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LIST OF ACRONYMS AND ABBREVIATIONS

Acronym/Abbreviation	Definition
AGO	Atmospheric Gas Oil
AIS	Automatic Information System
ALARP	As Low As Reasonably Practicable (Loss Control)
API	American Petroleum Institute
BATEA	Best Available Technologies Economically Achievable
bbl	Barrels
bbl/day	Barrels per day
Bpd	Barrels per day
BPH	Barrels Per Hour
BMP	Best Management Practices
°C	Degrees Celsius
C_2	Ethane
C_3	Propane
C_4	Butane
C_5	Pentane
CAD	Computer Aided Design
CASRN	Chemical Abstract Registry Number
CCG	Canadian Coast Guard
CCME	Canadian Council of Ministers of the Environment
CCR	Continuous Catalytic Reformer
CDWQG	Canadian Drinking Water Quality Guidelines
CEAA	Canadian Environmental Assessment Agency
CEPA	Canadian Environmental Protection Act
CO_2	Carbon Dioxide

Acronym/Abbreviation	Definition
CoA	Certificate of Approval
CPPI	Canadian Petroleum Products Institute
CSA	Canada Shipping Act
dBA	Decibels
DFO	Department of Fisheries and Oceans
Diesel HTU	Diesel Hydrotreater
DOEC	Department of Environment and Conservation
DWT	Dead Weight Tonne
EA	Environmental Assessment
ECAREG	Eastern Canada Vessel Traffic Services Zone Regulations
EEZ	Exclusive Economic Zone
EHSM	Environment, Health and Safety Management
EIS	Environmental Impact Statement
EOC	Emergency Operations Centre
EPA	Environmental Protection Agency
EPP	Environmental Protection Plan
ERP	Emergency Response Plan
ESD	Emergency Shutdown Device
°F	Degrees Fahrenheit
FM	Factory Mutual (Insurer Organization)
FCC	Fluid Catalytic Cracking
FFAW	Fish, Food and Allied Workers Union
FPSO	Floating, Production Storage and Offloading
FSP	Facility Security Plan
GHG	Greenhouse gas
GIS	Geographic Information System

Acronym/Abbreviation	Definition
GPM	Gallons per Minute
GPS	Global Positioning System
Ha	Hectares
HAZOP	Hazard Operability Analysis
HAZMAT	Hazardous materials
HP	High Pressure
HPU	Hydrogen Production Unit
H_2S	Hydrogen Sulphide
HS&E	Health, Safety and Environment
ICS	Incident Command System
l/s	Litres/second
IFC	Issued for Construction
IFRs	Internal Floating Roofs
IMO	International Maritime Organization
IMTT	International Matex Tank Terminals
ISM	International Safety Management
ISBL	Inside Battery Limits
ISGOTT	International Safety Guide for Oil Tankers & Terminals
Kerosene HTU	Kerosene Hydrotreater
kg	Kilograms
km	Kilometre
km^2	Square Kilometres
KPag	Kilopascal gauge
LNT	Low Normal Tide
LP	Low Pressure
LPG - C_3/C_4	Liquefied Petroleum Gas

Acronym/Abbreviation	Definition
m	Metre
m^3	Cubic metres
MCTS	Marine Communications and Traffic Services
MEA/DEA	mono/di-ethanol amine
MGD	Million Gallons per Day
MMSB	Multi Materials Stewardship Board
MMBtu/day	Million British Thermal Units per day
MoC	Management of Change
MP	Mean Effective Pressure
MSDS	Material Safety Data Sheet
Mt/day	Metric tonnes per day
MW	Megawatts
NARL	North Atlantic Refining Ltd.
NFPA	National Fire Protection Association
NFPRER	CCME National Framework for Petroleum Refinery Emission Reductions
NH_3	Ammonia
NLH	Newfoundland and Labrador Hydro
NLRC	Newfoundland and Labrador Refining Corporation
NOC	National Occupational Classification
NPRI	National Pollutant Release Inventory
NRC	National Research Council
NTL	Newfoundland Transshipment Limited
NWPA	Navigable Waters Protection Act
OHF	Oil Handling Facility
OPEP	Oil Pollution Emergency Plan

Acronym/Abbreviation	Definition
OPPP	Oil Pollution Prevention Plan
OWS	Oily Water Sewer
OSBL	Outside Battery Limits
PPE	Personal Protection Equipment
ppm	Parts Per Million
PSA	Pressure Swing Absorption
Psu	Pressurized square units
RA	Responsible Authorities
RDS	Residue Hydro-Desulphurization
RBCA	Risk-Based Corrective Action
RBOB	Reformulated Blendstock for Oxygenated Blends
REET	Regional Environmental Emergency Team
RFG	Refinery Fuel Gas
RO	Reverse Osmosis (Water Treatment)
SARA	Species at Risk Act
SCBA	Self-Contained Breathing Apparatus
SOLAS	Safety of Life at Sea Convention
SRU	Sulphur Recovery Unit
TAC	Transportation Association of Canada
TC	Transport Canada
TCH	Trans-Canada Highway
TDG	Transportation of Dangerous Goods
TERMPOL	Technical Review Process of Marine Terminal Systems and Transshipment sites
TRP	TERMPOL Review Process
TVOC	Total volatile Organic Compounds

Acronym/Abbreviation	Definition
ULSD	Ultra-Low Sulphur diesel
US or USA	United States of America
USgpm	US gallons per minute
USM	Unsuitable material
UTM	Universal Transverse Mercator
VBNC	Voisey's Bay Nickel Company
VDU	Vacuum Distillation Unit
VGO	Vacuum Gas Oil
VEC	Valued Ecosystem Component
VFDs	Variable Frequency Drives
VLCC	Very Large Crude Carriers
VOCs	Volatile Organic Compounds
VTS	Vessel Traffic System
WHMIS	Workplace Hazardous Materials Information System

1.0 INTRODUCTION

The five-volume Environmental Impact Statement (EIS) for the Newfoundland and Labrador Refinery Project has been prepared to meet the requirements of both the provincial and federal environmental assessment processes and to respond to the ideas, suggestions, questions and concerns of the residents of Placentia Bay and nearby communities.

The purpose of environmental assessment (EA) is to determine whether or not a proposed project is likely to cause significant adverse impact on the environment. Environmental effects are the direct changes that a project causes on the environment, including biophysical environment, health and socio-economic conditions and cultural heritage.

The EA documents (an Environmental Impact Statement or EIS for the Province and a Comprehensive Study for the federal process) identify and evaluate the environmental effects associated with the Project, identify mitigation measures to eliminate or reduce such effects, and predict the significance of residual effects as well as suggest appropriate monitoring and follow-on programs. It also addresses potential cumulative effects of the Project when combined with other projects in the area.

Environmental effects will be defined and discussed for all phases of the Project: planning, construction, operation, modification and decommissioning. The assessment will also consider the effects of the environment on the Project itself.

This volume, Volume 2, Project Description, describes the design principles for the refinery complex and marine terminal; the construction schedule and construction practices to be used; the refinery components and process, including operations and maintenance; and the associated marine terminal with its wharf, jetty and loading/unloading equipment as well as the vessel traffic. Decommissioning and rehabilitation, although many years distant, is considered during design and construction and also will be described. The Environment, Health and Safety Management (EHSM) Plans that will support all phases of the Project are outlined.

Volume 1 is the Project Summary, a synthesis of the approach and findings of the environmental assessment. Volume 3, Biophysical Environment and Effects Assessment and Volume 4, Socio-economic Environment and Effects Assessment describe and discuss the biophysical and socio-economic environments in which the Project would be constructed and operated and the effects of the Project on these environments. Both the biophysical and socio-economic assessments are focused on those aspects identified by communities and regulatory agencies as Valued Ecosystem Components (VECs). Volume 5, Public Consultations, describes the overall commitment and approach to involving the public and the suggestions and issues raised in these consultations.

1.1 The Undertaking and Proponent

The Newfoundland and Labrador Refinery Project is being proposed by the Proponent, Newfoundland Labrador Refining Corporation (NLRC). The proposed Project is to build and operate a new 300,000 barrel per day (bbl/day) crude oil refinery at the head of Placentia Bay in the Province of Newfoundland and Labrador (Figure 1.1).

In February 2006, Newfoundland and Labrador Refining Corporation (NLRC) was established and initiated a feasibility study into building and operating a second crude oil refinery in Placentia Bay on the west side of the Come By Chance Bay, across from the existing refinery (North Atlantic Refinery Limited, 105,000 bbl/day refinery near the town of Come By Chance) (Figure 1.2).

The Project's initial planned nominal capacity will be 300,000 bpd expandable to 600,000 bpd in the future, if market conditions allow. The Project will provide a new state-of-the-art oil refinery that is safe, efficient and environmentally in tune with today's expectations for a modern industrial development. The Project will be designed and constructed in a manner that will minimize the impact on the environment and will meet or exceed applicable Federal and Provincial Acts, Regulations and Standards.

Newfoundland and Labrador Refining Corporation is a private company registered in Newfoundland and Labrador and based in St. John's. The founding investors in NLRC are Altius Resources Inc., of St. John's, NL, and a core group of established European entrepreneurs with proven track records in both equity and debt finance arrangements for major development projects. NLRC may add additional partners as the Project develops.

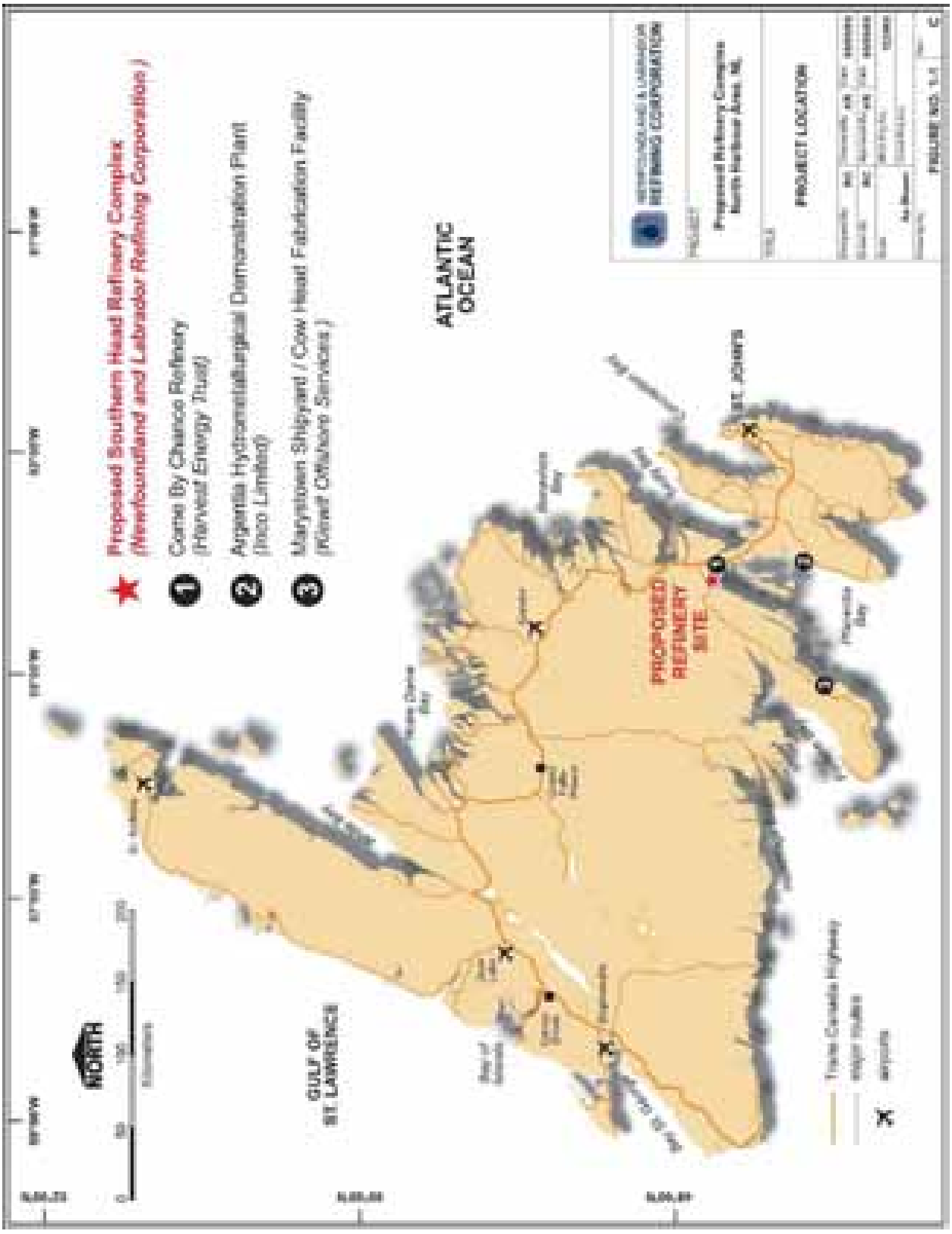

Figure 1.1 Project Location

Figure 1.2 Project Area with Surrounding Industry and Communities

1.2 Project Overview

Economic and market analyses have indicated that there is a shortage of refining capability in the world. The proposed Project is a 300,000 barrel a day crude oil refinery at the north end of Placentia Bay (Figure 1.3) complete with an associated marine terminal for receiving and exporting crude oil, products and by-products. The refinery will be able to process a wide range of heavy and sour crude oils and produce high quality clean fuels. The main products of this refinery will be Ultra-low Sulphur Diesel, gasoline, kerosene/jet fuel and by-products including liquefied petroleum gag (LPG-C_3/C_4), sulphur and petroleum coke.

The Project will require a capital investment in excess of US$4.6 billion for the construction of the facility. The facility will employ up to 3,000 people during the 4-year construction phase and approximately 750 permanent staff during the operational phase.

Placentia Bay is a strategic geographic location in the global sourcing and marketing of petroleum. Placentia Bay is a deepwater, ice-free bay. It has the additional advantages of an established vessel traffic management system and existing oil-related industrial infrastructure, with an operating refinery, major fabrication facilities and oil transshipment terminal as well as an experienced, highly skilled workforce.

1.3 Project Planning

The Project will take place in four stages:

1. Pre-construction planning phase, including feasibility study, engineering, public consultation and environmental assessment and permitting;
2. Construction, including site preparation, fabrication and construction of the refinery and marine terminal;
3. Operations;
4. Decommissioning and Rehabilitation.

At present, the Project is in the first stage and a brief description of the activities under this stage is presented below.

1.3.1 Feasibility Study

In February 2006, the Proponent announced the start of a three-phase feasibility study into establishing a second crude oil refinery in Placentia Bay. Phase 1 established that the economic basis existed and that Placentia Bay is a strategic location for a new refinery. Phase 2, in May 2006, included the start of preliminary engineering and initiation of the environmental assessment process. Phase 3 confirmed the basis for proceeding with the design of a 300,000 barrel per day refinery and provided a detailed cost estimate.

Figure 1.3 Refinery Layout, Access Roads and Associated Marine Terminal

1.3.2 Engineering

Engineering to date has confirmed the process and major components of the refinery, the range of crude oils and the products and by-products, concept design layouts for the refinery, wharf, jetty and tug basin as well as major technology suppliers. Work to date has also included detailed modelling of air emissions based on the level of engineering done to date, CO_2 management considerations, vessel management, oil spill prevention and emergency response preparedness and modelling of effluent discharges and outfall design.

Engineering has also incorporated concerns and recommendations from the ongoing consultation with regulatory agencies, residents and other users of Placentia Bay. For example, the jetty location and configuration has been modified in response to fishers' requests to avoid a productive cod ground; a second access road has been included to address the requests from residents and businesses on the Burin Peninsula; a high-volume interchange at the Trans-Canada Highway will be incorporated into the Project to address concerns with traffic congestion; an Air Quality Study advisory group was established; and a special fishing activity data collection program was developed with area fishers and the Fish, Food and Allied Workers (FFAW) union.

Newfoundland and Labrador Refining Corporation has also requested a voluntary review of the Project's marine terminal design and operational planning through the TERMPOL Review Process. This provides an objective, third party review of the safety measures and planning associated with the marine facilities construction and operation.

1.3.3 Public Consultations

Consultation with the public was initiated at the very outset of the Project and has included presentation and briefings to; all area town councils, a variety of regional associations, federal and provincial government departments, colleges and high schools; a number of public open houses throughout the greater Project area; and included the formation and work with two specific advisory groups.

The Air Quality Study advisory group includes representation from most nearby communities and industrial neighbours regarding air quality. The Project is also working with the FFAW regarding issues associated with an increase in vessel traffic and potential loss of fishing grounds in Placentia Bay. Working directly with the FFAW Placentia Bay Sub-Committee has greatly facilitated communication with the fishers, including introductory meetings that enabled virtually all fishers active in Placentia Bay fisheries to speak directly with the Project Proponent and the EA consultants.

Consultation with both provincial and federal regulatory agencies also started early in the planning stage for the environmental assessment, in order to be able to provide a thorough

Project Registration/Project Description document and to be able to initiate research to address information gaps identified by key agencies as early as possible in the planning process.

1.4 Project Design Principles

As the first grassroots refinery constructed in Canada in almost 25 years, NLRC is proud to adopt a set of Project design principles that will provide a new modern refinery that will be at the forefront of the industry. The following design principles will establish a set of guidelines for the implementation of the Project:

- Highest Safety Standards;
- Loss Control – As Low As Reasonably Practicable (ALARP);
- Best Available Technologies Economically Achievable (BATEA);
- Precautionary Approach;
- Emissions Reductions;
- Climate Change Considerations;
- Energy Efficiency;
- Sustainable Development;
- Operational Efficiency;
- Quality Control;
- Environmental Protection;
- Community Participation;
- Maximization of local benefits;
- Security;
- Third Party Review (TERMPOL Process).

1.4.1 Safety

The refinery design will incorporate the highest health and safety standards in design, construction and operations. A safety management system will be implemented to continuously identify, reduce and manage safety risks. This safety management system will extend safety leadership and expertise through all levels of authority within the refinery design, construction and operation phases. Specific expectations and goals will be set for each level of authority on the Project. Safety indicators will be established, tracked and monitored. Safety auditing will be implemented; an effective stewardship program will be established to allow senior management to understand and to participate in the safety program to ensure that the safety culture established for the refinery is recognized as an integral part of all employees' duties.

1.4.2 Loss Control (ALARP)

A detailed safety analysis of the Refinery will be completed during the Engineering Design Phase of the Project. The hazard identification and risk assessment (HAZOP analysis) will follow established techniques, such as event-tree modelling of the major hazards. The analysis will identify and assess major hazards with respect to the potential harm to personnel and the environment. All risks will be reduced to a level that is As Low As Reasonably Practicable (ALARP).

1.4.3 Best Available Technologies Economically Achievable

The design and construction of the facility will incorporate the best available technology economically achievable (BATEA) to provide a safe and robust refinery that complies with all national/provincial regulations and industry codes and standards. The refinery is configured to allow continuous improvement where there are possibilities to further improve operations as technologies change. The principle of BATEA will be applied for all phases of this Project and throughout all aspects and operating units of the refinery. This will ensure that the refinery is constructed and operated efficiently and with minimal impact on the environment.

Some of the BATEA that apply to this Refinery include:

- BATEA in all process units to maximize energy efficiency and minimize emissions;
- BATEA for Reaction Catalysts that provide the highest rates of conversion for the lowest energy input;
- BATEA for Fired Heaters and Boilers to maximize energy efficiency and minimize emissions;
- BATEA for the Sulphur Recovery Unit to maximize sulphur recovery and minimize emissions;
- BATEA for Heat Integration and Energy Conservation throughout the Refinery to enhance the Energy Efficiency and hence minimize emissions;
- BATEA in Energy Generation to maximize Energy Efficiency and hence minimize emissions;
- BATEA in Storage Tank Design to minimize emissions and maximize containment;
- BATEA in Wastewater Treatment to minimize emissions, including the reuse of treated wastewater within the Refinery;
- BATEA for loss control and risk reduction following the principles of “As Low As Reasonably Practicable” (ALARP);
- BATEA for Safety Systems with the goal to achieve zero incident safety targets;
- BATEA for Emergency Response;
- BATEA for Oil Spill Response;
- BATEA for Security Systems;
- BATEA for Vessel Traffic Management.

1.4.4 Precautionary Approach

NLRC will apply the precautionary approach in the design and implementation of the Project, where there is a potential threat of serious or irreversible damage to the environment, lack of full scientific knowledge about environmental protection measures will not deter reasonable action to protect the environment. In the absence of or lack of long-term data coverage, model forecasts using state-of-the-art models and worst case scenarios have been applied to predict the Project effects on the receiving environment and human health.

1.4.5 Emissions Reduction

Air quality in a region is determined by the concentration of various pollutants in the atmosphere as well as the size and topography of the air shed basin, and its meteorological conditions. The Placentia Bay region has high turbulent winds, which are not conducive to local high accumulation of air pollutants for extended periods. Although there is the possibility for quick dispersal of air pollutants, NLRC has committed to the reduction of air emissions to as low as possible with the use of BATEA. NLRC has established an Air Quality Advisory Group consisting of local community leaders, local industry and government agencies to advise and provide feedback on NLRC's efforts to reduce air emissions. Local knowledge with respect to air emissions related to oil refining is considerable due to the nearby Come-By-Chance Refinery.

NLRC has committed to install air quality monitors around the local area. These monitors will be installed early in the construction phase to provide a project baseline and will be used to supply continuous monitoring of local air pollutants and determine compliance with operating permits and the results of air quality modelling.

1.4.6 Climate Change Considerations

There is an increasing consensus that climate change is linked to the consumption of carbon-based fuels and that action is required now to avoid further increases in carbon emissions as the global demand for energy increases. NLRC is committed to sustained voluntary efforts to minimize the Projects' greenhouse gas (GHG) emissions through energy efficiency Projects in operations.

NLRC has reviewed the *Regulatory Framework for Air Emissions* issued by the Federal Government. The proposed framework is comprehensive and includes mandatory and enforceable reductions in emissions of greenhouse gases and air pollutants that will deliver tangible benefits to both the health of Canadians and the Environment. Climate change is a global issue of major concern for Canadians and it is crucial that all industrial sectors do their part to address their own contribution to climate change. NLRC will implement the requirements of the regulatory framework to reduce overall emission to as low as possible with the use of the BATEA and Best Management Practices (BMP). In addition, NLRC supports research into

technological solutions to curb GHG emissions and have started regulatory discussions to promote development of prudent policy frameworks.

As an industrial facility, the Project is designed to operate in a wide range of climatic conditions and is not vulnerable to climate change. The impact of the Project is generally minimal to all environmental systems, and such impacts are not likely to increase to a significant level with changes in climate during the expected life of the Project. The one area where climate change may have some influence is in the marine terminal. The marine terminal will be designed to accommodate climate change forecasts for sea level rise in the area.

1.4.7 Best Environmental Protection Practices

The Newfoundland and Labrador Refining Corporation is committed to stewardship of the environment in which it seeks to operate, and will design and execute the Project in a manner that will eliminate or minimize the potential adverse effect on the environment in all phases of the Project. NLRC is committed to prevent pollution and to continually improve the integration of environmental protection practices in all its activities. NLRC will ensure that Project activities are carried out in full compliance with all applicable environmental, health and safety laws and regulations by applying the BATEA and highest standards.

The Environmental Protection Plan (EPP), an important element of the Proponent's overall Environmental, Health and Safety Management (EHSM) system, will be prepared in a timely manner for the management of Project-related impacts, beginning with site preparation activities early in the construction phase. The EPP will provide a practical framework for implementation of the environmental requirements for the Project and consolidate all proposed mitigation and monitoring procedures for construction, operation, and decommissioning and abandonment.

NLRC is committed to the development and implementation of a comprehensive EPP to help ensure a high level of environmental protection throughout its work areas and activities associated with the construction and operation of the refinery. An EPP is a working document for use in the field for project personnel and contractors, as well as at the corporate management level for ensuring commitments made in the proponent's policy statements are implemented and monitored. The EPP provides a quick reference for project personnel and regulators to monitor compliance and to make suggestions for improvements.

The proponent has already taken a proactive approach to environmental protection at an early stage of project planning. Examples include the following:

- Minimizing the Project footprint and reduce disturbance to sensitive areas, particularly the headwater of Watson's Brook watershed;
- Relocation of the Project's marine terminal to avoid fishing grounds;
- Minimizing the zone of influence through siting and design of the marine intake and outfall;

- Reducing environmental effects on sensitive areas (e.g. allow sufficient buffer zones from sensitive areas, avoid and control sediment transport into water bodies, treatment of effluent and reduce its the zone of influence, etc.);
- Reducing the number of water intakes /effluent discharge points (only one salt water intake and one outfall/diffuser);
- Effective water management: reducing or eliminating reliance on existing fresh water resources through use of desalinization and increase the amount of recycling of process water;
- Reducing harmful alteration, disruption or destruction of habitat (HADD), and adoption of "no net loss" principle in the Project development;
- Reducing air emission by applying BATEA (as described in preceding sections);
- Developing a Marine Transportation and Protection Management Plan;
- Developing an effective Prevention and Emergency Response Plan;
- Development of an effective Environmental Protection Plan, including monitoring and follow up;
- Initiation of air quality and water quality monitoring programs within the Project area (e.g., Watson Brook stream flowmeter and water quality monitoring);
- Participation in and financial contribution to the Smart Bay program;
- Initiating and/or actively participating in Stewardship Groups in the greater Placentia Bay Area, e.g. The Air Quality Advisory Group, The Salmonoid Association of Eastern Newfoundland – Stewardship Committee, the Placentia Bay Traffic Committee and the Placentia Bay Integrated Management Committee.

1.4.8 Sustainable Development

Sustainable Development is the principle whereby development meets the needs of the present without compromising the ability of future generations to meet their own needs. The Project is incorporating the principle of sustainable development into project design and operations through planned integration of environmental, social and economic considerations.

The Province of Newfoundland and Labrador has issued a Discussion Paper and held public consultations toward establishing a Sustainable Development Act. The Project is being developed in alignment with the intent of the future Act to integrate social and environmental considerations into development decisions.

The principle of sustainable development respects the use of both renewable and non-renewable resources to satisfy human needs, improve quality of life and economy with full respect to the environment in which we live, and protect and preserve life-sustaining natural systems, without jeopardizing the needs of future generations.

1.4.9 Commitment to Community Participation

NLRC's project plans are founded on a belief that sustainable development not only incorporates environmental and economic objectives, but also acknowledges the importance of community relations to business success. The Project has engaged and been improved by a broad range of stakeholders through the Environmental Assessment process to ensure that the Project addresses any strains on local communities and the environment resulting from the construction and operation of the proposed refinery. Active and practical community liaison will continue throughout the Project.

1.4.10 Maximum Local Benefits

Community consultation has indicated that potential economic benefits through employment, business, training and investment are important to a range of stakeholders in the nearby communities and general project area. The Project analysis anticipates participation by local communities in the economic benefits of the Project, both through direct employment and by giving assistance and preference to local suppliers.

1.4.11 Security

Since 9/11 there has been a significant increase in the attention paid to security of facilities that handle dangerous goods or goods that, should the supply be interrupted, would cause widespread stress on the economy. The refinery will be such a facility, in that, not only does it handle dangerous goods but the fuel supply from the refinery will be a critical part of the supply chain for North America. As a consequence, the Project will be designed to meet international, national, and industry standards for refinery and marine oil product terminal security requirements.

1.4.12 Third-Party Review: TERMPOL Process

While the TERMPOL Review Process is not a design practice per se and not required for this Environmental Assessment, NLRC has volunteered to take part in a TERMPOL review of the Project. The "TERMPOL Review Process (TRP)" refers to the Technical Review Process of Marine Terminal Systems and Transshipment Sites. TERMPOL focuses on shipping routes for project vessels as they travel through Canadian jurisdiction to the proposed marine terminal and, specifically, to the process of cargo handling or off-loading from ship to shore.

The marine terminal system is defined in TERMPOL to mean the ship's berth, its approaches from seaward and related port or terminal infrastructure, including bulk oil, chemicals, liquefied gases and any other cargoes which may be identified by the TCMS as posing a risk to the ship, public or environmental safety. The intent of the TERMPOL process is to ameliorate, where possible, project elements which could, in certain circumstances, threaten the integrity of the ship's hull and its cargo containment system and thus reduce potential risks to the environment.

In conducting a TERMPOL Review, it is necessary that the proponent's submission demonstrates that:

- the operator's or owner's safety management system is in accordance with recognized safe management procedures;
- on-going operational audits of the safety and management system are planned;
- major accident hazards in the context of the proposed operations have been identified; and
- the risks arising from the review of major accident hazards have been evaluated and measures taken to reduce those risks to an acceptable level using the BATEA.

NLRC believes that there are significant benefits to participating in the TERMPOL review process. The TERMPOL process brings together expertise from all pertinent Government Departments and agencies to complete the review process and allows for a high quality, objective review of safety, operations and management systems.

1.5 Legislation, Permits and Policies (Regulatory Framework)

The Project will require federal, provincial and municipal approvals and permits for various activities during construction, operation and decommissioning. Anticipated relevant legislation and associated permits required are listed in Appendix A. This list will be revised as detailed design advances and additional project requirements are identified. This list will be available for scrutiny by regulatory personnel and will be continually revised and updated as required.

Contractors will submit a list of all required permits, authorizations, licences and certificates to the Company's Representative upon award of contract. The Vendors/Contractors will also identify any additional permits, approvals, authorizations and certificates that do not appear on the above-mentioned list.

Approval and permitting requirements under provincial legislation and regulation will govern much of the physical activity at the site, from the environmental assessment process to activities such as site clearing, quarrying, road construction, bog in-filling, etc., through construction, operations, and decommissioning. Government requirements and policy also affect socio-economic aspects of refinery construction and operation, such as occupational health and safety, training, and employment programs.

Areas of the proposed new refinery that are within the boundaries of the Town of Come By Chance, including the wharf, jetty and access road, will meet requirements of town by-laws. Available information is shown in Appendix A.

Contractors will be responsible for obtaining all permits and/or regulatory approvals directly related to their contract activities and which are not identified as being the responsibility of the Proponent/Owner or Company's Representative. The Contractors will submit their respective

applications to the Company's Representative, in sufficient time prior to the date required to commence on-site activities.

The Project schedule shows that approvals and permits must be in place to allow for construction start no later than January 2008. This start date enables a mechanical completion by mid-2011 and a production start date in the fourth quarter of 2011. See Appendix A for relevant federal and provincial legislation that is applicable to the Project. See Appendix B for a master codes and standards list, which will be used for the design phase of the Project.

1.6 Environmental Assessment

The proposed refinery project is undergoing review under both the provincial and the federal environmental assessment processes.

The Department of Environment and Conservation oversees the provincial process and development of the Environmental Impact Statement. Transport Canada and Department of Fisheries and Oceans are the Responsible Authorities (RA) for the federal assessment, in conjunction with the Canadian Environmental Assessment Agency (CEAA) and issue a report on the EIS called the *Comprehensive Study Report*.

Both levels of government contributed personnel to the provincially chaired Assessment Committee and provided input to the Guidelines for the assessment requirements to ensure the needs of both provincial and federal mandates are met in the assessment.

2.0 GENERAL PROJECT DESCRIPTION

This chapter provides a general description of the Project, its rationale, alternatives and components, Project activities and employment forecast. The Project will import crude oil feedstocks from world market and refine them into high-quality value-added petroleum products for export and also for domestic consumption.

2.1 Project Rationale

Worldwide there is a shortage of crude oil refining capacity. The shortage is more critical in North America due a large shortfall in refining capacity compared with refined product demand in this market. The demand for refined products has been continually growing, however the last refinery built in the United States was in 1976 and in Canada in 1984. There have been many expansion and upgrade programs in existing refineries in North America over the last few decades but the added supply has not kept pace with demand.

The largest concentration of North American supply of refined products is in the Gulf of Mexico Coast areas of the United States. Hurricane damage to the Gulf Coast refineries in 2005 dramatically demonstrated the vulnerability of the oil product supply market throughout North America, with major gasoline price increases over a sustained period. Earlier this year fires at the Imperial Oil refineries in Nanticoke and Sarnia, Ontario that temporally reduced production in these plants caused widespread gasoline price increases in Canada and product shortages for several months in southern Ontario and Quebec.

Crude oil is a global commodity and the world market will move quickly to fill the gap in refining capacity. Feasibility and market studies have confirmed that there is a time-limited opportunity for the development of a new refinery within the Placentia Bay region. The timeline proposed for the refinery project will ensure that Newfoundland and Labrador is at the forefront of efforts to provide the needed refining capacity.

As many traditionally relied upon crude supplies diminish, more and more crude oil is imported over larger distances. Therefore economy of scale considerations dictate that larger tankers are used to import crude oil (Figure 2.1).

Using larger tankers introduces economies of scale that will reduce emissions of air pollutants per barrel. Using larger tankers also reduces the frequency of shipping, minimizing vessel traffic. For this reason the new marine facilities will be designed to handle Very Large Crude Carriers (VLCC) sized tankers.

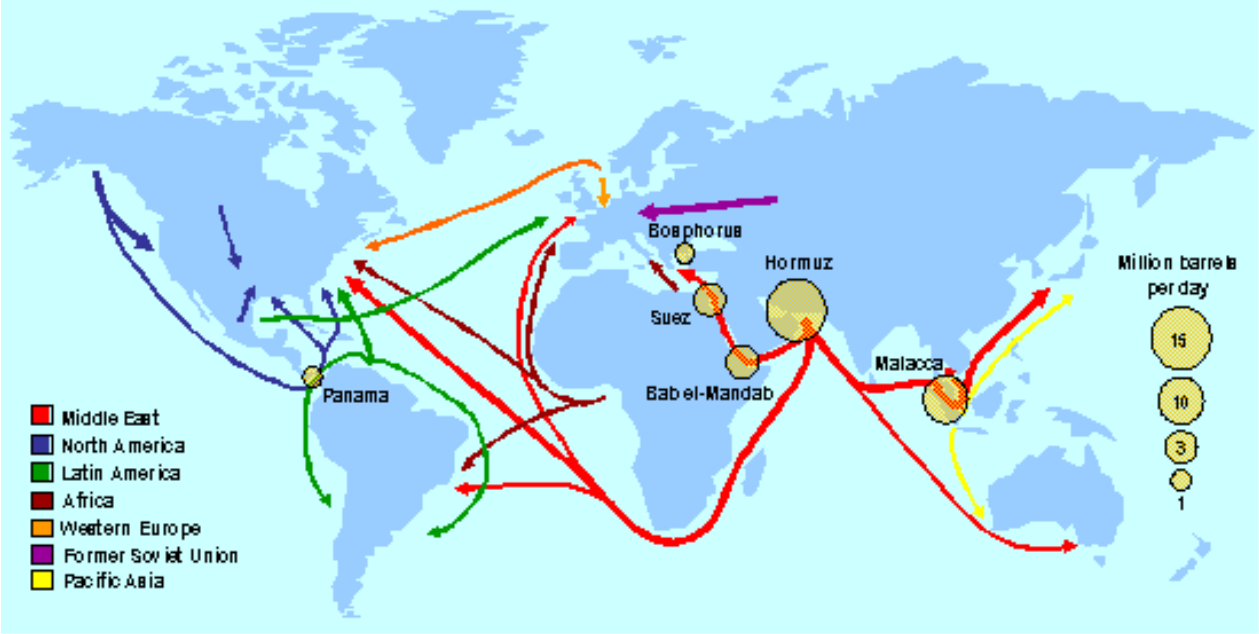

Figure 2.1 Worldwide Oil Transport Routes

Considering Placentia Bay's strategic location on major international shipping routes, along with the Province's oil and gas expertise, the expansion of our oil refining capabilities will further enhance and strengthen the sector, leading to positive economic implications for the Province.

Fabrication and construction of the refinery will provide opportunities for businesses and industry to acquire new skills and expertise, increasing the marketability of the province's infrastructure and workforce. The refinery itself will provide approximately 750 permanent jobs, as well as indirect and induced employment. A second refinery would prompt spin-off opportunities in the region that would allow the creation and expansion of companies to supply goods and services to the petroleum industry. Also, the proposed refinery could be an important customer for offshore stranded gas.

Both the federal and provincial environmental assessment processes specify that the climate change implications associated with the proposed Project be addressed.

The Province released a *Climate Change Action Plan* in 2005 that outlines a framework for climate change mitigation, including such efforts as equipment specifications and selection. An inventory of air emissions has been done to support air emissions dispersion modelling for the new refinery. It includes greenhouse gases, particularly carbon dioxide. Based on this and the new *Regulatory Framework for Air Emissions* issued by Environment Canada, the Project has developed a greenhouse gas mitigation strategy. The refinery facilities will be designed for a nominal 25-year life span and will incorporate climate change considerations, such as possible sea level change and increased frequency and severity of storms.

2.2 Prospective Site and Study Area

2.2.1 Overview

The Placentia Bay area was the focus for the site selection investigation for the Proposed Refinery. The Placentia Bay area is a very active location, with commercial fishing and fish processing, aquaculture, tourism, an oil refinery, an oil transshipment terminal, shipbuilding, offshore fabrication, passenger and cargo vessels and locations of ecological significance, such as the world-renowned Cape St. Mary's Seabird Reserve.

The continued safe and successful combination of the wide range of activities in Placentia Bay is facilitated by mechanisms such as the Placentia Bay Traffic Committee and more recent initiatives, the Placentia Bay Integrated Management Planning Committee and "SmartBay". Smart Bay is a pilot project to develop and implement an integrated electronic data and information management system for mariners of which NLRC has proudly become the first corporate sponsor/partner.

Market studies have confirmed the economic basis for the development of a new refinery within Placentia Bay. Safe year-round access by road and sea; access to water depths of greater than 30 m close to the shore to accommodate Very Large Crude Carriers; a proven traffic management system; and enough available land for present needs, with possibility for future expansion were important attributes considered in selecting a site for the refinery.

The presence of a skilled local workforce; established fabrication facilities; and proximity to both potential oil supplies and large markets for refined products along the east coast of North America and in Europe was also important attributes identified within this region.

In addition, with recent and proposed developments, such as the transshipment terminal and the VBNC proposed hydromet plant or smelter in Long Harbour, there has been considerable environmental research, field studies and monitoring resulting in a good understanding of the socio-economic and biophysical environment.

2.2.2 Geographical Location

The Newfoundland and Labrador Refinery Project (referred to in this document as "the Project"), will be located at Southern Head, a peninsula between North Harbour and Come By Chance Bay at the head of Placentia Bay, Newfoundland and Labrador (Figure 1.3). Although there is considerable industrial infrastructure nearby in this area of Placentia Bay, Southern Head is a greenfield site, today accessible only by boat. Detailed field studies carried out in the fall of 2006 through the spring of 2007 confirm that there is very little ongoing active use of the majority of this area by the public. Our field surveys and discussions with the public through open houses in the area indicates that uses of the area are limited to occasional recreational fishing, moose hunting and hiking.

The land at Southern Head is Crown Land, owned by the Province, and has been made subject to a land freeze for this Project. However, the marine facilities will extend below the high tide mark and will be in Federal jurisdiction. Figure 2.2 shows the land ownership map of the proposed project site and neighbouring industrial land use.

The head of Placentia Bay (the innermost areas) already has significant infrastructure that is an integral part of the petroleum industry of Newfoundland and Labrador. A successful 105,000-barrel per day oil refinery operates near the communities of Come By Chance and Arnold's Cove. The existing complex includes one of the largest marine terminal jetties in North America and refines lower-cost sour crude oil to produce premium refined petroleum products for markets around the globe.

Nearby is the Newfoundland Transshipment Limited (NTL) facility, which is owned by a consortium of major oil companies and operating company International Matex (IMTT). The facility temporarily stores crude oil from producing fields in offshore Newfoundland and Labrador and makes shipments to oil refineries, primarily throughout eastern North America. The Bull Arm industrial site is located a few kilometres north (although facing another bay, Trinity Bay). The Hibernia gravity-based oil production platform and the Terra Nova FPSO, both major scale capital projects, were constructed and assembled at Bull Arm and are now producing oil offshore Newfoundland and Labrador. The Marystown Shipyard and adjacent Cow Head fabrication facilities located in southwestern Placentia Bay continue to be an active service and supply centre for the province's offshore oil industry. As well, there is a potential industrial site at Argentia, the previous location of a USA military base.

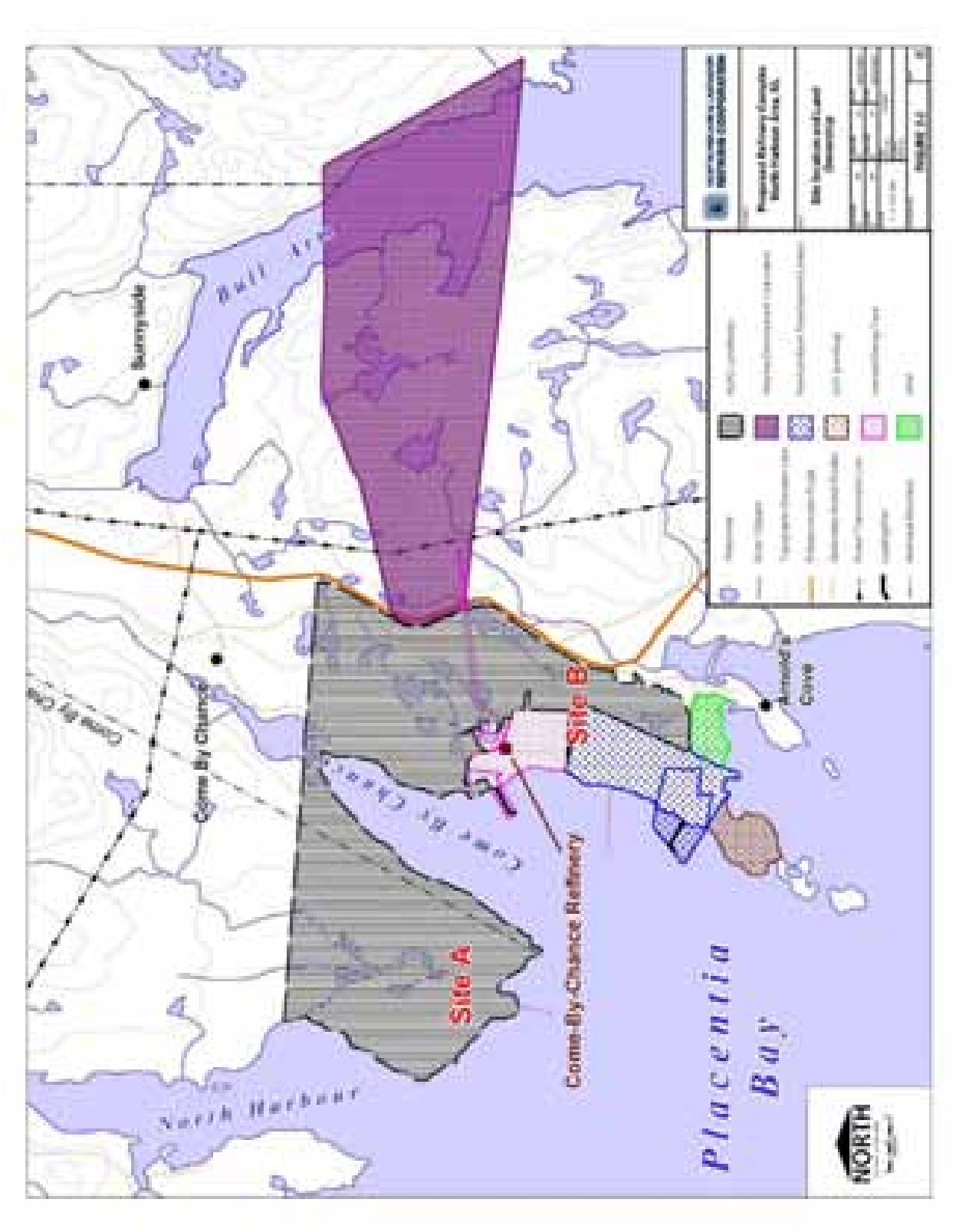

Figure 2.2 Site Location and Land Ownership Analysis of Alternatives

2.3 Analysis of Alternatives

2.3.1 Alternative Sites

Once the market studies confirmed the economic basis for the refinery, several sites in Placentia Bay were investigated. There was a preference for a brownfield site (already with industrial activity ongoing or previous) to reduce environmental impacts and access to nearby industrial infrastructure.

The sites considered were:

- Expansion of the North Atlantic Refinery Site: Site selection was under way when the existing refinery was put on the market. The Proponent investigated the potential synergies between the existing operations and a new refinery; however, NARL was ultimately sold to a third party, eliminating this option;
- Undeveloped land between the existing Come By Chance refinery and the transshipment terminal Site B on Figure 2.2: Although adequate land area, good potential synergies with neighbouring facilities and access to deep water where available, the land is presently under lease to Newfoundland Transshipment Limited. With the updated configuration of the proposed refinery based on concept development for the environmental assessment, this site would require a possible reconfiguration of the Trans-Canada and possibly some restrictions on the planned development of Arnold's Cove to the north in order for it to become the preferred site;
- Southern Head: This is a greenfield site at the head of Placentia Bay, on a peninsula separating North Harbour and Come By Chance Bay. Road access would have to be created, but the site has adequate land, and sites suitable for the wharf and jetty. The advantage of this site is that it is somewhat remote from the existing communities which gives an extensive buffer to mitigate some of the issues raised during the public consultation process, as follows:
    - Increased vessel traffic – locating the terminal at Southern Head will help mitigate congestion at the head of Placentia Bay by separating the vessel traffic for the proposed refinery to the western side of Come By Chance Bay. If a new terminal was built between the NARL refinery and Whiffen Head, all of the increased traffic would be focused in one area on the eastern side of the bay;
    - Distance from the communities mitigates the potential effects of noise, odours and visual impacts on the existing surroundings.

The Southern Head location means that an additional highway interchange will be required to relieve traffic congestion. If the site between the NARL refinery and Whiffen Head were used, all of the additional traffic would be focused through the existing interchange at Arnold's Cove. Compounded with the existing refinery traffic, this could lead to increased congestion and possible delays.

The Southern Head location provides an opportunity to spread the economic benefits of the Project along the western side of Placentia Bay. By providing a new access road to North

Harbour and the Burin Peninsula highway, local industry, businesses and workers living on the Burin Peninsula will have a shorter access route to the refinery.

For the site between the NARL refinery and Whiffen Head, water depths are shallow near shore and extend out 800 m from the shoreline to reach the required water depth for the marine terminal. To build a jetty at this site, a long causeway, similar to the existing NARL jetty, would have to be constructed. In order to establish inside and outside berthing at the jetty, dredging would be required. Depending on the depth of overburden over bedrock, marine blasting could also be required in this area.

Given these issues the Southern Head location has the preferred attributes for this Project and will be the site that the Project proposes to develop.

2.3.2 Alternative Excess Fill Disposal Sites and Laydown Area

Civil works at the Project site required to achieve the specific site grading conditions for construction, equipment installation and refinery operation will result in an excess of till and rock material from the excavation/infilling operation. While engineering and construction efforts will be aimed at minimizing the footprint of the Project and the amount of waste material generated during the site development, it is anticipated that this quantity will be substantial given the significant variation in elevation (>50 m) across the site and the requirement for a relatively level surface for facility construction. The objective of the Project planning process has been to make use of the waste material so that it can be integrated into construction procedures wherever possible and have the minimum impact on the environment surrounding the Project area.

Potential waste excavation storage sites were evaluated during the planning process. The Project area is constrained by substantial embankments at the shoreline; therefore there are no alternatives for storage except on the interior of Southern Head Peninsula. At the top of the shoreline embankments there is a plateau at the centre of the peninsula. This area will be accessible off the new main access road. However, it contains abundant wetland areas and small water bodies that all contribute to the watershed for Watson's Brook. One potential area, Option 2, is located approximately 2.2 km NNE of the administrative buildings area of the Project. Another possible location for the placement of waste excavated material is a proposed storage site/laydown area north of the process area, Option 1 (Figure 2.3).

A review of Option 2 indicated a number of constraints that removed it from further consideration. This location is not favoured because it would introduce a potential ongoing source of waterborne sediment that could impact an area of the watershed that would otherwise be unaffected by the Project development. In addition, trucks would be required to travel an additional 2.5 km with excavated material from the Project footprint resulting in an increase in associated vehicular emissions. There would be an increased potential for accidents leading to discharges such as fuel spills, which could increase the risk of hydrocarbon contamination in a larger area of the watershed in a location immediately upstream of the main ponds leading into

Watson's Brook. As construction on the Project will require a separate laydown area, the Project footprint would need to be enlarged to accommodate this as Option 2 would be too remote to be practically used for this purpose.

The location of Option 1 would result in a larger impacted area at the main Project site. However, it would impact on the same section of the watershed, thereby removing the additional potential sediment-loading concerns associated with Option 2. It is immediately adjacent to the Project site, so the travel distance for equipment carrying excavated material would be reduced to a maximum of 0.5 km. The potential for integrating the placement and storage of waste material with creating the laydown area required for construction also makes this a preferable alternative. As Option 1 is also a part of the long-term future expansion to 600,000 bbl/d, as a location for future development of the refinery, proper planning and material storage at this point in the Project could result in preparation of usable area while minimizing additional material handling. Option 1, therefore, is the preferred alternative for storage and management of excess material. It should be noted that in developing this laydown area, all measures will be taken to minimize the adverse impact on the headwaters of Watson's Brook watershed, including the pond that borders the proposed laydown area at the northeast edge.

2.3.3 Alternative Processing Options and Plant Design

The Refinery is a conventional petroleum refinery that will apply state-of-the-art refining technology for the conversion of crude oil into refined petroleum products. The key processing components of the proposed Project are described briefly herein and in detail in Section 6.0.

Crude Supply

Various crude oils were evaluated as potential feeds for the refinery. Economic evaluations and feasibility studies were conducted by the Proponent to determine the most economical, readily-available crude supply that would meet production goals and the product marketing plan.

The design basis for the refinery crude oil feedstock is equivalent in character to Arabian Medium and Arabian Heavy. The selected crudes may have a sulphur content of up to 3 percent. This will allow the new refinery to process a wide range of crudes from various parts of the world and provide greater flexibility for operational and economic success, while minimizing risk to the environment. It is expected that the primary sources for the Project's feedstock crudes will be the Middle East, Russia, South America and Africa.

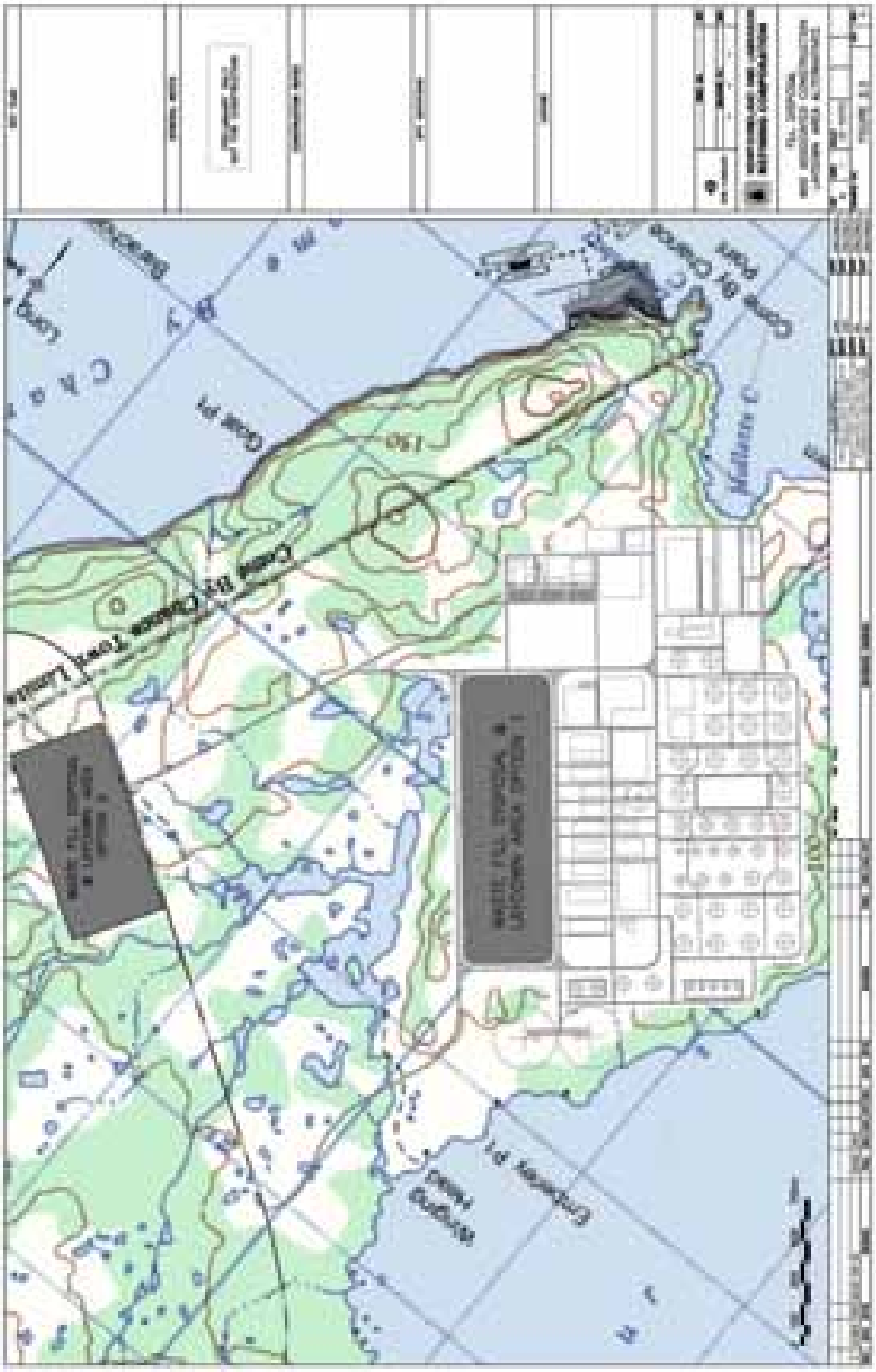

Figure 2.3 Refinery Layout and Associated Construction Laydown Areas

Product Split and Markets

The Proponent conducted marketing and economic studies to determine the most economic product split and marketing strategy for the Project. The preferred marketing strategy is for the production of Conventional and Reformulated Blendstock for Oxygenated Blends (RBOB) gasoline for export to the Eastern Seaboard of the United States, and distillates for export to both Europe and North America.

The economic analysis identified that the design basis for the Refinery is to maximize distillate production, and to split gasoline production to 75 percent RBOB and 25 percent conventional gasoline. Alternate product profiles were evaluated, but found not to provide the same level of economic benefit to the Refinery and the Proponent. Further details are provided in Section 6.1.1.

Numerous processing options for the Refinery have been considered during the Feasibility phase, and this evaluation will continue during the Engineering Design Phase. Process alternatives considered during the Feasibility Phase are described below.

Conversion Processes

There are many options available for conventional petroleum refineries to upgrade the heavier parts of the crude oil barrel (gas oil and residual products) into more valuable gasoline and distillate products. The Proponent conducted an evaluation of the available technologies in order to meet both the economic targets and the Refinery business plan.

Hydrocracking was selected in order to maximize distillate production and provide the greatest operating flexibility for the Refinery. An alternative process is Fluid Catalytic Cracking (FCC). FCC is more suited to maximizing gasoline production. In addition the olefins generated by an FCC unit would require additional downstream processing, including the possible addition of an alkylation unit. The environmental emissions from a hydrocracking process are far lower than from an FCC. For these reasons, hydrocracking was selected as the preferred process for upgrading gas oils.

The option of not upgrading gas oils (selling them as products on the open market) was rejected, as the economic targets for the Refinery would not have been met.

Delayed Coking was selected in order to maximize the upgrading of residual feeds. This was based on an economic evaluation of the available technologies compared with the production goals of the Refinery. Alternative processes include residue hydro-desulphurization (RDS), which for this Refinery is not economical compared to Delayed Coking.

The option of not upgrading residual feeds was rejected, as the economic targets for the Refinery would not have been met.

All other conversion processes selected for the Refinery are typical, common processing units that a conventional petroleum refinery requires to produce gasoline and distillates to meet today's clean fuel regulations and specifications. Additional work will take place during the Detailed Engineering Design Phase of the Project to update the refinery configuration and operating unit capacities. More details can be found in Section 6.0.

2.3.4 Waste Management Alternatives

Waste will be generated during all stages of the Project, including preliminary site preparation, construction, operation and maintenance and decommissioning. Potential characteristics of waste that will result from this Project have been defined to generate a baseline for the design of a comprehensive waste management plan. Legislation from the Provincial and Federal governments has been reviewed to establish the range of feasible management alternatives for anticipated waste streams. At all stages, waste management alternatives will be considered with a view to minimizing the waste generated by project activities. As the refinery design progresses, a detailed waste management plan will be established from feasible waste management alternatives. See Section 11.6 for more details.

Landfills

An on-site landfill was considered for the site but ruled out as an option based on the principles laid out in the Newfoundland and Labrador Waste Management Strategy. During the design period, the Project will select a suitable existing landfill based on the recommendations of the new Waste Management Strategy and for the approval of the Department of Environment and Conservation. Non-hazardous liquid wastes will be treated on-site to acceptable levels before discharge to the environment. Hazardous waste, both liquid and solid, will be managed by accredited contractors and sent to an approved disposal site.

Engineered Wetlands

As an alternative to the more conventional treatment methods already indicated, the potential application of engineered wetlands technology to the refinery is also being considered. Wetland technology incorporates natural processes into the treatment regime and relies on plants and flow media to remove contaminants. Rather than looking at wetlands to provide all of the wastewater treatment for the whole facility, which may not be practical due to the large flows of wastewater that will be generated, the technology will be applied based upon the suitability for treating specific components of the wastewater. Wetland technology has had good results in many jurisdictions with conventional domestic wastewater, and may also be applicable to treat specific parameters from the industrial wastewater stream.

This treatment system consists of a constructed wetlands designed to accommodate the wastewater flow generated from the applicable source. Typically, the wetlands are subsurface flow wetlands where there is no free water surface so no free-flowing wastewater is exposed. A

primary treatment tank or other facility is required at the front end of the wetland system to buffer influent flow and prevent hydraulic overloading and to allow for primary sedimentation if not already included in a previous treatment step. The beds are excavated, lined as required to prevent wastewater from exiting the process, and then filled with a porous media to allow the wastewater to flow through. The sizing of the facility will depend upon the hydraulic conductivity of the media and the flowrates anticipated. Reeds, typically *phragmites australis*, are then planted in the media and allowed to grow.

The treatment from the wetlands results from a number of different processes. The plants serve to enhance the permeability of the media substrate by increasing the porosity. The reeds' rhizomes also serve to increase the surface area in the wastewater stream to provide more surface for treatment. The nature of the reeds is to create microsites of oxygen in their root system which provides a supply of aeration to the treatment stream. The continuous fluctuation of aerobic to anaerobic conditions in the wastewater stream also allows for the treatment of the more resistant parameters. The media in which the plants are grown typically serves as an adhesion media for various wastewater components, like phosphorus, that would otherwise be discharged. The media has a finite capacity for adhesion and would periodically require removal and replacement to maintain treatment of such parameters.

The wetland system is a passive system that typically requires little operational effort. Once installed and operating at the required hydraulic loading rate, there is little that needs to be done with the system. The plants do not usually require harvesting and will die back naturally during winter conditions. The plant "skeletons" provide an air conduit to the substrate during the winter. Fallen foliage accumulates over the media surface and acts as an insular layer to protect the substrate and wastewater from freezing during the winter.

This technology has the potential to provide additional benefits in the form of reduced air emissions as it requires no input energy for normal operations and, as it is plant based, could also act as a carbon sink to absorb CO_2 emissions.

2.3.5 Alternative Watercourse Crossings

The location selected for the Project site lies on an undeveloped peninsula of land extending into Placentia Bay. Consequently, there are no existing accesses to the site and several watercourses lie on all routes to the Project site from existing developed highways. Three principal rivers isolate the Project site from currently developed areas and there is no alternative to crossing these rivers at some point in their footprint. The location for the watercourse crossings has been reviewed and will continue to be reviewed during design to minimize the impact of each crossing on each watercourse. The crossing for the Come By Chance River is located and will be designed to eliminate conflict with the Management Unit defined under the Stewardship Agreement the Town of Come By Chance has with the Eastern Habitat Joint Venture. The crossing points for North Harbour River and Watson's Brook have been located

and will be designed to reduce the span of the crossing and to ensure that the footprint of each bridge does not encroach on the riverbanks. All crossings (particularly fish bearing streams) will be in accordance with DFO guidelines for stream crossings as well as DOEC and NWPA permit requirements.

2.3.6 Alternative Shipping Corridors, Anchorages and Jetty Location

All large vessel traffic including oil tanker traffic in Placentia Bay is under the direction of Marine Communications and Traffic Services (MCTS), a division of the Canadian Coast Guard. The MCTS centre is located in Argentia and manages all vessel traffic in Placentia Bay along the established shipping lanes. The existing shipping lanes in Placentia Bay have been planned to maximize the safe transit of vessel traffic and minimize any potential adverse environmental effects on the marine ecosystems and local fishing industry. The current configuration of the shipping lanes was established based on extensive consultations with the oil industry, fisheries, government agencies and interest groups.

The Placentia Bay Traffic Committee is a stakeholder group made up of the oil industry, fisheries, government agencies and other interest groups around Placentia Bay. It is a forum that meets bi-annually and as–needed, to examine, discuss, resolve and co-ordinate issues related to vessel traffic in Placentia Bay. NLRC has become an active participating member of this committee.

Based on the configuration of the existing vessel traffic lanes and the quality of the vessel traffic management system, the Project is currently planning to use the existing traffic lanes within Placentia Bay for the shipment of crude and products. The Proponent has commenced a TERMPOL review process whereby shipping routes and anchorages will be examined to determine if there are possible improvements that can be made to improve operational safety.

Through public consultations with fisheries groups it has been determined that the local fishing industry does not want the Project to add more anchorages at the Head of Placentia Bay. During the consultation process the Proponent has made a commitment to seek alternatives to the use of additional anchorages.

As a result, a proposal has been put forward to the Placentia Bay Traffic Committee that would include subdivision of the existing anchorages and would allow additional ships to be anchored on the existing anchorages without an increase in the existing anchorage areas. NLRC has carried out an extensive study on vessel traffic at the new marine terminal taking into account weather delays, vessel arrival times and berth utilizations to optimize the number of berths that will be built in order to minimize the use of anchorages. These issues will be further examined by the TERMPOL review process, whereby final operations parameters will be developed.

Several alternative locations for the jetty were considered. The proposed location near Come By Chance Point (Figure 2.3) is based on consideration of prevailing winds and waves;

accessibility from the shipping lane; water depth; topography; consultations with experienced pilots; and discussions with area fishers to avoid interference with specific, locally important fishing grounds. The jetty location selected allows the Project to take advantage of some of the key attributes of Placentia Bay; i.e., the deep water near shore, the vessel traffic management system, and an experienced fishers community.

2.3.7 Null "Do Nothing" Alternative

The "Do Nothing" Alternative is constantly being evaluated by the Proponent as part of the due diligence and corporate responsibility associated with executing a project of this magnitude. There are financial risks associated with the execution of any project and the complexities of these risks magnify as the size of the Project grows. By all measures the proposed project is a megaproject that requires careful consideration before there is a decision to proceed.

If the proposed Newfoundland and Labrador refinery does not proceed, a similar refinery will be built elsewhere to fill the current North American market need for refined products. Newfoundland And Labrador Refinery Corporation will lose a competitive opportunity to enter the refinery business and the investments used to develop the Project planning to date. Newfoundland and Labrador in particular and the rest of Canada in general will lose a private capital investment in excess of US$4.6 billion for the construction of the facility and the associated construction and operations employment along with the associated tax revenues. The province of Newfoundland and Labrador will have more difficulty developing a diversified petroleum industry and lose a potential market for offshore stranded gas.

The most important aspect of the "do-nothing" alternative from the public and governmental policy perspective is that, without significant increases in refinery capacity in North America, there will continue to be dramatic swings in the price of gasoline and other consumer fuels as supply pressures continue to mount. Any number of supply chain interruptions can affect the price paid at the pump, whether it is an unscheduled extended maintenance shutdown of a major refinery, an accident at an existing refinery causing an extended shut down or a natural disaster such as was experienced with the hurricanes Katrina and Rita in the Gulf of Mexico in 2005. While a single installation cannot solve all of the supply/demand problems in North America, the proposed Project, even in its first phase alone, is large enough to make a significant difference in nearby markets.

If the Project does not proceed, the proposed project area will remain an undeveloped area with limited accessibility and use. On the other hand, potential issues of concern with the Project, primarily increased air emissions, increased vessel traffic and potential oil spill risk would no longer exist.

2.4 Project Footprint and Planned Capacity

Figure 2.4 shows the footprint of the refinery and the associated marine facilities. The area required for the refinery site is approximately 5 km^2 (500 ha). There will be two access roads, a 9.2 km road from Come By Chance and a 12.13 km road from North Harbour. The Come By Chance River, the North Harbour River and Watson's Brook (all fish habitat streams) will be crossed by single span bridges as part of these site access roads.

A new interchange has also been proposed for the Trans-Canada Highway, near the existing intersection, to deal with the increased traffic that will result from the Project. Consultations with the local towns of Come By Chance and Sunnyside have resulted in a proposed location of this interchange 1 km to the north of the existing intersection.

The Project's initial planned nominal capacity will be 300,000 bpd expandable to 600,000 bpd in the future, if market conditions allow. The proposed footprint and the overall site location will allow for the future location. Current refining capacity located within Newfoundland is 115,000 bpd from the nearby North Atlantic Refinery owned by Harvest Energy Trust.

2.5 Overview of Project Components and Activities

The main Project Components are discussed in more detail in Sections 5.0 and 6.0 and are:

- The Crude Oil Refinery
  - Processing Plant and Equipment
  - Process Control and Monitoring Facilities
  - Storage Tanks and Pipelines
  - Site Utilities and Infrastructure
  - Site Access Road and Transmission Lines
- The Marine Terminal
  - Heavy Lift Construction Dock
  - Tug Berth
  - Inshore Bulk Materials Berth
  - Jetty and Offshore Berthing Facilities
  - Jetty Control, Environmental and Emergency Response Building

The main Project Activities are discussed in Sections 5.0, 6.0 and 7.0, emissions and discharges, and accidents and malfunctions are presented in sections 8.0 and 9.0, respectively. The main Project Activities are: construction and site preparation; operation and maintenance; decommissioning and abandonment.

Figure 2.4 Refinery Layout, Access Road and Associated Marine Facilities

2.6 Employment Forecasts

2.6.1 Hiring Plans and Policies

The Proponent is committed to maximize the employment of residents of Newfoundland and Labrador. Pending approval of this project, hiring plans and policies will be put into place to ensure that first consideration for training and employment opportunities are to residents of this province. Initial meetings with key provincial initiatives addressing skilled labour supply in the province have been held to provide advance notice of project needs to government labour policy planning. The proponent has also met with trade schools in the area (Clarenville and Marystown) and the College of the North Atlantic in St. John's, as well as local unions, to address training and employment expectations of the Project.

The Proponent is committed to the advancement of women in occupations where they have historically been and are currently under-represented. Women's Employment Plans and Employment Equity Plans will be developed by the Proponent following approval of the Project. There has been a shortage of opportunities available for women to enter into work traditionally done by men, such as in the trades, technology and operations. Due to this imbalance, and also considering the potential for a shortage of skilled workers in the province, efforts will be made to promote the training and hiring of women throughout the duration of this project. A Women's Employment Program or equivalent will be developed and monitored during the construction, operation, and decommissioning stages. "Family Friendly", "No Harassment" policies will also be developed within the refinery project to ensure the establishment of a working environment that both attracts and retains a stable workforce.

2.6.2 Occupation Breakdown

Construction

The peak workforce during construction will be approximately 3,000 people. Details known thus far in the project have allowed the following estimates of occupation breakdowns for the construction stage of the project, along with the number of personnel required for each category and the appropriate National Occupational Classification (NOC) codes.

Extensive discussions are ongoing with provincial trade unions and the results of these discussions indicate strongly that the required skilled labour is available for the project period. The Project is also putting together an Employment Plan to address local concerns with regard to employment. It will contain initiatives for hiring apprentices and engineering and technology students, as well as initiatives to increase opportunities for under-represented groups.

Table 2.1 Breakdown of Occupations Anticipated for the Construction Stage of the Undertaking (Engineering and Design Phase)

Occupation	NOC Code	No. of People
Process Engineer	2134	20
Mechanical Engineer	2132	40
Civil/Structural Engineer	2231	20
Control Systems & Instrumentation Engineer	2133	30
Electrical Engineer	2133	20
Metallurgist	2142	5
Loss Prevention, Safety Engineer	2141	4
Designer (Drawing Office)	2252	50
CAD Operator	2253	60
Buyer (Procurement)	0113	20
Expeditor (Procurement)	1473	10
Document Controller	1413	15
Secretary	1241	10
Engineering Management	0211	15
Engineering Technologist	2232	20
HSEQ	2263	20
Project Management	0711	10
Project Controls	2131	20
Administration	1221	30
Total	-	419

Table 2.2 Breakdown of Occupations Anticipated for the Construction Stage of the Undertaking

Occupation	NOC Code	No. of People
Pipefitter	7252	690
Millwright	7311	280
Construction Management	0711	280
Labourer	7611	270
Electrician	7242	240
Equipment Operator	7421	230
Pipe Welder	7265	200
Insulator	7293	200
Painter	9496	140
Boilermaker	7262	100
Carpenter	7271	90
Ironworker	7264	90
Sheetmetal Worker	7261	90
Welder – Structural	7265	70
Concrete Finisher	7282	30
Total	-	3,000

Operations

Estimates have been given as to the number of personnel required for each occupation during the operations stage of the project, along with the corresponding National Occupational Classification (NOC) code. The peak workforce during operations will be approximately 750.

These estimates do not include outsourced/contracted services or construction personnel for turnaround, which is estimated to range from 300 to 750 depending on activities at the refinery.

Table 2.3 Breakdown of Occupations Anticipated for the Operation Stage

Occupation		NOC Code	No. of People
Management	Plant Manager	9212	1
	Maintenance Manager	0721	1
	SH&E Manager	2263	1
	Corporate Services Manager	0016	1
	Planning & Technical Services Manager	2233	1
	Marketing Manager	0611	1
	Commercial Manager	0711	1
Maintenance	Reliability/Field Services	2243	200
	Inspection	2262	25
	Warehouse	1471	38
	Turnaround (Pipefitters and welders)	7252 & 7265	35
Production	Chief Steam Engineer	9212	1
	Area Managers	0016	20
	DCS	7242	5
	Training	9232	7
	Process Operators	9232	200
SH&E	Environment	2263	8
	Safety, Fire Protection and Security	2263	20
	Industrial Hygiene	2211	4
Corporate Services	Accounting	1431	24
	Human Resources	0112	6
	Information Technology	2171	9
	Purchasing	0113	10
Planning & Technical Services	Operations Scheduling	9212	6
	Long-term Planning	9212	4
	Operations Support Engineering	9212	4
	Technical Services & Projects	9212	50
	Laboratory	2211	40
	Marine	2232	30
Total	-	-	750

3.0 THE CRUDE OIL REFINERY

The crude oil refinery site is shown on Figure 3.1. The refinery site is located at the end of the Southern Head Peninsula, remote from the local communities of North Harbour and Come By Chance. The site consists of gently rolling hills and valleys with small water bodies, shallow bogs and marshland. The site will be levelled and terraced to accommodate the new refinery. The Project footprint will directly affect two watersheds; (1) Hollett's Brook watershed, a very small watershed at the southwestern end of the peninsula which will be totally covered by the Project footprint; (2) the southern edge of Watson's Brook watershed (an area of less than 4.2 percent of this watershed will be disturbed).

The area immediately north of the refinery is designated as the location for the disposal of excess rock fill from the site. The area will be used as a laydown area for assembly during the construction process and will be used for future expansion of the refinery (to 600,000 bbl/d). All efforts have been made to protect the headwater of Watson's Brook watershed, by minimizing the infilling of ponds in the area and by locating the excess fill disposal area and laydown area adjacent to the site as discussed in Section 2.3.2. Additionally, during the detailed design phase of the Project, every effort will be made to reduce the proposed footprint of the Project and if possible, further reduce the area of watershed impacted.

The refinery area will consist of a process area in the centre of the site that will include all of the process equipment; the tank farm located to the south, a water treatment area on the southwest corner and the administrative and support buildings to the north east of the project site. There will be a saltwater intake in Hollett's Cove (for cooling water systems and desalination) whereas the treated effluent brine and heated water outfall diffuser system will be located west of the Southern Head headland (see Figure 3.1)

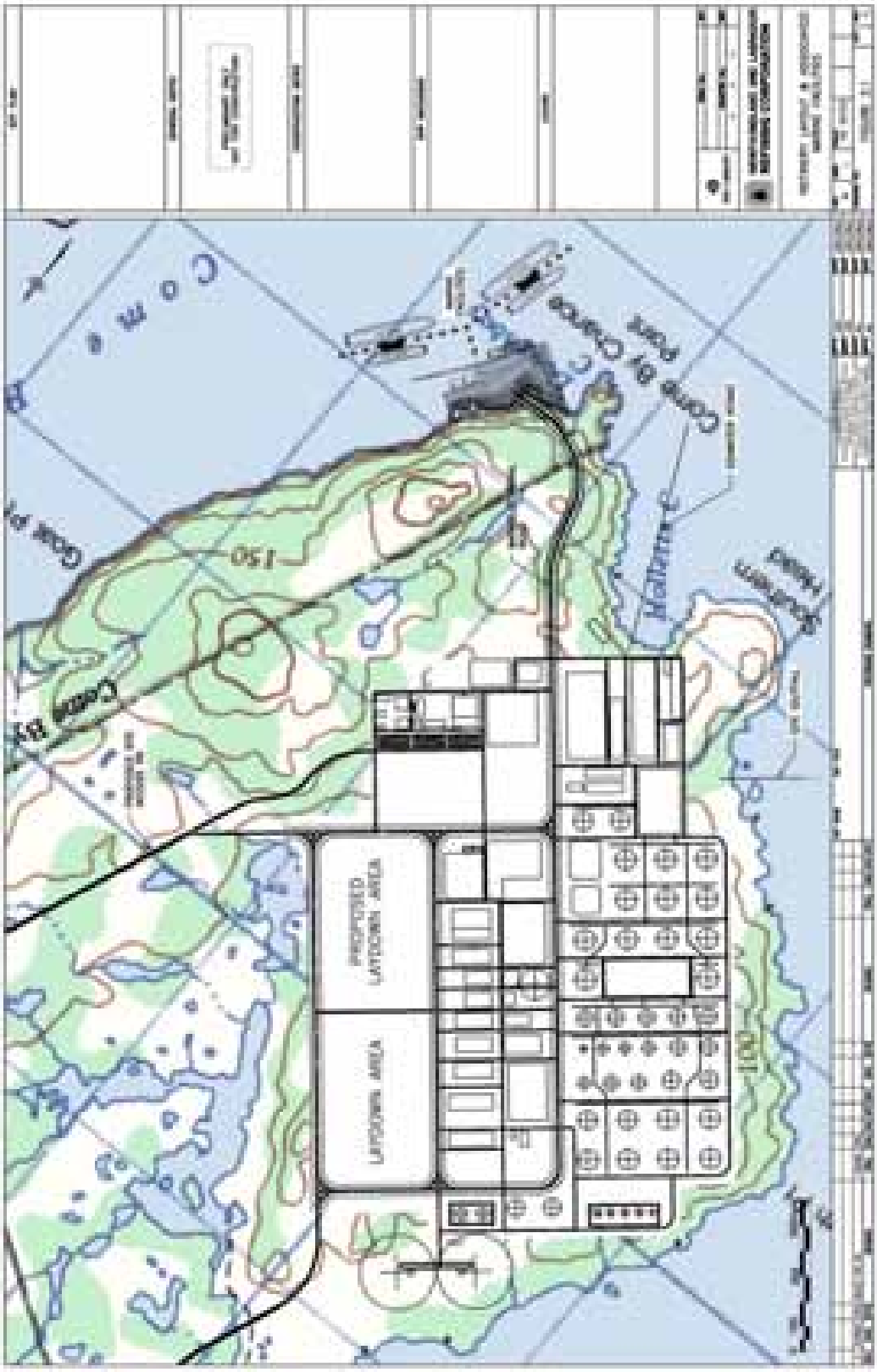

Figure 3.1 Refinery Layout and Associated Marine Facilities

3.1 Refinery Processing Plant and Equipment

The process plant is sized to accept 300,000 barrels of crude oil feedstock per day (nominal) on an annual basis. The plant will have an average operating efficiency of 98 percent. The current planned layout of the refinery area is shown in Figure 3.2.

3.1.1 Refinery – Process Units

The process units are configured for operational efficiency and flexibility to take maximum advantage of the available crude feed stocks from a variety of sources and with varying compositions. The process units generally are comprised of processing equipment including vertical and horizontal pressure vessels, fractionating towers, reactors, process heaters, pumps, pressure relief systems and piperack systems supporting interconnecting piping, control valves and cable trays with electrical and control cabling. These units will not be enclosed and access will be provided by platforms, stairs and catwalks with safety threads and protective handrails. Illumination of the area for workers will be provided using site lighting. Aircraft warning lights will be fitted to towers and stacks as required. Control equipment, sensors and remotely operated valves will allow operators to control the units from a central control room located outside the process area, or from field operating shelters.

The process area of the refinery complex will include the following units:

- Crude Blending;
- Atmospheric and Vacuum Distillation Unit;
- Light Ends Recovery Unit;
- Three Hydrotreating Units;
- Isomerization Unit;
- Two Hydrocracking Units;
- Delayed Coking Unit;
- Reformer Unit;
- Hydrogen Plant;
- Sulphur Recovery Facilities;
- Gasoline/ Distillate Blending.

The process area layout is shown in Figure 3.3 and the process flow diagram for the refinery process is shown in Figure 3.4.

Figure 3.2 Refinery Layout

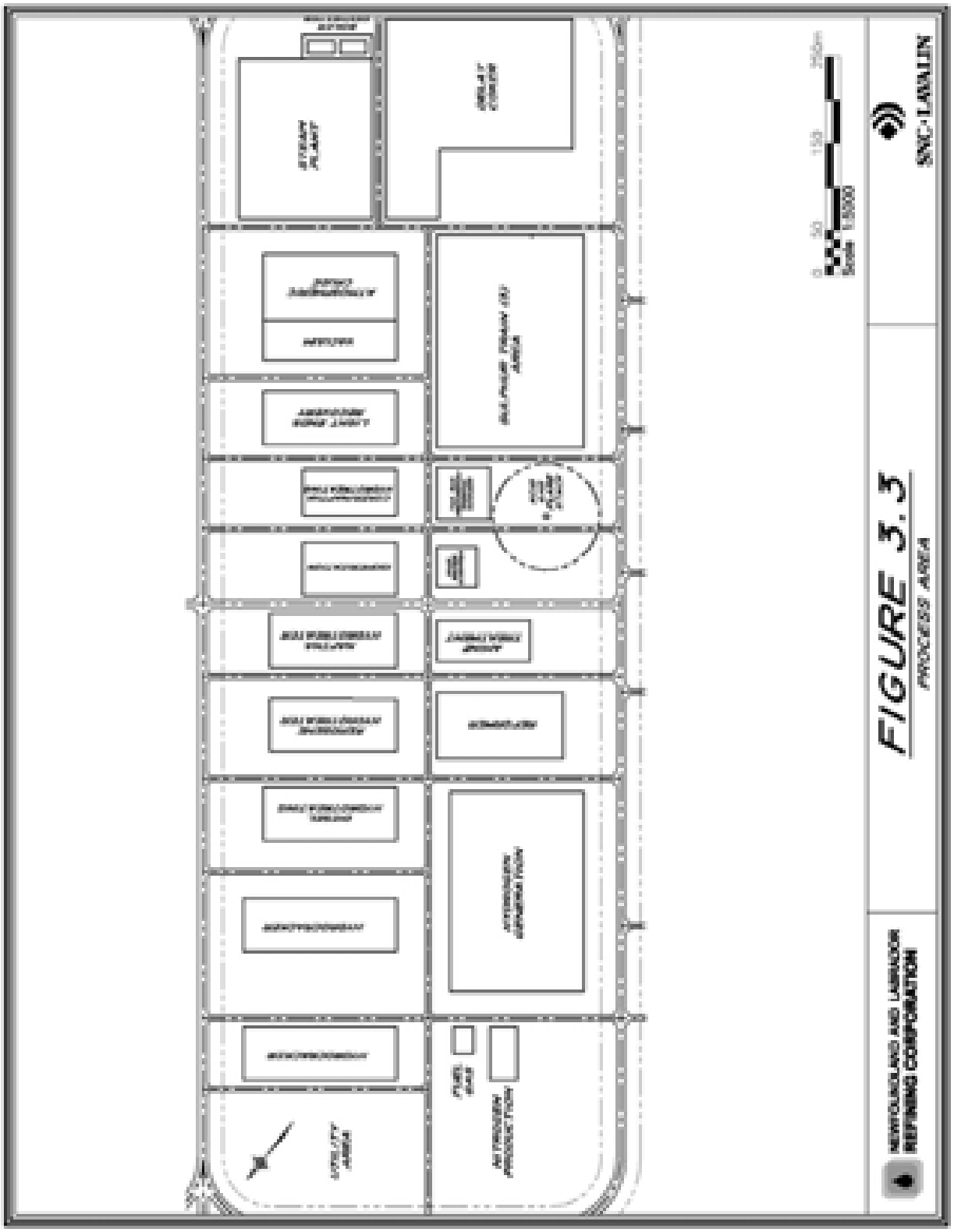

Figure 3.3 Process Area

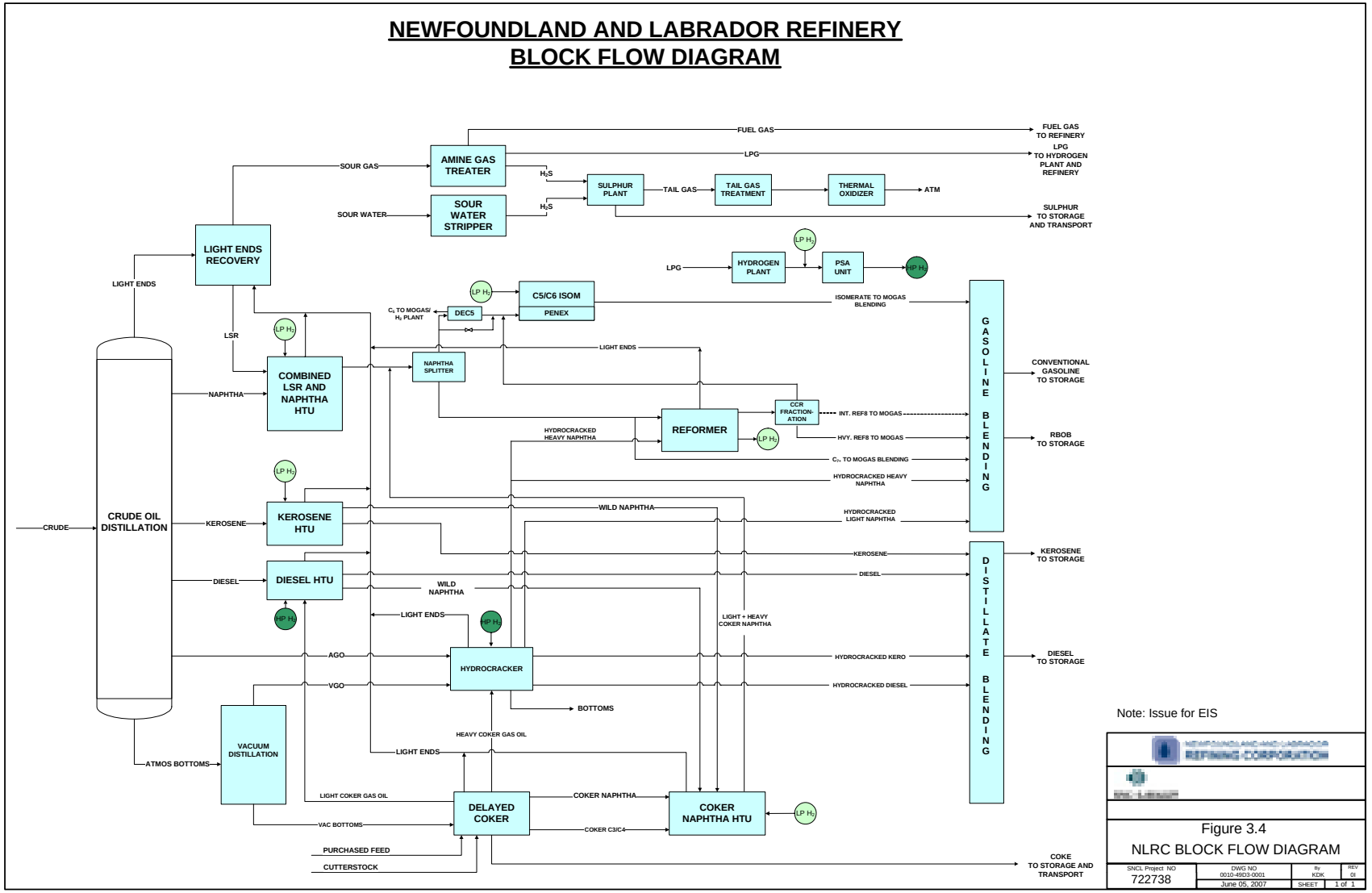

Figure 3.4 Process Flow Diagram

Crude Blending

A blending system will be incorporated at the beginning of the process stream to provide the means to physically mix two or more different crude streams from different storage tanks to produce a feedstock with desired characteristics for the most efficient operation of the plant. Crude will be blended either in-line through a manifold system, or batch blended in tanks depending on the type, quality and volumes to be blended.

Atmospheric and Vacuum Distillation Unit

This primary refinery unit will process the crude oil feed stock using desalting and fractional distillation equipment under both atmospheric and vacuum conditions to:

- Remove potentially corrosive salts to protect downstream process units;
- Separate the crude oil into naphtha, distillate, gas oil, and residual streams for further processing;
- Recover lighter hydrocarbon materials for further processing.

Distillation separates the various hydrocarbon constituents of the crude oil, based on their boiling points. Light hydrocarbons can be vapourized (boiled) at relatively low temperatures. Higher temperatures are required to vapourize heavier materials. Vacuum conditions are used to avoid thermal degradation of heavy feedstocks at high temperatures. Desalting, atmospheric and vacuum distillation are proven processes, widely used throughout the hydrocarbon processing industry.

The lighter hydrocarbon material will be sent to the Light Ends Recovery Unit for separation.

Light Ends Recovery Unit

The Saturate Light Ends Recovery Unit receives pentane (C5) and lighter streams from the Crude Unit, the Naphtha Hydrotreating Unit, the Coker Naphtha Hydrotreating Unit and the Hydrocracker Units and separates the components for further processing, sales, or other uses within the refinery.

Propane (C3) and butane (C4) will be separated from the ethane (C2) and lighter material. The C2 and lighter portion will be used for refinery fuel.

C3 and C4 will be used to provide the feedstock requirements of the Hydrogen Production Unit. Surplus C4 will be separated for gasoline blending or refinery fuel.

Hydrotreating Units

In the hydrotreating units, contaminants, principally sulphur and nitrogen, are removed from specific feedstocks to produce high quality hydrocarbon products for product blending or

additional downstream processing. In hydrotreating, the feedstock is mixed with hydrogen, heated, and passed through a catalyst bed where the contaminants are removed and the product quality is improved. These units operate at moderate temperatures and moderate to high pressures. The refinery will have the following hydrotreating units:

1. The Naphtha Hydrotreater removes sulphur from the Light Straight Run and Heavy Straight Run Naphtha from Crude Unit to make it suitable for further conversion in downstream processing units and for gasoline blending;

2. The Kerosene Hydrotreater (Kerosene HTU) removes sulphur and nitrogen from the Crude Unit kerosene and produces a product for blending into Jet A1 or kerosene;

3. The Diesel Hydrotreater (Diesel HTU) operates under high pressure to improve the quality (expressed as Centane number) of the diesel streams from the Atmospheric Distillation Unit and Delayed Coking Unit and to reduce its sulphur content to produce environmentally friendly Ultra-Low Sulphur diesel (ULSD).

The Coker Naphtha Hydrotreater removes sulphur from the naphtha streams produced by the Delayed Coking Unit and saturates the olefinic and di-olefinic components to levels that allow the resulting naphtha product stream to be processed in downstream refinery units or blended directly to gasoline.

Delayed Coking

In the Delayed Coking Unit, the heavy residual oil from the bottom of the Vacuum Unit is heated and charged to a coke drum where time and the heat from the feed cause the heavy oil to break down. The vapours from this thermal decomposition are condensed and separated into fractions for further processing. The light gases are recovered primarily for refinery fuel. The naphtha fraction is treated in the Coker Naphtha Hydrotreater. The light gas oil is sent to the Diesel Hydrotreater and the heavy gas oil to the Hydrocracker. The solid coke remaining in the drum is periodically cooled and mechanically removed; temporally stored on-site and then exported.

Hydrocracker

The Hydrocracker, operating at high pressure and moderate temperature, uses hydrogen and catalyst to remove the sulphur and nitrogen from the heavy gas oil streams from the Crude Unit, Vacuum Unit and the Delayed Coking Unit. It also cracks the heavier hydrocarbons into lighter components for use in commercial fuels. The quality of the Kerosene and Diesel produced will allow them to be used directly for product blending. The naphtha stream will be sent to the Reformer for octane improvement and to gasoline blending.

Isomerization Unit

The Isomerization Unit, using a catalyst in the presence of hydrogen, combines the C5 and C6 material from the Naphtha Hydrotreater Unit into a low volatility, high octane stock for gasoline blending.

Reformer

Operating with a noble metal catalyst and at high temperature, the Continuous Catalytic Reformer (CCR) rearranges the molecular structure of components of the various naphtha streams to generate a stream that provides high octane components for gasoline blending. As a result of the molecular rearrangement, the Reformer also produces hydrogen that supplements the volumes produced in the hydrogen generation unit to meet the total demand of the various hydroprocessing units.

Integral to the operation of the Reformer is the Reformate Splitter. The Splitter separates the Reformer product stream into a light fraction high in benzene and heavier fractions. The light reformate is sent to the C5 / C6 Isomerization unit to be converted into a high-octane gasoline blending component that is low in benzene. The heavy fractions are sent directly to gasoline blending.

Hydrogen Plant

The CCR unit produces low purity hydrogen as part of the conversion process. This hydrogen is collected and forms part of the hydrogen feed to other processing units. Additional hydrogen requirements will be met with production from the hydrogen plant. High purity hydrogen (95 percent to 99 percent) will be produced beginning with the Hydrogen Production Unit (HPU). Hydrogen is produced by the catalytic reforming of refinery gases in the presence of steam. The raw hydrogen produced is purified using Pressure Swing Absorption (PSA) technology.

Sulphur Recovery Facilities

The processes that remove sulphur from the various refinery feedstocks generate Hydrogen Sulphide (H_2S). In the Sulphur Recovery Unit (SRU), H_2S is converted to elemental sulphur with a high degree of conversion (99.8 percent conversion).

The Sulphur Recovery Unit (SRU) will use the following five (5) processes:

1. Acid Gas Treating;
2. Sour Water Stripping;
3. Sulphur Recovery;
4. Tail Gas Recovery;
5. Thermal Oxidation.

Sour gases, those containing H_2S, Ammonia (NH_3) and CO_2 (carbon dioxide), from the process units will be treated in a system that uses amine to absorb and remove the contaminants. A lean amine solution will be circulated to the various gas treating process units where it will be contacted with the sour gases. The resulting rich amine solution, containing the contaminants, will be returned to a central regeneration system where the contaminants, principally H_2S will be stripped out and sent for sulphur recovery. The stripped lean amine will be recirculated.

Process waters that have potentially come in contact with H_2S and NH_3 will be collected and sent to a sour water stripper where the contaminant gases will be thermally stripped from the water. The stripped water will be sent to the wastewater treating facility to be processed for recycle to the process units.

The H_2S rich streams from the amine unit and sour water stripper will be sent to a Claus type recovery plant where the H_2S will be converted to elemental sulphur, degassed, and sent to storage. Subject to environmental approval, any unconverted H_2S will be oxidized to SO_2 in the Tail Gas Recovery Unit before being discharged to the atmosphere through an incinerator and stack. Elemental sulphur is degassed, processed into pellets (prills), temporarily stored on-site and then exported.

Gasoline/Distillate Blending

A blending facility will be incorporated at the end of the process streams to provide a physical mixture of a number of different liquid hydrocarbons to produce finished products with certain desired characteristics. Products will be blended in-line through a manifold system. In-line blending of gasoline, distillates, jet fuel, and kerosene is accomplished by injecting proportionate amounts of each component into the main stream where turbulence promotes thorough mixing. Additives can be added during and/or after blending to provide specific properties not inherent in the blending components.

3.1.2 Refinery – Plant Equipment

The refinery process units are augmented with various pieces of plant equipment to provide functionality and connectivity within the process units and between interconnected units. Some of this equipment is located within the plot plan for each unit. Other pieces of equipment that service several units or the full plant are located in the off-site utilities areas. Plant equipment includes process heaters, coolers, cooling towers, compressors, turbines, pumps, piping and valves.

Process Heaters

Process heaters and heat exchangers preheat feedstock to achieve required reaction distillation temperatures for the various refinery units. Heat exchangers accomplish part of this function by using either steam or hot hydrocarbon transferred from some other section of the process as a

heat source. Heaters are usually designed for specific process operations, and most are of cylindrical vertical or box-type designs. The major portion of heat provided to process units comes from fired heaters fuelled by refinery gas, and residual oils.

Coolers

Heat also needs to be removed from some processes by heat exchange with air or water in fin fans, gas and liquid coolers, and overhead condensers, or by transferring heat to other systems. Cooling water use will be minimized and limited to those services where air cooling or heat integration are not applicable.

Cooling Towers

The refinery cooling water system will be a closed-loop cooling system. This has the significant benefit of mitigating the risk associated with leaks and failures of process cooling water exchangers, thus providing maximum protection to the marine environment. The closed-loop cooling system will be cooled by an open recirculating seawater cooling system, which will include a series of cooling towers to remove heat from the seawater prior to discharge. Therefore the seawater used for cooling does not have the potential to come into contact with process fluids. Cooling towers remove heat from water by evapouration and latent heat transfer between hot water and air. Utilizing seawater for cooling also provides the advantage of having an unlimited supply of cool water from Placentia Bay.

Turbines

Turbines will be steam-powered and used to drive pumps, compressors, blowers, and other refinery process equipment. Steam enters turbines at high temperatures and pressures, expands across and drives rotating blades while directed by fixed blades.

Compressors

Reciprocating and centrifugal compressors are used throughout the refinery for process gases and compressed air. Compressor systems include compressors, coolers, air receivers, air dryers, controls, and distribution piping. Blowers are used to provide air to certain processes.

Pumps, Piping and Valves

Centrifugal and positive-displacement (i.e., reciprocating) pumps will be used to move hydrocarbons, process water, firewater, and wastewater through piping within the refinery. Pumps will be driven by electric motors or by steam turbines. The pump type, capacity, and construction materials depend on the service for which it is used.

Process and utility piping distribute hydrocarbons, steam, water, and other products throughout the facility. Their size and construction depend on the type of service, pressure, temperature,

and nature of the products. Vent, drain, and sample connections are provided on piping, as well as provisions for isolation blanking.

Many different types of valves will be used in the plant depending on their operating purpose. These include gate valves, bypass valves, globe and ball valves, plug valves, block and bleed valves, and check valves. Valves can be manually or automatically operated.

Equipment Noise Limitations

For any piece of equipment, maximum allowable noise will be 80 dBA at 1 m distance. In the event of higher noise, adequate measures will be taken to minimize noise pollution (i.e., installed noise muffler, barriers, etc.). During engineering of the project, a noise map of the entire facility will be developed to check noise levels at perimeter and within plant working area. Baseline monitoring of the project area will be undertaken before project construction starts on-site. Noise monitoring during operations will ensure expectations are met. Where required, hearing protection will be mandatory on-site during construction and operations.

3.1.3 Pressure-Relief and Flare Systems

Pressure-relief systems will control vapours and liquids that are released by pressure-relieving safety devices and blow-downs. Pressure relief is an automatic, planned release when operating pressure reaches a predetermined level. Blowdown normally refers to the intentional release of material, such as blowdowns from process unit startups, furnace blowdowns, shutdowns, and emergencies.

Safety relief valves, used for air, steam, and hydrocarbons, will allow valves to open in proportion to the increase in pressure over the normal operating pressure.

The pressure relief and flare system will include relief valves and lines from process units for collection of discharges, knockout drums to separate vapours and liquids, seals, and/or purge gas for flashback protection, and a flare and igniter system to combust vapours. Discharging refinery streams directly to the atmosphere is not permitted.

The new facility will have three (3) flares: High Pressure (HP) Flare; Low Pressure (LP) Flare; and Acid Gas flare. While the acid gas flare will be an integral part of the sulphur recovery unit, the HP & LP Flares will be installed in the off-site area to the north west of the process area and will serve the remainder of the complex. Relief discharges from the high pressure systems in the hydroprocessing units will be routed to the HP Flare while relief discharges from the rest of the facility will be routed to the LP flare. Each flare will be equipped with its own knock-out vessel, pumps, pilots and seal system. Hydrocarbon from the knock-out vessel will be returned to the slop tank for further processing.

The purpose of the flares is to act as safety devices to protect plant equipment, piping and pressure vessels from overpressure. They are essential for the safe operation of the refinery.

3.1.4 Process Control and Monitoring Facilities

A state-of-the-art central control room for the Project will be installed outside the process area to house instrumentation, control and information facilities. These facilities will be used to monitor and control the process units to ensure the safety of the plant and its personnel, and to optimize plant performance

Instrumentation and Control

The Instrumentation and Control system will provide continuous, real-time operational data to the Refinery Control Centre located in the administration building. This Control Centre will be manned on a 24-hour basis by specially-trained senior operating personnel. NLRC proposes to use the control network to communicate data, video and control signals from the process units, tank farm, pipelines and delivery location facilities.

Typical information monitored by the system includes:

- Product-specific information such as temperature and density;
- Operational information such as pressure and flow rates, as well as information on the operational condition of pumps, valves, tanks, vapour recovery systems and vapour incinerator status and alarms;
- Security system status, intrusion detection alarms, remote video camera pictures;
- Firefighting system status and alarms, and other facility status points.

Numerous software applications will be integrated into the control system to assist the unit operators with certain functions, such as crude or product batch tracking, historical event analysis, trend monitoring, flow balance and leak detection monitoring. Automatic report generation systems will supply historical and current data to operations and maintenance personnel.

In addition to continuous monitoring, the control system will provide the unit operators with the ability to remotely control important aspects of systems operation, including starting and stopping pumps, opening and closing valves, switching into and out of storage tanks and facility emergency shutdowns. The control system will be programmed to alert the refinery system operators at any time that operational conditions fall outside established parameters. Upon detection of an irregularity, the system operators will have the capability to shut down the affected refinery equipment or pipeline by remotely stopping pumps and closing block valves that will be part of the various systems. Additionally, Emergency Shutdown Device (ESD) will be installed at key locations around the facilities, allowing system operators to securely halt operations in case of an emergency. Designing and operating the control system in this way will provide for a high degree of safety in the operations, allow for quick and technically sound responses to abnormal conditions, and simultaneously provide a basis for environmentally-sensitive operating decisions.

3.2 Storage Tanks and Pipelines

Atmospheric storage tanks and pressure storage tanks will be used throughout the refinery for storage of crude oils, intermediate hydrocarbons (intermediate storage during the refining process), and finished products. Tanks are also provided for process and treated water, acids, amines, additives, and other chemicals. The type, construction, capacity and location of tanks will depend on their use and materials stored. Special attention will be given to designing the tankage to control odours and the escape of volatile organic compounds (VOCs).

The tank farm will have a storage volume of approximately 6,000,000 barrels (954,000 m^3) for crude oil, 3,975,000 barrels (632,000 m^3) for intermediates, and 4,900,000 barrels (780,000 m^3) for product. LPG will be stored in spheres.

As per regulations, the tank storage area will be dyked and lined to provide containment in the case of an accidental spill and to prevent hydrocarbon escape into the surrounding environment. The secondary containment shall be a combination of dyking, diversion drainage channels and remote impounding similar in design to the Whiffen Head Transshipment terminal containment system. An oil/water separator will be fitted to the drainage system from the tank farm secondary containment area, to separate hydrocarbon products from drainage water before being discharged to the environment.

Pipelines are used extensively throughout the refinery to transfer hydrocarbons and process utilities. The pipe material, rating and design conditions will be specified during the design phase of the project. Compliance to regulations and current codes will be met.

3.2.1 Tank Farm

The new tank farm is located to the south of the process facilities and will be constructed with BATEA, as per the EIS Guidelines. The layout of the tank farm is shown in Figure 3.5. Tanks of "like" products are grouped together to gain operational efficiency as well as minimize land use. Crude tanks are positioned to minimize "boil over" impact from a fire situation on the rest of the refinery.

The tank farm will contain up to 40 crude and product storage tanks with:

- Internal floating roof tanks or fixed roof tanks depending on tank duty;
- Receiving and discharge manifolds;
- Inlet and outlet metering;
- Distribution pumps;
- Pipeline pigging facilities;
- Electrical substation;
- Control/switchgear building;

- Miscellaneous associated facilities.

The facilities will be designed to receive crude from the Marine Terminal at a rate of 100,000 BPH while delivering product to the Marine Terminal at rates up to 42,000 BPH. All facilities will be designed in full compliance with all Federal and Provincial codes and standards, as well as industry–recognized design standards. Additionally, the tank farm will incorporate landscaping elements to improve the visual appearance of the site and soften the industrial nature of the facility.

Tank Construction

Storage tank selection and design will be based on safety and reliability of the system and minimum environmental impact due to vapour or liquid release. Tanks will be built to API 650 or API 620 standard, as applicable. Modern tank design is aimed at preventing odour and health issues associated with older refineries. All tanks will be of welded steel construction. The tanks will range in size from 50 to 300 feet in diameter and 40 to 65 feet in height. To prevent corrosion from water present in crude oils, the crude tank internals will be epoxy-coated, preventing the water from contacting the tank shell. Crude Tanks will have fixed roofs with internal floating roofs similar to Figure 3.6.

The final number of tanks and storage volumes will be confirmed during the Engineering Design phase of the project. Storage tanks will also be provided within processing units for certain additives and chemicals. All hydrocarbon storage tanks will comply with applicable Regulations and Guidelines, including the *Environmental Code of Practice for Aboveground and Underground Storage Tank Systems Containing Petroleum and Allied Petroleum Products (Canadian Council of Ministers for the Environment, 2003)* and the *Environmental Guidelines for Controlling Emissions of Volatile Organic Compounds from Aboveground Storage Tanks (Canadian Council of Ministers for the Environment, 1995).*

Tank Farm Containment

The tanks will be installed on concrete ringwall foundations, elevated above the surrounding grade. The tanks will be installed in a dyked and lined containment area with remote impoundment. The remote impoundment basin will be designed to contain the entire contents of the largest tank, plus provisions for rainwater runoff from the tank farm. The tanks will also be equipped with level gauges and redundant level alarms. The devices will be integrated with the control system, stopping additional material from entering the tank should a high level alarm be detected. A stormwater collection system will be installed to collect rainwater and direct it to a holding area for treatment and discharge. Oil/water separation equipment will be installed to remove trace quantities of hydrocarbons in compliance with water discharge permits. Quality control will be verified though the use of hydrocarbon monitors and flowmeters at discharge points.

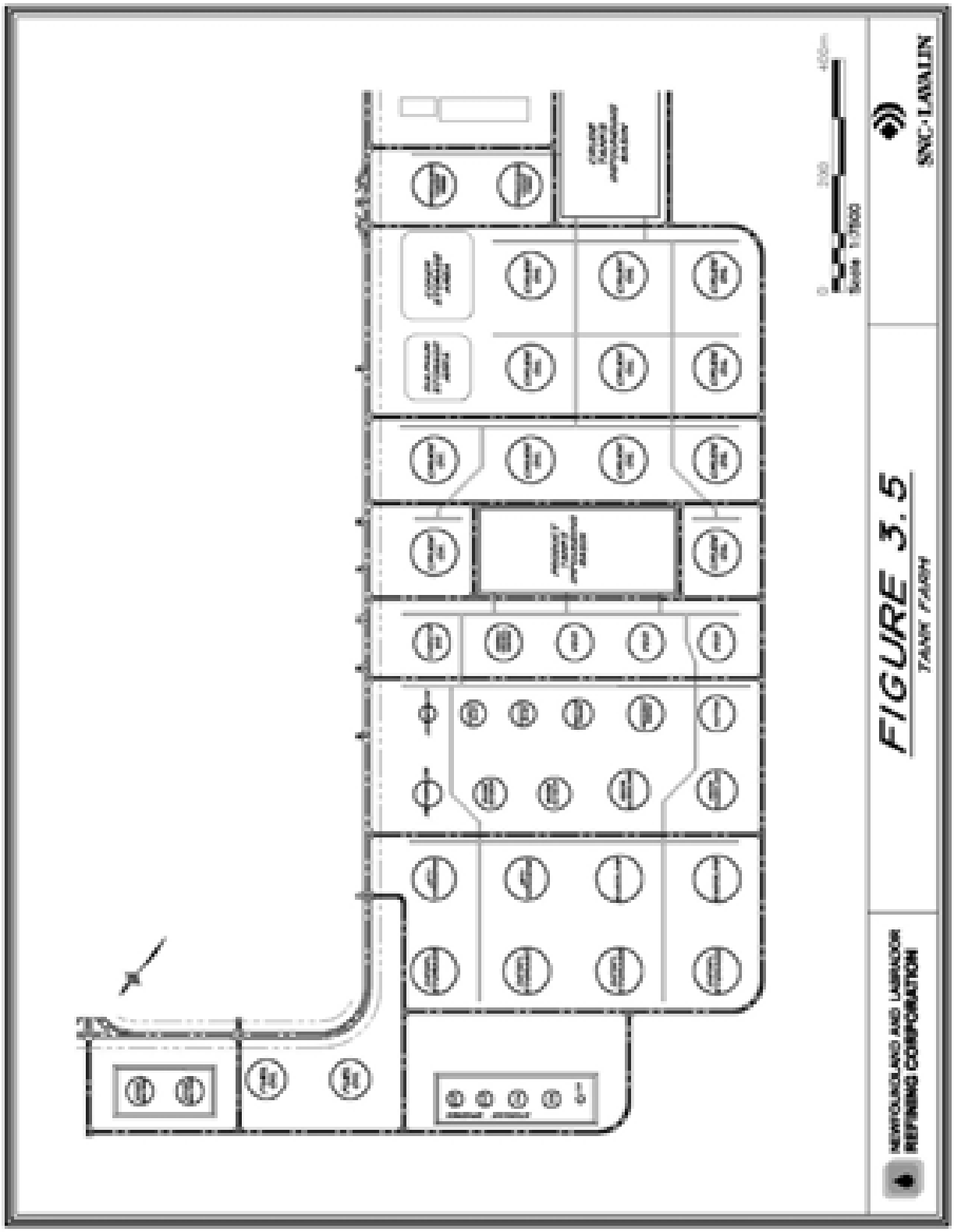

Figure 3.5 Tank Farm

Crude Tanks will have fixed roofs with internal floating roofs similar to Figure 3.6.

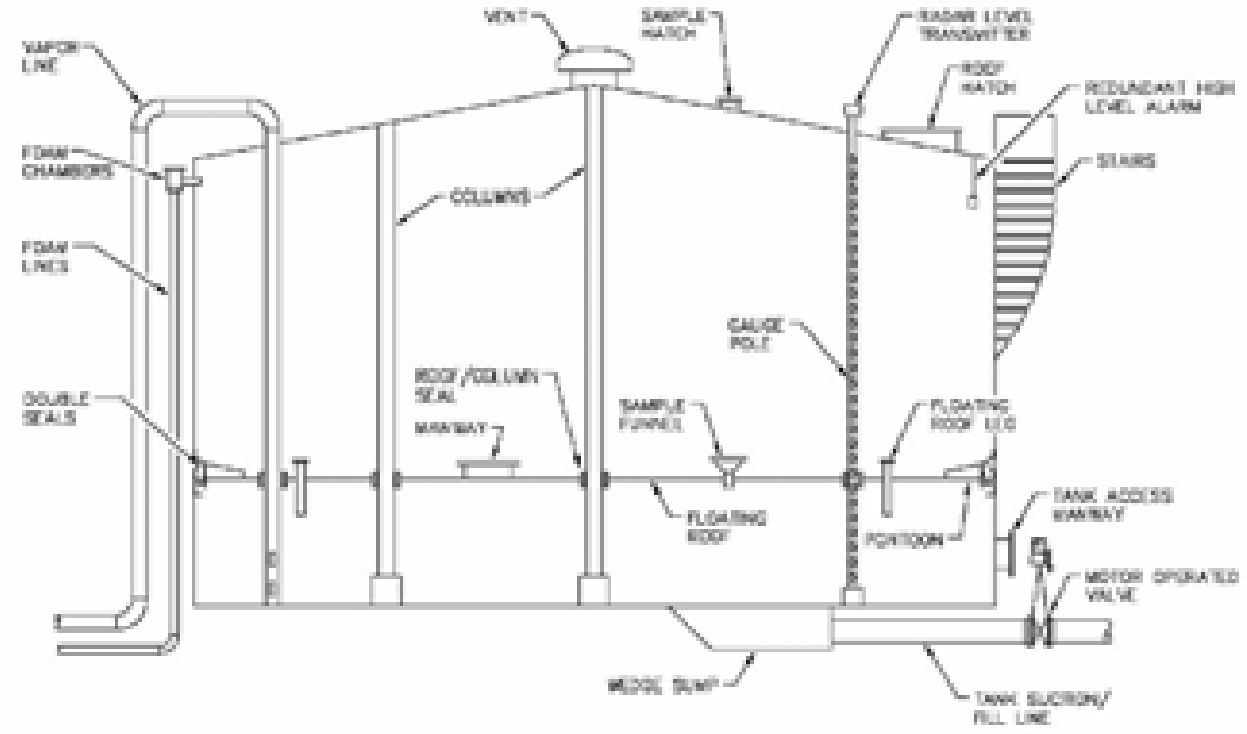

Figure 3.6 Typical Internal Floating Roof

Tank Farm Emissions Control

Where appropriate, tank emissions will be controlled with the use of internal floating roofs (IFRs). Internal floating roofs control emissions by resting (floating) directly on the stored petroleum product. This minimizes the area of the interface between the product and the air within the tanks, preventing vapours from being formed over the liquid surface. To further reduce emissions, the floating roof will be equipped with primary and secondary seals. The seals prevent emissions from escaping from between the floating roof and the tank shell. The primary seal is a metallic band (called a shoe) attached to the floating roof. The shoe slides in contact with the tank shell as the level of product in the tank rises and falls. The secondary seal is mounted above the primary seal. Secondary seals further reduce vapour losses from the gaps between the metallic shoe and tank shell. In addition to the floating roof seals, all penetrations through the floating roof are sealed. This includes penetrations for support columns, gauging poles and hatches and ladders. The tanks will be designed to include a vapour recovery system. Vapours will not be released while product is entering or being drawn from the tanks.

Tank Farm Fire Protection Systems

The tank farm fire protection systems will be designed in accordance with the National Fire Code of Canada, the National Fire Protection Association (NFPA) guidelines and industry standards as well as local fire requlations. Each area will have a complete firewater piping loop surrounding the tanks and pumping systems, supplied with the appropriate hydrants and monitors. The hydrants will be located on a fire access road, to provide adequate coverage to the tanks. Firefighting foam will be available to suppress fires. Firewater pumps will be installed to supply high pressure water to these systems. A Fire Protection Plan will be developed which will detail the layout of each area, area access, equipment locations and control systems.

Tank Farm Stormwater System

Stormwater management practices will be in place to contain and release water in a controlled fashion. Water that is released will meet Provincial water quality guidelines. Contaminated water will be treated to meet Provincial quality guidelines prior to release to the environment.

3.2.2 Sulphur and Coke Storage Area

Specific site areas will be designated for site storage of sulphur products and coke products. These areas will be designed to meet the applicable codes and standards for safety, environmental protection and the reduction of fugitive emissions.

Sulphur Storage

Sulphur will be stored in a purpose-built secure storage yard and loaded via a covered conveyor system to the designated export wharf and from there onto vessels (bulk carriers) for export. The amount of bulk sulphur in storage will be kept to a minimum by the regular scheduling of vessel shipments through the marine terminal.

The design of the storage area and the handling methods used will ensure the sulphur is not contaminated and that its storage and handling does not cause harm to the environment. Sulphur will be processed in a prilling plant to provide stabilized pellet product and to reduce fines (sulphur dust) as well as for ease of handling. An asphalt or concrete pad with liner will be provided. This will enable 100 percent recovery of the sulphur in the stockpile and provide a collection and containment system for water that has come into contact with the sulphur. Water runoff from the stockpile will be deemed to be contaminated. It will be collected in a contained drainage system and directed to the treatment plant for processing.

Coke Storage

Petroleum Coke will be stored in a purpose-built secure covered storage yard or silo and loaded via a covered conveyor system to the designated export wharf and from there onto vessels (bulk

carriers) for export. The amount of bulk coke in storage will be kept to a minimum by the regular scheduling of vessel shipments through the marine terminal.

The design of the storage area and the handling methods used will ensure the coke is not contaminated and that its storage and handling does not cause harm to the environment. To avoid the production of excessive fines, unnecessary or double handling of coke during processing and shipment will be eliminated. As with the sulphur storage area an asphalt or concrete floor with liner will be provided. This will enable 100 percent recovery of the coke in the stockpile and provide a collection and containment system for water that has come into contact with the coke. Water runoff from the stockpile will be collected in a contained drainage system and directed to the treatment plant for processing.

3.2.3 Unloading and Loading Pipelines

The loading and unloading pipelines will be designed to meet state-of-the-art Marine Oil Handling Facilities requirements. With the potential for environmental impact from hydrocarbon spills into the sea, particular attention will be paid to the design of equipment for the ship/shore interface. Spill prevention, containment and management will be a high priority. Best-in-class maintenance and operational practices and procedures will ensure operational integrity and high-performance equipment. The unloading and loading pipelines will be designed to discharge and load tanker cargoes quickly and efficiently, minimizing both vessel emissions and vessel time at berth. These systems will be large diameter pipelines and transfer systems, allowing tankers to achieve offloading rates up to 100,000 barrels per hour (BPH).

Pipelines will be supported on pipe racks and will run from the tank farm to the marine facilities. In addition, pipelines will have emergency shutdown control valves that can be fully engaged in an appropriate timeframe to minimize emergency impact.

3.3 Site Utilities and Infrastructure

To provide for the effective operation of the refinery, many complementary site utilities and infrastructure are required. As the project site is currently undeveloped and there are no existing support facilities, an entire support network is needed including the following:

- Site Water Supply (Process and Potable);
- Firewater Supply;
- Stormwater Management System;
- Oily Water/Process Water Drainage System;
- Sanitary Sewer System;
- Wastewater Treatment System;
- Steam System;
- Electrical Power Supply;

- Support Buildings.

3.3.1 Site Water Supply

Uninterrupted water supply is an important part of the refinery process. Water is used in many refinery processes, including crude desalting and steam generation and as process water within the operating units. The proposed water supply will be from a desalination plant constructed on-site. Depending on the characteristics of boiler feedwater, some or all of the following stages of freshwater treatment will be used:

1. clarification;
2. sedimentation;
3. filtration;
4. ion exchange;
5. aeration/de-aeration.

Of the more than 7,500 desalination plants in operation worldwide, 60 percent are located in the Middle East. The world's largest plant in Saudi Arabia produces 128 million gallons per day (MGD) of desalinated water. Some 12 percent of the world's capacity is located in the Americas, with most of the plants located in the Caribbean and Florida. To date, no desalination plants have been built along the Newfoundland and Labrador coast, primarily because the cost of desalination is generally substantially higher than the costs of other water supply alternatives available in the province (e.g., lakes, ponds, rivers and groundwater pumping). However, due to the relatively small supply of surface water at the proposed site and concern over water quality and local salmonoid resources in Watson’s Brook, desalination is an attractive source of water given the availability of waste heat and the unlimited supply of sea water.

Desalination is a process that removes dissolved minerals (including, but not limited to, salt) from sea water, or treated wastewater. A number of technologies have been developed for desalination, including reverse osmosis (RO), multi-effect distillation, electrodialysis, and vacuum freezing. Two of these technologies, RO and multi-effect distillation, are being considered by the project for development of sea water desalination.

During the Design phase, the total water demand will be finalized. A hydraulic model of the distribution, pumping and storage system will be developed to size major components and pipelines.

Due to the level of treatment required for various water usages, a central treatment plant has been selected.

The potable water supply will be supplied from the desalination water system. Potable water will be treated to Canadian Drinking Water Quality Guidelines (CDWQG). The potable water demand is small compared to the process and cooling water requirements; however, the

treatment level can be considerably higher. If this is the case, then consideration will be given to separate treatment of the potable water and a stand-alone piping system.

3.3.2 Firewater System

Firewater protection will be required in all areas of the site—particularly in the hazardous process areas. The firewater demand will be based on the assumption that only one major fire will occur at any one time. Both water spray and foam systems will be needed. The firewater demand will be highest for the ISBL process units and for the storage tanks.

The firewater system will be developed strictly in compliance with NFPA Guidelines, The National Fire Code of Canada, industry standards and any relevant local fire regulations. A hydraulic model of the piping, pumping and storage system will be developed to size the major components

The firewater system will be fed from a dedicated firewater pond. The pond level will be maintained by motor-operated weir gates and water make-up will be from the Stormwater Pond, from the Final Treated Effluent Water Pond, and as last resort, from the site freshwater supply system.

For the process units, the firewater system will be divided into a number of fire zones. Within each fire area in the process units a network of dry deluge piping will be provided from each riser to nozzles covering each piece of equipment. There will be a network of hydrants throughout the site equipped with fire hoses and nozzles, with fixed or portable monitors.

3.3.3 Stormwater Management System

The stormwater management system consists of three components and will provide an effective means to minimize the surface water affected by the project. The first component will be a series of interceptor ditches to divert uncontaminated surface water from the adjacent land areas and prevent it from entering the project site. The second component will be an on-site drainage system outside the process area and will consist of a network of drains and catch basins interconnected with an underground piping system. This system will collect and channel all uncontaminated stormwater runoff from non-process areas within the refinery complex. This water will be discharged to the stormwater outfall into Placentia Bay. A monitoring system will ensure that stormwater discharges meet Provincial wastewater discharge standards. Finally, a similar but separate network of drainage channels, catch basins and underground storm piping will collect stormwater from the process areas of the project site and direct it to a contaminated retention pond for storage and treatment. This system is separated to accommodate water runoff anticipated from process areas that may be contaminated and keep it isolated from the clean areas of the project site.

The volume of stormwater generated from the site will be estimated using a computer model (HEC or HYSYS). The model will be used to size the underground piping network and above-ground channels required to collect and convey the stormwater from the site. A sedimentation pond will be located and sized based on the estimated stormwater generation from the site. This pond will retain and prevent discharge of sediment from the project area into the environment. Stormwater from the process areas will be directed to a dedicated (potentially) oily stormwater retention pond where it will be continuously evaluated for contaminants. If contaminants are found in the runoff, the water will be sent to the treatment plant for treatment or if the runoff is free of contaminants it will be either used on-site or discharged into the environment.

3.3.4 Oily Water/Process Water Drainage System

The Oily Water/Process Water Drainage system forms part of the Stormwater Management System described above and consists of a network of surface drainage channels and catch basins interconnected with an underground piping system within the process area. This system will drain and handle all clean and dirty water runoff and expended process water from process areas. This system will also handle water drained from storage tanks and contaminated stormwater from the tank farm area. This water will be directed to a contaminated retention pond for storage and treatment in the wastewater treatment system.

3.3.5 Sanitary Wastewater Management System

The sanitary sewerage system consists of a network of underground pipes and manholes that connect all of the major buildings on-site. Sanitary wastewater will be collected from washrooms, utility rooms and other domestic wastewater discharge facilities in all site buildings and transported through the sanitary system to the wastewater treatment system.

Models of the sanitary sewer system and the discharge outfall will be developed to size the underground piping collection system and outfall pipe. The level of treatment required will also be evaluated.

3.3.6 Wastewater Treatment System

Wastewater treatment will be used for all process water, bilge water, contaminated stormwater runoff, and sewage prior to discharge or recycling. Wastewater from the project site will typically contain hydrocarbons, dissolved materials, suspended solids, phenols, ammonia, sulfides, and other compounds. Wastewater includes condensed steam, stripping water, spent caustic solutions, cooling tower and boiler blowdown, wash water, alkaline and acid waste neutralization water, and other process-associated water.

Pre-treatment will be used for the separation of hydrocarbons and solids from wastewater. API separators, interceptor plates, and settling ponds remove suspended hydrocarbons, oily sludge, and solids by gravity separation, skimming, and filtration. Gravity separation depends on the

specific gravity differences between water and immiscible oil globules and allows free oil to be skimmed off the surface of the wastewater. After pre-treatment, suspended solids will be removed by sedimentation or air flotation. Wastewater with low levels of solids may be screened or filtered. Flocculation agents may be added to help separation. Secondary treatment processes biologically degrade and oxidize soluble organic matter by the use of activated sludge, unaerated or aerated lagoons, trickling filter methods, or anaerobic treatments. Materials with high adsorption characteristics may be used in fixed-bed filters or added to the wastewater to form slurry, which is then removed by sedimentation or filtration. Additional treatment methods may be used to remove oils and chemicals from wastewater. Stripping may be used on wastewater containing sulphides and/or ammonia, and solvent extraction is used to remove phenols.

Tertiary treatments may be required to remove specific pollutants to meet regulatory discharge requirements. These treatments include, but are not limited to, chlorination, ozonation, ion exchange, reverse osmosis, activated carbon adsorption, etc.

3.3.7 Electrical Power Supply

The project requires an uninterrupted power supply of 170MW for the first phase of the project. This power will be delivered from Newfoundland and Labrador Hydro from a combination of spare capacity on the inter-provincial grid and/or with the construction of new electrical generation capacity.

The main electrical substations will receive power from the utility for distribution throughout the facility. These main substations will be located in non-classified areas, away from hazardous sources or cooling-tower water spray. Transformers, circuit breakers, and feed-circuit switches will be located in the main substations. The main substations will provide power to distribution stations within the process unit areas. Generally, the distribution stations will be located in non-classified rooms or buildings within the facility. Power transmission from the main substations to the distribution substations will be by a combination of overhead and underground cables. The main stations will have outdoor, liquid-filled transformer(s) and oil-filled or air-break disconnect devices. The distribution substations will have dry type transformers, and medium and low voltage distribution equipment as required by the process equipment.

3.3.8 Steam System

High-pressure, high-temperature steam will be required to provide heat to the various process units within the refinery complex. Steam will be generated in main steam generation plant, and/or at various process units by recovering heat from flue gas or other sources. Steam flows from the steam drum to the superheater before entering the steam distribution system. The boiler furnaces will be equipped with low-NOx burners and other emissions controls devices following the principles of BATEA.

The steam distribution system consists of valves, fittings, piping, and connections suitable for the pressure of the steam transported. Steam leaves the boilers at the highest pressure required by the process units or electrical generation. The steam pressure is then reduced in turbines that drive process pumps and compressors. Most steam used in the refinery is condensed to water in various types of heat exchangers. The condensate is reused as boiler feedwater or discharged to the wastewater treatment system.

3.3.9 Infrastructure-Support Buildings

Many support buildings are required to operate a facility of this size, housing 750 permanent employees for normal operations and up to 1,000 temporary construction staff for maintenance shutdowns. These buildings will include the following:

- Administration and Engineering Building;
- Emergency Response/Central Control Building;
- Laboratory;
- Medical Centre/Fire Station Building;
- Warehouse Buildings;
- Maintenance Shops;
- Service Garage/Storage;
- Canteen/Lunch Room Building;
- Change/Shower Room Building;
- Security Building;
- Jetty Control and Emergency Response Warehouse;
- Water Treatment Building;
- Electrical Substations and Utility Buildings;
- Unit Control Shelters and Permitting;
- Field Maintenance Buildings;
- Chemical Storage Facilities.

The main building area will be in the northeast corner of the site. A general layout of this area is shown on Figure 3.7.

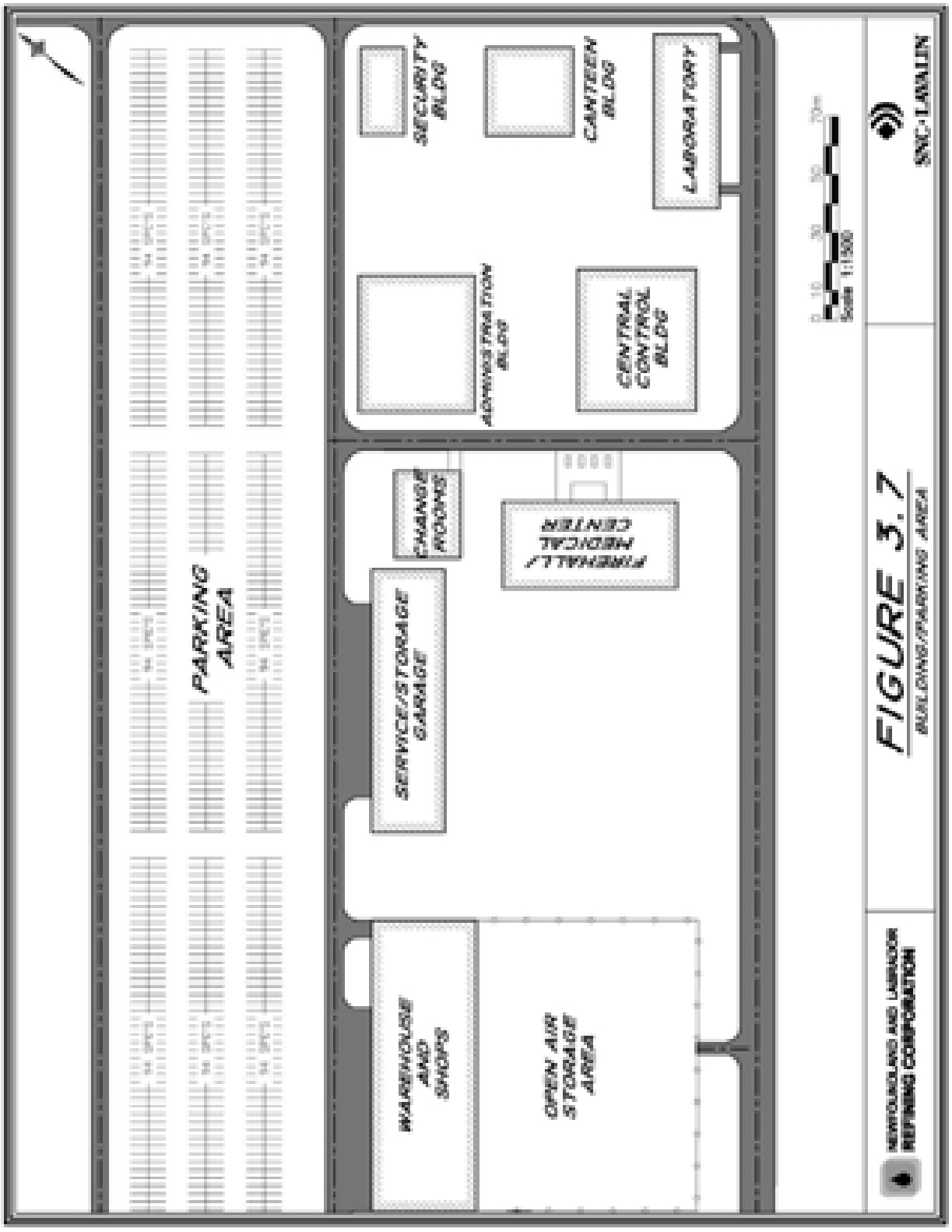

Figure 3.7 Building/Parking Area

3.4 Site Access Road and Transmission Lines

The project site is currently accessible only by boat, helicopter or all-terrain vehicle and a new access road is required to connect the site into the provincial highway network. The proposed principle access point will be from the Trans-Canada Highway (TCH) near the Town of Come By Chance. The volume of traffic during construction and operation precludes the use of the existing at-grade intersection as it is insufficient to accommodate the anticipated change in traffic patterns. A new interchange will be constructed approximately 1 km north of the existing intersection to provide a connection point for the main access road to the site. This interchange will consist of an overpass that will carry traffic from the TCH to the project site. It will also provide a new access point for the towns of Come By Chance and Sunnyside to the TCH. These towns will each be connected to the interchange with new service roads to allow for improved highway access for the towns and will allow for the removal of the existing intersection. The TCH will remain at the existing elevation and should not require substantial modification other than routine upgrading/resurfacing. The access road to the site will have a structure10 m wide, including a 7.5 m wide asphalt surface. Guiderails and drainage structures will be provided as required by the final design. The access road will have to pass over the Come By Chance River, and will require a bridge to be constructed to accomplish this crossing. The bridge will be a concrete structure with a clear span of 30 m and dry abutments. The length of the access road from the TCH to the main project site will be 9.2 km.

In order to expedite work on the refinery site while the access road is being constructed, a temporary access will be built consisting of a tote road located at or near the permanent road location. Where practical, the tote road will be designed to be incorporated into the permanent road structure. A temporary modular bridge will also be used for the Come By Chance River crossing during construction and removed upon completion of the permanent bridge.

Once permanent access to the site has been established from the Come By Chance area, an alternate access road will be extended to the North Harbour Area to connect into provincial Route 210. This extension will provide an alternate route for employee access from the Burin Peninsula, as well as for a second access into the site for emergency purposes.

This portion of the access road will match the design and construction of the access road from Come By Chance. It will require two additional river crossings, one at Watson's Brook and one at North Harbour River. Both bridges will be of concrete construction with clear spans and dry abutments. The Watson's Brook crossing will have a clear span of 10 m and the North Harbour River Crossing will have a larger clear span of 30 m. The length of this alternate access road is 12.1 km.

The volume of traffic anticipated for the North Harbour access is not expected to be as substantial as the Come By Chance access, especially during construction, as materials and equipment will be brought in from the TCH rather than Route 210. Also, the scheduling of

construction is such that it may not be operational during the full duration of construction. Consequently, an at-grade intersection will be developed with Route 210. In order to eliminate any conflict with the existing access from North Harbour to Route 210, the access road to the project site will be designed to incorporate a new intersection and service road to tie in North Harbour. The existing intersection would be terminated.

Transmission lines will be required to deliver power to the site during construction and during operations. The initial supply of power for construction purposes will be obtained from Newfoundland Power from the provincial grid using a temporary power line to be constructed adjacent to the main site access road. Power for facility operations will be obtained from Newfoundland and Labrador Hydro (NLH) and will be on a new, dedicated power transmission line to the project site. Where possible, the transmission line will run adjacent to the access road; however, the final alignment location will be determined during design and will depend upon the connection point into the NLH system.

4.0 THE MARINE TERMINAL

The project will require new marine facilities to be constructed to handle large ocean–going oil tanker and bulk carrier vessel traffic.

The new facilities will consist of the following primary elements (see Figure 4.1 – General Marine Terminal Isometric View):

- Marine Wharf;
- Heavy Lift Construction Dock;
- Tug Berth – Small Boat Basin;
- Bulk Materials – Dry Product Berth (Berth #1);
- Jetty Control Building and Emergency Response Warehouse;
- Offshore Berthing Facilities;
- Access Trestle;
- Jetty 1 (Berth No. 2 and Berth No. 3);
- Jetty 2 (Berth No. 4 and Berth No. 5).

A general layout of the marine terminal is shown in Figure 4.2. The facility is located to the west and slightly north of Come By Chance Point in Come By Chance Bay. The location has been selected based on available water depth, shelter from prevailing south west wind and ease of manoeuvring to and from the berths. Consultations with the local fishermen have significantly influenced the final location of the Marine Terminal based on efforts by NLRC to minimize interruption to local fishing activities. The layout and location has been reviewed by the Placentia Bay traffic committee and the Placentia Bay Pilots. Both groups have given favourable comments on the proposed location and layout.

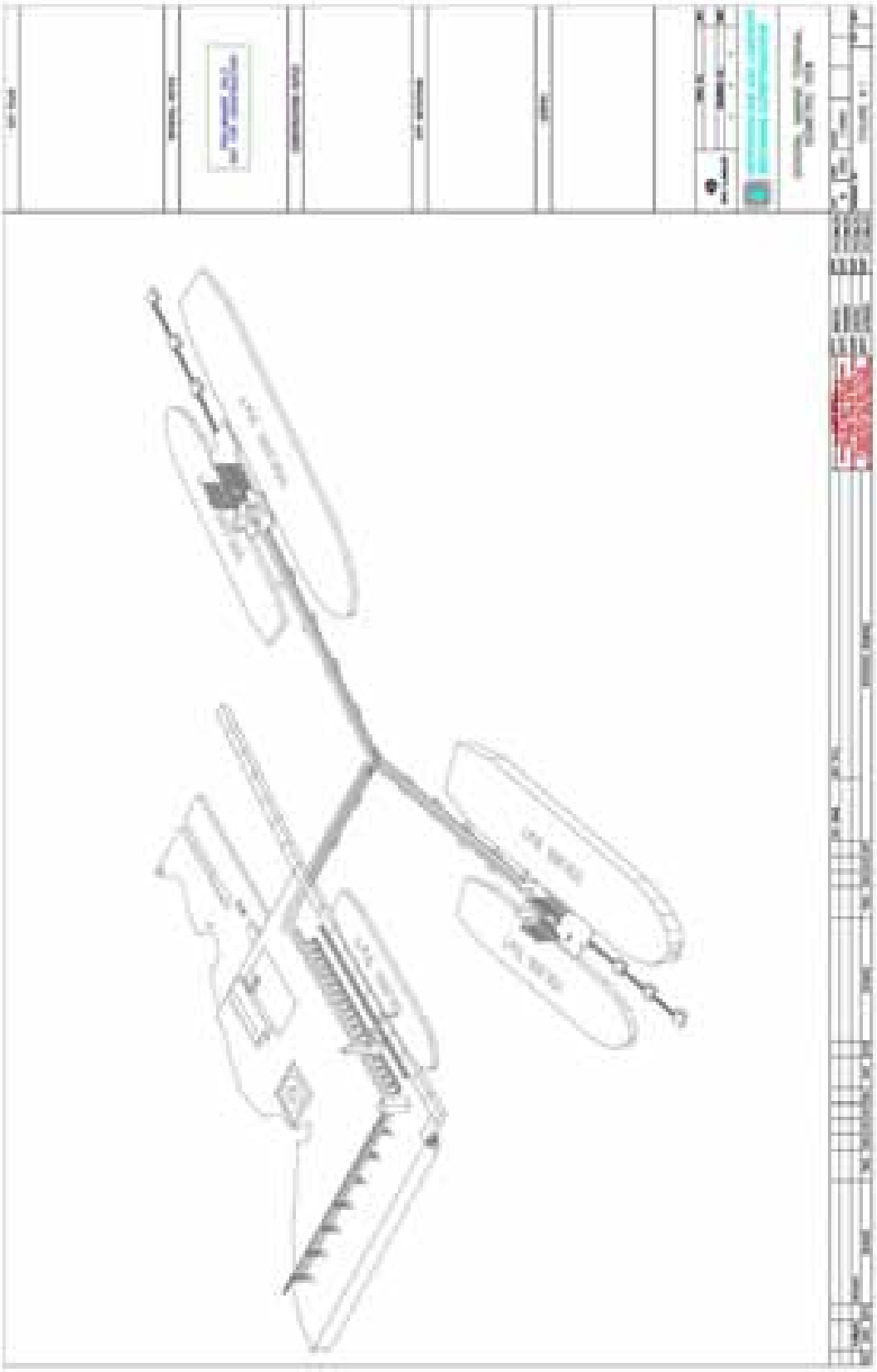

Figure 4.1 General Marine Terminal Isometric View

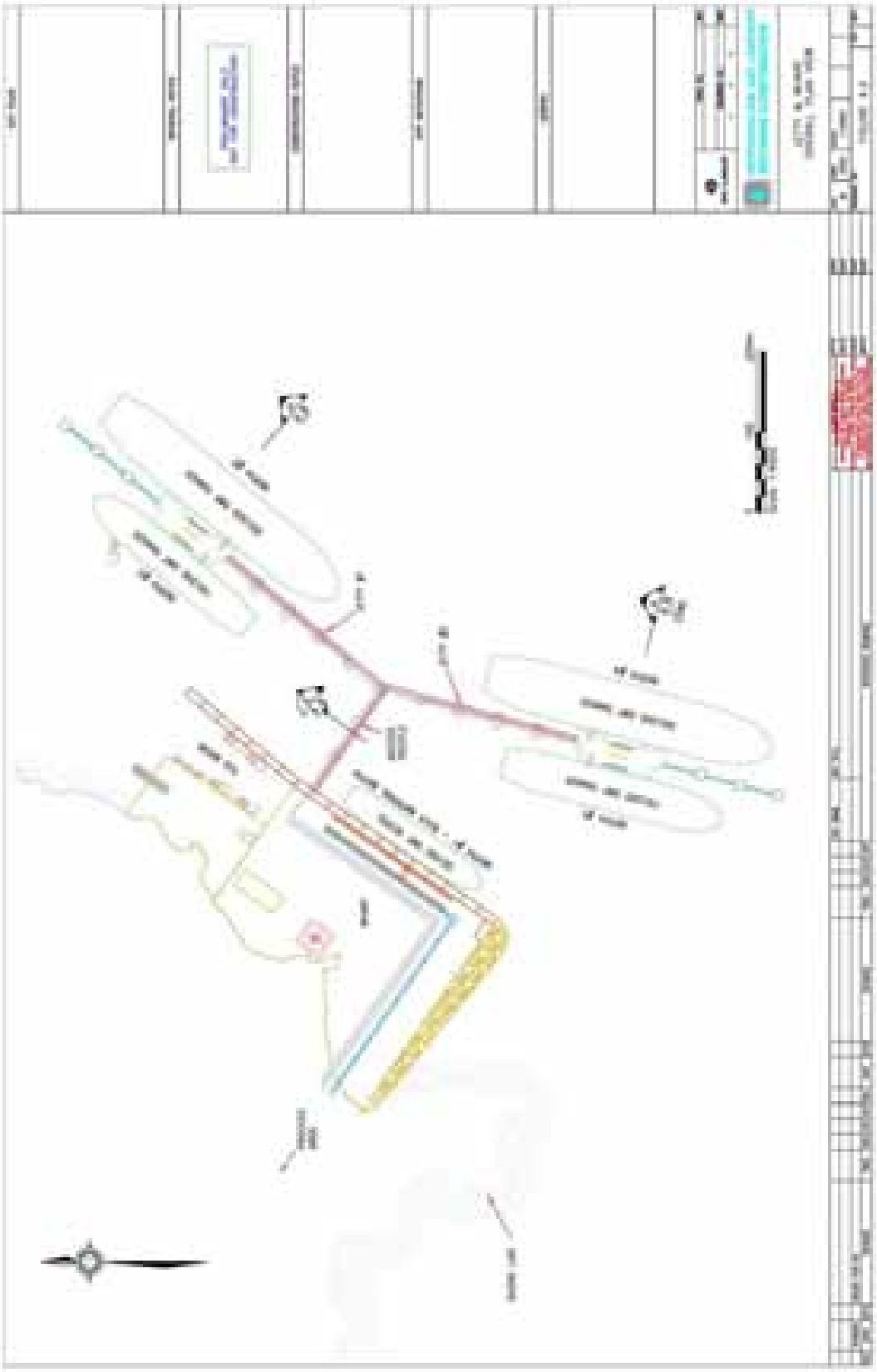

Figure 4.2 Jetty and Wharf Overall Plan View

4.1 Marine Wharf

The Marine Wharf facilities comprise all the land–based structures for the marine terminal and are shown in Figure 4.3 for wharf plan view and Figure 4.4 for wharf cross-section and equipment offloading. These facilities include a tug berth and construction dock, a dry product berth for loading petroleum coke and sulphur products, a small boat basin, central control building and emergency response warehouse. The marine wharf area will be constructed by infilling the existing marine area with rock fill from on–site excavations. The east side will be protected and supported with concrete caissons, sheet pile cells or sheet pile bulkhead walls. Armour stone similar to that used in the existing causeway at North Atlantic Refinery will be used as wave protection to the South (Figure 4.6).

4.1.1 Heavy Lift Construction Dock

The Heavy Lift Construction Dock will be incorporated into the Tug Berth/Small Boat Basin and will be designed to accept large pre-fabricated modules and construction supplies for the construction phase of the Project. Large deck, low draft barges will be used to transport construction supplies and large construction modules ranging in size from 100 to 5,000 tonnes. Most heavy packages (greater then 100 tonnes) will be transported with roll-on/roll-off barges via multi-wheeled transporters. Heavy packages can be rolled off the side or end of the barge depending on which direction is more advantageous for transport. Smaller packages can be handled by mobile cranes and placed into temporary storage areas on the wharf and from there transported to the main site.

4.1.2 Bulk Materials – Dry Products Berth

The southern portion of the marine wharf facilities will serve as a dry product berth for the export of sulphur and coke products. This berth will be capable of docking bulk carriers as large as 60,000 DWT and will have a minimum average water depth of 14 m at low normal tide. The berth will service the vessels via a dual stock traveling shiploader with interchangeable telescopic chutes. A closed dual conveyor system and reclaimer will feed the shiploader from the coke and sulphur storage areas. The closed conveyor will eliminate fugitive dust emissions from both products. Handling rates for the dry products will average 2,500 tonnes per hour. Figure 4.3 shows the bulk materials wharf plan view. Figure 4.4 shows a cross-section of the bulk material berth and materials handling system.

Figure 4.3 Marine Plan View

4.1.3 Tug Berth – Small Boat Basin

The tug berth is located on the north-eastern portion of the marine wharf facilities. Figure 4.5 shows the Tug Basin Plan View and Figure 4.6 shows the cross sections. The minimum depth at the berth will be 7 m at low normal tide. Berthing facilities will be provided for tugs sized to handle VLCC size tankers (350,000 DWT) in the sea conditions characteristic of Placentia Bay.

After the construction phase is completed, the area will mainly be used as a tug berth, but will also be used for general docking of barges for unloading of equipment or supplies as needed during operations. The tug berth will also be used during emergency response to launch and dock oil spill response vessels.

The northern portion of the tug berth will serve to dock small-sized watercraft (5 m – 15 m length). It will also be equipped with a concrete boat launch ramp for deploying spill response equipment in the event of an emergency. The ramp will also be capable of deploying small rescue craft.

4.1.4 Jetty Control Building and Emergency Response Warehouse

The Jetty Control Building and Emergency Response Warehouse will provide facilities to control all aspects of the marine terminal operations. It will contain a dedicated control centre to monitor all operational aspects, safety and security. Real-time video monitors will provide instant and close-up examination of conditions at critical locations in the terminal.

Control interfaces will monitor and control:

- Offloading of crude;
- Loading of fuel products, coke and sulphur;
- Monitoring environmental conditions such as wind and wave conditions;
- Monitor mooring line loads and mooring hooks;
- Gas detection devices;
- Fire control systems.

The control room will be staffed on a 24-hours/7 day a week basis. Strict access control to the marine facilities will be maintained as required by the new port security regulations (*Marine Security – International Ship and Port Facility Security Code (2004)*).

The building itself will be located near the middle of the wharf structure and will have office and warehouse facilities suitable for both regular operations of the marine terminal, as well as operation during emergency response conditions. The warehouse will provide storage for oil spill response equipment.

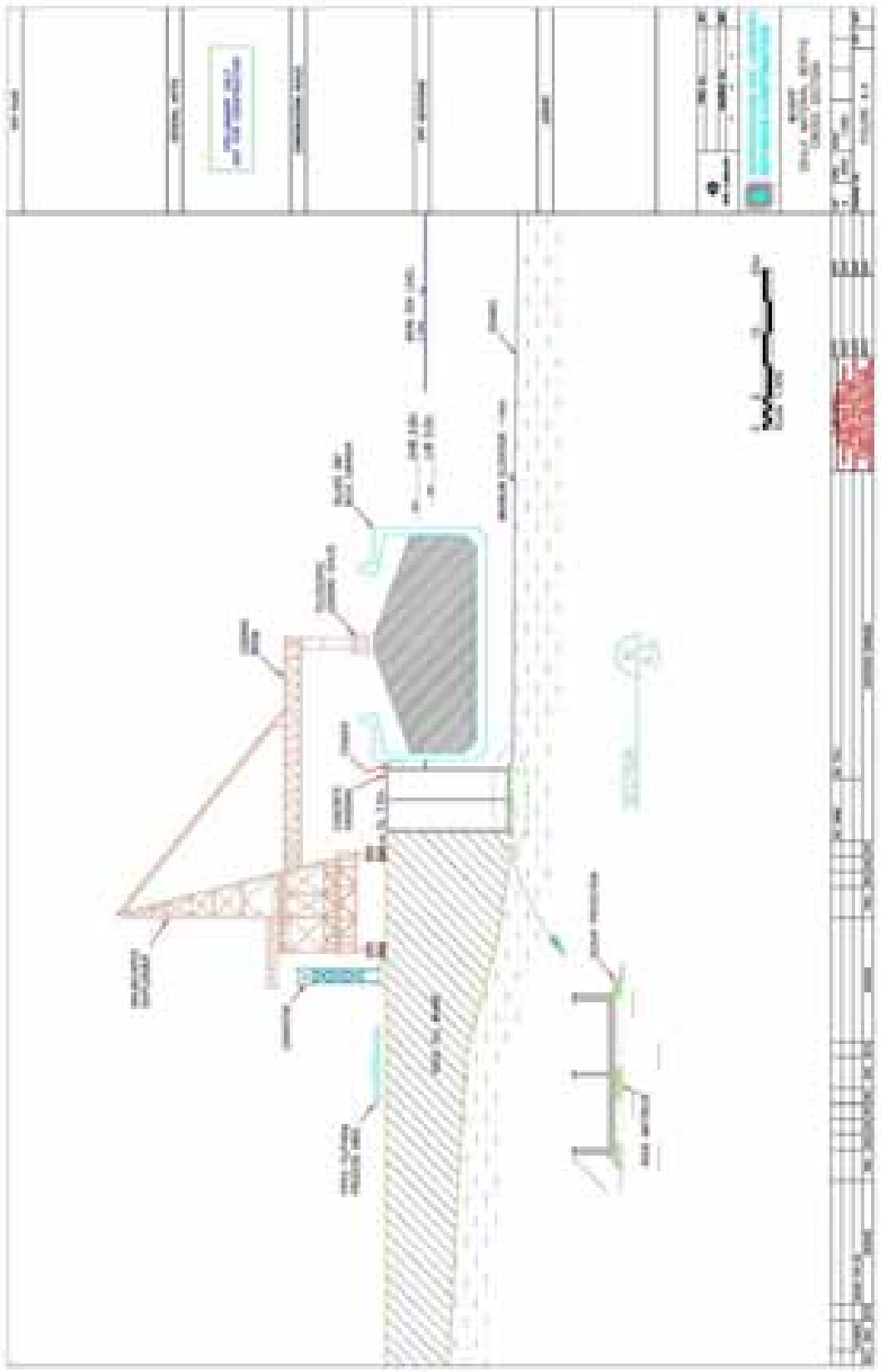

Figure 4.4 Wharf (Bulk Material Berth) Cross Section

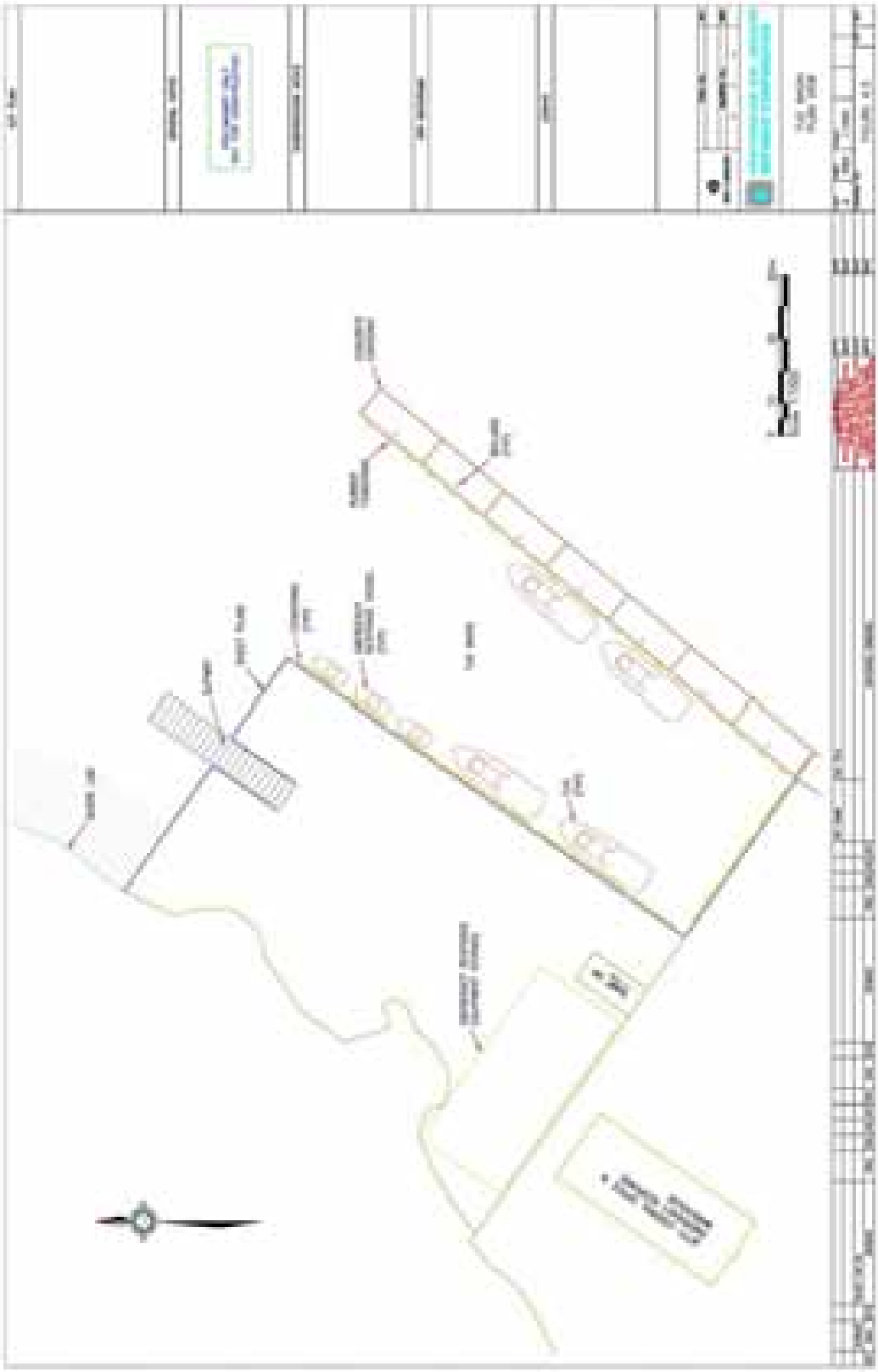

Figure 4.5 Tug Basin Plan View

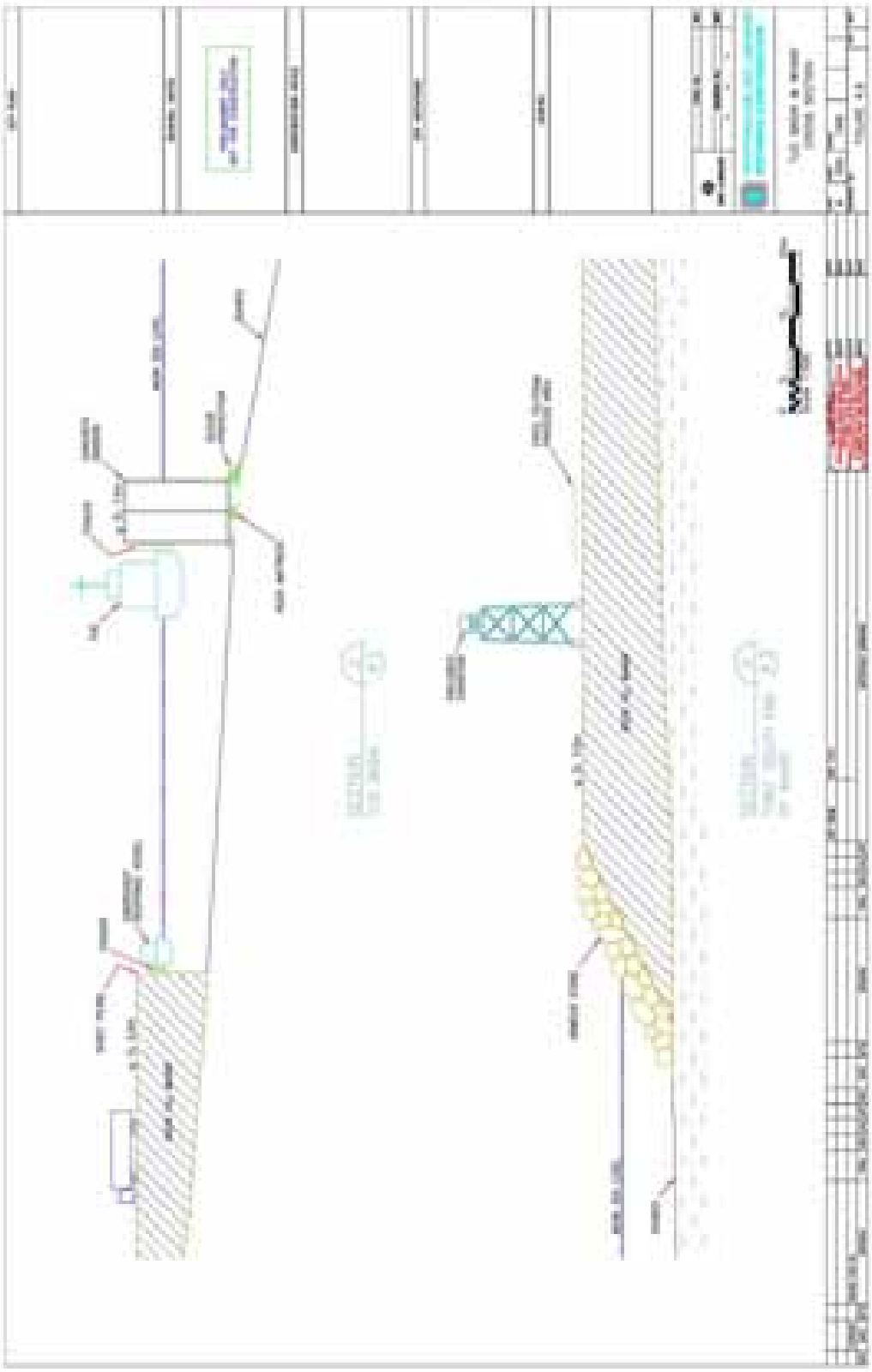

Figure 4.6 Tug Basin and Wharf Cross Section

4.2 Jetty and Offshore Berthing Facilities

The jetty and offshore berthing facilities portion of the marine terminal is located from 300 m to 400 m from shore and has a total length of approximately 800 m. The facility consists of two (2) offshore Jetties connected to the Marine Wharf area by an Access Trestle (Figure 4.2).

4.2.1 Access Trestle

The access trestle is approximately 100 m long and will form the link between the wharf facilities and the offshore berthing facilities. It will also be used for vehicle access during plant operation to access the jetty loading platforms for operations and maintenance as well as emergency response and firefighting. The access trestle carries the pipe racks for crude and refined products to and from the offshore berths and the refinery tank farm. A plan view of the Access Trestle is shown on Figure 4.2 and a typical cross-section is shown on Figure 4.9.

4.2.2 Jetties

There are two offshore Jetties, Jetty No.1 is located to the north of the marine facilities and Jetty No. 2 is located to the south. Figure 4.2 shows an overall plan view of the marine facilities. Figure 4.7 shows the plan view of Jetty No. 1. Figure 4.8 shows the jetty cross section and loading platform.

Jetty No. 1

Jetty No. 1 will be located in the north eastern corner of the marine facilities area. This jetty will be approximately 400 m long and have two vessel berths (Figures 4.7 and 4.8). The eastern or seaward berth will be designed to accommodate vessels ranging in size from 20,000 DWT up to 350,000 DWT (VLCC size tankers) will be used as a crude import and product export berth. This berth will have a minimum water depth of 34 m at low normal tide. The western or shore side berth will be designed to accommodate vessels ranging in size from 20,000 DWT up to 100,000 DWT and will primarily be used for the export of petroleum products. This berth will have a minimum water depth of 20 m at low normal tide. Both berths will have sufficient water depth for the largest design vessel when considering fully-loaded draft with wind, wave and tidal conditions at the site.

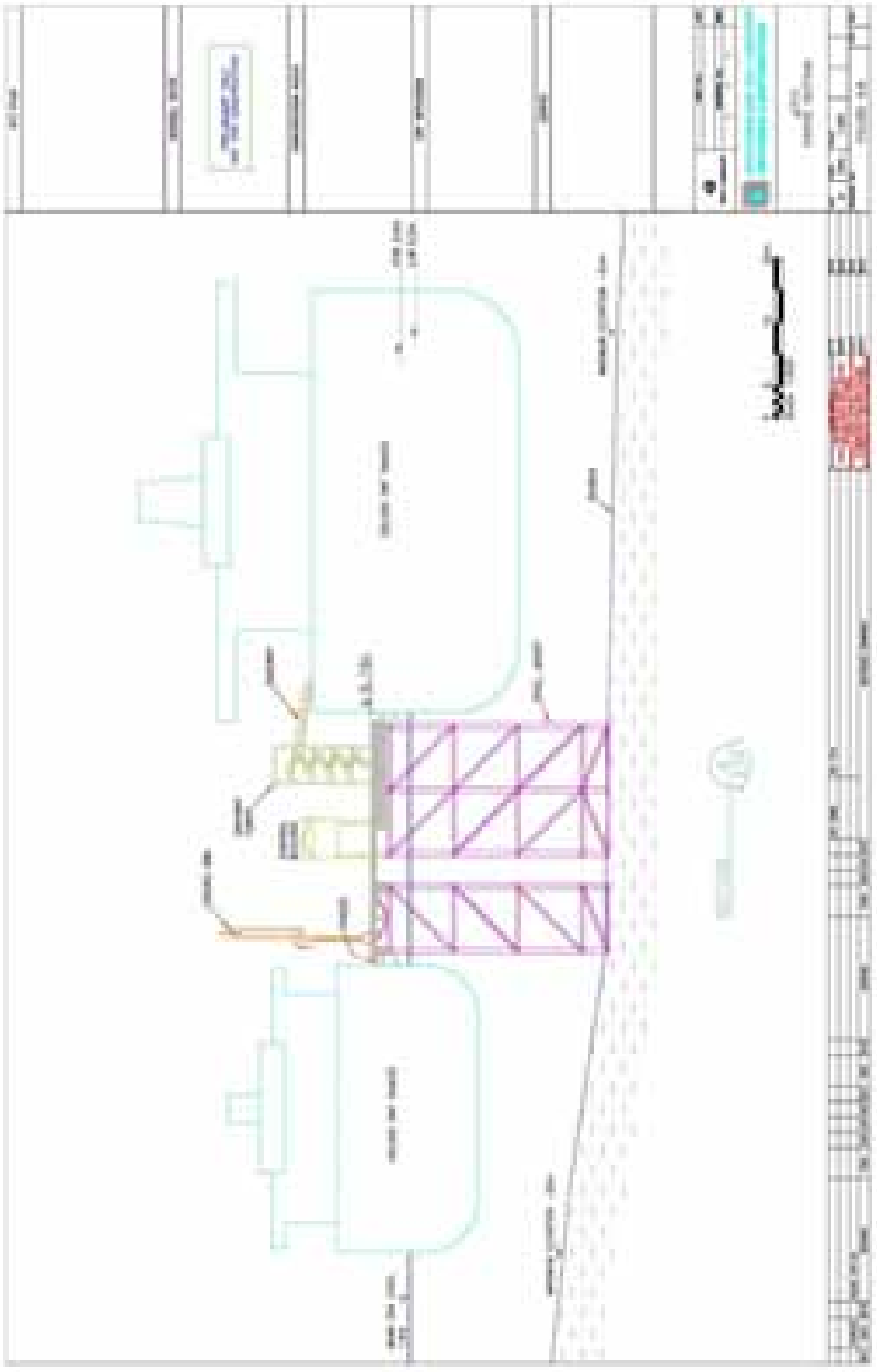

Figure 4.7 Jetty Layout Plan View

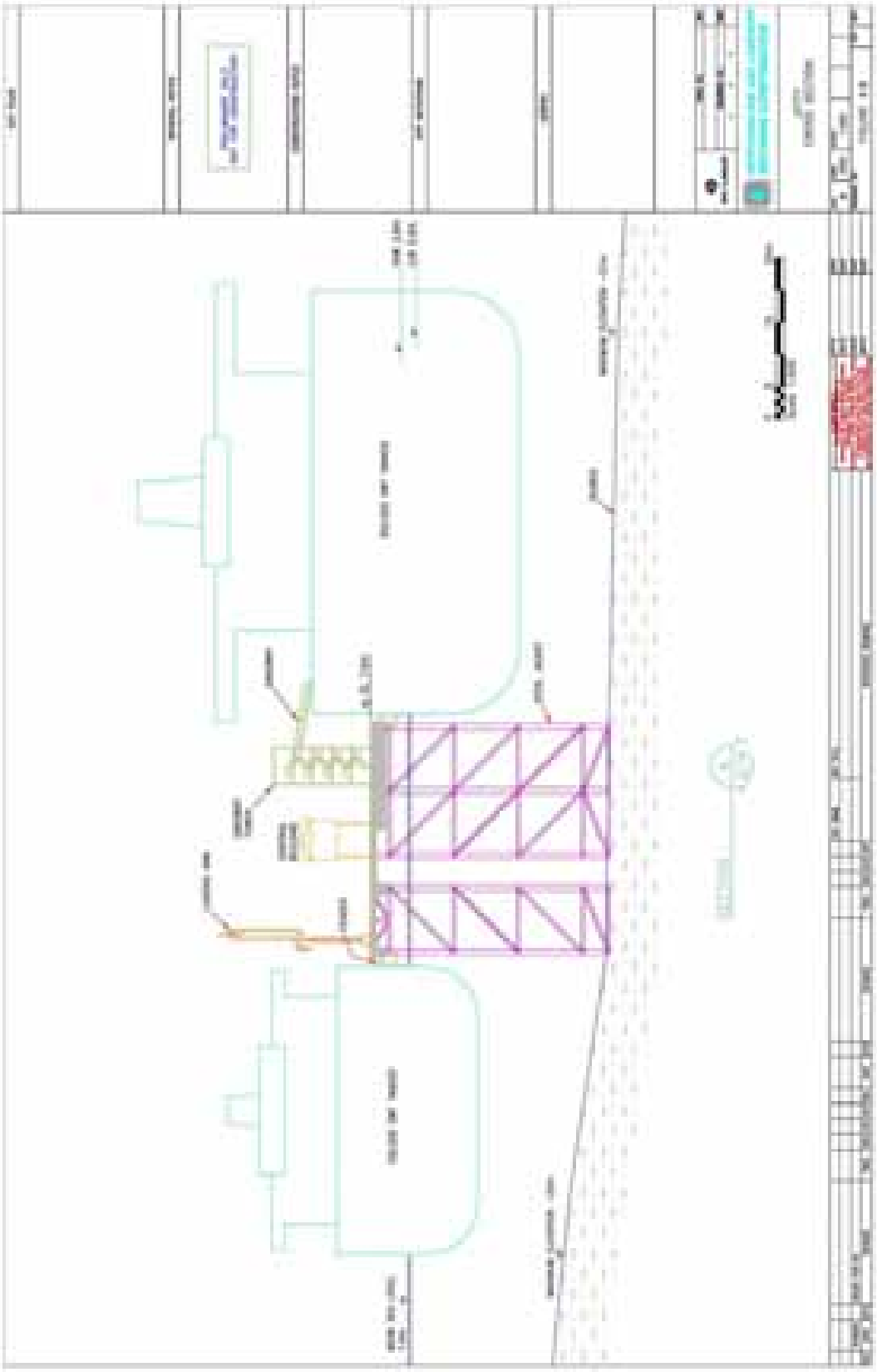

Figure 4.8 Jetty Cross Section

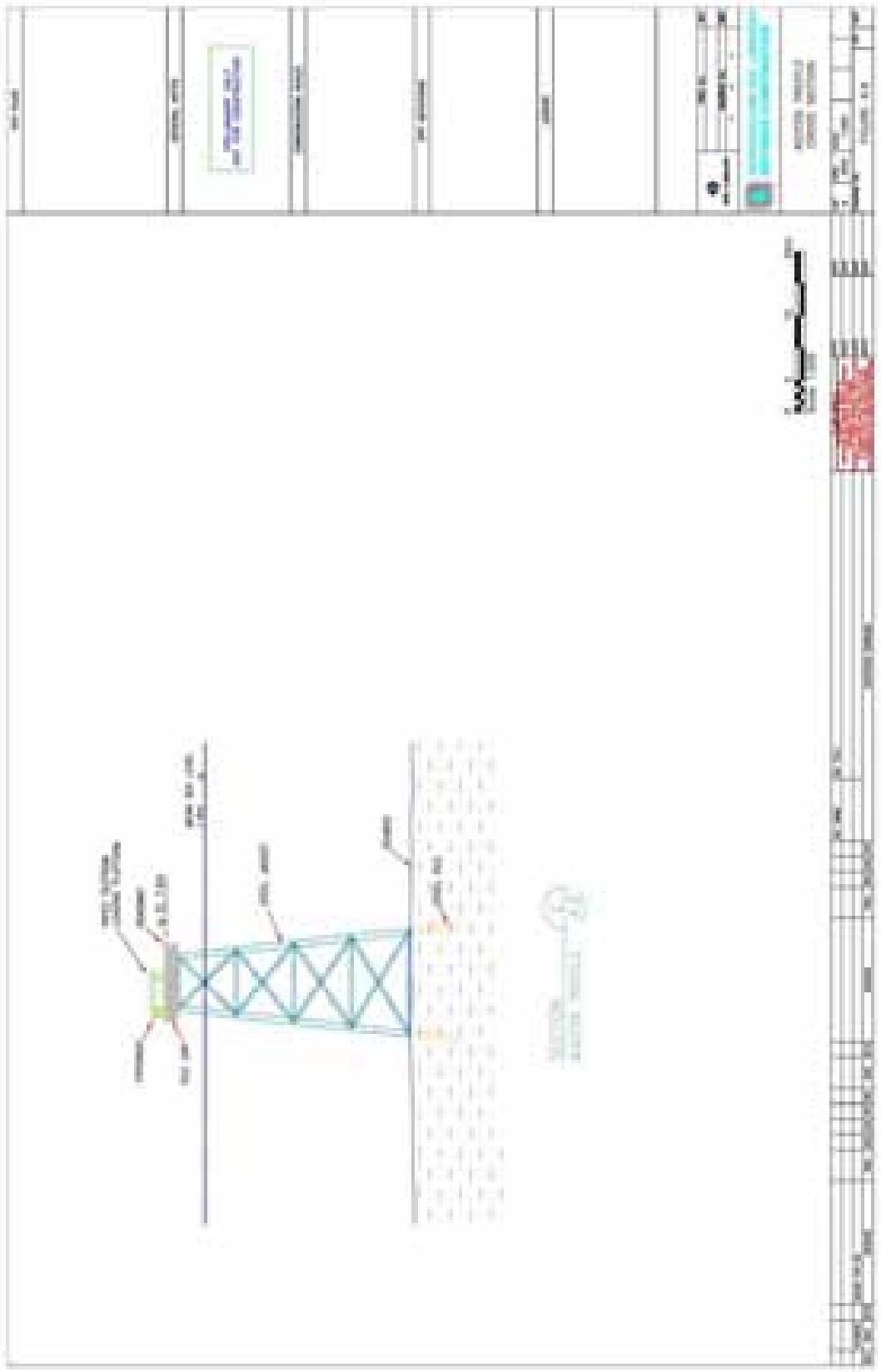

Figure 4.9 Access Trestle Cross Section

Jetty No. 2

Jetty No. 2 will be located in the south-eastern corner of the marine facilities. This jetty will be approximately 400 m long and will also have two vessel berths. The eastern or seaward berth will be designed to accommodate vessels ranging in size from 20,000 DWT up to 350,000 DWT (VLCC size tankers) and will be used as both a crude import and product export berth. This berth will have a minimum water depth of 32 m at low normal tide. The western or shore side berth will be designed to accommodate vessels ranging in size from 20,000 DWT up to 150,000 DWT (Suezmax) and will primarily be used for the export of petroleum products, but will also be capable of offloading crude from Suezmax size tankers. This berth will have a minimum water depth of 24 m at low normal tide. Both berths will have sufficient water depth for the largest design vessel when considering fully-loaded draft with wind, wave and tidal conditions at the site.

Layout of Jetty

Each marine jetty will include a loading platform incorporating fendering systems, mooring dolphins, and catwalks connecting the mooring and loading platform, a vessel access tower, and other dock structures. Other associated equipment will include the mooring system, cranes, utility and control shack, fire protection systems, spill prevention and containment equipment, and product piping systems.

Large rubber fenders will be mounted on the loading platform which forms the fender line, with which the moored ship will be in contact. The fender line is approximately 300 m to 400 m from the shore line. The loading platform is the larger rectangle in the centre of the berth that supports the loading arms, pumps and the utility and control shack. The smaller structures are mooring dolphins, which hold the mooring lines that secure the ship in place at the berth. Ships of various sizes will use the appropriate mooring dolphin to maintain the correct mooring line geometry at the berth.

All structures will be designed to withstand ship berthing loads (the loaded ship bumping the dock and the mooring lines pulling on the dock and mooring dolphins), wave loads, passing vessel loads and wind loads, all in accordance with recognized national and international standards for the design of marine terminals. The structures will be supported on steel piles or steel jackets complete with a corrosion protection system.

4.2.3 Vessel Loading/Off-loading

Specially designed vessel loading arms will be used to connect the vessel offloading manifold to the onshore piping systems. These marine loading arms are designed to operate within the full design range of vessel sizes and vessel movements at the berth. The range of motion of these arms is continuously monitored by sensors. If the vessel drifts outside the pre-determined design range of the arms, the sensors will engage the automatic shut–off valve built into the arm

and the transfer of crude or product stops. The arm automatically disconnects and prevents damage to either the arm or the vessel. The vessel loading and offloading systems will be designed to discharge tanker cargos quickly and efficiently, minimizing both vessel emissions and vessel time at berth. Offloading of crude will be accomplished through the import piping systems. Large diameter pipelines and transfer systems will allow tankers to achieve offload at rates up to 100,000 barrels per hour (BPH). The pipeline systems will be routed along the Jetty and access trestle, through the marine terminal to the new tank farm storage areas. Onboard ship pumps will pump the crude to the crude storage tanks. Product loading will be performed through the product export pipelines along a similar routing. Loading of the sulphur and coke materials will be carried out via a closed conveyor system to reduce fugitive dust emissions. The conveyor system will be connected to a ship loader on the berth. The ship loader will be designed for the full range of vessel sizes and motions at the bulk materials berth.

4.2.4 Marine Terminal Safety Features

The design of the marine terminal will incorporate state-of-the art technology. These technology enhancements provide a safe and efficient marine terminal. Some of the technology that will be incorporated is:

- Laser-assisted Berthing Aid System to facilitate a “soft landing” when the ship arrives at the berth;
- Real-time environmental monitoring of wind, current, waves, and water quality conditions. This process has already started with the incorporation of a new “Smart Bay Buoy” at the proposed Jetty site;
- Quick release hooks, which allow for the safe and timely release of the vessel’s mooring lines as the ship disembarks;
- Mooring load monitoring equipment, which senses the strain on the lines securing the ship and warns the terminal operators in advance of any impending problems;
- Two-stage alarm system to alert the operator to stop pumping when the unloading arms, or gangway, nears the limits of their reach, or when the mooring line loads near the limits of their capacity;
- Emergency Shutdown and Emergency Power System;
- Oil and chemical spill emergency response and clean-up equipment;
- A Fire protection system designed to supply water and foam to critical equipment will be installed in the loading areas;
- Control and monitoring systems, designed to graphically display the current status of all equipment to the facility operators, to alert the operators to potential problems so that they can take corrective actions should abnormal situations arise.

4.2.5 Marine Terminal Security

The Project will be designed to meet international, national, and industry standards for marine oil product terminal security requirements. Transport Canada and the Canadian Coast Guard are the primary regulatory authority over the security design and operational parameters of Liquid Bulk Terminals. Also ports shipping product into the US must comply with US Homeland Security requirements.

4.2.6 Oil Handling Facility

The new marine terminal will meet the criteria for designation as an Oil Handling Facility under the *Canada Shipping Act*. As such, oil spill prevention and oil spill preparedness/response plans will be developed, meeting or exceeding the requirements of regulations. The Proponent recognizes the importance of the traditional uses of the coast and waters of Placentia Bay and is aware that fishers in the area have been trained in spill response. The Proponent will ensure these plans are developed in consultation with fishers and other residents.

5.0 CONSTRUCTION AND SITE PREPARATION

5.1 Construction Schedule

Pre-construction activities will commence immediately upon receipt of the environmental approvals and necessary permits. Clearing and grubbing of the access road and site would begin as soon as possible. Other early site preparation activities include leveling/in-filling and installation of temporary offices with associated services (power, potable water cooler/storage systems, temporary sanitary facilities) will commence as soon as the access road is completed sufficiently for equipment and personnel to access the site. For the duration of construction of the access roads and process area, work will be adjacent to watercourses. The temporary power supply will be constructed starting in 2008 and be completed by the end of that year. The permanent power supply installation will commence in 2009 and be completed by the end of 2010.

Construction of the refinery and associated utilities and support systems is proposed to begin in January 2008 and is expected to be complete within three and a half years from the start. Construction of the marine terminal will also occur during this time frame. Commissioning will take place unit by unit as the facility is completed and will take approximately six months. It is anticipated that the first shipments of crude will be loaded before the end of 2011 (Figure 5.1).

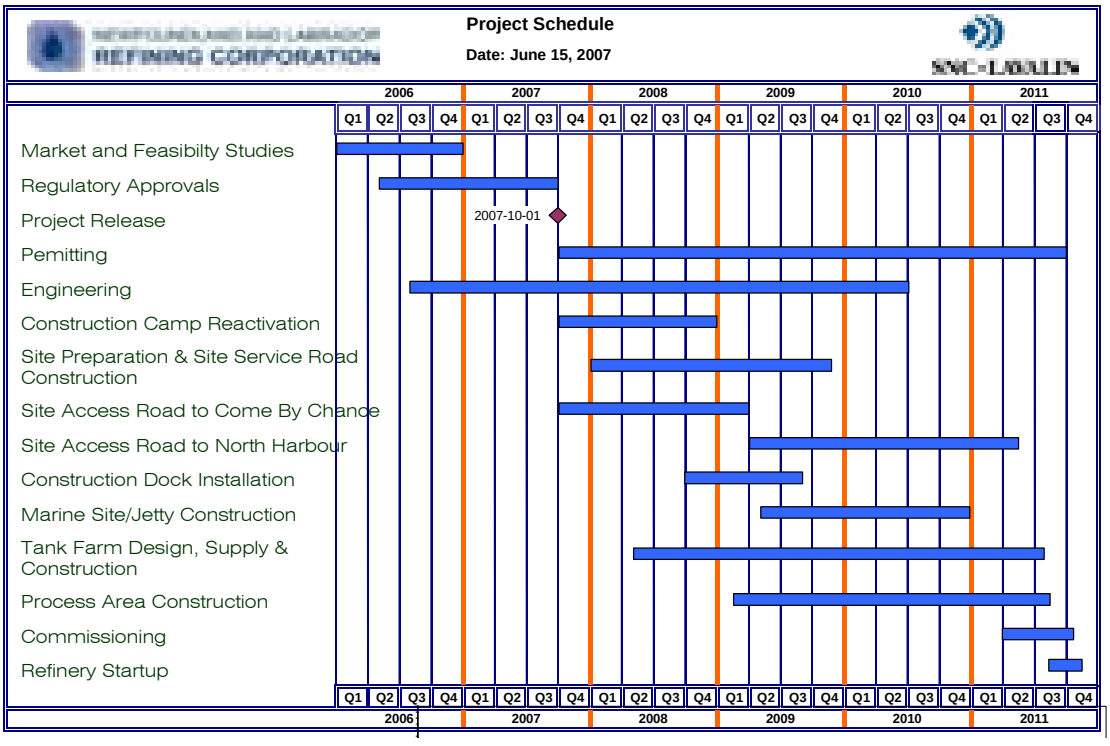

Figure 5.1 Project Schedule

5.2 General Construction Practices

Well established approved construction methods and practices will be used throughout the construction of the project components. Before any construction commences, a detailed construction methodology will be developed specific to the activities to be undertaken. This methodology will focus on minimizing the impact of construction procedures. An Environmental Protection Plan (EPP) for construction will be developed at an early stage of the Project. "EPP notation" will be included on the drawings, highlighting important environmental protection measures relevant to given construction activity (i.e. buffer zones, stream crossings, etc.).

Excavated surfaces during construction that are at risk for erosion will be protected by using adequate slopes to minimize slumping. After precipitation events, slopes will be inspected for erosion and immediate steps taken to restore slopes and correct any slumping to ensure that soils and other excavated material do not get carried into surrounding water bodies. Slopes for finished-grade surfaces will be in accordance with the recommendations of geotechnical specialists and will be surface-finished accordingly to provide long-term stability.

Dewatering of the site will be undertaken in accordance with approved practices and with the objective of preventing drainage-related issues in the area surrounding the site. Protective measures such as silt screening will be used to prevent silt from precipitation runoff from progressing to the surrounding area. Pumps may be used to assist with dewatering and will be used in such a manner as to prevent the passage of silted water into the surrounding area. Where pumps are used, backup capacity will be available in the event of a failure to provide secure control of the water flow. Surface water will be inhibited from entering the work site by using perimeter ditching to redirect the flow. Velocity controls such as check dams will be used to assist in the removal of sediment that may be in that drainage water. Surface water from the site will be directed to one or more settling ponds that will be constructed to remove silt and turbidity prior to discharge back into the surrounding environment. The water will be evaluated for compliance with the Provincial Environmental Control Water and Sewage Regulations prior to discharge.

Dust generated during construction will be controlled using one or more conventional measures as applicable to the particular location, including water spraying, wind breaks, spray-on adhesives and vegetative coverings. Chemical-based solutions will not be used or applied near water bodies.

Buildings, tanks and process facilities that have either heavy loading or vibratory foundations will be founded on bedrock, where required. Conventional shallow foundations and footings will be designed and constructed for conventional building requirements.

To protect watercourses and water bodies around the project site, concrete used will be prohibited from contact with the water until it has adequately cured. No tools or equipment used

in the production or placement of concrete will be washed in or adjacent to any water body. Formwork and procedures for concrete placement will be such that they will prevent spillage into any water body. Water course crossing (by bridge or culvert) will be in accordance with permit requirements. Fish bearing streams will be crossed in accordance with DFO guidelines and standards.

During the construction period, all activities will comply with the Construction Environmental Protection Plan (EPP). All contractors will provide Environment, Health and Safety staff at the site to ensure that project activities are conducted in accordance with the EPP. All required permits from regulatory agencies will be obtained prior to the start of any construction. Emergency response to oil or chemical spill procedures and clean up will be in accordance with Emergency Response Plan (ERP) approved by DOEC.

A large berm will be constructed at the south end of the project site to form a visual barrier. The berm will be used as a disposal area for organic soil, slash, grubbing and wood fiber. The berm will planted with natural folage so that it will blend into the landscape.

5.3 Construction Camp and Laydown Areas

The construction camp for the project is proposed as the former Bull Arm construction-site. Major infrastructure required to accommodate a large construction workforce is already in place, and the site is conveniently located near the Project site. As the camp has been dormant for several years, however, the site will require recommissioning of the utilities systems and installation of new accommodations trailer facilities.

Water and wastewater treatment systems are in place at the Bull Arm campsite and would be available for use. Solid waste will be removed from site and disposed at an existing landfill by a certified waste management company. An emphasis will be placed on opportunities for reduction, reuse and recycling of waste materials during all phases of the project. Any procedures or strategies for management of solid waste will be in accordance with the new Provincial waste management strategy.

At the construction-site, temporary facilities for day-to-day operations will be provided. This includes portable trailers for worker breaks during shifts. Portable toilets will be supplied at each work site for the convenience of construction staff. Fuel for site operations will be delivered to temporary/portable fuel storage facilities to be removed upon completion of construction, and will be distributed throughout the project work areas using tanker trucks.

Sewage and waste materials generated at the site will be routinely removed for treatment and disposal. No specific treatment or disposal facilities will be provided at the project site.

At the Project site, laydown areas will be required for the intermediary storage of equipment and materials, and for some fabrication procedures. To make the most efficient use of the laydown

area, it will be placed in the footprint of an anticipated future phase of the project immediately adjacent to the process area. This laydown area will serve another purpose in that it will become a valuable deposition-site for excess granular and till materials that must be removed from the main project site. The use of the excess excavated material from the project site eliminates the requirement to find a disposal site for excess material and transportation is minimized.

5.4 Borrow Pits and Quarries

The large footprint of the project site lends itself to providing a significant portion of the borrow materials required for use in construction. Several deposits were found in the project footprint and will be used for site construction operations. Marine sediment deposits were found in the area of the proposed crude tank farm as well as at the jetty site. These deposits contain a combination of sand and gravel that can be used for site grading. Additional sources of this type of material may be exposed at the site once construction commences. Deposits of glacial till have been identified along the proposed access road route to Come By Chance. This material is suitable for general backfill of site works. Rock outcrops throughout the site will be excavated and prepared for site backfill. Clean, well graded gravels will be stockpiled and used for river encasement, as required.

Engineered fill required for both the access road and the Project site will originate from cut/fill operations. Crushers will be used to crush the excavated rock into required dimensions. Supplemental granular material for road construction or concrete production will be obtained from existing quarries in the project area.

All surficial root mat, topsoil, grubbing, peat, and weathered glacial till will be to removed prior to the cut/fill operation. Unsuitable material (USM) will be placed on the south east edge of the project site to provide a berm to act as a visual screen of the project area from the shoreline. Organic material will be stockpiled in the same area. This stockpile will be used for surface preparation of the berm and other areas to be revegetated.

5.5 Excavations and Blasting Operations

The project footprint occupies an area that has a grade variation of approximately 52 m from the lowest valley to the highest peak. For effective construction of the project elements, the project site will require excavation to balance out the low and high areas to make a surface suitable for construction and operations. The types of vehicles to be used to mobilize materials, equipment and modules to be installed at the project site have maximum gradients over which they can travel; the grading for the site will be stipulated by the usage requirements. Excavation procedures will be required to redistribute rock and engineered fill over the Project area.

Standard earthmoving procedures will be employed at the site (in accordance with the EPP for construction), including drilling and blasting, mechanical busting and mechanical excavation. A

large portion of the material to be moved on the site consists of rock. There are lesser amounts of till and USM that also need to be excavated. The rock is typically hard, sound sandstone that will require blasting and mechanical impact to free it for excavation. Till and USM can be excavated using conventional mechanical means including excavators, loaders and dozers.

Blasting operations are only required during the site work phase of the project and will not be required for any operational phase after construction is complete. Blasting will be undertaken only by contractors licensed to do so. They will be responsible for maintaining current permitting with the regulatory agencies for the duration of construction. Explosives and auxiliary materials will be stored by the contractor as stipulated in relevant legislation and in compliance with the operations permit.

Blasting will be undertaken in such a manner as to make secure any elements and features, designated to remain. Overblasting will not be permitted. In order to minimize the seismic impact, blasting patterns and procedures will be used to reduce the shock wave and noise. Blasting activities will be co-ordinated and scheduled to minimize the number of blasts required per week. Time-delay blasting may be used as necessary to control the debris scatter. Prior to any blast, the site will be surveyed to identify the presence of any sensitive animals (Black bear, Caribou, etc.). Presence of such animals will result in delay or cancellation of the blast until such time that the sensitive animals are no longer present.

Blasting will not be undertaken in marine areas. Any areas where rock has to be moved, specifically for the intake and outfall areas, will be conducted using rock-splitting mortars. This excavation is undertaken by drilling a pattern of holes into the rock during low-tide. These holes are then packed with an expansive mortar that works over a period of several hours to overcome the internal forces of the rock and allow it to break into manageable fragments that can then be mechanically removed from the rock face. This work will be limited to a defined trench that will contain the intake and outfall piping for the site. Contractors will be required to minimize the footprint of the excavation to the minimum required for the pipe installation. Depth of the excavation will be restricted to a maximum of 5 m from low normal tide to the crown of the pipe being installed. Rehabilitation of the marine subgrade will be such that the surface of the trench will be infilled to match the existing grade and native substrate will be replaced to match the surrounding conditions. The resulting visual effect of the competed underwater excavation for pipe trenches should not be noticeable upon completion of the backfilling operations.

5.6 Vehicles and Hours of Operation

During early construction, loaders, both tracked and wheeled as required, and excavators will be used for excavating USM, topsoil, till, and granular material and loading this material into haulage trucks. Drill rigs and related blasting equipment will be used to prepare bedrock for excavation. Crushing equipment will be used to generate required grades of engineered material from excavated rock. Material transport will be accomplished using large haulage

trucks, primarily 40-tonne capacity and smaller as required. Haulage trucks used at the site and for access road construction will consist mainly of off-road vehicles. Upon completion of the main access road, only highway standard vehicles will be used for transportation to and from the Project area.

Conventional fuel transport vehicles will be used to deliver fuel from the temporary on-site storage to the vehicles and equipment at worksites throughout the project area. Fuel will be routinely delivered to site by typical truck tankers.

Upon completion of the major earthworks, process equipment and tank materials will be received at the marine site and moved throughout the project area to the appropriate locations using self-propelled modular transporters (hydraulic multi-wheeled vehicles). These vehicles are designed for loads over 2,000 tons and have extreme steering angles (>60°) that can provide safe manoeuvrability in confined areas.

Site preparation for refinery equipment installation and building construction will involve the use of compaction equipment including conventional and vibratory rollers. Final site levelling, and service and access road levelling will be done using graders. Concrete trucks will be used to transport concrete for use on the project site. Cranes will be used throughout the project site for assembling project components. Cranes may be barge mounted to be used at the marine site for construction of the jetty and for delivery of equipment.

Service roads will be maintained throughout construction using excavators and graders. Water trucks for dust control will also be used. Trucks with flatbed trailers will be used to float heavy equipment to and from site along the main access road to Come By Chance.

Construction at the site will take place in two shifts per day. Consequently, construction vehicles could be operated 24 hours a day. To minimize project-related traffic on the TCH, wherever possible the delivery of materials and equipment coming overland will be distributed over the course of the construction phase of the project. Personnel will be transported to, from and around the site using passenger vehicles including light-duty trucks, vans, and buses.

5.7 Vessel Traffic

Vessel traffic during construction will consist of barges and tugs for the construction of the marine facilities and ocean-going barges and tugs for the transportation of construction equipment and supplies to the refinery construction site. Heavy lift vessels will be used for some of the larger modules and process vessels and towers, particularly if they are being transported on the high seas.

All vessels will meet Transport Canada regulations and standards, under the Canada Shipping Act, as well as international regulations established by the International Maritime Organization (IMO). Barges will be inspected and approved for use by a recognized classification society

such as DNV, Lloyds or ABS. The project will retain the services of a Marine Warranty surveyor to verify that transportation procedures that are put into place for safe vessel operation and transportation of goods and materials to site are followed. Sea fastening of cargo will be designed to meet all requirements and follow recommended practice.

5.8 Water Body Alteration

On a project of this magnitude, there are water bodies that will be impacted by the construction. However, only those water bodies that are in the immediate project footprint will be disturbed. Water bodies outside the project footprint will have a minimum 15 m buffer zone as required by the regulatory agencies to preserve the shoreline.

Where water bodies will be impacted by the construction, it is expected that they will be effectively removed from site and will not exist in the project area upon completion of construction. Those water bodies will be electrofished to remove any fish present prior to the start of any construction. Those fish will be relocated to an area of similar habitat that will remain unaltered. The water body will then be dewatered in a manner to prevent siltation, incorporating silt control measures as previously identified in section 5.2. Unusable material from the drained water body will be excavated and removed to the USM waste site previously described. Earthmoving operations will then commence in accordance with the grading plan for the respective area.

5.9 Stream Crossings

Crossing of streams will be required for the construction of site roads and project infrastructure. Culverts will be installed at stream crossing locations on the site access roads. Bridge structures will be required for more substantial rivers (fish habitat) including Come By Chance River, Watson's Brook, and North Harbour River. All stream crossings will be constructed in accordance with the procedures outlined in the Environmental Protection Plan and will meet or exceed the requirements of the Department of Environment and Conservation, the Department of Fisheries and Oceans and Transport Canada pursuant to the Navigable Waters Protection Act. Consultations with local conservation and stewardship interests will also be undertaken prior to this work.

Alignment of culverts will be such that the original direction of stream flow is not significantly altered. Where possible, crossing infrastructure will be installed at right angles to the stream to minimize the crossing length. Approaches to all stream crossings will be constructed with erosion resistant materials such as rock or clean gravel. Any materials placed in the stream to improve the crossing will be clean, non-erodable, and non-toxic to aquatic life.

Where streams are deemed to be fish habitat, culvert installations will be designed to allow the passage of fish and to preserve habitat. Cylindrical culverts will be countersunk below the streambeds so that there is sufficient depth of water for fish passage. This will be accomplished

in multiple culvert installations by installing one culvert at a lower elevation than the others. For larger or more sensitive crossings, appropriate structures will be installed to preserve the natural substrate for resident fish populations. The stipulations of the Department of Fisheries and Oceans will be incorporated as required during design and construction as will the input of conservation and stewardship interests.

Electrical power lines for the project site will be accessed for construction wherever possible from access roads and service roads. Where this is not practical, watercourses may be forded for temporary access only for pole and cable installation. The immediate area will be stabilized by the use of brush mats, corduroy, or coarse clean gravel fill. When fording any watercourse, the *Environmental Guidelines for Fording* as published by the Newfoundland and Labrador Department of Environment and Conservation, Water Resources Division, will be applied.

5.10 Use and Transport of Hazardous Materials

During construction of this project, a variety of other potentially hazardous materials will be used. Equipment and vehicles used during construction will require fuels and other materials for routine operation and maintenance. Potentially hazardous materials that will be used on the project site include the following:

- Propane;
- Gasoline;
- Diesel fuel;
- Grease;
- Lubricants;
- Engine oil;
- Hydraulic fluids;
- Oxygen and other compressed gases;
- Acetylene;
- Form oil;
- Paints and coatings;
- Epoxies;
- Concrete additives;
- Glycol/methanol;
- Cleaners;
- Solvents;
- Explosives;
- Blasting Caps;
- Detonators;

- Liquid Asphalt/tars;
- Sodium Hypochlorite;
- Sodium Thiosulphate;
- Batteries.

Temporary facilities will be built for the construction period to provide storage for these materials and to provide areas for equipment servicing to control waste hazardous materials. The location of hazardous materials storage will be identified on a construction drawing to provide current information to workers present at the site.

Bulk storage of hazardous materials to be used in significant volumes will be in above ground, self-dyked storage tanks. Materials requiring less substantial volumes will be stored in drums with secondary containment as required specifically for the product. Only those persons trained in safe materials handling practices will handle hazardous materials. All product storage tanks and drum areas will be clearly marked as to content and will be located with markers to prevent accidental vehicular damage, especially where weather conditions can impede visibility. Appropriate firefighting equipment shall be present at materials storage facilities.

All fuel storage facilities will be registered with the Provincial Department of Government Services in accordance with the *Storage and Handling of Gasoline and Associated Products Regulations* under *The Environment Act.* Fuel storage logs will be maintained at the site in the office of the construction manager.

All materials will be inventoried and monitored, and the inventory will be updated as the project progresses to add or remove materials as required. Workers will be advised of the hazardous materials that will be used or be present during construction in accordance with the *Workplace Hazardous Materials Information System (WHMIS) Regulations* under the *Workplace Health and Safety Act of the Province of Newfoundland and Labrador*.

All transportation and handling of hazardous materials will be accordance with the requirements of the *Transportation of Dangerous Goods Act (TDG*). All commercial vehicles will be inspected and evaluated to ensure compliance with the placard standards in the Act and Regulations. Appropriate documentation must be in place with commercial transporters in accordance with the materials being transported and the required transportation procedures. Drivers of such vehicles must show certification of training in the transportation of dangerous goods as required under the TDG Act. Site personnel responsible for security, those responsible for subsequent handling of hazardous materials and site construction supervisors will be trained in the provisions and requirements of the TDG Act.

Management of waste materials and contaminated materials is addressed in the sections pertaining to construction waste handling (in accordance with the Waste Management Plan for construction).

5.11 Waste Handling and Disposal Sites

Wastes generated during all project phases will be handled, stored, transported and disposed of in accordance with all applicable acts, regulations and guidelines. Wastes will be source separated to facilitate reuse and recycling of materials. The migration of wastes from the site will be prevented by ensuring that all wastes are collected and properly contained. Hazardous wastes will be stored in appropriately labelled containers and transferred to disposal offsite by approved contractors. Domestic type wastes, including food waste and sewage sludges, will be stored so that animals (including insects) are not attracted to the site. Wastes that may cause leachate will be stored on an impermeable pad and within a structure that prevents the entrance of precipitation and runoff. Odorous wastes will be treated and stored so that odour problems are prevented. Wastes that cannot be reused or recycled on-site, will be transported by approved contractors to approved waste management facilities off-site. Removal of waste materials will be done on a regular basis to prevent the accumulation of refuse and recyclable material at the project site. Wastes will not enter or come in contact with watercourses or wetlands.

5.12 Temporary Sewage Facilities

Sewage generated during site preparation and construction will be collected and transported off-site for treatment and disposal. Portable washrooms and toilets will be used on-site until permanent facilities are completed. Permanent sewage systems will be installed and maintained to prevent the release of hazardous substances, pathogens and excess nutrients to the environment. All sewage and other wastewaters will be adequately treated prior to release to the environment.

Sewage will be managed in accordance with all applicable legislation and guidelines throughout all phases of the project. All sewage facilities will be designed, constructed and operated following the Provincial *Guidelines for the Design, Construction and Operation of Water and Sewerage Systems* (2005). Facilities will be permitted as required by Section 38 of the *Water Resources Act*. Discharge effluent from the Project works will be in accordance with the requirements of the *Environmental Control Water and Sewage Regulations of the Water Resources Act.*

5.13 Removal of Temporary Operations

Temporary facilities required for construction will be removed upon the completion of the Project. Portable trailers for office space and for use by workers for shelter and dining will be removed from service and relocated by contractors for reuse at other project sites. Portable water supply equipment and portable sanitary toilets will be removed from service and relocated to other project sites by the respective contractors.

Temporary oil and fuel storage tanks will be decommissioned and relocated for use at other project sites. All product and vapours will be removed from the storage tanks, which will then be dismantled and removed from site by the supplier/contractor. Any contaminated material under or around the tanks will be excavated and removed for treatment and disposal. The site will then be returned to a condition acceptable to the Department of Environment and Conservation. This will be done in accordance with the *Storage and Handling of Gasoline and Associated Products Regulations* under the provincial *Environmental Protection Act*.

All construction equipment will be demobilized and removed from site by the respective contractors for storage or reuse on other projects.

5.14 Site Rehabilitation and Monitoring

Project construction will result in impacts of varying degree and duration. Construction-related impacts will be addressed in the *Environmental Protection Plan (EPP)* for the construction phase, which will cover matters such as erosion and sedimentation control, site water control, temporary watercourse crossing procedures, emergency spill response, vehicle fuelling and maintenance, vehicle cleaning, waste collection and fire prevention, among others. Implementation of the measures covered in the EPP is expected to minimize or eliminate avoidable impacts, while reducing the risk of accidental impacts.

The majority of unavoidable construction-related impacts are expected to be temporary in nature and minor in terms of degree or significance of impacts. However, a number of construction activities (e.g., removal of small ponds and excavation and levelling of the site) will result in permanent impacts. These permanent changes to the site will be made in such a way to mitigate the impacts on the surrounding area; the extent of the mitigation measures will depend on-site conditions and design considerations.

Construction-related impacts that may require post-construction rehabilitation include:

- Temporary installations;
- Soil erosion;
- Slope stability;
- Mired areas due to operation of wheeled or tracked vehicles;
- Alteration of natural surface drainage;
- Clearing or physical disturbance of vegetation;
- Dust accumulation on foliage;
- Releases of hydrocarbons or substances of environmental concern (e.g., fuel, lubricants, hydraulic fluid).

Proposed rehabilitation and monitoring requirements for each of these potential impacts are outlined below.

5.14.1 Rehabilitation

Temporary Installations

Construction machinery and temporary structures that are not intended for long-term use during the operational phase of the refinery will be removed from the project site following completion of construction. Temporary structures and equipment that are suitable for continued use on-site, will be moved to a permanent location. Construction laydown areas will be selected within the boundaries of the permanent refinery site where possible; laydown areas outside the permanent site will be assessed to identify applicable rehabilitation measures. Temporary waste handling, storage and other facilities will be converted for permanent use or decommissioned. Exposed soil areas will be revegetated as outlined below.

Soil Erosion

Temporary erosion and sedimentation control measures will be installed and maintained by the contractor throughout the construction phase. These measures will remain in place and continue to be maintained following completion of the construction phase; they may be removed once the adjacent areas are stabilized.

Upon completion of the construction phase, a detailed inspection of the site will be performed by a qualified professional with demonstrable experience in erosion and sedimentation control. Areas of active erosion will be documented and assessed for rehabilitation. Site-specific erosion and sedimentation control plans may be developed for problem areas.

Appropriate erosion and sedimentation control measures will be applied where appropriate. In particular, rehabilitation of unstable swales, gullies, or other identified areas will be performed as directed by the site engineer.

Slope Stability

Upon completion of the construction phase a qualified professional, with demonstrable experience in slope stability evaluation, will perform a detailed inspection of the site. Borrow pits, quarries and excavations will receive particular attention, as these areas will be decommissioned following construction. Steep slopes will be stabilized using “bench and terrace” construction where necessary. Shallower slopes will be re-graded and track-walled, or otherwise stabilized by other measures. Obvious threats to human or wildlife safety such as pits or unstable precipices will be fenced and posted with warning signage.

Mired Areas

Mired areas may result from the use of wheeled or tracked vehicles in areas where the groundwater table lies close to the ground surface, in poorly drained areas, or in wetland/bog areas. Upon completion of the construction phase, the site engineer will identify mired areas.

Drainage improvements or fill (preferably from an on-site source) will be implemented where required to rehabilitate mired areas.

Alteration of Natural Surface Drainage

Alteration of natural surface drainage patterns is an inevitable consequence of this construction project given the required size of the Project footprint. The site grading/drainage plan, developed during the design phase, will be implemented during construction and post construction. All permanent drainage control features will be in place and functioning upon completion of construction. The site engineer will be responsible for ensuring that these features are stabilized and functioning as designed.

Nevertheless, minor rehabilitation of surface drainage patterns may be required upon completion of the construction phase. Removal of temporary roads and fill areas (e.g., construction laydown areas) is recommended if they impede surface drainage or impound runoff.

Revegetation of Cleared or Disturbed Areas

Upon completion of the construction phase, a detailed inspection of the site will be performed by a qualified professional to identify cleared areas that require revegetation. Temporary roads, laydown areas, and other areas of exposed soils will be scarified and hydroseeded using an appropriate seed mix, as specified by the Newfoundland and Labrador Department of Transportation and works. Slopes that require revegetation will be track-walled and hydroseeded. Natural revegetation and succession will be allowed to take place in other areas, except areas that must remain cleared for operational, accessibility, or security reasons; or, for areas where rapid re-establishment of woody vegetation is required to maintain slope stability.

Dust accumulation on foliage

If the site engineer observes areas where rainfall is not sufficient to wash away accumulations of construction-related dust on foliage, the affected foliage will be sprayed with clean water.

Releases of Hydrocarbons or Substances of Environmental Concern

Although all measures will be taken to prevent any releases of hazardous materials, any accidental releases that may occur during construction will be documented and addressed immediately, in accordance with the Construction Contingency/Emergency Response Plan. Impacted soil is expected to be excavated and disposed of in accordance with applicable regulations. Upon removal of contaminants, impacted areas will be assessed for further rehabilitation and remediation if necessary.

5.14.2 Monitoring

Erosion Control Monitoring

The success of corrective measures applied to unstable swales, gullies, or other identified areas will be monitored until the qualified professional deems them to be stabilized. The condition of temporary erosion control measures will be monitored, and maintained, until a qualified professional authorizes their removal. Periodic monitoring and corrective measures for erosion control may be undertaken as needed throughout the operational lifetime of the project, or as specified in the EPP.

Slope Stability Monitoring

Monitoring of areas where corrective measures were implemented to maintain and enhance slope stability will continue until the slopes are deemed stabilized by the qualified professional. Areas where possible slope stability problems are identified, but corrective measures are deemed unnecessary, will likewise be monitored until they are satisfactorily stabilized.

Drainage Control Monitoring

The effectiveness and stability of all temporary and permanent ditches, culverts, and other drainage control features will be monitored for one year (i.e., one full seasonal hydrologic cycle) following completion of the construction phase. Repairs, revegetation, revetment, or other corrective measures will be applied as directed by the site engineer.

Revegetation Monitoring

The success of revegetation efforts will be assessed for two full growing seasons following seeding. Areas that remain exposed or where vegetation density is inadequate will be scarified and re-seeded (either manually or by hydroseeding).

Monitoring of Remediated Areas

Areas where substances of environmental concern have been released during construction, and which were addressed in accordance with the construction contingency/emergency response plan, will continue to be monitored until applicable remediation standards are completed.

6.0 OPERATION AND MAINTENANCE

6.1 Refinery Operations

The refinery will be operated and maintained by trained, knowledgeable and experienced personnel following proven standard practices that result in a safe, efficient and environmentally responsive workplace. Management systems will be in place that comply with all regulatory requirements. These systems will cover, but not be limited to, the following:

- Operating and maintenance manuals and procedures;
- Equipment monitoring and inspections;
- Equipment and unit turnarounds;
- Risk management and mitigation systems;
- Loss control management;
- Equipment drawing and design specification data;
- Vendor equipment and catalogues;
- Continuous improvement protocols/tools:
- Emissions and discharges monitoring and control procedures:
- Operations training;
- Workplace safety training.

6.1.1 Crude Processing

Crude oils are complex mixtures containing many different hydrocarbon compounds and vary in appearance and composition from one oil field to another. Crude oils range in consistency from water-like liquids to tar-like solids, and in colour from clear to black. An "average" crude oil contains about 84 percent carbon, 14 percent hydrogen, 1 percent to 3 percent sulphur, and less than 1 percent each of nitrogen, oxygen, metals and salts.

The design basis for the Southern Head Refinery feedstock is a range of crudes from Arabian Medium and Arabian Heavy. This will allow the new refinery to process a wide range of crudes from various parts of the world and provide greater flexibility for operational and economic success. It is expected that the primary sources for the projects feedstock crudes will be the Middle East, Russia, South America and Africa. Should ongoing exploration in Newfoundland & Labrador result in the discovery of heavy sour crude oil in the future, it is possible that these could be economically processed as well. The Project will be capable of processing crude feedstocks with sulphur content up to 3 percent.

Crude from on-site tankage is blended and is fed to the Atmospheric and Vacuum Distillation Unit for preheating prior to desalting by an electric grid. After desalting, the crude oil is further

heated and enters the Crude Tower. In the Crude Tower the oil is fractionated into tower overhead, naphtha, kerosene, diesel, atmospheric gas oil (AGO) and crude tower bottoms. The Crude Tower Bottoms are sent to the Vacuum Distillation Unit (VDU) for further separation into Vacuum Gas Oil (VGO) for Hydrocracker feed and residuals.

Light gases are recovered, desulphurized and are separated into fuel gas and components for blending or sales. Light naphtha is stabilized, hydrotreated and separated for further treatment for blending with gasoline. Heavy naphtha is hydrotreated to remove sulphur and further treated to improve its octane quality.

Kerosene and diesel stocks are first steam stripped to remove light components and are then sent to the hydrotreating units to produce Jet fuel and Ultra-low Sulphur Diesel (ULSD). Atmospheric gas oil (AGO) is also steam stripped before it goes to the Hydrocracker for conversion to gasoline and middle distillate blending stocks. In the Delayed Coking Unit, the heavy residual oil from the bottom of the Vacuum Unit is converted into fractions for further processing. The light gases are recovered primarily for refinery fuel. The naphtha fraction is treated in the Coker Naphtha Hydrotreater. The light gas oil is sent to the Diesel Hydrotreater and the heavy gas oil to the Hydrocracker. The solid coke remaining in the drum is periodically cooled and mechanically removed.

The Hydrocracker processes AGO, VGO, and Heavy Coker gas oil over a catalyst in the presence of hydrogen at a high pressure (2,500 psig) and a moderate temperature (800°F) to produce high quality fuel blending components. The Heavy Hydrocracker naphtha is sent for octane improvement. The light naphtha, kerosene, and diesel from the Hydrocracker go directly to product blending.

6.1.2 Crude Oil Products

The refinery will produce gasoline and distillate products for sales into Europe and into the United States. Coke and sulphur by-products will also be exported from the refinery.

Gasoline

Gasoline is a blend of hydrocarbons with boiling ranges from ambient temperatures to about 400 °F. The important qualities for gasoline are octane number (antiknock), volatility (starting and vapour lock) and vapour pressure (environmental control). Additives are often used to enhance performance and provide protection against oxidation and rust formation. The quality of the product slate will be suitable for supplying conventional and “Reformulated Blendstock for Oxygenated Blends” (RBOB) into the eastern seaboard of the United States. RBOB will not meet finished gasoline specifications until it has been blended with 10 percent Denatured Fuel Ethanol. Ethanol blending will take place after the gasoline has been shipped and NOT at the refinery.

Table 6.1 Conventional Gasoline Specification

Gasoline	
RVP	10.0
MON	82.0
(R+M)/2	87.0
Benzene (%)	4.90

Table 6.2 RBOB Specification

RBOB	
RVP	8.6
MON	80.0
(R+M)/2	83.8
Aromatics (%)	50.0
Benzene (%)	0.6

Kerosene/Jet Fuel:

Kerosene is a refined middle-distillate petroleum product that finds considerable use as a jet fuel and around the world in cooking and space heating. When used as a jet fuel, some of the critical qualities are freeze point, flash point, and smoke point. Commercial jet fuel has a boiling range of about 375°-525°F, and military jet fuel 130°-550°F. Kerosene, with less-critical specifications, is used for lighting, heating, solvents and blending into diesel fuel.

Table 6.3 Kerosene/Jet Fuel Specifications

Kerosene/Jet Fuel	
Degree API	≥51
Sulphur content wt%	0.30
Flash Point °C	≥38
Freeze Point °	-47
Smoke Point mm	>19

Liquefied Petroleum Gas (LPG)

LPG consists principally of propane and butane. It is produced for use as fuel and is an intermediate material in the manufacture of petrochemicals. The important specifications for proper performance include vapour pressure and control of contaminants.

Distillate Fuels

Diesel fuels and domestic heating oils have boiling ranges of about 400°-700°F. The desirable qualities required for distillate fuels include controlled flash and pour points, clean burning, no deposit formation in storage tanks, and a proper diesel fuel cetane rating for good starting and combustion. Diesel streams will be treated to remove sulphur to the very low levels required for European ULSD standards (10 ppm).

Table 6.4 Ultra Low Sulphur Diesel (ULSD) Specifications

ULSD	
API	>30
Sulphur, ppm	<10
Flash Point °C	52
Cetane	>49

Petroleum Coke

Petroleum Coke is a gray-to-black carbonaceous residue that is produced from petroleum during thermal processing and is a by-product of the delayed coking process. Petroleum Coke or simply “Coke” is characterized by having a high carbon content (95 percent+ by weight) and a honeycomb type of appearance and is insoluble in organic solvents (ASTM D121). Coke can occur in many different forms depending on the petroleum feedstock. It is used as a fuel source for power plants, for the production of aluminum anodes, as a feed stock in coke ovens for the steel industry, for electrode manufacture, and for the production of chemicals.

Sulphur

Sulphur is a by-product of the refinery process whereby sulphur recovery converts hydrogen sulphide in sour gases to elemental sulphur.

Due to the presence of sulphur in crude oil, and the coking/hydrocracking/hydrotreating of hydrocarbons, a significant amount of H_2S is produced throughout the entire facility. H_2S is found in many gas streams in the refinery and in sour water. H_2S is removed from gas streams by using Amine. Rich amine, i.e. amine containing H_2S, is regenerated in Amine Regeneration Unit and gaseous H_2S stream from the top of the regenerator is routed to the Sulphur Recovery Unit. This H_2S gas will be sent for sulphur recovery.

Process waters that have potentially come in contact with H_2S and NH_3 will be collected and sent to a sour water stripper where the contaminant gases will be thermally stripped from the water. The stripped water will be sent to the wastewater treatment facility to be processed for recycle to the process units. All discharged water will conform to Environmental Guidelines.

In the Sulphur Recovery Unit (SRU), H_2S is converted to elemental sulphur with a high degree of conversion (99.8 percent conversion) resulting in a small percentage of sulphur that must be

burned in a tail gas incinerator and be vented to the atmosphere through the incinerator stack. Elemental sulphur is degassed and then exported.

The H_2S rich streams from the amine unit and sour water stripper will be sent to a Claus type recovery plant where the H_2S will be converted to elemental sulphur, degassed, and sent to storage. Subject to environmental approvals, any unconverted H_2S will be oxidized to SO_2 before being discharged to the atmosphere through a stack after further treatment and conversion in the Tail Gas Recovery Unit.

6.1.3 Process Utilities

The following are the major process utilities of this new refinery:

- Fuel Gas;
- Raw Water;
- Cooling Water;
- Process Water;
- Boiler Feed Water;
- Steam (different levels);
- Plant Air/Instrument Air;
- Nitrogen;
- Fuel Oil.

Fuel Gas

Combinations of light hydrocarbon gases containing some hydrogen will make up the fuel gas under normal refinery operation. This Refinery Fuel Gas (RFG) will be used to provide the fuel to the majority of the fired heaters and boilers within the refinery.

Raw Water

Raw water used to meet the need for cooling water make-up, process water, steam generation, potable water, etc., will be produced by the on-site desalination of seawater.

Cooling Water

To minimize the water requirements of the refinery, air cooling will be maximized throughout the refinery processes. Cooling water use will be minimized and limited to those services where air cooling is not applicable. Cooling water will be supplied by the desalination plant. Recirculating cooling water will be treated to remove impurities and dissolved hydrocarbons. Seawater will be used as a segregated cooling medium to remove heat from the circulating process cooling water stream. Recirculated cooling water must also be treated for hydrocarbons and other

contaminants. The seawater system will be an open recirculating system that will be cooled using a seawater cooling tower prior to discharge.

Process Water

Process water will be supplied by the desalination plant or recycled effluent water. Process water is used throughout the refinery. Process water applications include dissolving salts (chlorides, ammonium sulfides, etc.) in the Desalter vessels to prevent deposition and corrosion at cooler parts of different equipment (top of tower, at exchanger/air-cooler, etc.), for coke cutting within the Delayed Coking unit, and for numerous miscellaneous process operations and maintenance uses.

Boiler Feed Water

Boiler feed water will be produced by the additional treatment of water from the desalination plant. Water used in steam generation must be free of contaminants including minerals and dissolved impurities that can damage the system or affect its operation. Suspended materials such as silt, sewage, and oil, which form scale and sludge, must be coagulated or filtered out of the water. Dissolved gases, particularly carbon dioxide and oxygen, cause boiler corrosion and are removed by deaeration and treatment. Dissolved minerals including metallic salts, calcium, carbonates, etc., that cause scale, corrosion, and turbine blade deposits are treated with lime or soda ash to precipitate them from the water.

Steam System

Steam will be generated at two (2) levels (MP & HP: 1040 kPag and 4140 kPag respectively). Some process units will produce steam from boiler feed water.

The steam distribution system consists of valves, fittings, piping, and connections suitable for the pressure of the steam transported. Steam leaves the boilers at the highest pressure required by the process units or electrical generation. The steam pressure is then reduced in turbines that drive process pumps and compressors. Most steam used in the refinery is condensed to water in various types of heat exchangers. The condensate is reused as boiler feedwater or discharged to wastewater treatment.

Plant Air/Instrument Air

Plant Air and instrument air will be produced by conventional methods using air compressor and dryer systems to ensure adequate supply to all areas.

Plant air is provided for the operation of air-powered tools, catalyst regeneration, process heaters, steam-air decoking, sour-water oxidation and other uses. Instrument air is provided for use in pneumatic instruments and controls.

Nitrogen

Nitrogen will be supplied to the plant as required by an outside vendor. Nitrogen will be stored on-site in pressurized tanks rated for the service. Nitrogen is used to provide an inert atmosphere within process equipment. It is also used to purge hydrocarbon process equipment in preparation for maintenance activities.

Process Chemicals

A variety of chemicals, additives and catalysts will be used throughout the refinery. Storage and handling of such chemicals and lists of the expected chemicals to be used in the refinery is provided in Section 6.1.7.

Fuel Oil

Refinery Fuel Gas will be provided to fuel the majority of the fired heaters and boilers within the Refinery. Some of the refinery fired heaters will be designed to use heavy liquid hydrocarbons as a source of fuel, to supplement the refinery fuel gas. Various grades and qualities of fuel oil are available. All Provincial and Federal regulations regarding the burning of fuel oil will be met.

6.1.4 Water Use

All fresh water consumption in the refinery will come from a combination of the desalination plant on-site and recycled water from the stormwater or treated effluent water system. There will be no use of natural fresh water sources in the Southern Head Area.

Sea Water Intake

The seawater intake will consist of two (2) 1.2 m diameter high-density polyethylene pipes that will extend from the intake wet well at the shoreline to the seawater collection point approximately 985 m from shore. The pipe will be installed such that it is buried in the inter-tidal zone at the shoreline for protection from erosion and land-fast sea ice. It will be anchored with concrete bocks over the entire exposed length to prevent floating. The depth of the end of the intake will be at 18 m below low normal tide.

A wedge-wire or V-wire screen (Johnson Screen™) will be used at the end of the intake pipe to reduce the inlet velocity below 0.15 m/s. This reduced inlet velocity protects the surrounding aquatic species and serves to prevent debris from clogging the screen. The screen is also equipped with an air cleaning system in which a periodic blast of compressed air is backwashed through the screen assembly to remove any accumulated debris. The screen material will be selected specifically for the application to prevent corrosion and biofouling.

Water that passes through the intake will enter a wet well at or near the shoreline where the intake pumps will pump it through a pressurized water line to the treatment system.

The peak seawater intake rate is estimated to be 43,320 USgpm (2.73 m^3/s). This is made up of sea water cooling tower makeup and desalination intake (Table 6.5).

Table 6.5 Sea Water Intake Flow Rates

Seawater Intake	
Sea Water Cooling Tower Makeup	13,300 USgpm (0.84 m^3/s)
Desalination Intake	30,020 USgpm (1.89 m^3/s)

The desalination plant will provide a total of 3,000 USgpm (0.19 m^3/s) to meet the fresh water requirements for the refinery systems.

Water Users

A boiler feed water system is proposed to provide the steam system with an estimated 2,200 USgpm (0.14 m^3/s) of freshwater capacity. Desalinated water from the desalination plant passes through various treatment processes before vapourizing in the steam boilers.

Process and utility water is used in various units for the purpose of steam decoking, laboratory use, coker coke drums, etc.. It is estimated that 800 USgpm (0.05 m^3/s) of make-up water is required to satisfy process water needs.

Potable water requirement is estimated to be 20 USgpm (0.0001 m^3/s). Desalinated water will be treated as required and disinfected to provide potable water quality (Table 6.6).

Table 6.6 Desalinated Water (Freshwater) Use

Water Users	
Boiler Feed Water	2,200 USgpm (0.14 m^3/s)
Process / Utilities	800 USgpm (0.05 m^3/s)
Potable Water	20 USgpm (0.0001 m^3/s)

Water requirements will be adjusted as required during the engineering design phase.

Firewater

The source of water for the firewater system will be from the firewater storage pond with supplementary feed from the stormwater pond. The pond level will be maintained as required by clean stormwater drainage from the site, water from the final treated effluent water ponds and as last resort make up from the site fresh water supply system.

Water Reuse

In order to minimize costs and the size of the desalination plant, effluent and/or stormwater can potentially be used to replenish a portion of the refinery water demand. Such demands may be

cooling tower make-up, firewater, and process/utility water. The maximum economic level of water reuse will be established during the engineering design phase.

Effluent Outfall

Wastewater from the refinery that has been treated in the wastewater treatment plant will be discharged through an ocean outfall that will extend to a depth of –18.0 m below low normal tide TIDE. The pipe has a diameter estimated to be 1.2 m and will consists of a solid HDPE pipe to –15.0 m below LNT. After that point, 100 mm diameter diffuser check valves will be installed on the pipe at a spacing of 1000 mm. A total of 100 discharge ports will be required to provide sufficient dispersion of the wastewater in the current conditions at the discharge site.

The pipe will be anchored to the ocean floor using a series of concrete blocks. The section of the pipe containing the diffusers will be leveled either using a pad of washed granular material or concrete pedestals depending upon the characteristics of the ocean floor in that area.

The total length of the pipe is estimated to be 405 m. The estimated total wastewater discharge through the outfall during operations is 42,518 USgpm (2.68 m^3/s). The water balance is further discussed in section 8.4. See Figures 6.1 and 6.2 for a representative outfall plan and profile respectively.

6.1.5 Energy Consumption

The electrical power consumption of an oil refinery generally has a steady load profile. Most of the load runs continuously over extremely long overhaul cycles. The load is primarily inductive but the use of synchronous motors and capacitor banks improves the power factor; estimated at 0.90. The load profile does not vary much from day to day or season to season. The refinery will be a 24-hour, 7 day week, 365 day a year operation.

Peak consumption is estimated at 185MW with an average of 170MW. Start-up and any major maintenance will be a time for large load swings but these times are definite exceptions, with most years having no occurrences. A prudent use of soft starts and VFD's will reduce peak demand.

The possibility of utilizing cogeneration units will be investigated at later stages in the project development.

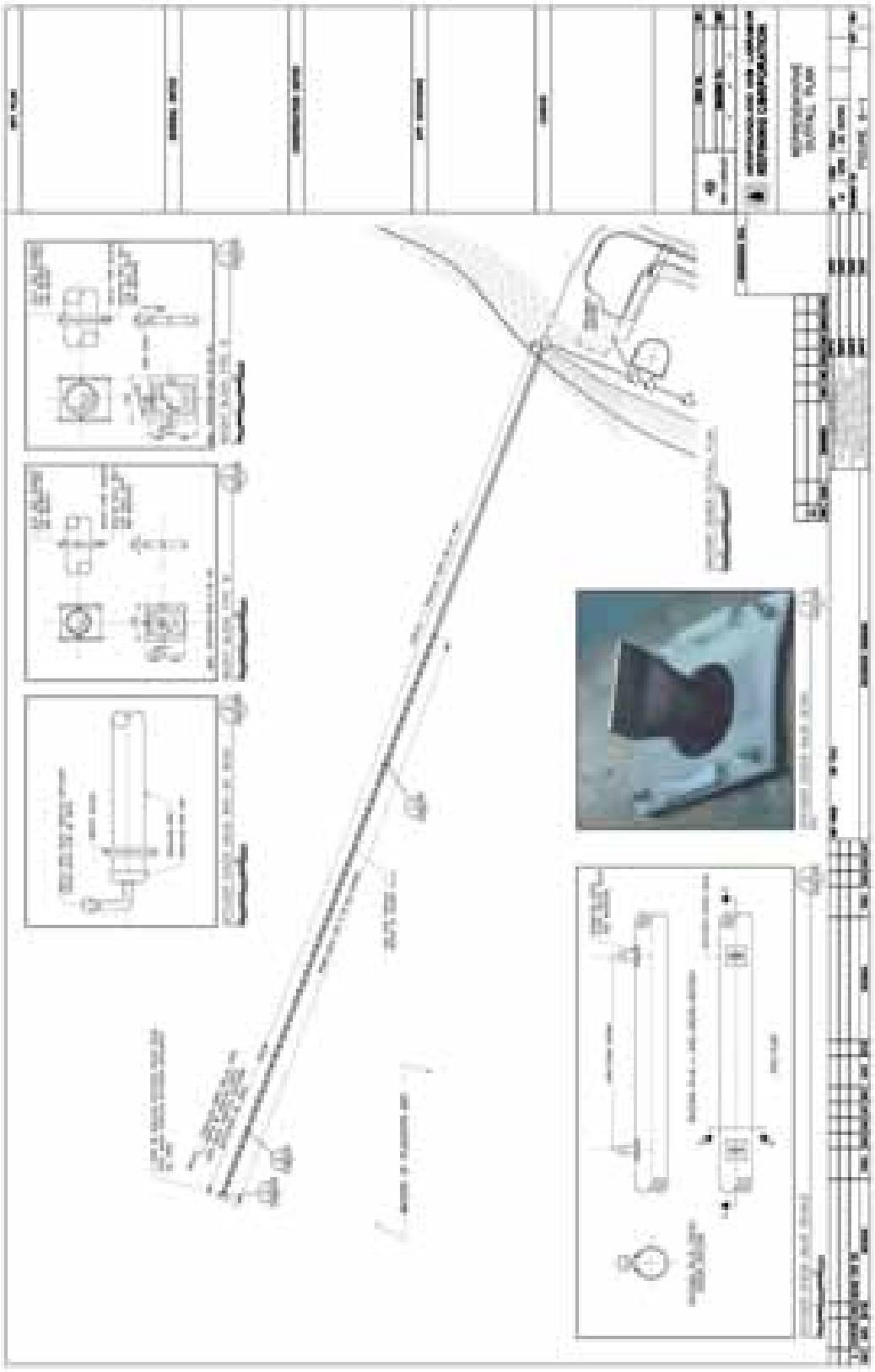

Figure 6.1 Representative Outfall Plan

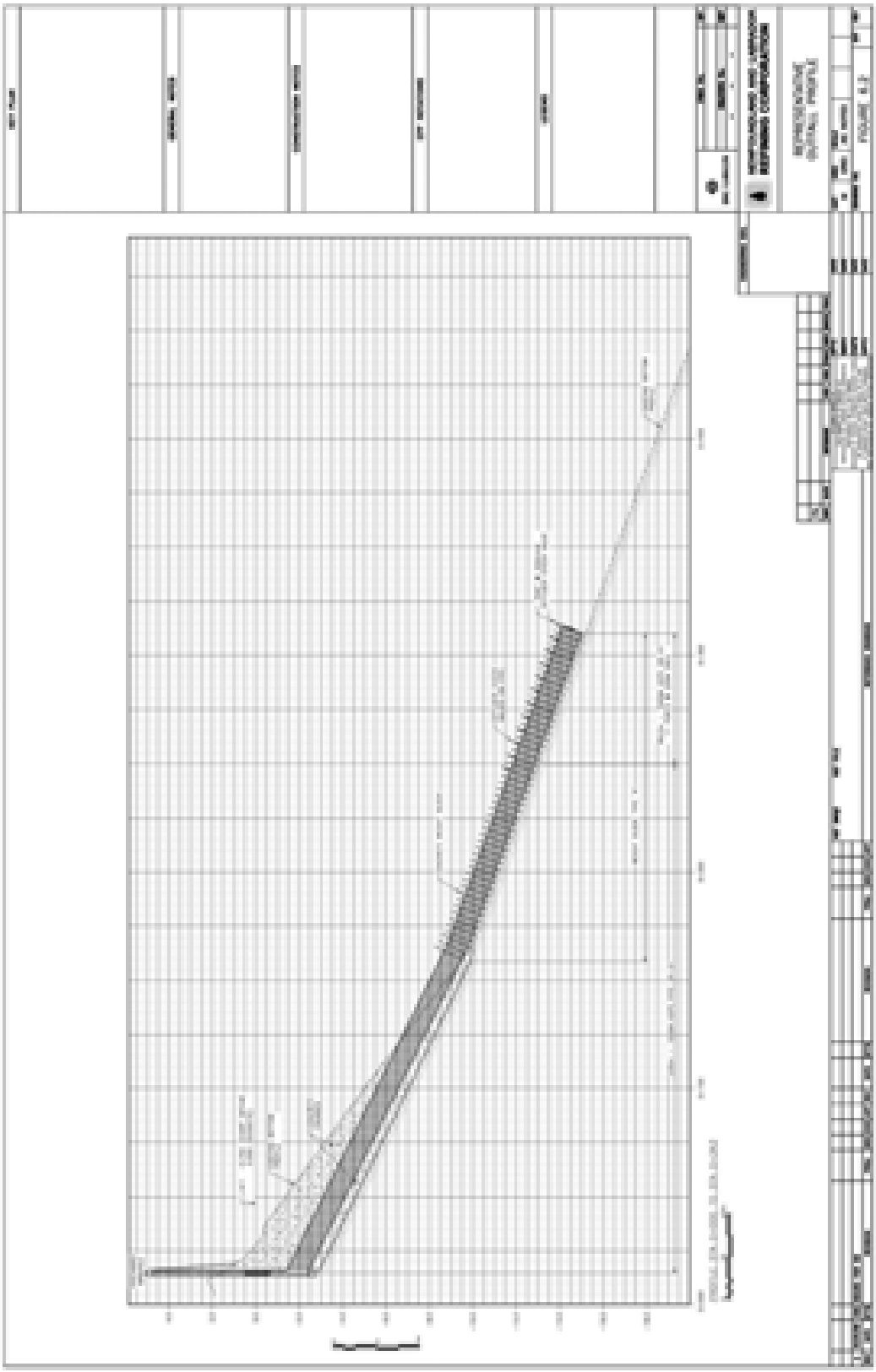

Figure 6.2 Representative Outfall Profile

6.1.6 Storage and Handling of Sulphur and Coke

Sulphur

Sulphur is a by-product of the refinery process. It is estimated that 1,000 tonnes per day will be produced for 300,000 bbl/d production. Liquid sulphur from the process units will be prilled (converted to pellets) and stored. Prilled sulphur will be stored in a purpose-built storage yard and loaded via a covered conveyor system to the designated export wharf onto bulk carriers for export. The amount of bulk sulphur in storage will be kept to a minimum by the regular scheduling of vessel shipments through the marine terminal.

The design of the storage areas and handling methods used will ensure the sulphur is not contaminated and that it doesn't damage equipment or cause harm to the environment. Sulphur will be processed in a prilling plant to provide stabilized pellet product and to reduce fines for ease of handling. An asphalt or concrete pad will be provided; this will enable 100 percent recovery of the sulphur in the stockpile. Water runoff from the stockpile will be collected and directed to the treatment plant for processing.

The movement of bulk sulphur from production to storage area to the ship will be via rubber belt conveyors. The conveyors will be covered to minimize the escape of dust to the environment. The maximum angle of inclination for a plain rubber belt conveyor will be 18° to 20°. All belts will be protected against the build-up of static electricity. To minimize the amount of dust formed the free-fall height from one conveyor or hopper to another, the number of drops in the conveying system will be minimized. Covered hoppers and flaps on the discharge and receiving belts will reduce air currents and the amount of dust that is picked up.

Telescoping spouts will be used to direct the sulphur at the stockpile, as well as during shiploading operation to minimize sulphur dust. The spout minimizes the height the sulphur must fall while exposed to the wind. The spout will be grounded to minimize the formation of static charges.

Coke

The new refinery will be fitted with a Delayed Coking Unit. Coke production will be approximately 5,000 tonnes per day for 300,000 bbl/d production. Coke will be stored in a purpose built closed storage facility and transported via closed conveyor system to bulk carriers for export. The amount of bulk coke in storage will be kept to a minimum by the regular scheduling of vessel shipments through the marine terminal.

The design of the storage areas and handling methods used will ensure the coke is not contaminated and that it does not damage equipment or cause harm to the environment. Coke will be processed. An asphalt or concrete pad will be provided. This will enable 100 percent

recovery of the coke in the stockpile. Water runoff from the stockpile will be collected and directed to the treatment plant for processing.

The movement of bulk coke from production to storage area to the ship will be via rubber belt conveyors. The conveyors will be covered to minimize the escape of dust to the environment. The maximum angle of inclination for a plain rubber belt conveyor will be 18° to 20°. All belts will be protected against the build-up of static electricity. To minimize the amount of dust formed the free fall height from one conveyor or hopper to another, the number of drops in the conveying system will be minimized. Covered hoppers and flaps on the discharge and receiving belts will reduce air currents and the amount of dust that is picked up.

Telescoping spouts will be used to direct the coke close to the stockpile, as well as during shiploading operation to minimize coke dust. The spout minimizes the height the coke must fall while exposed to the wind. The spout will be grounded to minimize the formation of static charges.

6.1.7 Chemical Storage Facilities

A variety of chemicals, additives and catalysts will be used throughout the refinery. The number of chemical storage areas will be kept to a minimum and placed at strategic locations in the refinery, depending upon where the chemicals will be used. In addition a dedicated chemical storage area will also be provided as part of the Warehouse facilities.

Dedicated on-site chemical storage facilities will be provided for all the chemicals, additives and catalysts to be used at the refinery. Chemical storage methods will include:

- Process vessels within operating units;
- Bulk chemical storage vessels;
- Tote tanks;
- Drums;
- Container construction will be appropriate for contents.

Chemicals will be handled in accordance with recommended practices and stored in an approved storage area that has been designed for containment and segregation to avoid chemical interactions. Chemicals will be identified by their Chemical Abstract Registry Number (CASRN) together with associated quantities, characteristics and toxicities. Personnel will be trained in the proper handling of chemicals and the proper response for spill cleanup and first aid. The Project will implement a Workplace Hazardous Materials Information System (WHIMIS) training program for the safe handling and use of chemicals stored and used on-site.

The selection of chemicals, additives and catalysts, including chemical injection requirements will be determined during the engineering design phase. The main catalysts anticipated to be used are hydrotreater catalyst, hydrocracker catalyst, reformer catalyst, sulphur recovery

catalyst and hydrogen plant catalyst. Alumina-based catalysts with metal oxides commonly used in refineries will be used in the hydrocracking and hydrotreating processes. Catalyst cycle life is estimated to be 24 months. Industry standard catalysts for the production of hydrogen will be used in the hydrogen plant. These catalysts will typically contain nickel, copper and iron. Hydrogen purification will utilize specialized forms of activated carbon. Alumina and titania-based catalysts commonly used in refineries will be used in the sulphur recovery plant. Catalysts promoted with platinum will be used in the continuous catalytic reformer.

Some of the types of chemicals required for normal refinery operations are listed below:

- Alumina Absorbents;
- Ammonium Polysulphide;
- Antifoam;
- Antioxidant;
- Biocide;
- Boiler Feed Water Treating Chemicals;
- Caustic 50 Baume;
- Cooling Water Treatment Chemicals;
- Corrosion Inhibitor;
- Demulsifier;
- Refinery Distillate and Gasoline Additives;
- Filming Amine;
- Glycol;
- Hydrogen Sulphide Scavengers (e.g. MEA or MDEA);
- Methanol;
- Neutralizing Amine;
- Organic Chloride;
- Potable Water Treating Chemicals;
- Refinery Gasoline Additives;
- Scale Inhibitor;
- Sodium Hypochlorite;
- Wastewater Treatment Chemicals;
- Soda Ash;
- Activated Carbon.

6.1.8 Control of Exposures to Chemicals and Hazardous Materials

Where the use of chemicals and hazardous materials cannot be eliminated or substituted, the following types of control measures may be used to control exposure, in descending order of priority:

1. Engineering controls;
2. Collective protection (e.g. administrative control);
3. Personal Protective Equipment (PPE).

Engineering Controls

Engineering controls are the most effective method of control as they remove, isolate or reduce the source of the chemical hazard rather than lessen the damage that may result from the hazard. Control must only come after the anticipation and recognition of a chemical hazard.

Substitution of a hazardous material or industrial process with a non-hazardous one is the best way to remove a hazard at the source.

Other engineering controls, such as mechanical ventilation, pneumatic dust transfer, and process enclosure, will be built into the work process where possible. These types of controls are less dependent on the chemical user who, unfortunately, is subject to human errors (for example, forgetfulness, preoccupation, insufficient knowledge).

Some techniques used in engineering controls are:

- Substitution of a hazardous material with a less or non-hazardous material;
- Substitution of a hazardous process with an inherently safer process;
- Process or equipment modification;
- Isolation or total enclosure;
- Ventilation (by general and/or local exhaust ventilation);
- Reduction of process temperatures and pressures;
- Reduction of storage inventory of hazardous raw materials and products;
- Use of equipment that requires less maintenance;
- Use of equipment with no moving part seals;
- Use of secondary containment on mechanical seal/glands.

Administrative Controls

Administrative controls are required either as supplemental hazard controls or to ensure that engineering controls are developed, maintained, properly functioning and effective. Administrative controls consist of managerial efforts to reduce chemical hazards, through planning, information and training (such as hazard communication, MSDSs), written policies and

procedures (for example, a Chemical Hygiene Plan), safe work practices and environmental and medical surveillance (for example, workplace inspections, equipment preventative maintenance, exposure monitoring and workers' health monitoring). They primarily address the human element of hazard controls.

Other administrative controls include:

- Reduction of the number of exposed workers;
- Reduction of the duration and/or frequency of exposure of workers;
- Good housekeeping;
- Education, training and evaluation;
- Management of Change (MOC);
- Regular environmental and medical monitoring or surveillance to check that the above control methods are effective.

Personal Protective Equipment (PPE)

Personal protective equipment (PPE) is clothing or devices worn to help isolate a person from direct exposure to a chemical or hazardous material or situation. PPE reduces or eliminates the risk of injury by interrupting the routes of entry (inhalation, absorption, ingestion) of hazardous material(s) into the body. Recommended personal protective equipment for a particular material is often listed in its MSDS.

6.1.9 Waste Management and Disposal

Waste will be generated during all stages of the project. Potential characteristics of waste that will result from this project have been defined to generate a baseline for the design of a comprehensive Waste Management Plan. Legislation from the Provincial and Federal governments has been outlined to establish the range of feasible management alternatives for anticipated waste streams. At all stages, waste management alternatives will be considered with a view to minimizing the waste generated by project activities. As the refinery design progresses, a detailed waste management plan will be established from feasible waste management alternatives.

6.1.10 Waste Characterization

Waste generated by the refinery will be characterized by several phases of the project lifespan. Both hazardous and non-hazardous wastes may be generated at all project phases. Table 6.7 outlines wastes anticipated at each stage of the project.

During site preparation, wastes will be generated by the removal and movement of vegetation, soils and rocks. Site preparation waste will be primarily of natural origin, but will also include wastes generated by heavy machinery, vehicles, tools and workers.

The construction phase of the project will result in wastes related mainly to construction materials, machinery and tools. Because of the large influx of workers during the construction phase, an increase in domestic type wastes is anticipated during this time, both at the Southern Head site and at worker residence locations. Wastes related to the fabrication of equipment and materials will be generated off-site during, and in preparation for, the construction phase.

The operation phase represents the majority of the refinery lifespan and will generate a sustained increase in waste generation in the Placentia Bay area for an estimated 25-year period, between 2011 and 2036. Refining wastes, maintenance wastes and domestic type wastes will be generated during the operation phase. Unanticipated releases such as spills or explosions could result in the generation of contaminated waste materials such as soils and debris.

Decommissioning will result in demolition and land reclamation wastes including those related to structures, roadways, wharves and equipment. Prior to abandonment of the site, all waste material generated by the refinery will be removed from the site and surrounding areas.

Waste quantities have not yet been determined in detail; this will be addressed in the detailed Waste Management Plan. Waste volumes will correspond to several key factors: the extent of site preparation in terms of excavation and vegetation removal, the activities that will take place on-site, the schedules and activities of personnel, the processing/production rates and the decommissioning and abandonment plans.

6.1.11 Legislation Pertaining to Waste Management

During design, site preparation, construction, operation and decommissioning of the proposed refinery, waste management practices will adhere to applicable legislation and best management practices. Throughout the project lifespan, contact will be maintained with appropriate regulatory authorities (DOEC, Department of Municipal and Provincial Affairs and Government Services) and management boards including the Multi Materials Stewardship Board (MMSB). Waste management practices will be updated with changes in legislation and the availability of environmentally favourable waste management alternatives. Management of solid waste at the Newfoundland and Labrador Refinery will adhere to all applicable acts, regulations and guidelines as listed in Appendix 1: Relevant Legislation and Associated Permits.

Table 6.7 Waste Streams Anticipated from the Refinery Project

Project Phase	Wastes	
Site Preparation	Used oil, lubricants, coolants Contaminated or expired fuels Used oil filters Containers for oil and other fluids Waste batteries Tires Vegetation	Beverage containers and other packaging Food waste Portable toilet waste Contaminated and uncontaminated soils, rock, vegetation Fungicide, herbicide, pesticide
Construction	Waste explosives Used oils, lubricants, coolants Used oil filters Containers for oil and other fluids Broken fittings, tools and other machinery Plastic, metal, concrete, asphalt, wood Adhesive Contaminated and uncontaminated soils, rock, vegetation	Paint, insulation, paper, cardboard, formwork Sandblasting residues Spent cleaning fluids Waste batteries Portable toilet waste Bulk construction debris Fungicide, herbicide, pesticide
Operation	Used oil, lubricants, coolants Used oil filters Tanks, drums and containers Waste batteries Spent catalysts Radioactive waste Unleaded scales and rust Caustic Sodium carbonate Chemical solvents and additives Light bulbs Fungicide, herbicide, pesticide	Broken fittings and tools Plastic, metal, wood, glass Spent cleaning fluids Electronics Oiled materials Salts and minerals from desalination processes MEA/DEA (mono/ diethanolamine) Domestic refuse* Pyrophoric wastes Wastewater treatment sludges Tires
Decommissioning	Used oil, lubricants, coolants Contaminated or expired fuels Tanks, drums, containers for oil and other fluids Waste batteries Plastic, metal, concrete, asphalt, wood Beverage containers and other packaging Fungicide, herbicide, pesticide All products and chemicals used during operations	Food waste Portable toilet waste Contaminated and uncontaminated soils, rock, vegetation Broken fittings and tools Bulky items including structures and machinery Tires Used oil filters

Note:
*Including food waste, beverage containers and other packaging

6.1.12 Waste Generation

The first step to responsible waste management is waste reduction by design. Machinery, processes and entire facilities can be designed such that waste is minimized through methods such as improved durability of materials, efficiency, reuse, recycling and energy recovery. These objectives will coincide with the availability of waste carriers and disposal sites for potential waste streams.

Site Preparation

During site preparation, wastes will be minimized by ensuring that removal of vegetation, soils and rock material are targeted to areas where it is absolutely necessary. Natural vegetation helps to prevent erosion and can buffer strong winds. Preservation of the natural environment will also decrease the resources required for site decommissioning and restoration practices. Where possible, materials will be used on-site for construction purposes. Larger trees will be harvested for use as timber or for firewood. Smaller trees, shrubs and plants can be mulched and used for landscaping purposes or composted either on or off-site to produce nutrient rich soil.

All machinery will be maintained to avoid the loss of fuel or other fluids to the environment. All environmentally-harmful materials such as fuels, oils and coolants will be kept in sealed, labelled, appropriate containers when not in use. Where appropriate, fuels and other fluids and tools will be housed within a temporary storage structure. Waste fluids, containers and filters will be segregated by type and stored for appropriate reuse, recycling or disposal.

Construction

During construction, effort will be made to minimize the use of virgin materials. Where possible, waste from other sources could be used as materials in the construction of the refinery and surrounding infrastructure. Excavated rock can be used for structural purposes, while vegetation and soils can be used for landscaping. Building materials will be chosen to avoid burden on the environment during the decommissioning phase.

Operation

Waste minimization is most effectively exercised during the operation of the refinery itself. Management of materials will be properly coordinated to make use of technologies that exist to reduce the quantity and environmental toxicity of waste materials. Some of the common methods of reducing and managing wastes at oil refineries are as follows:

Identify Sources of Contaminants

All potential sources of contaminants will be identified and the appropriate measures put into place to reduce environmental impacts.

The potential contaminants that are present in a conventional petroleum refinery are well understood. Waste management and treatment procedures and systems will be developed to treat and dispose of all contaminated waste.

Choose Materials Carefully

The Project will, where possible, choose materials that help prevent the production of waste. Toxic degreaser wastes and chromate containing waste streams from cooling towers and heat exchangers may be reduced or eliminated through the use of less toxic, biodegradable alternatives. The use of high-quality catalysts can increase process efficiency and decrease the frequency of catalyst replacement. Activated alumina catalyst supports can be used in place of activated ceramic supports. Alumina catalyst supports are more suitable for recycling and can be directed to recycling with spent alumina catalysts. Spent caustic waste can be minimized by using regenerable amines in the hydrogen sulphide/mercaptan removal process.

Train Personnel

The Project will train personnel to maintain awareness of safe and appropriate waste management practices. They will be trained to avoid soil contamination and properly segregate waste streams. All workers will also be trained in managing hazardous waste materials. Awareness will minimize accidents such as oil leaks and spills and improperly stored or disposed hazardous waste products.

Segregate Process Waste Streams

A large portion of refinery processing waste results from oily sludges found in combined process/storm sewers. Clean rainwater runoff will be segregated from process waste streams in order to minimize the quantity of oily wastewater generated. Smaller more concentrated process streams are typically better candidates for recovery and reuse. This approach will be adopted for other applicable waste streams as well.

Process units will have segregated hydrocarbon blowdown piping to capture and contain process unit shutdown material and direct it to a recovery system for reprocessing.

Improved Recovery of Oils from Oily Sludges

Because of the large amounts of oily sludge generated at oil refineries, any method that increases the separation and recovery of oil can significantly reduce the volume of waste for disposal. Technologies that improve oil separation include belt filter presses, recessed chamber pressure filters, rotary vacuum filters, scroll centrifuges, disk centrifuges, shakers, thermal driers, and centrifuge-drier combinations.

Recycle and Regenerate Spent Caustics

If caustics are chosen to absorb and remove contaminants from final product streams, the process will be designed such that spent caustics are recycled. Chemical recovery companies may be interested in purchasing spent caustic if contaminant concentrations are high enough to make separation economical. Contaminants may also be separated from spent caustics on-site by altering conditions such as pH. Once contaminants are removed, caustics can be processed along with refinery wastewaters.

Regenerate or Eliminate Filter Clay

Because of its high hydrocarbons content, spent filter clay is often classified as a hazardous waste. Backwashing filter clay can reduce hydrocarbon content to a level at which it can be reused or handled as a non-hazardous waste. Filter clay can also be regenerated through naphtha washing and heat treatment. Clay filters can be also be replaced by hydrotreating.

Minimize Solids Leaving Crude Desalter Units

The Crude Desalter Unit should aim to maximize the removal of solids from the process stream. Solids that are incorporated into the process stream tend to increase the formation of emulsions and oily sludges at later stages of processing. Techniques to maximize solids removal within the desalter include the use of low shear mixing devices for contact between crude oil and wash water, the use of lower pressure water in the desalter to avoid turbulence, and mud washing and removal systems. Final process will be developed during the detailed design phase.

Sewage Solids Control

The volume of oily sludges is also affected by the amount of solids that contribute to this waste stream. A common contributor is small particles such as soil that become coated in oil and complicate the treatment of oil/water mixtures. Industry reports that oily sludges have solids content between 5-30 percent by weight, which corresponds to the production of 3-20 kg of oily sludge per 1 kg of solids. Some of the options for minimizing solids include sweeping paved areas, planting vegetation on unpaved areas, cleaning solids from ditches and catch basins and reducing heat-exchanger bundle cleaning solids by using antifoulants in cooling water.

Decommissioning

Decommissioning will involve either dismantling the refinery and its associated infrastructure, or rendering the facility useful for other purposes. Both of these options necessitate remediation of any soils or water affected by refinery operations. This waste can be minimized through appropriate environmental management during operation of the refinery. Wherever possible, deconstruction and demolition waste should be directed to reuse, recycling or energy recovery.

6.1.13 Food Handling and Disposal

During site preparation and construction it is anticipated that the Bull Arm Construction and Fabrication site will be used to accommodate approximately 50 percent of the project's workforce. This site is located in nearby Trinity Bay approximately 14 km from the proposed project site. The existing site food handling and preparation facilities are not currently operational, but could be upgraded relatively quickly to provide these services. Food service plans for the proposed refinery have not yet been established. Facilities used by the Newfoundland and Labrador Refinery Corporation (NLRC), during all phases of the proposed project, will adhere to applicable legislation including the *Food and Drug Act* (1997). Food preparation facilities will obtain necessary licenses and undergo inspection. All food will be handled, stored, transported and prepared in a way that prevents contamination.

Food waste will be source-separated into appropriate waste streams. Beverage containers, cans and other recyclable food storage containers will be stored and collected for recycling by licensed contractors. Paper, boxboard and cardboard will be stored separately and collected for reuse and recycling by licensed contractors. Composting of organic food waste either on- or off-site will be considered during the design of the detailed waste management plan. Food waste and containers will be handled, stored, transported and disposed of in such a way that prevents attraction of wildlife, leachate production and disagreeable odours.

Requirements for separation, handling and disposal of wastes are anticipated to change over the project lifespan in accordance with improvements to regional waste management programs. NLRC will develop its waste management plans to remain in accordance with local best practices for waste management.

6.2 Marine Operations

Marine Terminal operations will be carried out in accordance with established national and international regulations, standards and codes of practice. The terminal will develop a set of safety standards and operational procedures for the safe and efficient operation of the terminal as well a "Marine Terminal Regulations and Information" booklet. This information booklet will be provided to vessel owners, operators, charterers and masters of tankers and bulk carriers and will give all traffic using the terminal a description of the terminal facilities and available services, conditions for acceptance for a vessel to berth at the facility and the safety regulations to be followed.

The terminal will have the appropriate equipment and support facilities to handle all anticipated vessel traffic at the berth including: central control room, loading and unloading facilities, mooring equipment, tugs, leak/gas detection, spill containment, firefighting equipment and spill response equipment. The facility will provide a safe working environment and project personnel

will be trained to operate and maintain the Marine Terminal equipment and to be first responders in the event of an emergency.

6.2.1 Vessel Traffic

Worldwide crude oil supplies are in decline and as a consequence more and more crude oil is transported over longer distances using established international and national shipping routes. Economy of scale influences the sizes of tankers that will be used to import crude oil and export refined products as well as the bulk carriers that will be used to export sulphur and petroleum coke. Therefore the project plans on utilizing larger tankers and bulk carriers to import crude oil and export products over longer distances. These economies of scale reduce emissions of air pollutants per barrel and reduces the frequency of shipping, helping to minimize the vessel traffic at the new marine facilities.

There is already extensive use of the waters of Placentia Bay by large ocean-going vessels and smaller vessels. The bay supports a healthy commercial fishery, aquaculture, oil tanker traffic associated with the existing refinery and transshipment terminal, cargo vessels, passenger ferries and recreational craft.

All commercial vessels twenty metres or more in length (with the exemption of a fishing vessel that is less than 24 m in length and not more than 150 tons gross tonnage) entering Placentia Bay must report to the Marine Communications and Traffic Services (MCTS) centre. In April 2004–March 2005 there were 485 inbound tankers and 496 outbound tankers in Placentia Bay and total vessel movements of 6785 excluding ferries. These figures, plus other vessel movements for this period, are shown in Table 6.8.

The new refinery will be processing 300,000 bbl/day (approximately 50,000 Mt/day) of crude oil. This processing capacity will require a total of approximately 421 new vessels per year entering Placentia Bay (See Table 6.9 below). The final total numbers of vessels will depend on the vessel size profile of the incoming crude oil tankers and the size of the outbound product tankers. Vessel numbers may range from 400 vessels to a maximum of 450 ships per year, with 325 to 375 of these vessels being oil tankers and the remainder bulk carriers.

Generally, to service the eastern seaboard of the United States, product tankers are for the most part not larger than 80,000 DWT. Larger vessels could be used to service areas with larger port capacities but such as Rotterdam and other parts in Europe, this hasn't been taken into account in the estimate given below. Typically, crude delivery will be made in VLCC tankers (2 million barrels/300,000 DWT) and/or in Suezmax size tankers (1 million barrels/150,000 DWT).

Table 6.8 Placentia Bay Vessel Movements, April 2004–March 2005

Vessel Type	Inbound	Outbound	Transit	In-Zone	Out-Zone	Total
Tanker <50,000 DWT	133	141	24	66	0	364
Tanker >50,000 DWT	352	355	12	193	0	912
Chemical Tanker	27	20	6	9	0	62
General Cargo	28	30	32	14	0	104
Bulk Cargo	6	6	14	0	0	26
Container	52	52	268	19	1	392
Tug	11	11	8	2,016	0	2,046
Tug with Tow	14	13	10	2	0	39
Government	46	48	18	119	0	231
Fishing	128	131	5	29	0	293
Passenger	2	1	5	0	0	8
Other (vessels >20m)	3	2	5	1,286	0	1,296
Vessels < 20m	0	16	18	978	0	1,012
Sub-total Movements	802	826	425	4,731	1	6,785
Ferry	39	42	9	1,411	0	1,501
Total Movements	841	868	434	6,142	1	8,286

Notes:

Note that vessel movements are categorized as follows:

Inbound: A vessel entering the VTS Zone.

Outbound: A vessel leaving the VTS Zone.

Transit: No arrival or departure port within the zone.

In-Zone: A vessel movement that begins and ends within the VTS Zone.

Out-Zone: A vessel participating in VTS but which is not within the VTS Zone of responsibility.

The new refinery will be processing 300,000 bbl/day (approximately 50,000 Mt/day) of crude oil. This processing capacity will require a total of approximately 421 new vessels per year entering Placentia Bay (See Table 6.9 below). The final total numbers of vessels will depend on the vessel size profile of the incoming crude oil tankers and the size of the outbound product tankers. Vessel numbers may range from 400 vessels to a maximum of 450 ships per year, with 325 to 375 of these vessels being oil tankers and the remainder bulk carriers.

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The Coke (at 5,000 t/day) and Sulphur (at 800–1,000 t/day) will be shipped out by bulk carriers of various capacities (10,000–50,000 DWT) and depending on the size profile could range between 50 and 75 ships per year.

Table 6.9 Estimate of Vessel Traffic for NLRC Refinery

Ship Size in DWT	Number of Ships
CRUDE Tankers	
350,000 DWT	39
150,000 DWT	27
Diesel Product Tankers	
80,000 DWT	45
50,000 DWT	48
Kero/jet Product Tankers	
60,000 DWT	12
50,000 DWT	15
40,000 DWT	18
30,000 DWT	25
Gasoline Product Tankers	
50,000 DWT	20
40,000 DWT	8
30,000 DWT	11
RBOB Product Tankers	
50,000 DWT	17
40,000 DWT	16
30,000 DWT	22
Coke Product	
50,000 DWT	25
Sulphur Product	
20,000 DWT	73
Total Number of Ships	**421**

6.2.2 Vessel Traffic Services in Canadian Waters

The Project anticipates using the existing vessel traffic services. Canada's jurisdiction over marine areas extends to the 200 nautical mile limit. This boundary is defined as Canada's Exclusive Economic Zone (EEZ). The Eastern Canada Traffic Zone comprises all Canadian waters south of the 60° N and the St. Lawrence River East of 66° W. Eastern Canada Vessel Traffic Services Zone Regulations (ECAREG) are mandatory and apply to every ship of 500 gross tons or more, every ship engaged in towing or pushing a vessel where the combined tonnage is 500 gross tons or more, as well as every ship carrying a pollutant or dangerous goods. These regulations are consistent with the *IMO Convention on the International Regulations for Preventing Collisions at Sea (COLREG, 1972)*, a convention to which Canada is a signatory.

Requests for clearance to enter the ECAREG zone or to depart from a berth within this zone should be made as follows (World VTS, 2005):

- 24-hours before entering the ECAREG zone;
- 2-hours before leaving a berth within the ECAREG zone;
- Before proceeding after collision or standing in the ECAREG zone;
- Before proceeding after a breakdown in the ECAREG zone.

Vessel Traffic Management within Placentia Bay is controlled by Marine Communications and Traffic Services (MCTS) located in Argentia. The Argentia MCTS centre covers the Placentia Bay VTS Zone and provides the following services;

- Distress–Safety–Communications and Coordination;
- Vessel Screening to prevent the entry of unsafe vessels into Canadian waters;
- Regulating Vessel Traffic Movements for marine risk reduction;
- Providing traffic and waterway information via VHF radio;
- Providing recommendations and directions, including the delivery of clearances, and under certain conditions, restricting traffic movement;
- Implementing actions necessary to ensure safe and orderly flow of marine traffic;
- Providing specialized surveillance for conservation and environmental protection;
- Managing an Integrated Marine Information System;
- Collecting, analyzing and disseminating marine traffic information;
- Initiate, monitor and coordinate the communication network for Coast Guard's responses to emergencies;
- Public Correspondence Services to facilitate ship–shore communications.

6.2.3 MCTS Regulatory Framework

MCTS functions are derived from a regulatory framework based primarily on the C*anada Shipping Act (CSA)* and the *Safety of Life at Sea Convention (SOLAS)*. Based on CSA, MTCS can recommend regulations establishing vessel traffic service zones and impose mandatory vessel traffic practices and procedures within those zones (*e.g., Vessel Traffic Services Zones Regulations and the Eastern Canada Traffic Zones Regulations*).

6.2.4 Vessel Traffic Corridor (Shipping Lane)

Within Placentia Bay, there is a designated traffic separation and management scheme that is controlled by MCTS in Argentia. Inbound traffic operates within the boundaries of the eastern vessel traffic lane, whereas outbound traffic stays in the western lane. Traffic separation minimizes the risk of collisions by ensuring that there is single direction traffic within each traffic lane (see Figure 6.3 below, Source: Marine Communications & Traffic Services, Fisheries and

Oceans Canada). The existing shipping lanes in Placentia Bay have been planned to maximize the safe transit of vessel traffic and minimize any potential adverse environmental effects on the marine ecosystems and local fishing industry. The current configuration of the shipping lanes follows a natural deepwater channel and was established based on extensive consultations with the oil industry, fisheries, government agencies and interest groups. NLRC has committed to work with these groups to minimize displacement of other users of the shipping lane as a result of its operations.

6.2.5 Vessel Traffic Management

All tankers calling at the Terminal must comply with all applicable International Maritime Organization (IMO) Conventions and recognized Industry Guidelines including the latest edition of International Safety Guide for Oil Tankers and Terminals (ISGOTT). All tankers nominated for calling at the Terminal will be required to be vetted and approved by NLRC before being accepted at the Terminal. Vessels arriving in Placentia Bay in transit to the NLRC Terminal must comply with the established marine traffic system protocol and procedures.

The marine traffic system in Placentia Bay has established specific call-in points (See Figure 6.3) at which vessels must contact MCTS in Argentia via VHF radio. At each call-in point, vessels report their position and give any updates on vessel condition and cargo. The bay is divided into two sectors, with a sector boundary extending out from Marystown across Placentia Bay to Gooseberry Cove. Communication is via VHF channel 14 in the outer part of the bay (sector 1). Inside the sector boundary in the inner part of the bay (sector 2), communication is via VHF channel 12.

MCTS queries each vessel to verify that the ship has an arrangement with an oil spill response organization as it enters Canadian waters. Within Placentia Bay, the legal zone of responsibility for the Placentia Bay MCTS is an area extending out 12 nautical miles, within which, vessels must comply with Placentia Bay MCTS regulations.

Specific requirements in Placentia Bay are such that no vessel can enter the inner bay (north of Red Island) without having a registered pilot on board. A pilot station is located in the centre of the traffic lanes just off Red Island. Once the pilot station is reached, any vessel on route to a port must be piloted by a marine pilot from the Atlantic Pilotage Authority, stationed out of Arnold's Cove.

The use of escort vessels is not legally required in Canada, however it is an industry best practice to escort laden tankers through higher-risk areas. NTL and NARL use their escort vessels as a preventative measure to assist laden tankers in Placentia Bay and NLRC would provide the same service.

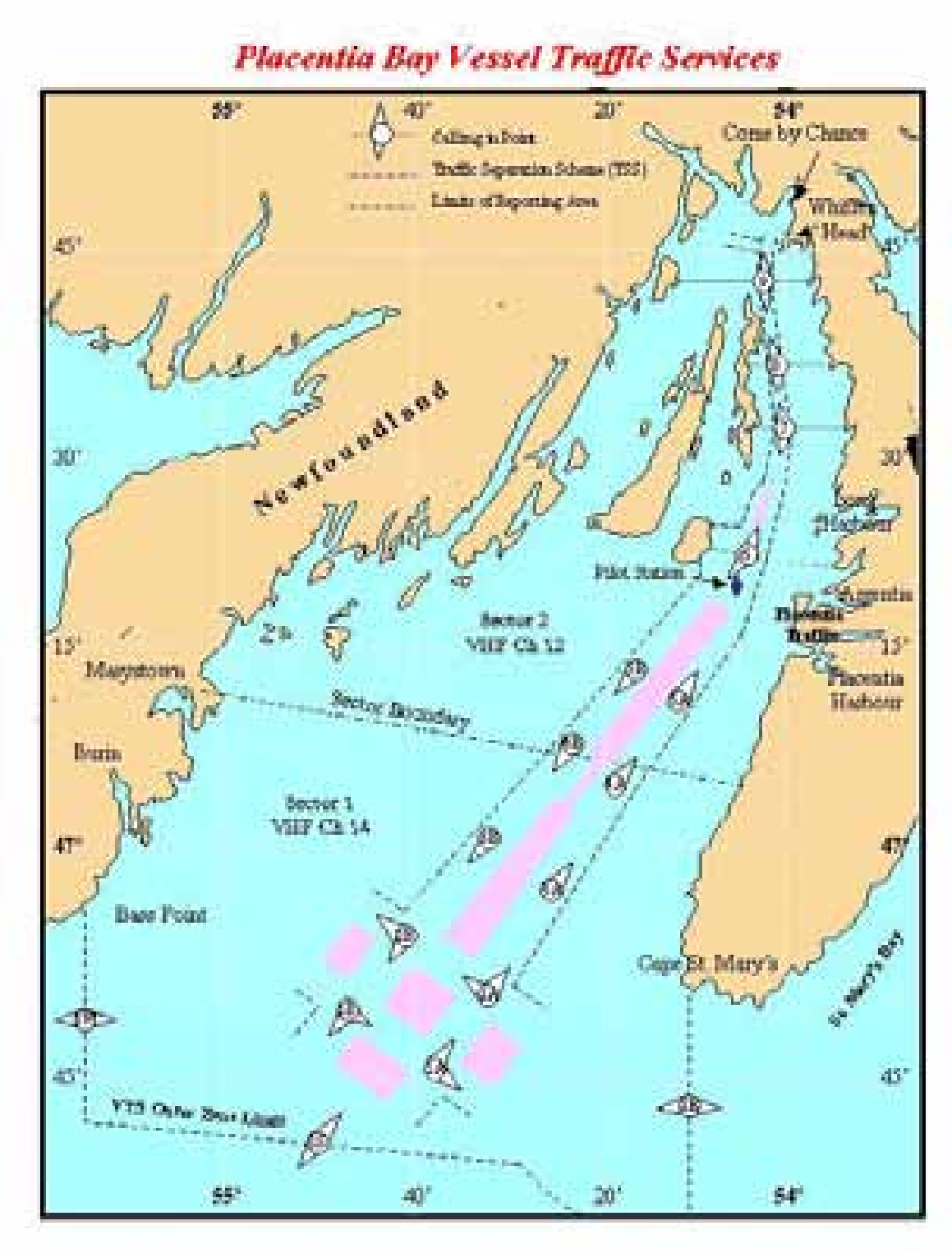

Figure 6.3 Existing Vessel Traffic Lanes in Placentia Bay

Cape St. Mary's has been identified as a sensitive environmental area and the configuration of the existing traffic lanes takes this into account. Traffic lanes are positioned in deep water at the centre of Placentia Bay with extensive buffer zones to either shore. Traffic lanes in the outer part of the bay are 2.5 nautical miles wide and have a 3-nautical mile separation. All tanker traffic will avoid landfall and keep to the established deepwater traffic lanes in the centre of the bay. The closest that tanker traffic should approach to Cape St. Mary's is approximately 12 nautical miles as vessels enter the traffic lanes and transit up Placentia Bay.

6.2.6 Vessel Characteristics

The modern tanker industry has undergone many changes in the past 50 years. These conscientious and continuous improvements have moved the industry towards safer and more responsible technologies which is reflected in the dramatic decline in the incidence of major oil spills over the last decade.

Double Hulls

Since 1990, the Canadian and international regulations have required all new ships to be designed with a double hull (Figure 6.4). All single hull tankers will be phased out by 2015 before the new refinery is operational.

A double hull is essentially a hull within a hull. The cargo is carried inside the inner hull. The space between the inner and outer hull varies by ship size from 7 to 10 feet or more. If an accident should occur (i.e., grounding, stranding, collision or striking a submerged object), the space between the hulls can absorb the energy of the accident and assist in preventing petroleum from entering the water. No cargo can be loaded in the space between the hulls.

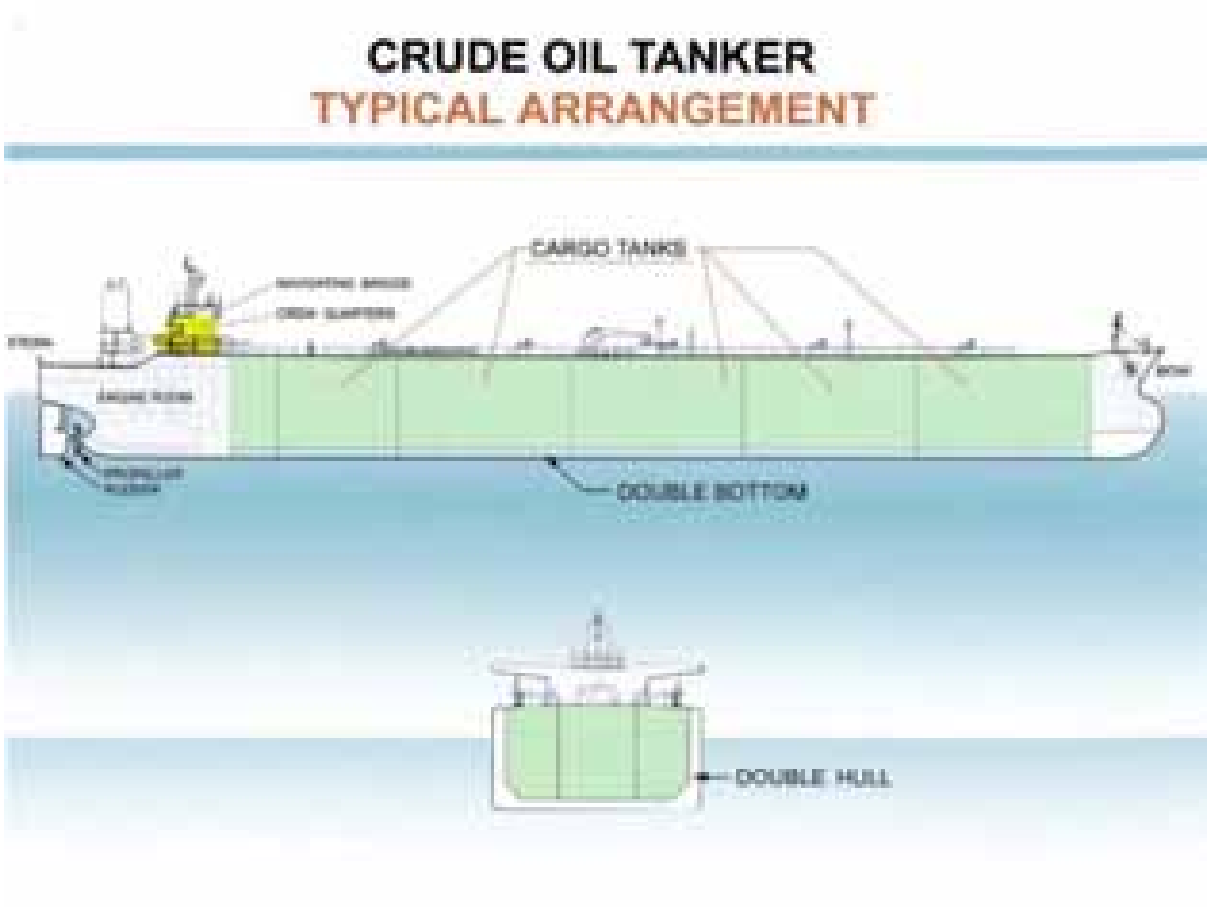

Figure 6.4 Double Hull Tanker

Segregated Ballast

Another advantage of double hull tankers is the ability to have segregated ballast. Once cargo has been discharged, all tankers must load ballast (for weight stabilization) into their tanks. The double hull area provides a perfect place for ballast as it does not come in contact with any of the cargo or cargo residue. NLRC has been committed to build a ballast water receiving and treatment system that could be used to treat contaminated ballast water if required. This is of particular importance if vessels are arriving from areas which may have invasive marine species and have untreated ballast water (Figure 6.5).

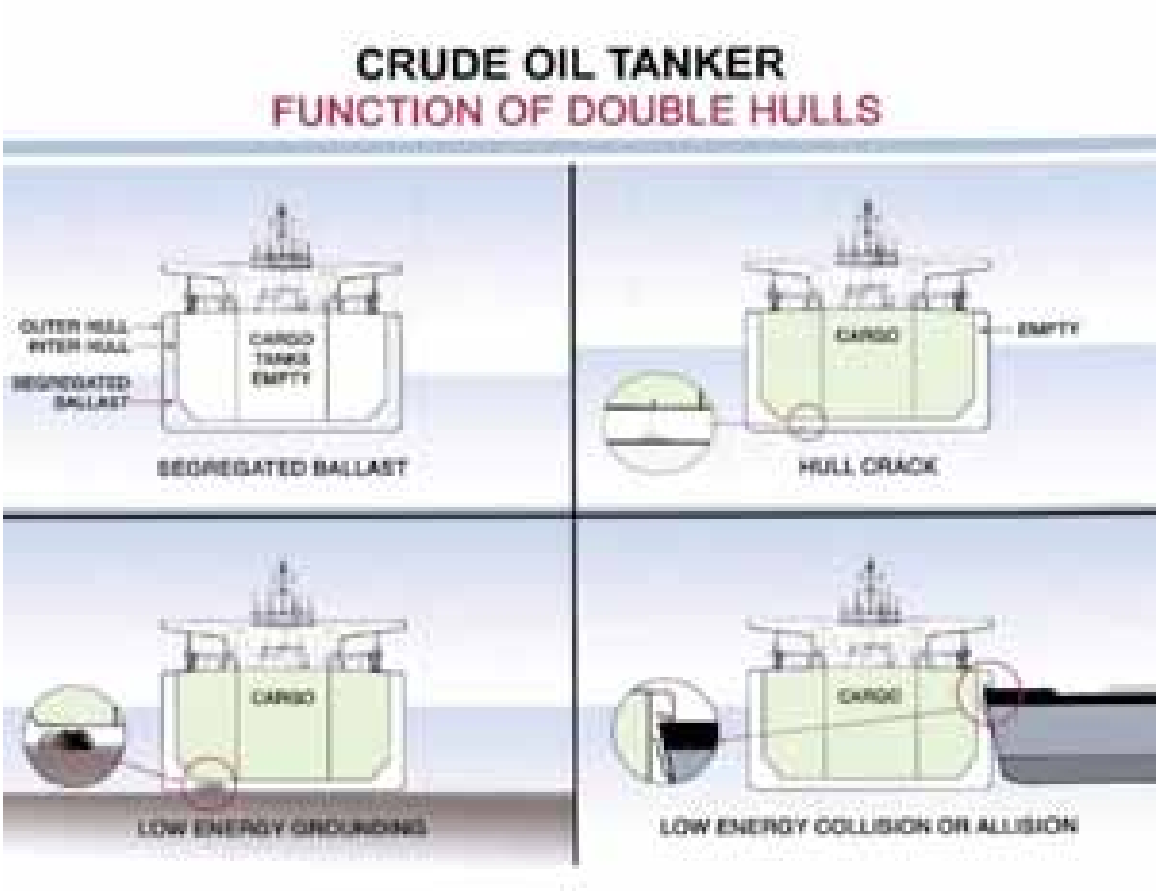

Figure 6.5 Advantages of Double Hull Tanker

6.2.7 Vessel Safety Systems

The International Safety Management (ISM) Code was developed by the International Maritime Organization (IMO), the international authority of maritime safety and an arm of the United Nations. The ISM code was designed to provide a clear link between the shore and sea staff in order to improve safety and preserve the marine environment from ship pollution. A key aspect of the ISM Code requires companies to have a verifiable safety management system in place. The code expects commitment from the executives of the shipping company and assigns responsibility to remedy deficiencies. Extensive audit requirements must be met, after which an ISM Certificate is issued. If, at any time, the ship is not in compliance with its certificate, it will not be allowed to leave the port.

Some of the modern safety systems on vessels today include;

- Inert Gas Systems;
  (Today, all tankers are required to have inert gas systems. These systems maintain the cargo tanks in an inert atmosphere so that there is not enough oxygen to support combustion. During cargo operations, inert gas is pumped into the cargo tanks. No tanker will be allowed to operate without a properly functioning inert gas system.)
- Redundant Steering Systems;
- Real-time instant satellite communications;
- Electronic Navigation Equipment;
- Global Positioning Satellite Systems (GPS);
- Radar and Collision Avoidance Equipment;
- Automatic Information System (AIS);
- Closed Cargo Loading and Discharge Operations (Figure 6.6);
  (Prior to the requirement for inert gas, when tankers loaded or discharged cargo, the open venting method was used. This meant that the hatch covers were open, allowing petroleum vapour to vent on the deck thus creating a dangerous situation. NLRC will also have a vapour recovery system for added protection and reduction of emissions.)
- Emergency Towing Systems.

6.2.8 Vessel Transit in Placentia Bay

All vessels will comply with MCTS Placentia Bay VTS Zone regulations on the transit through Placentia Bay. Pilotage is compulsory from the pilot station (off Argentia near Red Island Shoal) to the berth at the new refinery. Loaded crude oil tankers arriving at the terminal will be required to have a tug escort from the pilot station to the berth. NLRC tugs will be capable of tethered escort duties of tankers up to 350,000 DWT.

6.2.9 Vessel Berthing Operations

All vessels utilizing the Terminal will be required to use tugs provided by NLRC for the berthing operations. NLRC Tankers will be turned with tug assistance at a suitable distance from the berth to allow a parallel approach to the berth. Tugs will control the berthing velocity and place the vessel on the berth and hold the vessel while the mooring lines are being deployed. The vessel master shall secure the vessel at the berth with the appropriate number of mooring lines for the size of the vessel.

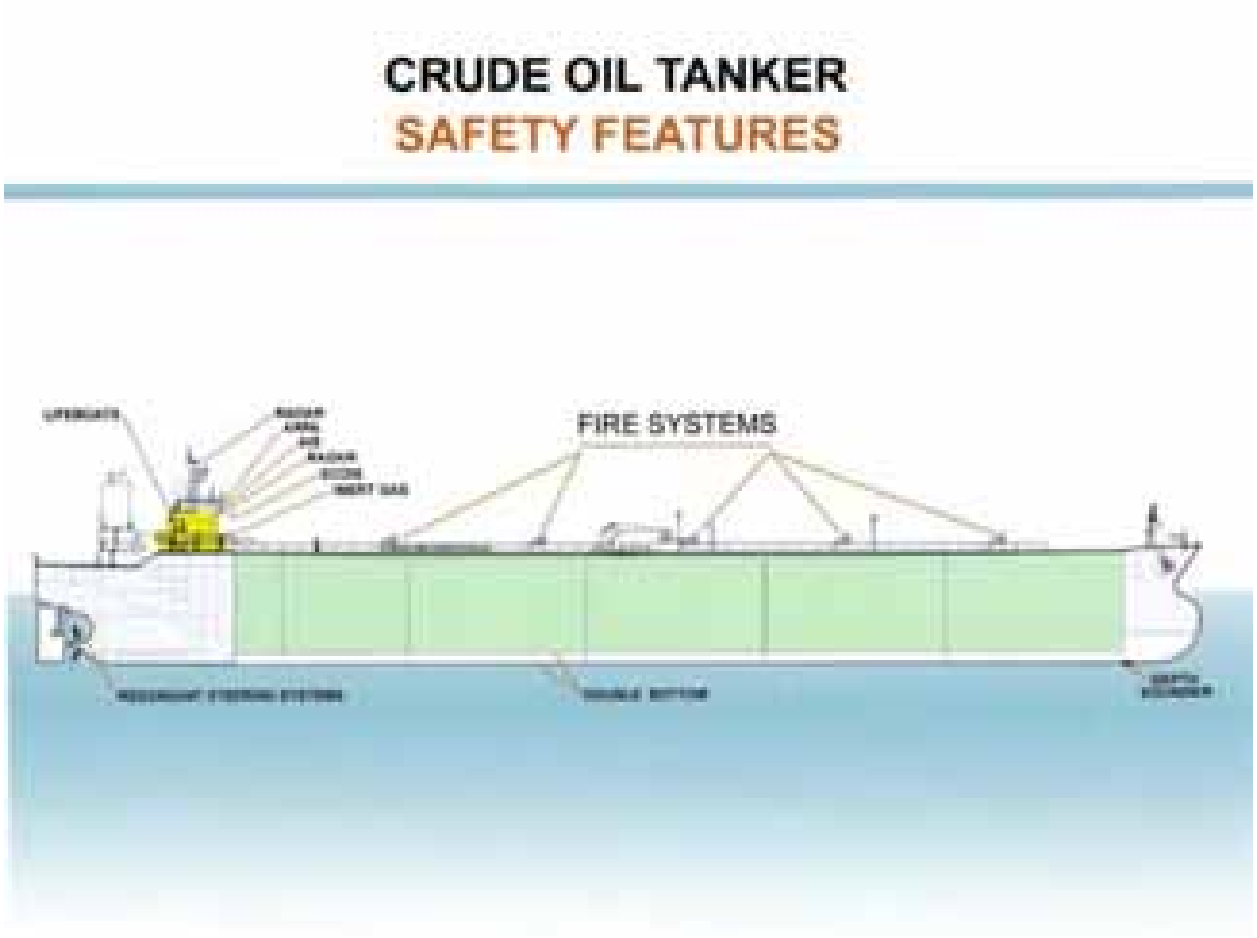

Figure 6.6 Oil Tanker Safety Features

6.2.10 Product Loading and Unloading

The vessel loading and offloading systems will discharge tanker cargoes quickly and efficiently, minimizing both vessel emissions and vessel time at berth. Offloading of Crude will be accomplished through the import piping systems. Large diameter pipelines and transfer systems will allow tankers to achieve offload at rates up to 100,000 barrels per hour (BPH). Onboard ship pumps will pump the crude to the crude storage tanks. Connection to tankers will be made with marine crude oil/product loading arms specially designed for the full range of vessel sizes and motions at the berth. Product loading rates will allow vessels generally to be loaded in a 24-hour period.

Loading of the sulphur and coke materials will be carried out via a closed conveyor system to eliminate fugitive dust emissions. The conveyor system will be connected to a ship loader on the

berth. The ship loader will be designed for the full range of vessel sizes and motions at the bulk materials berth.

The refinery plans to export the following material:

- Conventional gasoline;
- RBOB gasoline;
- Jet A/kerosene;
- Diesel;
- Sulphur;
- Coke.

The cargo transfer time will vary depending on the size of the tanker's pumps. It will range from 18-24 hours. The following activities will be carried out to assure the operation is proceeding according to the plan to detect any abnormalities:

- Continual observations by both tanker and terminal personnel of the tanker and marine terminal looking for any abnormalities. If an abnormality is observed, cargo operations will be stopped and an investigation will be conducted. Cargo operations will not resume until it is safe to do so;
- The marine terminal will be equipped with flood lights and operational cameras and monitoring equipment to detect leakage, spills or a change in position of the tanker while at the berth for early detection of any problem. Weather, wind and wave conditions will also be continuously monitored. The monitoring equipment is located in the control room which is manned 24 hours a day. Established parameters will be used to determine when conditions warrant stopping the discharge operation. If operating personnel detect any problem or the parameters are exceeded cargo operations will be stopped and an investigation will be conducted. Cargo operations will not resume until it is safe to so;
- When the cargo transfer is completed, cargo tanks will be inspected, documents will be signed and exchanged and cargo transfer arms will be removed;
- Loading/discharge operations shall be stopped in the event of electrical storms in the vicinity or when wind speeds reach a sustained 35 knots. Loading arms must be disconnected when wind speeds reach 40 knots. Tankers shall leave the berth if wind speeds reach a sustained 40 knots with a deteriorating forecast. Placentia Bay is considered ice free and the terminal should not be effected by ice during operations.

6.2.11 Marine Safety and Security

A safety management system will be implemented to continuously identify, reduce and manage safety risk. This safety management system will extend safety leadership and expertise through all levels of authority within the refinery and marine terminal design, construction and operation phases. Specific expectations and goals will be set for all levels of authority on the project. Safety indicators will be established, tracked and monitored. Safety auditing will be implemented. An effective stewardship program will also be established to allow senior

management to both understand and participate in the safety program and ensure that the safety culture established for the marine terminal is recognized as an integral part of everyone's responsibilities.

A Facility Security Plan (FSP) will be developed with all actions necessary to secure the facility at the various Maritime Security levels established by national and international agreements. The FSP contains the policies and procedures implemented at the Terminal to prevent unauthorized access and illegal activities. The FSP covers all security operations at the terminal, particularly the vessel–to–terminal interface. The FSP covers assignment of a Facility Security Officer, duties and responsibilities of personnel, training, drills, exercises, maritime security levels, vessel–to–terminal interface, documentation and record keeping, access control, restricted areas, cargo control, ship stores and bunkering, area monitoring and annual audits.

6.3 Emergency Response

6.3.1 Emergency Response, Safety and Firefighting Facilities

The Project's on-site emergency response, safety and firefighting facilities will be a self-contained emergency response group that will have the capability to deal with all anticipated emergency scenarios on-site. The Proponent anticipates forming strategic mutual aid agreements with other local industry and the surrounding towns to jointly support existing capacity in the area and improve the area infrastructure with regard to training and emergency response. The project will develop an Emergency Procedures Plan that includes consideration of the following:

- Types of emergency;
- Hazardous materials stored on-site;
- Emergency scenarios and consequences;
- Internal emergency resources, including: alarms, assembly areas, shutdown systems, gas detection systems, power supply, safety and emergency equipment, spillage collection and retention;
- Incident control centre and command structure responsibilities and duties;
- Procedures covering a range of projected emergency scenarios;
- Responsibilities for emergency communications;
- Emergency training, exercises and evaluation;
- Plan review and revision.

6.3.2 Refinery Emergency Response Program

General

All refinery personnel, contract workers and unescorted visitors will be required to complete an annual basic facility hazards awareness program, prior to proceeding into the operational areas

of the refinery. This program will include training to recognize emergency alarms and what to do in the event an alarm is sounded.

Refinery Employees

Refinery employees, as well as contractors, will undergo annual site safety training. This will cover hazard identification and avoidance, basic first aid, location of muster areas, escape routes, usage of a self-contained breathing apparatus, basic awareness of the refinery's firefighting equipment, fire extinguisher training on a live fire and usage of a fire hose.

Firefighting

The project will construct an on-site fire station with appropriate firefighting vehicles. A hazardous materials (HAZMAT) response trailer will also be stored on-site. The number and sizes of the firefighting equipment will be determined during detailed design when full hazard identification and response requirements are completed. The refinery is considering a live firefighting facility on-site, but may obtain usage of existing facilities.

The refinery will maintain a core group, fully trained and certified as a Fire Brigade and will be comprised of facility personnel that respond to refinery emergency situations involving fires and/or hazardous materials. The primary response group will be composed of on-shift operations personnel, with trained back-up being provided by day staff. The Fire Brigade personnel are expected to receive their initial training at the Fire Training School in Foxtrap and will have regular upgrading and training exercises to maintain skills. Training will be coordinated with other local area industry and Towns where possible.

Medical Facility and Personnel

The project will have a fully outfitted clinic with an on-site ambulance. Selected refinery personnel will be trained to respond to medical injuries at a basic emergency care level. The refinery will also have designated full-time employees who are certified as Emergency Medical Technicians (EMTs). Facilities will be in place to respond to all anticipated medical emergencies, stabilize the injured and provide rapid transportation to the hospital in Clarenville (1/2 hour away) or St. John's (1 ½ hours away). A helipad will be installed on-site for emergency evacuation of the critically injured.

Incident Command

Selected refinery employees will be trained as Incident Commanders. These employees will receive extensive training on emergency response and coordination. The refinery will conduct regular tabletop drills to reinforce the training and refine the procedures.

The new facility will be equipped with a central control room that can be used to control the facility remotely during an emergency. In addition, field control centres for individual units will

provide backup in an emergency situation. An emergency operations centre will be located in close proximity to the central control room and have direct communications links with the control room and radio communications with the response teams.

Off-site Responders Coordination

The refinery's Fire Brigade will participate in drills with other local area industrial and town Fire Departments in the area, an efficient local area response team and foster off-site responder capability.

Emergency events, spills and fires will be reported to local and provincial authorities. On-site emergency response teams will be first responders with immediate call-in of support as the situation requires

The Proponent intends to actively promote a local area Mutual Aid Organization, including the local town fire departments as well as the NARL and Whiffen Head fire departments. This mutual aid organization could provide additional response equipment, materials and personnel in the event of a large emergency anywhere in the local area.

Community Notification

The refinery will develop an emergency notification and response program to provide information and procedures for local area residents and industry regarding emergency situations in the area. The program will be communicated directly to the local residents and other potentially impacted groups by refinery personnel.

6.4 Maintenance

An effective maintenance program will allow the refinery to realize decreased labour costs, on-time delivery of shutdown projects and improved routine maintenance cycle time. This will ensure overall refinery efficiency. An effective maintenance program is an important tool for improving refinery operations, minimizing risk to the environment and ensuring maximum safety for employees.

An effective maintenance program can directly impact top-line sales, produce greater refinery safety and productivity and facilitate better decision making by improving availability and utilization.

An effective reliability-centred maintenance program will be put into place that will provide a program to mitigate the normal challenges faced in today's refinery industry. The refinery will develop a trained, knowledgeable and experienced workforce available to complete the required refinery maintenance work. Equipment monitoring and timely inspections will drive a proactive approach that will address equipment performance issues prior to any equipment failure.

A responsive mechanical prioritization and repair management system will provide prompt corrective action in the unlikely event that a critical piece of equipment unexpectedly fails. Planned unit turnarounds and regular scheduled maintenance using skilled tradesmen will keep the refinery at optimum performance levels. Maintenance practices and procedures will assist personnel in maintaining full compliance to all regulations and codes. Some maintenance repair activities will be contracted to certified specialty services off-site.

A large laydown area will be constructed to the north of the process area. It will be used for plant construction and also for extensive plant shutdowns and larger scale maintenance programs. This area will be used as a material storage yard for maintenance and turnarounds and has adequate space for a large workforce.

The plant layout has been designed to facilitate maintenance activities and major shutdown. The spacing of individual units, unit plot layout and equipment spacing is driven by loss prevention, safety and maintenance considerations. A wide ring road is provided completely around the process facility to provide ease of access to all areas for operations, emergency response and maintenance activities during operations.

Maintenance dredging will not be required at the marine terminal facilities.

7.0 DECOMMISSIONING AND ABANDONMENT

The initial design life of the refinery is 25 years. However, with continuous maintenance, re-fit, expansion, upgrading, modifications, etc., the final operating life of the refinery will be much longer and could extend to 50 years or greater. Upon completion of its operating life, the refinery will be decommissioned. The decommissioning and abandonment phase of the Project will help to reduce and remediate environmental impacts that are a result of Project infrastructure and activities. Re-usable equipment and machinery will be transported to other locations. Above-ground installations will be removed and underground installations will be either removed or left in place, depending on the environmental benefits of either option. Environmental contamination, if any, will be remediated in accordance with applicable environmental guidelines. Upon abandonment, the site will either be rehabilitated to a semi-natural state, or used for an alternate industrial or commercial development.

The following sections outline the management strategy that will be adopted during the decommissioning and abandonment phase. Updated details of the decommissioning procedure will be outlined in the Rehabilitation and Closure Plan, which will be prepared prior to decommissioning and adhere to applicable environmental regulations and standards that are in place at that time. Environmental protection procedures for the decommissioning phase will also be included in the Environmental Protection Plan. Preliminary considerations and current best management practices for refinery decommissioning and abandonment are discussed in the following sections. This discussion will focus on complete removal of operations and rehabilitation of the natural environment. It is assumed that this approach will include the most comprehensive environmental management requirements related to decommissioning and abandonment.

7.1 Relevant Legislation and Guidelines

Once refinery operations are complete, the project site will be decommissioned and rehabilitated for eventual abandonment. During this process, NLRC will follow applicable legislation and environmental standards to ensure that the proposed project site is left in a condition that approximates a healthy natural environment. It is possible, due to the nature of crude oil refining, that the project will impact the site in a negative way, particularly in relation to site contamination by petroleum hydrocarbons and process chemicals. All efforts will be made to prevent site contamination through monitoring and responsible operation; however, unexpected site impacts may be revealed at the decommissioning phase.

The Province of Newfoundland and Labrador and the Government of Canada have developed management strategies for sites that have been impacted by contaminating substances. Management strategies include the implementation of risk-based corrective action, environmental quality guidelines and contaminated site remediation guidelines. Legislation and

guidelines that may apply to the project site at the decommissioning and rehabilitation stage are described in the following subsections.

7.1.1 Provincial

Environmental Protection Act (2002)

Part VII, Section 26(2)

The environment at sites designated as contaminated sites by the Minister of the Environment and Conservation must be restored and secured to the satisfaction of the Minister. All the costs associated with restoration work must be provided by the proponent(s) of site activities. Sites are designated as contaminated sites by the Minister, based on the presence of substances or conditions that have caused, are causing or may cause adverse effects.

During site remediation an environmental site assessment and remedial action plan will be required. The requirements of these and other management and rehabilitation measures that must be taken at the site will be determined by the Minister.

Storage and Handling of Gasoline and Associated Products Regulations

Section 25

Storage tank systems that are out of use for 6 months, or another amount of time designated by the Minister, must be emptied of all liquids and vapours contained within storage tanks, connected piping and dispensing facilities. Tank systems including the dyke and any contaminated material, gasoline and associated products must be removed within 30 days of abandonment. The area must be restored to the satisfaction of the department.

Used Oil Control Regulations

The *Used Oil Control Regulations* outline requirements for appropriate storage, handling and disposal or use of used oil. These regulations aim to protect the environment from petroleum hydrocarbon-related contamination by prohibiting uncontrolled and inappropriate release of these substances to the environment.

Atlantic Risk-Based Corrective Action (RBCA)

Atlantic RBCA is the framework for developing risk-based corrective approaches to contaminated sites in the Atlantic Region. The RBCA approach is site-specific and aims to facilitate the remediation of contaminated sites for the protection of the environment and human health. The RBCA approach is commonly accepted in North America, and has been developed in cooperation with regulatory authorities.

Guidance Document for the Management of Impacted Sites

This document provides guidance to the required process for managing contaminated sites in the Province of Newfoundland and Labrador. Properly managed sites should result in satisfactory resolution of environmental contamination, which may be posing risk to both human and ecological health.

System Installation Inspection Manual – Heating Oil Storage Tank Systems

This manual is specific to home heating oil storage tank systems, but may provide additional guidance for appropriate management of small oil storage tank systems on the project site. Guidance is provided for both above ground and underground storage tank systems with emphasis on appropriate installation, alteration and removal of storage tank systems to prevent leaks and spills.

Policy Directive on Management of Impacted Sites

The *Policy Directive* was developed by the Department of Environment and Conservation to update and replace contaminated sites cleanup criteria. General provisions of the directive include:

- Protection of human health and the environment;
- Criteria and risk-based options to manage impacted/contaminated sites;
- Scientifically defensible at each step of the management process;
- Canadian Council of Ministers of the Environment *Canadian Environmental Quality Guidelines* as objectives for contaminated site cleanup;
- Management process to be completed in a timely manner.

7.1.2 Federal

Canada Wide Standards for Petroleum Hydrocarbons in Soil

The *Canada Wide Standards for Petroleum Hydrocarbons in Soil* set out the accepted levels to which contaminated sites must be remediated, when they require remediation. These standards provide a reference for soil test results and determine the need for, and extent of, remedial action.

Canadian Environmental Protection Act

Section 54(1)(b) prescribes the development of Environmental Quality Guidelines that must be adhered to under the Act. These guidelines are applied to Newfoundland and Labrador contaminated sites as objectives for site cleanup under the *Policy Directive on Management of Impacted Sites* (Government of Newfoundland and Labrador, 2004). The application of the guidelines should take into consideration the condition of the site and the risks associated with the characteristics and quantities of contaminants present.

Canadian Environmental Quality Guidelines

Canadian Water Quality Guidelines

The *Canadian Water Quality Guidelines* are subdivided into four categories based on water use.

1. *Water Quality Guidelines for the Protection of Aquatic Life* – Serve as guidelines for the protection of plants and animals that reside in water bodies. Acceptable levels for contaminants such as toxic substances, temperature and acidity are set based on toxicity data for sensitive plants and animals in order to provide a benchmark for the protection of habitat.

2. *Water Quality Guidelines for Agricultural Uses* – Serve as guidelines for the protection of sensitive crop species that may be exposed to contaminated irrigation water. Acceptable levels of contaminants are set based on maximum irrigation rates and the sensitivity of the crop to pollutants.

3. *Guidelines for Canadian Drinking Water Quality* – Serve as guidelines for the protection of human health by establishing maximum contaminant concentrations for drinking water. The guideline applies to all public and private drinking water supplies.

4. *Canadian Recreational Water Quality Guidelines* – Serve as guidelines for the protection of human health by setting maximum contaminant concentrations for water used for recreational purposes. The guidelines deal mainly with potential health hazards such as disease causing microorganisms, aesthetics and nuisance conditions.

Canadian Sediment Quality Guidelines

The *Sediment Quality Guidelines* were developed to protect aquatic organisms that live in and around lake or river sediment. The use of these guidelines should be combined with knowledge of water body characteristics, the effect of local environmental conditions on sediment quality, factors affecting the concentration of contaminants and factors that affect toxicity to aquatic organisms.

Canadian Tissue Residue Guidelines

The *Canadian Tissue Residue Guidelines* serve as guidelines for the protection of wildlife species that depend on aquatic organisms for food. The guidelines provide maximum limits for contaminant concentrations in the body tissues of aquatic food organisms that will not result in a negative impact at higher levels in the food chain.

Canadian Soil Quality Guidelines

The *Canadian Soil Quality Guidelines* serve to protect human and ecological receptors by setting maximum contaminant concentrations in soil. The guidelines are based on land use with defined exposure scenarios. Land use subdivisions include: agricultural, residential/parkland, commercial and industrial. The guidelines serve as a reference for soil testing and help to determine the degree of contamination, and thus the need for remedial action.

7.2 Rehabilitation

Decommissioning the proposed oil refinery will be completed in several stages. A staged approach will allow for organized rehabilitation of the project site and appropriate environmental control. Site rehabilitation will begin with deconstruction of the refinery. Deconstruction will involve complete removal of all storage tanks and piping systems and equipment related to the oil refining process and may involve complete demolition and excavation of roads, paved areas, structures and other associated works. Once removal of these materials has taken place, remediation or clean-up of contaminated areas will be performed where required. The site will then undergo remodelling to recreate a stable ground surface and rehabilitate natural drainage patterns for surface runoff. Revegetation of the area will be performed once remediation and remodelling of the area are complete.

7.2.1 Environmental Assessment

Approximately 3 years prior to decommissioning, the refinery site will be subject to a comprehensive environmental assessment. All records of spills, leaks and other environment-related incidents that occurred during refinery construction and operation should be reviewed. Non-intrusive investigation will be carried out on the entire site to determine unforeseen contaminated areas. Where contamination is expected, intrusive testing will be performed. In anticipation of site decommissioning, a Rehabilitation and Closure Plan should be developed. The Remedial Action Plan will be designed to protect human and ecological health in accordance with Provincial and Federal legislation and guidelines, as outlined in Section 7.1.

7.2.2 Deconstruction / Demolition

Site rehabilitation will begin with the removal of machinery and structures related to refinery operations. As outlined in *Newfoundland and Labrador's Storage and Handling of Gasoline and Associated Products Regulations*, all petroleum hydrocarbon-related storage tank systems, including piping, will be emptied and removed from the site. The extent of removal of other infrastructure will depend on the intended use of the site after abandonment and the environmental hazards associated with both removing and/or leaving the materials in place. The site will be evaluated to determine if portions of structures, such as foundations and concrete slabs, should be left intact to prevent further environmental damage.

Materials that result from deconstruction and demolition will be handled, stored and disposed or recovered according to legislation and best management practices. Decommissioning waste will be reduced where possible by reuse and recycling. Careful deconstruction can preserve machinery, structures and materials for use in similar applications. Salvageable metals, glass, asphalt, concrete and wood will be recycled by approved contractors and facilities. Materials that cannot otherwise be reused, recycled or used in energy recovery applications, will be disposed of in construction and demolition disposal sites, where available, or landfilled.

Once deconstruction and demolition are complete, the site will be cleared of all waste materials. Temporary housing, waste collection and sewage installations will be moved off-site. All machinery and tools related to deconstruction and demolition will be transported to alternate locations. The area will then be prepared for further assessment to determine the presence or absence of environmental contamination.

7.2.3 Remediation of Contaminated Areas

As required under *Newfoundland and Labrador's Environmental Protection Act* (Government of Canada, 1999) the site will be assessed to determine the presence or absence of environmental contamination. It is anticipated that remediation will be performed based primarily on the Atlantic RBCA protocol, and in accordance with other Provincial and Federal legislation of the time. The Rehabilitation and Closure Plan will outline the actions that will be taken during the remediation process. Details of the Rehabilitation and Closure Plan will depend on activities and incidents that occur during the lifespan of the proposed refinery project, and will therefore be created during the later stages of the project life. Any environmental incidents that cannot be addressed during refinery operation will be recorded, monitored and incorporated into the Rehabilitation and Closure Plan.

7.2.4 Rehabilitation of Surface Stability and Drainage Patterns

Once remedial action has been taken on contaminated areas, the site will be remodelled where necessary to improve stability of soils and the underlying geology, and to encourage the natural flow of surface runoff. This will be done to eliminate hazards associated with inconsistent or unstable land, and to prevent excessive erosion.

Stabilization will restore or improve the structural integrity of the site so that it can be used in future commercial or industrial applications, or reclaimed by the natural environment without posing risk to either animals or humans. Stabilization may include the construction or alteration of embankments to create stable slopes, vegetation to encourage stability and reduce erosion, and the installation of rip-rap revetment where necessary.

Runoff will be managed by restoring the flow of water into brooks and natural ditches. Culverts installed during site preparation and construction will be assessed to determine their suitability in the natural environment. Any infrastructure that remains on-site will be maintained and

replaced when necessary. Any infrastructure that inhibits natural surface or groundwater flow, such as causeways, wharves and culverts will be removed from the site and properly reused, recycled or otherwise disposed of.

7.2.5 Revegetation

Revegetating a site encourages further growth of plants and creates an environment that is available as animal habitat. Vegetation also helps to stabilize embankments, reduce surface runoff, prevent soil erosion and improve the overall health and quantity of soil on-site.

Native vegetation will be restored to areas where excavation and remodelling occur. Areas where soil and rock materials are compacted will be scarified to allow for aeration and increase soil moisture content. Hardy plants, bushes or trees will be planted where stabilization is required. Redundant roadways will be removed and seeded with vegetative cover. Other exposed soils will be revegetated with appropriate seed material. Any infrastructure that unnecessarily prevents the recovery of vegetation will be removed.

7.2.6 File official site closure documents

Closure documents will be submitted to regulatory authorities. These documents will summarize the activities that took place on-site, and discuss in detail the rehabilitation measures that were taken. Any remaining areas of concern or action that is or may be required in relation to site remediation, will be explained. Additional monitoring and maintenance plans will be included in the closure document. Close contact will be kept with regulatory authorities regarding the condition of the site.

7.3 Post-Decommissioning Monitoring

The following is an outline of post-decommissioning monitoring programs that are proposed for the refinery site at this time. Additional details and monitoring commitments will be provided in the Rehabilitation and Closure Plan.

7.3.1 Erosion Control Monitoring

The condition of temporary erosion control measures installed during decommissioning will be monitored, and repairs undertaken, until the site decommissioning supervisor authorizes their removal.

7.3.2 Slope Stability Monitoring

Monitoring of areas where corrective measures were implemented to maintain and enhance slope stability will continue until the slopes are deemed stabilized by the site decommissioning supervisor.

7.3.3 Revegetation Monitoring

The success of revegetation efforts will be assessed for two full growing seasons following seeding or tree planting (if applicable). Areas that remain exposed or where vegetation density is inadequate will be scarified and re-seeded (either manually or by hydroseeding) or replanted with appropriate tree seedlings.

7.3.4 Monitoring of Remediated Areas

During site decommissioning, appropriate techniques will be applied to remove contamination that threatens human and ecological health. Upon completion of remedial measures, samples of environmental components such as soil, water, river and ocean sediment and wildlife will be taken to demonstrate post-remediation compliance with applicable regulations.

Monitoring of areas impacted by hydrocarbons or substances of environmental concern will be performed in accordance with the Remedial Action Plan, or as directed by the regulatory authority. Generally, areas that were remediated during the decommissioning phase will require only confirmatory sampling to demonstrate regulatory compliance at the end of the remediation program. In locations where the Rehabilitation and Closure Plan does not require active remediation of contaminants, or where active remediation was found to be impractical, a long-term monitoring program may be undertaken as an alternative to ensure that the site does not pose future risk to human health or the environment.

8.0 EMISSIONS AND DISCHARGES

8.1 Introduction

The construction and operation of the refinery will result in various air emissions and effluent discharges into the surrounding environment. An inventory of all significant emissions and discharges has been prepared for both construction and operation phases. The inventory of emissions also identified expected greenhouse gas emissions (GHG) from the Project activities and a GHG Management Plan has been developed which incorporates continuous improvement and application of BATEA, and best management practices (BMPs) to reduce greenhouse gas emissions.

Air emission sources and methodology of estimating quantities and quality from each source are presented in the following sections.

All sources of effluent have been identified and characterized, methods of handling, treatment and discharges have been studied and presented in this Volume.

Various state-of-the-art air emissions and effluent discharge and dispersion models have been applied to study and evaluate the effects of these emissions and discharges on the receiving environment, habitat and human health as presented in Volumes 3 and 4 of the EIS.

The major sources of potential atmospheric pollution include combustion gases exhausted from process furnaces and boilers, as well as hydrocarbon vapours vented from process equipment and storage tanks. The major sources of liquid discharges are from the processing facilities, wastewater treatment plant, as well as offices and storm runoff.

Control and management of air emissions has been identified as an issue of interest to communities near the Project area. Site-wide modelling is carried out and the information provided in the Environmental Assessment (Volume 3). The refinery would be among the first to be built to modern standards in North America. Using advanced technology will greatly decrease the emissions from the refinery. BATEA will be implemented to control air emissions.

Emissions modelling will be incorporated into equipment selection and process and plant design, as well as compliance and effects monitoring. The Province has requested that the CALPUFF air dispersion model be used for air dispersion modelling. NLRC intends to initiate air quality monitoring on-site following project approval to establish baseline conditions.

The Canadian Council of Ministers of the Environment (CCME) issued the *National Framework for Petroleum Refinery Emission Reductions* in 2005. Both the Department of Environment and Conservation and the Department of Health and Community Services participated in development of the report and/or its background studies. This report and associated

background reports will be used as guidance regarding health indicators, benchmarking and emission monitoring. NLRC is working with Memorial University's Health Research Unit to establish a health profile for the communities in the general vicinity of the project site.

The National Framework primarily addresses the emissions of "criteria air contaminants." These are the focus of the air dispersion modelling for the proposed refinery: sulphur oxides, nitrogen oxides, volatile organic compounds (VOCs), particulate matter, carbon monoxide and benzene.

Air dispersion modelling considers both the new refinery alone and the combined or cumulative emissions from the new and existing refineries.

The dispersion modelling is based on an air emission inventory for the new refinery. The inventory considers:

- Plant and Process Description;
  - Number of units and process description of each,
  - Plant production capacity,
  - Plant location,
  - Plant layout, including major buildings and structures (to be considered for plume downdraft),
  - Specifications of typical crude oil to be refined,
  - List of process emission sources (stacks, vents, etc.) with their characteristics (height, diameter, exit velocity, emission rate and/or pollutants concentrations),
  - Quantity and nature of combustibles to be used.
- Tank Farm Operations;
  - Number of tanks,
  - Service of tanks,
  - Type of tank,
  - Operation information for each tank.
- Wastewater treatment;
  - API separators type and specifications,
  - Oily Water System design,
  - Amount of water to be treated and typical hydrocarbon content,
- Loading/Unloading Operations;
  - Monthly quantity and nature of material transferred for a typical year,
  - Type of vapour recovery or reduction system to be installed.
- Process Fugitive Emissions;
  - Number of components of each of these types: pumps, compressors, valves, flanges, etc.

- Mobile Sources;
  - Type and number of vehicles to be used in the refinery (operation),
  - Total amount of kilometres to be traveled,
- Other Sources;
  - Cooling towers, combined cycle power plants, refrigeration units, etc.

The results of the air dispersion modelling were presented and discussed with communities as soon as they were available. This dialogue has provided important input to equipment selection and to monitoring programs.

The National Pollutant Release Inventory (NPRI) has been established under the *Canada Environmental Protection Act* (Government of Canada, 1999). The Project will participate in NPRI reporting throughout its lifecycle. NPRI information is publicly available. Examples of activities that will be included in the NPRI report are wastewater treatment plants, diesel generators, any open burning of wood during site clearance and grubbing, quarrying and crushing, crude and product storage tanks and refinery emissions.

As stated above air- and water-monitoring will begin prior to construction, to obtain baseline data. Monitoring will continue during the construction and operations stages. Water monitoring has already started and will be completed for both marine environments and freshwater sources in the area.

8.2 Air Emissions – Construction Phase

8.2.1 Atmospheric Emissions

Various emissions will be associated with construction activities, which includes dust from site development, excavation, vehicular traffic and road construction, mobile equipment and vessels loading and offloading, etc.; also, emissions from temporary power generators, heaters, storage tanks, mobile equipment, etc. Construction methods and environmental control and mitigation measures considered for each activity have been described in detail in Chapter 5 of this volume.

Prior to the construction phase, the Proponent will prepare a general program to control atmospheric emissions of major heavy equipment.

This program will be incorporated into the contractors' specifications to make sure it is strictly enforced.

The program will include, among other items:

- A dust control program;
- Heavy equipment specifications to have recent equipment in good condition (to minimize air contaminants emissions);

- Heavy equipment maintenance program;
- Fuel oil specifications.

An environmental monitoring station will be installed at the property limit to verify the compliance to ambient air quality criteria.

8.2.2 Noise Control during the Construction Phase

Prior to the construction phase, the Proponent will prepare a general noise control program that will control the noise sources on the site.

This program will be incorporated into the contractors' specifications. The proponents representatives will make sure it is strictly enforced.

This program will include among other items:

- Maximum noise levels of major construction equipment (loaders, trucks, compactors, power generation equipment, etc.);
- Requirements to model construction noise in order to demonstrate noise criteria compliance in communities (day and nighttime).

A monitoring program will be established to verify compliance with applicable noise criteria during the construction phase, especially in the evening and during nighttime.

8.3 Air Emissions – Operations

8.3.1 Atmospheric Emissions Estimate

In the refinery, crude oil is converted into a variety of products, such as hydrocarbon fuels and feedstocks for the petrochemical industry. Crude oil will be transported to the refinery by marine vessel. The refined petroleum products will be exported by marine vessels.

Refining operations consist of separation processes, conversion processes, treating processes, feedstock and product handling, and associated auxiliary operations. The flow scheme of the NLRC refinery is determined by the composition of the crude oil and the chosen slate of products. (See Section 3.0)

The emissions associated with petroleum refining are described more fully in the following sections. In general, emission sources are either those resulting from the petroleum products (namely, VOC emissions) or those resulting from combustion sources at the refinery.

Volatile organic compound (VOC) emissions from refinery operations can be characterized as two types: process point source emissions and fugitive emissions. Process point source emissions are those emissions directly associated with or generated by a process unit. Process vents are an example of a point source emission. Fugitive emission sources are VOC emission

sources not specifically generated by a particular process unit. Such emission sources are found throughout a refinery and may or may not be associated with a process unit. They include valves, flanges, pump and compressor seals, cooling towers, storage tanks, transfer operations and wastewater treatment systems. Fugitive emissions also result from the evapouration of leaked or spilled hydrocarbon liquid and gases. Combustion sources at refineries result in emissions of SO_2, NO_x, CO, and particulate matter (Bounicore and Davis, 1992).

8.3.2 Methodologies Used to Estimate Pollutant Emission Rates

Storage Tanks

A refinery tank farm can be a significant source of VOC emissions. These emissions are a function of tank type, liquid characteristics, weather conditions and annual throughput. US EPA TANKS software was used to obtain estimates of VOC and benzene emissions from storage tanks.

The product types considered in this study are classified under six main categories:

- crude oil;
- intermediates;
- buffer/blending;
- product;
- fuel oil;
- sour water.

Except for the two crude oils (Arabian heavy and Arabian medium) mixture compositions were not available. Typical compositions given in TANKS were used for all other product types. Conventional gasoline and the Reformulated Blendstock for Oxygenate Blending (RBOB gasoline) benzene specifications were used in TANKS. These benzene concentrations were lower than the specified benzene fraction given in Table 15-8 of the CPPI Code of Practice (2006) , for emissions of benzene from TVOCs in a storage terminal.

The input parameters for the TANKS software included:

- the tank dimensions (height, diameter);
- tank description and contents;
- yearly turnover of product in each tank;
- liquid surface temperature;
- roof type (spherical, internal floating roof and fixed roof vertical storage tanks);
- number of tanks.

Meteorological data over 5 years (Head of Placentia Bay, 2002 to 2006) were also entered into the software in estimating the emissions from the storage tanks. Meteorological input data include:

- the local average atmospheric pressure;
- solar insulation factor;
- the monthly average of the maximum and minimum daily temperatures;
- average wind speeds.

Some of the storage tanks will contain liquids at higher than ambient temperature and contain intermediary products used in the refining operations.

In order to account for emissions for storage tanks containing liquids at higher than ambient temperature, it was necessary to assume and create an artificial meteorological file with average ambient temperatures matching those of the tank conditions, along with all the other meteorological input data taken as is. This is consistent with the EPA / API methodology that defines the TANKS software. Table 8.1 provides input parameters considered in the TANKS software.

The following assumptions for emission calculations were made in using TANKS:

- No emissions were calculated from spherical tanks except for fugitive emissions;
- For fixed roof tanks;
  - Maximum liquid height calculated from normal operating volume,
  - Mean height is 50 percent of maximum liquid height,
  - Roof is conic, with a slope of 0.0625,
  - External shell is white and in good condition.
- For internal floating roof tanks;
  - Storage tanks have internal columns for roof support,
  - Internal walls condition in TANKS set to “light rust”,
  - Column diameters unknown, and number of columns suggested by TANKS,
  - External shell and roof surface are white and in good condition,
  - Primary seal is “vapour-mounted” and secondary seal is “rim-mounted”,
  - Bridge is “welded” and its fittings are “typical”,
  - For artificial meteorological file, for hot tanks, the minimum, maximum and average annual temperatures were set at 34.5^{o}F, 140^{o}F and 87^{o}F, respectively.

Calculated annual total losses of VOC and benzene are presented in Table 8.2. Sour water storage tanks produce emissions of hydrogen sulphide and ammonia. The VOC emissions from sour water tanks are expected to be negligible.

The selection of tank type for each application was based on the CCME Environmental Guidelines for Controlling Emissions of Volatile Organic Compounds from Aboveground Storage Tanks. This ensures that BATEA is applied to the atmospheric storage tanks to ensure that emissions from tank farm operations are minimized.

Process Unit Emissions via Stacks

Process units that are emission sources of the pollutants covered in the study include:

- Hydrocracker;
- Diesel HTU;
- Kerosene HTU;
- Naphtha HTU;
- Coker Naphtha HTU;
- Atmospheric and Vacuum Distillation;
- Utility Plant;
- Hydrogen Plant;
- Reformer;
- Delayed Coking;
- Acid Gas Flare Stack;
- High Pressure Flare Stack;
- Low Pressure Flare Stack.

The process units and their service type, along with percent burner efficiency, burner combustion fuel source, total heat-fired and head absorbed data were provided for the study (Table 8.3). Two types of combustion fuels were specified:

- residual fuel oil No. 6 with a sulfur content of 0.7 percent wt and a heating value of 146,000 Btu/gal;
- refinery fuel gas with a hydrogen sulfide content of 20 ppm and a heating value of 1,265 Btu/scf.

Low NO_x burners will be used in the refinery. Emission factors for NO_x were selected as per Newfoundland and Labrador Regulation 39/4. US EPA AP-42 emission factors were selected from Chapter 1.3 for fuel oil combustion and Chapter 1.4 for natural gas combustion. The emission factors were selected based on varying firing configurations and on total heat fired for each burner. The total fuel required by the burners was calculated from the given data.

Table 8.1 Input Parameters Considered in the TANKS Software

Tank Description	Representative TANKS Component	Average Liquid Surface Temperature (°F)	Diameter (ft)	Height (ft)	No. of Tanks	Unit Normal Operating Volume (bbl/tank)	Total Normal Operating Volume (bbl)	Roof Type	Turnover (per yr)
Crude	Crude Oil (RVP 5)	42	260	60	12	500,000	6,000,000	Internal Floating Roof	18.25
Product									
Conventional Gasoline	Gasoline (RVP 10)	42	260	60	2	503,468	1,006,936	Internal Floating Roof	26.07
RBOB Gasoline	Gasoline (RVP 9)	42	220	60	2	345,828	691,656	Internal Floating Roof	26.07
Diesel	Distillate Fuel Oil No. 2	42	260	60	4	518,196	2,072,784	Fixed Roof	26.07
Kerosene	Jet Kerosene	42	240	60	2	431,690	863,380	Fixed Roof	26.07
Buffer / Blending									
BenSat Product	Gasoline (RVP 10)	87	150	48	1	136,500	136,500	Internal Floating Roof	1
Basestock	Gasoline (RVP 10)	87	180	48	2	170,063	340,125	Internal Floating Roof	1
Reformate	Gasoline (RVP 10)	87	150	48	1	112,546	112,546	Internal Floating Roof	1
Isomerate	Gasoline (RVP 10)	87	90	48	1	42,000	42,000	Internal Floating Roof	1
Intermediate									
Naphtha Intermediate	Gasoline (RVP 10)	87	200	60	1	270,000	270,000	Internal Floating Roof	1
Coker Naphtha Intermediate	Gasoline (RVP 10)	87	160	48	1	135,000	135,000	Internal Floating Roof	1
Naphtha / Distillate Swing	Gasoline (RVP 10)	87	200	60	1	270,000	270,000	Internal Floating Roof	1
VGO Tank	Distillate Fuel Oil No. 2	87	200	60	3	270,000	810,000	Fixed Roof	1
Coker Gas Oil Intermediate	Distillate Fuel Oil No. 2	87	200	60	1	270,000	270,000	Fixed Roof	1
Kerosene / Diesel Intermediate	Jet Kerosene	87	200	60	1	270,000	270,000	Fixed Roof	1
Light Slop	Gasoline (RVP 10)	87	140	48	1	90,000	90,000	Internal Floating Roof	1
Heavy Slop	Distillate Fuel Oil No. 2	87	140	48	1	90,000	90,000	Fixed Roof	1
Fuel Oil									
Fuel Oil	Residual Fuel Oil No. 6	160	220	48	2	260,400	520,800	Fixed Roof	26.00
Coker Feed	Residual Fuel Oil No. 6	160	240	48	2	315,000	630,000	Fixed Roof	17.38
Sour Water									
Sour Water Storage Tank		42	150	60	2	170,000	340,000	Fixed Roof	1

Table 8.2 VOC and Benzene Annual Emissions from Tanks

Tank Description	Representative TANKS Component	No. of Tanks	Annual losses (lbs/tank)	Total Annual Losses (t)	Benzene Annual losses (lbs/tank)	Benzene Total Annual Losses (t)
Crude – Arabian heavy		6	5,957	16.2	17.45	0.047
Crude – Arabian medium	Crude Oil (RVP 5)	6	5,632	15.3	30.76	0.084
Product						
C3 LPG	N/A	2	0	0	0	-
C4 LPG	N/A	2	0	0	0	-
Conventional Gasoline	Gasoline (RVP 10)	2	17,153	15.5	30.48	0.028
RBOB Gasoline	Gasoline (RVP 9)	2	10,672	9.7	23.64	0.021
Diesel	Distillate Fuel Oil No. 2	4	7,186	13.0	16.87	0.031
Kerosene	Jet Kerosene	2	7,776	7.0	60.76	0.055
Buffer / Blending						
BenSat Product	Gasoline (RVP 10)	1	19,889	9.0	48.01	0.022
Basestock	Gasoline (RVP 10)	2	29,953	27.1	72.3	0.066
Reformate	Gasoline (RVP 10)	1	19,888	9.0	48	0.022
Isomerate	Gasoline (RVP 10)	1	12,404	5.6	29.94	0.014
Intermediate						
Naphtha Intermediate	Gasoline (RVP 10)	1	34,409	16	83.06	0.038
Coker Naphtha Intermediate	Gasoline (RVP 10)	1	25,733	12	62.11	0.028
Naphtha / Distillate Swing	Gasoline (RVP 10)	1	34,409	16	83.06	0.038
VGO Tank	Distillate Fuel Oil No. 2	3	27,401	37	50.58	0.069
Coker Gas Oil Intermediate	Distillate Fuel Oil No. 2	1	27,401	12.4	50.58	0.023
Kerosene / Diesel Intermediate	Jet Kerosene	1	35,323	16.0	216.55	0.098
Light Slop	Gasoline (RVP 10)	1	18,869	8.5	45.54	0.021
Heavy Slop	Distillate Fuel Oil No. 2	1	11,709	5.3	21.62	0.010
Fuel Oil						
Fuel Oil	Residual Fuel Oil No. 6	2	416	0.38		0.000
Coker Feed	Residual Fuel Oil No. 6	2	397	0.36		0.000
Sour Water*						
Sour Water Storage Tank		2	14,654	13		-
Total				251		0.71

Table 8.3 Input Data for Emissions Rate Calculation from the Stacks

Stack No.	Unit	Service	Qty of Fired Heaters	Heat Absorbed (MMBTU/hr)	Total Heat Fired (MMBTU/hr)	% Eff.	Fuel Type
1	Hydro cracker	Recycle Gas Htr Unit 1	1	101	113	90%	Gas
2	Hydro cracker	Product Frac Fd Htr Unit 1	1	144	160	90%	Oil
3	Hydro cracker	Recycle Gas Htr Unit 2	1	101	113	90%	Gas
4	Hydro cracker	Product Frac Fd Htr Unit 2	1	144	160	90%	Oil
5	Diesel HTU	Combined Feed Htr	1	53	59	90%	Gas
6	Kero HTU	Rx Charge Htr	1	24	27	90%	Gas
7	Kero HTU	Stripper Reboiler	1	85	95	90%	Gas
8	Naphtha HTU	Charge Htr	1	51	57	90%	Gas
9	Naphtha HTU	Stripper Reboiler	1	93	103	90%	Gas
10	Naphtha HTU	Splitter Reboiler	2	177	196	90%	Gas
11	Coker Naphtha HTU	Rx 2 Charge Htr	1	29	35	83%	Gas
12	ADU	Crude Heater	3	453	539	84%	Oil
13	VDU	Vac Heater	2	243	290	84%	Gas
14	Utility	650# Steam Boiler	2	476	567	84%	Oil
15	Utility	150# Steam Boiler	2	241	287	84%	Oil
17	H2 Plant	Reformer	1	225	268	84%	Gas
18	H2 Plant	Reformer	1	225	268	84%	Gas
19	CCR	Charge Htr, Htr 1, Htr 2, Htr 3	4	523	575	91%	Gas
21	TGT/TO	Incinerator		-	-	-	
22	Delayed Coker	Coker Htr 1	1	156	173	90%	Gas
23	Delayed Coker	Coker Htr 2	1	156	173	90%	Gas
24	Delayed Coker	Coker Htr 3	1	156	173	90%	Gas

Emission estimates from these process units (Table 8.4) were made for:

- SO_2 (based on method for conversion as per AP-42 recommendation);
- NO_x (expressed as NO_2);
- CO, VOC, CO_2;
- CO_{2Eq} (for greenhouse gases of methane, N_2O and CO_2 emissions rolled-up);
- filterable particulate matter PM;
- total condensable PM, $PM_{2.5}$, PM_{10};
- Total Organic Compounds (TOC);
- non-methane TOC;
- formaldehyde and polycyclic organic matter (POM).

For SO_3, POM and NMTOC, there are no standard emission factors given in AP-42 for natural gas combustion. Neither are there standard emission factors given for VOC based on fuel oil combustion. Particle size distribution estimates for $PM_{2.5}$ and PM_{10} were made based on percentages of total PM in uncontrolled emissions, given by AP-42. Furthermore, emissions of organic compounds such as n-alkanes C_2 to C_6, BTX compounds, polycyclic aromatic hydrocarbons PAH, OCDD dioxin, naphthalene and trichlorethane were also estimated based

on fuel oil and natural gas combustion sources, as provided in AP-42, when applicable. Emissions of benzene were also estimated using natural gas and residual fuel oil No. 6 combustion sources. Finally, emissions of metals (18 elements) were accounted for including lead, zinc, nickel, cadmium, mercury, chrome, etc. Emission factors for the metals were also obtained from AP-42.

Consideration will be given to combining stacks, where appropriate, for the purpose of developing the dispersion model.

Table 8.4 Estimation of Emissions from these Process Units (T/Year)

Stack No.	Unit	SO_2	NO_x	CO	PM	PM_{10}	$PM_{2.5}$	NMTOC	VOC	Benzene	CO_{2eq}
1	Hydro cracker	1.2	42	30	2.7	2.7	2.7		1.9	7.4E-04	42537
2	Hydro cracker	478	133	22	48	43	30	1.22		9.3E-04	108899
3	Hydro cracker	1.2	42	30	3	2.7	2.7		1.9	7.4E-04	42537
4	Hydro cracker	478	133	22	48	43	30	1.22		9.3E-04	108899
5	Diesel HTU	0.64	14.3	16	1.4	1.4	1.4		1.0	3.9E-04	22381
6	Kero HTU	0.29	6.5	7	0.64	0.64	0.64		0.46	1.8E-04	10164
7	Kero HTU	1.02	23	25	2.3	2.3	2.3		1.6	6.2E-04	35666
8	Naphtha HTU	0.61	13.7	15	1.4	1.4	1.4		1.0	3.7E-04	21460
9	Naphtha HTU	1.1	38	27	2.5	2.5	2.5		1.8	6.8E-04	38927
10	Naphtha HTU	2.1	73	52	4.7	4.7	4.7		3.4	1.3E-03	74078
11	Coker Naphtha HTU	0.37	8.3	9	0.83	0.8	0.8		0.60	2.3E-04	13103
12	ADU	1,611	449	73	163	144	101	4.1		3.1E-03	367252
13	VDU	3.1	107	76	6.9	6.9	6.9		5.0	1.9E-03	109212
14	Utility	1,694	472	77	172	76.5	54	4.3		3.3E-03	386142
15	Utility	858	239	39	87	65	41	2.2		1.7E-03	195544
16	H2 Plant	2.9	99	71	6.4	6.4	6.4		4.6	1.8E-03	754638
17	H2 Plant	2.9	99	71	6.4	6.4	6.4		4.6	1.8E-03	754638
18	CCR	6.2	213	152	14	14	14		10	3.8E-03	216926
19	TGT/TO	94									82401
20	Delayed Coker	1.9	64	46	4.1	4.1	4.1		3.0	1.1E-03	65327
21	Delayed Coker	1.9	64	46	4.1	4.1	4.1		3.0	1.1E-03	65327
22	Delayed Coker	1.9	64	46	4.1	4.1	4.1		3.0	1.1E-03	65327
	Total	**5,241**	**2,394**	**949**	**584**	**521**	**386**	**13**	**47**	**2.8E-02**	**3581383**

Process Vents

There will be a number of process vents in both continuous and intermittent use within the refinery. Details regarding the application, number and type of vents will be developed during the engineering phases of the project. Process vents will be minimized as much as practicable. BATEA will be applied to control emissions from process vents.

Process Fugitive Emissions

Fugitive Emissions are emissions of VOC due to minor equipment leaks, process upsets, sampling procedures and process turnarounds. Equipment will be selected to minimize or eliminate process fugitive emissions by the application of BATEA.

Fugitive emissions are a function of equipment quantity and the emission rate of each individual piece of equipment. The equipment emission source inventory for refineries is based on data from the CPPI Code . It is estimated that 196 pumps and 31 compressors will be used in the refinery. The average component count for equipment in both light liquid and gas service was obtained from Table 3-1 in the CPPI Code, enabling the estimation of the source counts for emission points. The correlation factors presented in Table 3-4 of the CPPI Code were then applied to obtain TOC emission estimates from fugitive emission sources. These correlations predict TOC emission rates (including non-VOCs such as methane and ethane)[1]. The average emission rate from fugitive sources for each type of component was then calculated, and is presented in Table 8.5.

The emissions for benzene were estimated based on information obtained in CPPI Code of Practice. This recommends a refinery speciation profile of TVOCs, with 1.72 percent benzene composition (typical for TVOCs). There are no existing norms for TOC or VOC emission rates from fugitive sources, so average TOC emission rates were used, giving a more conservative approach. Emissions factors for pump seals and compressor seals were selected as zero based on the assumption that dual mechanical seals would be installed on all pumps and that the BATEA would be used for compressors.

[1] These equations were originally provided in the “Protocol for Equipment Leak Emission Estimates EPA-453/R-95-017,” November 1995 document. In order to use this method, a screening value was attributed to each process fugitive emission source. The screening value distribution for each component type was based on SNC-Lavalin Environment’s (SLEIs) experience in refinery processes.

Table 8.5 Process Fugitive Emissions

Sources	Average Component Counts	Source Counts	TOC Correlations Factors Kg/h/source	Average Emission kg/h	Average Emission t/year
Pumps	**196**				
Valves per pump	41	8,036	E = 2.29 * 10^-6 * C^0.746	1.05	9
Flanges per valves	4.1	32,947.6	E = 4.61 * 10^-6 * C^0.703	6.54	57
Mixer seals	1	196	E = 1.36 * 10^-5 * C^0.589	0.06	0.5
Pump seals per pump	1.35	264.6	E = 5.03 * 10^-5 * C^0.610	0.32	2.8
Compressors	**31**				
Valves per compressor	133	4123	E = 2.29 * 10^-6 * C^0.746	0.54	5
Flanges per valves	4.1	16,904.3	E = 4.61 * 10^-6 * C^0.703	3.36	29
Compressor seals per compressor	2	62	E = 1.36 * 10^-5 * C^0.589	0.02	0.16
Total TOC					**104**
Benzene					**1.8**

Wastewater Treatment and Cooling Towers

The main sources of atmospheric emissions from the wastewater collection and treatment systems are VOCs and benzene that evaporate from the surfaces of wastewater. The control of wastewater collection and treatment system emissions involves adding vapour tight covers where emissions are greatest (e.g. such as with oil/water separators). In this study, two sources of wastewater emissions are considered:

- those from cooling towers;
- wastewater treatment plants.

Atmospheric emissions from cooling towers would normally consist of VOCs and some dissolved gases, such as hydrogen sulfide and ammonia, which enter the cooling system from leaking heat exchangers and condensers. However, the cooling tower in this refinery is a closed loop system with sea water being used as the cooling medium. As such, the cooling tower does not contact water that contacts the refinery heat exchangers. Consequently, no VOC or other emissions are expected from the cooling tower itself. Any VOC or other emissions that might normally be expected from the cooling tower will instead come from the vent on the tempered water loop pump surge drum. The standard methodology for determining emissions from cooling towers has been used to determine the emissions rate from the cooling water vent.

Concerning wastewater treatment processes, these vary greatly by refineries, and generally include oil/water separators and air flotation.

The emissions and multiplication factors of VOCs and benzene were estimated using emission factors and assumptions found in AP-42 and in the CPPI Code of Practice (Table 8.6). In the absence of cooling water rates and wastewater flow rates, AP-42 recommends applying 40 times the refinery feed rate in the case of cooling water rates and 0.95 times the refinery feed rate for wastewater flow rates. The refinery feed rate is defined as the crude oil feed rate to the atmospheric distillation unit (ADU). The selection of the emission factors was made based on controlled emissions. CPPI Code Table 7-3 provided the emission factor applied for oil/water separators. Emission rates for benzene from the oil/water separators were obtained using the recommended speciation profile of TVOCs in the refinery, where benzene is given as 1.72 percent of TVOCs. The results of the VOC emissions from the cooling towers may also include emissions of H_2S and ammonia.

Table 8.6 Wastewater Treatment and Cooling Water System Emissions

Emissions	Units	Cooling Water System	Wastewater Treatment
Multiplication Factor	-	40	0.95
VOC Emission Factor	$kg/10^3 m^3$	0.08	
	kg/m^3		0.0033
VOC emissions	t/year	**56**	**55**
Benzene emissions	t/year	**0.96**	**0.94**

Ship Loading

Loading losses occur as organic vapours in empty cargo hulls are displaced to the atmosphere by the liquid loaded into the vessels. Unloading losses are accounted for in storage tank emissions and are not covered in this section. These were accounted for using TANKS software. The ships will be filled with submerged lines rather than splash filled. Ballast emissions are excluded during unloading. It was assumed that BATEA use would require double-hulled cargo ships for the transportation of product, eliminating this type of emission. Loading/unloading emissions consist mainly of VOCs including benzene (Table 8.7).

Table 8.7 Input Parameters

Products	Ship Type	Tonnage of Vessel DWT	Number of Ships/Year
Crude type 1, 2 and 3	VLCC	319,000	39
Crude type 1, 2 and 3	Suezmax	150,000	27
Gasoline	Handymax	50,000	20
Gasoline	Handymax	40,000	8
Gasoline	Handymax	30,000	11
Kerosene	Panamax	60,000	12
Kerosene	Handymax	50,000	15
Kerosene	Handymax	40,000	18
Kerosene	Handymax	30,000	25
RBOB	Handymax	50,000	17
RBOB	Handymax	40,000	16
RBOB	Handymax	30,000	22
Diesel	Panamax	80,000	45
Diesel	Handymax	50,000	48
Sulphur	Bulk Carrier	20,000	73
Coke	Bulk Carrier	60,000	25

The input parameters include:

- the product transported;
- the type of ship used;
- tonnage of the vessel (in deadweight ton);
- the number of ships per year to be passing through the port.

VOC emission factors and estimated quantities for gasoline loading operations at marine terminals were taken from AP-42, with the assumption of a clean vessel tank. In the estimation of VOC and petroleum liquids emission rates, a recovery efficiency of 95 percent was applied in reducing emissions during loading operations. Total emissions for these pollutants calculated take into account this recovery efficiency. The estimation of benzene emissions was carried out by applying the specified benzene compositions in the conventional gasoline and RBOB blends. Thus benzene emissions represent a certain percentage of the VOC emissions, and also accounts for 95 percent recovery efficiencies. Table 8.8 provides a summary of the estimated ship loading emissions.

Table 8.8 Ship Loading Emissions

Results	Loading Operations	
	VOC (t/year)	Benzene (t/year)
Gasoline loading	1,023	6.75
Petroleum liquid loading	6	0.0001
Total raw	**1,029**	**7**
Gas recovery efficiency	95%	
Total emitted	**51**	**0.34**

Vessel Operation Emissions

Maritime manoeuvring operations for which emissions of pollutants are considered include ship approach into the Head of Placentia Bay to account for the time to arrive at the site, berthing manoeuvres, emissions from loading/unloading operations, re-berthing manoeuvres, and the time to leave the Head of Placentia Bay during departure. The input information considered in the vessel operations emissions estimates are the same as that used for ship loading operations described earlier. During each stage of vessel operations, emissions will vary based on various procedures used, as follows:

- Approach and departure from the site involve VOC emissions during cargo transit from the ship's storage tanks, as well as emissions of pollutants from the main engine and auxiliary engine power of the ship;
- Main engine power is applied during manoeuvres such as the slow cruising during approach, berthing/re-berthing operations and departure from the site, to propel the ship;
- Auxiliary power is used mainly to power the ship's utilities and provide electricity. During berthing/re-berthing and loading and unloading operations, the power output required from the auxiliary engines is higher compared to slow cruise and departure;
- VOC losses from the storage tanks are also considered during berthing/re-berthing operations;
- The emissions of VOC and benzene during transit from gasoline blends were calculated using AP-42. The presence of benzene in kerosene and diesel are considered to be negligible;
- Emissions were also considered from the main engine and auxiliary engines powering the tugboats used during berthing/re-berthing operations, enabling the ship to position itself properly at the pier;
- Once at the pier, the main engine is turned off and emissions during loading and unloading result only from the auxiliary engine and the ship's boilers used to generate the steam required to power the transfer pumps.

US EPA "Analysis of Commercial Marine Vessels Emissions and Fuel Consumption Data, EPA420-R-00-002," February 2000 edition, was consulted to obtain the emission rate algorithms. For all pollutants for which emission rates have been estimated, the marine engine emission factor and fuel consumption algorithms given in EPA were used. The emission rates for SO_2 apply a similar equation, which also accounts for fuel consumption and the sulphur content of the fuel. These emission factor and fuel consumption rate algorithms are applicable to all engine sizes. Emission rates were considered for:

- total hydrocarbons;
- total PM, $PM_{2.5}$, PM_{10};
- NO_x (expressed as NO_2);
- SO_2;
- CO, CO_2 for all stages of vessel operations with the addition of N_2O, TOC and methane emissions during loading/unloading operations.

Greenhouse gases, rolled-up as CO2EQ were calculated during loading/unloading stages mainly originating from boiler combustion and the CO_2 emitted from auxiliary engine power.

The particulate fractionation into $PM_{2.5}$ and PM_{10} were estimated based on the percentages recommended in "Exhaust and Crankcase Emission Factors for Non-road Engine Modelling Compression – Ignition, EPA420-P-04-009", April 2004.

The main engines are powered by heavy fuel oil with sulphur content of 2.7 percent, while the auxiliary engines and boilers are fed marine diesel oil containing 1.5% sulphur. The sulphur content in these two fuel sources represents a conservative approach so that the emissions will be overestimated. Normally however, as more stringent regulations limiting the content of sulphur in these types of fuels will come into effect in the coming years, the sulphur emissions will decrease. A boiler efficiency of 90 percent was applied.

The main engine power for the cargo ships was not specified and was calculated from the bulk carriers and tankers equation given in the EPA420-P-04-009 document. The auxiliary engine loads for the ships, in different stages of the manoeuvres were also taken from the EPA document.

The main engine power rating for tugboats was obtained from the EPA document, while the auxiliary power was not specified, and was assumed to be the same as that of the cargo ship during berthing/re-berthing operations.

The emission rates of pollutants originating from the ship's boilers were estimated based on SLEI experience. It should be noted that the cleaned flue gases generated from the boilers are assumed to be partially (36 percent) reused as inert gases in the cargo ship's storage tanks.

Emission rates for benzene were estimated based on the percentage specified for the mixtures as 0.62 percent in the conventional gasoline, 0.69 percent in the RBOB blend gasoline and an average of 0.855 percent in the Arabian crude oil.

The results of the above estimates of vessel operations emissions are summarized in Table 8.9.

Table 8.9 Vessel Operations Emissions (t/year)

Products	SO_2	No_x	CO	PM	PM_{10}	$PM_{2.5}$	VOC	Benzene	CO_{2eq}
Crude type 1	71	46	8.4	1.3	1.2	1.1	38	0.34	4,832
Crude type 2	71	46	8.4	1.3	1.2	1.1	38	0.34	4,832
Crude type 3	71	46	8.4	1.3	1.2	1.1	38	0.34	4,832
Crude type 1	35	22	3.8	0.64	0.6	0.54	14	0.12	2,530
Crude type 2	35	22	3.8	0.64	0.6	0.54	14	0.12	2,530
Crude type 3	35	22	3.8	0.64	0.6	0.54	14	0.12	2,530
Gasoline	58	36	5.8	1.1	0.98	0.88	23	0.15	4,390
Gasoline	24	15	2.3	0.43	0.40	0.36	7.8	0.05	9,353
Gasoline	31	19	3.0	0.57	0.52	0.46	7.9	0.05	2,371
Kerosene	37	23	3.7	0.67	0.61	0.56	0.48	0.01	2,735
Kerosene	43	27	4.3	0.79	0.72	0.65	0.55	0.01	3,243
Kerosene	52	32	5.1	0.96	0.87	0.79	0.65	0.01	3,973
Kerosene	68	42	6.6	1.2	1.1	1.02	0.82	0.01	5,232
RBOB	50	31	5.0	0.92	0.84	0.76	20	0.14	3,795
RBOB	46	28	4.5	0.84	0.77	0.69	15	0.11	3,495
RBOB	60	37	5.8	1.1	1.00	0.90	15	0.11	4,592
Diesel	140	88	14	2.6	2.4	2.1	1.9	0.03	10,335
Diesel	139	86	14	2.5	2.3	2.1	1.8	0.03	10,502
Sulphur	197	120	19	3.6	3.3	2.9	2.2	0.04	15,270
Coke	76	47	7.7	1.4	1.3	1.2	0.95	0.02	5,694
Total	**1,342**	**833**	**137**	**25**	**23**	**20**	**254**	**2.2**	**10,7066**

Flares

For this refinery, there will be three flare systems; one at high pressure, another at low pressure and a third for acid gas flaring. To estimate flare emissions, the total thermal release from all three flare systems was combined under one flare total thermal release that was used as input information to arrive at emission estimates. The total thermal release parameter used was 111 MMBtu/day (combining all three flare lines). Emissions estimates were prepared using the following factors:

- Factors for estimating emission rates for CO, NO_x and total hydrocarbons were obtained from AP-42.
- The average volume composition in total hydrocarbons (AD-42) considers the emissions of methane, ethane/ethylene, acetylene, propane and propylene emissions.
- The flare gas heating value and sulphur levels in the flare gas were taken from the CPPI code.

- For the distribution size of particulate matter, AP-42 was consulted for the emission factor of filterable PM and the sample calculation for estimating flaring emissions presented in Appendix D of the CPPI code was applied to obtain the emissions of PM_{10} and $PM_{2.5}$. It is being assumed that PM_{10} and $PM_{2.5}$ emissions are 100 percent of PM emissions.

The results of the above estimates are shown in Table 8.10 below.

Table 8.10 Flare Emissions (t/year)

	SO_2	NO_x	CO	PM	PM_{10}	$PM_{2.5}$	Total Hydrocarbons
Total Emissions	6.2	1.25	6.8	0.035	0.035	0.035	2.57

8.3.3 Summary of NLRC Refinery Emissions

Table 8.11 summarizes the overall refinery atmospheric emissions. (It should be noted that the methodology used herein is conservative, which means that the emissions rate overestimates the real emissions expected at plant start-up.)

These estimates also use the worst-case scenario specified in the project. For example, the fuel oil was assumed to have a maximum sulphur content of 0.7 percent w. In practice, the actual average concentration will be lower.

These estimates are considered to be the best estimation possible at the present time (i.e., at the preliminary engineering phase). As the detailed engineering progresses, all these estimates will be reviewed and are expected to reduce the value presented in Table 8.11.

The refinery will be engineered to use the BATEA from the petroleum industry in order to minimize atmospheric emissions at source. The Proponent will use BATEA for all significant emissions.

Also during the engineering phase, an emission management program will be developed. All sources of emissions will be reviewed and detailed further as more information becomes available. At the present time, all significant sources of emissions have been reviewed and accounted for in the modelling work.

Various mitigation measures have been considered for the elimination or reduction of fugitive emissions from the sulphur and coke storage and handling facilities as described in detail in Section 6.16 of this volume.

Table 8.11 Summary Table of Pollutants

Source	PM Total t/year	PM 10 t/year	PM 2.5 t/year	NOx t/year	SO2 t/year	CO t/year	CO2 eq t/year	COV t/year	Benzene t/year
Tanks								251	0.71
Stacks	584	521	386	2394	5241	949	3,581,383	60	0.028
Fugitive emissions								104	1.8
Wastewater treatment								55	0.94
Discharge									
Cooling tower								56	0.96
Ship loading								51	0.34
Ship manoeuvring	25	23	21	833	1342	137	107,066	254	2.2
Flares	0.035	0.035	0.035	1.2	6.2	6.8	*Note	2.6	
Total	**609**	**544**	**406**	**3228**	**6589**	**1093**	**3688449**	**834**	**6.9**

*Note: To be determined at the detailed engineering phase.
Table developed from refinery capacity 300,000 bbl/day.

8.4 Greenhouse Gases Management Plan

Climate change due to global warming is a major national and international concern.

NLRC is committed to taking action on climate change and has considered the national and provincial plans in incorporating continuous improvement and BATEA with respect to greenhouse gas (GHG) emissions in the design and implementation of the Project, and has developed an Emissions Management Plan. NLRC will implement policies, designs, and processing equipment while being mindful of the need to avoid or reduce GHG emissions and to comply fully with Canada's new *Clean Air Act* and the Regulatory Framework for Air Emissions, within its sphere of ability to directly control or mitigate its emissions.

NLRC's greenhouse gas management strategy contains the following major key elements:

- Incorporating BATEA in the refinery's design;
- Maximizing the use of light (C_{5-}) as refinery fuel and hydrogen plant feed which will fulfill the requirements under the Regulatory Framework for Air Emissions for using cleanest available fuels;
- Evaluating the entire refinery configuration to identify energy conservation opportunities and taking measures to enhance energy-efficiency and savings;
    - optimizing equipment design to minimize fugitive emissions of process streams (that include GHGs) including: using gaskets and seals on equipment joints that are designed to eliminate leaks, use leakless designs and specify low emissions equipment,
    - using tank vapour control and vapour recovery systems to reduce the loss of hydrocarbons to the atmosphere,

  - o implementing a fugitive emissions leak detection, inspection, maintenance and repair program,
  - o minimizing flaring events through proper process control and co-ordinated maintenance,
  - o implementing burner management systems on all fired heaters to optimize heat recovery, improve combustion and reduce GHG emissions.
- Reviewing of energy use and operational practices on a regular basis, and providing training programs for operators with focus on energy conservation, energy efficiency, and reducing direct emissions under operational control;
- Implementing a GHG monitoring and reporting program to measure GHG emissions and identify GHG reduction opportunities. Setting continuous-improvement targets for energy efficiency and GHG emissions as part of the business planning cycle;
- Reducing energy consumption within the design and operational phase of the project by;
  - o Executing only commercially proven and reliable technologies,
  - o Enhancing of heat exchange in preheating systems and furnace combustion,
  - o Preferably using equipment that is known to be energy efficient,
  - o Using high-efficiency process heaters,
  - o Insulating equipment and piping where relevant,
  - o Eliminating fugitive GHG emissions by using gaskets and seals on equipment joints that are specially designed to eliminate leaks; using the BATEA to reduce the loss of GHG to the atmosphere; implementing a fugitive emissions leak detection inspection and appropriate maintenance.
- Maximizing the volume of high-quality fuel products, particularly Ultra-Low Sulphur Diesel (ULSD) that meet or exceed the stringent standards of the U.S. PADD IA and IB (Petroleum Administration for Defence Districts; Subdistrict IA (New England) and Subdistrict IB (Central Atlantic)), air shed-specific standards and European markets, both present and as projected over the coming 10-15 years. While this does not reduce the refinery emissions it has a tremendous impact on end user emissions both for greenhouse gases and other pollutants (CAC);
- Considering the refinery configuration and plan to facilitate ease of CO_2 capture, providing for plot space and tie-in connections either pre- or post-combustion, when appropriate commercial technologies or CO_2 sinks become available;
- During the construction period, NLRC will also minimize GHG and CAC emissions by implementing the following directives;
  - o Use new construction equipment that is in good working conditions,
  - o Use high-efficiency generators and switch to the existing electricity grid power as soon as possible,
  - o Require a strict maintenance program for all heavy equipment,
  - o The plant will be tested for process equipment leaks (pipes, valves, etc.) prior to start-up.

- NLRC will implement a GHG management program, which will be consistent with ISO series 14000 standards (which specifies requirements for environmental management systems) and particularly ISO 14064 that applies to Greenhouse gases, the *Clean Air Act*, and the *Kyoto Protocol*. Through this program, NLRC would be responsible for;
    - Ensuring all operations and activities are managed in conformity with acceptable practices,
    - Implementing a GHG monitoring, controlling, and reporting program to measure GHG emissions, and recognizing the opportunity for GHG mitigation,
    - Ensuring regular evaluations to make certain that NLRC meets the regulatory framework for GHG emissions,
    - Evaluating and participating in CO_2 markets as they develop,
    - Encouraging the sequestering of CO_2 by enhancing biological absorption capacity by participating in forest rehabilitation or similar projects,
    - Continuing to explore business opportunities for economic capture and storage of CO_2. NLRC is committed to remaining current with respect to emerging carbon capture and mitigation technologies. The possibility also exists for providing technical and financial support for emerging technology applications at a demonstration level,
    - Exploring business opportunities for the development and use of renewable fuels.

The Proponent has already started discussions with the relevant regulatory agencies, reviewed most recent Acts and Regulations (Canada's new Clean Air Act, the new Regulatory Framework for Air Emissions, etc.) and has prepared a GHG Management Strategy which is outlined above, which will identify and implement the BATEA and best management practices (BMPs) to be employed to reduce greenhouse gas emissions.

8.5 Noise

8.5.1 Baseline Noise

The baseline noise represents the existing noise conditions before the implementation of the project. It varies from point–to-point based on the proximity to the existing ambient noise sources; the hour of the day; as well as the climatic conditions.

In order to characterize the baseline noise, monitoring will be performed prior to the beginning of the construction of the refinery.

The number and the location of the noise monitoring sites will be established to cover the noise sensitive areas and the boundary limits of the proposed refinery.

The measurements will be performed using hand-held equipment and remote noise monitoring stations.

8.5.2 Ambient Noise Regulations

Sound levels are conventionally measured in decibels using the "A" weighting that corresponds to the average perception of noise by humans (dBA). The wide range of sound levels in the environment can be expressed on a logarithmic scale as shown in Table 8.12. A doubling of the sound energy gives an increase of 3 dBA on the logarithmic scale. For the human perception, it is barely noticeable. To be generally perceived as a doubling of the loudness, the increase must be about 10 dBA.

Table 8.12 Typical Noise Levels

Sound Pressure Level dBA	Situation	Subjective Evaluation
0	Normal threshold of hearing	Very faint
10	Rustle of leaves	
20	Background in TV studios	Faint
30	Residence without human activity	
40	Refrigerator	Moderate
50	Conversation at 1 m, average office	
60	Restaurant, department store	Loud
70	Lawn mower at 15 m	
80	Busy street	Very loud
90	Concrete breaker at 15 m	
100	Auto horn at 3 m	Deafening or Intolerable
120	Loud musical group	
140	Near jet engine, threshold of pain	

The refinery project is located in the Southern Head peninsula of Newfoundland. There are currently no regulation regarding environmental noise in the province of Newfoundland and Labrador.

To evaluate if the noise emissions of the proposed project are acceptable, the *General Environmental Guidelines (World Bank, 1998)*will be applied. The maximum noise level of the proposed refinery should be either the levels given below or, if higher, a maximum increase in the baseline noise levels of 3 dBA.

Table 8.13 Noise Criteria Applied to the Project (Operating Phase)

Location of the receptor	Allowable Limits for Noise Levels in dBA	
	Day time (7:00 a.m. - 10:00 p.m.)	Night-time (10:00 p.m. - 7:00 a.m.)
Outdoor residential, institutional, educational	L_{Aeq1h} = 55 dBA	L_{Aeq1h} = 45 dBA
Outdoor industrial, commercial	L_{Aeq1h} = 70 dBA	
L_{AeqT} : **eq**uivalent continuous sound pressure ***L***evel over the time period ***T*** (or the average sound energy), in dB**A**		

8.5.3 Projected Noise

During the detailed engineering phase of the project, based on the project description, a noise map of the entire facility will be developed to evaluate the noise levels.

Refinery noise will be modelled accordingly, to the ISO 9613-2 methodology using the SoundPLAN® software. The numerical model of the facility will be developed from the refinery layout, the topographic data of the study area and the equipment list. Noise emission levels will be assigned to the main sources and the model will calculate the attenuation of sound when propagating towards the receiver. The methodology takes into account the geometric spreading due to distance, the atmospheric attenuation, the ground effect, and the reflection from surfaces, the barrier effect of the topography or other large objects. Refinery noise levels will be calculated for specific sensitive receptors and for a grid to produce noise maps of the plant. The results are representative of the continuous equivalent A weighted sound pressure level (LAeq in dBA) under normal operating conditions.

The results of the modelling will be compared to the applicable noise criteria. Compliance to the project requirement will be checked. Results will also be compared to the baseline noise survey. The impact on the noise environment will be evaluated using the ISO 1996-1, taking into consideration the extent and the duration of the impact.

Mitigation measures will be evaluated, as required, to comply with the noise criteria and minimize the noise impact of the project. Examples of mitigation measures are listed below:

- selection of low noise equipment;
- noise barrier;
- noise enclosure;
- silencers on stacks and exhausts.

8.5.4 Engineering / Commissioning Phases

The noise emission issues of the refinery will be considered in the detailed engineering phase, as well as in the commissioning phase.

During the detailed engineering phase, a specialist will be identified and will carry out the following activities:

- preparation of noise data sheets for all noisy equipment;
- analysis of the quotations and of the suppliers;
- follow-up during the in-factory noise testing of noisiest equipment;
- if the actual noise level is different from the specified one, update the noise model;
- for all changes in the noise model, update the mitigation measures.

During the commissioning phase, noise measurements will be performed close to the equipment and at remote locations within the noise sensitive areas, to verify the compliance of the noise emissions from the refinery, and the mitigation measures will be updated if required.

8.6 Effluent Discharges

The site water supply and treatment and usage are described in detail in Sections 3.3.1 to 3.3.6 and in Sections 6.1.3 and 6.1.4.

8.6.1 Construction Phase

The construction phase is anticipated to start in early 2008 and finish in 2011. During construction, the main source of water will be from drainage of some ponds in the project footprint, runoff (sedimentation ponds) and potable water trucked to the site.

Effluent or liquid discharges from the product site during construction are due primarily to storm water and surface runoff. There are no centralized or on-site domestic wastewater management systems in the project scope. All domestic requirements will be accommodated through the use of temporary facilities; existing permanent wastewater facilities are located at the construction camp site (at Bull Arm).

Storm water runoff during construction will be modeled using standard computer models (HEC or HYSYS) to incorporate both precipitation and dewatering components. The model will be used to determine optimal drainage channels, pipe sizes and retention facilities.

The objective of the storm water system will be to intercept water entering the project site from surrounding areas, precipitation falling on the areas under construction, and surface water encountered during construction. The intercepted runoff water, will be collected in temporary (or permanent) sedimentation ponds of sufficient capacity and retention period to ensure settlement of suspended solids. The quality of the storm water will be monitored during retention procedures to ensure it meets the governing regulations prior to release into the surrounding environment.

8.6.2 Operations

During operations, the main freshwater supply for processing and domestic usage will come from the desalination plant. Additional make-up waters will be obtained from surface runoff/storm water or recycled treated water. The clean surface runoff will be collected in sedimentation ponds with sufficient retention period to remove silt and particulate matter. Drainage water from the plant site and tank farm and other potentially contaminated areas will be sent to the oil/water separation plant/treatment plant for treatment before discharge to the environment. All effluents will be treated to meet the applicable regulations before being

discharged to the environment. The water balance schematic for the refinery is shown in Figure 8.1.

The number of intakes and outfalls has been reduced to one seawater intake (two pipes, each 950 m long at Hollett's Cove) and one outfall pipe approximately 400m with a 100m diffuser at its end, located west of the Southern Head point. Discharge from the sedimentation ponds will be directly to the marine environment via a specially designed outfall pipe fitted with appropriate controls in accordance with permitting requirements. All discharges will be in compliance with the Newfoundland & Labrador "*Environmental Control Water and Sewage Control Regulations and Associated Guidelines.*" (Government of Newfoundland and Labrador, 2003). The design and construction of the intake and outfall will be in accordance with all applicable permits and Certificates of Approvals (CofA) (See Appendix A for list of permits and approvals).

Storm Water

Figure 8.2 shows the overall site storm water flow diagram. In general, there are two main runoff streams:

- Contaminated storm water drainage from the refining process area, tank farm, sulphur storage area, and marine terminal laydown areas. This water, that may contain elevated levels of suspended solids, hydrocarbon products and their potential contaminants, will be collected in specially designed ponds (sedimentation ponds which are lined with an impermeable liner). The water in these ponds or tanks will be tested and if contaminated will be directed to the wastewater treatment plant. The treated water will then be discharged to the marine environment via the outfall diffuser or recycled in the plants fresh water make-up.
- Uncontaminated storm water drainage from the site will be directed into conventional storm water ponds (sedimentation ponds) to settle the suspended solids. These ponds will have sufficient capacity (retention time) to reduce the suspended solids below the regulatory limit (30 ppm). This water may be used for firefighting and process make-up, etc. The residual water will be discharged to the environment either through the plant diffused outfall or directly through an undiffused outfall.

Water Balance Schematic

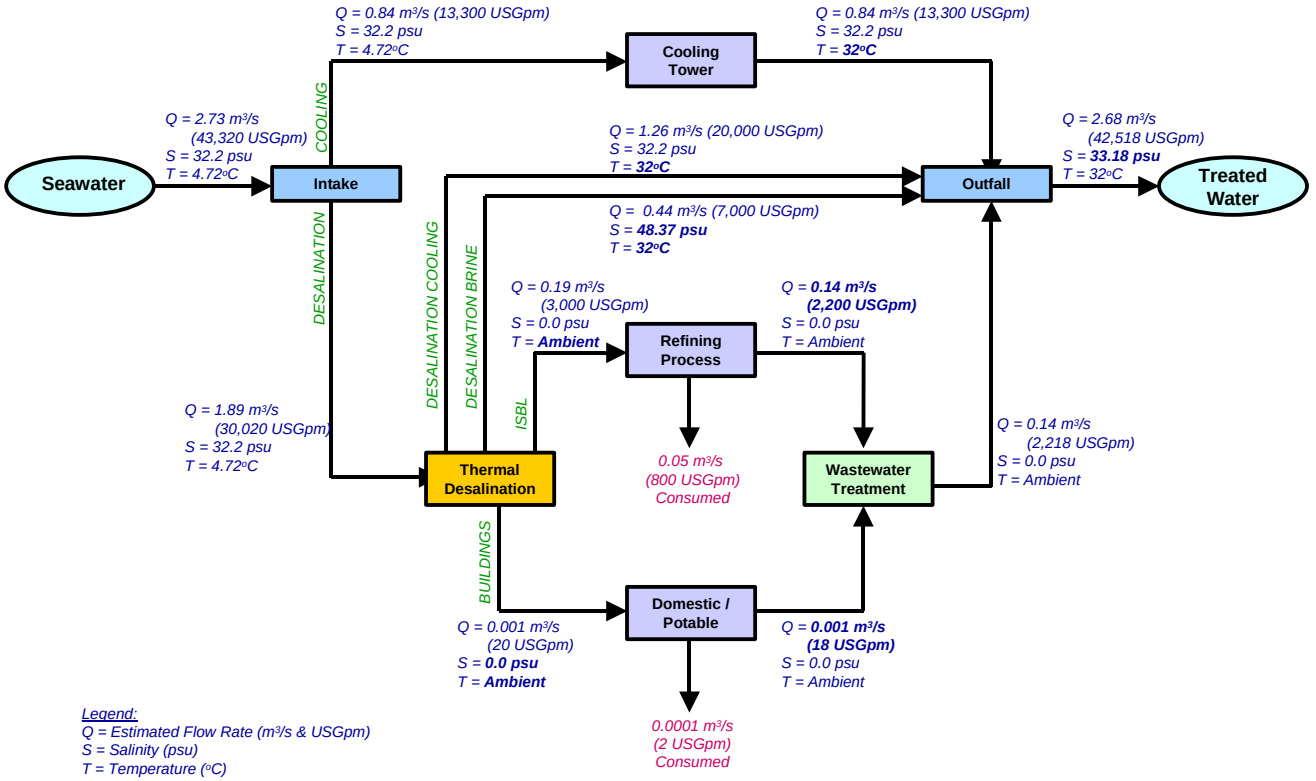

Figure 8.1 Water Balance Schematic

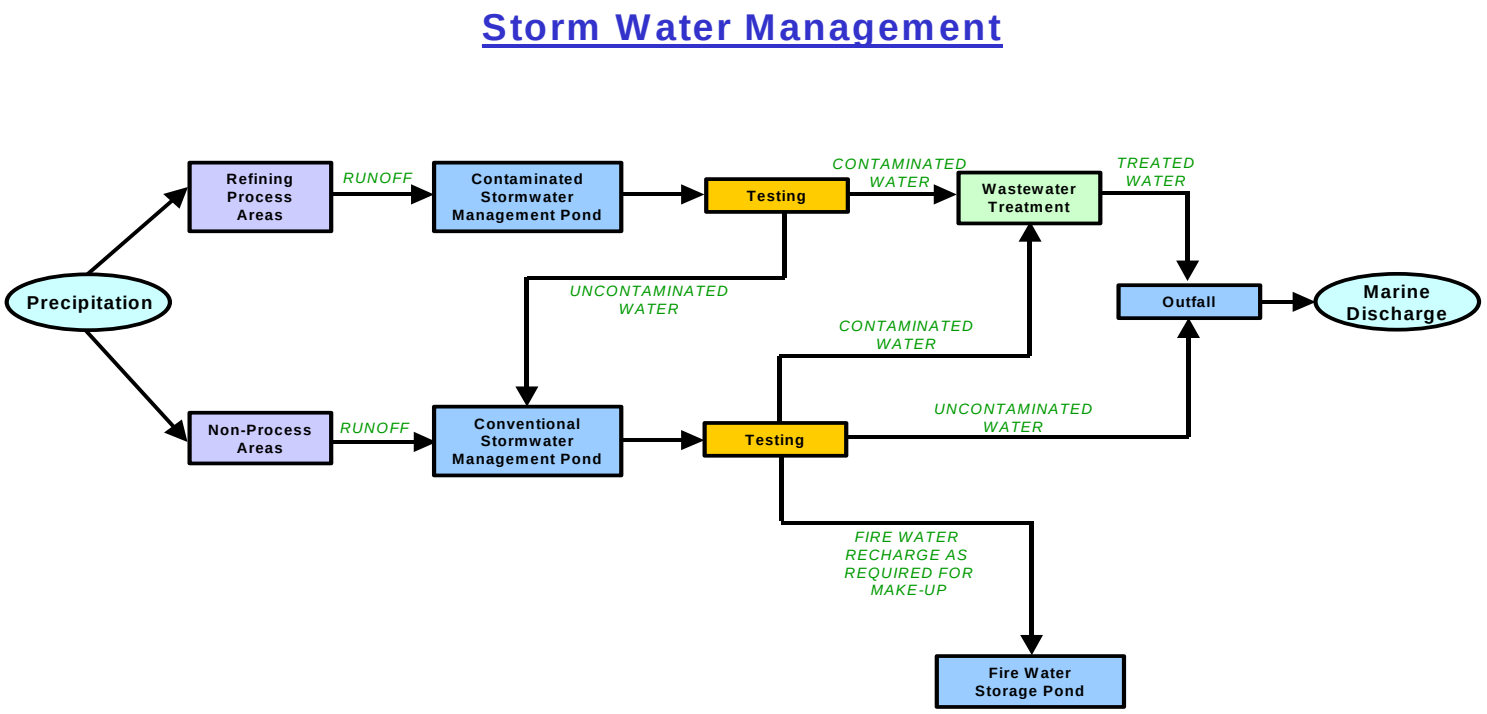

Figure 8.2 Refinery Storm Water Balance

Process Water

Seawater will be the main source of water for cooling systems and freshwater supply for process water and domestic (potable) water use. shows the water balance schematic. It provides a summary of intake and outfall water volumes and characteristics (temperature and salinity).

As described earlier in Section 6.1.4, a seawater intake of a total capacity of 43,320 USgpm (2.73 m^3/s) will be constructed in Hollett's Cove. The intake pipe will be at a water depth of 15 to 18 m.

The water usage for the refinery operations is as follows:

- Cooling Tower: 13,300 USgpm (0.84 m^3/s), salinity 32.2 psu (ambient seawater) and temperature varies depending on the season (T = 4.72°C was used in the model). The cooling system is a closed circuit system, where the cooling water does not come in contact with the hydrocarbon contaminants. The discharged water will have an elevated temperature of 32°C, which isabove ambient (intake) water temperature.
- Desalination Plant: (Thermal desalination) Total required seawater is 30,020 USgpm (1.89 m^3/s) used as follows:
  - 20,000 USgpm (1.26 m^3/s) for desalination plant cooling system which will be discharged at elevated temperature of 32ºC above ambient temperature (AT);
  - 7,000 USgpm (0.44 m^3/s desalination brine (AT = 32ºC and 48.37 psu; i.e., 1.5 times the ambient seawater salinity). It will also be directed to the outfall diffuser;
  - 3,000 USgpm (0.19 m^3/s) desalinated (fresh) water used for processing out of which approximately 800 USgpm (0.05 m^3/s) will be consumed through the process, and remaining 2,200 USgpm (0.14 m^3/s) goes to the wastewater treatment plant for treatment. The treated water will then be directed to the marine outfall/diffuser for discharge into the marine environment;
  - 20 USgpm (0.0001 m^3/s) of desalinated water is used for domestic and potable water.

The above discharges (total of 42,518 USgpm (2.68 m^3/)) will be combined before being discharged through the marine outfall diffuser.

Sources of contaminated effluents are described in the following subsections.

Hydrocarbons

All hydrocarbon drains will be routed to a closed drain system. The number of drain collection vessels and pipe headers will be determined based on the topography of the facility and the location of different units. Automatic process drain blowdown requirements, if any, will be identified and routed separately. Hydrocarbon collected from these systems will be returned to the slop tanks. The vessels will be vented to a flare.

The Amine system will have a separate closed drain system. The requirement for separate drain vessels in individual units will be identified.

Process Sour Water

Process sour water will have a separate closed drain; the requirement for separate drain vessels in individual units will be identified. The Sour Water will be stripped of H_2S in the Sour Water Stripping Unit. Stripped Sour Water will be reused as process water, or sent to the Wastewater Treatment Plant for further processing prior to reuse or discharge.

Oily Water

An Oily Water Sewer (OWS) system will be provided for collecting oily water from process drainage, storage tank water drainage, tank farm runoff and maintenance activities such as the steaming and water washing of different equipment. Oily water will be collected in an oily process drainage, water pond. Oil will be removed from water and returned for reprocessing. The oily water will be sent to the Wastewater Treatment System for further processing prior to reuse or discharge. Treated water that meets the environmental regulations will be either reused on-site or discharged.

Brine

Effluent water from the crude desalting operation will be sent to the Wastewater Treatment System for further processing prior to reuse or discharge.

Concentrated brine from the Desalination Plant will be combined with seawater cooling tower blowdown, and disposed of directly to the Bay via the diffuser. It will meet provincial regulations.

Wastewater

The wastewater from the project will be treated to remove hydrocarbons and other contaminants prior to being ready for reuse or discharge. If being reused, the treated wastewater will be directed back into the processes requiring a water input. If being discharged, it will be sent into the main discharge/outfall diffuser system. Wastewater for reuse will be treated to meet the influent water requirements of the refinery processes. Wastewater for discharge will be treated and monitored to ensure compliance with the “Environmental Control Water and Sewage Regulations” of the *Water Resources Act*.

Effluent Outfall/Diffuser Design

The diffuser is designed to provide the required mixing, to minimize the zone of influence of the effluent discharges into the marine environment (to less than 100 m radius from the diffuser).

It should be noted that the actual concentration of various substances of chemicals in the treated effluent is not known at present and will be determined as detailed engineering

progresses. However, as mentioned earlier, all discharges will meet the regulatory requirements ("Newfoundland and Labrador Water and Sewage Control Regulation, Schedules 1 and 2").

Detailed design for the project will incorporate more refined considerations of these discharges as the refinery water flowrates and system balance becomes more established.

Treated wastewater from the plant that meets those requirements will be combined with other discharges from the site: cooling water from the main closed loop cooling system, Cooling water from the thermal desalination process, and desalination brine from the thermal desalination process. The principal components of concern in the combined discharge are high salinity and temperature. Site-specific models will be prepared to ensure these parameters fall within acceptable ranges for marine discharge.

Evaluations of estimated water flowrates and parameter concentrations have undergone the first phase of modelling. Given the influent characteristics of 32.2 psu salinity and 4.72°C temperature at a maximum flowrate of 43,320 USgpm (2.73 m^3/s), the processes were evaluated for discharge conditions. The final combined effluent leaving the project site for outfall discharge will have an estimated flowrate of 42,518 Usgpm (2.68 m^3/s); 800 Usgpm (0.05 m^3/s) will be consumed. The discharge salinity will be 33.18 psu, which does not vary substantially from the influent salinity concentration and should be easily assimilated and dispersed through the diffusion provided by the outfall. The maximum effluent temperature will be 32°C, which, after mixing with ambient seawater, will be in compliance with the above noted regulations governing discharge to the marine environment. The estimated water balance as shown in Figure 8.2, summarizes the flowrates, salinity and temperature of the water as it passes through each major phase of the refinery operations.

8.7 Marine Operations

8.7.1 Air Emissions and Greenhouse Gas Emissions

The air emissions and GHG considerations are provided in previous sections 8.3 and 8.4.

8.7.2 Effluent Discharges

Sources of effluent produced at the marine terminal from marine operations will be as follows:

- Site Buildings - Sanitary and gray water;
- Vessel Traffic - Ballast water;
- Jetty Spill Containment - Oily water system on loading platforms;
- Storm Water Run-off.

Site Buildings

The Marine terminal site buildings will produce sanitary and gray water from normal operations. Sanitary sewers and gray water drains will be routed to a central location and treated for disposal. The treatment system may be either a self-contained system at the marine terminal or the wastes will be pumped to the Refinery central treatment plant.

Vessel Traffic

The marine terminal will have a ballast water receiving facility for the treatment and disposal of ballast water.

Jetty Spill Containment

A containment system is in place on the jetty in the event of an operational spill. The containment system will consist of a system of curbs drains to contain a spill on the deck and direct it to an oily water sump tank. Oily water collecting in the tank will be pumped to the main treatment facility for treatment and disposal.

Storm Water Run-off

Storm water run-off from the marine terminal and laydown area may contain contaminants and suspended solids above the allowable regulatory limits for discharge to the environment. The water will be drained into sedimentation ponds and will be treated, if needed, before discharge to the marine environment.

9.0 ACCIDENTS AND MALFUNCTIONS

Despite the best efforts and implementation of best management practices the Proponent will develop and put in place, various accidents and malfunctions may occur at different stages of the project. The prevention and mitigation of accidents and malfunctions will be accomplished through the following measures:

- Plant Design;
- Loss Control Management;
- Operational Procedures and Training.

9.1 Plant Design

Inherent safety features will be designed into the Project. Plant layout, as well as all facilities and equipment, will be designed to strict codes and standards. Design and construction processes will be carried out in conformance to ISO 9000 quality assurance standards to ensure that the design and field construction meets the required standards. HAZOP (Hazard Operability Analysis) will be carried out on the design of the facility layout and design systems, and will specifically examine accident and malfunction scenarios.

9.2 Loss Control Management

The refinery management will provide effective safety leadership and establish safety goals. This leadership group will implement a management system to continuously identify, reduce and manage risk. This management system will extend safety leadership and expertise through all levels of authority within the refinery. Specific expectations and goals will be set for each level of authority in the refinery. Safety indicators will be established, tracked and monitored. Safety auditing will be implemented. An effective stewardship program will be established to allow senior management both to understand and participate in the safety program, and ensure that the safety culture established for the refinery is recognized as an integral part of a senior manager's duties.

A detailed safety analysis of the Refinery will be completed during the Engineering Design Phase of the project. The hazard identification and risk assessment will follow established techniques, such as event tree modelling of the major hazards. The analysis will identify and assess major hazards with respect to the potential harm to personnel and the environment. All risks will be reduced to a level that is As Low As Reasonably Practicable (ALARP). Cost-benefit studies will be conducted during the Engineering Design Phase to ensure that appropriate risk reduction techniques are incorporated into the design. The following types of major hazards that will be considered includes, but is not limited to:

- Process and non-process loss of hydrocarbon containment (fire and explosion);

- Land Spills;
- Marine Spills;
- Other Environmental incidents.

The results of the assessment will also provide the framework for the Refinery Emergency Response Plans and the Loss Control Management program.

The Loss Control Management program will cover, but is not be limited to the following:

- Personal Health and Injury;
    - Management of change,
    - Medical Facility and staff,
    - Industrial hygiene,
    - W.H.M.I.S..
- Environment – Air, Land, Water;
    - Exceedances,
    - Reporting Issues,
    - Uncontrolled Releases,
    - Emissions Issues.
- Property Damage;
    - Vehicle accidents,
    - Fires,
    - Equipment failures/damage.
- Security;
    - Unauthorized access,
    - Theft,
    - Off-site impact.
- Business;
    - Ethic violations,
    - Business violations.
- Near Miss Reporting.

9.2.1 Organization

A Health, Safety and Environmental organization will be established for the refinery. Roles, responsibilities and reporting structures will be defined and administered.

9.2.2 Criteria/Response

For each focus area, limits or targets will be defined. Based on the severity of the incident various management leadership levels at the refinery will be required to participate/lead incident reviews and corrective action activities.

9.2.3 Data Management

Incident reporting tools will be available. Data will be collected and analyzed and the results will provide direction for loss control activities. Reports and performance trends will be published and circulated throughout the refinery to inform and raise awareness.

9.2.4 Incident Investigation

Incident investigation will be completed in a timely fashion. The severity of the event (per the documented violation criteria) will dictate timing and degree of formality with which the investigation is to be conducted.

9.2.5 Training and Reporting

Roles and responsibilities in the incident reporting and investigation process will be explained to all site staff during site orientation activities and included in all training programs as appropriate.

9.3 Operational Procedures and Training

Operational procedures will be prepared and training will be provided to minimize the risk of accidents and malfunctions. Operational procedures will define the safe and efficient operation of the facilities and the operational parameters. Employees will be trained in risk avoidance and possible accident and malfunction scenarios and be fully prepared to implement the emergency response plans should an accident or malfunction occur.

9.4 Accidents or Malfunctions – Refinery Operations

Refineries by their nature handle a variety of hazardous materials that, given a combination of failed systems or procedures, a number of credible scenarios could develop.

9.4.1 Spills of Hazardous Materials

The potential for spills of hazardous materials exists for all phases of the Project. During operations potential spills could occur from the transportation of crude oil, refined products and chemicals used in the plant. Spills and leaks of crude, refined products or chemicals could result from the refining or storage areas as a result of a pipeline, flange or valve failure, or malfunction. These risks will be mitigated through design features such as containment, operator training, inspection, implementation of a reliability and maintenance program and the loss control program.

9.4.2 Fires

Fires at the refinery or storage area could result from an accident, from inadvertent ignition of petroleum products, sabotage, or from natural sources such as a lighting strike.

A comprehensive leak and gas detection system will be in place to detect possible sources of ignition. A permit to work system will be in place to work in all areas of the plant and will be strictly controlled with regard to hot work in areas with a potential to have an ignition source.

Site security will tightly control access to the site to approved personnel, and the refinery will have a system of remotely operated cameras to monitor all areas of the plant for unusual activity.

The fire detection and alarm system will be monitored from the central control room and the fire brigade will train to minimize response time so that small fires are detected and extinguished before developing into a major incident.

9.4.3 Explosions

Explosions at the refinery or in the storage area could result from an accident, failure of process equipment, over-pressure, sabotage, or as the result of a fire.

A comprehensive leak and gas detection system will be in place to detect possible sources of ignition. A permit to work system will be in place to work in all areas of the plant and will be strictly controlled with regard to hot work in areas with a potential to have an ignition source.

Site security will tightly control access to the site to approved personnel, and the refinery will have a system of remotely operated cameras to monitor all areas of the plant for unusual activity.

The fire detection and alarm system will be monitored from the central control room and the fire brigade will train to minimize response time so that small fires are detected and extinguished before developing into a major incident.

9.4.4 Process Upsets

Process upsets are defined as any malfunction or unplanned event that occurs outside normal operations. These could include inefficient operation, mechanical breakdown of process unit operation or unit trips. These situations may cause a temporary increase in emissions from the refinery.

Process upsets can be minimized by routine preventative maintenance and strict control and monitoring of process operations. In the event of a process upset, operators would be alerted and quickly respond to adjust the process parameters to resolve the situation as quickly as possible. Maintenance crews would be dispatched immediately to repair the affected equipment.

In the event of a major process upset, where the issue cannot be resolved in a timely manner, the process unit involved would be shut down in a controlled manner.

9.4.5 Power Interruptions

The refinery will rely on electrical power supplied by Newfoundland and Labrador Hydro. In the event of a full unexpected power outage the refinery will have sufficient backup generation capacity to initiate a controlled shutdown.

The refinery will have dual hi-voltage transmission lines supplying the site from the inter-provincial grid for redundancy. Lightning arrestors will be installed on the transmission line to provide added protection.

9.4.6 Vehicle Accidents

Vehicle accidents may occur during operations either on-site or on the commute to and from the Project site. Increased traffic will be handled by the installation of a new high-volume interchange at Come By Chance. Traffic volumes will also be alleviated with the construction of a second access road to the site from North Harbour. A training program will be put into place to educate employees on the safe operation of vehicles both on-site and on public roadways.

9.5 Accidents or Malfunctions – Marine Operations

The refinery's Marine operations will have similar accident or malfunction scenarios as those for the refinery operations with regard to spills, fire, explosion, power failures and vehicle accidents. However there are also other issues related specifically to the Marine Terminal such as:

- Spills in the Marine Environment;
- Shipping Accidents.

9.5.1 Spills in the Marine Environment

During operations potential spills could occur from transportation and loading and unloading activities. Spills and leaks of crude, refined products or sulphur and coke could result from the marine terminal as a result of a pipeline rupture, flange or valve failure or malfunction. These risks will be mitigated through design features such as containment, operator training, inspection, implementation of a reliability and maintenance program and the loss-control program. Oil spill response equipment will be stored on-site and slipway facilities will be provided for the launch of oil spill response equipment. Oil spill response will be an integral part of the Emergency Response Plans for the Marine facility.

9.5.2 Fires

Fires at the marine terminal could result from an accident, from inadvertent ignition of petroleum products, sabotage, or from natural sources such as a lighting strike.

A comprehensive leak and gas detection system will be in place to detect possible sources of ignition. A permit to work system will be in place to work in all areas of the plant and will be strictly controlled with regard to hot work in areas with a potential to have an ignition source.

Site security will tightly control access to the site to approved personnel, and the refinery will have a system of remotely operated cameras to monitor all areas of the plant for unusual activity.

The fire detection and alarm system will be monitored from the central control room and the fire brigade will train to minimize response time so that small fires are detected and extinguished before developing into a major incident.

9.5.3 Explosions

Explosions at the marine terminal area could result from an accident, over-pressure, sabotage, or as the result of a fire.

A comprehensive leak and gas detection system will be in place to detect possible sources of ignition. A permit to work system will be in place to work in all areas of the plant and will be strictly controlled with regard to hot work in areas with a potential to have an ignition source.

Site security will tightly control access to the site to approved personnel, and the refinery will have a system of remotely operated cameras to monitor all areas of the plant for unusual activity.

The fire detection and alarm system will be monitored from the central control room and the fire brigade will train to minimize response time so that small fires are detected and extinguished before developing into a major incident.

9.5.4 Power Interruptions

The refinery relies on electrical power supplied by Newfoundland and Labrador Hydro. In the event of a full unexpected power outage the refinery will have sufficient backup generation capacity to initiate a controlled shutdown.

The refinery will have dual hi-voltage transmission lines supplying the site from the inter-provincial grid for redundancy. Lighting arrestors will be installed on the transmission line to provide added protection.

9.5.5 Vehicle Accidents

Vehicle accidents may occur during operations either on-site or on the commute to and from the Project site. Increased traffic will be handled by the installation of a new high volume interchange at Come By Chance. Traffic volumes will also be alleviated with the construction of

a second access road to the site from North Harbour. A training program will be put into place to educate employees on the safe operation of vehicles both on-site and on public roadways.

9.5.6 Drowning

Work in the Marine Terminal will occur in close proximity to and over the water on the edge of the marine wharf, on the jetties and on the marine terminal vessels. Activities in these areas could lead to a “man overboard” incident.

All personnel will receive training in safe work practices while working on or near the water. Where possible, barriers will be erected to reduce the risk of someone falling in the water. Warning signs will be posted to alert personnel of the risks and where there are no barriers personnel will be required to wear personal flotation devices while working in the area.

10.0 OCCUPATIONAL HEALTH AND SAFETY

The Proponent recognizes that a good occupational health and safety program is the basis for all health and safety activities in the proposed refinery and that an effective health and safety program benefits all workplaces. The occupational health and safety program will be a master plan to:

- Identify and control hazards before they cause accidents or illnesses; and will
- Provide procedures for response to emergencies.

The refinery will strive for a ZERO INCIDENT safety target.

10.1 Introduction

Safety is an integral part of the Project. It is an integral part of project operations and is there to protect employees, clients, property, the environment, and the public.

There are many costs associated with accidents and unsafe work practices. The greatest costs are human costs. By protecting employees, the Project will also be protecting their friends, families, fellow workers, management, the public, and the environment from the far-reaching effects of serious accidents. In addition to protecting lives, a safety program contributes to employee morale and pride because employees will participate in identifying safety needs and in developing safe work procedures.

By fulfilling their safety responsibilities, everyone who works for the Project will share the benefits of a safe workplace.

10.2 Occupational Health and Safety Plan

An Occupational Health and Safety Plan will also be developed, to ensure the undertaking is carried out in accordance with the Occupational Health and Safety Act and Regulations. These measures will provide the necessary equipment, systems and tools to ensure a safe workplace is maintained. Proper information, instruction, training, supervision, and facilities will maintain the health and safety of personnel for all stages of the project.

Safety professionals will be in place to monitor and assess work practices and procedures. Safety awareness will be a prime focus for all site activities. The Occupational Health and Safety Plan will include the following:

- A dedicated Health, Safety and Environmental organization;
- The plan will be specific to the refinery and marine terminal;
- The plan be made available to all employees and will be effectively communicated;
- There will be site orientation for all workers;

- The plan will have commitment from the employer and senior management;
- The plan will have input from the workers;
- The plan will assign clear responsibilities and accountabilities;
- The plan will have an evaluation mechanism;
- There will be a safety performance tracking, reporting and stewardship system;
- Safety awareness and communication programs will be established;
- Provide procedures for emergency response teams and equipment.

The site will have an Emergency Management Team that will deal with all incidents. Should external resources be required to support the refinery needs, the appropriate protocols will be in place to manage the incident using the Incident Command Structure and Mutual Aid.

10.3 Responsibility

Safety is everyone's responsibility. Everyone employed on the Project will be responsible for maintaining the safety program. Managers and supervisors will be responsible for identifying safety needs, communicating safety hazards, investigating hazardous conditions and accidents, providing training, supplying or wearing appropriate safety and personal protective equipment, and ensuring all equipment is properly maintained and meets legislated safety standards. Their role is supported by input from all employees.

All Project employees, and contractors will be responsible for obeying all safety rules; following recommended safe work procedures; wearing and using personal protective equipment when required; participating in safety training programs; and informing supervisors of any unsafe work conditions. Everyone has the right and responsibility to refuse work when unsafe conditions exist.

10.4 Enforcement

Systems will be put into place so that the Occupational Health and Safety Plan is mandatory. Employees and subcontractors who knowingly violate safety rules may face disciplinary action, dismissal or legal action. Visitors may also face legal action if they knowingly disobey safety rules. In addition, the company may face legal action and fines for violations of regulatory requirements. Those individuals who do not fulfill their safety responsibilities will become accountable for any problems their negligence creates, and may be liable under the law.

11.0 ENVIRONMENTAL MANAGEMENT

NLRC is committed to implementing appropriate environmental management in all facets of the proposed Newfoundland and Labrador Refinery Project. To ensure minimum impacts during daily operations of the refinery, the Best Available Technology that is Economically Achievable (BATEA) will be integrated into the project at all phases. In particular, BATEA will be incorporated into the refinery design and implemented during the construction and operation phases. All measures will be taken to ensure that project-related activities have as few adverse impacts on the environment as possible.

Environmental Management planning provides NLRC with the tools to ensure environmental protection measures are implemented and appropriate monitoring is conducted. A sound environmental management strategy and suitable mitigation measures can minimize or eliminate adverse effects to the environment.

NRLC will protect the environment by addressing air emissions, noise and effluent discharge, waste management and water management at all phases of the project. To prevent harm to the environment, a detailed Environmental Protection Plan will be developed. All employees will be trained to prevent environmental harm during work activities. The refinery will also be designed and prepared to respond to environmental emergencies. Environmental monitoring will be concurrent with project activities to foster continuous environmental consciousness, protection and control. A reclamation plan will be developed in anticipation of project decommissioning and abandonment after operation. The reclamation plan will aim to restore the project site to a condition that approximates a healthy natural environment.

11.1 Environmental Management Program Scope

The Environmental Management Program will cover all aspects of this project including initial site assessment, land clearing, site construction practices, site operating philosophy, marine operations, wastewater management, waste disposal and emissions controls. This program will ensure that the site will be in compliance with legislative requirements.

Environmental management for NLRC will include:

- Air emissions control measures;
- Noise and dust control measures;
- Waste management planning;
- Water management planning;
- Reclamation planning;
- Environmental protection planning;
- Environmental monitoring and follow-up.

11.2 Environmental Management Program Objectives

Local environmental conditions will affect, and must be considered in, the design of the project components, the construction methods, operations and decommissioning of the Project. The Project will be designed and constructed with full consideration of the environmental setting and sensitivities.

The objective of the Environmental Management Program is to ensure that all project activities are carried out in an environmentally-responsible manner, with minimum adverse impact on the environment during all phases of the project. It ensures that all project personnel, including the owner, their consultants, vendors, contactors, and operators are aware of and understand their environmental responsibilities when conducting their respective activities associated with the Project.

11.3 Relevant Codes and Standards

Section 2.0 references applicable Federal, Provincial, and Municipal legislation as they may apply to specific Project activities. Appendix A contains a preliminary list of relevant legislation and associated permits, including the responsible agency that may be required to undertake specific project activities. This list will be revised as detail design advances and additional project requirements are identified.

11.4 Air Emissions Control

The Environmental Management Program will define all sources of emissions and criteria levels for monitoring. Methods to reduce air emissions will be included along with ongoing project improvement targets to be met. It will contain an air emissions monitoring plan for the refinery and surrounding communities.

11.5 Noise and Dust Control

11.5.1 Noise

The Environmental Management Program will outline methods to reduce noise to provide a safe work environment and to mitigate excessive noise in the local environment. During engineering of the project, a noise map of the entire facility will be developed to check noise level at perimeter and within plant working area. Baseline monitoring of the project area will be undertaken before project construction starts on-site. Noise monitoring during operations will ensure expectations are met. Hearing protection will be mandatory on-site in clearly identified location during construction and operations. Areas that have excessive noise will be identified with signage and cautions will alert personnel to wear the proper protective equipment.

11.5.2 Dust

The Environmental Management Program will outline methods to minimize dust to provide a safe work environment and protect the local environment. Designs will incorporate proper dust suppression enclosures and filtering as required to minimize fugitive emissions from the sulphur and coke storage and transportation areas. Areas that have gravel surfaces during construction and operations will be wetted to minimize dust generation.

11.6 Waste Management

The Environmental Management Program will outline methods to reduce solid waste and ensure the proper disposal of produced waste. Solid wastes will be generated during all phases of the project. Waste management practices will adhere to applicable regional, Provincial and Federal waste management acts, regulations, and guidelines. Wherever possible, best management practices will be adopted in the management of waste streams.

NLRC is committed to managing its wastes, in so far as possible, as resource materials. NLRC intends to reduce waste generation at all project phases through appropriate system design and operation. Wherever possible, waste materials will be reused to prevent the use of virgin or reprocessed materials. Recycling of refining additives such as catalysts and caustic will be incorporated into the refinery design at all feasible prospects. Recycling of waste materials that require additional processing will be processed off-site by an approved facility.

Waste materials that cannot be further reduced, and that are not appropriate for reuse, recycling or energy recovery will be disposed in a manner approved by regulatory authorities. NLRC will communicate its waste management procedures, policies and objectives to regulatory authorities and employees by creating a detailed Waste Management Plan.

11.6.1 Waste Reduction

All feasible opportunities for reducing waste will be taken throughout the course of the Newfoundland and Labrador Refinery Project. It is recognized that waste prevention will reduce environmental impacts, decrease the need for raw materials and reduce costs associated with storage, handling, transport and disposal. Employees will be trained in waste prevention and the appropriate management of fuels and oils to prevent spills.

During site clearing, merchantable crown timber (9 cm in diameter or greater, 1.3 m above mean ground level) will be salvaged. Harvesting will be performed by a commercial permit holder in the area. Salvaged crown timber will be directed to the best available markets, which may include use as sawlogs, fuelwood or pulpwood. Remaining rock, soil and vegetation that is removed during site preparation will be reused and recycled on-site during site preparation and construction. If possible, reusable and recycled materials from other sources will be used as construction materials in order to reduce the use of virgin materials. The refinery itself will be

designed to minimize the production of waste during operation. Waste from refinery processes will be reduced by source separating process streams for the recovery of materials. During decommissioning, all usable materials will be directed to reuse, and recyclable materials will be directed to appropriate markets in order to prevent waste disposal.

11.6.2 Hazardous Waste

Hazardous wastes may be generated during all phases of the Project including site preparation, construction, operation and decommissioning. It is recognized that the generation of hazardous wastes depends on the types of materials used during each project phase. The production of hazardous wastes also depends on the reaction between various materials during their use. All efforts will be made to reduce the generation of hazardous wastes through the use of less toxic and biodegradable materials, combined with process design to minimize the formation of hazardous products. However, due to the nature of crude oil refining, it is anticipated that hazardous wastes will be generated, and thus increase the negative impacts associated with these materials. Table 11.1 includes a list of hazardous wastes that may be generated by during construction and operations.

Table 11.1 Hazardous Waste Generated During Construction and Operations

Construction	Operations
Used oil, lubricants and coolants	Used oil, lubricants and coolants
Contaminated or expired fuels	Contaminated or expired fuels
Waste batteries	Waste batteries
Materials such as soils and debris that contain hazardous substances	Spent catalysts
Fungicides, herbicides and pesticides	Radioactive wastes
Paint and solvents	Leaded/unleaded scales and rust
Compressed gases and fire extinguishers/suppressants	Caustic
Adhesive	Sodium carbonate
Contaminated soils, rock and vegetation	Chemical solvents and additives
	Light bulbs that contain mercury
	Electronics
	Oiled materials
	Salts and minerals from the desalination process
	MEA/DEA (mono/di-ethanol amine)
	Pyrophoric wastes
	Wastewater treatment sludges
	Fungicides, herbicides and pesticides
	Materials such as soils and debris that contain hazardous substances
	Parts from machinery and electronics
	Contaminated soils, rock and vegetation

All hazardous wastes will be contained, labelled, stored, transferred and disposed or treated in accordance with relevant legislation and guidelines, particularly the *Provincial Dangerous Goods Transportation Act,* the *Federal Transportation of Dangerous Goods Act,* the *Hazardous*

Products Act and the *Canadian Environmental Protection Act* (Government of Canada, 1999). Hazardous wastes, both liquid and solid, will be managed by accredited contractors and treated/disposed using local best management practices.

It is anticipated that through appropriate planning and training, negative environmental impacts resulting from the generation of hazardous wastes by can be mitigated. Proper management of hazardous wastes will require an expansion of the current workforce and processing capacity of hazardous waste service providers in the area. This increase in demand for environmentally conscious hazardous waste management may encourage the development or implementation of more advanced techniques.

11.6.3 Non-hazardous Wastes

Non-hazardous wastes will be generated at all phases including site preparation, construction, operation and decommissioning. The production of non-hazardous waste is dependent on the efficiency of processing and the awareness of project designers and employees of waste reduction, reuse, recycling and energy recovery techniques. All effort will be made to reduce waste production; however, it is anticipated that various waste products will be generated by, and thus increase the negative impacts associated with these materials during the project lifespan. Table 11.2 includes a list of hazardous wastes that may be generated during construction and operations.

Table 11.2 Non-Hazardous Waste Generated During Construction and Operations

Construction	Operations
Used oil filters (after cleaning)	Clean tanks, drums and containers
Containers for oil and other fluids	Packaging materials
Packaging materials	Used oil filters
Food waste	Broken fittings and tools
Portable toilet waste	Plastic, metal, concrete, asphalt and wood
Vegetation	Electronics
Uncontaminated soils, rock, vegetation	Domestic refuse
Broken fittings, tools and other machinery	Wastewater treatment sludges
Plastic, metal, concrete, asphalt, wood, formwork	Food waste
Sandblasting residue	Portable toilet waste
Bulk construction debris	Uncontaminated soils, rock and vegetation
	Bulky items including structures and machinery

All waste generated on-site will be handled, stored, transported and disposed of according to applicable legislation and guidelines. All wastes transported from the site will be handled and treated/disposed of by accredited contractors. Management of all non-hazardous wastes will be done according to local best management practices to prevent negative impacts on the environment. At present, there are two landfills located near the proposed project site in the communities of Sunnyside and Southern Harbour respectively. It is anticipated that these landfills may provide a disposal option for non-hazardous wastes.

The Province of Newfoundland and Labrador is currently implementing a Waste Management Strategy that includes plans to close many old landfills and create central disposal sites that meet current standards. Environmental impacts related to landfill disposal could be mitigated by the development of improved waste disposal facilities. The large volumes of waste that will be generated by the refinery over the 25-year operating period may encourage the development of an improved landfill. The implementation of an improved landfill would also benefit surrounding communities and businesses.

11.6.4 Recyclable Materials

Many of the wastes generated can be recycled using modern technology. Recycling waste materials can be economically beneficial and demonstrates environmental stewardship. Recycling is addressed, and in some instances required, by Provincial regulations. Table 11.3 includes a list of recyclable wastes that may be generated during construction and operations.

Appropriate source separation and storage of wastes will be performed by NLRC to preserve the quality of recyclable materials. NLRC will follow all applicable legislation as well as local recycling practices including the *Used Oil Control Regulations and Waste Management Regulations under the Environmental Protection Act*. Tires, used oil, used oil filters, beverage containers, metals, paper and cardboard will be recycled using accredited carriers and recycling facilities. Materials that do not have a well-established recycling system in the Province will be recycled where opportunities exist. The volume of recyclable waste materials produced by the proposed refinery may encourage markets for these materials.

It is anticipated that a portion of the waste generated can be mitigated by recycling. Recycling often minimizes the environmental impact of wastes and can reduce the demand for virgin materials.

Table 11.3 Recycled Wastes Generated During Construction and Operations

Project Phase	Recyclable Materials
Construction	Used oil and lubricants Used oil filters Rechargeable batteries Tires Beverage containers and other packaging Plastic, metal, concrete, asphalt and wood Paint Paper and cardboard
Operation	Used oil and lubricants Used oil filters Tanks, drums and containers Rechargeable batteries Tires Beverage containers and other packaging Plastic, metal, concrete, asphalt and wood Paint Paper and cardboard Spent catalysts Caustics Plastic, wood, metal, glass Electronics salts and minerals from the desalination process Beverage containers and other packaging Paper and cardboard Bulky items including structures and machinery

11.6.5 Waste Management Plan

A detailed Waste Management Plan will be developed during the design of the proposed refinery. This plan will act as a working document developed in accordance with applicable legislation and environmental standards. The plan will detail procedures and policies for appropriate handling, storage and disposal of waste products generated on-site.

Purpose

The proponent is committed to taking all steps necessary for the proper collection, storage, transportation and disposal of all wastes generated by the construction and general operations of this project. A comprehensive Waste Management Plan will be developed for all phases of the project. This is a working document to be used by all employees and contractors on the refinery site, which will be updated and improved throughout all stages of the project.

Implementation

A Waste Management Plan will be developed and implemented for each stage of the project (construction, operations and decommissioning) to deal with specific waste management issues

unique to that particular stage. Revisions and additions will be made as necessary and the structure of the Plan will allow for updates and revisions to be made easily as further details of the engineering design and work methods become available. The implementation of the plan will ensure activities are compliant with all applicable Acts, Regulations and Guidelines.

Waste Management Plan Content

Section 1 of the Waste Management Plan will provide an introduction, responsibilities of project personnel and implementation procedures.

Section 2 of the Waste Management Plan will provide a detailed description of the disposal plan and measures necessary for proper disposal of all waste types, including refinery process waste, non-process hazardous waste and non-hazardous waste at all project phases.

Section 3 of the Waste Management Plan will provide references to pertinent regulations and key sources of information to enable high levels of waste management performance, such as:

- Provincial Legislation;
  - *Water Resources Act (2004),*
  - *Environmental Control Water and Sewage Regulations (2003),*
  - *Environmental Protection Act (2002),*
  - *Storage and Handling of Gasoline and Associated Products Regulations (2003),*
  - *Used Oil Control Regulations (2002),*
  - *Waste Management Regulations (2003),*
  - *Air Pollution Control Regulations (2004),*
  - *Dangerous Goods Transportation Act and Regulations (1990).*
- Federal Legislation;
  - *Transportation of Dangerous Goods Act (1992),*
  - *Fisheries Act (1985),*
  - *Canadian Shipping Act (1985),*
  - *Migratory Birds Convention Act (1994),*
  - *Hazardous Products Act (1985).*

Section 4 of the Waste Management Plan will provide contingency plans for occurrences such as improper disposal of wastes, fire, extreme weather conditions, and accidental spills.

Section 5 of the Waste Management Plan will provide the names and numbers of key contacts for the project.

11.7 Water Management Plan

Refinery operations require a supply of both saltwater and freshwater. The supplies must be readily accessible and continuously available, as the facility cannot operate without water. Most water for the project will be collected through an ocean intake and used directly or treated for use as required. Additional water from surface run-off will also be collected and stored for use (fire water, make-up, etc.). The estimated total volume of water to be used at the site in all forms is 43,320 USgpm (2.73 m^3/s).

The water management plan for the project is formulated to satisfy the following objectives:

- ensure a reliable, acceptable quantity and quality of water be available to the project components for all operations;
- minimize the amount of water requiring desalination through the reuse and recycling of storm water and treated wastewater wherever possible;
- reduce the amount of water required by concerted efforts to incorporate conservation during design and operation of the refinery;
- reduce wherever possible through design the length and size of pipelines needed for water and wastewater transport, pumping requirements, and treated water volumes; and
- provide sufficient flexibility in designing the project footprint and facility layout to enable the use of stored water from site reservoirs wherever possible, to minimize the volume of influent water to be brought into the site from the marine supply.

11.7.1 Water Supply Integrity

Reservoirs of freshwater will be created on the project site to permit downtime of the desalination processes and equipment. Saltwater for cooling, however, must be continuously available and due to the flow rates and volumes required reservoir storage is impractical. For this reason and also to reduce the pipe size to a practical size, the intake will consist of two pipes, one of which can be temporarily shut down in the event of emergency or routine cleaning or maintenance of the intake or screens. The second pipe can be used on an interim basis until full operations can be restored. Flow rate adjustments may be required should only a single pipe be available for an extended period of time, due to the head loss in delivering higher flows of seawater to the wet well. Because the intake is so crucial to the operation of the refinery, regular inspections and routine maintenance programs will be used during operations to prevent unnecessary shutdowns.

Water for firefighting purposes will be obtained from freshwater reservoirs on-site. Water stored in the firewater pond will be the primary source. Water in this pond will be supplied primarily from the uncontaminated stormwater stream from the project site and will be replenished as required from that source. The required firewater pond storage capacity is estimated at 8,750,000 USgal (33,130 m^3). If the demand exceeds the volume of the firewater pond all

uncontaminated freshwater reserves will be made available. The detailed operation of this system for water recycling is described in sections 3.3.2 and 8.5.

11.7.2 Water Requirements

The total volume of saltwater supply estimated for refinery operations is 43,320 USgpm (2.73 m^3/s) as described in Section 8.6.

Water systems for firefighting processes will be appropriate to the final design and in accordance with the NFPA standards.

11.7.3 Stormwater Management

The program for stormwater management is designated to ensure that clean runoff is intercepted and diverted from site before it can become potentially contaminated by refinery operations. The remainder of the stormwater control process is to intercept runoff water from the site and treat it in a manner appropriate to the potential contaminants and sediment loadings, so that it can be discharged back into the marine environment. A detailed description of stormwater control and treatment measures is provided in Sections 3.3.3 and 8.6.

11.8 Reclamation Plan

The Environmental Management Program will cover all aspects of reclamation and rehabilitation during construction, operations and decommissioning. A site Decommissioning and Closure Plan will be developed in the design phase and is outlined in Section 7.0. The plan will focus on protecting public health and safety, improving or eliminating environmental damage and liabilities and allowing the land use to be similar to its original use or an acceptable alternative.

At each stage of the project a reclamation plan will be developed to restore and protect the environment and restore disturbances caused by construction and operations. The following will occur prior to reclamation of the site at each stage of the project:

- Inspection of the property pre-closure;
- A preliminary site contamination/facility inventory will be developed;
- A draft conceptual plan will be developed which will identify information needs;
- Site characterization will occur and concerns will be identified;
- Options will be considered and a preliminary plan will be developed.

The following rehabilitation measures will be addressed in the Reclamation Plan:

- Construction;
    - Temporary facilities will be removed and the area restored,
    - Temporary equipment will be removed and the area restored,
    - Areas disturbed by heavy equipment and vehicles will be restored,

  - Temporary settling ponds will be restored,
  - Vegetation cover will be re-established where possible,
  - Areas will be cleared and cleaned of construction debris.
- Operations;
  - Temporary facilities will be removed and the area restored,
  - Temporary equipment will be removed and the area restored,
  - Areas disturbed by heavy equipment and vehicles will be restored,
  - Hazardous chemicals, reagents and materials will be removed for proper disposal,
  - Pipelines and equipment that is decommissioned will be drained and cleaned,
  - Oil and fuel storage tanks that are decommissioned, will have all product and vapours removed from the storage tanks. They will then be dismantled and removed from site by the supplier/contractor,
  - Modification or removal of site buildings or other infrastructure will be properly managed,
  - An ongoing monitoring program to assess soil contamination in the facility will be developed. If contamination is found the appropriate remediation measures will be implemented to address contaminated soil,
  - Fencing will be kept in good repair to provide security to the site,
  - Road surfaces will be maintained,
  - Revegetation will occur where practical, including seeding and reforestation through the introduction of vegetation and organic material on-site.

The Reclamation Plan will address the entire facility. For each project component the reclamation plan will address potential environmental effects, the final end use of the land and the long-term physical and chemical stability of the reclaimed component.

11.9 Environmental Protection Plan

Environmental Protection Plans (EPPs) are a vital part of the NLRC Environmental Management System. EPPs set out detailed site specific protection measures and procedures which must be implemented during each phase of the Project.

11.9.1 Purpose

The EPP is the cornerstone for implementing environmental protection measures during the construction and subsequent phases of the Project, providing documentation of environmental protection procedures (general and site-specific), against which performance can readily be assessed and, if appropriate, the need for additional corrective measures can be determined. It is a working document to be used by project personnel and contactors in the field, as well as at

the corporate level, to ensure that environmental requirements and commitments made in policy statements are implemented and monitored.

11.9.2 Implementation

An EPP will be implemented for each phase (construction, operations and decommissioning) of the Project to deal with environmental issues specific to each individual phase. Revisions and additions to the EPP will be made to reflect new and site-specific construction sequences, work methods and environmental protection requirements and responsibilities. The EPP will be structured to allow for updates and revisions as required to meet the needs of the reviewers, and as engineering design and work methods are further defined. Each EPP and revision thereof will be reviewed and approved by the Proponent.

All Issued for Construction (IFC) drawings will be annotated with environmental considerations and/or EPP notation boxes referencing specific sections of the EPP to be consulted by contractors/field personnel when carrying out activities in the area defined by the IFC drawing.

11.9.3 EPP Content

The style and format of the EPP is intended to enhance its use by project personnel in the field and to provide an important support document between the overall approach to environmental protection planning and the specific requirements contained in various permits, approvals and authorizations issued for project development and activities. The following is a generic contents list of the Project EPP.

Section 1 of the EPP provides an introduction, responsibilities of various project personnel and implementation procedure.

Section 2 of the EPP provides an overview of the environmental concerns and the standard environmental protection measures associated with a variety of specific activities anticipated to occur in relation to each specific phase. Standard environmental protection procedures have been or will be developed for:

- Clearing of vegetation;
- Grubbing and disposal of related debris;
- Storage, handling and transfer of fuel and other hazardous material;
- Sewage disposal;
- Solid waste disposal;
- Quarrying and aggregate removal;
- Buffer zones;
- Erosion prevention;
- Excavations, embankment and grading;

- Stream crossings;
- Dust control;
- Trenching;
- Dewatering – work areas;
- Marine vessels;
- Pumps and generators;
- Noise control;
- Blasting;
- Winter trails;
- Groundwater development and use;
- Drilling – Geotechnical/Water well/marine;
- Concrete production;
- Linear developments;
- Vehicular traffic;
- Works in/around marine environment;
- Construction camp;
- Surveying;
- Equipment operations;
- Drilling – Geotechnical Drilling in the Marine Environment;
- Emissions Reduction;
- Coke and Sulphur Handling and Transportation;
- Miscellaneous – Others.

Section 3 of the EPP references key sources of information for the purposes of HS&E performance including, for example, Department of Fisheries and Oceans (DFO) fact sheets and a list of Proponent's background technical data reports compiled during the environmental assessment.

Section 4 of the EPP provides contingency plans for:

- Accidents and Malfunctions ;
- Fuel and Hazardous Materials Spills;
- Wildlife Encounters;
- Discovery of Historic Resources;
- Forest Fires;
- Vessel Accidents.

Section 5 of the EPP provides the names and numbers of key contacts for the project.

Section 6 of the EPP contains the site-specific EPPs for the principal work areas for construction. These areas include:

- Port Area;
- Coke and Sulphur Handling and Transportation;
- Access and Service Roads;
- Construction Campsite;
- Process Area;
- Tank Farm;
- Site Utilities (sewage, water supply, firewater, power, etc.).

Site-specific EPPs, will be modified or expanded as needed throughout the various phases of the Project as engineering design, work methods and overall schedule progress. The site-specific EPPs contain information on local environmental issues and concerns; potential effects and sensitive areas/periods; general environmental protection measures; relevant drawings and documents; and a listing of applicable permits, approvals and authorizations and associated compliance monitoring requirements.

11.10 Environmental Monitoring and Follow-up

The Proponent will develop a comprehensive Environmental Monitoring Plan at an early stage of the Project implementation. It will start with baseline monitoring of existing conditions. The program has already started and will continue for some time during construction. Then a long-term monitoring program will be implemented as needed by permits and certificate of approval.

11.10.1 Environmental Monitoring Plan

The Environmental Monitoring Plan will will include Environmental Effects and Compliance Monitoring. The Plan will be developed in consultation with regulators and the Community Liaison group.

The Plan will detail the methods and procedures to be used by contractors on-site when conducting their activities. The Plan will allow Vendors/Contractors to ensure that all the activities carried out under their direction or by their subcontractors/suppliers are in compliance with the permit, approval and authorization requirements, the Proponent's site EPP, the Emergency Preparedness Plan and, where applicable, the Rehabilitation and Closure Plan. The Proponent's HS&E On-site Supervisor (or designate) and/or Company Representative has the right to monitor and/or audit any work in progress, or completed, at any time to ensure compliance with the EPP.

11.10.2 Permits, Approvals and Authorizations

An initial list of the required permits, approvals and authorizations has been identified (Appendix A). Contractors will submit a list of all required permits, authorizations, licences and certificates to the Company Representative upon award of contract.

Contractors will be responsible for obtaining all permits, approvals, authorizations and certificates directly related to their contract activities, which were not identified as being the responsibility of the Proponent or Company Representative. The Vendors/Contractors will also identify any additional permits, approvals, authorizations and certificates that do not appear on the above-mentioned list. The Contractor(s) will submit their respective applications to the Company Representative, in sufficient time prior to the date required to commence on-site activities.

11.10.3 Documentation

Documentation submitted in support of, and copies of the permits, approvals and authorizations obtained by the Proponent, Company Representative and Contractors will be maintained at the site and at the offices of NLRC and/or the Company Representative.

11.10.4 On-Site Monitoring and Control

Contractors, including all their sub-contractors/suppliers and associated personnel, will be responsible for the implementation and compliance with all conditions specified on the permits, approvals or authorizations and practices and procedures identified in the EPP.

The Proponent or the NLRC Representative will have full-time monitors on-site to monitor and enforce environmental protection measures and to ensure all activities are conducted in accordance with the EPP and the conditions specified in all permits, authorizations or approvals. In addition, Contractors are required to have a full-time Environmental Coordinator on-site for the duration of the contract activities.

11.10.5 Environmental Orientation

The Proponent is committed to providing a Site Orientation Program as part of the overall HS&E Management System. Upon arrival at site a Site Orientation will be provided to all new site workers/visitors prior to commencing activities at the site. The orientation will provide information on a broad range of site rules and policies, worker health and safety, workplace health and safety, environmental protection planning, historic resources management and wildlife harassment issues The effectiveness of environmental orientation has been proven at other projects in the province, such as the Bull Arm construction-site during development of the site and building of the Hibernia platform, and the on-going Voisey's Bay mine/mill site in Labrador.

12.0 EMERGENCY RESPONSE PLANS

As part of NLRC's Environmental, Health & Safety Management System, an Emergency Response Plan will be developed and implemented during all phases of the Project.

The Emergency Response Plan will provide an appropriate and consistent response to emergency situations that may occur during the construction, operation, and decommissioning of the Project. The Proponent is dedicated to making investments in infrastructure to enhance the response capacity to environmental threats or accidents within Placentia Bay.

12.1 Purpose

The main purpose of the Emergency Response Plan is to ensure the protection of life, environment and property/equipment and to identify predetermined courses of action for accidents, oil spills and release of hazardous/toxic substances, system failure, or other emergency situations. This plan defines the responsibility of key personnel and outlines the general procedures to be followed when responding to emergencies in a way that will avoid or reduce health and safety risks, minimize trauma, safety hazards and environmental damage, and reduce cleanup cost and minimize property damage.

The Plan outlines the emergency response protocols to be followed by all site management, engineering and environmental staff and all contractor's site workforce. It provides easy access to information needed in dealing with emergency situations involving personnel, as well as spills or incidents involving release of hazardous or environmentally damaging substances.

12.2 Scope

The Emergency Response Plan will apply to all personnel working at the Project site, and describes the emergency procedures that will be implemented immediately upon the discovery of a situation that may endanger:

- safety and/or health of individuals;
- environment; and
- property and/or equipment.

12.3 Emergency Response Plan

The NLRC oil refinery will be designed and operated in a manner such that accidents and malfunctions will be prevented or avoided. Despite risk-reduction measures, accidents may still occur.

NLRC is an organization that may be affected by natural, technological, and human events that could have a detrimental impact on the following:

- The health and safety of persons in the affected areas;
- The health and safety of persons responding to incidents;
- Continuity of business operations;
- Property, facilities, and infrastructure;
- Delivery of services;
- Environmental conditions;
- Economic and financial conditions;
- Regulatory and contractual obligations;
- Organizational reputation.

The Canadian Standards Association standard *CAN/CSA-Z731-03 Emergency Preparedness and Respons*e will be used to guide NLRC's response planning process. The Standard provides advice on planning, administration, training, resource utilization, auditing, and other aspects of emergency preparedness and response.

12.3.1 Emergency Response Plan Outline

The NLRC Refinery will have an umbrella emergency response plan with sub-plans for each type of emergency. Contingency plans will be designed to deal with events such as:

- Power failure;
- Computer Control System Failure;
- Refinery fire and/or explosion in various refinery facilities;
- Accidental release of a substance on land at the Refinery site;
- Accidental release of a substance to the sea from the Refinery site;
- Chemical spill on refinery site;
- Gas release (hydrocarbon, LPG, benzene, H_2S);
- Pipeline rupture;
- Jetty loading arm rupture;
- Support vessel Incident (tugs, line handling boats, oil spill response vessels);
- Tanker incident at jetty;
- Man overboard from a wharf, jetty or ship berthed at Refinery;
- Injury to a person or persons;
- Loss of life;
- Heavy snowfall and freezing rain;
- Contamination of potable water supply;
- Vehicle incident with death or injury;
- Vehicle in the water;

- Journey management overdue report;
- Confined space entry incident – one or more persons;
- Security Breach;
- Bomb threat or sabotage;
- Forest Fire;
- Hurricane;
- Earthquake;
- Tsunami.

Tanker-related incidents will be the responsibility of the tanker operator and owner. Numerous resources are available in Newfoundland and Labrador to assist a tanker in distress in Canadian waters. Depending on the incident situation and location, NLRC will provide assistance when requested to do so by the tanker operator.

12.3.2 Organizational Structure for Emergency Response

The NLRC Refinery operations will use an Incident Command System (ICS) structure to organize the response to each emergency situation. For each emergency event, an incident management team will be activated along with an Emergency Operations Centre (or command centre). The ICS structure is further described below.

The organizational structure assumes that there is an incident management team addressing the different operational components of the incident:

- Emergency operations;
- Core Business operations;
- Pollution Response operations;
- External Affairs activities;
- Internal Affairs activities;
- Health and Safety operations.

Depending on the size of the incident, the size of the team addressing each operations component will vary. The incident management team will set objectives and priorities and decide the appropriate allocation of resources between these response operations components as the incident situation evolves, based on continuous assessment and analysis of the situation.

12.3.3 Emergency Operations

The emergency operations component involves the true emergency response: securing the plant operations, securing the scene to protect people (responders, refinery workers and the public), preventing fire and explosion, fire containment, preventing escalation of the incident, rescue and evacuation of personnel to safe zones, and provision of medical and other logistics

support. The emergency component always has priority for resources. Despite the urgent need to respond, the safety of responders is the major consideration.

12.3.4 Core Business Operations

In this case the core business operations component is the long-term refinery operation. An incident may have resulted in disruption and damage to plant and process components which must be identified and repaired so the refinery can recover and resume its business.

12.3.5 Pollution Response Operations

During an incident, oil or other substances may be released on land or to the marine environment. Whether on land or ocean, the release must be contained to minimize environmental damage. In such cases, the health and safety of the response personnel and other persons will be the priority.

12.3.6 External Affairs Operations

The external affairs operations component of any incident involves communications with government agencies, the community and the media. The objectives are to protect people, the environment and property and to return to normal operations as soon as possible. To do this requires extensive communication to deal with a wide range of problems and issues. Certain communications must be systematically managed to be effective.

12.3.7 Internal Affairs Operations

The internal affairs operations component involves ensuring that the relevant corporate managers and refinery staff clearly understand the situation and have sufficient resources to fulfill their roles. This component includes providing support for the personal needs of staff and their families. The corporate internal affairs aspects include financial, legal, insurance and business considerations.

12.3.8 Recovery Planning and Operations

The recovery planning and operations component addresses the processes and programs needed to return to a normal stable situation for plant operations, for the environment and for the surrounding community. The assigned team members would address restoration of damages to people, the environment and property within NLRC and the affected community.

12.4 Incident Command System (ICS) Structure

The Incident Command System (ICS) provides an organizational structure and systematic approach to managing any incident response. The Incident Management Team who work in the Emergency Operations Centre (EOC) and Field Task Groups, who work in the field, are organized by key functions, as illustrated in Figure 12.1.

The number of Field Divisions is expandable by the Incident Manager from one to as many as necessary to respond effectively to each incident. The number of Task Groups within each Division is also expandable to four to six groups reporting to each Division Leader. In expanding the number of groups under each Division the span of control limits of the leader must be considered. The span of control limit will differ with each person and the intensity and stresses of the tasks assigned. Safety of personnel should be a major consideration in choosing and tasking competent field leaders.

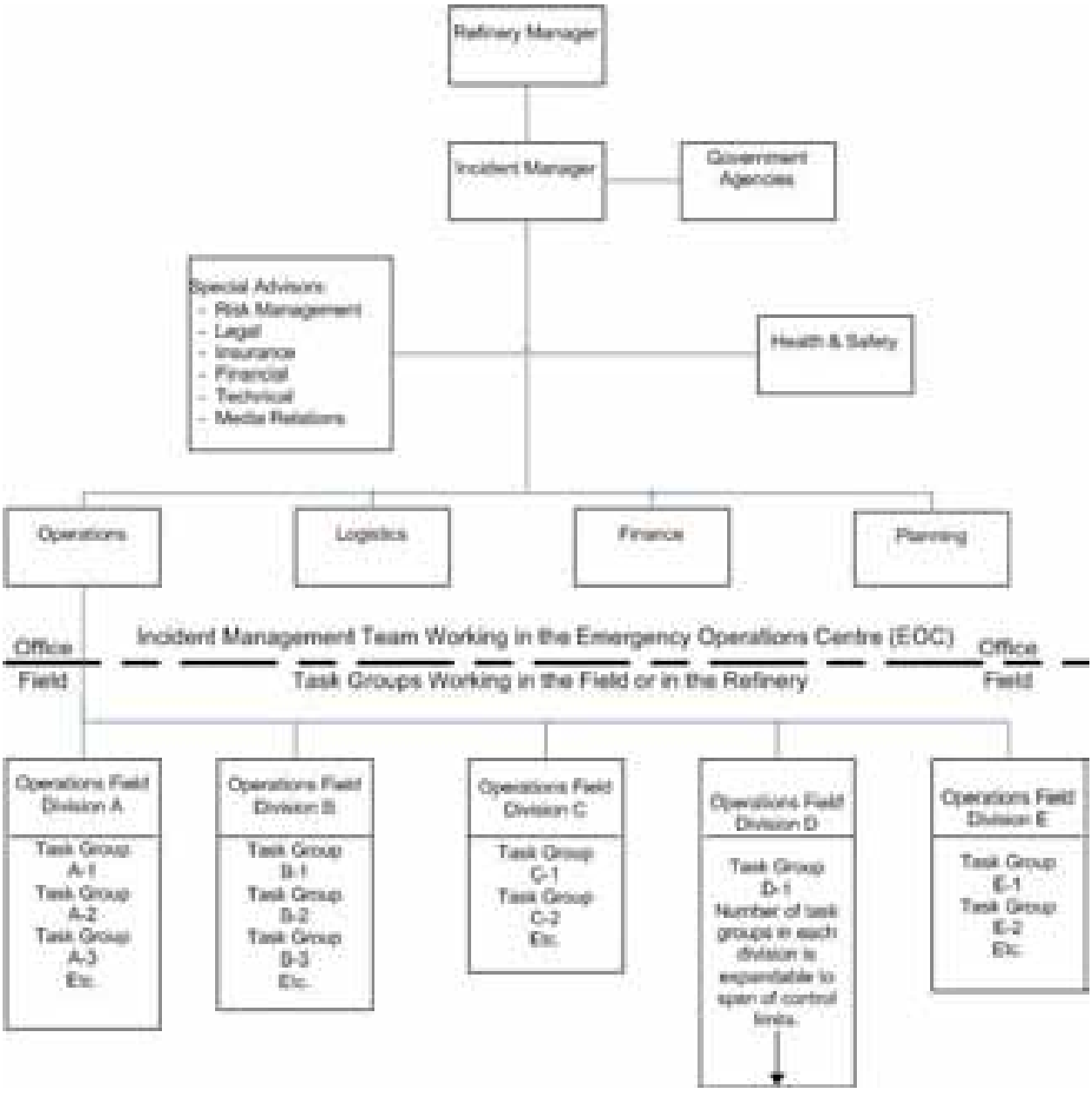

Figure 12.1 Incident Command System (ICS) Organizational Structure (in Functional Groupings)

Depending on the incident situation, different Field Divisions are typically assigned tasks around a common theme such as:

1. Planning: Surveillance, investigation, analysis and problem-definition tasks;
2. Health/Safety Assessment of health and safety hazards and risks to people and property; safety plan development, continuous safety monitoring;
3. Operations: Plant Operations securing and/or shutdown tasks;
4. Operations: Fire prevention, suppression and control tasks;
5. Operations: Emergency tasks (rescue, evacuation, first aid, medical support);
6. Operations: Land-based oil spill response tasks;
7. Operations: On-water oil spill response tasks;
8. Operations: Shoreline oil treatment and removal tasks;
9. Logistics: Staging, lifting, handling and transportation tasks for different operational activities;
10. Logistics: Feeding, housing and hygiene tasks;
11. Logistics: Communications infrastructure development tasks;
12. Logistics: Personnel and Equipment decontamination tasks;
13. Logistics: Recovered oil treatment and disposal tasks;
14. Logistics: Waste segregation and management tasks;
15. Logistics: Observation and briefing for key personnel (internal and external affairs);
16. Logistics: Security tasks relating to Refinery site and field operations sites;
17. Finance: Resource and cost monitoring and tracking, damage claims Management;
18. Management: External Affairs presentations, briefings, communications and interviews to a variety of audiences (government, community and media) with participation of management when appropriate.

Within each Field Division, each Field Task Group is assigned one work task (field work order or field mission) to be executed including the mobilization and demobilization of the people and equipment resources needed to execute the task and to report progress. A disciplined approach is taken to assess health and safety conditions, identify hazards and risks and to managing risks downward. Each work task is treated as a separate and distinct project so that classical project management principles can be used in regard to assembling resources, purchasing, tracking progress and expenditures, and documentation. The ICS requires documenting and archiving work tasks, daily-action plans, long-term plans, safety plan, waste management plan and meeting minutes.

12.5 Emergency Operations Centre

The Emergency Operations Centre (EOC) will be located in the refinery's administration building, very close to the Refinery Control and Communications Centre. This proximity to the Control room will ensure efficient communications with critical refinery operations staff during an emergency.

The EOC will be comprised of a larger room surrounded by several smaller "break-out" rooms for small task groups to address specific aspects of an incident.

12.6 Communications

To ensure that communications between all parties are highly effective, each EOC room will be outfitted with telephones, refinery-wide intercom, data lines, computer intranet, e-mail and Internet infrastructure. Computer capability will be available in the EOC to access digital drawings of refinery systems and other graphical information (maps, charts, aerial photos, satellite imagery, photos) using Geographic Information System (GIS) and Computer Aided Design (CAD) software systems. Radio communications with tankers, marine support vessels and emergency aviation support resources will be available through the Control Room and through other radio base stations in the jetty control rooms and oil spill response warehouse.

12.6.1 Community Notification

The refinery will develop an emergency notification and response program to provide information and procedures for local area residents and industry regarding emergency situations in the area. The program will be communicated directly to the local residents and other potentially affected groups by refinery personnel.

12.7 Emergency Response Training

While the above possible incidents have been recognized, it is important to note that the implementation of safety education and training initiatives are essential in minimizing their potential occurrence.

Effectiveness of emergency response relies heavily on planning, training and instruction to ensure that all aspects of the response activities are communicated and understood. Additionally, to ensure that individuals perform emergency response safely and efficiently, specific training programs are required to develop an understanding of tasks required.

All site employees and visitors entering the project site must have an understanding of emergency response procedures for the Project, and become familiar with their role in an emergency situation. Site employees/visitor training for emergency response will be presented in the Project site orientation.

NLRC will train all staff in Emergency Response procedures according to the content and procedures in its emergency response plans. Each Refinery staff member will have a role to play in any emergency situation. In-house training will endeavour to ensure that each staff member clearly understands this role.

The Health and Safety Supervisor on staff at the NLRC Refinery will be responsible for emergency response planning as well as for delivering emergency response training.

Emergency response training will include:

- Notification procedures;
- The organization of a response using the Incident Command System and the Emergency Operations Centre (EOC);
- Responsibilities of ICS team members and field responders;
- Emergency checklists;
- Properties and hazards of the petroleum hydrocarbons handled by the Refinery;
- Sensitivities and resources at risk (human use and environmental);
- Site safety plan.

Notification exercises will be done once per quarter. In-house tabletop exercises will be held at least once every six months with a variety of themes to help staff become comfortable with their emergency response roles.

Generic incident command system training will be given to those responsible for:

- Overall incident command;
- The Emergency Operations component of an incident (response to fire, explosion, medical evacuation, injured staff, etc.);
- Refinery Operations component of an incident (response to secure the terminal operations and the source of a spill);
- Oil Spill Response component of an incident;
- ICS Operations function Team Leads;
- ICS Logistics function Team Leads;

- ICS Finance function Team Leads;
- ICS Planning function Team Leads;
- ICS Health and Safety function Team Leads.

This generic ICS training will allow the individuals to address all contingencies in NLRC's Emergency Plan. Generic ICS training will be considered from various training providers.

All staff will receive a comprehensive orientation to all areas of the refinery, its Control Room; Emergency Operations Centre (EOC); tanker familiarization; tanker loading; jetty operations and support tug operations. This exposure will allow all staff to function with greater understanding during emergencies.

12.8 Firefighting Emergency Plan

Emergency Preparedness and firefighting will be addressed in the site Environmental Protection Plan and the Emergency Response Plan. Site plans will be developed in conjunction with the Provincial standards and in consultation with the Fire Commissioner and Emergency Measures Office. The site will have trained personnel and state-of-the-art equipment on-site. Accommodations established for the construction phase will meet all Provincial and NLRC safety standards.

The project will construct an on-site fire station with appropriate firefighting vehicles. A hazardous materials (HAZMAT) response trailer will also be stored on-site. The number and sizes of the firefighting equipment will be determined during detailed design when full hazard identification and response requirements are completed.

The refinery will maintain a core group, fully trained and certified as a Fire Brigade, and comprised of facility personnel who respond to refinery emergency situations involving fires and/or hazardous materials. The primary response group will be composed of on-shift operations personnel with trained backup being provided by day staff. The Fire Brigade personnel are expected to receive their initial training at the Marine Institute of Newfoundland and Labrador in Foxtrap and will have regular upgrading and training exercises to maintain skills. Training will be coordinated with other local area industry and towns where possible.

Emergency response training for fire-team individuals will include:

- Refinery accidents and malfunctions;
- Consequences of accidents and malfunctions;
- Potential for fire and explosion;
- Fire suppression and control systems;
- Fire and explosion prevention and containment;
- Prevention of incident escalation;

- Procedures to secure a spill source;
- Procedure to control the spread of oil during a spill;
- Minimizing environmental effects;
- Firefighting training;
- Fire theory;
- Firefighting equipment theory;
- Firefighting equipment;
- Protective clothing and equipment;
- Self-contained breathing apparatus (SCBA);
- Fire – water pumping systems;
- Foam application systems;
- Firefighting procedures;
- Tabletop exercises;
- Emergency response planning.

Refinery firefighters will be given oil industry standard firefighting training and will regularly practice with their equipment. Training could include integration with firefighting resources from outside the refinery to help foster off-site responder capability.

Fires will be reported to local and provincial authorities. On-site emergency response teams will be first responders with immediate call-in of support as the situation requires.

As mentioned earlier, the Proponent is actively promoting a local area Mutual Aid Organization, including the local town fire departments as well as the NARL and NTL fire departments. This mutual aid organization could provide additional response equipment, materials, and personnel in the event of a significant emergency anywhere in the local area.

12.9 Oil Pollution Contingency Plan

12.9.1 NLRC Approach

NLRC's statement on Health, Safety, Environment and Social Responsibilities acknowledges that oil refining comes with an inherent risk for environmental damage, and commits to take a leadership role in ensuring that all areas of potential environmental impacts within the Placentia Bay region are understood and addressed. It will also make investments in infrastructure that will enhance the response capacity of Placentia Bay to environmental threats or accidents. NLRC will include oil spill prevention and response preparedness plans in the overall Environmental Protection Plan for the refinery site. The EPP is described in Section 11.9 of this document and in detail in Volume 3, Biophysical Assessment. Spill prevention and spill management are incorporated into the design and will be integral to operational policy and

procedures. Key aspects of NLRC's approach to oil spill prevention and response preparedness planning for the Project are described below.

Environmental Assessment

The EIS Guidelines require that the Proponent outline the contingency plan for a spill, on land or in the marine environment, as part of their overall emergency response planning. The potential effects of an oil spill are considered in the EIS Volume 3 Biophysical Assessment. The sections below will provide information on NLRC's planning to date.

TERMPOL Review

Contingency planning will be further developed and receive additional regulatory review through a TERMPOL Review to be conducted at a later stage in project design. A TERMPOL Review is voluntary: the objective of TERMPOL Process is to provide a critical review of planned marine terminal operations, including all safety and emergency policies, plans, manuals and procedures. The TERMPOL Review requires detailed studies be prepared and provided to a multi-agency review Committee (including both Provincial and Federal representatives). Spill risk and contingency planning will be reviewed through two specific studies: General Risk Analysis and Extended Methods of Reducing Risk and Contingency Planning (as well as the regulations associated with Oil Handling Facilities).

Placentia Bay Traffic Committee

The Placentia Bay Traffic Committee has been in place for several years, initiated and chaired by the Coast Guard. The Committee provides a forum for the identification, discussion and resolution of concerns and potential and actual conflicts among the many types of traffic/uses in Placentia Bay. NLRC has participated in Committee meetings since the Refinery feasibility study was started in late spring 2006. This forum has already been helpful in planning for the refinery; for example the fishers' concern regarding additional anchorages was first raised at a Committee meeting. At the April 2007 meeting, the idea of a Bay-wide approach to contingency planning was suggested and there was considerable interest in the concept.

Partnerships

One of the benefits of situating the refinery on Southern Head was the nearby petroleum-related infrastructure and the anticipation of synergies, including mutual aid for a number of types of emergencies including spill response.

In community consultations throughout the Project Area, in particular with the fishing community, the suggestion has been made that area fishers could be of assistance during a spill. This was the case in the recent (2003) oil spill off the coast of Spain: much of the oil recovered from the surface of the sea was collected by small boat fishermen. The oil industry/fishing industry liaison association, One Ocean, based in St. John's, has been working

on a project that would train fishers in on-water oil spill response techniques. NLRC is following up on the suggestion by some fishers that this initiative or something similar would be welcomed, and provide a readily available workforce familiar with the area in the event of a spill.

Spill Prevention

Spill prevention is a key consideration in facilities design and in operations planning, for both the plant and the marine terminal at Southern Head. International, national and industry prevention measures over the last several years have been successful in greatly reducing the frequency of marine spills. The role of IMO in requiring all new tankers to be double-hulled and the phasing out of existing single hulled tankers by 2015 is especially notable.

In Placentia Bay spill prevention has been enhanced by the active monitoring and management of vessels through the Marine Communications and Traffic Services Centre; the Transport Canada requirements for vessel condition reports well in advance of approaching the Bay; the requirement for proper charts and pilotage before proceeding well into the Bay; and the practice of both the existing refinery and the transshipment terminal to provide escort tugs for laden tankers. NLRC will adopt comparable procedures.

12.9.2 Oil Spill Response Regime

Transport Canada is responsible for the oil spill response regime in Canada. The Canadian Coast Guard, a Special Operating Agency within the Department of Fisheries and Oceans, is the operational agency within the regime.

The *Canada Shipping Act* sets out the basis and requirements for oil spill preparedness and response for owners/operators of both oil handling facilities (OHFs) and vessels (tankers over 150 gross tonnes and all vessels over 400 gross tonnes). Work is ongoing on additional regulations that will require Oil Pollution Prevention Plans as well as Oil Pollution Emergency Plans.

The basis of the regime is that the polluter must be prepared to respond to a spill. One of the fundamental components of the regime is the requirement for an OHF or vessel to have an agreement in place with an accredited Response Organization. The Response Organization for eastern Canada, accredited with response capability for a spill of 10,000 tonnes, is Eastern Canada Response Corporation (ECRC).

The refinery will have a marine terminal for unloading crude oil cargoes from marine tankers for processing into refined products. The proposed refinery will also load cargoes of refined oil products (gasoline, kerosene/jet fuels, and low-sulphur diesel fuel) onto marine tankers for transportation to markets.

Oil Handling Facility

It is expected that once the proposed Refinery begins operating it will be designated by Transport Canada as an "*oil handling facility* (OHF)" pursuant to the *Canada Shipping Act (Government of Canada, 2001)*. As an OHF, NLRC will be required to prepare and submit to Transport Canada and to the Government of Newfoundland and Labrador an "*Oil Pollution Emergency Plan* (OPEP)."

In anticipation of OHF designation, NLRC has developed a basic approach to spill prevention and preparedness, including a draft Table of Contents for the Oil Pollution Emergency Plan or Contingency Plan (Figure 12.2) that is designed to meet the requirements of an OHF.

NLRC is also anticipating that an "*Oil Pollution Prevention Plan* (OPPP)" will be required under revised regulations before the Refinery begins operations.

Oil Pollution Emergency Plan

The OPEP is guide to ensuring an effective response to a spill, on land or on the water. It is designed to be easily understood and followed, allowing for safe and timely action.

The scope of this document is as follows:

- To address the potential release of crude oil or refined product to the marine environment from either the refinery or a marine tanker while secured to a berth at the refinery jetty;
- To guide response operations for oil releases originating within the boundaries of the refinery;
- To guide response operations for an accidental release of a hazardous substance at the refinery.

Oil Pollution Prevention Plan

The Oil Pollution Prevention Plan (OPPP) addresses measures that NLRC will take to prevent marine pollution at or from its operations at the Refinery and marine terminal.

The Plan will:

- demonstrate that NLRC understands the importance of spill prevention;
- provide NLRC's analysis and consideration of prevention opportunities;
- indicate measures that can and will be taken for spill prevention;
- outline NLRC's commitment to spill prevention.

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Figure 12.2 Draft Outline for the Refinery Oil Pollution Emergency Plan (OPEP)

Spill prevention is considered in engineering design; operations; tanker operations at the terminal; and tanker operations in transit to and from the open sea. Spill prevention will be an integral part of the planning and implementation of construction activities and included in the Project EPP.

Existing petroleum facilities in Placentia Bay have been successful in their implementation of procedures for pollution prevention. NLRC will implement comparable procedures and policies. For example, NLRC will require that all tankers visiting the terminal are pre-screened against specific technical, safety and performance criteria. The procedures in place at the existing facilities include:

- Newfoundland Transshipment Limited, 2002, Terminal Regulations and Information Booklet (www.ntl.net/TR.PDF);
- North Atlantic Refinery Limited, 2003 Come By Chance Terminal, Jetty Regulations and Information Booklet.

In addition, the TERMPOL Review Process will examine safety and pollution risks from tanker operations along the tanker routes into Placentia Bay to and from the open sea, as well as the operational activities and relationship between the expected design tankers (VLCC, Suezmax, Panamax, and Handymax) and the refinery. After due consideration, actions to reduce the risks that are identified through the review process will be recommended by the Termpol Review Panel for implementation. These actions will address areas such as tanker safety, navigation, manning, crew training, navigation aids, tanker route zoning, and escort tug services.

12.9.3 Basis for Contingency Planning

As owner/operator of an OHF, NLRC is responsible for spills originating at the marine facilities or the refinery itself. Tankers and bulk carriers using the marine terminal will be chartered vessels and are responsible for their own spill response arrangements.

NLRC will have specific terminal requirements that will ensure vessels coming to and from the terminal will meet the requirements of the *Canada Shipping Act*. The potential effects of a spill from a tanker in Placentia Bay have been included in the assessment and are discussed in Volume 3, Biophysical Assessment, with the potential effects on the commercial fisheries discussed in Volume 4, Socio-economic Assessment

Credible Spill Scenario

The oils that NLRC will be moving through Placentia Bay area are similar to those already passing through the Bay in association with the existing refinery and transshipment terminal. As such, the information used in the environmental assessment and TERMPOL Review of the transshipment terminal and published information on refined products such as diesel and kerosene have been used in this assessment and for initial response planning for the refinery.

The OHF requirements outlined under the *Canada Shipping Act* and review of spill accident statistics provided the basis for the Refinery Contingency Plan. Based on the crude oil unloading rate and shut-off times, an instantaneous release of 250 tonnes was considered credible for planning purposes.

The oil occurrence probability contours developed for hypothetical spills associated with the transshipment terminal have been extrapolated to provide a basis for response planning and effects evaluation of a spill at the refinery terminal for the environmental assessment (Figure 12.3).

For its own response planning purposes, and to meet *Canada Shipping Act* requirements for the OPEP, NLRC intends to develop oil probability distribution maps for hypothetical spills from the refinery site.

NLRC has initiated oceanographic data collection to support site-specific spill trajectory modeling, which will be used in finalizing an oil spill prevention and response plan (OPEP) and in the TERMPOL Review. NLRC has entered into partnership with SmartBay to fund an oceanographic data collection and transmission buoy positioned off Come By Chance Point on the Southern Head peninsula, close to the planned marine facilities. In addition, current meters have been placed at the outfall location and additional measurements are planned for farther inside Come By Chance Bay. This information will be used to develop a hydrodynamic model for site-specific spill trajectory modelling.

It is anticipated that OilMap or a comparable model acceptable to regulatory agencies will be used for trajectory modelling. For the OPEP, NLRC proposes to model the following hypothetical spills at the refinery jetty:

- 50 cubic metre releases at the Refinery jetty of each oil product that will be handled by the Refinery (Arabian Medium and Heavy Crude; No 6 Fuel oil; Diesel; Jet/Kerosene fuel; Gasoline);
- A credible large spill would be from a hypothetical break in the main pipeline between the Refinery and the jetty for which the automatic shutdown system would close its valves in less than 60 seconds. The estimated release volume for 60-seconds of flow is 256 cubic metres. For the drift forecasting it would be assumed that the entire volume released would reach the sea.

This modelling will indicate spilled oil drift directions and confirm the area of focus (on a probability risk basis) in spill response planning.

Figure 12.3 Probability of Ocean Surface Contact after an Oil Spill from the NLRC Jetty

Response Strategies

Experience with spill response throughout the world has provided guidance for response strategies and for determining sensitivities. The OPEP will contain site-specific strategies for areas potentially affected by a spill at the refinery and the marine terminal. Initial considerations for appropriate response strategies are based on an understanding of the fate and behaviour of the oils that will be handled that could enter the environment through a spill, as well as familiarity with response equipment and countermeasure techniques.

Oil containment at the refinery wharf or jetty will be a fundamental strategy for environmental protection in a spill response. This strategy clearly recognizes the sensitivity of the area surrounding the refinery. Some of the sensitivities are: the other industrial sites nearby (the existing refinery, the transshipment terminal at Whiffen Head); fisheries and recreational wharves along the shorelines of Come By Chance Arm; shallow water scallop habitats along the shorelines; the Come By Chance River estuary; otter slides; and bald eagle nest sites along Come By Chance Arm.

It is likely that there would be shoreline impact from a spill at the marine terminal.

In Atlantic Canada, years of experience, research and observation have been collected and mapped by Environment Canada in a series of maps (Atlantic Canada E-maps) that provide a ready source of information on areas of ecological importance (endangered species, bird colonies, protected areas, wildlife occurrence), shoreline/backshore type and spill clean-up guidance. The maps are available on-line (www.e-map.gc.ca/) which allows for ready access in an actual event, as well as for planning. Key sensitivity maps will be included in the OPEP.

As part of planning for the Refinery and marine terminal, the geomorphology of the coast in the immediate area of the refinery was mapped according to the classification system used by Environment Canada. As well, NLRC had several surveys completed throughout Placentia Bay to augment the existing information on seabirds, marine mammals, sea turtles, and otters.

NLRC will contribute information from wildlife and shoreline surveys carried out in support of the Refinery EIS to the E-map database.

A combination of shoreline type and material plus exposure to wave forces affects not only the response strategy but the extent and duration of oiling itself, hence influencing the environmental effects of the spill. The Oil Residence Index has been calculated for the area in the immediate vicinity of the marine terminal as another factor to consider in spill prevention and response preparedness.

Final development of response strategies will be done in conjunction with regulatory agencies and the communities. During an actual spill event, response strategies would be developed in collaboration with REET, the Regional Environmental Emergency Team. REET is a multi-

agency advisory group, chaired by Environment Canada, that can be pulled together very quickly to assist with spill-response planning and implementation.

Resources

The OPEP will clearly identify the location and access to resources needed for spill response, including equipment, materials and personnel.

The OPEP addresses spills on land as well as in the marine environment. While personnel resources are similar, equipment and materials differ for a land spill. Stockpiles of basic containment and clean-up materials will be strategically located around the refinery itself, including a variety of sorbent materials, containment booms and temporary oil storage tanks, drums, plastic liners and bags. The tank farm will be located at the lowest elevation on the refinery site to eliminate spread of spilled oil. The tank farm (tanks and protective dykes) will be built to BATEA standards and government requirements.

As an OHF, the refinery and marine terminal will have equipment and trained personnel on-site. Access to additional resources will be prearranged through arrangements with local contractors as well as with the accredited Response Organization. The Response Organization in turn can provide support for spills of up to 10,000 tonnes in volume.

Regulations for response time for Response Organizations and OHFs are demanding and require effective pre-planning, exercising and implementation. Regulations require that the equipment and resources to contain and control a spill of the minimum size relevant to the OHF (i.e. for the refinery, 150 tonnes) be deployed within one hour of discovery of the spill and the equipment and resources to recover and clean up the oil within six hours ("Reponse Organizations and Oil Handling Facilities Regulations, SOR/95-405").

Oiled Wastes Management

A number of solid and liquid wastes result from an oil spill and oil spill clean-up. The volumes of waste can be significant and without effective management can be an obstacle to continuing with clean-up.

First-hand observations of the need for waste management for oiled waste from the major oil spill off Spain, in 2003, prompted the Newfoundland and Labrador Environmental Industry Association to host an international workshop on oil spill waste management. Subsequent to the workshop, a report, "Toward An Oil Spill Waste Management Strategy for Newfoundland and Labrador" (Cormorant Ltd., 2004) was prepared: it includes measures to address oil spill waste minimization, handling, treatment and disposal and offers advice on waste management.

NLRC is incorporating oil spill waste management into the design of both wharf and plant infrastructure and will work with industry and the various levels of government toward a management plan for oily wastes.

13.0 COMMUNITY LIAISON PLAN

Community consultation has been an important part of the environmental assessment process for the refinery. Public input has been directly incorporated into project design and has enabled aspects of the project that could have been contentious to be addressed and alleviated and, equally important, allowed opportunities to be identified that might otherwise have been missed.

In addition to working with communities in the immediate Project area, NLRC is also participating in a number of other area groups, associations and initiatives, ranging from Chambers of Commerce to the Placentia Bay Traffic Committee. NLRC has already formed a community/industry/government advisory group specific to the Project, an Air Quality Study Advisory group, and is working with another key committee, the FFAW's Placentia Bay Sub-Committee.

NLRC state their approach to community liaison in their Commitment to Health, Safety, Environment Responsibilities at the beginning of this EIS volume:

"NLRC understands that its planned operations will be situated within a region that includes several communities and its ability to operate successfully will be dependent on an open, interactive and positive relationship with its neighbours. It commits to open communication in order to ensure understanding at all times of community level needs. NLRC will participate in the wellbeing and overall strengthening of communities within the region."

14.0 REFERENCES

Atlantic Risk Based Corrective Action (RBCA). 2007. : http://www.atlanticrbca.com (Accessed June 2007

Bounicore, Anthony J. and Wayne T. Davis, editors. “Air Pollution Engineering Manual.” *Air & Waste Management Association*. 1992.

Canadian Council of Ministers of Environment (CCME). “Environment Guidelines for Controlling Emissions of Volatile Organic Compounds from Aboveground Storage Tanks.” 1995.

Canadian Council of Ministers of Environment (CCME). “National Framework for Petroleum Refinery Emissions Reductions.” 2005.

Canadian Council of Ministers of the Environment. “Canada Wide Standards for Petroleum Hydrocarbons in Soils.” 2000. : http://www.ccme.ca/ourwork/soil.html?category_id=43 (Accessed June 2007)

Canadian Petroleum Products Institute (CPPI). “Code of Practice for Developing and Emission Inventory for Refineries and Terminals.” Revision 10. 2006.

Canadian Standards Association (CSA). “Emergency Preparedness and Response CAN/CSA-2731-03.” 2003.

Cormorant Ltd. “Toward an Oil Spill Waste Management Strategy for Newfoundland and Labrador.” 2004.

Environment Canada. “Canadian Environmental Quality Guidelines.” 2004. : http://www.ec.gc.ca/ceqg-rcqe/English/default.cfm (Accessed June 2007)

Government of Canada. “ Migratory Birds Convention Act.” 1994.

Government of Canada. “Canadian Shipping Act.” 2001.: http://www.tc.gc.ca/acts-regulations/GENERAL/C/csa2001/menu.htm

Government of Canada. “Environmental Protection Act.” 1999. : http://www.ec.gc.ca/CEPARegistry/the_act (Accessed June 2007)

Government of Canada. “Fisheries Act.” 1985.

Government of Canada. “Hazardous Products Act.” 1985.

Government of Canada. “Regulatory Framework for Air Emissions” 2007.: http://www.ec.gc.ca/doc/media/m_124/toc_eng.htm

Government of Canada. “Transportation of Dangerous Goods Act.” 1992.

Government of Canada. Canadian Shipping Act. “Response Organizations and Oil Handling Facilities Regulations SOR/95-405.” 1995.

Government of Canada. Department of Environment. “Canadian Water Quality Guidelines for the Protection of Aquatic Live.”

Government of Canada. Department of Environment. “Canadian Water Quality Guidelines for the Protection of Agricultural Water Users.”

Government of Canada. Health Canada. “Canadian Drinking Water Guidelines.” 2007.: http://www.hc-sc.gc.ca/ewh-semt/water-eau/drink-potab/guide/index_e.html

Government of Canada. Health Canada. “Canadian Recreational Water Quality.” 1992.: http://www.hc-sc.gc.ca/ewh-semt/pubs/water-eau/guide_water-1992-guide_eau_e.html

Government of Newfoundland & Labrador. “Food and Drug Act.” 1997, 2004.: http://www.hoa.gov.nl.ca/hoa/statutes/f21.htm#1

Government of Newfoundland & Labrador. Provincial Department of Environmental and Conservation. “Storage and Handling of Gasoline and Associated Products Regulations.” 2003.

Government of Newfoundland & Labrador. Provincial Department of Environment and Conservation. “Guidelines for the Design, Construction and Operations of Water and Sewage Systems.” 2005.: http://www.env.gov.nl.ca/Env/env/waterres/CWWS/Guidelines_Water_Sewerage/Guidelines_for_Design_Constr_Oper_WSS.pdf

Government of Newfoundland & Labrador. Water Resources Division. Water Investigations Branch. Provincial Department of Environment and Conservation. “Environmental Guidelines for Fording.” 1992.

Government of Newfoundland and Labrador. “Air Pollution Control Regulations.” 2004.

Government of Newfoundland and Labrador. “Climate Change Action Plan” 2005.: http://www.env.gov.nl.ca/env/Env/policy%20and%20planning/climatechangereport/default.htm

Government of Newfoundland and Labrador. “Dangerous Goods Transportation Act and Regulations.” 1990.

Government of Newfoundland and Labrador. “Environmental Control water and Sewage Regulations.” 2003.

Government of Newfoundland and Labrador. “Guidance Document for the Management of Impacted Sites.” 2004. : http://www.atlanticrbca.com/data_eng/nl_impacted_site_guidance_v1.pdf

Government of Newfoundland and Labrador. “Heating Oil Storage Tank System Regulations.” 2003. : http://www.atlanticrbca.com/data_eng/nfl_oil_storage_tank_reg.html (Accessed June 2007)

Government of Newfoundland and Labrador. “Policy Directive for the Management of Impacted Sites.” 2005. : http://www.env.gov.nl.ca/env/env/pollprev/waste_manag/PPD0501.pdf (Accessed June 2007)

Government of Newfoundland and Labrador. “Storage and Handling of Gasoline and Associated Products Regulations.” 2003. : http://www.hoa.gov.nl.ca/hoa/regulations/rc030058.htm (Accessed June 2007)

Government of Newfoundland and Labrador. “System Installation Inspection Manual – Heating Oil Storage Tank.” 2002. : http://www.atlanticrbca.com/data_eng/nfl_system_installation_inspection_manual.pdf (Accessed June 2007)

Government of Newfoundland and Labrador. “Waste Management Regulations.” 2003.

Government of Newfoundland and Labrador. “Water Resources Act.” 2004.

Government of Newfoundland and Labrador. ”Used Oil Control Regulations.” 2002. : http://www.hoa.gov.nl.ca/hoa/regulations/rc020082.htm (Accessed June, 2007)

International Chamber of Shipping. Oil Companies International Marine Forum. International Association of Ports and Harbours. “ International Safety Guide for Oil Terminals and Tankers.” 2006.

International Marine Organization (IMO). “Marine Security – International Ship and Port Facility Security Code.” 2004.

International Panel on Climate Change. “Carbon Dioxide Capture and Storage.” *Cambridge University Press*. 2005.

Newfoundland Transshipment Limited. “Terminal Regulations and Information Booklet.” 2002.

North Atlantic Refinery Limited. “Jetty Regulations and Information Booklet.” 2003.

United States Environment Protection Agency. “Analysis of commercial Marine Vessels Emissions and Fuel Consumption Data, EPA A490-R-00-002.” 2000.

US EPA (United States Environmental Protection Agency). “Analysis of Commercial Marine Vessels Emissions and Fuel Consumption Data, EPA420-R-00-002.” February 2000.

Witherbys Publishing Limited and Seamanship International Limited. “Tanker Jetty Safety – Management of the Ship/Shore Interface.” 2007.

World Bank. “General Environmental Guidelines.” 1998.

15.0 GLOSSARY OF TERMS

Term	Definition
additive	Chemicals added to petroleum products in small amounts to improve quality or add special characteristics.
air fin coolers	A radiator-like device used to cool or condense hot hydrocarbons; also called fin fans.
airshed	A geographical area within which the air is frequently confined or channelled, with all parts of the area thus being subject to similar conditions of air pollution.
amine	An organic compound containing nitrogen as the key atom. Amines structurally resemble ammonia, where one or more hydrogen atoms are replaced by organic molecules. Amines are typically used as a selective scrubbing medium for sulphur dioxide.
API gravity	The universally accepted scale adopted by the American Petroleum Institute for expressing the specific gravity of oils, determined by the following formula: API gravity = (141.5/Specific Gravity at 60F) – 131.5
aromatic	Organic compounds with one or more benzene rings.
atmospheric tower	A distillation unit operated at atmospheric pressure.
baseline	Background, pre-activity, pre-construction or pre-project environmental conditions.
bathymetry	Measurements of water depths of a water body, or topography of the bottom of the water body.
benzene	An unsaturated, six-carbon ring, basic aromatic compound.
blending	The process of mixing two or more petroleum products with different properties to produce a finished product with desired characteristics.
block valve	A valve used to isolate equipment.

Term	Definition
blowdown	The removal of hydrocarbons from a process unit, vessel, or line on a scheduled or emergency basis by the use of pressure through special piping and drums provided for this purpose.
bottoms	Tower bottoms are residue remaining in a distillation unit after the highest boiling-point material to be distilled has been removed. Tank bottoms are the heavy materials that accumulate in the bottom of storage tanks, usually comprised of oil, water, and foreign matter.
catalyst	A material that aids or promotes a chemical reaction between other substances but does not react itself. Catalysts increase reaction speeds and can provide control by increasing desirable reactions and decreasing undesirable reactions.
caustic	Caustic generally refers to any strongly corrosive chemical substance, especially one that attacks organic matter. In an industrial setting, the term caustic is often used in lieu of caustic soda, also known as sodium hydroxide. Caustic soda is often used as a neutralizing agent for strong acids.
CEAA	*Canadian Environmental Assessment Act.* The legislation of the Government of Canada that governs the conduct of environmental assessments by federal authorities in Canada.
coke	A high carbon-content residue remaining from the destructive distillation of petroleum residue.
coking	A process for thermally converting and upgrading heavy residual into lighter products and by-product petroleum coke. Coking also is the removal of all lighter distillable hydrocarbons that leaves a residue of carbon in the bottom of units or as buildup or deposits on equipment and catalysts.
condensate	The liquid hydrocarbon resulting from cooling vapours.
condenser	A heat-transfer device that cools and condenses vapour by removing heat via a cooler medium such as water or lower-temperature hydrocarbon streams.
contaminant	A substance, entity or quality that renders its surroundings impure.

Term	Definition
continuous emission monitor	Also abbreviated as CEM, a continuous emissions monitor consists of instrumentation placed in a stack or duct to continuously measure the emissions of a particular contaminant to the environment.
cooler	A heat exchanger in which hot liquid hydrocarbon is passed through pipes immersed in cool water to lower its temperature.
cracking	The breaking up of heavy molecular weight hydrocarbons into lighter hydrocarbon molecules by the application of heat and pressure, with or without the use of catalysts.
Crude oil	A naturally occurring mixture of hydrocarbons that usually includes small quantities of sulphur, nitrogen, and oxygen derivatives of hydrocarbons as well as trace metals.
dead weight tonne	Abbreviated dwt, dead weight tonne is a term used to characterize the capacity of a ship, which is determined in terms of the displacement of the ship at any loaded condition minus the lightship weight.
desalting	Removal of mineral salts (most chlorides, e.g., magnesium chloride and sodium chloride) from crude oil.
desulphurization	A chemical treatment to remove sulphur or sulphur compounds from hydrocarbons.
distillate(s)	A light petroleum product resulting from the distillation of crude oil into lighter fractions. Distillates typically refer to petroleum fractions ranging from kerosene to vacuum gas oil.
distillation	The process of purifying a liquid into its boiling range fractions by successive evaporation and condensation.
feedstock	Stock from which material is taken to be fed (charged) into a processing unit.
flash point	Lowest temperature at which a petroleum product will give off sufficient vapour so that the vapour-air mixture above the surface of the liquid will propagate a flame away from the source of ignition.
fractions	In a refining process, fractions refer to the individual components of crude that have been vapourized through distillation (boiling) or other

Term	Definition
	refining processes. Fractions have distinct boiling points and thus can be separated by distillation to recover the individual chemical species contained in the crude.
fuel gas	Refinery gas used for heating.
gasoline	A blend of naphthas and other refinery products with sufficiently high octane and other desirable characteristics to be suitable for use as fuel in internal combustion engines.
greenhouse gas	A gas whose reflection of long wave radiation from Earth may contribute to the greenhouse effect, whereby a gradual warming of the Earth's atmosphere results from the trapping of heat within the lower atmosphere.
heat exchanger	Equipment to transfer heat between two flowing streams of different temperatures. Heat is transferred between liquids or liquids and gases through a tubular wall.
hydrocracking	A process used to convert heavier feedstock into lower-boiling, higher-value products. The process employs high pressure, high temperature, a catalyst, and hydrogen.
hydrodesulphurization	A catalytic process in which the principal purpose is to remove sulphur from petroleum fractions in the presence of hydrogen.
inhibitor	Additive used to prevent or retard undesirable changes in the quality of the product, or in the condition of the equipment in which the product is used.
isomerization	A reaction that catalytically converts straight-chain hydrocarbon molecules into branched-chain molecules of substantially higher octane number. The reaction rearranges the carbon skeleton of a molecule without adding or removing anything from the original material.
knockout drum	A vessel wherein suspended liquid is separated from gas or vapour.
mitigation	In respect of a project, the elimination, reduction or control of the adverse environmental effects of the project, and includes restitution for any damage to the environment caused by such effects through

Term	Definition
	replacement, restoration, compensation or other means.
mobile source	A source (of emissions) that moves or travels from point-to-point, such as a truck, car, vessel or airplane.
naphtha	A general term used for low boiling hydrocarbon fractions that are a major component of gasoline. Aliphatic naphtha refers to those naphthas containing less than 0.1 percent benzene and with carbon numbers from C3 through C16. Aromatic naphthas have carbon numbers from C6 through C16 and contain significant quantities of aromatic hydrocarbons such as benzene (>0.1 percent), toluene, and xylene.
noise	Unwanted sound.
olefins (alkenes)	A series of aliphatic hydrocarbons containing a double bond which are more reactive than paraffins. Examples of olefins include ethylene, propylene and butylenes.
Panamax	In reference to a ship or marine vessel, ships classified as Panamax class are of the maximum dimensions that will fit through the locks of the Panama Canal, as determined by the dimensions of the lock chambers and the depth of the water in the canal.
particulate matter	Also referred to as total suspended particulate matter, or colloquially called soot or dust, particulate matter is a general term to describe the solid portion of particles or liquid droplets contained within an exhaust gas stream or in ambient air.
petroleum coke	The solid carbon residue produced by gasifying petroleum residues from the refining process to solid form. It is used as a fuel in large boilers and in making steel. It is a co-product of some refining processes.
point source	A source of contaminant releases that occupies a fixed point in space and which has a concentrated output of releases. Examples of point sources of contaminant releases include stacks, vents and discharge pipes.
pour point	The pour point of oil is defined a 3°C above that temperature at which the oil just fails to flow when cooled under prescribed conditions.

Term	Definition
process wastewater	Wastewater used in an industrial process which is no longer suitable for its original purpose and is therefore treated before being released to the environment.
project	As defined under *CEAA*, means in relation to a physical work, any proposed construction, operation, modification, decommissioning, abandonment or other undertaking in relation to that physical work. Analogous to undertaking under the *Newfoundland and Labrador Environmental Impact Assessment Regulation.*
Project	As described herein, the Project is "Newfoundland and Labrador Refinery Project at Southern Head, Placentia Bay, NL." The Project is a project as defined under *CEAA*.
proponent	In respect of a project or undertaking, the person or body corporate that proposes the project or undertaking.
Proponent	In the context of the EIA Registration/Project Description, the Proponent is Newfoundland and Labrador Refining Corporation (NLRC).
quality assurance program	A defined set of procedures and practices used on a process or data collected from a process, aimed at ensuring the optimal performance of the process or the accuracy, precision, and reliability of the data.
reforming	The thermal or catalytic conversion of petroleum naphtha into more volatile products of higher octane number. It represents the total effect of numerous simultaneous reactions such as cracking, polymerization, dehydrogenation, and isomerization.
reformulated gasoline blendstock for oxygenate blending (RBOB)	The United States Environmental Protection Agency's (USEPA) standard for gasoline intended for ethanol reformulation prior to use in the United States.
sour	A description for crude oil that indicates a relatively high sulphur content of the crude oil.
straight run	Fractions produced directly from crude oil by distillation, but which are not subsequently treated, cracked or reformed.

Term	Definition
tail gas	The lightest hydrocarbon gas released from a refining process.
turnaround	A planned complete shutdown of an entire process or section of a refinery, or of an entire refinery to perform major maintenance, overhaul, and repair operations and to inspect, test, and replace process materials and equipment.
ultra low sulphur diesel (ULSD)	The Canadian government and United States Environmental Project Agency (USEPA) standard for diesel fuel sold with a sulphur content of 15 ppmv or less.
vacuum distillation	The distillation of petroleum under vacuum which reduces the boiling temperature sufficiently to prevent cracking or decomposition of the feedstock.
vapour	The gaseous phase of a substance that is a liquid at normal temperature and pressure.
very large crude carrier (VLCC)	An ocean-going tanker transport vessel that can carry 200,000-350,000 dead weight tonnes (dwt) of liquid petroleum products.
wastewater	Water whose physical and/or chemical properties have been altered from its original state, which alteration makes it no longer suitable for its original purpose and is therefore ultimately destined for treatment before eventual disposal or release to the environment. In the context of this EIA Registration/Project Description, wastewater includes process wastewater and site run-off.

APPENDIX A

RELEVANT LEGISLATION AND ASSOCIATED PERMITS

RELEVANT LEGISLATION (PROVINCIAL)

Environmental Protection Act (2002)

Storage and Handling of Gasoline and Associated Products Regulations (2003)

Gasoline and associated products are to be stored, transferred and disposed so that releases to the environment are prevented.

Used oil shall be collected in a tank or closed container, which is emptied regularly and disposed of in a manner that does not cause pollution.

Used Oil Control Regulations (2002)

Bans unacceptable disposal methods for used oil and used oil filters, controls the storage of used oil and provides for the proper return of used oil and lubricants.

Waste Management Regulations (2003)

Part I – Designates the Multi Materials Stewardship Board as the authority responsible for the implementation and operation of waste management programs.

Part II – Controls beverage container deposits, depots and refunds.

Part III – Prohibits inappropriate disposal of used tires and controls the tire levy.

Air Pollution Control Regulations (2004)

Section 4 –Restricts incineration and pyrolysis practices by standard in-stack emission concentrations.

Section 12 – Prohibits the burning of designated materials in open fires without written approval of the Minister.

Section 13 – Restricts the burning of waste materials to approved facilities that are designed and operated accordingly.

Water Resources Act (2004)

Sections 39,4(a) and 61,2(a) - Prohibits the placement, disposal, discharge or presence of any material that may adversely affect a public water supply, including groundwater and well fields.

Environmental Control Water and Sewage Regulations (2003)

Section 4 – Prohibits the discharge of sewage or other effluent into a public sewer or sewer leading into a public sewer containing materials such as oils or oil by-products, flammable, explosive, toxic or poisonous liquids, solids or gases, fats, congealing materials and other substances in quantities that will interfere with free flow within the public sewer.

Section 7 – Prohibits the discharge of pollutants into a body of water.

Dangerous Good Transportation Act (1990)

Requires the implementation of safety standards and labelling during handling and transport of dangerous goods. These requirements are also subject to inspection. The Act reinforces the requirements and prohibitions of the federal *Transportation of Dangerous Goods Act (1992)*.

RELEVANT LEGISLATION (FEDERAL)

Canadian Environmental Protection Act (CEPA) (1999)

Calls for the submission and implementation of pollution prevention plans, when requested by the Minister of the Environment. Regulates the release of toxic substances and calls for the virtual elimination of materials that demonstrate severe negative environmental effects. Controls the disposal of wastes and other materials at sea. Defines restrictions on the movement of hazardous waste, hazardous recyclables, and other non-hazardous materials internationally and interprovincially.

Transportation of Dangerous Goods Act (TDGA) (1992)

The Act and Regulations require identification of all goods under one of nine categories (Class 1-9), appropriate containers and packaging, and training for all individuals involved in handling dangerous goods.

Section 5 – Prohibits handling, transport or import of goods unless they comply with safety requirements, have the necessary safety marks and are accompanied by applicable documentation.

Section 7 – Requires an appropriate emergency response assistance plan prior to the transport or import of dangerous goods.

Fisheries Act (1985)

Section 36 –Prohibits the discharge of deleterious substances into any type of water frequented by fish.

Canada Shipping Act (CSA) (1985)

Part XV – Garbage Pollution Prevention Regulations – prohibits the discharge of garbage including solid galley waste, food waste, paper, rags, plastics, glass, metal, bottles, crockery, junk or similar refuse.

Part XV – Oil Pollution Prevention Regulations – Requires that vessels have an installation capable of retaining oil residues on board for subsequent discharge to a reception facility and equipment that meets oily mixture discharge requirements set out in Sections 31 and 33.

Vessel Traffic Services Zones Regulations – Requires that before a ship of a certain size enters a Vessel Traffic Service Zone set out in the regulation the master of a ship shall ensure that a report is made to a marine traffic regulator at least 15 minutes before the ship enters a Vessel Traffic Services Zone.

Migratory Birds Convention Act (1994)

Section 35 – Migratory Birds Regulations – Prohibits the deposit of oil, oil wastes or any other substance harmful to migratory birds in any waters or any area frequented by migratory birds.

Hazardous Products Act (1985)

The basis for the Workplace Hazardous Materials Information System (WHMIS), which promotes proper labelling of controlled products and requires workers to receive education and training regarding safe storage, use and handling of controlled products.

Marine Security – International Ship and Port Facility Security Code (2004)

Transport Canada has implemented the ISPS Code through the Marine Transportation Security Regulations, which apply to commercial vessels of 500 tons (gross tonnage) or more, or carrying more than 12 passengers and travelling between countries, and marine facilities and ports serving such vessels. The regulations require such things as the completion of security assessments and security plans, and the designation of security officers.

Regulatory Agency	Permit and/or Regulatory Approval	Activity Requiring Regulatory Approval	Legislation Requiring Compliance
Department of Environment and Conservation			
Environmental Assessment Division	Release from Environmental Assessment	General	Environmental Protection Act Environmental Assessment Regulations
Pollution Prevention Division	Certificate of Approval for the Construction and Operation of a Refinery	General	Environmental Protection Act
Water Resources Division	Alteration to a Body of Water (Schedule A to H). This application form is required as well as the appropriate Schedule application form (See below)	Any activity in or near any body of water Permit required for any infilling of any water bodies including marine infilling	Water Resources Act
Water Resources Division	Schedule A – Environmental Approval of Culverts	New road construction	Water Resources Act
Water Resources Division	Schedule B – Environmental Approval of Bridges	New road construction	Water Resources Act
Water Resources Division	Schedule D – Environmental Approval of Fording	Power Line Construction	Water Resources Act
Water Resources Division	Schedule E – Environmental Approval of Pipe Crossing – Water Intake		Water Resources Act
Water Resources Division	Schedule F – Environmental Approval of Stream Modification or Diversion	New road construction	Water Resources Act
Water Resources Division	Schedule G – Environmental Approval of Small Bridges	New road construction	Water Resources Act
Water Resources Division	Schedule H – Environmental Approval of Other Alterations	Other works within 15 metres of a Body of Water	Water Resources Act
Water Resources Division	Certificate of Approval for Site Drainage	Water run-off from the project site	Water Resources Act
Water Resources Division	Water Use Authorization	Water withdrawal for use during construction and/or operation	Water Resource Act
Water Resources Division	Certificate of Approval – Water & Sewer Distribution System		Water Resources Act Environmental Control Water and Sewage Regulations
Water Resources Division	Certificate of Approval for Temporary AGM (ARD) Storage		Water Resources Act

Regulatory Agency	Permit and/or Regulatory Approval	Activity Requiring Regulatory Approval	Legislation Requiring Compliance
Pollution Prevention Division	Certificate of Approval for Industrial Facilities or Processing Work	A Certificate of Approval may be required for any industrial or processing works	Environmental Protection Act
Pollution Prevention Division	Certificate of Approval – Waste Disposal Facility		
	Environmental Protection Plan (EPP) – Construction	Construction, Operation and Decommissioning	
	Emergency Response Plan	Construction, Operation and Decommissioning	
	Environmental Effects Monitoring Plan	Also has to be submitted to Department of Fisheries and Oceans	
Department of Natural Resources			
Forestry Resources Branch	Commercial Cutting/ Operating Permit	Site Clearing and Construction Activities	Forestry Act Cutting of Timber Regulations
Forestry Resources Branch	Burning Permit	Site Clearing and Construction Activities	Forestry Act Forest Fire Regulations
Mines and Energy Branch	Magazine Licence		Explosives Act
Mines and Energy Branch	Explosives Transportation Permit		Explosives Act
Mines and Energy Branch	Application for Exploration Approval and Notice of Planned Mineral Exploration Work		Mineral Act
Mines and Energy Branch	Quarry Permit	Quarry Construction and Operation	Quarry Materials Act and Regulations
Mines and Energy Branch	Reclamation Plan (Including Financial Assurance)		Mineral Exploration Standards Regulations
Department of Government Services			
Government Services	Licence to Occupy Crown Land		Lands Act
Government Services	Certificate of Approval – Sewage Treatment Plant	Effluent Discharge	Water Resources Act Environmental Control Water and Sewage Regulations
Government Services	Certificate of Approval – Water Supply >4,500 L/day		Water Resources Act
Government Services	Certificate of Approval – Storage and Handling of Gasoline and associated products		Environmental Protection Act Storage and Handling of Gasoline and Associated Products Regulations

Regulatory Agency	Permit and/or Regulatory Approval	Activity Requiring Regulatory Approval	Legislation Requiring Compliance
Government Services	Permit for Flammable and Combustible Liquid Storing and Dispensing (Above or Below Ground) and for Bulk Storage (above ground only)		Environmental Protection Act Storage and Handling of Gasoline and Associated Products Regulations
Government Services	Storage Tank System Application	All Storage Tanks on Site Including Waste Oil Tanks	Environmental Protection Act Storage and Handling of Gasoline and Associated Products Regulations
Government Services	Compliance Standards – National Fire Code, National Building Code and Life Safety Code	All Buildings on Site	Building Accessibility Acts and Regulations
Government Services	Building Accessibility Exemption	All Building on Site	Building Accessibility Acts and Regulations
Government Services	Statutory Declaration for Registration of Boiler and Pressure Vessel Fittings Fabricated in Newfoundland and Labrador		Public Safety Act The Boiler, Pressure Vessel and Compressed Gas Regulations
Government Services	Certificate of Plant Registration for Power, Heat, Refrigeration, Compressed Gas or Combined Plant		
Government Services	Contractor's Licence – Pressure Piping System		
Government Services	Examination and Certification of Welders and Blazers[CMc1]		
Government Services	Examination and Certification of Propane System Installers		
Government Services	Food Establishment Licence	If a cafeteria is located on site.	Food and Drug Act Food Premises Regulations
Government Services	Waste Management Plan	General	
Department of Transportation and Works			
Transportation and Works	Compliance Standard – Storing, handling and transporting dangerous goods	General	Dangerous Goods Transportation Act and Regulations
Department of Human Resources Labour and Employment			
Human Resources Labour and Employment	Compliance Standard – Occupational Health and Safety	Project-related employment	Occupational Health and Safety Acts and Regulations
Department of Tourism, Culture and Recreation			

Regulatory Agency	Permit and/or Regulatory Approval	Activity Requiring Regulatory Approval	Legislation Requiring Compliance
Tourism, Culture and Recreation	Compliance Standard – Historic Resources Act	Construction and operation	Historical Resources Act
Tourism, Culture and Recreation	Archaeological Investigation Permit		Historical Resources Act
Department of Human Resources, labour and Employment			
Human Resources, Labour and Employment	Occupational Health and Safety Manual	General	Occupational Health and Safety Act and Regulations
Town of Come By Chance			
Town of Come By Chance	Compliance Standard/ Development Plan	Project Construction and Operation	Urban and Rural Planning Act
Town of Come By Chance	Approval for Waste Disposal	Waste Disposal	Urban and Rural Planning Act

APPENDIX B

MASTER CODES AND STANDARDS LIST

Standard No. (if applicable)	Title
Province of Newfoundland And Labrador Government Regulations	
Province of Newfoundland And Labrador	Occupational Health and Safety Act
Province of Newfoundland And Labrador	Consolidated Newfoundland and Labrador Regulation 1165/96 'Occupational Health and Safety Regulations under the Occupational Health and Safety Act'
Province of Newfoundland And Labrador	National Fire Code of Canada
Province of Newfoundland And Labrador	Regulation for Design, Construction and use of Boilers and Pressure Vessels. Pressure piping shall be registered with the Provincial Authority in compliance with the Statutes of Newfoundland 1996, Public Safety Act, Chapter P-41.01, "An act to provide for the safety of the public with respect to the use and operation of elevating devices, amusement rides, pressure and electrical systems"
Province of Newfoundland And Labrador	Regulations for the Welding of Boilers Pressure Vessels and Pressure Piping
Province of Newfoundland And Labrador	Government of Newfoundland And Labrador; Department of Works, Services and Transportation "Highway Design Specifications Book" - March 2003 - for civil work.
Province of Newfoundland And Labrador	Hydro Codes and Standards
Province of Newfoundland and Labrador	Environmental Protection Act
Province of Newfoundland and Labrador	Newfoundland and Labrador Regulation 58/03 "Storage and Handling of Gasoline and Associated Projects Regulations, 2003 under the Environmental Protection Act"
Province of Newfoundland and Labrador	Newfoundland and Labrador Regulation 39/04 "Air Pollution Regulations, 2004 under the Environmental Protection Act"
Province of Newfoundland and Labrador	Water Resources Act
Province of Newfoundland and Labrador	Newfoundland and Labrador Regulation 65/03 "Environmental Control Water and Sewage Regulations, 2003 under the Water Resources Act"
Province of Newfoundland and Labrador	Forestry Act
Province of Newfoundland and Labrador	Newfoundland and Labrador Regulation 1108/96 "Cutting of Timber Regulations under the Forestry Act"
Province of Newfoundland and Labrador	Newfoundland and Labrador Regulation 11/96 "Forest Fire Regulations under the Forestry Act"
Province of Newfoundland and Labrador	"Guidelines for the Design, Construction and Operation of Water and Sewerage Systems", 2005, Department of Environment and Conservation
Province of Newfoundland and Labrador	Department of Environment and Conservation Environmental Guidelines from the Water Resources Management Division, Water Investigation Section

Standard No. (if applicable)	Title
Province of Newfoundland and Labrador	Endangered Species Act
Province of Newfoundland and Labrador	Public Safety Act
Province of Newfoundland and Labrador	Dangerous Goods Act
Province of Newfoundland and Labrador	Public Health Act
Province of Newfoundland and Labrador	Quarry Materials Act, 1998
Province of Newfoundland and Labrador	Newfoundland and Labrador Regulation 804/96 "Quarry Materials Regulations under the Quarry Materials Act"
Province of Newfoundland and Labrador	Buildings Accessibility Act
Province of Newfoundland and Labrador	Newfoundland and Labrador Regulation 1140/96 "Buildings Accessibility Regulations under the Buildings Accessibility Act"
Province of Newfoundland and Labrador	Urban and Rural Planning Act, 2000 and Regulations
Industrial Codes and Standards Bodies	
AFBMA	Anti Friction Bearing Manufacturers Association
AGMA	Rotors and Timing Gears
AMCA	Air Movement & Control Association
ASHRAE	American Society of Heating Refrigeration and Air-conditioning Engineers
ASTM	American Society for Testing and Materials
AWS	American Welding Society
BS	BSI British Standards Institution
CAGI	Compressed Air and Gas Institute
CISC	Canadian Institute of Steel Construction
CSA	Canadian Standards Association
CTI	Cooling Tower Institute Bulletins and Codes
EEMAC	Electrical & Electronic Manufacturers of Canada
HI	Hydraulic Institute
ISA	Instrument Society of America
NACE	National Association of Corrosion Engineers
NBC	National Building Code (of Canada)
NBFU	National Board of Fire Underwriters

Standard No. (if applicable)	Title
NFPA	National Fire Protection Association (NFPA) 2006 National Fire Codes
OCIMF	Oil Companies International Marine Forum
OSHA	Occupational Safety & Health Act (USA)
SSPC	Steel Structures Painting Council
TEMA	Tubular Exchanger Manufacturers Association
TC	Transport Canada
ULC	Underwriters' Laboratories of Canada
IEC	International Electrotechnical Commission
FM	Factory Mutual
API	American Petroleum Institute
IES	International Illuminating Society (of North America)
ICEA	Insulated Cable Engineers Association
TAC	Transportation Association of Canada
Electrical Codes and Standards	
ANSI C37.010	Application Guide for AC High Voltage Circuit Breakers Rated on a Symmetrical Current Basis
ANSI C37.06	Preferred Ratings and Related Required Capabilities for AC High Voltage Circuit Breakers Rated on a Symmetrical Current Basis
ANSI C37.11	Requirements for Electrical Controls for AC High Voltage Circuit Breakers Rated on a Symmetrical Current Basis
ANSI C37.13	Standards for Low Voltage AC Power Circuit Breakers Used in Enclosures.
ANSI C37.16	Low-Voltage Power Circuit breakers and AC Power Circuit Protectors – Preferred Ratings, Related Requirements and Application Recommendations.
ANSI C37.17	Trip Devices for AC and General Purpose DC Low Voltage Power Circuit Breakers.
ANSI C37.20.1	Standard for Metal-Enclosed Low-Voltage Power Circuit-Breaker Switchgear.
ANSI C37.20.2	Metal-Clad and Station-Type Cubicle Switchgear
ANSI C37.20.2	Metal-Clad and Station-Type Cubicle Switchgear
ANSI C37.23	Metal-Enclosed Bus and Guide for calculating Losses in Isolated Phase Bus
ANSI C37.50	Test Procedures for Low Voltage AC Power Circuit Breakers Used in Enclosures.
ANSI C57.12.00	General Requirements for Liquid-Immersed Distribution, Power and Regulating Transformers

Standard No. (if applicable)	Title
ANSI C57.12.90	Test Code for Liquid-Immersed Distribution, Power and Regulating Transformers
ANSI C57.12.98	Guide for Transformer Impulse Tests
ANSI C57.13	Requirements for Instrument Transformers
ANSI C57.13	Requirements for Instrument Transformers
API 617	Axial and Centrifugal Compressors and Expander-Compressors for Petroleum, Chemical and Gas Industry
ANSI/API RP 500	Recommended Practice for Classification of Locations for Electrical Installations at Petroleum Facilities Classified as Class I, Division 1 and Division 2, 1998. (Reaffirmed, November 2002.)
ANSI/API RP 505	Recommended Practice for Classification of Locations for Electrical Installations at Petroleum Facilities Classified as Class I, Zone 0, Zone 1, and Zone 2, 1998.
API 505	Classification of Locations for Electrical Installations at Petroleum Facilities Classified as Class I, Zone 0, Zone 1, and Zone 2
API 540	Electrical installations in petroleum processing plants.
API 541	Form-wound Squirrel-Cage Induction Motors—500 Horsepower and Larger
API 547	General-purpose Form-wound Squirrel Cage Induction Motors—250 Horsepower and Larger
API 547	General-purpose Form-wound Squirrel Cage Induction Motors—250 Horsepower and Larger
ASTM B3-74	Soft and Annealed Copper Wire
ASTM B3-74	Soft and Annealed Copper Wire
C22.2 No.100	Motors and Generators
C22.2 No.145	Motors and Generators for use in Hazardous Locations
CAN/CSA C88-M90	Power Transformer and Reactors
CAN/CSA-C802.1-00	Minimum Efficiency Values for Liquid-Filled Distribution Transformers
CAN/CSA-C88.1-96	Power Transformer and Reactor Bushings
CEC	C22.1 Canadian Electrical Code
CSA 22.2 No.100	Motors and Generators
CSA 22.2 No.145	Motors and Generators for use in Hazardous Locations
CSA B78.1	Mechanical Engineering Drawing Standards, Drafting Practices – General Principles
CSA C13	Instrument Transformers
CSA C13	Instrument Transformers

Standard No. (if applicable)	Title
CSA C13	Instrument Transformers
CSA C22.1	Canadian Electrical Code - Part I
CSA C22.2 No. 0.3	Test Methods for Electrical Wires and Cables
CSA C22.2 No. 0.3	Test Methods for Electrical Wires and Cables
CSA C22.2 No. 100	Motors and Generators
CSA C22.2 No. 100	Motors and Generators
CSA C22.2 No. 107	Rectifying Equipment
CSA C22.2 No. 131	Type Teck 90 Cable
CSA C22.2 No. 131	Type Teck 90 Cable
CSA C22.2 No. 14	Industrial Control Equipment for Use in Ordinary (non-hazardous) Locations
CSA C22.2 No. 145	Motors and Generators for Use in Hazardous Locations
CSA C22.2 No. 145	Motors and Generators for Use in Hazardous Locations
CSA C22.2 No. 174	Cables and Cable Glands for Use in Hazardous Locations
CSA C22.2 No. 174	Cables and Cable Glands for Use in Hazardous Locations
CSA C22.2 No. 201 — M1984	Metal-Enclosed High Voltage Busways
CSA C22.2 No. 232	Optical Fibre Cable
CSA C22.2 No. 239	Control and Instrumentation Cable
CSA C22.2 No. 27	Busways
CSA C22.2 No. 38	Thermosetting Insulated Wire and cable
CSA C22.2 No. 38	Thermosetting Insulated Wire and cable
CSA C22.2 No. 51	Armoured Cables
CSA C22.2 No. 51	Armoured Cables
CSA C22.2 No. 68.3	
CSA C22.2 No. 75	Thermoplastic Insulated Wires and Cables
CSA C22.2 No. 75	Thermoplastic Insulated Wires and Cables
CSA C22.2 No. 77	Motors with Inherent Overheating Protection
CSA C22.2 No.31	Switchgear Assemblies.
CSA C22.2 No. 130.1	Heat-Tracing Cable Systems for Use in Industrial Locations
CSA C22.2 No. 138	Heat-Tracing Cable and Cable Sets for Use in Hazardous Locations

Standard No. (if applicable)	Title
CSA C22.2 No. 31	Switchgear Assemblies
CSA C22.2 No. 31	Switchgear Assemblies
CSA C50-1976	Electrical Insulating Oil for Transformers and Switches
CSA Z107.51	Procedure for In-Situ Measurement of Noise from Industrial Equipment
CSA Z299.3	Quality Verification Program Requirements
EEMAC	
EEMAC E14-2	Industrial Controls and Systems
EEMAC G8 2	Switchgear Assemblies
EEMAC G8 2	Switchgear Assemblies.
EEMAC M1 6	Motors and Generators (Exceptions to NEMA MG 1)
EEMAC M1-6	Motors and Generators
EEMAC/NEMA MG-1	Motors and Generators (Exceptions to NEMA MG-1)
IEC 1000-4-5	Electromagnetic compatibility (EMC)- Testing and measurement techniques
IEC 529	Degree of protection provided by enclosures (IP code)
IEC 60146	General requirements and line commutated converters
IEC 79-0	Electrical apparatus for explosive gas atmospheres, Part 0 General Requirements
IEC 79-1	Electrical apparatus for explosive gas atmospheres Part 1 Construction and test of flameproof enclosures of electrical apparatus
IEC 79-10	Electrical apparatus for explosive gas atmospheres, Part 10 Classification of hazardous areas
IEC 79-11	Electrical apparatus for explosive gas atmospheres, Part 11 Intrinsic safety "i"
IEC 79-14	Electrical apparatus for explosive gas atmospheres, Part 14 Electrical installations in explosive gas atmospheres (other than mines)
IEC 79-7	Electrical apparatus for explosive gas atmospheres, Part 7 Increased Safety "e"
IEEE 515	Recommended Practice for the Testing, Design, Installation, and Maintenance of Electrical Resistance Heat Tracing for Commercial Applications
IEEE 515	Standard for the Testing, Design Installation and Maintenance of Electrical Resistance Heat Tracing for Industrial Applications
IEEE 519	Standard Practices and Requirements for Harmonic Control in Electrical Power Systems
IEEE 112	Test Procedure for Polyphase Induction Motors and Generators

Standard No. (if applicable)	Title
IEEE 112	Test Procedure for Polyphase Induction Motors and Generators
IEEE 484	Recommended Practice for Design and Installation of Vented Lead-Acid Batteries for Stationary Applications (BCI)
IEEE 485	Recommended Practice for Sizing Lead-Acid Batteries for Stationary Applications –Description
IEEE 62.41	Guide on the Surge Environment in Low-Voltage (1000 V and less) AC Power Circuits
IEEE 841	IEEE Standard for Petroleum and Chemical Industry—Severe Duty Totally Enclosed Fan-Cooled (TEFC) Squirrel Cage Induction Motors— Up to and Including 370 kW (500 hp).
IEEE 844	Recommended Practice for Electrical Impedance, Induction, and Skin Effect Heating of Pipelines and Vessels
IEEE 85	Test Procedure for Airborne Sound Measurements on Rotating Electrical Machinery
IEEE C37.010	Application Guide for AC High Voltage Circuit Breakers Rated on a Symmetrical Current Basis
IEEE C37.011	Application Guide for Transient Recovery Voltage for AC High Voltage Circuit Breakers.
IEEE C37.06	Application Guide for AC High Voltage Circuit Breakers Rated on a Symmetrical Current Basis
IEEE C37.20.2	Metal-Clad Switchgear
IEEE C37.23	Standard for Metal-Enclosed Bus
IEEE C57.13	Requirements for Instrument Transformers
IEEE No. 32-1972	Requirements, Terminology and Test Procedure for Neutral Grounding Devices
NEMA ICS 1 & 2	Standards for Industrial Control Devices and System
NEMA ICS 1 & 2	Standards for Industrial Control Devices and Systems
NEMA ICS 61800-2	Adjustable Speed Electrical Power Drive Systems Part 2 General requirements. Rating specifications for low voltage adjustable frequency AC power drive systems
NEMA ICS 7.1	Safety Standards for Construction and Guide for Selection, Installation, and Operation of Adjustable-Speed Drive Systems
NEMA MG 1	Motors and Generators
NEMA MG 2	Safety Standards for Motors and Generators
NEMA MG-1	Motors and Generators
NEMA MG-1	Motors and Generators
NEMA MG-2	Safety Standards for Motors and Generators
NEMA PE1	Uninterruptible Power Systems

Standard No. (if applicable)	Title
NEMA PE5	Utility Type Battery Chargers
NEMA WC7	Cross-linked Thermosetting Polyethylene Insulated Wire and Cable for Transmission and Distribution of Electrical Energy
NEMA WC7	Cross-linked Thermosetting Polyethylene Insulated Wire and Cable for Transmission and Distribution of Electrical Energy
NFPA 497	Classification of Flammable Liquids, Gases, or Vapors and of Hazardous (classified) Locations for Electrical Installations in Chemical Process Areas
NFPA 780	STANDARD FOR INSTALATION OF LIGHNING PROTECTION SYSTEMS
UL 508C	Power Conversion Equipment
UL1112/1836	Motors and Generators for Use in Hazardours Locations
UL1730	Electric Motors
ULC 1778	Uninterruptible Power Supply Equipment.
Civil and Structural Codes and Standards	
ACI 302.1R-04	Guide for Concrete Floor and Slab Construction
ACI 350.3-01	Seismic Design of Liquid Containing Concrete Structures
ACI 350/350R-01	Environmental Engineering Concrete Structures
API Publication 2218	Fireproofing Practices in Petroleum and Petrochemical Processing Plants
API Recommended Practice (RP) 2001	Fire Protection in Refineries
API Standard 650	Welded Steel Tanks for Oil Storage
ASCE 7-05	Minimum Design Loads for Buildings and Other Structures
ASCE Report	ASCE Engineering Report on 'Design of Blast Resistant Buildings in Petrochemical Facilities'
ASCE Report	ASCE Engineering Report on 'Guidelines for Seismic Evaluation and Design of Petrochemical Facilities'
ASCE Report	ASCE Engineering Report on 'Wind Loads and Anchor Bolt Design for Petrochemical Facilities'
ASTM A185-06	Steel Welded Wire Reinforcement, Plain, for Concrete
ASTM A252	Foundation Steel Pipe Piles
ASTM A307-04	Carbon Steel Bolts and Studs, 60 000 psi Tensile Strength
ASTM A307-04	Carbon Steel Bolts and Studs, 60 000 psi Tensile Strength
ASTM A325-06	Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength

Standard No. (if applicable)	Title
ASTM A497-06	Steel Welded Wire Reinforcement, Deformed, for Concrete
ASTM A992-06a	Structural Steel Shapes
ASTM F1554-04	Anchor Bolts, 36, 55 and 105 ksi Yield Strength
BS 6349: 1985	Maritime Structures
Canadian Foundation Engineering Manual	Fourth Edition (2006)
CISC Guide	Guide for the Design of Crane-Supporting Steel Structures
CCPS	CCPS Guidelines for Facility Siting and Layout
CCPS	CCPS Guidelines for Fire Protection in Chemical, Petrochemical, and Hydrocarbon Processing Facilities
CCPS	CISC 'Guide for the Design of Crane-Supporting Steel Structures'
CSA A165-04	Concrete Masonry Units
CSA A179-04	Mortar and Grout for Unit Masonry
CSA A23.1-04/A23.2-04	Concrete Materials and Methods of Concrete Construction / Methods of Test and Standard practices for Concrete
CSA A23.3-04	Design of Concrete Structures
CSA A23.4-05	Precast Concrete Materials and Construction
CSA A3000-03	Cementitious Materials Compendium
CSA A371-04	Masonry Construction for Buildings
CSA B651-04	Accessible Design for the Built Environment
CSA G164-M92(R2003)	Hot Dip Galvanizing of Irregularly Shaped Articles
CSA G30.18	M92 Billet-Steel Bars for Concrete Reinforcements
CSA G40.20-04/G40.21-04	Rolled or Welded Structural Quality Steel
CSA S6-06	Canadian Highway Bridge Design Code
CSA S16-01	Limit States Design of Steel Structures
CSA S304.1-04	Design of Masonry Structures
CSA S37-01	Antennas, Towers, and Antenna-Supporting Structures
CSA W47.1-03	Certification of Companies for Fusion Welding of Steel
CSA W59-03	Welded Steel Construction (Metal Arc Welding)

Standard No. (if applicable)	Title
CSA Z432-04	Safeguarding of Machinery
Foundation Analysis and Design	Fifth Edition by J. E. Bowles
Handbook of Steel Construction	Eighth Edition (2004)
National Fire Code of Canada 2005	
National Building Code of Canada (NBC) 2005	Division B Parts 4 and 9
National Master Specifications (NMS)	Structural Master Specifications
National Master Specifications (NMS)	Architectural Master Specifications
National Master Specifications (NMS)	HVAC Master Specifications
National Master Specifications (NMS)	Plumbing Master Specifications
OCIMF Report	Prediction of Wind and Current Loads on VLCCs
OCIMF Guidelines	Mooring Equipment Guidelines
UL 1709	Rapid Rise Fire Tests of Protection Materials for Structural Steel
User's Guide	NBC 2005 Structural Commentaries (Part 4 of Division B)
Technical Paper	Vibration Analysis and Design of Foundations for Machines and Turbines by A. Major
TAC	Geometric Design Guide for Canadian Roads (1999)
Transport Canada: 2001	Termpol Review Process: Fender System Design
Mechanical and Piping Codes and Standards	
ASME Section I	Power Boilers
ASME Section II	Material Specifications Part A/B/C/D
ASME Section V	Non Destructive Examination
ASME Section VIII Div.1	Boiler & Pressure Vessels Code-Pressure Vessels.
ASME Section VIII Div. 2	Alternate Rules for Construction of Pressure Vessels.
ASME Section IX	Boiler and Pressure Vessel-Welding and Brazing Qualifications
ASME Code Case 2235	Use of Ultrasonic Examination in lieu of Radiography
ASME B 31.1	Power Piping
ASME B 31.3	Process Piping
ASME B 16.5	Pipe Flanges and Flanged Fittings
ASME B 16.9	Factory Made Wrought Steel Butt Welding Fittings

Standard No. (if applicable)	Title
ASME B 16.10	Face to Face and End to End Dimensions of Valves
ASME B 16.10	Face to Face and End to End Dimensions of Valves.
ASME B 36.10	Welded and Seamless Wrought Steel Pipe
ASME B 16.21	Non Metallic Flat Gaskets for Pipe Flanges
ASME B 16.25	Butt Welding Ends
ASME B 16.36	Orifice Flanges
ASME B 16.34	Valves-Flanged Threaded and Welding Ends
ASME B 16.47	Type A Large Diameter Steel Flanges (NPS 26 through NPS 60)
ASME B1.20.1	Pipe Threads General Purpose (inch)
ASME B 46.1	"Surface Texture (Surface Roughness waviness & Lay)
ASME B 73.1	Horizontal End Suction Centrifugal Pumps
ASME B 73.2	Vertical In-Line Centrifugal Pumps
API RP 520	Pressure Relieving: Part I Sizing & Section; Part II Installation.
API RP 521	Guide for Pressure Relieving & De-pressuring System
API 5L	Specification for Line Pipe
API 530	Calculation of Heater Tube Thickness in Petroleum Refineries
API 560	Fired Heater for General Refinery Services
API 572	Inspection of Pressure Vessels (Towers/Drums/reactors/Heat Exchangers)
API 582	Welding Guide Lines for the Chemical Oil and Gas Industries
API 598	Valve Inspection and Testing
API API 6D	Butt Welding Ends Pipeline Valves
API 600	Steel Gate Valves Flanged and Butt Welded Ends
API 608	Metal Ball Valves
API 610	Centrifugal Pumps for Petroleum Chemical & Gas Industries
API 611	Gen. Purpose Steam Turbines for Petroleum/Chemical/Gas Industries
API 613	Special Purpose Gear Units for Petroleum Chemical & Gas Industries
API 614	Lubrication Shaft Sealing and Control Oil System for Special Purpose
API 615	Sound Control of Mechanical Equipment for Refinery Service.
API 617	Centrifugal Compressors for General Refinery Services

Standard No. (if applicable)	Title
API 618	Reciprocating Compressors for Petroleum/Chemical/Refinery Services
API 619	Rotary Compressors for General Refinery Services
API 620	Design & Construction of Large welded Low Press. Storage Tanks
API 650	Welded Steel Tanks for Oil Storage Tanks
API 660	Shell & Tube Heat Exchangers for General Refinery Services
API 661	Air Cooled Heat Exchangers for General Refinery Services
API 662	Plate Heat Exchangers for General Refinery Services
API 670	Machinery Protection Systems
API 671	Special Purpose Couplings for Refinery Service
API 673	Centrifugal Fans for Petroleum Chemical and Gas Industry Services
API 674	Reciprocating Pumps
API 675	Controlled Volume (Metering) Pumps
API 676	Pump Rotary Gear or Screw Type
API 677	Gen. Purpose Gear Units for Petroleum Chemical & Gas Industries
API 678	Accelerometer Based Vibration Monitoring System
API 682	Pumps Shaft Sealing Systems for Centrifugal and Rotary Pumps
API 685	Sealless Magnetic Drive Pumps/Vertical Inline Pumps
API 2218	Fireproofing Practices in Petroleum and Petrochemical Processing Plants
Test Codes: PTC 4	Test Code for Fire Steam Generators
Test Codes: PTC 10	Test Code for Compressors & Exhausters
Test Codes: PTC 30	Test Code for Air Cooled Heat Exchangers
WRC-107	Welding Research Council Bulletin-no.107
WRC-29	Welding Research Council Bulletin no.29
ASTM C 553	Standard Specification for Mineral Fiber Blanket Insulation for commercial and Industrial Applications
ASTM C 612	Standard Specification for Mineral Fiber Block and Board Thermal Insulation
ASTM C 1393	Specification for Perpendicularly Oriented Mineral Fiber Roll and Sheet Thermal Insulation for Pipes and Tanks
ASTM C 1136	Standard Specification for Flexible Low Permeance Vapor Retarders for Thermal Insulation
AWS A4.2	Standard Procedures for Calibrating Magnetic Instruments to Measure the Delta Ferrite Content of

Standard No. (if applicable)	Title
	Austenitic and Duplex Ferritic Austenitic Stainless Steel Weld Metal
AWS A5.1	Specification for Carbon Steel Electrodes for Shielded Metal Arc Welding
AWS A5.4	Specification for Stainless Steel Electrodes for Shielded Metal Arc Welding
AWS A5.5	Specification for Low-Alloy Steel Electrodes for Shielded Metal Arc Welding
AWS A5.9	Specification for Bare Stainless Steel Welding Electrodes and Rods
AWS A5.11	Specification for Nickel and Nickel-Alloy Welding Electrodes for Shielded Metal Arc Welding
AWS A5.14	Specification for Nickel and Nickel-Alloy Bare Welding Electrodes and Rods
AWS A5.17	Specification for Carbon Steel Electrodes and Fluxes for Submerged Arc Welding
AWS A5.18	Specification for Carbon Steel Electrodes and Rods for Gas Shielded Arc Welding
AWS A5.23	Specification for Low Alloy Steel Electrodes and Fluxes for Submerged Arc Welding
AWS A5.28	Specification for Low-Alloy Steel Electrodes and Rods for Gas Shielded Arc Welding
CSA	Boiler, Pressure Vessel and Pressure Piping Code
CSA Z662	Oil and Gas Pipeline Systems Code