project Development Funding	06 – 2022
Appoint Local Consultant Engineers	06 – 2022
Topographic Survey/Site Investigation	06/09 – 2022
CHP Feed Study	06/09 – 2022
HTL Feed Study	06/09 – 2022
Initiate Permitting	07 – 2022
Land Lease Agreement Term Sheet	07 – 2022

Activity/Milestone	**Month - Year**
Quay and Fuel Jetty/Dolphins Design	06/10 – 2022
Infrastructure Design	07/10 – 2022
Design of Buildings	07/10 – 2022
Refinery and Storage Tank Design	07/10 – 2022
Visitor Centre	09/12 – 2022
SRF Supply and Fuel, Thermal, Power Off-Take Agreements	06/08 – 2022
Prepare ITT Documents	05/09 – 2022
Select EPC and Negotiate Contract	09/12 – 2022
Prepare/Update Project Development Program	06/12 – 2022
SWP/EPC Project Design Report for Funding	09 – 2022
Project Financial Close	12 – 2022
Project Kick-Off Meeting	12 – 2022
Construction Bonds and Permits Complete	01 – 2023
Break Ground for Construction on Main Project	02 – 2023
Oversee Construction/Weekly Project Meetings	02/2023 – 02/2026
Cargo Quay Complete	01 – 2024
Fuel Jetty Complete	05 – 2024
Civil Infrastructure Complete	02 – 2024
CHP Plant 1 Complete	02 – 2025
CHP Plant 2 Complete	02 – 2026
HTL Plant 1 Complete	08 – 2024
HTL Plant 2 Complete	08 – 2025
Refinery and Tank Farms Complete	11 – 2024
Completion of Construction	02-2026
Initial Plant Commissioning Operation of 1 CHP and 1 HTL	05/2025; 10/2025
Initial Facility Commercial Operations	01 – 2025
Full Facility Commercial Operations	05 – 2026

2.8 Potential Environmental Interactions and Emissions

2.8.1 Construction

Construction Environmental Management Plan

A Construction Environmental Management Plan (CEMP) sets out the controls and processes that are to be adopted to mitigate environmental impacts throughout the construction phase of a project and measures set out to comply with consent conditions. The CEMP is an iterative document that develops throughout the construction phase of a project. Preparation of a project CEMP will be the responsibility of the appointed Marine Contractor for the project that they have been awarded.

There are potential environmental sensitivities associated with the development of the proposed berthing quay and fuel jetty, which need to be identified and considered before construction of the project and its associated infrastructure takes place. These potential effects will have been deduced from the project Environmental Impact Assessment which our Marine Consultants will produce following project Registration and outlined in the project Environmental Statement (ES), including embedded mitigation in the form of good practice that will require to be adhered to during the construction phase as a minimum.

Typical Contents for a marine project CEMP are set out below:

- Project Description and Environmental Sensitivities
- Environmental Management Structure and Responsibilities
- Associated Documentation
- Management of Key Environmental Issues
- Monitoring and Site Inspections
- Legislative and Regulatory Compliance
- Training and Awareness
- Communication and Reporting
- Subcontractor Management
- Sustainable Construction

The potential impacts and pollutants associated with marine construction in inshore coastal waters include:

Noise and vibration: Noise and vibration have the potential to be generated during the construction process, especially from heavy plant and machinery. Measures will require to be implemented on site to minimise any effects and a programme of monitoring may be required. The project ES will identify receptors that are potentially sensitive to noise and vibration impacts together with mitigation measures, which must be implemented. For offshore construction projects involving piling and foundation works in the marine environment, it is likely that a specific noise and vibration mitigation and monitoring plan to mitigate potential impacts on marine mammals/fish will be required.

In addition, a specific Marine Mammal Mitigation Protocol will be prepared and agreed with the regulator, where required. In addition, an Environmental/Ecological Monitoring Plan will be prepared, as required, setting out requirements and responsibilities; this may include noise and vibration monitoring. For works occurring onshore, standard noise and vibration mitigation techniques will require to be considered, such as specified working times and use of low noise emitting plant and equipment.

Marine ecology: Monitoring of flora and fauna should be undertaken as part of the Environmental/Ecological Monitoring Plan by the appropriate personnel. Monitoring details should be recorded in the form of a monthly report; the report should be issued to the Project Team, with findings of the report being discussed at periodic health, safety and environmental meetings. For offshore construction, it is likely that a risk assessment for any Protected Species (cetaceans) will require to be incorporated into the CEMP.

The project ES will identify areas of conservation/protection and set out mitigation as appropriate. The CEMP should include the measures to be adopted. This will enable communication of awareness of any sensitive areas and potential protected features (e.g., reefs) to the project team. The procedures to be adopted in the event of an incident in proximity to these features should also be set out in the CEMP. The Environmental Monitoring Plan will also set out requirements for monitoring benthic habitats as appropriate. The Contractor's CEMP will require consideration, and mitigation provisions for, potential seabed and sediment movement impacts.

Marine archaeology and cultural heritage: The Project ES will identify sites/wrecks etc. of potential archaeological importance and these should be identified in the Written Scheme of Investigation (WSI) with appropriate mitigation, such as establishment of exclusion and buffer zones clearly marked out. The CEMP should include the measures to be adopted to communicate awareness of sensitive archaeological sites to the project team and the procedures to be adopted in the event of an unanticipated find.

Dropped object in the marine environment: A Dropped Objects into the marine environment plan or similar should feature as a component of the Contractor's CEMP. This may be a specific Marine Licence requirement. This procedure should detail the proposed recovery for both floating and non-floating objects and the reporting and documenting of the incident to the Project Team and the regulator. The procedure requires to be reviewed by the Project Team prior to the contractor commencing work.

Wastewater discharges: For offshore construction projects, any wastewater discharges to sea must comply with current legislation, regulatory limits, and good practice such as effluent discharges, ballast waters, bilge waters, and deck runoff. Controls for discharges should be included in the CEMP. Monitoring records in relation with the disposal of foul water, bilge water or ballast water during the construction phase must be retained.

Oils, fuel, and chemicals: It is the responsibility of the contractor to have in place adequate controls for the delivery, storage and use of fuels, oils and chemicals on site and on vessels and other materials as required. This includes checks that chemicals to be used offshore comply with relevant regulations. Within their environmental management plan, the contractor must consider the delivery, storage and handling of hazardous materials and in particular oils and fuels taking into account the legal requirements and good practice guidelines.

Oils and chemicals must be clearly labelled, and the contractor should retain an up-to-date hazardous substance register. Activities involving the handling of large quantities of hazardous materials, such as deliveries and refuelling, should have detailed method statements in place and be undertaken by designated and trained personnel. Oil and fuel storage tanks must be robust and provide adequate secondary containment and be located in designated areas taking into account security, the location of sensitive receptors and pathways such as drains and watercourses, and safe access and egress for plant and manual handling. Spill response materials should be provided nearby and be readily accessible, with local project personnel trained in spill response.

Waste management: Where waste is produced, reuse, recycle or recovery should be considered where practical and economically feasible prior to considering disposal.

Transport and vessel management: For offshore construction, it is likely that a specific Project Vessel Coordination Plan will be developed. Vessels will be subject to inspections and audits as described in Section 8 below. Vessel movements within the site will be monitored and directed as required by the Marine Coordinator.

Emissions to air: For marine construction and operations, vessel emissions must comply with MARPOL Annex VI requirements in relation to ozone depleting substances regulations, nitrogen oxide, sulphur oxide and particulate and volatile organic compounds. Where relevant, vessels shall have a valid International Air Pollution Prevention (IAPP) certificate.

For the reclamation activities and quay deck construction, the CEMP will need to consider the potential for dust nuisance to arise, and detail appropriate mitigation measures.

2.8.2 Operations

Operations at TNEC will be sequenced as follows. Bulk cargo ships carrying baled SRF arrive at the TNEC port and are unloaded by port longshoremen using forklifts for side loading S-Class ships or dockside cranes for conventional hold vessels. The bales are transported across Route 340 by way of an underpass or by conveyor and stacked in the bale lot. Prior to processing, bales are transported to a ready shed where snow and ice are removed or prevented from collecting on the bales before the bales are opened and the contents sorted. Canadian waste feedstock arriving from the Norris Arm MRF will be pre-sorted

Solid waste arriving from other Canadian sources is weighed in and unloaded onto a tipping floor before sorting. SRF and unsorted Canadian waste is mechanically separated into biomass and plastic fractions. Biomass fractions will be gasified without further treatment. Plastics fractions will be washed, reduced to a particle size of approximately 50 mm minus and sent to the HTL plant. All loose waste handling will be carried out indoors under a slight negative pressure. This will prevent solid waste materials such as paper or plastic bags from entering the environment as fugitive solid emissions as may happen when handling waste in of open landfills.

Plastic will be processed in the HTL plant to make hydrocarbon oil using hot high-pressure water. The raw HTL oil will be refined to produce liquid and gas phase fuels as described above. These liquid fuels will be stored in a tank farm until being loaded onto tanker ships or tanker trucks for distribution to retailers and end users.

Biomass will be gasified in rotary kilns in the combined heat and power plants. The clean fuel gas produced will be combusted in a LoNOx burner to heat a steam boiler. High temperature high pressure steam will drive a steam turbine to generate renewable electrical power. After most of the energy has been extracted, a portion of the steam from the turbines will be used to heat water for the greenhouses.

Sintered bottom ash from the rotary kilns will be stored temporarily on an engineered pad before either being exported back to Europe as aggregate, used for cinder block making or for road grit.

Spent reagents from the CHP plant flue gas clean up system will be transported to the Norris Arm landfill for final disposal. The amount of spent reagent placed in landfill will be far less than the among of material diverted from the landfill for use as TNEC feedstock.

Air emissions of criterial pollutants from operations are described elsewhere in this application and will be well below Canadian Federal and Provincial standard limits in terms of stack concentrations and annual gravimetric quantities. Additional information on TNEC air emissions and their sources is shown below and in Appendix F.

Water management and release from operations are described elsewhere in this application and will be in accordance with applicable

Irrigation water provided to the greenhouse will be the responsibility of the greenhouse tenants association.

Emissions Associated with Operations

CHP Gasification Plant: The primary air emission source at TNEC will be the 40 MW power plant that will gasify biomass extracted from municipal solid waste, light construction and demolition waste, source-separated commercial waste, and other materials such as green waste and wood chips, when available. As described above, source thermal island consists of a biomass tipping floor, modular gasification line, heat recovery boilers, flue gas clean-up system (Figure 2-5).

The source power island includes electrical power generating equipment and a generator substation. The source will consume on average 1,200 and up to 1,400 tonnes of SRF per day and will reduce the volume of incoming waste by approximately 90 percent, producing a safe, inert residue that is non-leachable and suitable for use as construction fill, road grit or cement block manufacture.

In the US, the source is classified as a synthetic minor stationary source of SO_2 emissions, and a minor source for all other pollutants, and as determined under NAICS 221119 (Other Electric Power Generation and SIC 4911: Electric Services.)

Actual emissions estimates are based upon use of a redundant air pollution control system, which consists of one or more of the following units in series, as required to meet emission standards:

In-line acid gas removal unit (AGRU), into which fine powered bicarbonate is injected to capture the acid gases. In the acid gas removal (scrubbing) system a dry reagent is injected downstream of the boiler. Once the reagent mixes with the flue gas and reacts with any acid gases including HF, HCl or SO_2, the reacted material is then removed by the particulate control device.

Electrostatic precipitator (ESP) to remove fine (<20micron) dust/fly ash that is not readily captured in the cyclone that is incorporated in each gasifier-combustion system up stream of the boilers. The electrostatic precipitator is sized to remove the particulate load from the gas stream to the emission level specified. The precipitator uses high voltage to charge the particulate which then migrates to the grounded surfaces. The precipitator will be followed by the SCR systems.

Catalytic Reduction Oxidation System for CO & VOCs the CO catalyst system is sized to reduce carbon monoxide and VOCs from the gas stream to the specified emission level.

Selective Catalytic Reduction System (SCR) for NOx: The NOx catalyst system is sized to reduce the nitrogen oxides from the gas stream to the specified emission level.

Bag House with in-line activated carbon and bicarbonate injections upstream of a fabric gas filtration system.

Estimated annual emissions for a 50 MW gasification power plant similar in design to those planned for TNEC are shown below in Table 2-8. Ground level ambient air concentrations of emitted gasses and particulates from this 50 MW gasification power plant are shown in Table 2-8.

Estimated maximum stack concentrations of criteria pollutant stack emissions from the 40 MW CHP plant shown in Table 2-8 are expressed in terms of 0% oxygen concentration in Column 2 and adjusted to 11% oxygen in Column 3. Data shown in Table 2-8 is from a 50 MW gasification plant similar in design to that planned for TNEC.

Table 2-8: Annual Gravimetric Emission of Criteria Pollutants from 50 Gasification MW Power Plant

Annual Gravimetric Stack Emissions of the 50 MW CHP Plant in Tonnes per Year						
HAP	CO	NOx	SO_2	PM	VOC	Subtotal
AE (TPY)	36	45	45	17	4.8	147.8
Annual Gravimetric Stack Emissions of Individual HAP Minor Constituents in TPY						
HAP Species	HCI	Dioxins Furans	Cd	Pb	Hg	Subtotal
AE (TPY)	4.4	$1.4E^{-06}$	$2.9E^{-03}$	$7.2E^{-03}$	$8.1E^{-06}$	4.5
Total Estimated Stack Emissions in Tonnes per Year						153.3

Hydrothermal Plastics to Liquid Fuels Plant: Phase I of the TNEC will include two HTL plastics to liquid fuel units, each operating at 500 metric tons per day. A third HTL unit is planned for Phase II. These systems convert sorted plastics into diesel and naphtha liquid fractions, a fuel gas, and a pet coke. Fuel gas produced in the HTL unit is burned to heat the water and plastic reaction mixture. This fuel gas is burned in Low NOx burners to minimize emissions. Representative stack concentrations of criteria pollutants are shown in Table 2-9, as measured at a similar facility.

Table 2-9: Stack Concentrations of Criteria Pollutants for a HTL Unit System Similar to that Proposed by TNEC

Constituent	Stack Concentration mg/Nm^3	Adjusted Stack Concentration mg/Nm^3 (at 11% oxygen)
CO	23	50.6
NOx	13	28.6
SOx	0.71	1.56
PM	8.8	19.4
VOC	4.5	9.9
Total	50	110

The HTL produces more fuel gas than is required to heat the reaction mixture. The excess fuel gas (a mixture of mainly C1, C2 and C3 gasses) is used to power an off the shelf 5 MW reciprocating engine genset for each HTL unit. An afterburner will also be installed to burn and safely vent the excess fuel gas produced when the reciprocating engines are not running and during start-up.

Exhaust stack emissions estimates shown for these engines are based on US Department of Energy publications regarding the emissions of gas powered gensets used for CHP application. While some variation in fuel for these engines when in service is anticipated, the overall emissions will remain within the estimated range indicated in Table 2-10 for each 5 MW of power generated. Annual emissions are estimated based on 8000 hr/year of operation (91% availability). Table 2-11 shows air emissions from the HTL heater burners also operating on fuel gas by-product.

Table 2-10: Annual Gravimetric Stack Emissions from 2 x 5 MW Gas Engine Gensets with Abatement

Pollutant	Reciprocating Gas Engine Genset with Emissions Abatement				
	Genset MWe	Emissions lb/MWh	Percent Availability	Operating hours/year	10 MWe Total (Tonnes/yr)
NOx	5	0.22	91	8,000	7.92
CO	5	0.22	91	8,000	7.92
VOCs	5	0.15	91	8,000	4.4

Table 2-11: Annual Gravimetric Stack Emissions from Fuel Gas Burners

Pollutant	Low NOx Burners for HTL system heating				
	g/MWh	MW_t	kg/hr	Operating hours/year	Total (Tonnes/yr)
NOx	31.0	21.1	0.65	8,000	5.2

Pollutant	Low NOx Burners for HTL system heating				
	g/MWh	MW_t	kg/hr	Operating hours/year	Total (Tonnes/yr)
CO	154	21.1	3.27	8,000	26.1
VOCs	61.9	21.1	1.31	8,000	10.5

Air Dispersion Modeling: Air dispersion modelling for TNEC facility as a whole (Phase I and Phase II) for Ambient Air Particulate Matter Concentrations at Ground Level will be carried out when sufficient local meteorological and surface topographic data are available. Air dispersion modeling shown below provides an example of the ground level contribution of this type and scale of gasification power plant to ambient air concentrations of NOx.

This modelling was done using AERMOD, an air dispersion model that uses meteorological data, upper air soundings, local terrain and land cover to estimate ground level pollutant concentrations in the region around the source in all likely atmospheric conditions. An example of the data produced by AERMOD is shown in Figure 2-25. The plot is centred on the location of the proposed stacks and based on a similar 50 MW facility.

The Potential for Significant Deterioration (PSD) is the largest negative contribution to air quality from the source at any time in any location. Compare these concentrations as shown in Table 2-12 with the Canadian Ambient Air Quality Standards shown in Table 2.13.

Synergy World Power

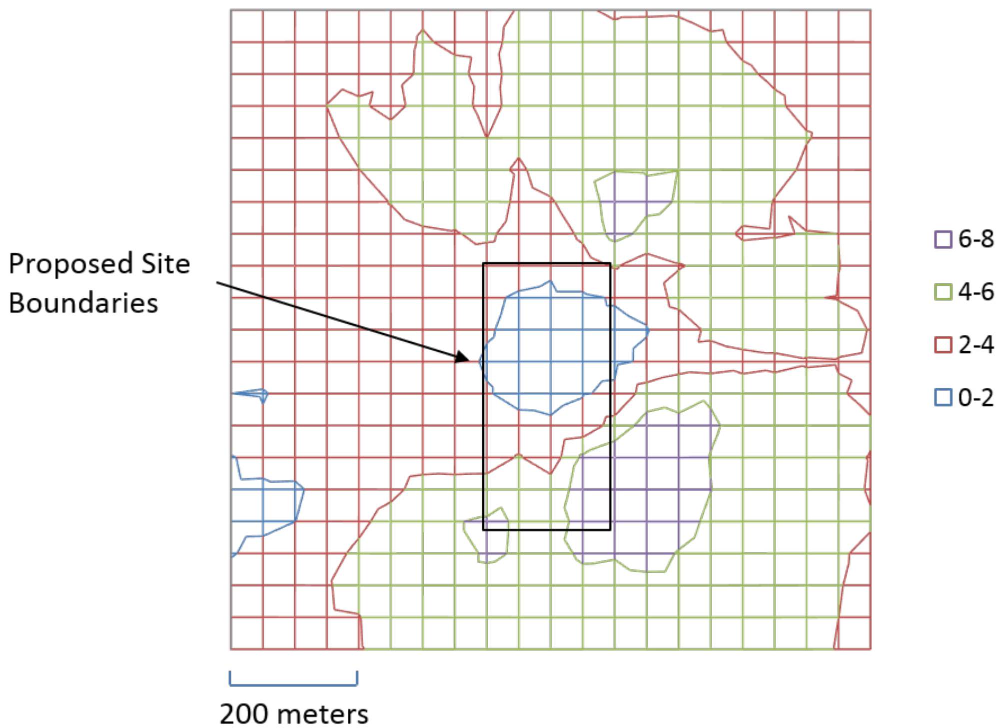


Figure 2-25 Maximum One-Hour NOx Concentrations (ppb), as Predicted by AERMOD

Table 2-12: PSD Analysis for Similar Gasification Plant

Pollutant	Averaging Period	PSD Increment Consumption by the Source ($\mu g/m^3$)
SO_2	3-hour	3.26
SO_2	24-hour	1.26
SO_2	Annual	0.16
NOx	Annual	0.14
PM_{10}	24-hour	0.36
PM_{10}	Annual	0.04

While this modeling was done in a different climate and over different terrain, the order of magnitude ground level concentrations will be similar the 50 MW CHP sources at TNEC. The reciprocating gas engines will be the other sources and will contribute, in total, between 20 and 25% of the gravimetric amount emitted by the 50 MW sources. As can be seen, from Tables 2-13, the TNEC will have no significant effect on ambient air quality in the region.

Table 2-13: Canadian Ambient Air Quality Standards

Component	Unit of Concentration	Maximum Value	Maximum Value
CO	μg/Nm^3	35000 (1 hr)	15000 (8 hr)
NOx	μg/Nm^3	400 (1 hr) 200 (24 hr)	100 (1 yr)
Sox	μg/Nm^3	900 (1 hr) 600 (24 hr)	300 (24 hr) 60 (1 yr)
PM (total)	μg/Nm^3	120 (24 hr)	60 (1 yr)
Hg	μg/Nm^3	2.0 (24 hr)	

Air Dispersion in the Lewisporte Area: Air quality typically deteriorates during occasional calm weather with no wind, or during high wind times when a plume cannot form over the stack. In both these cases the worst affected areas are near the stack. The area of maximum air quality impact is typically within 1 km of the source. In Lewisporte, this area is nearly completely on the TNEC property. Even in the most severely affected areas, under the most unfavorable conditions, the air quality impact is low, as shown by the PSD numbers (see Tables 2-12, 2-13 and Figure 2-25).

Compared to the previous air dispersion modelling, which was in desert climate near Las Vegas, the maritime location of TNEC should decrease the frequency of calm (windless) weather. The cooler temperatures also help plumes form, preventing pollutants from reaching ground level. The forests around the site can hinder the dispersion of pollutants compared to deserts, though this is unlikely to have a major effect. Unlike the situation when with trees as ground cover, the open water of Burnt Bay that separates the stacks from Lewisporte, improves air dispersion by allowing steady wind near the surface.

Most of Lewisporte is 3 km or more from the stacks. This is well outside the range of the noticeable effects. With the prevailing winds, the stacks are also downwind of Lewisporte, meaning in typical weather there will be no effect on air quality whatsoever.

Greenhouse Gas Emissions

Industrial Facilities in Newfoundland and Labrador must report greenhouse gas emissions as outlined in SNL2016 Chapter M-1.001. Table 2-14 on the following page shows an estimate of the major sources of greenhouse gases that will be emitted from TNEC.

The calculations were done according to the document "*A Guidance Document for Reporting Greenhouse Gas Emissions for Large Industry in Newfoundland and Labrador*." SRF, the primary fuel at TNEC, is not listed in the document, neither is any type of refused derived fuel or pulp product. In lieu of these more accurate categories, Municipal Solid Waste numbers were used.

For the Hydrothermal Liquefaction process, ethane was used as the closest analog to the combustible portion of the fuel gas. The fuel gas is both produced and combusted in the process. The unit for the high heat value in the guidance for ethane is gigajoules per kilolitre (GJ/kL), which assumes a liquid state. No liquid ethane will be used or stored on site. Instead, a typical high heating value of 51.8 GJ/tonne was used to estimate the gigajoules (GJ) of ethane used annually.

Other greenhouse gas emissions onsite, such as diesel engine use and natural gas burning, will represent a minor (<1%) portion of the total greenhouse gas emissions.

Table 2-14: Major Greenhouse Gas Emission Sources at TNEC

Process	Fuel Used (GJ/yr)	GHGe (t/yr)
Gasification	5,814,000	498,000
Hydrothermal Liquefaction	1,631,000	92,000
Total		590,000

Note: This information is also provided in Table 6-5.

Surface Water Releases

Releases to surface water will be confined to storm water and snow melt run-off. This water will be held in a settling pond before being released to flow into Burnt Bay, where it would have otherwise ended up if it were surface water run-off.

Ground Water Releases

Sewage wastewater will be processed by an approved septic tank system prior to release by way of the drain field. The volume of water to be disposed of in this manner is provided in the water use Tables 2-4 and 2-5. The engineered inert material storage facility onsite will have a leachate treatment system, which will release treated water to settling ponds.

Solid State Terrestrial Emissions

Gasifier Bottom Ash will be a granular sintered inorganic material that may be used for construction fill or road grit. Gasifier Fly Ash and Spent Reagents used in the air pollution abatement will be placed in the inert material storage facility which will be an engineered landfill with a leachate collection and treatment system. Plant Refuse will be sorted with the biomass material being gasified to generate thermal energy and the plastics being converted to liquid fuels in the HTL units. Inert materials (glass ceramics, inorganic fines) sorted from plant refuse or from the incoming SRF, will be placed in the inert materials storage facility.

2.8.3 Decommissioning

The conventional end of service life process for a thermal power plant starts with planned retirement, during which the last of the onsite fuel is consumed by the plant, prior to final shutdown. The operating permits are surrendered, and the plant is decommissioned. Machinery or other components may be sold for reuse elsewhere, while the steel and other recoverable materials are cut up and sold for scrap.

Once removal of the buildings and equipment is complete, the site is remediated to remove any residual hazardous materials. Concrete masonry and other inert materials are placed in a construction and demolition landfill or repurposed for road or waterway riprap as the property is prepared for re-development. The TNEC will have an engineered inert materials landfill onsite that will be suitable for placement of any non-recyclable inert material generated during remediation.

Design service life for both the HTL and WTE (CHP) components of the TNEC Facility is 30 years. SWPNL management will maintain a capital reserve for replacement of major components on a periodic basis which will be equivalent to a complete plant overhaul in 20 years.

The capital reserve will be sufficient for two complete refurbishment cycles with residual capital for final retirement and decommissioning sometime after between 50 and 60 years of service. Plans call for the thermal energy in the form of steam or hot water from the TNEC biomass WTE plant will be used for space heating in greenhouses that will be built in the immediate area surrounding the TNEC facility.

Use of this land for agriculture is likely to be commercially viable on a longer-term basis than 50 or 60 years. Therefore, it is likely that the normal life cycle for the CHP thermal plant will be altered by eventual installation of a second WTE gasification unit so that at least one of the two units can be available to provide thermal energy to the greenhouses on a near continuous basis.

The HTL units will be comprised mainly of high-pressure vessels and pipes carrying plastic derived organic fluids suspended in superheated water. These units will be maintained on component replacement schedule similar to that for the WTE gasification systems. After retirement, they will be decommissioned by conventional means. The capital accrual or set aside will be used for retirement and decommissioning, followed by remediation and re-development of the site. It is likely that the two types of units on the site will be retired and decommissioned at separate times, since the HTL and WTE units have different functions and different uses in the community.

Provincial regulations for registration, operation and abandonment of above-ground storage tanks used for gasoline or associated products are set forth in Newfoundland and Labrador Regulation 58/0 (O.C. 2003-225). The regulations stipulate that riveted tanks may not be re-used and must be thoroughly cleaned prior to being cut up for scrap during decommissioning. The scrap may be placed in a scrap yard or landfill.

The TNEC sea port will be a valuable infrastructure that can be in service for far longer than the mechanical systems of the TNEC. The TNEC port facility is designed for a service life that extends well beyond 50 years. Ports of this general type can be designed and built from materials that would allow them to be in use for a century or more. The port facility design and associated costs are appropriate for the likely service life of the TNEC. Specifically, the port service life will extend well beyond that of TNEC, which is designed for 30 years with budget provisions for service live extension to between 40 and 60 years. During the decommissioning of the TNEC proper, It is more likely that the port will be refurbished and upgraded than demolished and removed.

2.9 Environmental Management and Protection

TNEC will retain a qualified full time environmental compliance officer who will also have responsibility for operation of the Facility analytical laboratory and be responsible for proper operation of plant environmental monitoring equipment and for identifying and addressing any upsets in a timely manner. Among the environmental compliance officer's duties will be developing, maintaining and periodically exercising an Environmental Emergency Response Plan in relation to environmental risks associated with the industrial operation. This individual will report to the Plant Manager as well as the responsible officer at the EPRD corporate level. The EPRD corporate CTO along with TNEC management will develop Standard Operating Procedures, in addition to those already set forth in the Preliminary Plant Operations plan (Appendix C) that will include operating requirements relating to environmental protection and control aspects of the facilities.

Technicians trained in the operation and maintenance of the environmental monitoring equipment will be tasked with the responsibility of properly calibrating and maintaining sensors and equipment necessary to ensure that atmospheric terrestrial and aqueous emissions from the TNEC are will within the limitations imposed by regulations and plant operating permits. The environmental compliance officer and technicians will ensure that control and monitoring equipment will be operated and maintained in conformance with regulatory requirements and manufacturers specifications. The analytical laboratory will be equipped and manned to support this task.

Environmental emissions associated with TNEC will include cleaned exhaust gases from the HTL units and the waste to energy gasification plant, followed by motor vehicle and ship engine emissions. Minor or insignificant air emission sources will include fuel storage tank vents, and occasional small amounts of fugitive dust from the loading and transport of bag house filtrate and ash. Readily available steam or hot water from the gasification plant will be used for space heating for the buildings.

Exhaust gas from the LoNOx rotary kiln-based gasification plant will be cleaned with a lime injection into the gas stream, a baghouse, and a low temperature selective catalytic reduction system. Table 2-8 provides the anticipated emissions for criteria pollutants from this system. The gasification plant will be fitted with an emergency dump stack that will release overpressure gas in the event of an upset that would lead to a gas path blockage or overpressure event. Although gas released from this dump stack is at a temperature that would cause it to spontaneously combust upon contact with ambient air, a conventional flare ignition system will be installed in the stack as backup.

HTL plant air emissions will be mainly from the exhaust of the piston engine genset operating on fuel gas by-product of the HTL process. As described above and illustrated in Appendix E exhaust emissions from the HTL plants will be cleaned by sorbent injection and a baghouse before release to the atmosphere. There will be a flare system to release gas pressure in case of a process upset. Flared gas will not be at combustion temperature and will require an ignitor.

2.9.1 Environmental Planning and Design

As described above, environmental performance was a priority in the design of the TNEC starting with the rotary kiln gasifiers that will be used for the CHP plant. The efficiency of these environmentally friendly thermal conversion technologies is further enhanced by the use of a portion of the thermal energy for space heating in greenhouses rather than rejection to the environment. That portion of the waste derived feedstock that supports the greenhouse heating project will be converted with a thermal efficiency exceeding 60% as compared to approximately 25% for conventional Rankine cycle only power generation.

The patented design of the rotary kilns also allows the bottom ash from the biomass fraction of the SRF to be sintered to a carbon free aggregate material, most of which will be exported to the UK for use as construction aggregate or in cement products.

Likewise, conversion of higher calorific value plastics into ultralow sulphur, low carbon intensity liquid fuels using HTL is a technology choice based on the most environmentally beneficial use of non cyclable waste plastic. Diversion of Canadian MSW from the Norris Arm or other Atlantic Canada landfills will also reduce the carbon footprint of local waste management activities.

Finally, the inclusion of stack CEMS systems and other environmental monitoring as well as the establishment of standard operating procedures for the quality and quantity of materials released to the environment from the plant will be done in full compliance with all applicable regulations.

2.10 Approval of the Undertaking

Table 2-15 is a list of anticipated permits and authorizations. Many of these will be conditions of release from the EA process. SWPNL will comply with all Newfoundland and Labrador and Canadian regulatory requirements.

Table 2-15: Project Environmental Permits and Authorizations

Category	Legislation	Permit /Authorization
Municipal – Town of Lewisporte		
Town of Lewisporte	Municipal Development Regulations	Building Permit
		Business Occupancy Application
		Zoning Requirements
Provincial - Digital Government and Service NL		
Waste	Environmental Protection Act, 2002	Requirements for disposal of waste material generated during Project construction and operation.
		Requirements for site housekeeping.
Pollution Control	Environmental Protection Act, 2002	Fuel Tank Registration All fuel storage tank systems, other than those connected to a heating appliance of a capacity of 2,500 litres or less, and

Category	Legislation	Permit /Authorization
	The Storage and Handling of Gasoline and Associated Products Regulations, 2003 Heating Oil Storage Tank System Regulations, 2003 Used Oil and Used Glycol Control Regulations	any proposed fuel cache will require registration prior to installation.
		All fuel storage tank systems, other than those connected to a heating appliance of a capacity of 2,500 litres or less are subject to the *Storage and Handling of Gasoline and Associated Products Regulations* and will require registration prior to installation.
		All used or waste oil is to be collected in a tank or closed container and is to be disposed of by sale or transfer to an approved waste oil collection facility.
		The storage, handling and disposal of used and or waste oil must be in compliance with the *Used Oil and Used Glycol Control Regulations*.
		Any spill or leak of gasoline or associated product is to be reported immediately to Service NL by calling the Environmental Emergencies Telephone Line at 772-2083 or 1-800-563-9089.
Boiler, Pressure Vessel and Compressed Gas	Boiler, Pressure Vessel and Compressed Gas Regulations	Contractor's Licencing – required for contractors who fabricate, install, alter, repair or test boilers, pressure vessels, fittings or pressure piping systems.
		Fitting Registration – All fittings' designs must be registered in this Province before the fittings are fabricated.
		Gas Plant Licencing – All individuals involved in the installation, alteration, purging, activation, service repair or removal of any propane gas appliances, equipment, systems, cylinders and tanks must be certified to do so.
		Gas Technician Certification and Renewal – All individuals involved in the installation, alteration, purging, activation, service repair or removal of any medical gas appliances, equipment, systems, cylinders and tanks must be certified to do so.
		Pressure Piping System Registration – The design of all pressure piping systems exceeding the size

Category	Legislation	Permit /Authorization
		limitations specified by the Regulations must be registered.
		Pressure Plant Registration – A Certificate of Plant Registration may be issued to owners of registered pressure plants who are operating a power plant, heating plant, refrigeration plant, compressed gas plant or combined plant as defined in the Regulations.
		Pressure System Inspections – Any installation of or alterations to a pressure system, in accordance with the Boiler, Pressure Vessel and Compressed Gas Regulations, must have a permit and must be inspected when the work is completed. In addition, all boilers and pressure vessels are inspected periodically in accordance with the Periodic Inspection Internal Policy.
		Pressure System Permits – Installation or alterations to a Pressure System require a Permit.
Electrical	Public Safety Act, 1996 Electrical Regulations, 1996	Electrical plans (if required) must be submitted to the Government Service Centre for review and approval.
		An Electrical Permit is required for each meter. An Electrical Permit may only be issued to a person who is the holder of an Electrical Contractor's Registration Certificate.
Environmental Health	Sanitation Regulations Environmental Control Water and Sewage Regulations, 2003	Wastewater or Water System Approval (Greater Than 4546 L/d Wastewater Flow/Private Water Treatment) – Medium to large commercial establishments in unserviced areas will require a Permit to Construct for wastewater or water treatment. Daily wastewater flows to be determined using the Guidelines for the Design, Construction and Operation of Water and Wastewater Systems.
		Wastewater or Water System Approval (Less Than 4546 L/d and Well Approval) – A building lot in an unserviced area must be approved for the

Category	Legislation	Permit /Authorization
		installation of the disposal system and well. Design must be prepared by an Approved Designer.
Buildings Accessibility and Fire and Life Safety	Buildings Accessibility Act, 2006 and Regulations	Buildings Accessibility Design Registration – Required for any building or part thereof that is being constructed, reconstructed or renovated where the work is required to conform to the Buildings Accessibility Act and Regulations.
		Signage Requirements – Required for buildings subject to the Buildings Accessibility Regulations.
		Building Accessibility Exemption Registration – Required for any building or part thereof that is being constructed, reconstructed or renovated where work is not required to conform to The Buildings Accessibility Act and Regulations.
		Fire and Life Safety Plan Review
Development Control	Protected Road Zoning Regulations, 1996	The extent of land clearing and grubbing should be restricted such that naturally vegetated areas between the site and surrounding properties and throughfares are maintained
		Any existing tree screen concealing the operation from public view is to be maintained.
		The construction of an access to a highway that is classified as a Protected Road requires the prior approval of Transportation and Infrastructure and/or the Government Service Centre. (Preliminary Application to Develop Land)
Occupational Health and Safety	Occupational Health and Safety Act and Regulations	
Provincial – Environment and Climate Change		
Climate Change Branch		Provide a Site Drainage and Site Control Plan and outlined mitigation measures to address site runoff.
	Guide to Building Energy Efficient Homes and Small Buildings – 2016	For buildings, Climate Change Branch has developed guides for small and large buildings.

Category	Legislation	Permit /Authorization
	Guide to Better Building Envelopes for Large Buildings – 2016.	
Pollution Prevention Division	Environmental Protection Act and Regulations Air Pollution Control Regulations Halocarbon Regulations Environmental Control Water and Sewage Regulations Ambient Air Monitoring Guidelines (GD-PPD-065)	A Certificate of Approval (COA) will be issued by Pollution Prevention Division. Monitoring requirements identified for construction and operation of the project will be incorporated into the COA. COA terms and Any required water quality/effluent and ambient air monitoring programs will be detailed in the COA terms and conditions.
Water Resources Management Division (WRMD)	Water Resources Act, 2002 Policy for Development in Shore Water Zones (P.D. W.R.97-1) Policy for Infilling Bodies of Water (P.D. W.R.91-1)	Environmental Permits for Alterations to a Body of Water - under Section 48 of the Water Resources Act for any work in any body of water (including culverts, bridges, dams, fording, pipe crossings, water intakes, stream modifications, infilling within 15 m of a body of water, dredging and debris removal, flood risk areas, wetlands and miscellaneous works). Application for Water Use Licence: Non-domestic water use for any purpose, forall non-domestic uses with an existing, new or planned water use from any water source.
		Application for Permit for Constructing a Non-Domestic Well - Groundwater monitoring requirements would be determined prior to start of construction, in consultation with WRMSD.
Provincial - Executive Council		
Office for the Status of Women		Women’s Employment Plan

Category	Legislation	Permit /Authorization
Provincial - Fisheries, Forestry and Agriculture		
Forestry Division	Forestry Act and Regulations	Commercial Cutting Permit is required prior to any harvesting or timber removal.
		Operating Permit is required prior to start of any work during the forest fire season.
Crown Lands Division	Lands Act Guidelines for the Preparation of Applications for Crown Lands	Application for Crown Land
Provincial – Tourism, Culture, Arts and Recreation		
Provincial Archaeology Office	Historic Resources Act	If archaeological resources are encountered during any ground disturbing activities work must stop and the Provincial Archaeology Office be notified immediately.
Federal – Fisheries and Oceans Canada (DFO)		
NL Regional Office	Fisheries Act (2019) Guidelines for the Protection of Fish	Request a Review of Your Project Near Water – The project review process and steps determine if a review is required.
Federal – Transport Canada (TC)		
Navigation Protection Program	Canadian Navigable Waters Act (CNWA) A Guide to the Navigation Protection Program's Application and Review Requirements	
Federal – Environment and Climate Change Canada (ECCC)		
	Fisheries Act	Pollution prevention and control provisions of the Fisheries Act (Section 36(3)) are administered and enforced by ECCC. Environmental protection and mitigation measures should reflect the need to comply with Section 36(3) of the Fisheries Act.

Category	Legislation	Permit /Authorization
	Migratory Bird Convention Act and Regulations	Under Section 6 of the Migratory Birds Regulations (MBR), it is forbidden to disturb, destroy, or take a nest or egg of a migratory bird; except under the authority of a permit. It is the responsibility of the proponent to ensure that activities are managed so as to ensure compliance with the MBCA and associated regulations.
Federal – Impact Assessment Agency of Canada (IAA)		
Impact Assessment Agency of Canada	Impact Assessment Act	Impact Assessment Process

3.0 PROJECT BENEFITS TO THE LOCAL COMMUNITY AND THE PROVINCE

Project benefits to the Lewisporte area, the Province of Newfoundland and Labrador, and Canada in general, including benefits to the economy, environment, education, agriculture, energy security, and quality of life are listed and briefly described below and illustrated in Table 3-1.

The SWPNL Plant will provide:

- Investment of approximately $1 billion (CAD) over the first three years in the Lewisporte area.
- Approximately 180 to 220 well compensated jobs to the local community and the region for operations. Additional jobs will be created during construction.
- Support for the Dietrac Technical Institute, including needed equipment and the hiring of qualified students from their programs to positions at the plant.
- Creation of a new, larger port for import of plastic and biomass fuel and the export of liquid fuel, and aggregate by-product from TNEC as well the opportunity for export of local mineral timber and agricultural products as backhaul on available shipping.
- Creation of additional regional positions due to the number of employees, maritime operations, parts and maintenance programs.
- A cooperative arrangement with the Central Newfoundland Waste Management (CNWM) landfill and MRF by becoming an outlet for non-recyclable plastic or biomass material when there is no other market, as well as providing sintered ash for daily landfill cover when needed, thus helping to reduce costs and to extend the service life of the landfill.
- A contribution to the global environment by reducing GHG emissions by more than 500,000 tons per year.

3.1 Economic Benefits

Economic benefits of the project include creation of new, well-paid jobs, economic diversification, increased tax revenue, enhanced local production of agricultural products, and the development of an ongoing promotional campaign for the Lewisporte area as a centre for innovation and enterprise in central Newfoundland.

In addition to use of the TNEC port for import of feedstock and export of clean low carbon intensity liquid fuels, the port will be available to commercial concerns for more efficient import and export of locally produced commodities, thus reducing the road traffic and this reducing the transport costs of goods from Central Newfoundland making them more competitive on the world market.

Table 3-1: Community Benefits

Education	Agriculture	Energy	Environment	Quality
• Onsite Interpretation Centre • Partnership with Dietrac Technical Institute • TNEC Onsite Technical Skills Training • Centres of Excellence (physical and virtual) in: Greenhouse Operations, Hydroponics, Cannabis/Hemp Cultivation, Agriculture, Hobby Farming	• Greenhouse food production including hydroponics and aquaponics • Sustainable food security • Cannabis hemp production • Social enterprise farm • Composting • Bee friendly welcome garden /beehives	• Net zero energy usage • Clean diesel and fuel oil production • Potential for baseload renewable and demand power generation • Help stabilize Island power grid • Thermal Energy to facilitate agricultural component	• Leader in environmental stewardship • Worldwide plastic waste reduction • Sustainable freshwater use and re-use • Road salt reduction through grit production • Bee friendly to counter trends in bee population reduction	• High standards of environmental performance • Positive work environment • Quality work/ life balance • Professional development through training • Diverse inclusive work force • Quality long term career opportunities • Future community recreational opportunities

3.1.1 Employment Opportunities

Employment numbers for the Project during the construction phase are anticipated to vary between approximately 100 to 220 full time equivalent (FTE) employees depending on the work phase. In full commercial operation, total FTE employment is anticipated to be between approximately 180 and 230. Project staffing will be comprised of four crews to alternatively cover three weekday shifts (for 24/7 operation), as well as weekends. Table 3-2 shows number of positions by National Occupational Code (NOC).

Construction phase jobs will be mainly contract positions with the various contractors making some local hires of crafts people and importing labor not available locally. TNEC operations will be conducted primarily by full time direct hire employees. Contractors will be used for some specialized periodic maintenance tasks. Auditing and legal work will be handled at the corporate level through the use of contractors. All of the job titles listed in Table 3-2 and Table 3-3 will be direct hires.

Table 3-2: Project Employment by National Occupational Code (2016)

Code	Title	Number at TNEC	Comments
Management and Administration			
0016	Senior Managers in Production and Utilities including CEO	1	
01-05	Specialized Middle Managers	6	
011	Admin Services Managers	4	
0111	Financial Managers	1	
0112	Human Resources Manager	1	
0113	Purchasing Manager	1	
0124	Public Relations Manager	1	
01222	Administrative Assistants	6	
2112	Chemists	2	
213	Mechanical Chemical Engineers	4	
2145	Petroleum Engineers	2	
2174-2175	Computer Programmer/Web Developer	1	
221	Physical Science Techs	19	
720	Electrical and Construction	4	
7203	Pipefitter	2	
723	Machining and Metal Forming	4	
7234	Boilermaker	2	
7237	Welder	2	
7243	Power Systems Electricians	2	
725	Plumbers Pipefitters Gas Fitters	2	
7252	Steamfitters	2	
7302	Heavy Equipment Operator Crews	17	
7312	Heavy Duty Equipment Mechanics	2	
745	Longshore Workers	4	
751	Drivers	4	
92	Occupations in Manufacturing and Utilities Control Operators	12	
9	Other Occupations in Manufacturing and Utilities	88	Balance of workers not otherwise listed.

As the agricultural component of the project is developed, additional jobs will be created, although these employees will not be working directly for TNEC. They will be paid by independent entities who are operating the greenhouses on a lease basis.

Table 3-3: Preliminary TNEC Staffing Roster

Position	No.	Priority for Women's Employment	Education/Training/Experience Required
Management/Administration			1 Shift + As Needed/On Call/Overlap
TNEC General Manager	1		B.S. Degree + Minimum of 15 years experience including Plant Manager
Finance Manager	1	1	MA Finance or CPA + 5-10 years relevant exper.
Chief Engineer	1		B.S. + 15 years experience power plant/refinery Ops P.Eng. Required
Chief Security and Fire Dept	1		B.S. + 10 years exp. as security or first responder
Env. Health & Safety Manager	1	1	B.S./B.A. + relevant experience (may be part time)
Reg. Compliance Manager/ Environ. Compliance Officer	1	1	B.S. + 10 years experience in regulatory affairs and environmental compliance
IT Manager	1	1	B.S. + 10 years experience
Purchasing Manager	1		B.S./B.A. + relevant exper. in refinery/utility ops.
HR Administrator	1	1	B.S./B.A. + relevant experience
Planner	1		B.S./B.A. + relevant experience in refinery ops.
Media/Community Relations	1	1	Assoc Deg + 5 years relevant experience
Greenhouse Project Liaison	1		TBD by PPP
QA/Laboratory Manager	1	1	B.S. + 5 years experience in Lab management
Environ Monitoring Inst Tech	1		Assoc Degree + 5 years relevant experience
Office Manager	1		Assoc Degree + 10 years relevant experience
Accountant	1	1	B.S./B.A. + Professional Certification
QA/Drawings/Records	1	1	Assoc. + 2 years experience in similar job
Accounts Payable + Scales	1	1	High School Graduate + 2 years experience
Receptionist	2	2	High School Graduate + 2 years experience
Bookkeepers	2	1	High School Graduate + 2 years experience
Timekeepers	2	1	High School Graduate + 2 years experience
Port Operations Manager	1		B.S. + 10 years in port operations and mgt.
HTL Plant Manager	1		B.S. + 10 years refinery mgt experience (P.Eng.)
CHP Plant Manager	1		B.S. + 10 years power plant mgt exper. (P. Eng).
Warehouse Supervisor	1		Trade Certification + 5 years experience
Maintenance Supervisor	1		Assoc. Deg + Trade Certification +10 years exper
QA/Plant Lab Supervisor	2		B.Sc. + some relevant exper. in similar position
Safety Technician	1		B.S./B.A. + 5 years experience
Lab Tech	4	1	Assoc. + 2 years experience
P.R. + Visitor Centre	1		B.S./B.A. + interpersonal skills & some experience

Position	No.	Priority for Women's Employment	Education/Training/Experience Required
Port Operations			**4 shifts (24/7) as needed for vessel turnaround**
Dock Shift Supervisor	4		Assoc. + 5 years marine operations experience
Dock Equipment Operators	8		High School + 5 years experience
Longshoremen	4		High School + 5 years; dock experience
Marine Ops Logistics	1	1	Assoc. + 5 years marine operations experience
Storage Facility/Fuel Prep			**3 Shifts 16 + 4/6/365 – Weekends + some Holidays**
Fuel Prep Facility Supervisor	4		Assoc + 5 years solid waste management exper.
Heavy Equipment Operator	9		Licensed Operator + Min 2 years experience
Plastics Feedstock Logistics	3	1	High School + 2 years relevant experience
Storage Lot Crews/Pickers	12	1	Unskilled/semi-skilled (some may be part time)
Load Inspectors	3	1	High School + 2 years relevant experience
HTL Fuel Plant			**4 Shift/24/7/365**
Shift Supervisor	4		Assoc Deg + Trade Certifications + 5 years exper.
Plant Operators	8		Assoc Deg + Trade Certifications + 5 years exper.
Refinery Operators	4	1	Assoc Deg + Trade Certifications + 5 years exper.
Tank Farm Supervisor	1		High School + 10 years experience
CHP Plant			**4 Shifts 24/7/365**
Shift Supervisors	4		Min. Assoc. Degree
Tipping Floor Operators	4		High School + 1 year experience
Feedstock Equipment Operator	4		High School + 2 years experience
Power Operators	6	1	Licensed Power Operator + 5 years experience
Boiler Operators	4	1	Licensed Boiler Operator + 5 years experience
Laborer	4		High School + 2 years experience
Maintenance Facility			**Mostly 2 shifts + weekend + 3 selected on Night Shift**
Maintenance Mechanics	8		Trade Certification + 5 years experience
Welder	2		Trade Certification + 5 years experience
Steam Fitter	2		Trade Certification + 5 years experience
Machinist	2		Trade Certification + 5 years experience
Electronics/Instrument Techs	4	1	Trade Certification + 5 years experience inc. digital systems

Position	No.	Priority for Women's Employment	Education/Training/Experience Required
Electricians (Power Systems)	4		Trade Certification + 5 years experience incl. HV experience
Tool Room and Parts Cage	2	1	High School + relevant experience
General Facility			**3 Shifts + Weekends as needed + 24/7 for Guards**
Drivers	4	1	CDL as required
Weigh Bridge/Gate Ops	4	1	Unskilled/semi-skilled (will be trained)
Security Guards/+Captain	13	1	Some military or security experience preferred
Janitors	3		High School
Laborer	10		High School Graduate or GED
Total FTE Employment	196		On Site Only – Not Including Offsite Sorting and Transport
Total WP Positions		27	Women Priority in hiring for one or more slots in the occupations designated in the WP column

3.1.2 Gender Equity, Diversity and Inclusion

As recommended by the Office of Women and Gender Equality, TNEC – "aims to achieve equity rather than equal treatment, recognizing that treating everyone the same may not necessarily produce equitable results because individuals have different life experiences to consider." To this end, TNEC management will consider qualified women for any position in the company.

In addition, we have identified at least 27 job titles, some requiring more than one worker, for which qualified women will be actively sought and recruited. These are not strict "set aside" positions for women, rather they are positions for which hiring preference will be given to women in cases where otherwise equally qualified candidates of both genders are available.

As a component of its support of the Dietrac Technical Institute, TNEC will offer apprenticeships to qualified women. Through discussions with Office of Women and Gender Equality, TNEC will determine whether set aside apprenticeship programs for women interested in entering the trades as a profession are appropriate for women enrolled at Dietrac in specific training courses.

For those engaged in trades, there will be flexibility in shift work schedules, as well as maternity and family leave options available. Less than full time work schedules will be available for many jobs. This, together with the fact that most skilled trades operations will be manned by four complete crews (three weekday shift crews and a weekend shift crew), will allow the kind of flexibility.

Professionals and skilled staff positions, as well as semi-skilled and unskilled jobs will be filled with individuals meeting the required educational, skill, and experience qualifications as outlined on the Staff Roster (Table 3-3), regardless of age, gender, race, or ethnicity.

While several of the TNEC senior management positions may be occupied initially by US or UK citizens, it is the express goal of TNEC to move Canadian nationals into top management slots as soon as possible, commensurate with good business practices.

3.1.3 Diversification and Follow-on Enterprise Opportunities

Establishment of TNEC as a new and environmentally beneficial industry in Central Newfoundland will also provide several follow-on economic opportunities for the region. In addition to the infrastructure improvements in port facilities and creation of more than 200 well-paying jobs, there will be opportunities for follow-on business including the following:

- Agriculture Products: TNEC will produce thermal energy that can be used to make low-cost steam or hot water for heating for greenhouse to be built in the area near the plant. TNEC can also supply low-cost renewable electrical power to local greenhouses or for other agricultural uses.

- Transportation and Logistics: The new port facility at TNEC will improve import-export opportunities in the region, making available back haul shipping of commodities produced in Central Newfoundland such as minerals, timber, and specialty hydrocarbons.

- TNEC Project Expansion: Depending on the subscription for greenhouse heating and power off-take, adequate thermal energy for the operation of both the greenhouse heating scheme and baseload power generation my require the import of additional SRF and expansion of the gasification capability.

- Building Materials: The grit can be used as an aggregate in manufacture of cement blocks or other cementitious building materials.

3.1.4 Confirmed and Potential Revenue Sources

Economic benefits to the community are driven, in large part, by the revenue streams available to the Project when in full commercial operation. Confirmed and potential revenue streams are described below.

- Tipping or Gate Fees from Imported SRF: A primary source of revenue for the plant will be tipping or gate fees from the processing of approximately 2,000 t/d of SRF material imported from Europe in Phase I.

- Tipping Fees from Processing of Plastic and Biomass Waste from Canada: TNEC will also accept domestically generated biomass and plastic waste for processing to diesel fuel and thermal energy under terms and conditions to be determined. The processing of solid waste from Canadian sources will help to reduce the amount of waste going to landfill, thus reducing greenhouse gas emissions and the amount of fugitive plastic in the environment, while also reducing the energy cost of liquid fuel.

- Liquid Fuels from Plastics: The SRF materials being imported from Europe will initially include approximately 250,000 metric tons (tonnes) per year of plastic materials that are suitable as feedstock for the hydrothermal liquefaction (HTL) process. HTL breaks down the plastic polymers into smaller hydrocarbon molecules that are constituents of diesel fuel or fuel gas. This ultralow sulfur fuel oil will be produced to meet ASTM D 975 as a "drop in" diesel fuel. It can be sold to wholesalers to be blended into retail petroleum products. The term "drop-in", as used here, means a fuel oil that meets ASTM specifications for a #2 or #1 diesel fuel but does not contain the additive packages that may be required in some jurisdictions. Demand for ultralow sulfur diesel is likely to remain high in Canada.

- Ferrous and non-ferrous metals: Contractual specifications allow for up to 2% of metals in the SRF. Recovered metals will be stored in bulk and sold.

- Fuel Gas from Plastics: Methane, ethane, and propane (non-condensable) gas by-products from the HTL process will be used onsite to fire multi-fuel reciprocating engine generators that will produce house power for the plant. If needed, this clean fuel gas can also be used for trimming the gasifiers or used along with heavy oil from the HTL process to fire peaking generators for baseload or demand power to the grid or a Data Centre.

- Sintered Aggregate: A course grit for construction fill and highway de-icing will be produced by the sintering of the bottom ash from the rotary kiln gasifiers. This will be a carbon-free inorganic material with particle sizes of between about 0.5mm and 2mm.

- Carbon Credits: Conversion of the biomass portion of the SRF for electricity generation will be eligible for generation of carbon credits. These can be applied for and then traded on the carbon credit markets. These credits should also be available for CHP operations due to the high thermal efficiency of the process.

- Canadian Clean Fuel Standard Credits: Liquid fuels produced from waste plastic by HTL will qualify as low carbon intensity fuels, requiring only a about 5% of the energy to produce per MJ of energy content as diesel from petroleum crude oil. TNEC will accrue credits from production of these fuels, which credits can be traded in markets to be established in Canada. www.annex_clean_fuel_standard_liquid_fuels.pdf

- Hot Water for Greenhouse Space Heating: The CHP gasification plant will generate thermal energy in the form of hot water that will be used as a source of heating for local greenhouses or aquaculture schemes. Approximately 100 acres of the TNEC site will be available for greenhouses.

A portion will be graded to be suitable for greenhouse pads in Phase I. Electrical power and hot water will be available to the greenhouses from TNEC.

- Renewable Baseload Power: The Project will include turbine generators driven by steam from the biomass gasifiers. This CHP plant will have a nameplate capacity of approximately 40 MW and will provide 36 MW net to the grid. A smaller back pressure steam turbine will be installed to generate electricity as well as steam to make hot water for the greenhouses. The CHP plant generator will provide power through a substation to the grid and the site microgrid.
- Peaking Power Generation Option: Fuel gas and heavy fuel oil by-products of the HTL process can be used to fire multifuel reciprocator driven genset that can produce peaking power on demand. This dispatchable power can be an important component of a resilient power gird and, when needed, can command a premium price. This option has not been designed into Phase I and can be added in Phase II if a market develops.

3.2 Other Community Benefits

The Project will result in spinoff economic, education and training benefits in the community, the region and the province. It will also contribute to sustainable usage of waste materials presently landfilled at Norris Arm.

3.2.1 Education

TNEC will provide support to the Dietrac Technical Institute in Lewisporte through programs established to support employment at TNEC. TNEC will also support Dietrac through the provision of specialized equipment, as needed, to help it prepare students with specific skills required at the TNEC facility.

TNEC will provide support and assistance to science, technology, engineering, and math programs in local schools and make its visitors centre available for educational seminars and public lectures and plant tours. Paid apprenticeship programs will be established as will a scholarship fund for qualified and deserving local students to attend college or university.

3.2.2 Environmental Benefits

EPR's patented "LoNOx" gasification process that will be used for converting the biomass portion of the SRF to renewable thermal and electrical energy is the cleanest technology available for conversion of combustible solid waste. SWPNL's experts understand that the HTL process for converting plastics to fuels is the cleanest and most efficient process for plastics conversion. The HTL process itself produces no air emissions aside from those that result from use of the liquid, gas phase and solid fuels produced. In addition to processing clean, dry SRF material imported from Europe, TNEC will also process most of the dry biomass and plastic municipal solid waste from the region that is now being placed in the Norris Arm Landfill. Thermally processing biomass waste greatly reduces the emission of greenhouse gas equivalents that would otherwise result if the materials were placed in a landfill.