2.0 PROJECT DESCRIPTION

The Keltic Project will be an integrated facility, receiving LNG by ship, for delivery to the M&NP after regasification, and utilizing the natural gas liquids for the production of polyethylene and polypropylene pellets for shipment to customers across North America. A cogeneration plant will be included to supply power and process heat. The Project has completed Pre Front End Engineering Design to date and will proceed shortly to final Front End Engineering Design (FEED). The essential components of the Project are defined under the following four headings:

- LNG facility, including marine terminal;
- Petrochemical facilities including shipping logistics area and marginal wharf;
- Co-generation plant; and
- Utilities and support facilities.

Each of the essential components is described in the Section 2.3 and summarized in Table 2.0-1. Figures 2.0-1A and B show the overall layout of the site.

TABLE 2.0-1 Key Characteristics of Keltic Project Components

Component	Description
LNG Facility	Consists of marine terminal, transfer pipelines, storage, regasification , nitrogen production plant, and extraction facilities, a vapour handling system and associated infrastructure/support facilities including: • Natural gas pipeline connecting to the MN&P pipeline, • Natural gas pipeline connecting to the co-generation plant; • Natural gas pipeline connecting to the petrochemical plant; • Programmable Logic Control (PLC) based control system; • Emergency shutdown system; • Hazard detection system; • Security system and facilities; • Fire response system; • Natural gas vent; • Plant air, instrument air and nitrogen systems; • Electric power distribution and control systems; • Storm-water system; • Control building; • Access roadways and service buildings; • Fire and emergency access roads; and • Other facilities as required to support safe, efficient, and reliable operation. The maximum transfer rate from ships will be at 24,000 cubic metres per hour (m^3/hr) @ 75 pounds per square inch gauge (psig) -160 degrees Celsius (^oC). Storage will be in 3 full containment tanks of 160,000 cubic metres (m^3) each (with future expansion to 6).

Component	Description
Petrochemical Facilities including Storage and Shipping Logistics Area and Marginal Wharf	The facility is fed by ethane and propane obtained from the LNG terminal and the SOEI pipeline. The facility produces primarily ethylene and propylene using steam cracking. Polyethylene and polypropylene pellets are subsequently produced for shipment. The following will be produced as pellets for shipment: • Polypropylene; • High Density Polyethylene (HDPE); • Low Density Polyethylene (LDPE);and • Linear Low Density Polyethylene (LLDPE). Products are then stored in silos at the shipping and logistics area near the marginal wharf. The petrochemical facilities use power from the co-generation plant.
Co-generation Plant	Includes gas turbines and heat recovery steam generators with a capacity of approximately 200 mega watts (MW) to meet Project electrical energy requirements
Utilities and Common Support Facilities	Common support facilities include raw water supply sourced by way of a dam with a fish-way, raw water intake and pumping infrastructure at Meadow Lake; raw water treatment plant; wastewater collection; treatment and disposal; storm-water management; central administration and maintenance facilities; emergency medical facilities; fire station, helipad and upgrades to the rural road network.

2.1 THE PROPONENT

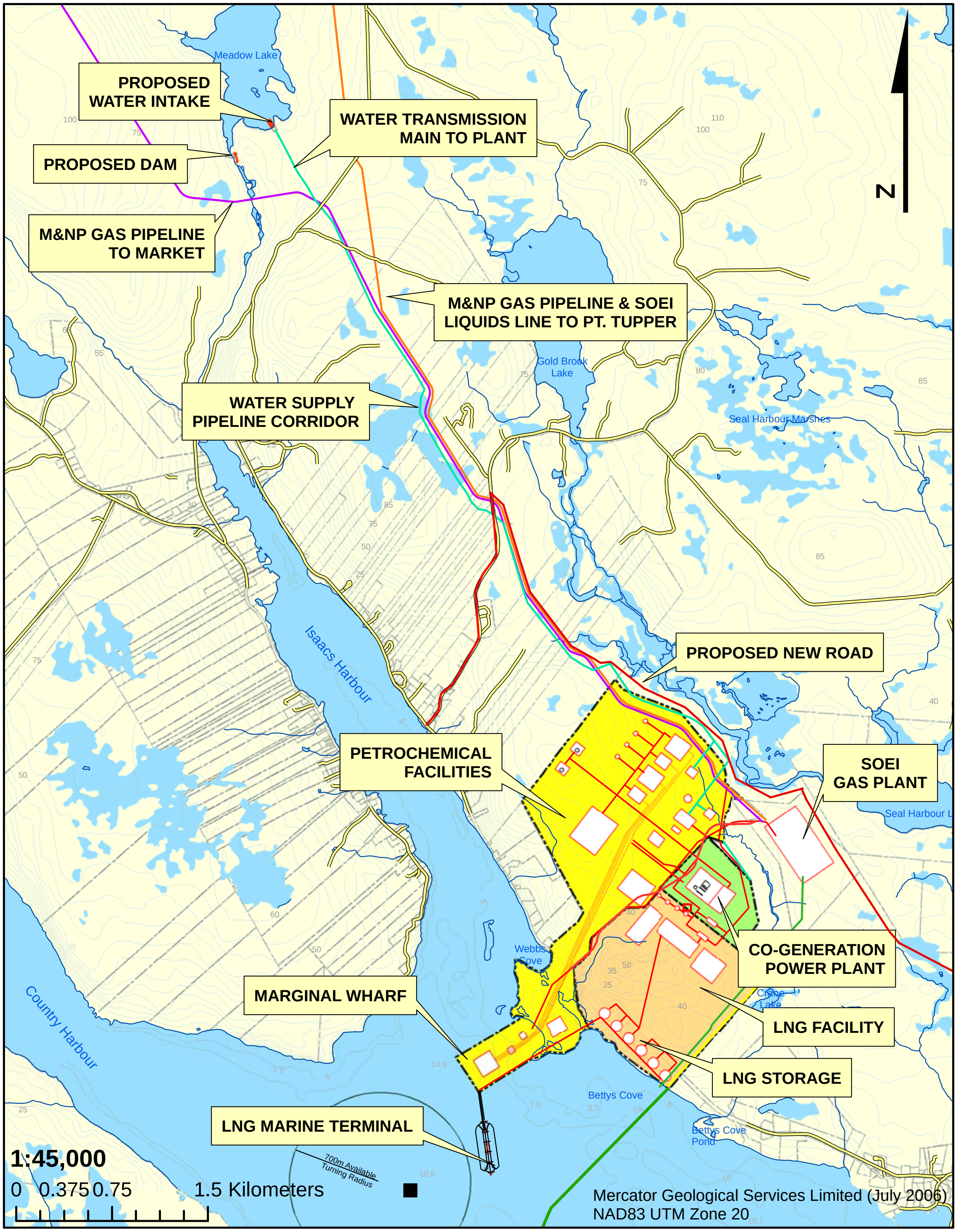
The Proponent, Keltic is a Canadian registered corporation, committed to establishing a petrochemical complex, LNG importing facilities, and a co-generation plant at Goldboro, Guysborough County, Nova Scotia. The head office of Keltic is located in Halifax, Nova Scotia with coordinates as follows:

Address: Keltic Petrochemicals Inc.
5151 George Street, Suite 603,
Halifax, Nova Scotia.
B3J 1M5

Contact: Mr. W. Kevin Dunn, President
Tel: (902) 422 4557
FAX: (902) 422 5980
kevin.dunn@kelticpetrochemicals.ca

It is Keltic's corporate commitment to provide an economical and sustainable complex in accordance to the highest level of environmental goals and principles. As the agreements between Keltic and the financial, licensors and petroleum firms are finalized; a detailed EMS will be developed for each component of the Project.

FIGURE 2.0-1A Plan of Essential Components of the Keltic Project

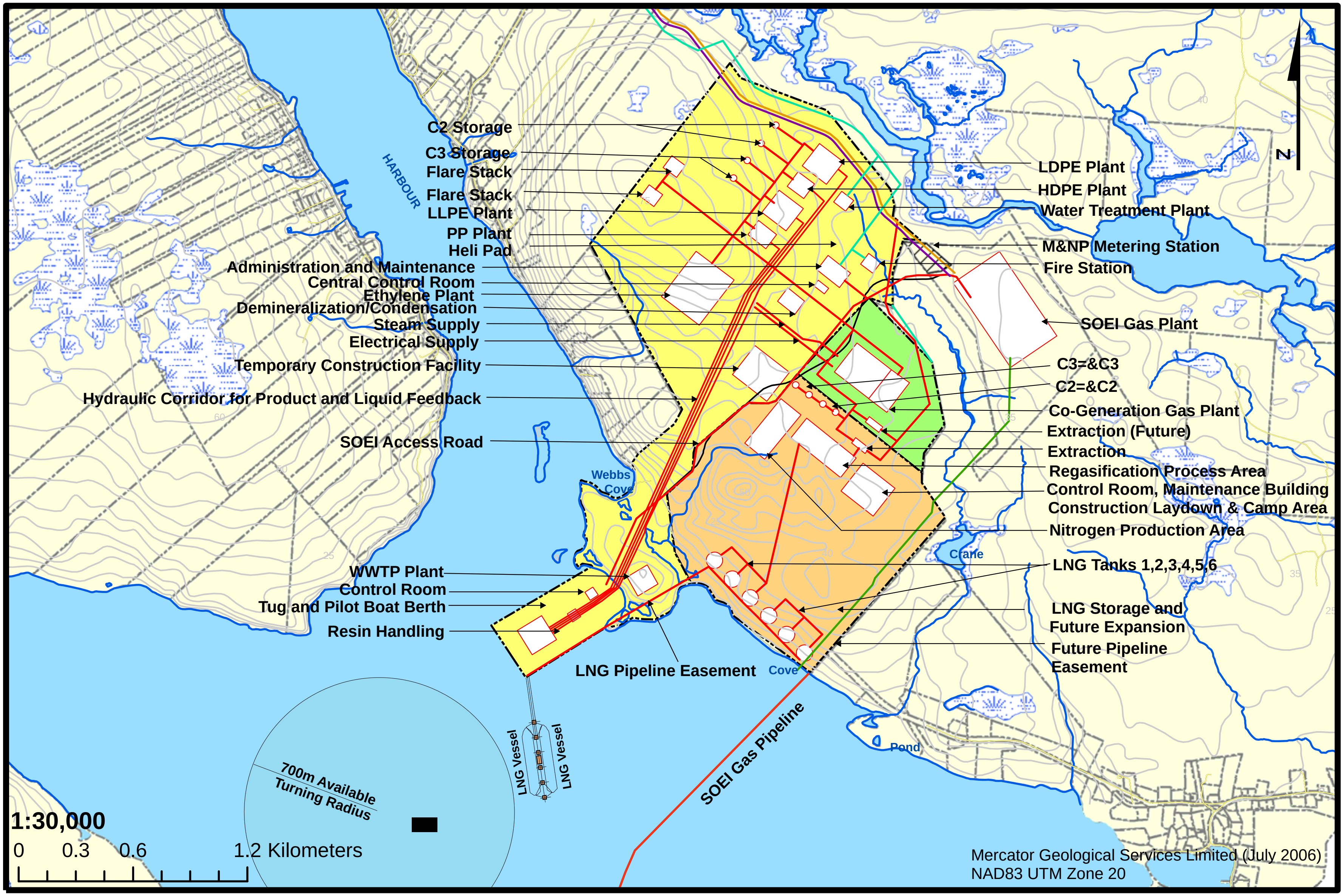


Legend

- Petrochemical Facilites
- Co-Generation Power Plant
- LNG Facility
- New Marine Drive

FIGURE No. 2.0-1A
KELTIC PETROCHEMICALS INC.
OVERVIEW PLAN OF ESSENTIAL COMPONENTS OF THE KELTIC PROJECT
JULY 2006

FIGURE 2.0-1B Plans of Essential Components of the Keltic Project



Legend

Petrochemical Facilities

Co-Generation Power Plant

LNG Facility

FIGURE No. 2.0-1B

KELTIC PETROCHEMICALS INC.

PLAN OF ESSENTIAL COMPONENTS OF THE KELTIC PROJECT

JULY 2006

Keltic and its various partners will jointly provide detailed EMSs in compliance with the environmental impact statement and approvals granted.

Although Keltic has no corporate experience in this area, they have aligned themselves with the best in the industry. Keltic's corporate structure is depicted in Figure 2.1-1.

2.1.1 Project Participants

2.1.1.1 Maple LNG

In March 2006, Keltic entered into an agreement with Maple LNG where Maple will acquire 100% of the LNG portion of the Keltic Petrochemicals combined Petrochemical/LNG Project. Maple LNG is owned by 4Gas North America Ltd. and Suntera Canada Ltd. 4Gas operates on a stand-alone basis with a management team dedicated entirely to LNG and power. 4Gas focuses on developing and operating LNG terminals around the world including the Dragon LNG project in Milford Haven, Wales and the LionGas project in Rotterdam, The Netherlands, both currently under development. Dragon LNG is expected to be operational in 2007, LionGas in 2009. They have booked all of the Dragon LNG terminal's capacity and will supply the terminal with LNG when the terminal becomes operational at the end of 2007. LionGas LNG, in Rotterdam, The Netherlands, with an initial capacity of at least 6-9 billion cubic metres per annum (bcm/a) with a phased expansion to 18 bcm/a. LionGas is expected to be operational before the winter of 2009-2010.

2.1.1.2 Stone & Webster

Stone & Webster, Inc. (S&W), a subsidiary of The Shaw Group Inc., is one of the world's foremost engineering-construction companies. Founded in Boston in 1889, Stone and Webster has evolved into a global organization and has been responsible for the development, consulting, engineering, and construction of nuclear, fossil-fuelled, geothermal and hydroelectric power generation projects. S&W has a portfolio of power projects spanning over 50 countries, six continents, and 115 years. The company is a recognized leader in refining, petrochemical and polymer technology and has supplied the process technology for over 35% of the world's Ethylene capacity constructed since 1995.

2.1.1.3 The Shaw Group Inc.

The Shaw Group Inc. is a leading provider of consulting, engineering, construction, remediation, and facilities management services to government and private sector clients in the environmental, infrastructure, and emergency response markets. Shaw is also a vertically integrated provider of comprehensive engineering, consulting, procurement, pipe fabrication, construction, and maintenance services to the power and process industries worldwide. A Fortune 500 company, with $3.3 billion in revenues in 2003, The Shaw Group also debuted on the magazine's "America's Most Admired Companies" list in 2004. Shaw is headquartered in Baton Rouge, Louisiana, USA and employs approximately 17,000 people at its offices and operations in North America, South America, Europe, the Middle East and the Asia-Pacific region.

FIGURE 2.1-1 Keltic's Corporate Structure

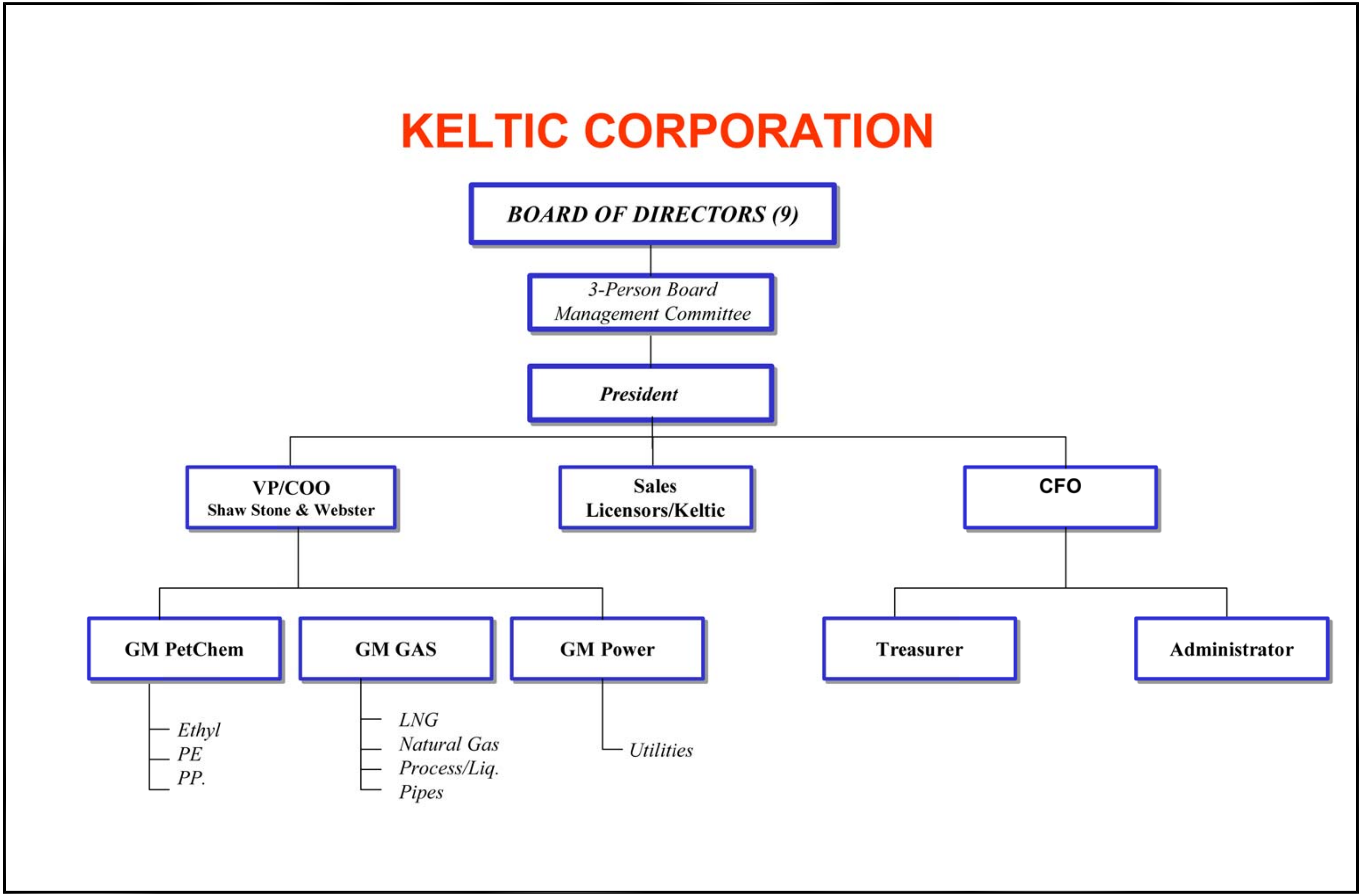


FIGURE No. 2.1-1
KELTIC PETROCHEMICALS INC.
KELTIC'S CORPORATION STRUCTURE
JULY 2006

Keltic has entered into an agreement with Shaw S&W for them to act as the Integrating Contractor from the pre- FEED through to the operation phase of the Project. This relationship is laid out in Figure 2.1-2.

2.1.1.4 EPC Phase

S&W will act as overall Project Management Contractor but with specific Engineering Procurement and Construction (EPC) responsibilities for the ethylene unit and power generation plant. S&W EPC activity will be done upon a lump sum basis with schedule compliance.

2.1.1.5 Operations and Maintenance

S&W will take the responsibility for developing the Keltic organization and for long term maintenance at the site. The envisaged Keltic organization will be located at the Goldboro site and also in Halifax.

It should be noted that the polyolefin licensors have agreed to participate in operations and maintenance support. Measures to sustain the asset will be incorporated into the licensing agreements with polyolefin licensors and managed by the Keltic organization.

2.2 PROJECT LOCATION

The Keltic Site is located in Goldboro, Guysborough County, Nova Scotia (Figures 1.1-1A and B) and is positioned within the Goldboro Industrial Park and other land holdings along the northern shore of Isaac's Harbour. The associated marine facilities include a marginal wharf and LNG terminal to be located on the northeast side of Isaac's Harbour.

The 240 ha Goldboro Industrial Park is owned by the Municipality of the District of Guysborough (Municipality). The Goldboro Industrial Park is zoned M-3 heavy industrial. Additional land holdings adjacent to the Industrial Park have been or are in the process of being purchased by the Municipality. These lands have been included in the recent rezoning to M-3 heavy industrial to facilitate the development of this Project and similar projects. Sufficient land has been optioned by Keltic and will be purchased from the Municipality of the District of Guysborough.

The Keltic Project is located in proximity to the SOEI gas plant and M&NP metering station, which are situated in the northeast of the Industrial Park. The M&NP also runs along the north boundary of the Industrial Park.

2.3 KEY PROJECT COMPONENTS

The overall scheme is depicted on the schematic Figure 2.3-1. This schematic indicates the interface between the petrochemical plants including product storage and shipping area, and the LNG terminal, LNG storage, extraction plant and power plants. The petrochemical facilities are summarized as follows in Table 2.3-1:

FIGURE 2.1-2 Shaw S&W Scope

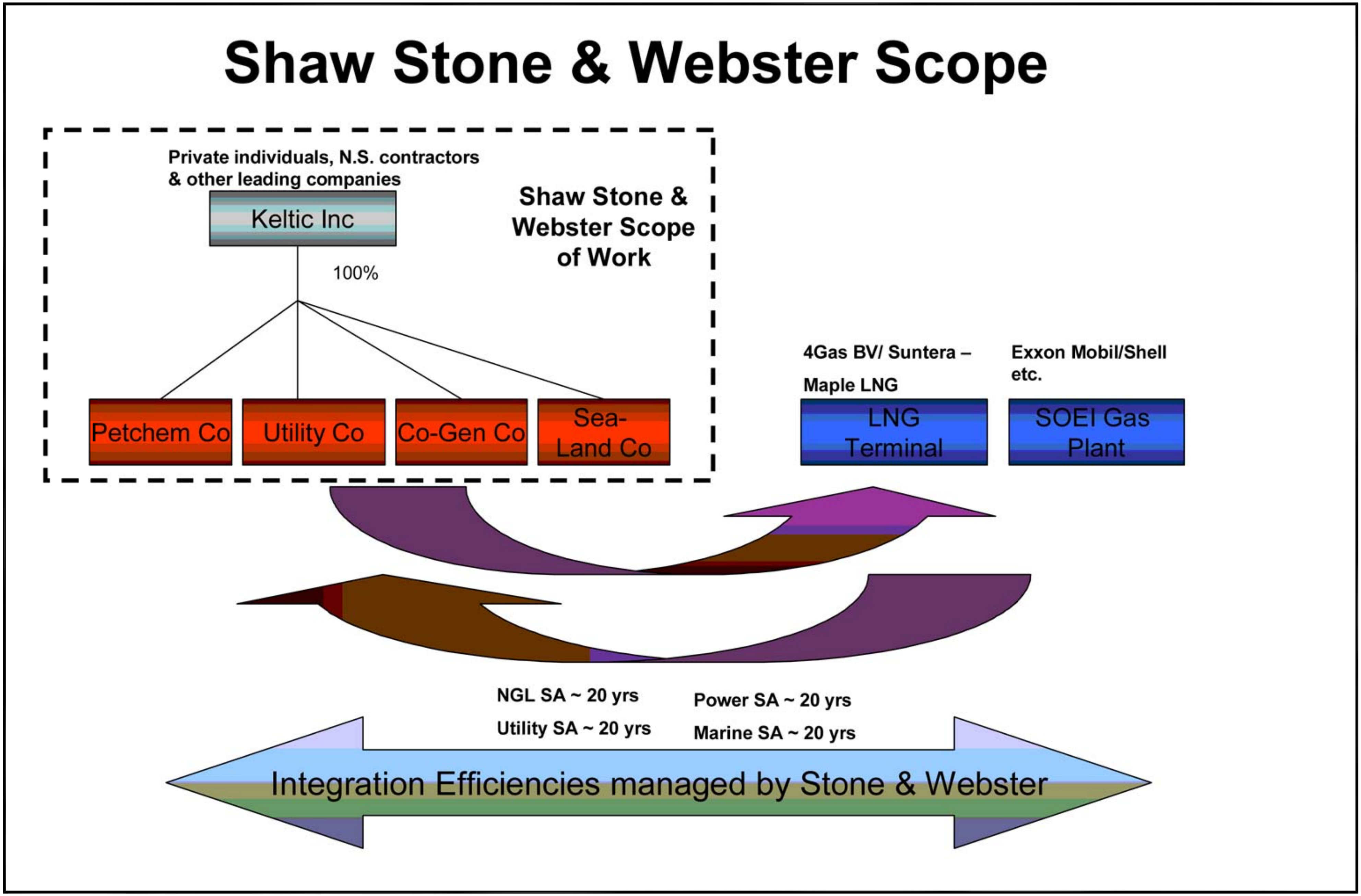


FIGURE No. 2.1-2
KELTIC PETROCHEMICALS INC.
SHAW STONE & WEBSTER SCOPE
JULY 2006

TABLE 2.3-1 Inside Battery Limits (ISBL) Facilities

Extraction plant	Extraction Natural Gas Line at 1480 kilotonnes per annum (kTA) of ethane and 880 kTA of propane as feed to the ethylene unit
Ethylene	1200 kTA ethylene and expandable to 1500 kTA.
HDPE	400 kTA
LLDPE	400 kTA
LDPE	400 kTA
Polypropylene	400 kTA

Product Handling Facilities:

- Hydraulic conveying;
- Drying;
- Pneumatic conveying;
- Blending;
- Storage and transfer system; and
- Truck and ship loading.

Outside Battery Limited (OSBL) Facilities:

Storage:

- ethane and propane storage and regasification storage;
- ethylene and propylene refrigerated storage;
- hexene and butene storage and feed systems for LLDPE and HDPE units;
- chemicals and catalyst storage; and
- byproduct storage including fuel oil, hydrogenerated gasoline and mixed C4s.

Power:

- electric power generation and distribution systems;
- power plant to provide auxiliary steam for ethylene unit start-up; and
- part of power plant to provide emergency power.

Fuel:

- auxiliary fuel and common fuel supply system.

FIGURE 2.3-1 Overall Scheme

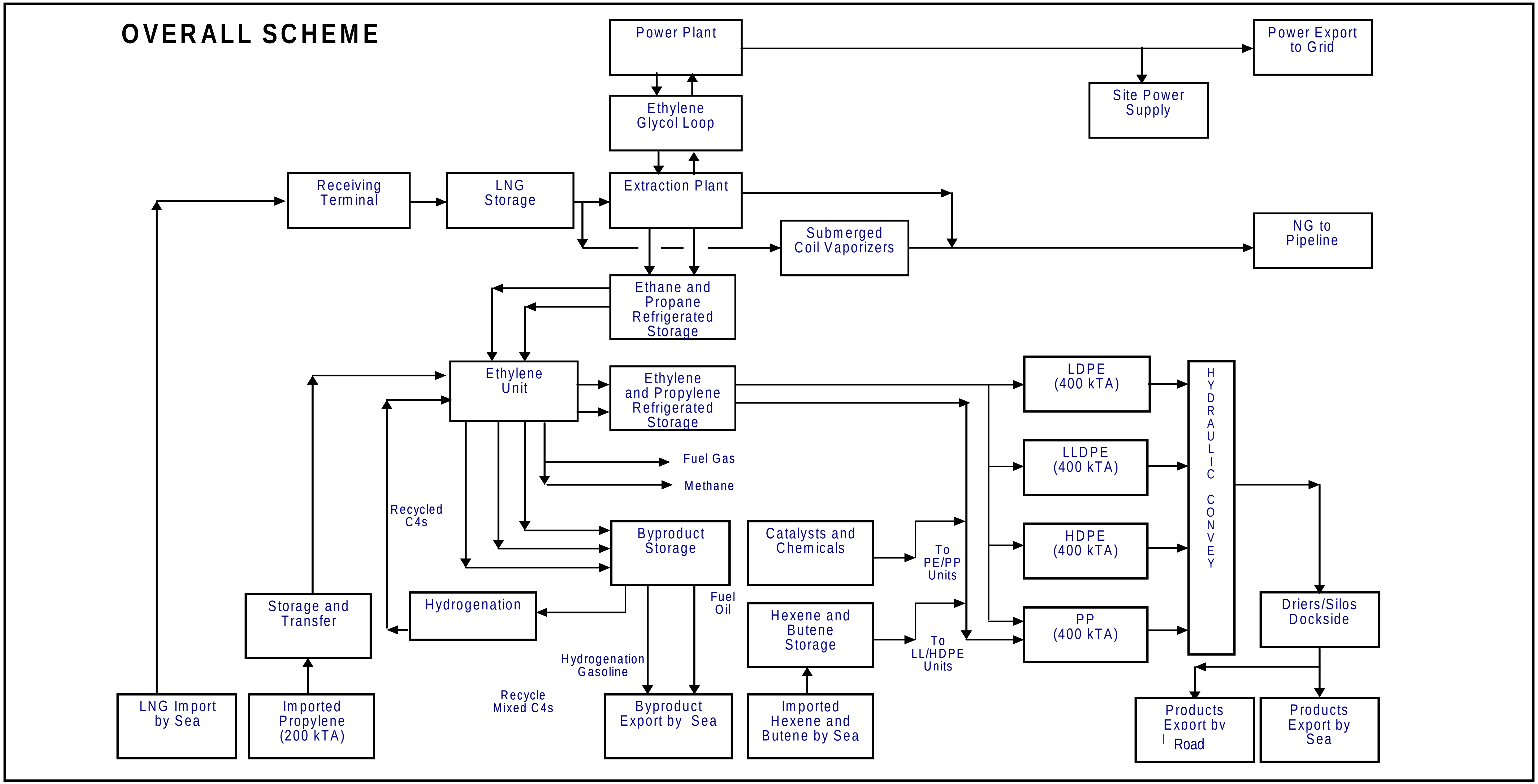
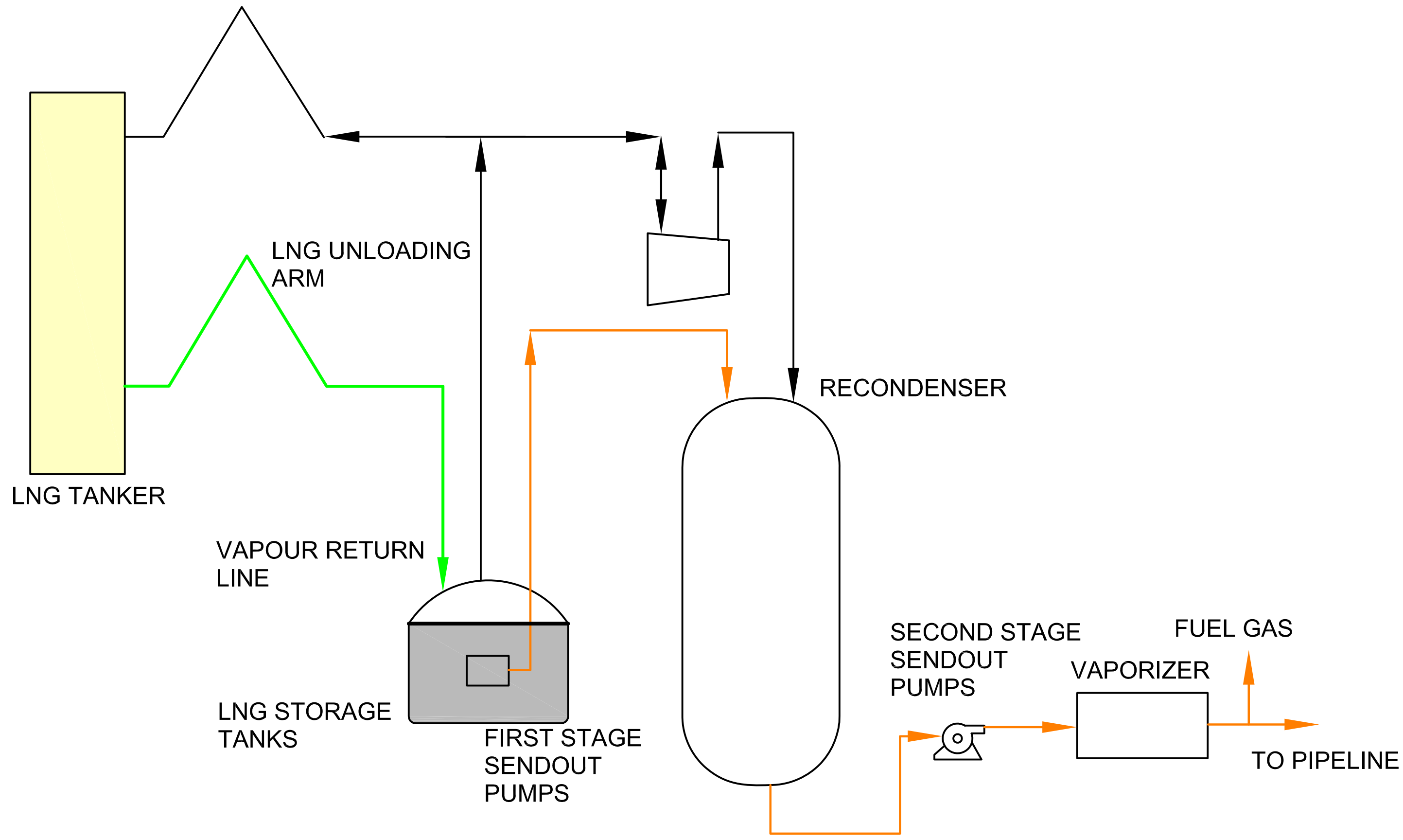


FIGURE 2.3-1
KELTIC PETROCHEMICALS INC.
OVERALL SCHEME
JULY 2006

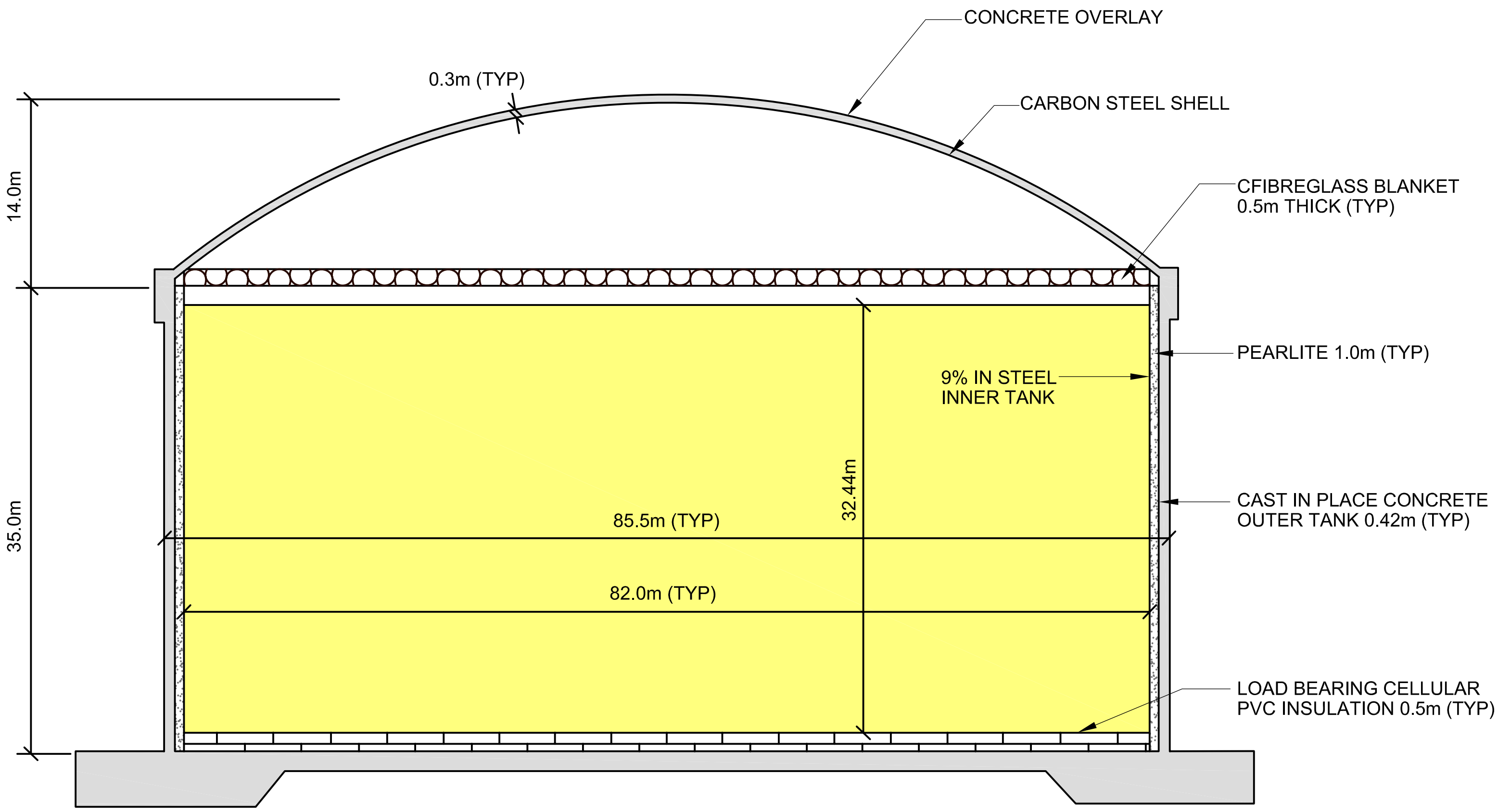
FIGURE 2.3-2 Flow Chart



Source: Foster Wheeler, Aug. 2003
The Shaw Group Inc.

FIGURE No. 2.3-2
KELTIC PETROCHEMICALS INC.
FLOW CHART
JULY 2006

FIGURE 2.3-3 Typical LNG Tank Design



Source: Shaw Stone & Webster International Inc. Drawing No. SK-4, 2005

1 : 600

0m 6 12 18 24

FIGURE No. 2.3-3

KELTIC PETROCHEMICALS INC.

TYPICAL LNG TANK DESIGN

JULY 2006

FIGURE 2.3-4 Typical Submerged Vapourizer

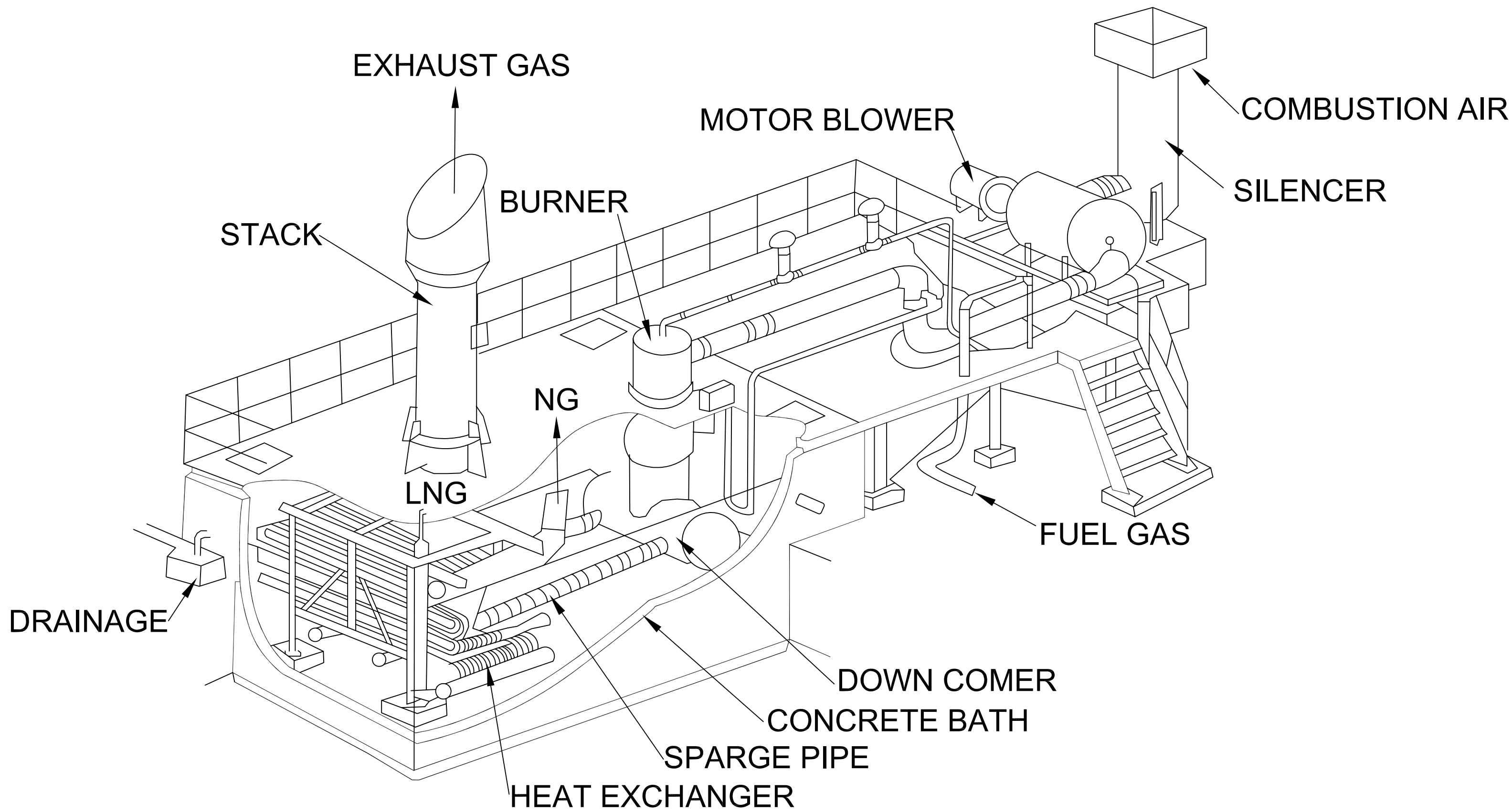


FIGURE No. 2.3-4

KELTIC PETROCHEMICALS INC.

TYPICAL SUBMERGED VAPORIZER

JULY 2006

Water and Steam Systems:

- raw water supply and treatment;
- boiler feedwater supply system (VHP and High Pressure levels);
- steam condensate recovery and polishing;
- seawater cooling system;
- firewater systems; and
- potable water supply.

Waste Treatment:

- spent caustic handling and treatment;
- incineration;
- wastewater handling and treatment; and
- solids waste handling and storage.

Other OSBL Facilities:

- plant air and instrument air supply systems;
- nitrogen; (nitrogen spiking is still option so ISBL LNG facilities);
- flare systems;
- interconnecting piping and pipe racks;
- maintenance shops;
- receiving and stores;
- control room;
- substation;
- firehouse and fire truck;
- plant security and communications;
- administration and laboratory facilities; and
- custody metering stations.

Off-Plot Facilities:

- natural gas pipeline;
- shipping and receiving terminals; and
- wharf.

2.3.1 LNG Facility, Marine Terminal and Components

2.3.1.1 Process Overview

The LNG import terminal consists of the following five systems:

- LNG unloading;
- LNG storage;
- nitrogen injection;
- LNG regasification; and
- natural gas transport and distribution to the petrochemical plant, the co-generation unit and to the M&NP.

In the unloading system the LNG is unloaded from the tanker ships and transported to the storage tanks. The storage section consists of three tanks with a gross LNG storage capacity of 162,500 m^3 each, which makes the total gross LNG storage capacity of the facility 487,500 m^3. With future expansion to 6 tanks the total gross LNG storage capacity will increase to 975,000 m^3.

To make the LNG available for use in the M&NP or for direct use in petrochemical facilities the LNG is extracted from higher hydrocarbons, ethane, propane, and higher hydrocarbons. These products are used in the petrochemical plant of Keltic, where ethylene and propylene are produced and from which LDPE and HDPE are produced.

When extraction of LNG is not possible a back-up system for adjustment of the natural gas properties is foreseen. This back-up system uses nitrogen injection into the natural gas for adjustment of the heating value to meet the specifications of the M&NP. The required nitrogen will be produced by an air separation unit (ASU).

Subsequently the LNG is regasified in submerged combustion vapourizers (SCVs) (See Figure 2.3-4 above).

The heat required for the regasification of LNG is supplied by low pressure fuel and/or waste heat from the petrochemical plant and the co-generation unit. The low pressure fuel is taken as a side stream of the vaporized gas and is reduced to the desired pressure by a system of let down valves.

The product of the regasification section is natural gas, which is sent to the distribution section where the natural gas is transported to the local end-users, the co-generation plant and the petrochemical plant, and the M&NP by pipeline for further distribution to customers.

<u>Key parameters</u>

Within the LNG facility LNG is imported, temporarily stored, regasified, and subsequently distributed to several customers:

- the petrochemical plant;
- the co-generation plant; and
- M&NP for distribution to the market.

LNG mainly consists of methane with small amounts of ethane, propane and higher hydrocarbons also being present (see also Table 2.3-2). Besides the LNG facility the Project also entails a petrochemical plant for production of ethylene and propylene polymers. Feedstock for this plant is ethane and propane. Therefore the Petrochemical facility includes an LNG extraction plant in which ethane and higher hydrocarbons are separated from the LNG. The extraction process has a dual function:

- Providing feedstock for the petrochemical plant;
- Adjustment of the off-spec gas properties to meet the specifications of the gas consumers (petrochemical plant, co-generation plant, and M&NP).

TABLE 2.3-2 Specification imported LNG[1]

Component	Unit	Minimum	Maximum
Nitrogen	Mol%	0.2	0
Methane	Mol%	99.6	82.0
Ethane	Mol%	0.2	16
Propane	Mol%	0	1.5
Butane	Mol%	0	0.5
Isobutane	Mol%	0	0
Property	Unit	Minimum	Maximum
Density	kg/m m_o^3	0.70	0.80
	kg/m^3	450	500
Lower heating value	MJ/ m_o^3	34	40
Higher heating value	MJ/ m_o^3	38	44

Notes:
1. Based on Basis of Design for terminal design Dragon LNG, Wales, UK and Lion Gas, The Netherlands
2. m_o^3 at 15°C (60 °F) and 1 atmosphere (atm)

The LNG facility must always be able to deliver on-spec gas quality (gas send-out). This means that if the ethane and/or propane storage tanks belonging to the petrochemical plant are completely full and off-spec LNG is delivered/stored, extraction of LNG (extraction plant) can not be carried out, because the produced ethane and propane can not be handled. Although these circumstances will only take place occasionally, a back-up process is needed within the LNG facility to be able to deliver on-spec gas. This process involves injection of nitrogen. The required nitrogen will be produced from air by a cryogenic ASU.

The LNG facility will have an annual send-out capacity of nominally 18 BCM (billion cubic metre = 10^9 Nm^3), maximum and peak send out capacity are 140 and 165% of the nominal capacity respectively. This capacity will be realized in two phases of 9 BCM (see below). The extraction plant will have a capacity to provide for 1,480 kTa (kilotonne per annum) ethane and 880 kTa propane (depending on LNG composition) as feedstock for the petrochemical plant. The nitrogen plant will have a capacity to provide for sufficient nitrogen to produce on-spec gas quality at peak send-out (see Table 2.3-2) based on richest LNG composition).

Three LNG storage tanks each with a gross capacity of 162,500 m^3 are required in order to be able to handle the amount of LNG supplied (with future expansion to six). This tank capacity is selected because it corresponds to recent designs (i.e. Dragon LNG (Wales), Lion Gas (Netherlands)) which were, at that time, the maximum capacity available. Currently tanks with a gross capacity of 180,000 m^3 are available. Selection of this capacity will result in a reduction of a quarter of a tank, which means that still six tanks will be required for the Project.

A two berth piled marine terminal connected to a marginal wharf facility by a piled jetty will be used to receive and transfer product via LNG transfer lines along the jetty and marginal facility to the LNG tanks where it is stored.

Phased Development

The LNG facility will be designed in two phases: the first phase comprises three LNG storage tanks with a nominal send-out capacity of 9 BCM/year. In the second phase the LNG facility will expand to six LNG storage tanks with a nominal send-out capacity of 18 BCM/year. At the first phase the LNG facility will strategically be designed and constructed to be able to expand at minimum costs (i.e. natural gas send out pipe diameter will in the first phase be designed for a nominal capacity of 18 BCM/year).

The time schedule of the expansion is dependent on commercial developments. More specifically, this means that the expansion could take place directly after realization of the first phase or that a longer period (possibly years) could separate the two phases.

Codes and Standards

The Proponent will provide an LNG facility that is safe, efficient, easily operable, and maintainable, and meets all environmental regulations. The design of the facility will be based on the LNG Code of Practice as issued by the Nova Scotia Department of Energy (NSDE). The LNG Code of Practice is used by the Nova Scotia Utility and Review Board (NSUARB) when reviewing applications for the construction of LNG plants. The LNG Code of Practice refers, amongst others, to the requirements of Canadian Standards Association (CSA) Z276-01, LNG Product, Storage, and Handling. Although the next edition of CSA Z276 (edition 2006) has not been issued yet, the design of the facility will be based on the applicable standards.

A more detailed list of applicable codes and standards is presented in Section 2.3.5.

Key parameters

In Table 2.3-3 the key parameters which will form the basis of the design of the LNG facility are presented.

TABLE 2.3-3 Overview of Phase One Key Project Parameters of LNG Facility

Parameter	Unit	Value
LNG/natural gas		
Quality	-	Specifications of M&NP
Density LNG	kilograms per metres cubed (kg/m^3) LNG	453
Density natural gas	kilograms per nominal cubic metres (kg/Nm^3) natural gas	0,781
Calculated volume ratio	Nm^3 natural gas/ m^3 LNG	580
Storage capacity		
Gross capacity per LNG storage tank[6]	m^3	162.500
Net capacity per LNG storage tank[7]	m^3	154.000
Number of storage tanks	-	3 (6)
Anticipated total storage capacity	m^3	3 x 162.500 = 487.500 (975.000)
Send-out		
Total send-out capacity	BCM /a	9 (18)
	kTA	7.029 (14.058)
Availability	%	99
Nominal send-out	kTA	804 (1.606)
Maximum send-out[1]	% of nominal send-out	140
	kTA	1.124 (2.248)
Peak send-out[2]	% van nominal send-out	165
	kTA	1.325 (2.650)

Notes:

3. Realization of the LNG facility up to the maximum capacity concerns a phased development
4. BCM is the abbreviation of Billion Cubic Metre (109 Nm^3)
5. the amount of LNG regasified within the LNG facilities to natural gas is called the send-out capacity
6. Maximum send-out is the highest possible send-out at which the availability is guaranteed. This means that sufficient spare capacity is provided to guarantee the availability
7. Peak send-out refers to the send-out at which all installed capacity is used. Because in this case no spare capacity is available no guarantees concerning the availability can be given. The peak send-out will in practice only take place occasionally in cases of extreme high demand of natural gas
8. the gross capacity of the LNG storage tanks is the actual volume of the tank
9. the net capacity of the LNG storage tanks concerns the usable volume of the tank. Remark: each tank will always contain a minimum level of LNG. This minimum amount of LNG is not included in the net capacity.

In addition to the key parameters for the design of the LNG facility, the following specification of imported LNG (Table 2.3-2) and send-out natural gas (Table 2.3-4) are taken into account.

TABLE 2.3-4 Specification natural gas[1]

Specification	Natural gas	
	[in US units]	[in SI units]
Total heating value	967-1100 Btu/CF	36.02-40.98 MJ/m^3
Temperature	<120 °F	<48.9°C
Composition:		
Oxygen	<0.2% by volume	
Non-hydrocarbon gases (combined: CO_2 and N_2)	<4% by volume	
Non-hydrocarbon gases (CO_2 only)	<3% by volume	
Liquids	Free of water	
Hydrogen Sulphide	<0.0025 grain/ CF_o^3	<5.72 mg/ m_o^3
Total Sulphur	<2000 grain/ CF_o^3	<0.458 g/ m_o^3
Water vapour	<7 lbs/million CF_o^3	<0.112 g/ m_o^3

Specification	Natural gas
Liquefiable hydrocarbons	No liquid hydrocarbons or hydrocarbons liquefiable at temperatures >15 Degrees Fahrenheit (°F) (>-9.4°C) and operating pressure 100-1440 psig (6.9-99.2 barg)
Microbiological agents	Not any microbiological organism, active bacteria or bacterial agent capable of contributing to or causing corrosion and/or operational and/or problems

Notes:
1. Derived from M&NPs FERC tariff agreement, section 12
2. CF_o^3: cubic foot; m_o^3: cubic metre at standard conditions (15°C (60 °F) and 1 atm)

2.3.1.2 LNG Unloading

2.3.1.3 Design Specifications

Besides the key parameters described in Table 2.3-3 the LNG facility will also include a number of other specific design specifications. The most important are presented here.

Integration with co-generation plant and petrochemical plant

The process lay-out and design will incorporate the integration with the co-generation plant and petrochemical plant. This integration concerns the following:

- using waste heat from the co-generation plant and/or petrochemical plant as a heat source for the regasification of LNG;
- supply of natural gas to the co-generation plant as fuel for electricity production;
- supply of natural gas to the petrochemical plant as fuel for heating purposes;

In the design provisions will be incorporated to make this integration possible. This means that the regasification island will be designed with the ability of using waste heat from the co-generation plant and/or petrochemical plant as the heat source. The optimal design for this heat integration is not yet determined. The natural gas pipeline will have at least two additional valved tie-ins with blinds to the natural gas transport pipeline of the co-generation plant and the petrochemical plant.

LNG Storage Tanks

With respect to the design of the storage tanks the following important design specifications will hold:

- The maximum heat inleak of the storage tanks will result in the vaporization of 0.065 vol%/day of stored LNG based on a full tank;
- The LNG storage tanks will be of a full containment design, comprising of an inner tank of 9% nickel steel, a pre-stressed concrete outer tank shell with a reinforced concrete base slab and reinforced concrete roof;
- The design will be conform to the NBCC seismic effects standards ;
- The minimum design pressure of the storage tanks is -10 mbarg and the maximum design pressure is 200 - 300 mbarg;

- The minimum design temperature of the storage tanks is -168°C and the maximum design temperature 60°C;
- The maximum pump capacity of the in-tank pumps in one storage tank is equal to 1,570 m^3/h (approximately 710 tonnes per hour (t/hr)).

Flare/Vent

The capacity of the flare or vent will be designed based on the maximum amount of boil-off gas (BOG) that may be formed within the LNG facility assuming one ship being present for possible handling of the BOG resulting from unloading.

Redundancy Philosophy

To allow the LNG facility to have the highest availability practically feasible, a philosophy of providing spare capacity has been adopted of all major equipment items. In general this is the N+1 or N+2 rule, this means that one or two more than the number of equipment items (N) required for maximum flow rate will be provided.

Peak send-out will be reached on the basis of N+1 or N+2 process units, where these units also operate at maximum throughput. At maximum send out the process units are operated at optimal efficiency.

Distances between Process Units and Distance to Site Boundaries

The distances between process units (i.e. LNG storage tanks and LNG regasification section) as well as distances between process units and site boundaries are mainly limited by land use and determined by means of a quantitative risk assessment. The basic approach in this respect is that malfunction of a process unit must not result in domino effects to other process units or surrounding areas.

The minimum distance between two tanks is based on (code CSA Z276-01) and is equal to a quarter of the sum of adjacent tanks.

2.3.2 Petrochemical Facilities and Marginal Wharf

Keltic has contracted S&W, a Shaw Group Company, to provide a pre-FEED study for the grass roots (a previously undeveloped site) petrochemical complex planned for Goldboro. For the study, S&W prepared a definition of equipment sufficient to produce an order of magnitude total installed cost for all process units, and defined a preliminary recommendation for feedstock and product storage. As part of the effort, S&W also prepared a summary of estimated utility consumption and environmental emissions of the complex.

2.3.2.1 Definition of Plant Complex

The petrochemical complex is based on the production of olefins, specifically ethylene and propylene, from an ethylene plant. This ethylene plant is based upon Stone & Webster's proprietary Ultra Selective Conversion technology for the steam cracking of hydrocarbons.

Cracking is the process whereby complex organic molecules are converted to simpler molecules by the breaking of carbon-carbon bonds in the precursors. The Keltic olefins will be produced from the steam cracking of fresh ethane and propane feedstocks.

A refinery grade propylene mix will be imported by sea to the Keltic complex. Any facilities required to treat the refinery grade propylene for contaminants removal will be provided within the ethylene plant. After treating, the refinery grade propylene stream will be fed to the propane (C3) splitter facilities in the ethylene plant.

The polymer grade ethylene produced from the ethylene plant is the feed to a polyethylene plant with a polymerization train for LLDPE and a train for HDPE and an LDPE plant.

The polymers are pressurized through a heated die and cut into pellets which are cooled, dried, and stored for shipment by sea and truck. The pellets will be hydraulically conveyed to the marginal wharf, where the drying and storage will take place before shipment.

The other co-products of the ethylene plant will be exported for sale or consumed as fuel onsite. A stabilized mixed butane (C4s) stream will be produced by a hydrogenation unit in the ethylene plant treating the raw mixed C4's from the debutanizer. The hydrogenated C4 mix containing predominantly butylene will then be shipped by sea. A hydrotreated gasoline will be produced from a gasoline hydrogenation unit. The gasoline hydrogenation unit will also be contained in the ethylene plant, treating the raw pyrolysis gasoline produced by the steam cracking process. A pyrolysis fuel oil product will be used as auxiliary/power boiler fuel. A residue gas will be produced in the ethylene plant, which will flow to the central fuel gas mix drum of the complex. Any high purity hydrogen that may be required for the polyethylene and polypropylene plants will be produced in the ethylene plant. Vent streams from the polyethylene and polypropylene plants will be diverted to the ethylene plant for collection.
The Keltic Petrochemical Complex will consist of the following process units and capacity;

Process Units	**Capacity kTA**
Ethylene	1500
Propylene	200 + 200 kTA imported
polypropylene	400
HDPE	400
LDPE	400
LLDPE	400

The following feedstock storage systems will be provided:

- ethylene plant feedstock handling and storage systems;
- ethylene plant product handling and storage systems;
- hexene and pentane storage for polyethylene plants;
- OSBL storage for fresh caustic;
- demineralized water for boiler feed; and
- OSBL storage for spent caustic treatment and process waste water.

The polyethylene plant and polypropylene plant products will be pelletized, dried, and stored until loaded on ships for export and tanker trucks for local markets.

Three extruder trains and two mixer/melt pump trains are expected to handle the complex's production of polyethylene and polypropylene respectively. The extruders convey and melt the polymer and a melt pump pressures the polymer melt through a steam heated die-plate with the strands of polymer being cut into pellets by a pelletizer.

The pellets have to be cooled and dried before storage. The storage facilities will consist of elevated silos situated at the marginal wharf. The pellets will be conveyed to the storage area by a hydraulic conveyor system where they are first dried before storing.

2.3.2.2 Marginal Wharf

The marginal wharf area is required for receipt and shipment of products and by-products in support of the petrochemical plant and for receiving supplies and equipment during construction of the entire complex. It will be constructed as one of the first elements of the Project. It will function as follows:

- dockside space for product container ship(s);
- dockside space for ships delivering operating plant supplies/other feedstocks;
- dock side space for tugs and pilot boats;
- customs and immigration facilities for all shipping;
- supports along south east side for the LNG pipeline (42 inch) and vapour return pipeline (16 inch) and consideration for a future 42 inch line;
- roll off dock for unloading of equipment and materials from ships during construction; and
- containment structure for product servicing reclamation area.

The north and western faces of this facility will be designed for berthing tugs, the pilot boat, supply ships, and product carrying ships. The eastern face will be enclosed behind an armour stone blanket, with the LNG transfer pipeline extending from the service trestle en route to the LNG storage site along its deck. Navigation and berthing aids will be provided.

2.3.2.3 Storage Shipping and Logistics Area

The land extension and infill area behind the caissons of the marginal wharf will constitute the product service area. As noted it has a number of functions including the following:

- operations centre/control room/substation for all marginal wharf operations and security;
- a dewatering and drying facility for the Polyethylene and Polypropylene pellets that were slurried from the polyethylene and polypropylene production plants;
- pneumatic conveying system to transfer dried pellets into blenders and 25 metres (m) high storage silos;

- storage silos for the polyethylene and polypropylene resins – quantity of 160 shown on the conceptual layout;
- pneumatic conveying systems to unload the silos;
- traveling conveying lines to bulk load the polyethylene and polypropylene resins into container ships;
- utilities area for fire water pumps, plant and instrument air;
- waste water treatment facility;
- warehousing facility; and
- miscellaneous OSBL facilities to be determined during the FEED phase.

Pellets will be transported from the petrochemical plant to the wharf by a hydraulic pipeline for storage in silos prior to shipment. The excess water will be removed, and the pellets dried using a centrifuge prior to storage. Water used for transporting the pellets to the wharf will be recovered and returned to the petrochemical plant for reuse. A schematic of the transport and storage system is provided as Figure 2.3-5. The pellets will be stored in multiple silos north of the wharf face with load out facilities for bulk shipment on vessels or on railcars and/or trailers that would be transported by ship. A typical arrangement of the storage silos is shown as Figure 2.3-6.

The wharf will also be used for receiving propylene and for shipping co-products of the ethylene plant such as hydrogenated C4 mix and refinery grade propane.

A warehouse facility will be located at the wharf. One side of this facility will be designed for berthing tugs, the pilot boat, supply ships, and product carrying ships. The other side will consist of armour stone. Navigation and berthing aids will be provided.

The LNG transfer pipeline and service trestle from the LNG terminal will also terminate at the marginal wharf and follow along one side en route to the LNG storage site.

2.3.2.4 Water and Steam System

The petrochemical plant utilizes a large quantity of water, mainly for steam. A separate water treatment plant is required to prepare demineralized water from a central water treatment plant for an auxiliary boiler feed. The auxiliary boilers provide steam for the ethylene and derivative plants as they are driven by the cracking of hydrocarbons under very high temperature and pressure. The boiler produced steam is at a VHP level. As a result of the steam generation and utilization, there is need for steam condensate recovery and polishing as well as cooling water systems. Process cooling needs, condensate recovery, and effluents will be evaluated as part of the FEED work. It is expected that to meet the needs of the petrochemical facility, a combination of aerial cooling, and a freshwater closed loop system and perhaps seawater cooling will be required.

FIGURE 2.3-5 Schematic of Pellet Transfer to the Wharf and Storage

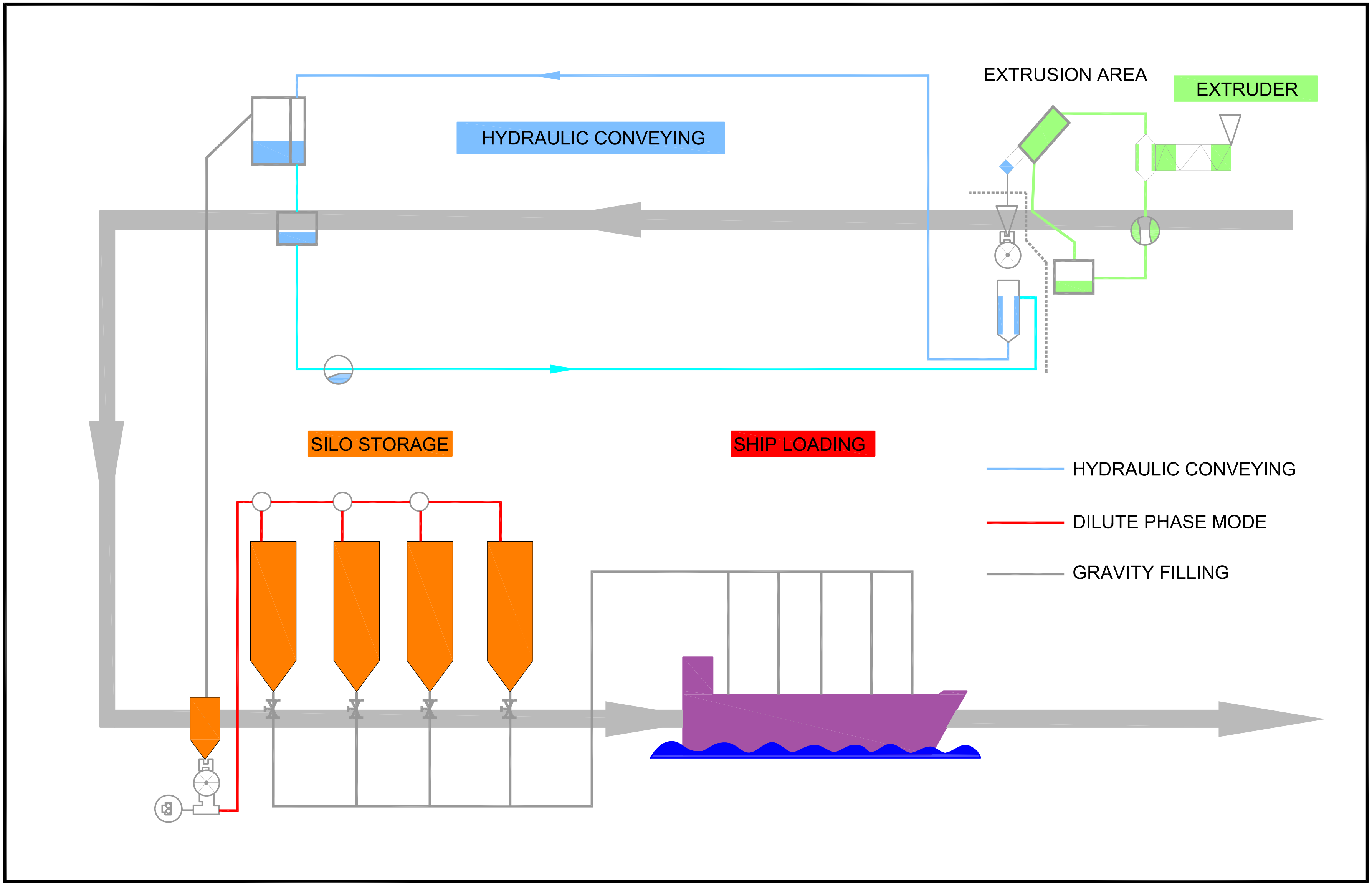


FIGURE No. 2.3-5
KELTIC PETROCHEMICALS INC.
SCHEMATIC OF PELLET TRANSFER TO THE WHARF AND STORAGE
JULY 2006

FIGURE 2.3-6 Typical Arrangement of Product Storage Silos

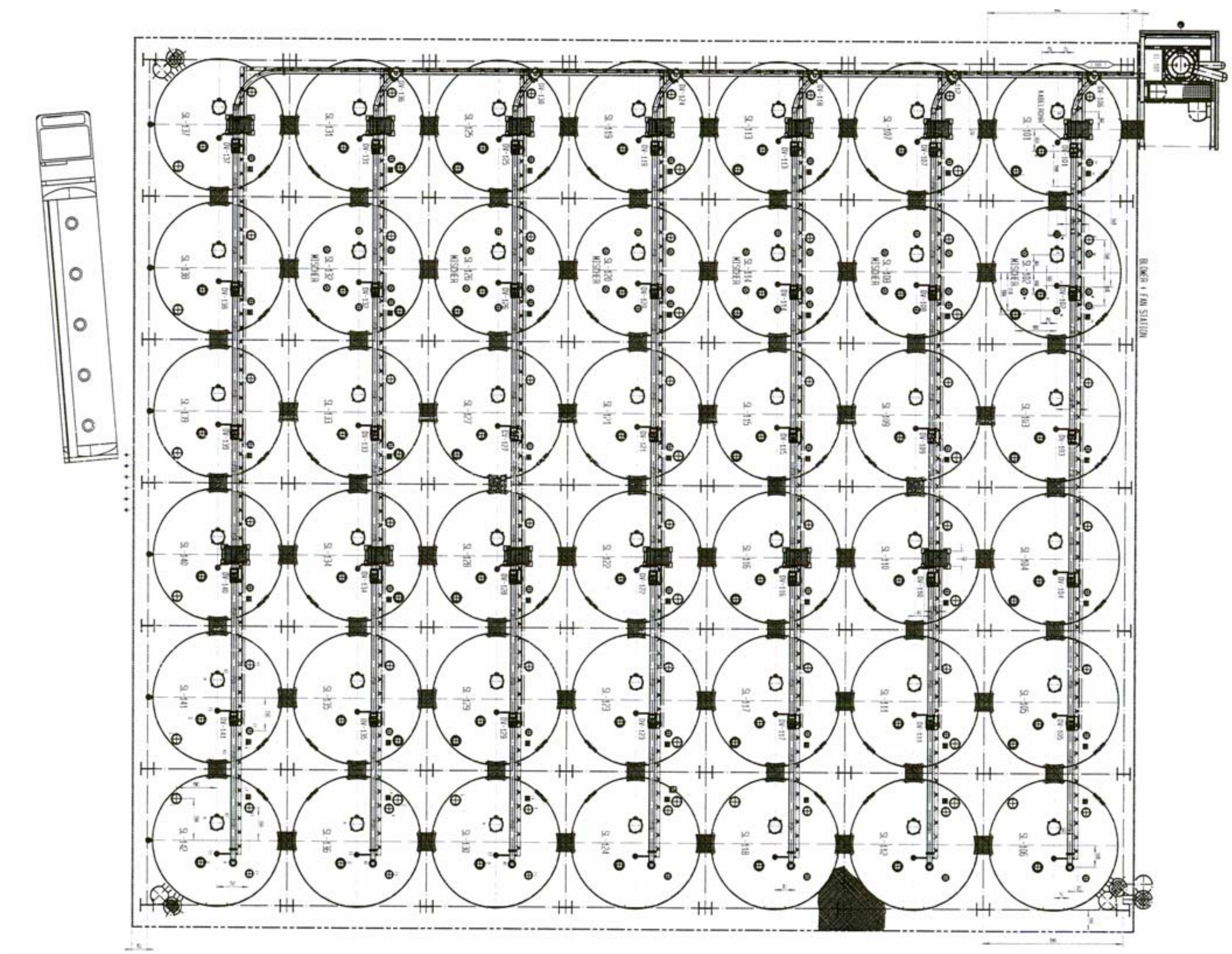


FIGURE 2.3-6
KELTIC PETROCHEMICALS INC.
TYPICAL ARRANGEMENT OF PRODUCT STORAGE SILOS
JULY 2006
Source:Zeppelin

2.3.2.5 Wastewater Management

There are several types of wastewater streams at the petrochemical facility. These streams can be categorized as storm-water, potentially contaminated storm-water, process water, oily water, and domestic wastewater. The domestic wastewater will be considered under Utilities and Common Support Facilities.

Storm-water runoff from uncontaminated areas will be segregated from potentially contaminated areas and discharged through a storm-water outfall. The non-contaminated storm-water will not include runoff from areas that have the potential for oil contamination or contamination with process chemicals or solids. These uncontaminated areas generally include roads, building roof drains, undeveloped areas, and uncontaminated areas in the utility and offsite units. The non contaminated runoff will generally flow through open site ditches with final disposal in Isaac's Harbour. Ditch checks, vegetation and siltation ponds will be utilized to treat the storm-water before discharge.

Storm-water runoff from uncontaminated areas will be segregated from potentially contaminated areas and discharged through a storm-water outfall. The initial 25 mm of rainfall is diverted to storm-water ponds. Rainfall in excess of 25 mm is considered to be clean and is diverted to the storm-water outfall. Water from the storm-water pond will be transferred at a controlled rate to the onsite wastewater treatment system. The storm-water ponds will also be designed to accept fire deluge.

Oily water will be collected in the oily water system and pumped to the Coalescing Plate Interceptor (CPI) separator, where initial separation of oil and water takes place. Water effluent from the CPI separator flows to the Induced Air Flotation Unit (IAFU) for further removal of any remaining free and/or emulsified oils. In the IAFU, oil, suspended solids, and grease adhere to bubbles and are floated to the surface. This froth then overflows to a collection point while the water from the IAFU is pumped to the equalization basin. In the equalization basin, the IAFU water combines with non oily wastes and potentially contaminated storm-water.

Recovered oil from both the CPI separator and the IAFU is collected and pumped to the recovered oil tank. This oil will be disposed of offsite. Solids removed by the CPI separator will collect in the bottom of the separator and will be removed periodically via vacuum truck for disposal at an approved facility.

A biological treatment unit consisting of an extended aeration activated sludge system and carbon adsorption will be utilized for further treatment of wastewater. Effluent from the equalization basin is sent to the bioreactor basin and is contacted with activated sludge. The activated sludge permits natural biological reactions to further treat the wastewater. The mixed biological slurry overflows to the secondary clarifier where the biological solids are removed and recycled back to the bioreactor. The effluent from the wastewater treatment plant will be of sufficient quality to be discharged to the Isaac's Harbour.

Arrangements will be made with a licensed waste hauler to remove excess sludge from site to licensed disposal sites. Sludges from sanitary waste treatment plants can also be utilized on farmland in lieu of fertilizer addition.

2.3.2.6 Infrastructure and Support Systems

Infrastructure and Support Systems dedicated to the petrochemical plant will consist of:

- cryogenic ASU with oxygen and nitrogen supply systems;
- plant air and instrument air supply systems;
- flare systems;
- interconnecting piping and pipe racks;
- plant security and communications;
- shipping and receiving terminals;
- storm-water management (local);
- fire fighting water distribution and hydrants;
- site roads; and
- resin conveyance to wharf.

2.3.3 Cogeneration Plant

A power plant incorporating gas turbines and heat recovery steam generators will be constructed to provide power to the facility. The LNG terminal and regasification will have a power demand of 16 mega watts of electricity (MWe). The mature facility (LNG terminal and petrochemical plant) will have an estimated power demand of 180 MWe. Approximately 40% of this is associated with the LDPE unit compression system.

The Project provides an opportunity for export of surplus power to the Nova Scotia grid. Although this is not part of the current Project, should additional power supplies be required by the province, the Keltic site could be considered as potential source of clean energy.

As the installation of the LNG terminal will precede development of the petrochemical plant the power plant will be developed in 2 phases:

- Phase I – to meet LNG terminal and regasification power demand of 16 MWe; and
- Phase II- to meet total facility, power demand of 180 MWe.

The power generation concept is based upon this phased expansion with the following units:

<u>Phase I (16 MWe)</u>

Two GE LM2500 gas turbines units will most likely be used. These will be simple cycle gas turbines with the addition of a heat recovery steam generation for steam. In the mature facility these turbines will be used for emergency/back-up power supply.

Phase II (180 MWe)

The configuration could be 4 x GE6000 or 2 x GE Frame 7 turbines. A detailed techno-economic evaluation of the configuration and possible power export to the local grid is under investigation.

2.3.4 Utilities and Common Site Support Facilities

2.3.4.1 Plant Water Supply

The Keltic Facility will have a significant industrial water requirement. Water will be drawn from Meadow Lake to provide daily industrial needs. The present estimated demand is 1200 m^3/hr. Initial assessment suggested that Meadow Lake could provide adequate water supply without a need for the construction of a dam if Goldbrook and/or Ocean Lake could be considered as a supplementary supply during prolonged periods of dry weather conditions. It was intended that during these periods water would be pumped from these lakes to meet the daily demand of the complex. Further analysis indicated that there would not be sufficient water resources from Goldbrook and/or Ocean Lakes to supplement Meadow Lake thus an impoundment of Meadow Lake is proposed as the preferred solution. The location is shown on Figures 2.0-1A and 2.3-7.

The impoundment will require a concrete gravity dam to raise the water level roughly 2 m above the existing level. Basic features include a 1 m wide flow section for a Denil type fishway with a single resting pool. The fishway would also function as the primary source for make up water to the river. Since all low flows and minor storm flow would go through the fishway, fish should have little difficulty finding and making entry into the fishway. The fishway is located on the south side of the dam that is just upstream of a pool in the river where resident or migratory fish would normally hold or stage. A preliminary concept of the Dam is shown in Figure 2.3-8.

A second 1 m wide section next to the fishway will be used to discharge frequent storm flows. This opening or sluiceway could be constructed such that the height is variable (i.e. use stop logs) and also function as a step pool type fishway under higher flow conditions. A 24.0 m wide spillway at elevation 36.25 m provides relief for spring melt and larger summer storm flow events.

A screened intake structure consisting of three inlets; two in service and one to allow for maintenance will lead to a pump house facility. The screen design will comply with Fisheries and Oceans Canada (DFO, 1995) "Freshwater Intake End of Pipe Fish Screen Guidelines," based on meeting the requirements for the anguilliform group of fish like eels. Submersible pumps (approximately 100 horsepower each) will deliver the raw water to the central water treatment plant through a pipeline. The water treatment plant will likely be of the dissolved air flotation design to treat water to "Canadian Drinking Water Standards." A preliminary concept of the intake is shown in Figure 2.3-9.

FIGURE 2.3-7 Impoundment of Meadow Lake

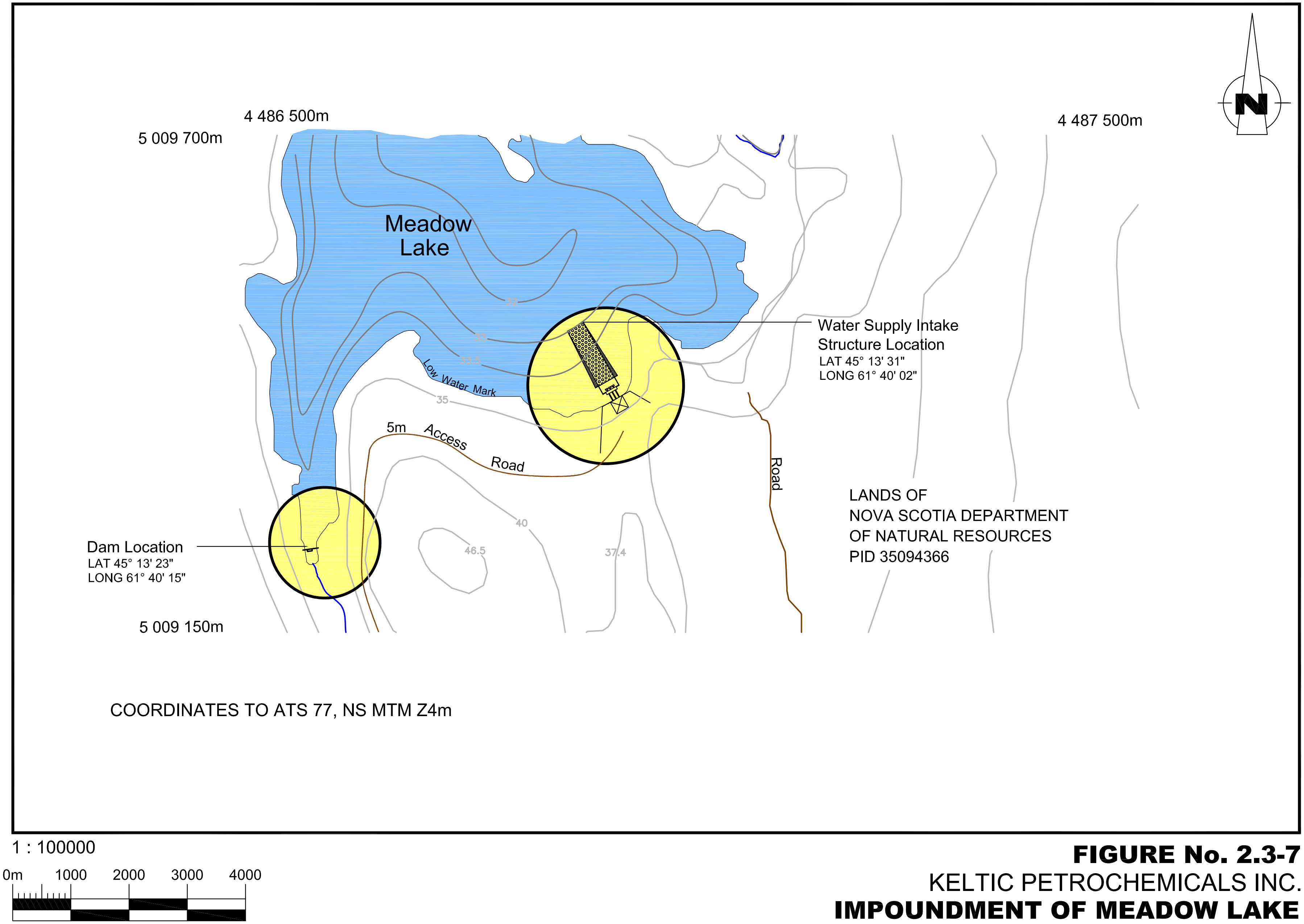


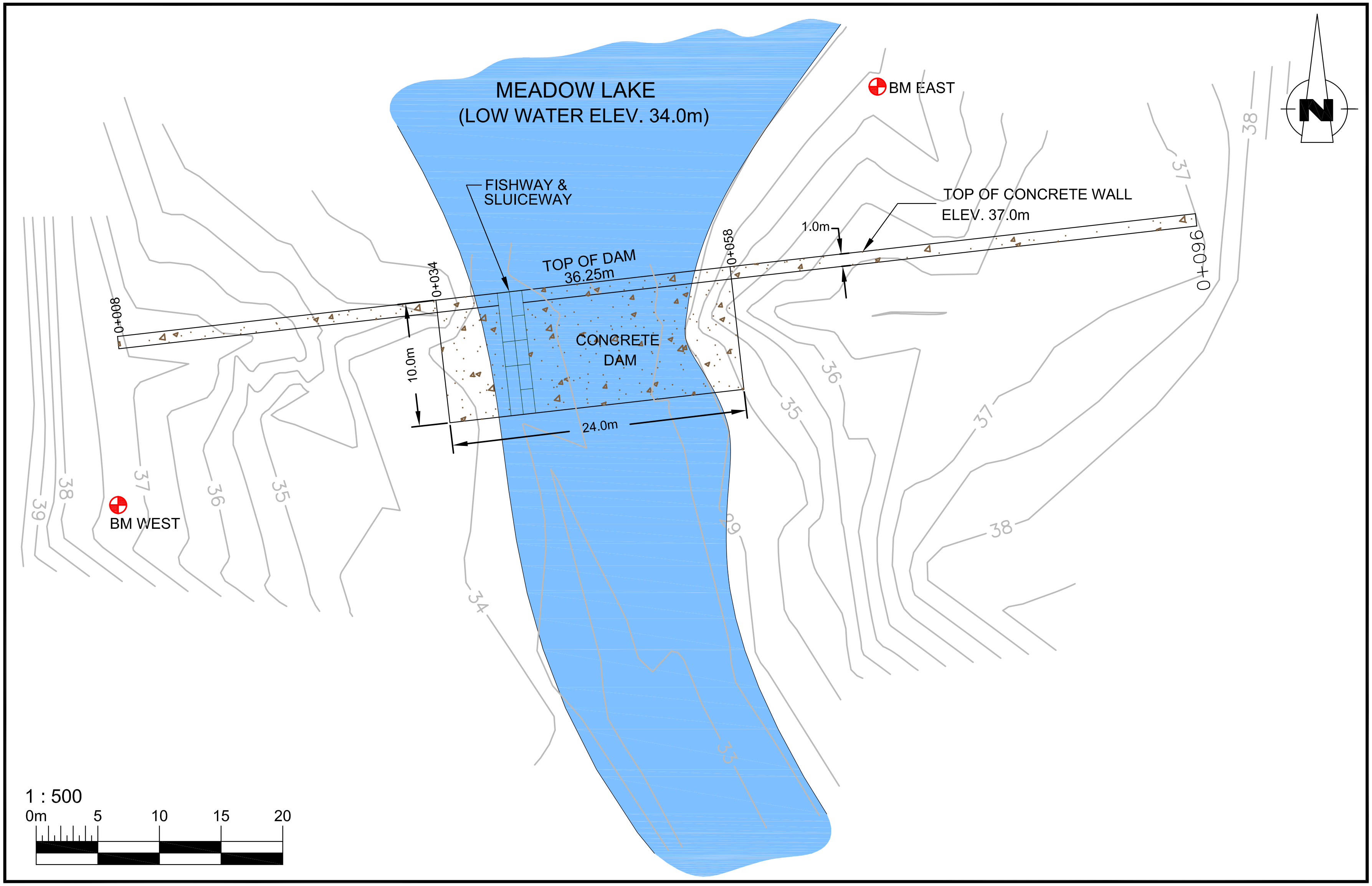
FIGURE No. 2.3-7

KELTIC PETROCHEMICALS INC.

IMPOUNDMENT OF MEADOW LAKE

JULY 2006

FIGURE 2.3-8 Preliminary Concept of the Dam



Legend:

Bench Mark Location

FIGURE No. 2.3-8

KELTIC PETROCHEMICALS INC.

PRELIMINARY CONCEPT OF THE DAM

JULY 2006

FIGURE 2.3-9 Preliminary Concept of the Intake

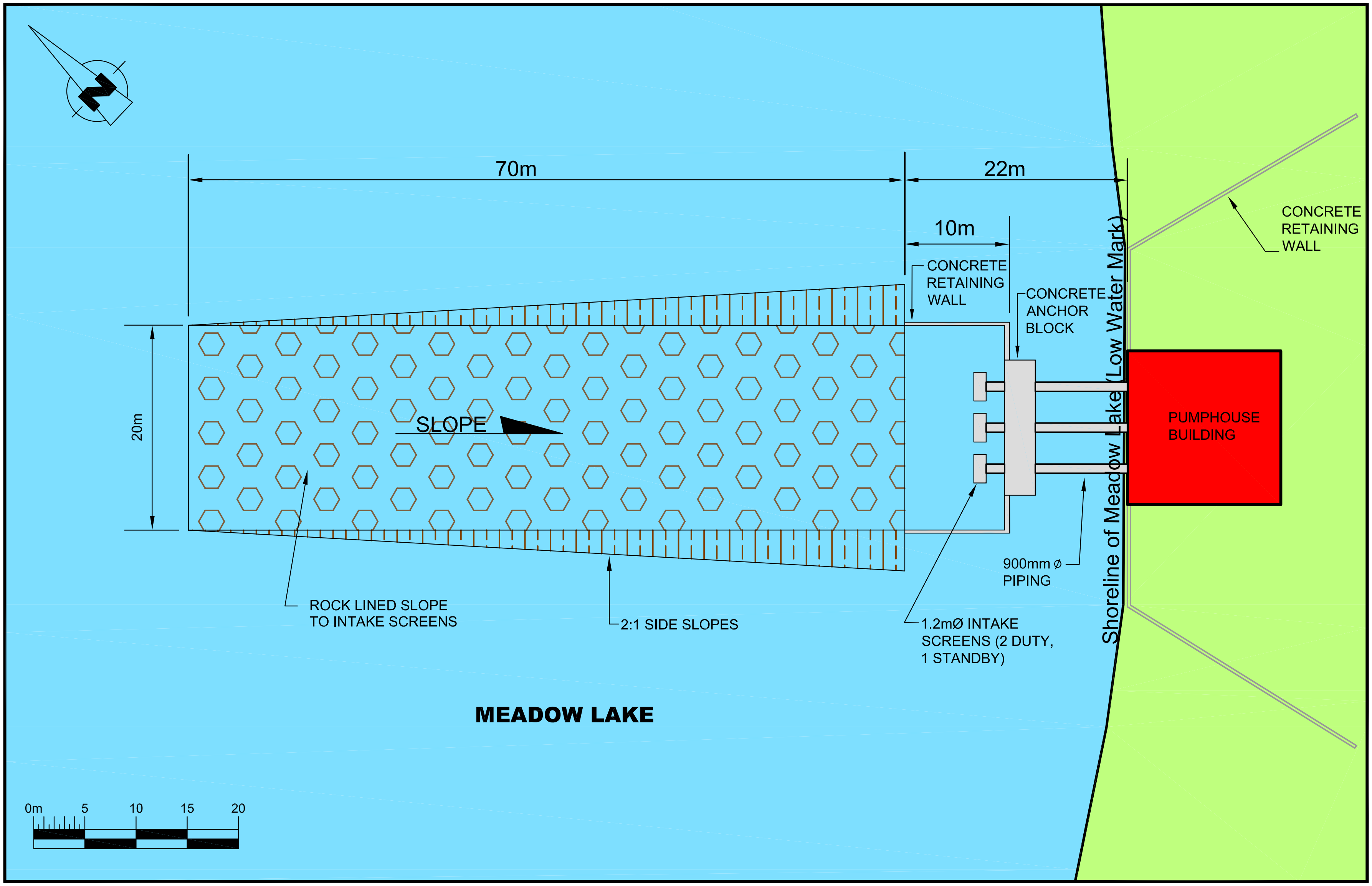


FIGURE No. 2.3-9

KELTIC PETROCHEMICALS INC.

PRELIMINARY CONCEPT OF THE INTAKE

JULY 2006

Further water treatment (demineralization) will take place at the petrochemical complex for the boiler feedwater.

Cooling water will be provided to the petrochemical plant via a closed loop system. A sea water circulating system will remove heat from the cooling water system via plate and frame heat exchangers or make-up water will be supplied by desalination (reverse osmosis). Alternative cooling systems are under review and are described more fully in Sections 2.5.10.13, and 2.5.10.17.

The detailed designs of water intake and wastewater discharge structures will consider minimal interference to marine traffic.

2.3.4.2 Sanitary Wastewater

Sanitary sewage generated from the various plant sites will be collected by a sanitary sewer system and conveyed to a central wastewater treatment plant in the vicinity of the marginal wharf (See Section 2.3.2.5). The plant will treat wastewater from washrooms, showers, canteen, and other facilities. This treatment system will be provided as part of the common user facilities.

All wastewater treatment facilities will be designed to meet Nova Scotia Guidelines for the Collection, Treatment, and Disposal of Sanitary Wastewater.

2.3.4.3 Storm-water

A storm-water management plan will be developed for the operation phase. The storm-water management plan is discussed in Section 9. Storm-water would be gathered and pumped out of the storage tank dyke area and the process area impoundment. Based on normal operations and given proper housekeeping and maintenance operations conducted at the facility, storm-water flows may be expected from these areas. There is no planned treatment of the storm-water that is pumped from the impoundment basins into the firewater pond. All storm-water management will be in accordance to Nova Scotia Department of Environment and Labour (NSEL) “Erosion and Sedimentation Control Handbook for Construction Sites.”

2.3.4.4 Central Administration and Maintenance Facilities

One central administration complex is to be provided for management of all of the Keltic facilities. The complex will include offices, boardroom, stores, central receiving and maintenance work shops, cafeteria, showers, vehicle garages.

Each of the individual complexes, such as LNG and Petrochemical, will have their own localized centre to contain control room, lunch and washrooms, safety and local fire response.

2.3.4.5 Emergency Medical Facilities

Emergency Medical Facilities will be provided at the central administration complex with first aid stations at each of the main facilities and within the process areas and marine facilities as required.

2.3.4.6 Fire Station and Helipad

The central administration complex will have a fully equipped fire station. The operation of the fire station will be coordinated with the local community volunteer fire departments. Local fire fighting response will be available at each of the main process areas. The existing helipad in the Industrial Park will be re-established at the central administration complex.

2.3.5 Applicable Project Design Codes, Standards and Regulations

The number of codes, standards, and regulations associated with the construction of a facility such as the Keltic Project is very substantial. Some of the primary ones are included in Table 2.3-5.

TABLE 2.3-5 Codes and Regulations

Code	Edition	Description
CSA Z276-01	2001	LNG – Production, Storage and Handling
National Fire Protection Association (NFPA) 59A	2004	Standard for the Production, Handling and Storage of LNG
Society of International Gas Tanker and Terminal Operators (SIGTTO)	1996	Society of International Gas Tanker and Terminal Operators
A23.1-00/A23.2-00		Concrete Materials and Methods of Concrete Construction/Methods of Test for Concrete
A23.3-94	R2000	Design of Concrete Structures
A23.4-00/A251-00		Precast Concrete – Materials and Methods of Concrete Construction/Qualification code for Architectural and Structural Precast concrete products
B51-97		Boiler, Pressure Vessel, and Pressure Piping Code
B149.1-00		Natural Gas and Propane Installation Code
C22.1-98		Canadian Electrical Code, Part 1
CSAZ299 SERIES		
CSAZ299.0-86	R1997	Guide for Selecting and Implementing Quality Assurance Program Standards
CSAZ299.1/2/3/4	R1997	Quality Assurance Program
NFPA 70	2002	National Electric Code
American Petroleum Institute 620 App. Q	10th Add. 1	Design and Construction of Large, Welded, high pressure Storage Tanks
American Society of Mechanical Engineers (ASME) Section VIII	2001	Boiler and Pressure Vessel Code, Division 1 & 2
ASME Section IX	2001	Boiler & Vessel Code – Qualification Standard for Welding and Brazing Procedures. Welders, Brazers, and Welding and Brazing Operators
ASME B31.3	1999	Chemical Plant and Petroleum Refinery Piping
American Concrete Institute 318	1999	Building Code Requirements for Reinforced Concrete
American Institute of Steel Construction	Latest	American Institute of Steel Construction – Manual of Steel Construction
ASME – Section IV	2001	Boiler Code
ASME – Section VIII	2001	Pressure Vessel Code
Tubular Exchanger Manufacturers Association	1999, 8th edition	Standards of Tubular Exchanger Manufacturers Association
American Society of Civil Engineers 7	1998	Minimum Design Loads for Buildings and Other Structures
Instrument Society of	1998	Standards and Practices for Instrumentation

Code	Edition	Description
America (ISA)		
National Building Code of Canada (NBCC)	2005	National Building Code of Canada
NFPA 10	1998	Standard for Portable Fire Extinguishers
NFPA 20	1999	Standard for Installation of Centrifugal Fire Pumps
NFPA 24	1995	Installation of Private Fire Service Mains
NFPA 30	1996	Flammable and Combustible Liquids Code
NFPA 37	2002	Standard for the Installation and use of Stationary Combustion Engines and Gas Turbines
NFPA 54	1999	National Fuel Gas Code
NFPA 72	1999	National Fire Alarm Code
NFPA 780		Lightning Protection Code
NFPA 121	1999	Standard for the Installation, Maintenance and use of Public Fire Service Communication Systems
Institute of Electrical and Electronics Engineers		Grounding
Transportation Association of Canada		Manual for Geometric Design Standards for Canadian Roads
NSEL		Erosion and Sedimentation Control Handbook for Construction Sites
Centre for Water Resource Studies, Dalhousie University		Controlling Sediment on Construction Sites
NSEL		Nova Scotia Standards and Guidelines Manual for the Collection, Treatment and Disposal of Sanitary Sewage
Nova Scotia Consulting Engineers Association & Nova Scotia Road Builders Association		Standard Specifications for Municipal Services
NSEL		Treatment Standard for Municipal Surface Source Water Treatment Facilities
Canadian Dam Association		Dam Safety Guidelines
DFO		Freshwater Intake End of Pipe Fish Screen Guidelines
Occupational Health and Safety Act		Occupational Health and Safety First Aid Regulations
Forest Act		Wildlife Habitat and Watercourse Protection Regulations
TP312E, Part 2	4th Edition	Aerodome Standards and Recommended Practices (Helipad).
Standard Specification		NSTPW

2.4 CONSTRUCTION

2.4.1 General

The sequence of construction would see the overall site activities start with the general site preparation, marine construction, and site utilities. The LNG facilities and the petrochemical construction would start next followed by start of construction for the co-generation plant and the storage and shipping areas. The construction schedule is given on Figure 2.4-1. All construction will be preceded by full construction planning including FEED and preparation of an Environmental Protection Plan (EPP).

Other than for the construction of the LNG storage tanks, none of the proposed construction requirements are beyond the experience of the construction industry in Atlantic Canada. The Project will provide opportunities for Nova Scotia companies to participate in all aspects of the

Project on a competitive basis. Given that a number of components are larger than can be accommodated with the existing highway structure, large units can be transported using barges and docking at the existing wharf in Goldboro.

The construction work force is estimated to peak at approximately 3,000 people. Although this peak will occur at Goldboro, the Project may result in additional construction related employment outside Guysborough County, such as sub-assembly of Project components at fabrication shops in Nova Scotia and elsewhere.

Accommodations for the workforce will be provided in several ways: Local residents traveling to the site, accommodations with local residents or in the commercial sector of the surrounding counties, towns and villages, and, if required, a temporary construction camp constructed on the site at Goldboro. If a construction camp is required, it will include temporary water and wastewater facilities until the main facilities will be constructed. The permanent water and wastewater facilities would be expected to be operational during the peak construction period.

2.4.1.1 Access (road)

Access to the Project site by the work force will be accomplished over the provincial highway/roadway system to Goldboro, as the current Route 316 will be in the thermal exclusion zone and for safety purposes. Route 316 will need to be re-routed along Goldbrook Road and continued north of the site along a newly constructed secondary highway connecting with Route 316 at Seal Harbour. The general alignment of the new route is shown on Figure 2.4-2. Temporary access points will include one at the northernmost part of the site and two locations on the former Highway 316 at the south of the site. While all three access points will be used, the majority of construction traffic will be diverted to the southern access points to minimize interference with non-project traffic. The northern access point will be an at grade intersection that will be constructed with turning lanes and developed as the permanent access. Road construction details will be finalized in the FEED Stage and will follow NSTPW standard practices.

Roads on the Project site will be provided for operation, maintenance and fire and emergency vehicles. Design of these access roads and structures will consider the maintenance of natural water flow where practical. Existing drainage patterns will be maintained and ditches should not be permitted to flow directly into any surface water. All work will be accomplished according to an Environmental Protection Plan (EPP) and an erosion and sedimentation control plan. All roads will be maintained in a serviceable condition year round including snow removal in winter and dust control in summer. Permanent roads and parking areas will be paved as soon as possible after grading.

Access for construction will also be by water. Marine equipment will be on-site for caisson construction and placement during early construction and for shipping construction materials and heavy lift items during the construction of other site components.

FIGURE 2.4-1 Project Schedule

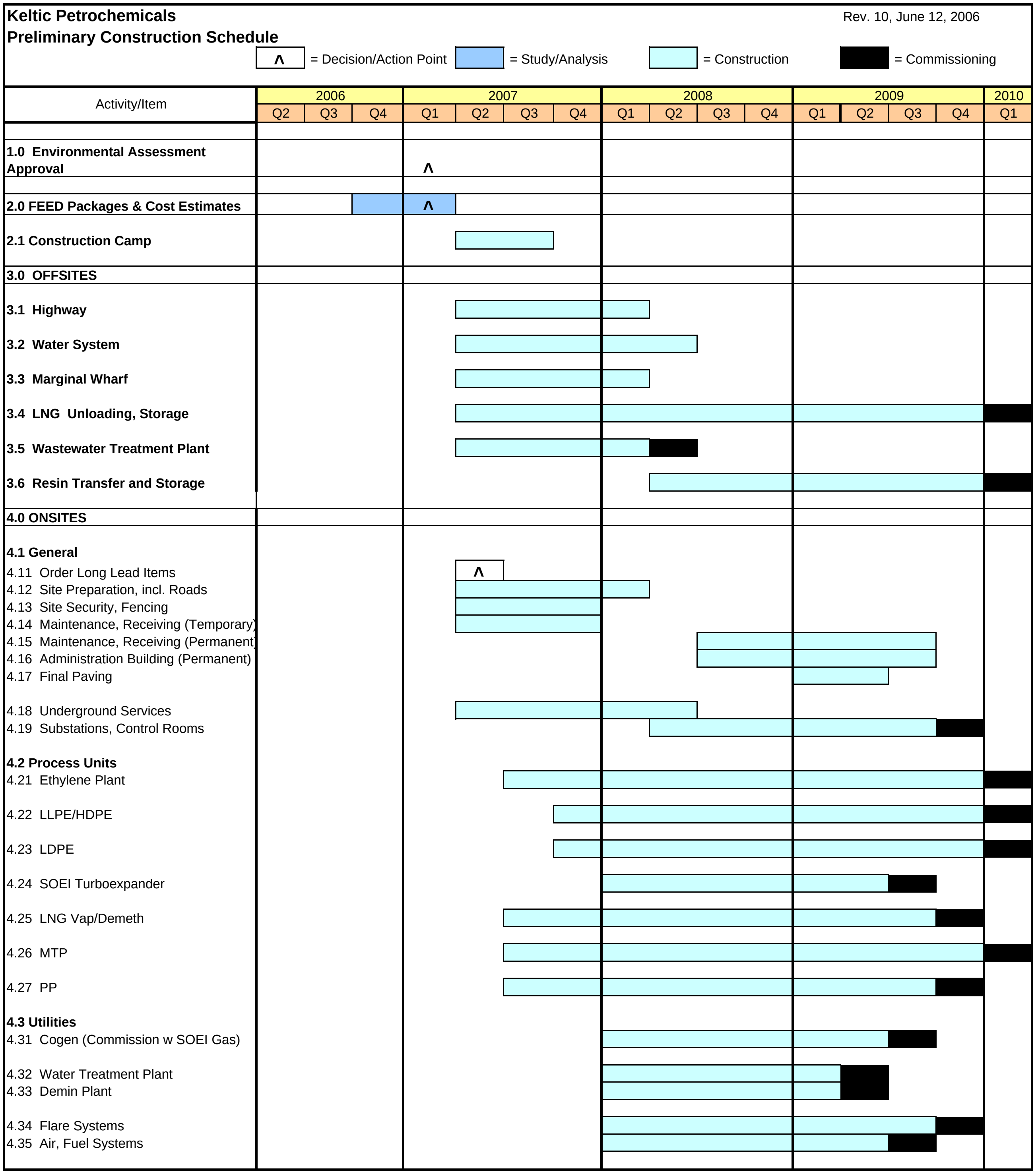


FIGURE 2.4-1

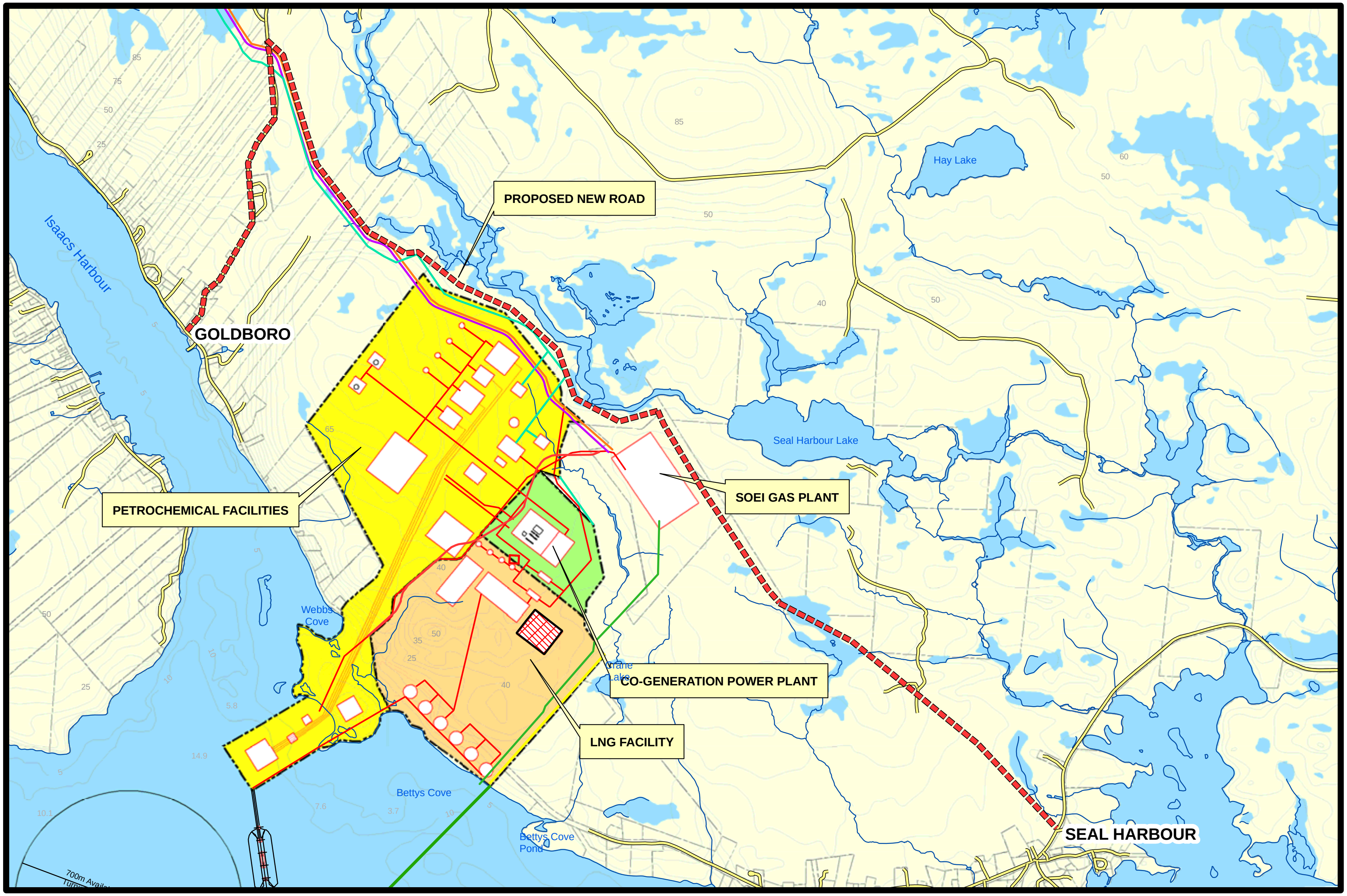
KELTIC PETROCHEMICALS INC

PROJECT SCHEDULE

JULY 2006

Source:Keltic Petrochemicals Inc. (June 2006)

FIGURE 2.4-2 General Road Alignment and Work Camp Location – to be inserted



Legend

Petrochemical Facilites

Co-Generation Power Plant

LNG Facility

Road Alignment

Work Camp Location

FIGURE No. 2.4-2

KELTIC PETROCHEMICALS INC.

GENERAL ROAD ALIGNMENT AND WORK CAMP LOCATION

July 2006

Temporary parking will be constructed in the vicinity of the major construction activities and the work camp and will be sized to accommodate the workforce. Approximately five 5000 m^2 locations and several smaller locations are expected. Generally these parking areas will be gravel surfaced and those that are paved will be designed with details to control runoff.

2.4.1.2 Work Camp

A temporary construction work camp, if required and administration centre will be provided on-site at the Goldboro facility, with temporary power, water, wastewater and solid waste facilities as noted in Section 2.4.1.5, for the period of the construction and commissioning. The work camp will provide housing for construction personnel on site. Approximately 40 ha has been identified on Figure 2.4-2. This site would accommodate up to 3000 workers in 300 self contained portable units of 180 sq m each. The administrative centre is intended for as office space for management and administration staff.

The work camp site will be isolated from the main construction activity and will be designed to include cafeteria and recreation facilities. Final needs and housing availability in the local area will be studied during the FEED phase of the Project to identify regional ability to support the physical needs of intended work force. The Project Management Committee (PMC) will develop and monitor the work camp activity under the umbrella of the Project EHSS program.

2.4.1.3 Material Storage

Project materials will be stored on site within the Project boundary or at the site of approved suppliers off site. Procurement rules established by the PMC during the FEED phase will require approved suppliers to conform to Project policies regarding storage. Materials stored during construction would include construction materials and plant for the construction, including such items as concrete and steel, specialized metal products, electrical wiring and mechanical process piping.

Under the Project’s site management and security plans, all contractors and subcontractors will be held responsible for management of contracted materials storage. The plan will instruct contractors to prevent, reduce, or eliminate the discharge of pollutants from material delivery and storage to the storm-water system or watercourses by minimizing the storage of hazardous materials onsite, storing materials in a designated area, installing secondary containment, conducting regular inspections, and training employees and subcontractors in site usage.

Diesel, gasoline, and heating oils are expected to be maintained on site during construction. It may be expected that 5-2000 litre (L) tanks of gasoline and diesel would be on site along with 1-1000 L heating oil tank. The PMC contractor will have overall responsibility for the management and control of fuels and toxic consumables on the Project site. A storage site will be identified at the start of the construction process by the PMC contractor that takes into consideration the volumes and types of storage

A toxic/hazardous materials management plan will be developed and implemented which will be in accordance with relevant federal and provincial legislation pertaining to these materials. Spill contingency plans will be developed and appropriate equipment to implement such plans will be in place, including a program of training ensuring employees will be aware of such emergency procedures in the event of accidental spillage or tank malfunction. Fire protection equipment will be available onsite.

2.4.1.4 Staging Areas

Construction staging will occur on site within the Project boundary or at the site of approved suppliers off site. Procurement rules established by the PMC during the FEED phase will require approved suppliers to conform to Project policies regarding this activity.

Process access roads and staging areas for specific site construction activities will be designated as part of the final site design. Construction area boundaries, including staging areas, will be clearly marked and enclosed to ensure all construction activity and storage of construction materials will occur within these marked limits. Each site contractor will be responsible to the PMC for activity within the staging enclosure, in accordance with established site management plan.

2.4.1.5 Temporary Site Services

Once specific construction Project sites have been identified and approved through the FEED process, details for temporary site services (power, storm-water, wastewater, waste management) will be developed as a part of construction logistics planning.

Power will come from the local grid. Private contractors will be used for removal of wastewater from portable units dispersed throughout the site, and for solid waste removal. Wastewater treatment for the construction camp area will be achieved using an on-site system such as a temporary sewage treatment package plant with discharge to Isaac’s Harbour. The on-site system will be designed to meet NSEL discharge criteria for marine receiving waters. Water wells will be drilled on site until the permanent source is operational.

A storm-water management plan will be developed to prevent sediment-laden runoff from the facility from entering streams or the marine environment during the construction phase of the plant facilities. This plan will be developed in accordance with the NSEL “Erosion and sediment control Handbook for Construction Sites” (NSEL, 1988).

2.4.1.6 Road Upgrades

Goldbrook Road will be upgraded and a new leg of Route 316 will be constructed north east of the site, all as shown on Figure 2.4-2. A detailed assessment of Route 316 and Goldbrook Road, including the bridges and structures, will be conducted during the FEED phase when all the transportation logistics are developed. The Marginal Wharf will be constructed early so that the need to transport heavy loads by road will be minimized.

The Highway extension will be constructed to the same standard as the existing Highway 316, which is a designated by NSTPW as a secondary road. Route 316 will require minor widening and repaving with an asphalt surface. The proposed new construction of Highway 316 is 12 km long. The new alignment avoids wetlands and watercrossings and by aligning the roadway with existing M&NP easement will minimize impacts on developed woodlands. The will be no agricultural lands crossed by the proposed realignment.

The right-of-way (RoW) will have to be approximately 50 m wide to accommodate the 2-lane highway. A preliminary evaluation of the area indicates that three intersections are necessary but no structures are required (a structure is any of; grade separation, or river crossing that has to be constructed on-site rather than prefabricated).

Although not anticipated at this time, river and stream crossings have to be addressed for compliance under *Navigable Waters Protection Act* (NWPA). The preliminary route will be provided to Transport Canada (TC) and the streams that are considered applicable under NWPA will be identified. Any updated alignment and applicable stream and river crossings will also be addressed for compliance under NWPA.

The road upgrades and new construction planned are typical of what NSTPW would carry out in the province. The road construction process is comprised of several phases which generally include survey and design, land clearing, grubbing, grading, construction of overpasses, underpasses and interchanges, paving, and hydroseeding. The highway construction practices would comply with NSTPW Standard Specifications (1997 and revisions); and the Generic EPP for the Construction of 100 Series Highways. Construction activities would also be conducted in accordance with the Erosion and Sediment Control Handbook for Construction Sites (NSEL, 1988). Work in and adjacent to watercourses would take place during the period of June 1 to September 30 in accordance with Nova Scotia Water Approvals, and Nova Scotia Watercourse Alterations Specifications (NSEL, 1997).

Some or all of the following typical activities will take place. Many of these activities will be employed for site preparation of the plant sites.

Excavation

The removal of material for the construction of subgrade (bottom layer of material) may involve one or more methods of excavation, including common excavation, rock excavation, and swamp excavation. Common excavation is the removal of overburden, including till, smaller boulders, and topsoil. Rock excavation is the excavation of rock, which is considered to be bedrock or single pieces greater than one cubic metre in size. Cuts in “soft” rock can be accomplished using ripper blades attached to larger heavy equipment, breaking up the rock so that it can be loaded onto trucks with an excavator or loader. This procedure tends to be successful in softer rock such as shales and sandstones, and in areas where the bedrock surface is highly weathered and/or fractured.

Swamp excavation occurs where soil is unsuitable for use as a subgrade. The soil is either excavated and replaced with a competent fill, or “floated over” using geogrids or berm construction. This may occur when peat is encountered or when exposed soil has been saturated with water. Excavated soils unsuitable for use as fill or dressing slopes are disposed of off site.

Stability of slopes for both cuts and embankments will be considered along the proposed alignment. Conservation slopes for cuts and embankments will not exceed 3 H : I V in sands and gravel as well as in cohesive soils (silts and clays). Flatter slopes will be used if necessary.

Blasting

The use of blasting for rock excavation is dependent upon the competency of the rock. The FEED will determine whether or not blasting will be required for the construction of the proposed alignment. Wherever possible, rock excavation will be performed by ripping rather than blasting.

If blasting is deemed to be necessary, blasting operations will be conducted in accordance with the applicable regulations and guidelines. Blasting operations are governed by provincial regulations throughout Nova Scotia. Blasting in or near watercourses will require approval from Fisheries and Oceans Canada (DFO), and shall be conducted in accordance with the "Guidelines for Use of Explosives in or Near Canadian Fisheries Waters" (Wright and Hopky, 1998). Blasting shall also be conducted in accordance with the *General Blasting Regulations* made pursuant to the Nova Scotia *Occupational Heath and Safety Act*. The Contractor performing the blasting will have a valid "Blaster's Licence" and will ensure that a pre-blast survey has been conducted, prior to blasting.

Before construction, the PMC Contractor will determine the locations, chemical quality, and the physical condition of wells, if possible, within a distance of at least 800 m of blasting areas.

Blasts must be designed to limit ground vibration and air concussion below provincial guidelines, which are set to prevent damage to wells and structures. Blasting will be monitored for ground vibration and air concussion, both close to the blast site and at the closest structures.

Borrow Materials

Construction of the alignment will consist of cut and fill operations to bring the area to subgrade level using materials along the alignment. Borrow material, required for subgrade construction, will likely be derived from glacial till found near the alignment. Based on the surficial and bedrock geology of the Project area, most of the materials used in subgrade construction will consist of glacial tills and bedrock. Glacial tills tend to be suitable as a subgrade fill material but are sensitive to moisture and are difficult to work with during wet periods of the year. They are also erodible, therefore, erosion/sediment control measures will be necessary at borrow pits and along the alignment where these materials are used. Rock fill may be used as borrow material, but tends to be more expensive to obtain than glacial till. Borrow pits and existing quarries for rock will avoid Halifax Formation bedrock to minimize the risk of encountering acid producing rock.

All layered bedrock within the proposed alignment that may be disturbed or exposed will be tested for its potential to produce acid. Testing will comply with specifications outlined in the *Sulphide Bearing Material Disposal Regulations* under the Nova Scotia *Environment Act.* Exposure, removal, and disposal of potentially acid generating bedrock must be conducted in compliance with the Guidelines for Development on Slates in Nova Scotia (NSEL and EC, 1991) and the *Sulphide Bearing Material Disposal Regulations*.

Aggregates for the Project will be required for such items as sub-base and base gravels, shoulder gravel, asphaltic concrete, backfill for structures and culverts, erosion protection, and stream bank stabilization. The Contractor selected for the construction of the realignment will be responsible for identifying borrow areas and for obtaining necessary permission from landowners. All aggregate, alone or as a pavement component, will conform to the NSTPWs Standard Specifications (1997 and revisions).

Subgrade Construction

Subgrade is the bottom layer of material on a road, providing strength and stability. Subgrade is constructed by spreading acceptable fill, either from cuts or borrow sources, in a layer of specified thickness (depending on the engineering properties of the material but not usually exceeding 200 mm) and using moisture control procedures, compacting it to a specified density. Subsequent layers are added until the desired elevation is reached.

Where feasible, as determined by suitability of the material and hauling costs, material excavated from the RoW is used for fill. If the excavated material is determined to be unacceptable for use as road building material along the alignment, materials will be obtained from nearby borrow sources.

Subbase and Base Construction

Once the subgrade has been developed, a granular graded structural base known as subbase and base is prepared. The subbase course (gravel) is placed immediately above the subgrade and consists of material superior in quality to that used for subgrade. The base course is placed immediately above the subbase and consists of a series of layers graded to provide structural integrity and good drainage beneath the asphalt concrete surface.

Dust

A dust control plan will be implemented and enforced during dry weather periods. This will include, at a minimum, wetting of aggregate storage areas and haul roads to minimize the generation of fugitive dusts by construction vehicle traffic. The tracking of soils onto existing primary and secondary roads will be minimized to prevent the generation of fugitive dusts by roadway vehicle traffic. Dry sweeping of asphalt/concrete surfaces will not be conducted; wet sweeping will be employed as needed. Minimizing the quantity of soil or aggregate stockpiles at the Project site will also reduce wind-generated dust emissions. Anti-idling policies will minimize the release of particulate matter (PM) from diesel construction equipment and/or truck exhausts.

Drainage and Water Crossings

The development of a drainage system and installation of culverts is generally conducted during the earthwork operation. Roadside ditches and cross culverts will direct surface water away from the highway and into natural drainage systems.

Erosion and sediment controls associated with the construction will be designed based on: the drainage design; the erodibility of the fill material and any exposed soils on the site; the Standard Specification; the Project EPP and related environmental control plans; and the NSELs *Erosion and Sediment Control Handbook for Construction Sites*.

Paving

Conventional asphalt concrete is made by mixing petroleum based liquid asphalt with sand and crushed stone in an asphalt plant. The hot mix is easily transported, spread, and rolled to provide a smooth surface that can be used almost immediately. Since the surface is "flexible", it is subject to wheel track rutting and frost action that may break the pavement and cause pot holes.

Shouldering

Shouldering requires the placement of gravels next to the pavement edge. This gravel material not only supports the pavement edge, but makes a more gradual transition from the paved driving surface to the side slopes, in the event of vehicle runoff. Gravels are generally placed using a shouldering machine, which conveys shoulder material from trucks to the shoulder area. The material is then graded and rolled.

Topsoil

Topsoil will be saved during the grubbing process and will be reused to dress side slopes.

Hydroseeding

Hydroseeding is conducted as soon as possible after completion of surface preparation. Areas to be hydroseeded shall be dressed or otherwise left in a loosened condition conducive to seeding. Hydroseeding shall not be performed under windy conditions or during periods of rainfall, on areas covered by standing water, over frozen surface or under other adverse conditions. Application rates and procedures as detailed by NSTPWs Standard Specifications (1997 and revisions) for hydroseeding will be implemented.

2.4.1.7 Upgrading of Existing Wharf for Temporary Use

The existing wharf in Goldboro was substantially upgraded by the Sable Offshore Energy Inc. (SOEI) to handle heavy pieces of equipment in the construction of the gas plant in approximately 1998.
Minimal use of this facility for the Keltic Project is contemplated so no upgrades or dredging have been identified.

2.4.1.8 Environmental Management Planning

To avoid adverse environmental effects and to minimize unavoidable negative effects, an EPP will be prepared specifically for the construction phase of the Project. The EPP will prescribe all environmental management measures, mitigation measures, spill prevention protocols, contingency measures, responsibilities, supervision, and reporting measures necessary to ensure the least impact to the environment during construction.

The EPP is an essential tool for minimizing adverse environmental effects. Its content is briefly described here as it applies to most of the discussions of effects and mitigation measures provided in the following sections.

For example, the EPP will include an erosion and sedimentation plan for each major segment of the Project, i.e. marine facilities, water supply source, and process facilities. The NSEL "Erosion and Sedimentation Control Handbook for Construction Sites" will be followed and the plans submitted to NSEL for review and approval. Due to the large areas that will be disturbed by construction, extreme effort will be undertaken to avoid release of dust and sediment into the environment. Storm-water management will be exercised during construction to address both dust control and erosion and sediment control. Sediment-laden storm-water runoff will be prevented from entering surface water bodies. Control features will include utilizing granular material, ditch checks, silt fences, vegetation, and siltation ponds

Keltic will require all contractors to work in compliance with the EPP. Key provisions of the EPP are described in Section 13 of this report. A response and follow up procedure will be included in the EPP to manage any complaints.

2.4.1.9 Monitoring

Through the EPP, the PMC will provide site-wide monitoring network to ensure all site activities are regulated and monitored so that the environment is protected. Performance standards will be established for each recognized valued environmental component (VEC). Specifications and standards will be identified against which the various monitoring programs will be validated and measured. Based on the results of the monitoring programs, the PMC will make necessary modifications to mitigation plans and/or operations, to prevent continued unacceptable environmental effects, to the satisfaction of NSEL.

Typical monitoring activities would include sewage discharge monitoring, water quality monitoring of surface water discharges, groundwater quality monitoring, air quality monitoring of dust and other sediment, noise monitoring and other variants as identified in the EPP. The program will be maintained, as required, over the lifetime of the Project.

2.4.1.10 Health and Safety

An Environment, Health, Safety, and Security (EHSS) Plan will be developed by the PMC to promote, create, and maintain a safe, secure, and healthy workplace.

2.4.1.11 Training

The PMC will develop a comprehensive EHSS system that encompasses internal requirements for employee safety, security and environmental training and reporting. Under the umbrella of the EHSS program all site personnel will be required to participate in EHSS operated training and exercises/drills. Personnel training requirements and programs will comply as a minimum with the elements identified in Section 28 of the *Occupational Health and Safety Act*, regulations pursuant to the International Ship and Port Facility Security (ISPS) Code and as required in the Nova Scotia Environmental Act. All contract personnel will be required to meet the terms of the previously mentioned Acts.

2.4.1.12 Public Information

Keltic will develop a public information and communications plan to provide ongoing Project information to area residents, First Nations, businesses, and users of Isaac's Harbour, including other individuals or groups that express a specific interest in the Project. The program will include an active website, community newsletters, open houses at key Project milestones, designated communications officials within Keltic and an information booth at the facility upon completion. The receipt of information on public and stakeholder comments and concerns will be tracked through implementation of a system to track concerns and how they were addressed. This will be used to help ensure that all stakeholder interest is represented in the Project.

2.4.2 Construction of LNG Facility Including Marine Terminal

2.4.2.1 Construction Envelope

Designated temporary material storage and lay-down areas will be established within the development envelope. The active construction site and associated laydown areas will be surrounded with fencing and security guards will be employed to prevent public access.

2.4.2.2 Site Preparation/Clearing/Grubbing

Site clearing and grading will be undertaken within a demarcated development envelope. The overburden soils will be retained on site for use in berms and landscaping. The underlying rock will be levelled to working grade. This will involve some blasting, heavy excavation equipment, crushing, and screening. The site will provide rock suitable for crushing for concrete and foundation backfill and will also become the principle source of granular material for site roads and fill for the marginal wharf. Samples of rock from rock excavation areas will be tested to determine its acid generating potential prior to construction. If acid generating rock is found to exceed regulatory volume levels (500 m^3) a management plan for the rock will be developed for approval by NSEL.

2.4.2.3 Fencing

In accordance with the *Canadian Marine Transportation Security Regulations* established in 2004, ports and marine facilities of the nature proposed here require approved security plans. In compliance with these plans and inline with best management and security practices, all access to dockside marine facilities, and or work sites, will be controlled through the erection of security fencing, gates, signage, and lighting. A site security plan identifying locations of work sites, types of acceptable enclosure and responsibilities in meeting the intent of the regulations will be developed prior to commencement of activities. In line of the International Maritime Organization’s (IMO) security requirements, this will also include for marine facilities and vessels.

2.4.2.4 Lighting

All on-site illuminations will be capable of complying with the *Canada Occupational Health and Safety Regulations*, Part VI, Section 6.5 – “Lighting in Industrial Areas”. All such lighting will be adequate for the work intended and emergency lighting will be provided, as necessary, in the event of interruptions. In general, high mast lighting for area lighting is anticipated. In all cases, the lights will be pointed downward wherever practical. All fixtures will be approved for the area classification in which they are to be installed. Investigations in to the possibility of aviation obstruction light will be considered with the input of TC.

2.4.2.5 On-shore Cut and Fill, Blasting

All on-shore site development (cut and fill operations) will be planned and conducted in accordance with the guidelines as provided in Nova Scotia *Occupational Health and Safety Act*, S.N.S. 1996, c. 7 and as directed in the Project's EPP and site development plan. Site preparation will be accomplished according to NSEL guidelines, policies, and requirements and in compliance with the respective divisions of the *Occupational Health and Safety Act* and 'Company' EHSS policy requirements, ensuring the protection of the environment including personnel safety and security. A pre-blast survey of structures within a designated radius of the blasting site including wells, building, foundations, etcetera, any of which that may experience damage or impact due to seismic vibrations or air concussion, will be conducted according to the EPP.

Mitigative measures will be undertaken to minimize the potential for erosion and siltation of the nearby streams and waterfront from site runoff while soils are exposed and unstabilized and from movement of construction vehicles. These measures will be specified in erosion and sediment control procedures to be included in the Environmental Protection Plans (EPP). In general, these measures will be consistent with NSEL guidelines (NSEL, 1988). Any shoreline areas that do need protection will have typical armour stone protection designed and placed using conventional methods.

2.4.2.6 Foundations

Foundations will be installed for major equipment and buildings. Underground services will be installed such as sewers. The storm-water management system will be constructed comprising ditches, catch basins, and detention pond, and discharge systems to the sea. Site roads will be established around the complex. Foundation options and construction methods will be determined upon the results of geotechincal investigations made during the FEED phase.

2.4.2.7 LNG Terminal, In-water Works (dredging, pipe/sheet-pile driving, fill)

The terminal will be constructed of pipe pile mooring piers and berthing dolphins. The piers will be capped and connected with a steel and concrete bridge and deck.

2.4.2.8 Shoreline Stabilization

The tank locations will be optimized to utilize the existing topographic bench at the proposed site. The precise siting of the LNG tanks will be confirmed during FEED following geotechnical investigation of the tank storage area. An assessment of the stability of the slope/shoreline will also be undertaken. Should it be required, the shoreline will be stabilized with a blanket of armour stone. The thickness of the blanket and the size of the armour stone will be confirmed during detailed design. The armour stone will be placed along the shoreline by an excavator in a manner similar to the shoreline protection employed for the SOEI pipeline landfall south of the LNG tank storage.

2.4.2.9 Equipment Installation

Process towers and reactors, storage tanks, pipelines, gas turbines and all ancillary equipment will be installed to complete the Petrochemical facilities. Utilities and plant services such as water and wastewater treatment units, power supply, and steam will be constructed. Buildings will be erected for site administration and maintenance and processing.

2.4.2.10 Transportation of Construction Material (mode; quantities; source/destination)

During the construction period, deliveries of equipment, materials and consumables will be delivered either by marine transport (for highway sensitive (size, volume or weight) products and equipment), or by using the surface road structure. Each contractor is responsible for the safe delivery and storage of those products necessary in completing their area of the works, and as such is responsible for observing all Nova Scotia and regional highway regulations and restrictions. It is expected that all high volume products will be delivered by marine transport and maintained in the contractors lay-down or staging areas. Surface transport to those areas will be over the prepared access road network.

2.4.2.11 Management of Surface Water (creek diversion; treatment; discharge points)

A small intermittent watercourse is located in the northeast corner of the site and based on preliminary plans will not be disturbed. A 15m buffer will be placed on the watercourse for protection.

2.4.2.12 Management of Waste Water (treatment; discharge points)

Sanitary wastewater generated from construction will be treated, as necessary, to comply with the regulatory requirements prior to discharge. A variety of liquid wastes will be generated during construction, including oils and lubricants from equipment, and wastewater (i.e. site runoff, sewage). Storm-water management controls such as sedimentation ponds and site drainage ditches would be constructed at the site and will be controlled through the EPP. Sanitary wastewater will be treated onsite using a packaged sanitary wastewater treatment unit approved under relevant regulations and guidelines. Initially for the construction activities it may only need special holding tanks for sanitary waste management, this will be determined following the FEED assessment.

A Spill Management Plan and Emergency Response and Contingency Plan will be developed and implemented to minimize the chances of a spill reaching any waterbody including groundwater, and also include mitigation measures to minimize impact if a spill does occur and reach a waterbody. In order to minimize, contain, and control any potential releases of hazardous materials, a site-specific Spill Management Plan will be developed. All staff will be appropriately trained in the handling, storage, and disposal of hazardous materials (i.e. WHMIS, Transportation of Dangerous Goods (TDG)). Chemical storage and handling will be done in accordance with the manufacturers' recommendations and federal and provincial regulations, where applicable.

2.4.2.13 Management of Contaminated Soils (excavation & disposal; isolation)

In general, the site is considered to have a low risk of contaminated soils as it is and has been largely undeveloped. However, the site contains areas of suspected and known mine tailings from historic mining activities. These tailings have levels of arsenic and mercury above CCME criteria (see Section 8.13.4). Following site clearing, these areas will be delineated and overlain with the Project's grading plans to determine whether avoidance is possible.

Where avoidance is not possible, a management plan for the material will be prepared which will consider the suitability of isolating the tailings on site in fill areas or berms using a human health risk assessment approach; stabilization; and excavation and disposal at a facility approved to accept material. Samples of rock from rock excavation areas will be tested to determine its acid generating potential prior to construction. If acid generating rock is found to exceed regulatory volume levels (500 m^3) a management plan for the rock will be developed for approval by NSEL.

All attempts will be made to prevent or reduce the discharge of pollutants to storm-water from contaminated soil and highly acidic or alkaline soils by conducting pre-construction surveys, inspecting excavations regularly, and remediating contaminated soil promptly. A Spill Management Plan and Emergency Response and Contingency Plan will be developed to avoid impacts from release of potentially hazardous materials during contract works. Contaminated soils that cannot be treated onsite must be disposed of offsite by a licensed hazardous waste hauler.

2.4.2.14 Site Rehabilitation (temporarily used sites)

Upon completion of activities at temporary sites all surface structures will be dismantled and removed from the site. Disturbed areas will be landscaped and re-vegetated as necessary. Solid waste will be disposed of in an approved manner, and hazardous waste will be collected for disposed in accordance with the established waste management plan.

2.4.2.15 Schedule

The construction period to commissioning of the Project is expected to take 36 months. The schedule is broken down into four categories as shown in Figure 2.4-1. It is noted on the Bar Chart that certain phases of the Project are underway. In order to provide a Project definition, specific activities, including selection of licensors/technology, contracts for LNG and feedstock supply, field work for the EA and pre-FEED activities, to name a few, have been initiated.

Construction of the Project facilities is expected to occur year around for some work, utilizing the more favourable construction season to undertake most of the work. Most work would be scheduled to occur during a single shift consisting of 40 hours per week. There are likely to be some critical path items that will require additional shifts

2.4.2.16 Labour Requirements

The PMC will ensure the selected contractor has sufficient access to skilled and experienced trade, supervisory personnel, and specialist to accomplish the LNG construction activities.

Labour from the local, provincial and national labour market will be recruited according to established activity needs and availability.

2.4.2.17 Malfunctions and Accidents (spills; truck accidents)

To minimize, contain, and control any potential releases of hazardous materials, a site-specific Spill Management Plan will be developed. All staff will be appropriately trained in the handling, storage, and disposal of hazardous materials (*i.e.* WHMIS, TDG). Chemical storage and handling will be done in accordance with the manufacturers' recommendations and federal and provincial regulations, where applicable. On-site safety measures include: leak alarms; emergency shutdown systems; spill containment and personnel training programs that will be developed.

A traffic management plan will be established under the umbrella of an EPC Contractor's Health & Safety and Security Program. This program will be developed to ensure personnel and asset safeguard against planned or unintentional anomalies. Controls will be in place to ensure coordination of onsite emergency services, civil response authorities, and incident record management.

2.4.3 Construction of Petrochemical Plant Including Marginal Wharf

Commencement of construction of the LNG complex will precede that of the Petrochemical complex with both proceeding in parallel for some duration. After site preparation for the Petrochemical / LNG complex, the activities will shift to the fabrication and erection of the major industrial components and steel framed buildings. Potential environmental issues to be addressed will include noise, dust suppression, and storm drainage control.

Key construction and site development activities include:

- site clearing and grading;
- establishing construction laydown areas;
- major foundation and underground utilities installation;
- equipment installation; and
- commissioning and testing.

2.4.3.1 Construction Envelope

Designated temporary material storage and lay-down areas will be established within the development envelope. The active construction site and associated laydown areas will be surrounded with fencing and security guards will be employed to prevent public access.

2.4.3.2 Site Preparation/Clearing/Grubbing

Site clearing and grading will be undertaken within a demarcated development envelope. The overburden soils will be retained on site for use in berms and landscaping. The underlying rock will be levelled to working grade. This will involve some blasting, heavy excavation equipment, crushing, and screening. The site will provide rock suitable for crushing for concrete and foundation backfill and will also become the principle source of granular material for site roads and fill for the marginal wharf. Samples of rock from rock excavation areas will be tested to determine its acid generating potential prior to construction. If acid generating rock is found to exceed regulatory volume levels (500 m^3) a management plan for the rock will be developed for approval by NSEL.

2.4.3.3 Disposal of Excess Fill

Overburden excavated from the Project site will be utilized on site for landscaping and berms. Rock blasted for the development of the site will be suitable for crushing for concrete and foundation backfill and will also become the principle source of granular material for site roads and fill for projects in the area. The EPP will cover environmental management policies and procedures for the construction phase.

2.4.3.4 Fencing

In accordance with the *Canadian Marine Transportation Security Regulations* established in 2004, ports and marine facilities of the nature proposed here require approved security plans. In compliance with these plans and inline with best management and security practices, all access to dockside marine facilities, and or work sites, will be controlled through the erection of security fencing, gates, signage, and lighting. A site security plan identifying locations of work sites, types of acceptable enclosure and responsibilities in meeting the intent of the regulations will be developed prior to commencement of activities. In line of the IMOs security requirements, this will also include for marine facilities and vessels.

2.4.3.5 Lighting

All on-site illuminations will be capable of complying with the *Canada Occupational Health and Safety Regulations*, Part VI, Section 6.5 – “Lighting in Industrial Areas”. All such lighting will be adequate for the work intended and emergency lighting will be provided, as necessary, in the event of interruptions. In general, high mast lighting for area lighting is anticipated. In all cases, the lights will be pointed downward wherever practical. All fixtures will be approved for the area classification in which they are to be installed. Investigations in to the possibility of aviation obstruction light will be considered with the input of TC.

2.4.3.6 Cut and Fill, Blasting

The overall site preparation of 240 ha will be planned with a balanced cut and fill. Materials for filling behind the marginal wharf will come from the petrochemical site excavations. Gravel and rock materials will be either crushed on site or imported from local quarries.

Proposed Project activities will be consistent with current quarry operations approved by Nova Scotia Environment and Labour (NSEL) and in accordance with the Nova Scotia Pit and Quarry Guidelines (NSEL, 1999). These guidelines apply to all pit and quarry operations in the province of Nova Scotia and provide: separation distances for operations, including blasting; liquid effluent discharge level limits; suspended PM limits; sound level limits; and requirements for a rehabilitation plan and security bond. All on-site blasting will be conducted in accordance with the “Guidelines for Use of Explosives in Canadian Fisheries Waters”. Rock excavation is expected but not absolute, depending on the grades.

Aggregate production will begin with drilling and blasting, which will be conducted by a qualified blasting contractor. The blasted rock will be processed by portable crushing equipment transported to the work site. Product piles will be built in layers to minimize segregation and prevent contamination by mixing of different piles. Material will be hauled and moved within the quarry with a front-end loader or excavator. In accordance with best practices and standard NSEL requirements, runoff controls will be in place to ensure that effluent generated during operations is managed appropriately.

If acid bearing rock should be encountered during site excavation, excavated acid rock will be managed according to the *Sulphide Bearing Materials Disposal Regulations* and the Guidelines for Development on Slates in Nova Scotia (NSEL and EC, 1991), which includes requirements for monitoring surface water runoff. For potentially acid generating rock, samples of bedrock will be collected during geotechincal investigations for the site and tested to determine if acid generating rock is present. Based on the testing additional testing and acid rock management plan will be developed.

All excavations (cut and fill operations) will be planned and conducted in accordance with the guidelines as provided in Nova Scotia *Occupational Health and Safety Act*, S.N.S. 1996, c. 7.

Mitigative measures will be undertaken to minimize the potential for erosion and siltation of the nearby streams and waterfront from site runoff while soils are exposed and unstabilized and from movement of construction vehicles. These measures will be specified in erosion and sediment control procedures to be included in the Environmental Protection Plans (EPP). In general, these measures will be consistent with NSEL guidelines (NSEL, 1988). Any shoreline areas that do need protection will have typical armour stone protection designed and placed using conventional methods.

2.4.3.7 Foundations

Foundations will be installed for major equipment and buildings. Underground services will be installed such as sewers. The storm-water management system will be constructed comprising ditches, catch basins, and detention pond, and discharge systems to the sea. Site roads will be established around the complex. Foundation options and construction methods will be determined upon the results of geotechincal investigations made during the FEED phase.

2.4.3.8 Marginal Wharf

No dredging is anticipated in the construction of the marine facilities. Cranes fixed atop floating or spudded barges will accomplish site preparation for the marginal wharf. The storage area at the marginal wharf will be formed by backfilling rock excavated from the Project site area.

Construction of the facility will be with pre-cast concrete caissons. The first phase of their construction will take place at a temporary location, most likely on land at an existing launching yard in the Strait of Canso. Partially completed caissons will be floated into place where the top lifts will be completed. Their placement will be on a granular mattress placed on the seabed at such location to provide the required draft for vessels. This will eliminate the need to dredge and dispose of seabed materials. The area behind the cribs will be filled with filter layers of granular material (stone); from coarse at the bottom to smaller size at top to above the tidal zone. This material will be placed from land, working seaward to the cribs. Due to the heavy loading from the storage facilities, the subgrade has to be well constructed. Till may be used for fill up to the top of subgrade at the inland area. The subgrade will be followed with base material before asphalt paving.

Silt curtains and booms will be used during construction to minimize siltation in the marine environment. A section and profile of the wharf construction is shown in Figure 2.4-3.

2.4.3.9 Shoreline Stabilization

Shoreline stabilization will occur utilizing traditional methods of erosion control and placement of armour rock protection in the areas where at risk shoreline is identified. An erosion and sedimentation control plan will be developed to reduce the sites soil and erosion potential and implement best management practices. This plan will include the establishment of protection measures during site development; permanent protection measures; and, a maintenance program to ensure the effectiveness of the erosion and sedimentation control plan.

Mitigative measures will be undertaken to minimize the potential for erosion and siltation of the nearby streams and waterfront from site runoff while soils are exposed and unstable, and from movement of construction vehicles. These measures will be specified in erosion and sediment control procedures to be included in the Environmental Protection Plans (EPP). In general, these measures will be consistent with NSEL guidelines (NSEL, 1988). Any shoreline areas that do need protection will have typical armour stone protection designed and placed using conventional methods.

2.4.3.10 Equipment Installation

Process towers and reactors, storage tanks, pipelines, gas turbines and all ancillary equipment will be installed to complete the Petrochemical facilities. Utilities and plant services such as water and wastewater treatment units, power supply, and steam will be constructed. Buildings will be erected for site administration and maintenance and processing.

2.4.3.11 Transportation of Construction Material (mode; quantities; source/destination)

Throughout the construction period, deliveries of equipment (both site preparation machinery and materials plus Project component elements) will be delivered by marine transport to the Goldboro Wharf using the self unloading vessels as well as floating barges or scows under tow.

2.4.3.12 Management of Surface Water (creek diversion; treatment; discharge points)

A small intermittent watercourse traverses the northeast corner of the site in the area of the petrochemical plant. A 15 m buffer will be placed on the watercourse for its protection.

FIGURE 2.4-3 A Section and Profile of the Marginal Wharf Construction

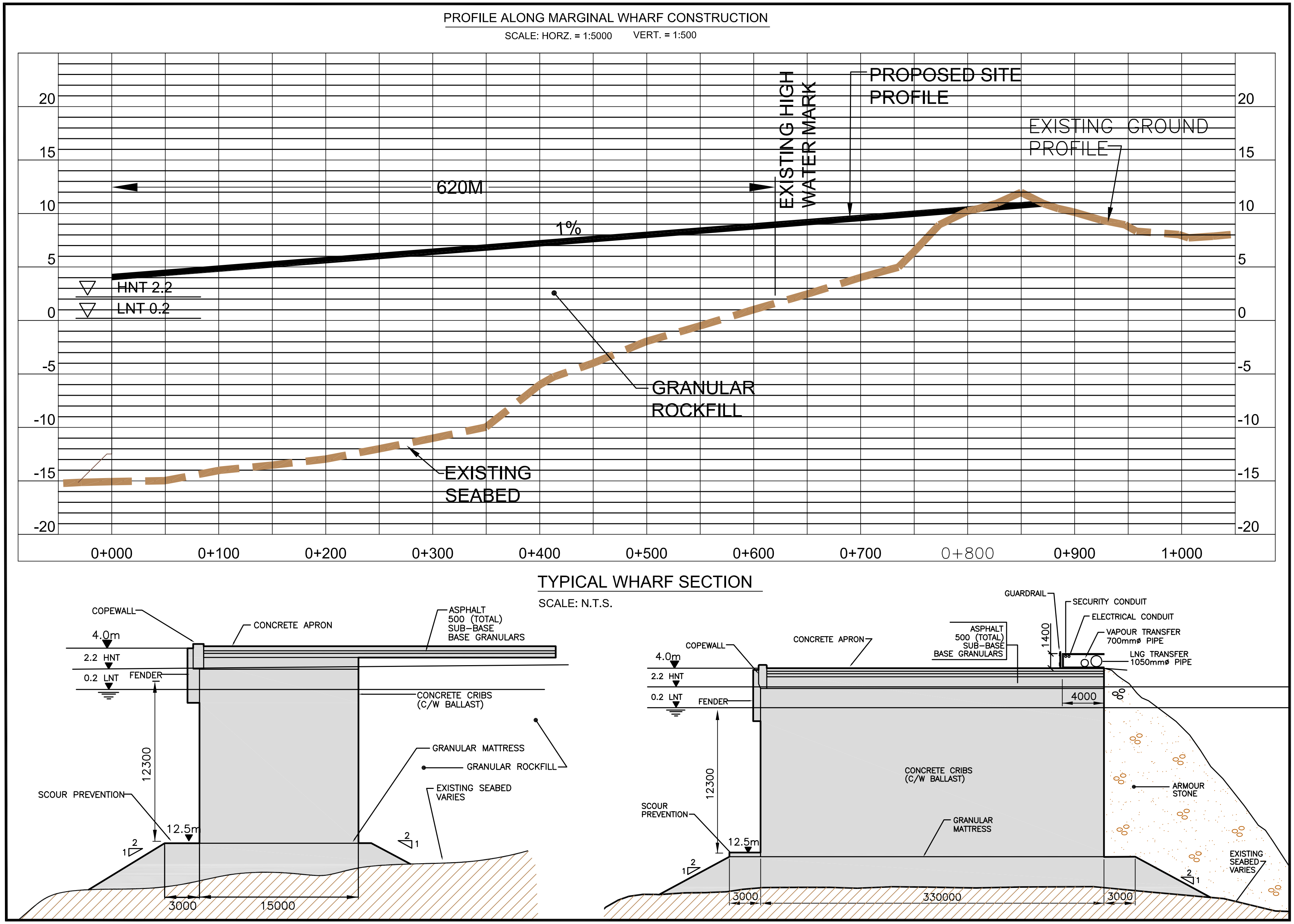


FIGURE No. 2.4-3

KELTIC PETROCHEMICALS INC.

A SECTION AND PROFILE ALONG MARGINAL WHARF

JULY 2006

2.4.3.13 Management of Waste Water (treatment; discharge points)

Sanitary wastewater generated from Project operations will be treated to comply with the regulatory requirements prior to discharge. A variety of liquid wastes will be generated during construction, including oils and lubricants from equipment, and wastewater *(i.e.* site runoff, sewage). Storm-water management controls such as sedimentation ponds and site drainage ditches would be constructed at the site and will be controlled through the EPP. Sanitary wastewater will be treated onsite using a packaged sanitary wastewater treatment unit approved under relevant regulations and guidelines. Discharges to the Isaac's Harbour at a location south of Dung Cove will be monitored for compliance with existing regulations under the EPP.

A Spill Management Plan and Emergency Response and Contingency Plan will be developed and implemented to minimize the chances of a spill reaching any water body including groundwater, and also include mitigation measures to minimize impact if a spill does occur and reach a water body. In order to minimize, contain, and control any potential releases of hazardous materials, a site-specific Spill Management Plan will be developed. All staff will be appropriately trained in the handling, storage, and disposal of hazardous materials (*i.e.* WHMIS, TDG). Chemical storage and handling will be done in accordance with the manufacturers' recommendations and federal and provincial regulations, where applicable.

2.4.3.14 Management of Contaminated Soils

In general, the site is considered to have a low risk of contaminated soils as it is and has been largely undeveloped. However, the site contains areas of suspected and known mine tailings from historic mining activities. These tailings have levels of arsenic and mercury above CCME criteria (see Section 8.13.4). Following site clearing, these areas will be delineated and overlain with the Project's grading plans to determine whether avoidance is possible.

Where avoidance is not possible, The PMC will prepare a management plan for the material which will consider the suitability of isolating the tailings on site in fill areas or berms using a human health risk assessment approach; stabilization; and excavation and disposal at a facility approved to accept material. Samples of rock from rock excavation areas will be tested to determine its acid generating potential prior to construction. If acid generating rock is found to exceed regulatory volume levels (500 m^3) a management plan for the rock will be developed for approval by NSEL.

All attempts will be made to prevent or reduce the discharge of pollutants to storm-water from contaminated soil and highly acidic or alkaline soils by conducting pre-construction surveys, inspecting excavations regularly, and remediating contaminated soil promptly. A Spill Management Plan and Emergency Response and Contingency Plan will be developed to avoid impacts from release of potentially hazardous materials during contract works. Contaminated soils that cannot be treated onsite must be disposed of offsite by a licensed hazardous waste hauler.

2.4.3.15 Site Rehabilitation (temporarily used sites)

As part of the Keltic EPP, the decommissioning of temporarily used sites will be managed per established procedures and safeguards established within the EPP. Decommissioned sites shall be reclaimed in a manner that minimizes and mitigates impacts upon the environment and complies with applicable regulations.

Decommissioned sites shall be evaluated for potential contamination. Analysis will be appropriate to the past and present conditions associated with the environment. Assessment to determine potential contamination will be conducted by a qualified person. Site reclamation criteria will be established in accordance with Project and regulating body requirements. Records of remediation projects will be maintained as part of quality records.

2.4.3.16 Schedule

The construction period to commissioning of the Project is expected to take 36 months. The schedule is broken down into four categories as shown in Figure 2.4-1. It is noted on the Bar Chart that certain phases of the Project are underway. In order to provide a Project definition, specific activities, including selection of licensors/technology, contracts for LNG and feedstock supply, field work for the EA and pre-FEED activities, to name a few, have been initiated.

Construction of the Project facilities is expected to occur year around for some work, utilizing the more favourable construction season to undertake most of the work. Most work would be scheduled to occur during a single shift consisting of 40 hours per week. There are likely to be some critical path items that will require additional shifts

2.4.3.17 Commissioning, Start-Up and Training

Prior to plant start-up, all systems will be commissioned to correct deficiencies and adjust the operating parameters to optimize performance. Acceptance testing will be completed on equipment to ensure that it meets the engineering specifications, including environmental controls. Operating staff will be trained on the equipment controls. This phase is conducted in the presence of engineers and technical specialists representing the owner, contractor, and equipment suppliers.

2.4.3.18 Labour Requirements

The labour force will be comprised of a myriad of skilled trades and professionals, ranging from manual labour through artisans, marine support personnel (captains, crew, and operators), superintendents, project engineers and managers, security and administration. During the construction phase of the Project the supporting labour force should peak in the area of 4700 people. Table 2.4-1 gives an indication of the expected workforce and Figure 2.4-4 presents the projected employee statistics.

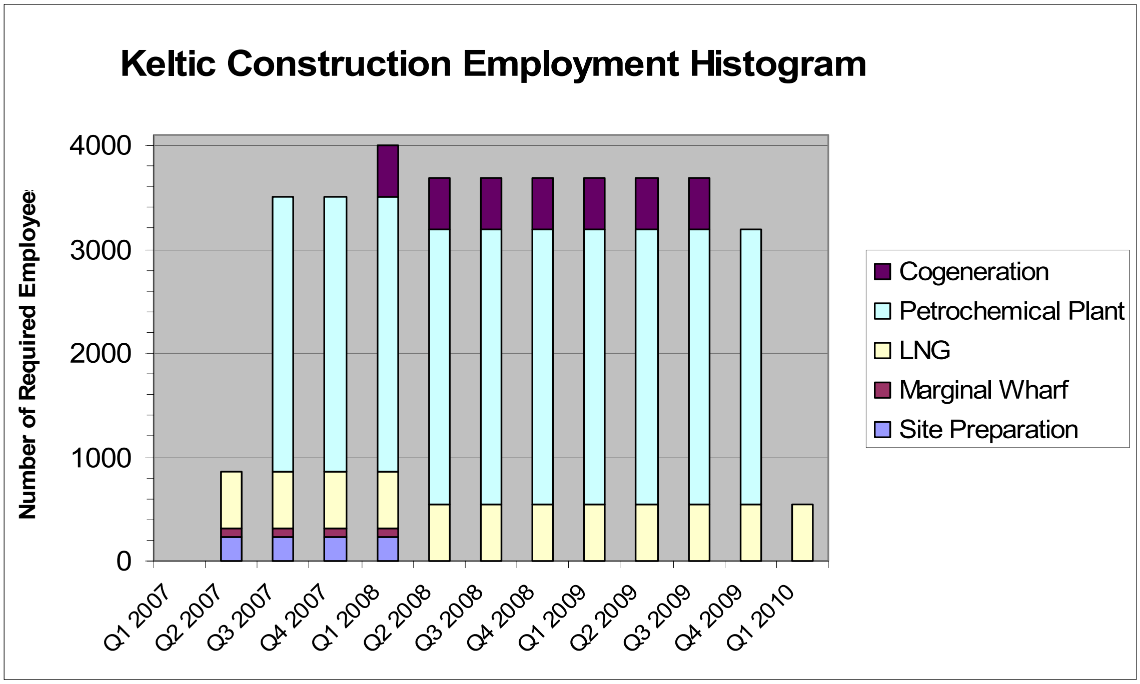
TABLE 2.4-1 KELTIC - Employment During Construction

Position	Wharf	LNG Plant	Tanks	polypropylene Plant	polyethylene Plants	Ethylene	Cogeneration	Total
Direct								
Construction Management	9	26	7	10	72	31	30	185
General Contractor Management	2	10	6	10	72	31	10	141
Insulation/painting		11		13	91	39	20	174
Pipe fitters	1	33	17	69	412	177	153	862
Welders	3	23	17	44	294	126	61	568
Electricians		44	26	27	181	78	45	401
Structural Iron Workers		26	26	9	60	26	10	157
Piling		30						30
Crane Operators	3	2	10	4	23	10	2	54
Concrete Finishers	5	10		8	42	18	16	99
Laborers/misc	31	67	51	16	104	45	54	368
Iron workers	9	7	34	10	69	30	17	176
Carpenters	25	35	26	22	121	52	51	332
Heavy Equipment Operators	5							5
Bricklayer				4	28	12		44
Millwrights		7		12	19	34	30	102
Boilermaker				17	15	50		82
Route 316 Realignment (Appendix A)								305
Site Preparation (Appendix B)								210
Offsites and Utilities (Appendix C)								249
Support Services (Appendix D)								229
Total	**93**	**331**	**219**	**275**	**1603**	**759**	**499**	**4772**

2.4.3.19 Malfunctions and Accidents (spills; truck accidents)

To minimize, contain and control any potential releases of hazardous materials (hydraulic hose burst, vehicle collisions, etc.) a site-specific Spill Response Strategy will be developed within the Spill Management Plan. All staff will be appropriately trained in the response. All staff will be appropriately trained in the handling, storage, and disposal of hazardous materials (*i.e.* WHMIS, TDG). Chemical storage and handling will be done in accordance with the manufacturers' recommendations and federal and provincial regulations, where applicable. On-site safety measures include: leak alarms; emergency shutdown systems; spill containment and personnel training programs that will be developed.

FIGURE 2.4-4 Projected Employment Statistics



A traffic management plan will be established under the umbrella of the EPC Contractor's Health & Safety and Security Program. This program will be developed to ensure personnel and asset safeguard against planned or unintentional anomalies. Controls will be in place to ensure coordination of onsite emergency services, civil response authorities, and incident record management.

2.4.4 Cogeneration Power Plant

This is a power plant incorporating gas turbines and heat recovery steam generators that will be constructed to provide power to the facility which will be located ISBL. The power plant will be developed in 2 phases:

- Phase I – to meet LNG terminal and regasification power demand of 16 MWe; and
- Phase II- to meet total facility, power demand of 180 MWe.

In Phase I the plant will be possibly composed of two GE LM2500 gas turbine units, where in Phase II the configuration could be 4 x GE6000 or 2 x GE Frame 7 turbines. The configuration of the mature facility will be further developed within the FEED process.

2.4.4.1 Construction Envelope

Designated temporary material storage and lay-down areas will be established within the land based development envelope. Access to the construction area will be controlled according the Project EHSS security plan, the site will be enclosed and remain under the responsibility of the

Cogeneration Plant contractor, in compliance with established plant Project plans and procedures.

2.4.4.2 Site Preparation /Clearing/Grubbing

The site development plan and EPP will outline the BMPs to be employed in site preparation. Existing site characteristics such as vegetation, environmental features, and areas of historic contamination (natural and/or industrial or agricultural) will also be recorded on the Project layout. Soil laboratory analysis may be required should prior contamination be suspected. The selection and implementation of construction BMPs will be affected by what existing features need to be protected or mitigated during construction. Those practices will include as a minimum:

- control of erosion, and discharge of sediment;
- manage non-storm-water discharges and materials; and
- waste management and materials pollution control.

2.4.4.3 Fencing

Construction fencing will be provided to delineate work areas and protect sensitive areas from encroachment by construction activities, if appropriate, and as well in delineating work zones. Fencing will be placed around all protected areas during initial site preparation, even before the access roads are fully constructed and before wholesale earthmoving begins. Fencing material should be easy to see, and areas should be labelled as to purpose (protected area, contractor work area, etc.). Fencing will be required as an enclosure for Project activity as stipulated in the site security plan.

2.4.4.4 Lighting

The construction site will be provided with overhead construction lighting which will comply with Occupational Health and Safety Regulations and NSEL standards. The quantity and quality of lighting will be sufficient to ensure the provision of illumination is sufficient for the type of work and the area in which the work is being done. Emergency lighting will be provided as necessary.

2.4.4.5 On-shore Cut and Fill, Blasting

All on-shore site development (cut and fill operations) will be planned and conducted in accordance with the guidelines as provided in Nova Scotia *Occupational Health and Safety Act*, S.N.S. 1996, c. 7 and as directed in the Project's EPP and site development plan. As relating to the cogeneration plant any additional site modification will be accomplished according to NSEL guidelines, policies and requirements and in compliance with the respective divisions of the *Occupational Health and Safety Act* and the EHSS policy requirements, ensuring the protection of the environment including personnel safety and security. A pre-blast survey of structures within a designated radius of the blasting site including wells, foundations, et cetera, any of which that may experience damage or impact due to seismic vibrations or air concussion, will be conducted according to the established EPP.

2.4.4.6 Foundations

During the FEED phase, the PMC will determine the most suitable site for installation of the cogeneration facility and all site grades and surfaces will be prepared. Foundations preparations for the cogeneration plant facilities will be the responsibility of the specific contract. All foundation works will be accomplished according to the site development plans, the site established EPP, EHSS policies, and all appropriate provincial and federal requirements and statutes. All materials will meet established site codes and standards. Any changes or modifications to initial foundations will be cleared and covered over to the existing grade and reseeded.

2.4.4.7 Transportation of Construction Material (mode; quantities; source/destination)

During the construction period, deliveries of equipment, materials, and consumables will be delivered either by marine or by using the surface roads. Each contractor is responsible for the safe delivery and storage of those products necessary in completing their area of the works, and as such is responsible for observing all Nova Scotia highway regulations and restrictions. It is expected that all high volume products will be delivered by marine transport and maintained in the contractors lay-down or staging areas. Surface transport to those areas will be over the prepared access road network.

2.4.4.8 Management of Surface Water (treatment; discharge points if applicable)

All surface water will be managed according to the ‘Water Management Plan.’ Treatment and discharge of surplus surface waters generated or accumulated within specific contract work areas will be the responsibility of the specific area contractor. The Contractor will be held accountable by the PMC for deviations form established water control plans.

All Company installed controls (culverts, ditches, dykes, settlement ponds, embankments, etc.) that are within contract area works or staging/lay-down areas will be maintained by the specific area contractor and will be monitored through the site EHSS management process. All surface water control measures established by the Company will be appropriately maintained for full NSEL compliance.

2.4.4.9 Management of Waste Water (treatment; discharge points if applicable)

Sanitary wastewater generated from Project operations will be treated to comply with the regulatory requirements prior to discharge. A variety of liquid wastes will be generated during construction, including oils and lubricants from equipment, and wastewater *(i.e.* site runoff, sewage). Storm-water management controls such as sedimentation ponds and site drainage ditches would be constructed at the site and will be controlled through the EPP. Sanitary wastewater will be treated onsite using a packaged sanitary wastewater treatment unit approved under relevant regulations and guidelines. Discharges to the Isaac’s Harbour at a location south of Dung Cove will be monitored for compliance with existing regulations under the EPP.

A Spill Management Plan and Emergency Response and Contingency Plan will be developed and implemented to minimize the chances of a spill reaching any water body including groundwater, and also include mitigation measures to minimize impact if a spill does occur and reach a water body. In order to minimize, contain, and control any potential releases of hazardous materials, a site-specific Spill Management Plan will be developed. All staff will be appropriately trained in the handling, storage, and disposal of hazardous materials (*i.e.* WHMIS, TDG). Chemical storage and handling will be done in accordance with the manufacturers' recommendations and federal and provincial regulations, where applicable.

2.4.4.10 Management of Contaminated Soils

In general, the site is considered to have a low risk of contaminated soils as it is and has been largely undeveloped. However, the site contains areas of suspected and known mine tailings from historic mining activities. These tailings have levels of arsenic and mercury above CCME criteria (see Section 8.13.4). Following site clearing, these areas will be delineated and overlain with the Project's grading plans to determine whether avoidance is possible.

Where avoidance is not possible, The PMC will prepare a management plan for the material which will consider the suitability of isolating the tailings on site in fill areas or berms using a human health risk assessment approach; stabilization; and excavation and disposal at a facility approved to accept material. Samples of rock from rock excavation areas will be tested to determine its acid generating potential prior to construction. If acid generating rock is found to exceed regulatory volume levels (500 m^3) a management plan for the rock will be developed for approval by NSEL.

All attempts will be made to prevent or reduce the discharge of pollutants to storm-water from contaminated soil and highly acidic or alkaline soils by conducting pre-construction surveys, inspecting excavations regularly, and remediating contaminated soil promptly. A Spill Management Plan and Emergency Response and Contingency Plan will be developed to avoid impacts from release of potentially hazardous materials during contract works. Contaminated soils that cannot be treated onsite must be disposed of offsite by a licensed hazardous waste hauler.

Transportation and storage of contaminated soils will comply with the Nova Scotia Dangerous Good Management Regulations and *Transportation of Dangerous Good Act* and Regulations. Only provincially licensed haulers will be used.

2.4.4.11 Site Rehabilitation (temporarily used sites)

Upon completion of activities at temporary sites all surface structures will be dismantled and removed from the site. Disturbed areas will be landscaped and re-vegetated as necessary. Solid waste will be disposed of in an approved manner, and hazardous waste will be collected for disposed in accordance with the established waste management plan.

2.4.4.12 Schedule

The construction period to commissioning of the Project is expected to take 36 months. The schedule is broken down into four categories as shown in Figure 2.4-1. It is noted on the Bar Chart that certain phases of the Project are underway. In order to provide a Project definition, specific activities, including selection of licensors/technology, contracts for LNG and feedstock supply, field work for the EA and pre-FEED activities, to name a few, have been initiated.

Construction of the Project facilities is expected to occur year around for some work, utilizing the more favourable construction season to undertake most of the work. Most work would be scheduled to occur during a single shift consisting of 40 hours per week. There are likely to be some critical path items that will require additional shifts.

2.4.4.13 Labour Requirements

The anticipated labour force is discussed in Section 2.4.3.18.

2.4.4.14 Malfunctions and Accidents (spills; truck accidents)

As a means to minimize, contain and control potential releases of environmental contaminants, both a site specific Emergency Response and Contingency Plan will be developed based on CSA Standard CAN/CSA Z731-03. All personnel will be appropriately trained in the applications of first response measures and emergency communication requirements. A traffic management plan will be established under the umbrella of the PMC Contractor's EHSS Program. This program will be developed to ensure personnel and assets are safeguarded against deliberate or unintentional anomalies.

2.4.5 Utilities and Common Site Support (incl. Meadow Lake Water Supply)

Utilities, infrastructure, and support systems dedicated for the LNG facility will consist of:

- PLC based control system;
- emergency shutdown system;
- hazard detection system;
- security system and facilities;
- fire response system;
- natural gas vent;
- plant air, instrument air and nitrogen systems;
- electric power distribution and control systems;
- storm-water system;
- two control building, one for the process and one for berthing of tankers;
- access roadways and service buildings;
- fire and emergency access roads;
- service water and drinking water systems (Meadow Lake Impoundment);
- administration and service buildings; and
- sanitary wastewater system.

The following process buildings will also be provided on site:

- BOG compressor shelter;
- main electrical substation building;
- jetty electrical substation building; and
- firewater pump house, as well as.

Access roads will be provided for operation, maintenance and fire and emergency vehicles.

2.4.5.1 Construction Envelope

Construction activities required to accommodate the Utilities and support systems preparation and erection will include:

- land clearing with merchantable timber and residual material (hog fuel) salvaged including the flooded area of the Meadow lake watershed;
- general earth grading (till and rock) to prepare uniform site with excess material stocked piled;
- surface water drainage with erosion and sedimentation control (silt fences, ditch checks, siltation ponds, hydroseeding etc.);
- temporary fencing, service roadways, construction parking and site including lay down areas;
- concrete construction including temporary concrete batching plant;
- portable asphalt batch plant for roadway and site surfacing;
- stream crossing structures;
- building construction and parking spaces;
- raw water impoundment, intake and water transmission main;
- process facilities (petrochemical, LNG regasification and demethanization, raw water and wastewater treatment);
- electrical generation works;
- pipe lines, marine works (LNG terminal and marginal wharf);
- permanent fencing and security systems and;
- wastewater outfall.

These activity will be required both ISBL and OSBL, and as well in the neighbouring communities of the Keltic Project site. At each active construction site and associated laydown area, fencing and security will be employed in accordance with Company Health & Safety and Security programs.

2.4.5.2 Site Preparation/Clearing/Grubbing

Site preparation, clearing and grubbing will be undertaken within specific demarcated development envelopes. The overburden soils will be retained on site for use in berms and landscaping. The underlying rock will be levelled to working grade. This may involve some blasting, heavy excavation equipment, crushing, and screening depending on specific site requirements. Samples of rock from rock excavation areas will be tested to determine its acid generating potential prior to construction. If acid generating rock is found to exceed regulatory volume levels (500 m^3) a management plan for the rock will be developed for approval by NSEL.

2.4.5.3 Fencing

Construction fencing will be provided as a means of security and as well in delineating work zones. A perimeter enclosure will be installed as a means of protection and security for all general work sites that are open to public access during initial site preparations, even before the access roads are fully constructed and before wholesale earth work begins. Fencing material should be easy to see, and areas should be labelled as protected areas. Fencing will be required as an enclosure as stipulated in the site security and Health & Safety programs. The Company security plan will identify locations of work sites, types of acceptable enclosure and responsibilities in meeting the intent of the regulations will be developed prior to commencement of activities.

2.4.5.4 Lighting

Construction lighting will be maintained in compliance with the Nova Scotia *Occupational Health and Safety* Act, lighting must be adequate for the work being conducted, emergency lighting is to be provided as necessary at all work sites. In general, high mast lighting for area illumination is proposed, but that will depend upon application. All area lighting will most likely be photocell controlled, and pointed downward wherever practical. All fixtures will be approved for the area classification in which they are installed.

2.4.5.5 On-shore Cut and Fill, Blasting (if applicable)

All excavations (cut and fill operations) will be planned and conducted in accordance with the guidelines as provided in Nova Scotia *Occupational Health and Safety Act*, S.N.S. 1996, c. 7. The overburden soils will be retained on site for use in berms and landscaping, the underlying rock will be levelled to working grade. The activities will involve some blasting, heavy excavation equipment, crushing, and screening. A qualified company will conduct all blasting.

The blasting subcontractor is responsible for blast designs and methods in accordance with the General Blasting Regulations made pursuant to the *Nova Scotia Occupational Health and Safety Act*. Blasting activity will be conducted in accordance with the Pit and Quarry Guidelines. A blast design will be prepared and submitted to NSEL. A pre-blast survey of all residences and wells within 800 m of the proposed modification boundary will be undertaken, as required. Blasting agents will not be stored within Company controlled areas. Storage and selection of blasting agents will be the responsibility of the blasting contractor.

Mitigative measures will be undertaken to minimize the potential for erosion and siltation of the nearby streams and waterfront from site runoff while soils are exposed and unstabilized and from movement of construction vehicles. These measures will be specified in erosion and sediment control procedures to be included in the Environmental Protection Plans (EPP). In general, these measures will be consistent with NSEL guidelines (NSEL, 1988). Any shoreline areas that do need protection will have typical armour stone protection designed and placed using conventional methods.

2.4.5.6 Foundations

Foundations will be installed for major equipment and buildings. Underground services will be installed according to Project plans. All foundation activity will be accomplished according to the Project development plans, maintaining Company EPP and EHSS policies and all appropriate provincial and federal requirements and statutes. All materials will meet established site codes and standards. Any changes or modifications to initial foundations will be cleared and covered over to the existing grade and reseeded.

2.4.5.7 Shoreline Stabilization (if applicable)

Four (4) methods will be considered in providing shoreline stabilization or shoreline erosion control, specifically within the Meadow Lake area. According to BMP and company EPP these will involve either: 1) non-structural and preventative measures; 2) structural; 3) bioengineering; or 4) biotechnical processes. Choosing what erosion control method will work best for a particular segment of shoreline will be accomplished through the FEED and design development stages of the Project development. The NSDE&L “Erosion and Sedimentation Control Handbook for Construction Sites” will be followed and the plans submitted to NSDE&L for review and approval.

2.4.5.8 Meadow Lake Dam Construction

In order to facilitate the construction of the dam and fishway, the outlet of Meadow Lake will be diverted around the construction area to allow the work to be completed ‘in the dry’. The diversion can either be a plastic or rock lined channel depending on the approval requirements from NSEL and DFO. Staging and fish rescue requirements will be reviewed with DFO prior to the construction of the diversion. A coffer dam will be constructed to isolate the work area of the dam and fishway from Meadow Lake. Water that is accumulating in the work area will be pumped to vegetated area away from Isaac’s Harbour River or if space is limited, pumped to a filter bag. Mechantible timber as well as brush will be cleared within the area to be flooded prior to commissioning of the dam and fishway.

2.4.5.9 Transportation of Construction Material (mode; quantities; source/destination)

During the construction period, deliveries of equipment, materials and consumables will be delivered either by marine transport (for highway sensitive (size, volume or weight) products and equipment), or by using the surface road structure. Each contractor is responsible for the safe delivery and storage of those products necessary in completing their area of the works, and as such is responsible for observing all Nova Scotia and regional highway regulations and restrictions. It is expected that all high volume products will be delivered by marine transport and maintained in the contractors lay-down or staging areas. Surface transport to those areas will be over the prepared access road network.

2.4.5.10 Management of Surface Water (creek diversion; treatment; discharge points)

All surface water will be managed according to the Company 'Water Management Plan'. Treatment and discharge of surplus surface waters generated or accumulated within specific contract work areas will be the responsibility of the specific area contractor. The Contractor will be held accountable for deviations form established water control plans.

All Company installed controls (culverts, ditches, dykes, settlement ponds, embankments, etc.) that are within contract area works or staging/lay-down areas will be maintained by the specific area contractor and will be monitored through the site EHSS management process. All surface water control measures established by the Company will be appropriately maintained for full NSEL compliance.

2.4.5.11 Management of Waste Water (treatment; discharge points)

Sanitary wastewater generated from Project operations will be treated, as necessary, to comply with the regulatory requirements prior to discharge. A variety of liquid wastes will be generated during construction, including oils and lubricants from equipment, and wastewater *(i.e.* site runoff, sewage). Storm-water management controls such as sedimentation ponds and site drainage ditches would be constructed at the site and will be controlled through a Storm and Waste Water Management Plan. Sanitary wastewater will be treated onsite using a packaged sanitary wastewater treatment unit approved under relevant regulations and guidelines.

A Spill Management Plan and Emergency Response and Contingency Plan will be developed and implemented to minimize the chances of a spill reaching any waterbody including groundwater, and also include mitigation measures to minimize impact if a spill does occur and reach a waterbody. In order to minimize, contain, and control any potential releases of hazardous materials, a site-specific Spill Management Plan will be developed. All staff will be appropriately trained in the handling, storage, and disposal of hazardous materials (*i.e.* WHMIS, TDG). Chemical storage and handling will be done in accordance with the manufacturers' recommendations and federal and provincial regulations, where applicable.

2.4.5.12 Management of Contaminated Soils (excavation & disposal; isolation)

All attempts will be made to prevent or reduce the discharge of pollutants to storm-water from contaminated soil and highly acidic or alkaline soils by conducting pre-construction surveys, inspecting excavations regularly, and remediating contaminated soil promptly. A Spill Management Plan and Emergency Response and Contingency Plan will be developed to avoid impacts from release of potentially hazardous materials during contract works. Contaminated soils that cannot be treated onsite must be disposed of offsite by a licensed hazardous waste hauler. The presence of contaminated soil may indicate contaminated water as well.

Transportation and storage of contaminated soils will comply with the Nova Scotia Dangerous Good Management Regulations and *Transportation of Dangerous Good Act* and Regulations. Only provincially licensed haulers will be used.

2.4.5.13 Site Rehabilitation (temporarily used sites)

Upon completion of activities at temporary sites all surface structures will be dismantled and removed from the site. Disturbed areas will be landscaped and re-vegetated as necessary. Solid waste will be disposed of in an approved manner, and hazardous waste will be collected for disposed of in accordance with the established EPP.

2.4.5.14 Schedule

The construction period to commissioning of the Project is expected to take 36 months. The schedule is broken down into four categories as shown in Figure 2.4-1. It is noted on the Bar Chart that certain phases of the Project are underway. In order to provide a Project definition, specific activities, including selection of licensors/technology, contracts for LNG and feedstock supply, field work for the EA and pre-FEED activities, to name a few, have been initiated.

Construction of the Project facilities is expected to occur year around for some work, utilizing the more favourable construction season to undertake most of the work. Most work would be scheduled to occur during a single shift consisting of 40 hours per week. There are likely to be some critical path items that will require additional shifts

2.4.5.15 Labour Requirements

An assessment of the Project's potential impact on the Nova Scotia labour market will be undertaken through an examination of the supply capabilities of the Nova Scotia labour force in relation to Project requirements. A likely supply of personnel would depend on the ability of the Nova Scotia labour force to meet Project-specific demands, as they arise. Precedence shall be given to qualified and competitive regional, provincial, and Atlantic Canada labour markets in meeting personnel requirements. Labour is assumed to be performed outside Nova Scotia only when it appears that the skills required are currently not available within the province, cannot be competitively provided or if the imported labour requirement is likely due to special purpose equipment for which the manufacturer would require some portion of its own work force.

2.4.5.16 Malfunctions and Accidents (spills; truck accidents)

As a means to minimize, contain, and control potential releases of environmental contaminants, both a site specific Emergency Response and Contingency Plan will be developed reference the CAN/CSA Z731-03 standard. All personnel will be appropriately trained in the applications of first response measures and emergency communication requirements. A traffic management plan will be established under the umbrella of the EPC Contractor’s Health & Safety and Security Program. This program will be developed to ensure personnel and asset safeguard against deliberate or unintentional anomalies.

2.5 PROJECT OPERATION

2.5.1 Facility Overview

The following is an overview of the Project operations, consisting of the following components:

- LNG facility;
- cogeneration plant; and
- petrochemical facility.

A simplified block flow diagram is provided as Figure 2.3-2. The general facility layout is presented in Figures 2.0-1A and B.

2.5.2 Component Integration

2.5.2.1 Energy Efficiency

There are three major energy integration concepts inherent in the design of the facility and these associated with the:

- LNG extraction/regasification facility;
- ethylene unit; and
- power plant.

LNG Extraction/Regasification

Conceptually the "cold" (-160°C) available in the LNG feed to the extraction plant is used for reflux cooling while the "heat" available in the power plant flue gas is used for superheating recompressed natural gas prior to export into the pipeline. Additionally this power plant waste heat will provide heat to the extraction plant distillation column reboilers. This low quality waste heat from the power plant is recovered in an ethylene glycol recirculating loop.

Ethylene Unit

The ethylene unit will have seven major pyrolysis furnaces for the cracking of ethane and propane. The radiant sections of the furnaces are used for pyrolysis while the convection sections are used for preheating of feedstocks, preheating of air and for superheating Super High Pressure (SHP) steam to 500°C at 107 kg/cm^2(g).

In addition to the heat recovery from the convection sections of the furnaces, the pyrolytic products from the furnaces are rapidly cooled in transfer line exchangers. In the first part of the transfer line exchangers quench exchanger heat is exchanged against boiler feedwater to generate SHP steam at 105-112 kg/cm^2(g). This SHP is then superheated as described above and is used for powering of the major steam turbine drives within the ethylene unit.

The ethylene unit is essentially a stand alone integrated energy system with most of the process equipment operating on steam turbine drives.

Steam is generated at:

- 107 kg/cm^2(g) (SHP);
- 42 kg/cm^2(g) (MHP);
- 10.5 kg/cm^2(g); and
- 3.5 kg/cm^2(g).

The SHP and MHP steam pressure levels are connected to steam turbine drives. The 10.5 kg/cm^2(g) and 3.5 kg/cm^2(g) steam pressure levels are used for process heating or steam tracing system.

The ethylene unit requires either SHP or MHP for start-up which is normally supplied from start-up boilers. For Keltic the plan is to use the power plant as the start-up boiler system.

Power Plant

The choice of power plant will be either combined cycle or cogeneration system. This decision will be made during the FEED phase of the Project.

A cogeneration unit is preferred but the optimum use of low level heat needs to be assessed in terms of the overall facility and possible users outside of the facility.

The most likely choice will be a combined cycle plant which is described in Section 2.5.11.2.

On the basis of a cogeneration unit the following description applies.

Cogeneration (Combined Heat and Power (CHP)) is the simultaneous production of electricity and heat, both of which are used. The central and most fundamental principle of cogeneration is that, in order to maximize the many benefits that arise from it, systems should be based upon the heat demand of the application. Through the optimum utilization of the heat, the efficiency of cogeneration plant can reach 90% or more. Cogeneration therefore offers energy savings ranging between 15-40% when compared against the supply of electricity and heat from conventional power stations and boilers (Figures 2.5-1 and 2.5-2).

2.5.2.2 Component Integration

Integration is a key factor in achieving operating cost reductions and is a key business driver for Keltic.

Energy integration has been described in Section 2.5.2 and represents a significant energy integration concept. However, process integration concepts also exist and will be defined below.

A fundamental requirement for the operation of the overall facility is that each component can operate independently with no time limit on such independent operation (i.e. LNG terminal power generation and utility supplies) in some cases.

However, other components of the facility are limited in their operating time by the amount of intermediate storage provided (i.e. the ethylene unit and polyolefin units).

Specific component integration concepts are:

- The ethylene unit will provide fuels (liquid and gaseous) and steam for use within the complex. High purity hydrogen is also provided to the polyolefin units.
- All of the polyolefin units will recycle purge gas containing ethylene and propylene to the ethylene unit.
- The complex has centralized systems for all utility supplies (i.e. power, steam, water, air, nitrogen, etc.).
- The complex has common emergency and emergency response system.
- The complex will have centralized training facilities. Operations and maintenance personnel will be rotated between units (especially polyolefins). The latter concept was one of the primary reasons for the selection of gas phase polyolefin units.

Overview and Schematic

ISLB & OSBL elevations will be influenced by the marginal wharf elevations as all access elevations to the wharf facilities will maintain the design slope of the marginal facility. Dimensions of main buildings and stacks (SCV, Cogeneration Exhaust, Cooling Tower, Petrochemical Facilities, etc.) are as follows:

- building height variable, but not more that two stories, expect for MTCE shop;
- each SCV will support it own emissions stack, which will be 12 to 15 m in height;
- cogeneration facility to be designed with one stack designed within SCV height limits, but could be modified to more stacks under further analysis;
- petrochemical furnace stack at 55 – 60 m height;
- fractionators and product strippers at 80 – 90 m heights;
- flare design heights between 100 to 25 m heights; and
- cooling tower height will be determined during the FEED.

FIGURE 2.5-1 Typical Cogeneration Scheme

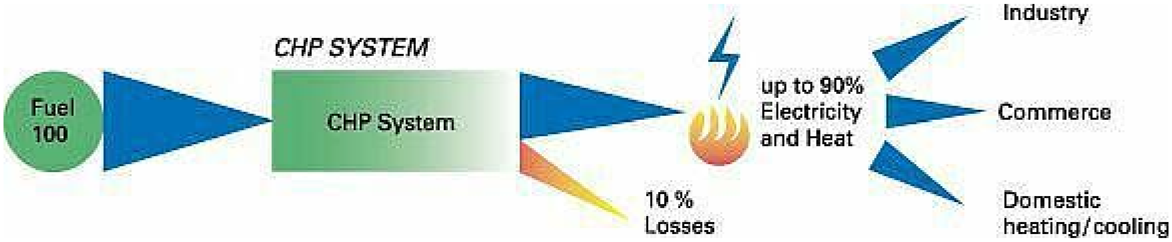


FIGURE 2.5-2 Typical conventional power generation scheme

2.5.3 Workforce

2.5.3.1 LNG Facility

The work force employed during the operations phase of the Project covering these activities should be in the neighbourhood of up to110 skilled professionals, technicians, and labourers. They will be composed of individuals ranging from chemical process operators, electrical engineering technicians, environmental technicians, fire station support personnel, cleaners, maintenance staff and janitors, dock workers, material handling personnel, ships crew and marine support personnel, administration including onsite security and miscellaneous support services. All personnel will be appropriately screened and familiarized with Project requirements through applications of the facility's Environment, Health, Safety and Security (EHSS) programs requirements.

2.5.3.2 Cogeneration Plant

As are all components of the product support processes the work for this facility will be ongoing continuously (24/7). The total number of personnel operating this portion of the complex would be in the area of 50 individuals mainly composed of process operators and mechanical and technical support personnel all involved in ensuring continual power generation.

2.5.3.3 Petrochemical Facility

This portion of the works during the operational phase of the Project will be composed of a myriad of process management personnel, each skilled in the production and operations activity involved in their product output. Over 60% of the staff will be involved in actual plant production activities where the other 40% will be accomplishing periphery support activities. The amount of personnel required for the operations of the petrochemical plant will be in the neighbourhood of 290 individuals.

2.5.4 Environmental Management Plan

The Environmental Management Plan will address the key elements of environmental management for each component of the Project, including the LNG facility, the cogeneration plant, and the petrochemical facility; for the life of each component. Performance criteria for all elements will be determined in the process of EMP development.

The EMP will include (as a minimum) the following components:

- establishment of agreed performance criteria and objectives in relation to environmental and social impacts. These should include measurable indicators and standards;
- detailed prevention, minimization and mitigation strategies or action programs (including design standards) for controlling environmental impacts at specific sites;
- details of the proposed monitoring of the effectiveness of remedial measures against the agreed performance criteria in consultation with relevant government agencies and the community;
- details of implementation responsibilities for environmental management;

- timing (milestones) of environmental management initiatives;
- reporting requirements and auditing responsibilities for meeting environmental performance objectives;
- corrective actions (as options) to rectify any deviation from performance standards; and
- scheduled review (audit) and periodic updates to ensure plan relevance.

2.5.5 Monitoring

Compliance and effects monitoring programs will be designed and implemented in order to determine the effectiveness of implemented mitigation measures envisaged throughout the life of the Project. The format of these monitoring programs and reporting methods will be developed to ensure consistency, accuracy, and expediency in report delivery. The effectiveness of the program will depend on ensuring that the workforce can identify and address potential impacts during construction and operation. This will be accomplished through continuous on site training and orientation programs given to employees during construction and operations of the facility.

The development of plans for applications of the compliance and effects monitoring shall include, but not be limited to: air quality monitoring; noise monitoring; surface water monitoring: pre-blast survey; and, groundwater and well water survey.

2.5.6 Health and Safety

As part of Best Management Practices and in compliance with NSEL Occupational Health and Safety Division requirements, a health and safety program will be initiated in order to promote a safe and healthy workplace (Section 28 of the *Occupational Health and Safety Act*). As a means to maintaining a safe and healthy environment and reducing the number and severity of workplace injuries and illnesses, this will include management of a system of ongoing: training, procedural documentation, inspections, reporting, safety record management, and evaluation.

This will cover the full range of on-site and off-site activities accomplished to fulfill the mandate of the process operations. Each contract/subcontract entity and employee will be held responsible in compliance with safety policy and procedures.

2.5.7 Training

A framework shall be developed for providing training and orientation to on site employees. This training may involve:

- promoting the primary responsibility of employers and employees to create safe and healthy workplaces through the use of safe work practices and suitable equipment.;
- the training and education of workers engaged in activities related to hazardous materials and waste generation, removal, containment, transportation and emergency response in compliance with the *Occupational Health & Safety Act* (i.e. WHMIS worker training program);

- educating of the workforce in identifying potential environmental effects during the various stages of construction and operations as well as effects monitoring; and
- utilizing the Workers' Compensation Board On-the-Job Programs offering training for workers that have been injured on the job.

2.5.8 Public Information/Community Liaison

Records of the results of public consultation and information sessions will detail what comments were raised, and how they were addressed, including any commitments made by the Company. The records will document the dates and formats for public consultation undertaken, the material presented to the public, the opportunity for receiving public input, the concerns expressed by the public and how these concerns were addressed. It will be made clear how the input from consultations was used in the assessment and what changes to the process or Project were made as a result of comments provided.

2.5.9 LNG Facility

2.5.9.1 Primary Components

The LNG facility consists of the following main activities and/or areas:

- marine terminal;
- LNG transfer lines;
- LNG storage;
- LNG process area;
- send-out gas metering; and
- nitrogen production facility.

A conceptual lay-out of the LNG facility is presented in Figure 2.0-1B.

The main visual components of the LNG facility are the LNG storage tanks. The tanks have an outer diameter of 80 m, a height of 38 m with a 9 m higher dome. In Figure 2.5-3 two pictures are presented of similar tanks under construction at the Dragon LNG terminal, Wales (United Kingdom (UK)).

During LNG unloading another main object is present: LNG carrier. A photo rendered by an artist of a similar situation at 4Gas' terminal under development in Rotterdam (LionGas facility). The photo has been taken from village Hoek van Holland, located approximately 1,400 m from the LionGas facility. The picture also includes three LNG storage tanks.

2.5.9.2 Process Description

LNG is unloaded from dedicated LNG carriers at one of the two berths at one conventional jetty via a set of unloading arms. Next, the LNG is transferred via LNG transfer lines along the jetty to the LNG storage tanks where it is stored. Via so called in-tank pumps LNG is transferred to the process area. At the process area, LNG is boosted to the required pressure lever for send-out purposes. Furthermore, part of the LNG can be extracted, in the extraction plant, for the generation of ethane and propane, as feedstocks for the adjacent petrochemical plant. Additionally to feedstock generation, extraction results in adjustment of the quality of LNG. For some imported LNG qualities this adjustment is required to meet the M&NP pipeline quality requirements, for other LNG qualities no adjustment is needed. Alternatively to extraction the LNG can be brought to pipeline specification by means of nitrogen injection.

In SCVs LNG is vapourized to the gaseous state and further sent out via a metering system to the M&NP.

2.5.9.3 Marine Terminal

<u>**LNG Delivery**</u>

The proposed LNG marine terminal will employ a conventional two-berth jetty in Isaac's Harbour. A preliminary plan of the terminal is shown in Figure 2.5-4.

The jetty location is sheltered within Isaac's Harbour, and therefore protected from the influence of ocean swells. Detailed bathymetric surveys of the proposed terminal location will be undertaken as part of the Project design and development phase. The scope of the survey will be developed to make certain any underwater hazards are identified and that bottom contours are well defined, especially at the berth and in the turning basin. The terminal will be located such that dredging is not anticipated.

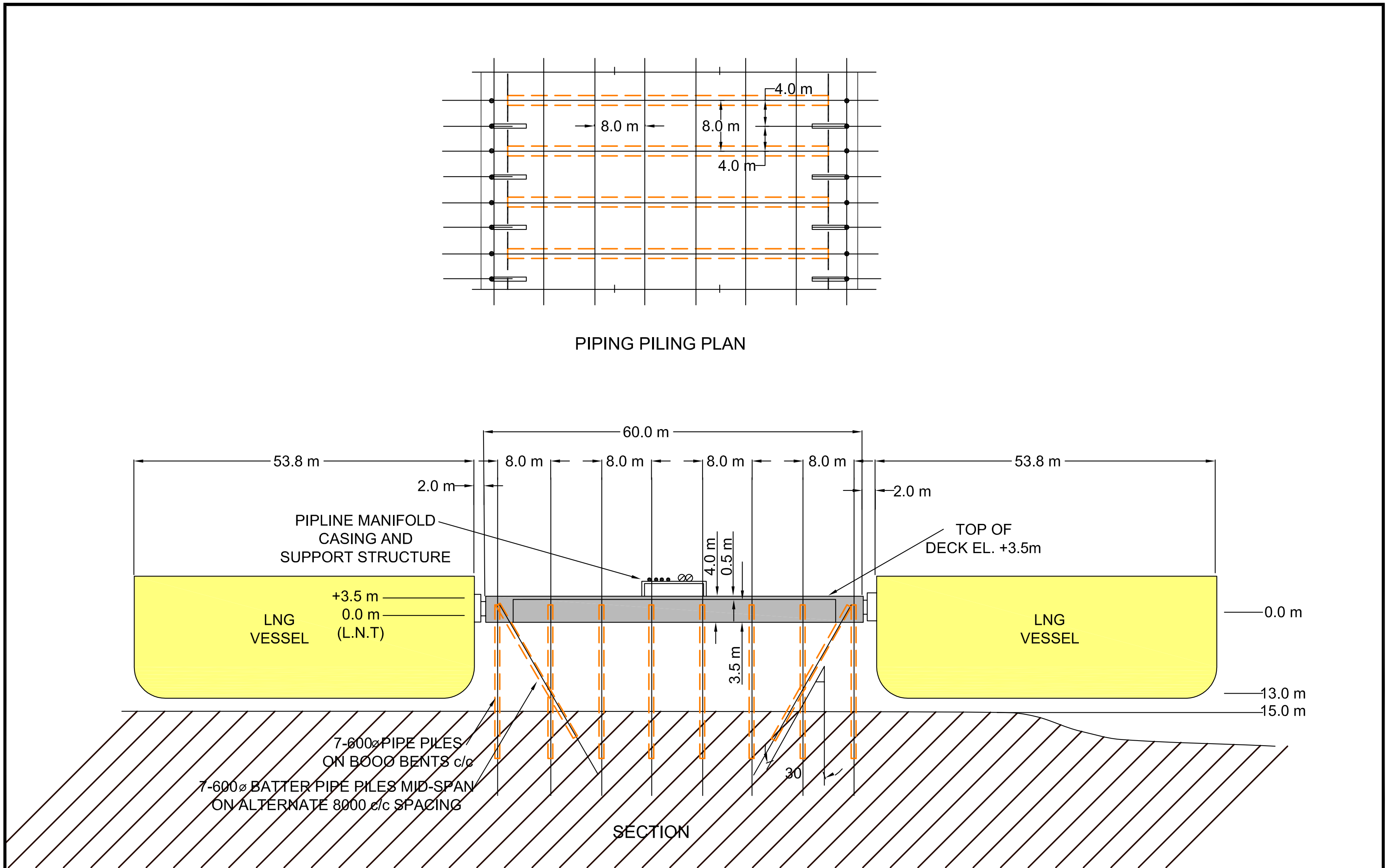
LNG tankers presently trading in the Atlantic Basin have a capacity in the range of 75,000 m^3 to 145,000 m^3. The current standard capacity for the LNG tanker fleet is 135,000 m^3 with a draft in the 13 m range. The berth arrangements will be flexible enough to accommodate the anticipated range of tankers in the market place now as well as in the future. The maximum capacity anticipated will be ships of 250,000 m^3 with a draft of approximately 13 to 14 m.

Technical Review Process of Marine Terminal Systems in Trans-shipment Sites (TERMPOL) regulations will be followed for the marine facilities. A simulation study for the navigability of Isaac's Harbour has been undertaken and was conducted by the Nova Scotia Community of College, Marine Institute, Port Hawkesbury, Nova Scotia. The arrival and departure of LNG vessels will be under the Atlantic Pilotage Authority Regulations. Tugboats and a pilot boat will be available. Navigation and berthing aids will be included.

The LNG transfer lines, cryogenic piping, and utility lines will be routed from the LNG terminal to the LNG storage tanks via a maintenance trestle connected to the marginal wharf. The trestle will also include vehicle access to the terminal for personnel and maintenance. The LNG will be unloaded into a ring main.

FIGURE 2.5-3 Typical LNG Tanks under construction at the Dragon LNG Terminal, Wales (UK)

FIGURE 2.5-4 Preliminary Plan of LNG Marine Terminal



Source: MacDonnell Group, Project No. 1080, Nov. 2005

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FIGURE No. 2.5-4

KELTIC PETROCHEMICALS INC.

PRELIMINARY PLAN OF LNG MARINE TERMINAL

JULY 2006

LNG vessels will arrive approximately every 3 to 4 days for 140,000 m^3 and 180,000 m^3 vessels respectively at the initial plant capacity.

Refuelling of Tankers

Refuelling of tankers and other transport and support vessels will not be done at the proposed Keltic facilities, or within the area of Isaac's Harbour.

Management of Bilge and Ballast Water

All ballasting activities will be accomplished in accordance with TC 'Ballast Water Control and Management Regulations', in agreement with the U.S. Coast Guard requirements and with the International Convention for the Control and Management of Ship's Ballast Water and Sediments. LNG vessels will be brought in fully loaded and reballasted offshore. Ballast water issues are not expected to arise under current navigational regulations.

Marine Traffic

The marginal wharf will serve as the port facility for loading and unloading of petrochemical by-products, process feed stocks and as a transport and containment vessel dockage facility. All service craft (tugs, pilot vessel, etc.) will be maintained either on their own secure moorings outside the bounds of the marginal wharf or possibly berthed along the northern face of the structure. Ship layover locations for transport vessels will be assessed for alternate moorings outside the boundaries of the LNG vessel traffic lanes and terminal. There will be no dredging required during the on-going operations.

At the two-vessel proposed output scenario (2 bcf/d vs. 1 bcf/d) assuming a lower end of tanker capacity of 160,000 m^3, one LNG tanker will arrive at the LNG terminal every 3.5 to 1.8 days. This will result in a total of 105 to 210 LNG tankers per year. This number can be marginally reduced if larger capacity LNG tankers (250,000 m^3) are made available. (5.4 to 2.7 days)

In support of the product output, marine traffic for the facility will include the trans-shipment of feedstocks, product components, and byproducts. These shipments will increase traffic levels somewhere in the neighbourhood of 200 additional vessels entering the port per year. This means a yearly traffic flow into the harbour of 300 to 400 LNG and product carriers. The total number of ships accessing the zone equals approximately half the number of moves presently managed through the pilot authority. This number does not include the movement of harbour tug, offshore and inshore fisheries vessels or vessels of less than 100 m length overall.

Navigation

All vessels arriving from deep sea enter Canadian Waters at the '12 mile limit' are required to report into Marine Communications and Traffic Services Eastern Canada Vessel Traffic Services Zone Regulators 24 hours before arriving at the 12-mile limit. In most cases, this means that Marine Communications and Traffic Services has information on the intended passage of vessels in excess of 200 miles from shore. Routing across the Atlantic and along the Nova Scotia coastline will bring the vessels to the proposed traffic control point outside of Isaac Harbour from different directions.

The proposed scheme will allow one lane for entry in the neighbourhood of the Light Whistle buoy #635 – TT (location east of Jarvis Bank, 45°02′15”N - 61°32′ 35” W) setting roughly 14.5 km outside the mouth of Isaac harbour and 3 km south of Country Island. It will be the proposed pilot boarding stations, from which all vessels, which require pilot assistance will initiate their entrance to Isaac Harbour facilities. This station as well as vessel parameters, exclusion zones or navigational restrictions (proximity and speed limits) controlling the movement of tankers and support vessels will be developed by harbour authorities in consultation with Atlantic Pilots Association, TC and the Canadian Coast Guard and will be a component of the established local Vessel Traffic System for the facility. All developed exclusion zones or navigation restrictions will be posted in the “Practices and Procedures” of the port authority as per the *Canada Marine* Act Section 56 (1) (b).

Although all product transfer vessels entering the harbour will be carrying the appropriate electronic aids to Navigation (i.e. Differential Global Positioning System (DGPS); Loran C; Radar and Racon Beacons; Radio Direction Finders: and Automated Information Systems), the addition of the appropriate buoys, lights and range markers will be made according to the Aids to Navigation Program administered under the direction of the Canadian Coast Guard. The Canadian Coast Guard will verify that the lights and shapes within the harbour and its approach meet the National Levels of Service Standards for all Canadian waters. These aids will be frequently reviewed and will be subject to public consultation. The current aids to navigation in the vicinity of Isaac’s harbour are sufficient for its current usage, but insufficient within the intent of this document.

During the FEED phase, every phase of the port transit will be analyzed with the express purpose of eliminating the credible probability of any ship sustaining serious hull damage. This will require an analysis of physical features of the transit – i.e. the approach channel, and the examination of associated port services, such as pilotage, tugs and harbour controls. Operational plans and procedures will be developed to ensure the safe transit, mooring, and discharge of product by the LNG carriers. These procedures will be part of the overall documented process control measures included within established safety and quality management systems. Tug size and numbers, speed of approach to the berth, telltale aids for berthing, mooring line arrangements, gangways and services will be included in the TERMPOL Review Process.

LNG vessel navigation and docking procedures for the Keltic facility as well as other necessary marine operational manuals will be developed through the TERMPOL process and with consultation with Canadian Coast Guard, TC, and the Atlantic Pilotage Authority. Keltic initiated a simulations study (Communication Environmental and Fisheries (CEF) Consultants Limited, Nautical Institute , Nova Scotia Community College Port Hawkesbury, February 1, 2005) assessing the dynamics of berthing LNG carriers at the proposed facility. Results of the study supported the premise for docking and loading LNG carriers at the proposed site. Movement and management of vessels in the local area will be discussed with the local marine pilots and the Atlantic Pilots Authority.

2.5.9.4 LNG Unloading, Extraction, Transfer, Storage

Unloading of LNG ships and hoteling will typically require 24 hours including activities such as customs and immigration and provisioning (excluding fuel).

The terminal will be designed to moor two tankers simultaneously. Onboard ship pumps will deliver LNG to low-pressure LNG storage tanks via stainless steel loading arms and cryogenic piping. The unloading section will be equipped with three arms for liquid delivery and one arm for vapour return to the ship. The unloading arms will have swivel joints to provide the required range of movement between the ship and the terminal connections. Each arm will be fitted with power emergency release coupling valves to isolate the arm and the ship in the event of a non-scheduled separation.

The estimated maximum unloading rate for one ship is 12,000 m^3/hr and a total maximum unloading rate is 24,000 m^3/hr for two ships.

<u>LNG Transfer Lines</u>

A ring main will be provided between the LNG unloading arms on the jetties and the LNG storage tanks. The ring main consists of two parallel cryogenic pipes and has a double function. Firstly, a double unloading capacity can be achieved compared to a single line. Secondly, the ring main can be kept at cryogenic temperatures continuously by pumping a slip stream of LNG through the ring main. In addition to the ring main an LNG vapour return line will be provided. Both lines (ring main and vapour return line) will be heavily insulated.

The piping system from the unloading arms will run along the marine pipeline trestle in a northerly direction to the Marginal Wharf. At this point the piping will head easterly until it reaches the main tank area. The piping will be supported on sleepers that will also provide lateral restraint but will allow the pipe to expand and contract in a longitudinal direction during the initial cool down cycle. The piping will be anchored at the unloading arms and at certain other locations where movement must be restricted. The piping configuration will allow expansion and contraction to occur naturally at the location of major changes in direction, such as at the intersection of the pipeline marine trestle and the Marginal Wharf. Where expansion and contraction has to be accommodated within a pipe run this will be through the use of a pipe loop rather than through the use of bellows or other types of mechanical joints.

The marine transfer line will require a minimum of three pipe anchors, several pipe guides, and possibly some loops to allow contraction and expansion. A non return valve will be located just before the unloading transfer line connects to the tank header system. The purpose of the non return valve is twofold:

- to prevent the possibility of large transient pressures occurring in the unloading transfer line in the event that the ship pumps trip off line during unloading; and
- to prevent the LNG contained in the tank header and tank fill lines from adding to the LNG spilled in the event of an unloading line rupture.

The LNG ship unloading transfer piping system will be fully impounded to protect the LNG marine carrier, product storage area, and waterway in the event of a spill from the transfer piping. The piping impoundment will be constructed on top of the trestle, and along side the road that connects the unloading platforms to the Marginal Wharf, and then along the transfer line route until the pipeline reaches the tanks.

LNG Storage

Tank description

Ultimately 6 storage tanks each with a gross capacity of 162,500 m^3 LNG will be provided. The outer diameter of each tank equals 80 m, a height of 38 m with a 9 m higher dome. Currently it is assumed that all tanks have the same function which means that all tanks can be directly filled from the LNG ships.

The LNG storage tanks will be of a full containment design, comprising of an inner tank of 9% nickel steel, a pre-stressed concrete outer tank shell with a reinforced concrete base slab and reinforced concrete roof. The inner tank will be filled with stored LNG while the outer tank functions as a safety net in cases of malfunction and/or leakage of the inner tank. The space between the inner tank and outer tank is filled with insulation. All connections to the tank will be made through the top; this prevents the tank from being (partially) emptied in case of leakage at locations in lower parts of the tanks. In Figure 2.5-5 a schematic diagram of a full containment tank is depicted.

Although the tanks are very well insulated, it is inevitable that ambient heat will penetrate through the tank walls in to the LNG. This heat in-leak causes a part of the LNG being evaporated (maximum 0.065 vol%/day of a full tank). The evaporated LNG is collected and, depending on operating conditions, compressed and/or condensed (through a so-called boil-off gas handling system or BOG system, see below) and injected in the main LNG flow or used as fuel on the site.

In-tank pumps

]In the tanks, several pumps are placed to firstly deliver the required send out rate to the regasification area and secondly deliver a minimum LNG recirculation flow through unused LNG piping to retain the cryogenic temperature in this piping. These in-tank pumps are fully submerged in the LNG.

The required pump pressure is not determined by the pressure drop between the storage area and the regasification area, but by the amount of BOG formed in the storage tanks and the required subcooling related to this (see also below). In addition a minimum pump pressure is needed at the suction head of the pump (the so-called ‘net positive suction head’) to prevent local formation of vapours.

BOG system

Condensation of the formed BOG takes place in a BOG condenser based on direct heat exchange between the BOG and the LNG send out flow from the storage tanks. Before condensation takes place the collected BOG is first compressed to a pressure of approximately 7 bar.

In order to be able to apply direct heat exchange between the BOG and the LNG, the LNG is pressurized before entering the BOG condenser by the in-tank pumps. Because of the pressurization the boiling point of LNG increases. In addition, pressurization itself does cause a significant increase in temperature, which means that by pressurization of LNG, LNG is subcooled. As a result, a small increase in temperature, i.e. by heat exchange with BOG, does not cause vapourization of LNG. Furthermore, because of the subcooling no vapours (BOG) will be formed in the piping between the storage area and the regasification area.

The desired LNG flow for condensation of the formed BOG is determined by the heat in-leak in the storage tank (i.e. the amount of BOG formed) and the temperature increase caused by compression of the BOG in the BOG compressor.

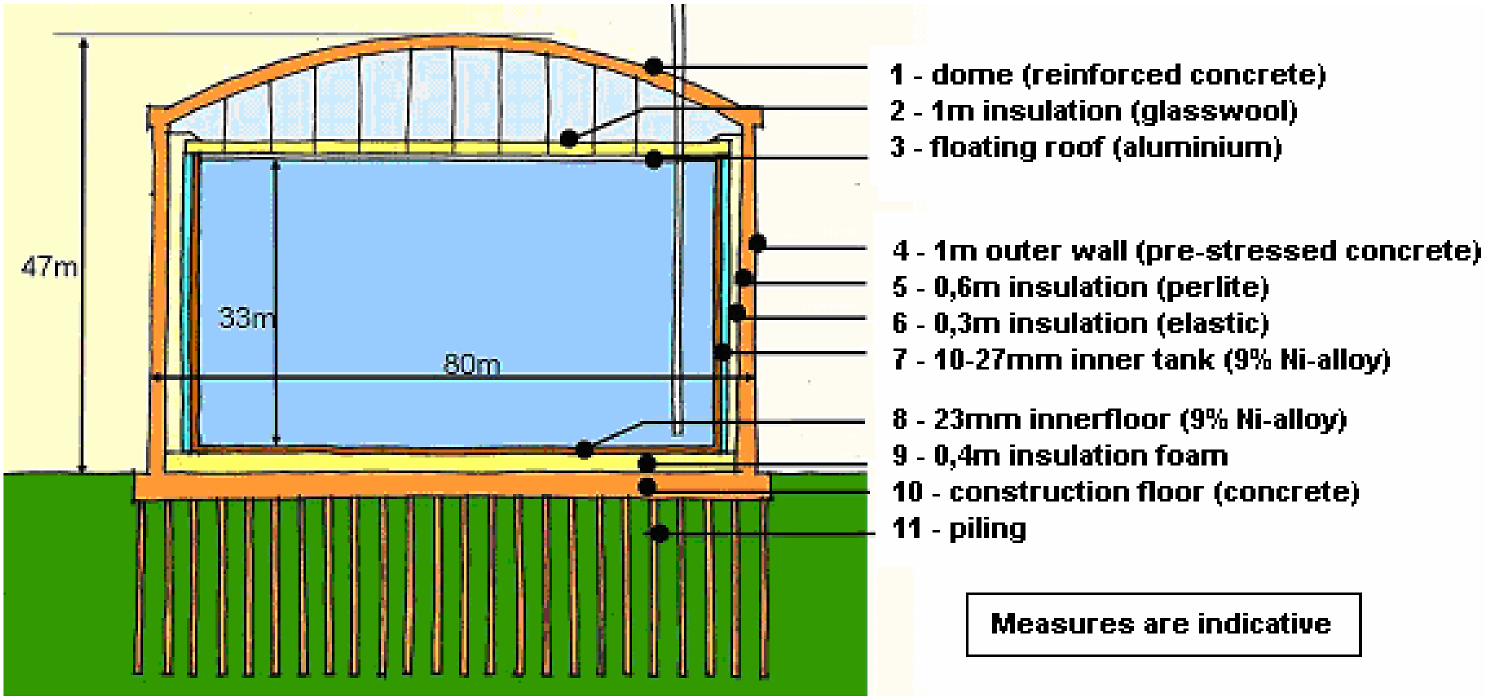
Stratification and roll over

The origin of the LNG being brought to the LNG facility will vary. This means that the composition and density may differ. Because of these differences in density two (or more) layers could be formed in the storage tanks. As a result, an unstable situation called stratification could occur. When these layers spontaneously and suddenly start mixing it is called roll over. This phenomenon mostly is related to LNG being stored in a tank for a longer period of time. The absorbed heat in the lower lying layers that can not be withdrawn may be released in the case of a roll over which may cause extensive vapourization of LNG. The amount of formed vapours may be too large to release through the safety relief valves, which may cause the pressure to run up in the tank. As a result, the tank may be damaged.

To minimize the possibility of roll over a number of measures are taken. Firstly, the tanks are continuously monitored on liquid level, temperature and density (LTD-monitoring) and formation of BOG. When formation of layers is observed the in-tank pumps will be set on internal recycle to mix the contents of the tank. Furthermore, the tanks can be filled at different levels by different systems. Each tank has one connection at the top of the tank through which the LNG is fed. In the tank the LNG can be handled by different systems:

- Direct feeding on the top layer by means of a pipe;
- Feeding on the top layer by means of a sprinkler system; and
- Feeding at the bottom of the tank through an internal pipe (‘down comer’). By means of this down comer LNG with a higher density will be naturally transported to the bottom of the tank.

FIGURE 2.5-5 Schematic diagram of full containment tank



Lay-out Description

The preferred tank location was selected to be as low an elevation and closely spaced as possible to accommodate the hydraulic capacity of the ship's transfer pumps. Thus the founding elevation has been set at 16 m. The initial site grading will also include the area required for the installation of tanks to be constructed during the second phase as blasting would not be allowed once the tanks are in service as shown in Figure 2.5-6.

All six tanks have been located to make the best use of the existing terrain between Dung Cove and the property boundary. The existing roadway runs parallel to the shoreline, at an approximate elevation of 20 m. The alignment will be moved further to the north east and raised to an elevation of approximately 25 m, as it is currently within the proposed location of the tanks. A new road located on the south west side of the tanks, at an elevation of +15.5 m will provide primary access to the storage tank pipe headers and individual tank piping and valves, and also provide access to the base of the tanks. The founding elevation of the tanks at +16 m has been optimized in order to minimize construction costs. The finish grade to the south west of the pipe rack will slope down towards the sea, following the existing contours. Tank A has been located such that the regulated levels of thermal radiation fall within the property boundary. The

spacing between the outer walls of adjacent tanks is 43 m, which is in compliance with LNG code general spacing criteria.

Initially, during phase 1 of the Project, tanks A, B, and C, shown on the left hand side of Figure 2.5-6 will be constructed. However, it will be prudent to complete the rock excavation required for tanks D, E, and F during phase 1. This will avoid blasting at a future time in the vicinity of the storage tanks already in service.

The main pipe rack that services the storage tanks is located to the south west of the storage tanks, as shown in Figure 2.5-6. The elevation of the base of the pipe rack is +16 m and will not be required to be separately impounded. The rack contains the following piping systems:

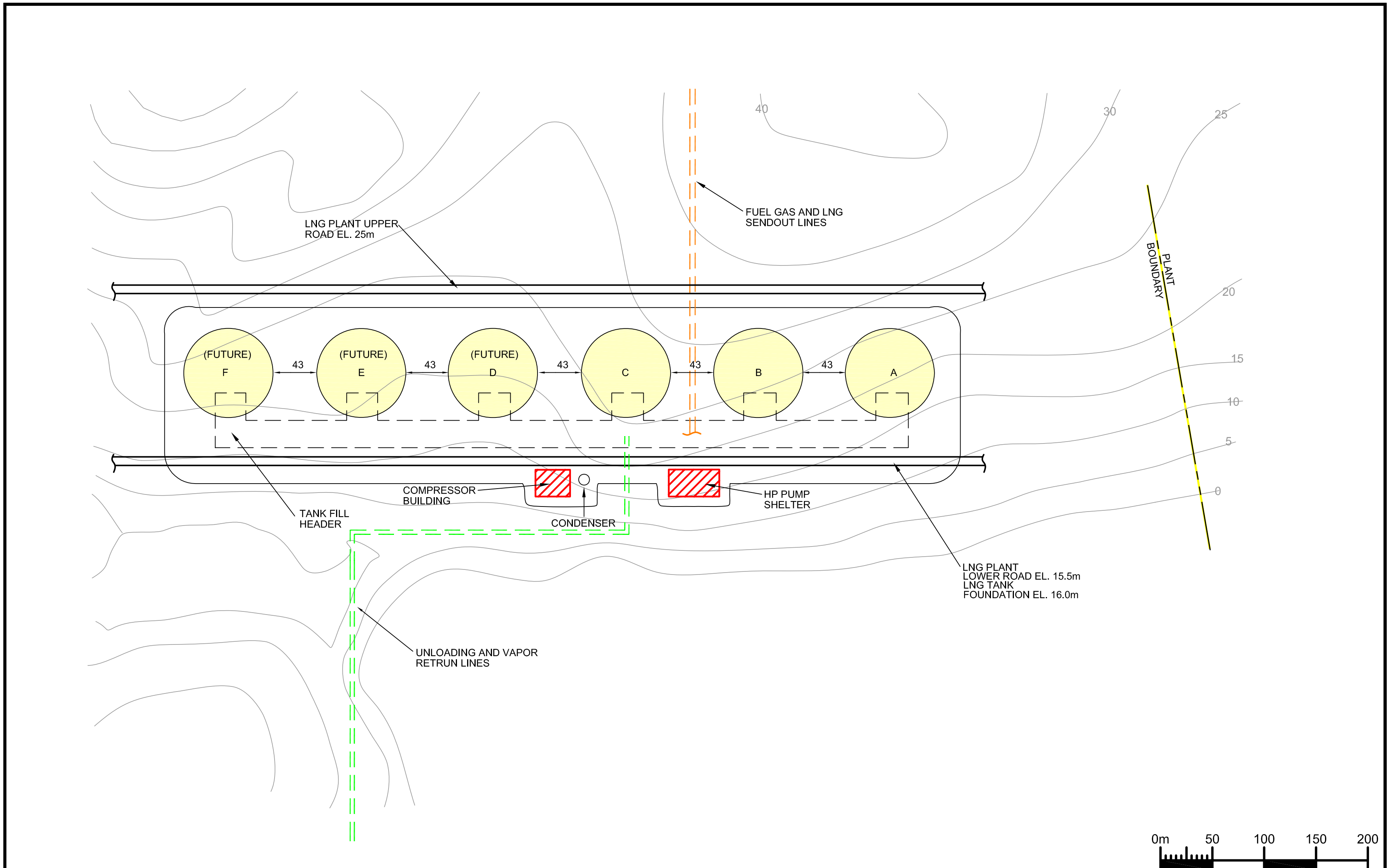
- LNG tanker unloading header;
- cold boil off vapour line;
- low pressure LNG line from the tank low pressure pumps to the high pressure pumps;
- high pressure LNG from the high pressure pumps to the vapourizers and demethanization plant;
- fuel gas and condenser; and
- A number of other lines required to operate the LNG storage tanks.

2.5.9.5 LNG Regasification and Send-Out

The key components of LNG regasification and send-out will be:

- high pressure multi-stage LNG booster pumps which discharge at a pressure sufficient for regasification and send out;
- high pressure submerged combustion vapourizers.

FIGURE 2.5-6 Conceptual Storage Tank Layout



Source: Shaw Stone & Webster International Inc. Drawing No. SK-2, 2005

FIGURE No. 2.5-6

KELTIC PETROCHEMICALS INC.

CONCEPTUAL STORAGE TANK LAYOUT

JULY 2006

LNG originating form the LNG storage tanks is pressurized to approximately 80 bar by means of high pressure multi-stage booster pumps. For a capacity of 18 BCM/a (nominally 1,606 t/hr and peak 2,650 t/hr) 14 booster pumps with a capacity of 200 t/hr are required. The pumps are of the vertical multi-stage centrifugal type with an installed power of 1,500 kW each and are electrically driven.

The pumps will operate to provide the send-out flow of LNG firstly to the demethanizer then to the vapourizers, then to local use (cogeneration plant and petrochemical facility) and to the M&NP.

Specification of Natural Gas

Two possible technologies can be used to adjust the natural gas product properties to meet the M&NP specifications:

- extraction of ethane and higher hydrocarbons from LNG;
- injection of nitrogen in the product natural gas or in the LNG feed stream.

A description of these technologies is presented below.

Extraction plant

The plant cleans up off-specification LNG received at the LNG terminal by extracting ethane and propane to be used in various units at the petrochemical facility. An expander/recompressor effectively adjusts pressure levels of gas streams without any additional external power usage. Heat integration is maximized by using the cold temperature LNG for low temperature users, and low quality waste heat from the nearby cogeneration plant for all heating requirements. The following key processes are described below:

- Demethanizer Distillation System;
- Deethanizer Distillation System;
- Expander/Recompressor; and
- Heat Integration (Cold Temperature LNG/Power Plant Waste Heat).

A demethanizer is used to separate methane from the heavier components in the hot LNG feed stream. An option to process Sable Gas exists by feeding Sable Gas to a separate feed tray. Depending on the amount of ethane and propane, it may be more economical not to perform the extraction on Sable Gas.

The reflux rate of the demethanizer column can be varied to ensure the natural gas from the column overhead has a heating value that meets the pipeline heating value specification. To facilitate separation and to reduce the cost of the demethanizer column, the column is operated at approximately 425 psi. At this pressure level and an ethylene composition of 99 mole percent (mol%), the reflux temperature is approximately -92°C. The LNG feed (-160°C) can be used to provide the necessary cooling.

The bottoms product from the demethanizer is a mixture of mostly ethane and propane. Bottoms temperature is approximately 25°C but can vary depending on the ethane to butane ratio in the LNG feed and the column pressure.

A deethanizer column is used to separate the ethane/propane mixture from the demethanizer bottoms product. The top product is liquid ethane with a purity of 99 mol% and the bottom product liquid propane with purity of 95 mol%. The products are chilled by integration with the low temperature LNG feed stream and sent to refrigerated storage, and subsequently fed to the ethylene unit.

The methane gas from the demethanizer must be brought back to pipeline pressure before it can be exported to the natural gas pipeline. A compressor is used to repressurize the natural gas from the column pressure of 425 psi to pipeline pressure of 1210 psi. The power required for compression is provided by direct coupling with an expander turbine located upstream of the demethanizer.

Cooling required for the demethanizer condenser, deethanizer condenser, and product chilling is provided by the cold temperature LNG from the storage tanks. The cold temperature is utilized first by the demethanizer condenser since the demethanizer operates at the lowest temperature of all users. Next, the LNG is passed through the ethane and propane chillers. Finally the LNG is fed to the deethanizer overhead system. Pinch analysis can be used to determine the most economical method for heat integration taking into account the size of the required heat exchangers. This has the added benefit of preheating the cold LNG prior to the distillation columns. Additional heat required to warm up and vapourize the LNG is provided by low quality waste heat from the cogeneration plant/ethylene glycol loop. Since the compression power required (to recompress the natural gas to pipeline specification) is provided by the expander, the temperature of the vapourized gas from the glycol loop can be adjusted to provide the necessary expansion power to drive the compressor.

Optionally, an expander/recompressor effectively adjusts pressure levels of gas streams without any additional external power usage. Heat integration is maximized by using the cold temperature LNG for low temperature users, and low quality waste heat from the nearby cogeneration plant for all heating requirements. Vapourization of the incoming LNG can also be carried out by the product gas stream. By this method the methane can be condensed back to the liquid form after which pressurization and regasification of the LNG can occur using the SCVs. Which of these techniques is selected is not yet determined and will be based on further analysis of environmental, economical, and technical studies.

Additional low quality waste heat from the cogeneration plant/ethylene glycol loop is used to superheat recompressed natural gas prior to export, and may also be used to provide heat for the distillation column reboilers.

Nitrogen injection

Adjustment of the natural gas product properties to meet the M&NP specifications can also take place by nitrogen injection into the LNG or in the natural gas product. The required nitrogen will be produced using a cryogenic ASU. Figure 2.5-7 presents a typical schematic of an ASU.

FIGURE 2.5-7 Typical schematic of an air separation unit (ASU)

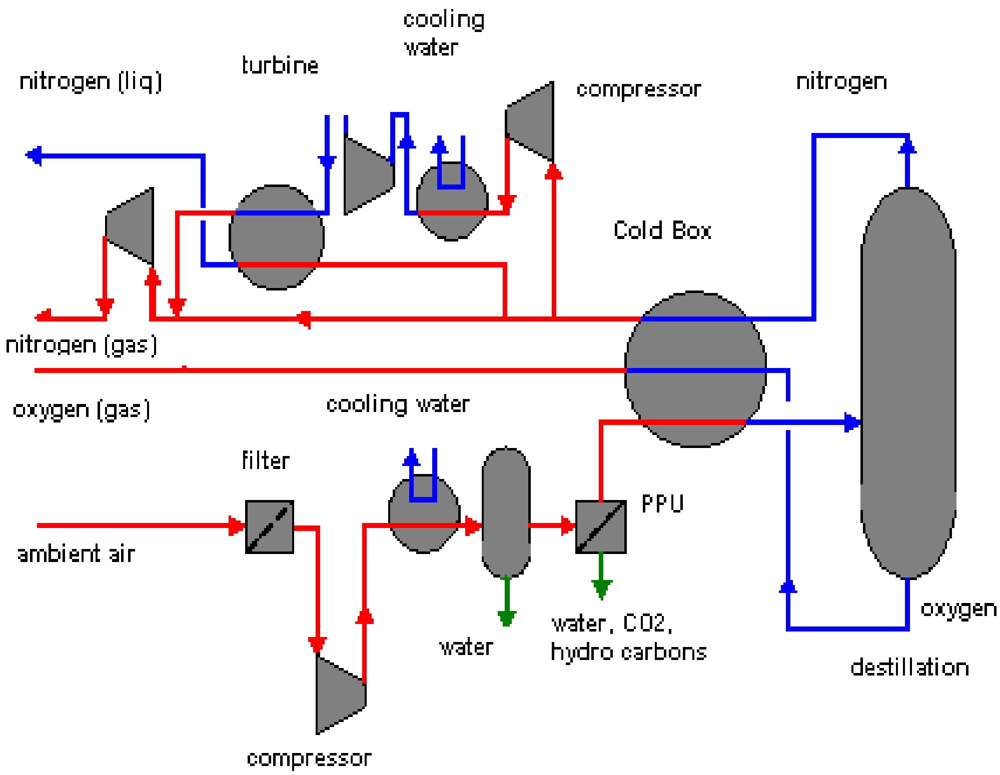
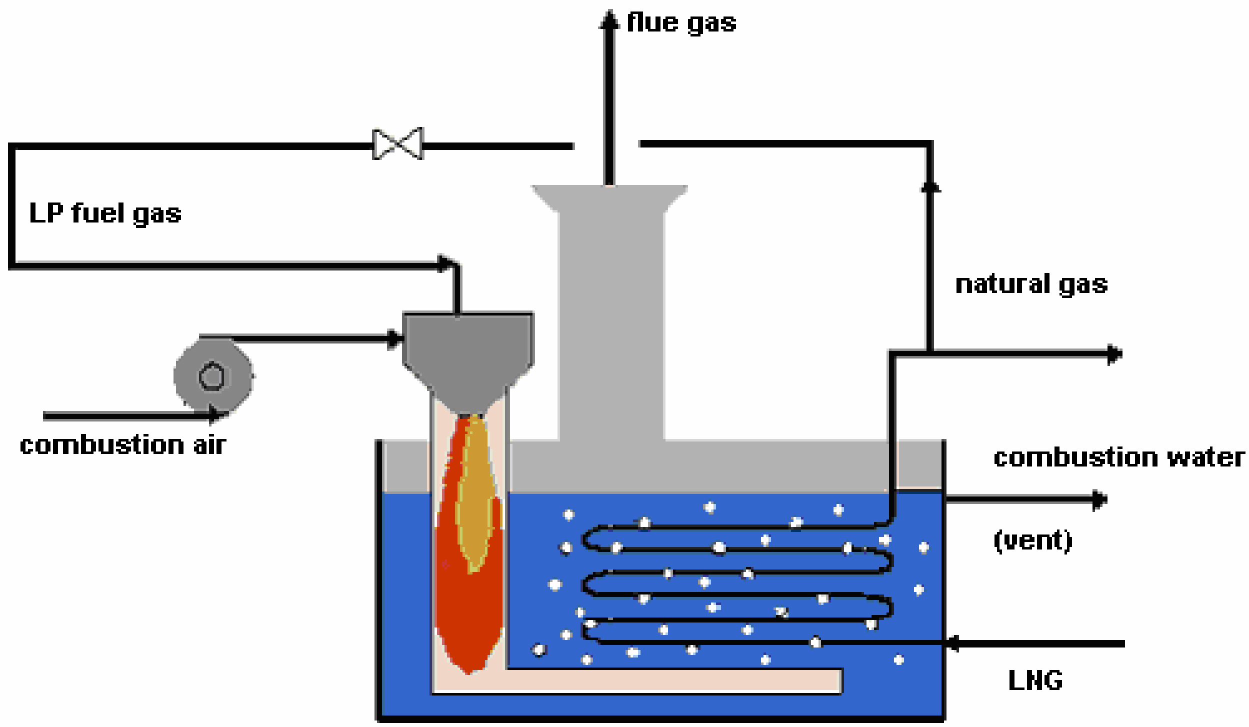


FIGURE 2.5-8 Submerged combustion vapourizer (SCV)



Dry air is feedstock for nitrogen production by an ASU. Ambient air however, generally contains water vapour and some other components like CO which shall be separated before entering the cryogenic process.

LNG vapourization

The pressurized LNG coming from the booster pumps is then fed to the regasification section consisting of SCVs. In the SCVs the LNG is vapourized in a water bath with a temperature of approximately 15°C, which is kept at the desired temperature by means of under water (‘submerged’) combustion of low pressure fuel gas. The LNG is led through the water bath by means of heat exchanger pipes. The source for fuel gas may be part of the vapourized LNG (depressurized) and/or BOG. A schematic diagram of a SCV is depicted in Figure 2.5-8.

The energy required for vapourization of the nominal send out of LNG is equal to 340 MW. This corresponds with 1.3 to 1.5% of the vapourized LNG.

The air required for the combustion of the low pressure fuel gas is sucked in by air fans and mixed with the fuel and combusted in a low NO_x-burner.

The hot flue gas – mainly consisting of nitrogen from air, carbon dioxide (CO_2) and water – flows through the water bath transferring heat to the water. The water vapour mostly condenses and a major part of the CO_2 dissolves in the water bath. The nitrogen flows through the water bath and is emitted through a stack. By-products of the combustion like NO_x and CO are also emitted.

Because the CO_2 dissolves in the water bath HCO_3^- and $H_2CO_3^{2-}$ are formed in the water bath which results in a lower pH of the water. To keep the pH of the water bath within the desired range each SCV will be provided with a de-acidification unit. This unit operates on the principle of addition of chemicals like sodium carbonate and/or calcium carbonate. The so-formed pH-buffer will result in a pH of the water bath of between 7.5 and 8.5 (neutral).

The thermal efficiency of the SCVs is equal to 95% related to the direct contact between the combustion gas and the water bath and the high turbulence of the gas in the water.

The most important part of the SCVs is the relatively low height, order of magnitude 7 to 8 meters. However, each SCV is provided with a stack with a height of approximately 10 meters.

The design capacity of a currently state-of-the-art SCV is 175 t/hr. For the LNG facilities of the Project 16 SCVs will be installed.

Send-out Gas System

After the LNG is vapourized in the SCVs the natural gas product is further transported and distributed to customers. The customers are:

- petrochemical facility;
- cogeneration plant; and
- M&NP gas distribution network.

The specifications of the natural gas for all customers are the same. Depending on the source of LNG, the quality has to be adjusted to meet the specifications. This will normally take place by de-methanizing, but nitrogen injection will be used as back-up in case the de-methanizer is not in operation (i.e. due to revision, no storage volume available for ethane/propane). Nitrogen originates from the nitrogen production plant.

The send-out natural gas will be sent out through a metering station. Metering will be included for gas consumption by the petrochemical facility and cogeneration plant. The send-out pipe line will be made from high strength steel and may be installed aboveground or buried. The pipeline will have isolation valves which will be located at tie-in points to other facilities in the Project and at the M&NP. The M&NP will not require expansion to accommodate additional gas supplies from the development of the Keltic Project.

2.5.9.6 Air Emissions and Controls

Air emissions mainly concern NO_x, CO and CxHy (unburned hydrocarbons) caused by fuel gas combustion in the SCVs. To suppress NO_x emission the SCV burners are provided with low-NO_x devices.

In addition to that NO_x, CO and CxHy are emitted while the flare is in operation. However, flare operation will take place occasionally. Furthermore if the in tank pressure is too high LNG vapours will be vented to atmosphere. These occasions are very rare.

During normal operation small diffuse emissions caused by small leakages may occur. These emissions concern unburned hydrocarbons. It should be noted that before, during and after LNG unloading there will be no diffuse emissions.

2.5.9.7 Water Supply

Process water is supplied to the complex from the fresh water make-up source and/or by desalination of sea water (still under review). Some of the service water will be directly supplied to the users without any treatment. At present it will only be used as feedstock for the desalination plant and for the utility stations. Fire water make-up will be exclusively from the reclaimed water supply, which is collected storm-water from all areas that has been treated

Potable water will be produced in a centralized treatment system consisting of sand carbon filters and chlorination. The potable water tank will be sized for a minimum of eight hours independent supply at normal demand. The potable water is also distributed to the safety showers, eye washes, drinking fountains, changing rooms, toilets, cafeteria, etc., within the area and exported to the interconnecting piping header for distribution to the rest of the complex.

A decision is to be made during the FEED stage on the use of additional pretreatment to remove unsaturates and heavy organics before entering the low pressure water stripper

2.5.9.8 Storm and Waste Water Management System

Storm-water runoff from uncontaminated areas will be segregated from potentially contaminated areas and discharged through a storm-water outfall. These uncontaminated areas generally include roads, building roof drains, undeveloped areas and uncontaminated areas in the utility and offsite units. The non contaminated runoff will generally flow through open site ditches with final disposal in Isaac's Harbour. Ditch checks, vegetation, and siltation ponds will be utilized to prep the storm-water before discharge, in accordance with established Waste Water Management Plans in line with EPP.

2.5.9.9 Infrastructure and Support Systems

Infrastructure and support systems dedicated to the LNG facility will consist of:

- PLC based control system;
- emergency shutdown system;
- hazard detection system;
- security system and facilities;
- fire response system;
- natural gas vent;
- plant air, instrument air and nitrogen systems;
- electric power distribution and control systems;
- control building;
- access roadways and service buildings;
- fire and emergency access roads; and
- other facilities as required to support safe, efficient, and reliable operation.

LNG terminal, storage, and regasification control and monitoring will be performed by a PLC based control system. An independent safety instrument system will perform emergency shutdowns when unsafe conditions are detected. A hazard detection system will monitor the LNG facilities for fire, combustible gas, and low temperature.

The fire response system will consist of several independent systems based on water and foam. A firewater system will be provided which consists of monitors, a firewater pond, firewater pumps, underground distribution piping, hydrants and hose reels. The fire fighting capability will be supported by a central fire station and community volunteer fire fighting organizations.

Two stacks will be provided for venting high pressure and low pressure natural gas. Normally only a small nitrogen purge flow will be vented. BOG will be temporarily vented to the high pressure vent stack when it exceeds the vapour handling system capacity during upsets such as equipment malfunction or power failure.

Instrument and utility air will be provided from package units. Each package unit will have a lubricated, screw compressor with electric motor drive. Each package unit will have filters and an air dryer. Instrument and utility air distribution piping will run throughout the LNG facility.

Nitrogen distribution piping will run throughout the LNG facility.

A substation will be located on site to receive electrical power from the co-generation plant.

The following buildings will be provided on the LNG site:

- control building;
- BOG compressor shelter;
- high pressure pump shelter ;
- main electrical substation building;
- terminal control and electrical substation building; and
- firewater pump house.

Access roads will be provided for operation, maintenance, fire, and emergency vehicles.

2.5.9.10 Other Utilities and Common Support Facilities

Other utilities and common support facilities will be provided as common user facilities and are described in Section 2.3.4.

2.5.9.11 Malfunctions and Accidents

During engineering and construction phase of the LNG facility, failure scenarios will be defined per component. Per failure scenario the technical and organizational measures will be described to minimize the effects in case of failure. The following malfunctions have been defined preliminary:

- Malfunctions during LNG unloading:
    - slipping off of the unloading arms: the carrier's unloading pumps will immediately be shut down automatically; and
    - slipping off of the vapour return line: the carrier's unloading pumps will immediately be shut down automatically.
- Malfunctions of LNG storage:
    - Too high pressure in the LNG storage tanks: first vapours will be directed to the flare. In the event the pressure further increases, vapour will be released via a pressure relieve valve.
    - Failure of the boil off gas compressors: boil off gas will be flared.
- Malfunctions of the booster pumps and SCVs:

  - Failure of the booster pumps or SCVs: available spare capacity will be put in operation. If this is insufficient, the in tank pumps will be turned down, resulting in a decrease of the send-out capacity. Increased emissions are avoided.
- Malfunctions of nitrogen production:
  - Failure of the air compressors: ASU will operate at part load or will be completely shut down. This will not result in increased emissions.
  - Failure of other compressors: expansion cooling can only take place partly or not at all. As a result the ASU will operate at part load or will be completely shut down. This will not result in increased emissions.

It should be mentioned that for both scenarios none or only part of the nitrogen production and thus injection take place. As a result the flexibility of the send-out gas quality and the amount is reduced.

Pipe Fracture

Pipe fracture may occur through the complete LNG facility. For the benefit of registration of possible pipe fractures, periodical inspections are included. Furthermore leakage detection will be installed at strategic locations. In the event of a pipe fracture the fracture location is isolated according to the Emergency Shut Down procedure.

Long term Power Failure

In the event of power failure the uninterruptible power supply will become in operation. The capacity of the uninterruptible power supply is sufficient to shut down the LNG facility in a controlled and safe way in case of a total or long term power failure.

Marine Safety

Since commercial LNG transport began in 1959, LNG has been safely transported, stored, and delivered to densely populated cities in the US, Europe, and Japan. LNG has an excellent safety record with more than 33,000 carrier voyages covering 60 million miles around the globe without a major accident over a 45-year history.

Ocean-going tanker transportation of LNG has a long record of safe operation. Few accidents have occurred since the first converted freighter delivered a Lake Charles, Louisiana cargo of LNG to the UK in January 1959, none involving a fatality or major release of LNG. The outstanding LNG shipping safety record is attributable to continuously improving tanker technology, tanker safety equipment, comprehensive safety procedures, training, equipment maintenance, and effective government regulation and oversight.

LNG ships are well-built, robust vessels with a double-hull designed and built to withstand the low-energy impacts common during harbour and docking operations. They are a common sight throughout much of the world.

Marine/navigational safety issues will be addressed while working through the TERMPOL Review Process under direction of the *Canadian Environmental Assessment Act* (CEAA) and in conjunction with TC Marine Safety. TC is mandated to be part of the technical review committee for the EA to serve this purpose. TC will use the tools in the TERMPOL Review Process to objectively appraise operational ship safety, route safety, management and environmental concerns associated with the location, construction, and subsequent operation of a marine terminal system for the bulk handling of LNG and other deleterious cargoes identified by TC.

As part of the risk management process identified in the TERMPOL Review Process, establishing safe conditions for the port transit of LNG will be of major importance and will be a direct responsibility of the port authority along with input from Keltic and the various ship operators. Some form of Vessel Traffic System, as specified by the IMO (Resolution A.578-14) for marine traffic management will be implemented in order to prevent close encounters between LNG carriers and other marine traffic. Necessary subordinate specifications concerning traffic management will be developed according to the risk identified in each particular situation.

Other conditions for establishing safe operations in port will include adequate navigation marks and lights in accordance with NWPA, limited ship movement in conditions of poor visibility, and a high standard of pilotage service all of which will contribute to minimizing the risk of marine transport anomalies. The quality of pilotage service is of particular importance. As part of terminal planning Keltic with the facilitation of APA will establish a fixed pilot boarding area at a safe distance offshore beyond which specific sized vessels will not be allowed to continue without a pilot in place.

As part of the operations study within the port design process, navigational risks management will be reviewed and developed upon the following factors:

- number and types of ships and other craft using the port;
- projected accident scenarios;
- navigational distances and difficulty through the port and jetty approach;
- the maximum draft of the ships;
- tidal conditions (tidal ranges and tidal currents);
- the nature of the sea-bed;
- meteorological conditions (wind, waves, sea-ice and visibility); and
- proximity of the terminal to populated areas and industrial sites.

<u>Marine Emergency and Contingency Planning</u>

Emergency response and contingency planning will take precedence in the development of facility process control measures. Emergency planning will consider dealing with the largest incident that can reasonably be foreseen, but detailed plans will concentrate on events that are most probable as identified through the impending risk analysis program.

These activities will be developed with close consultation with port users, ship's agencies, municipal authorities, police, fire, and medical services. The plan will be communicated to all relevant parties that may be involved in responding to each specific emergency and ensure they all understand their appropriate response.

Critical procedures for mobilizing emergency services, triggering mutual aid arrangements, personnel evacuation, casualty handling and external announcements will be set out in the plan. The plan will also specify the critical actions to be taken to minimize the impact of an accident (marine or land based) in its immediate aftermath, to secure the affected area and to render the individuals involved and the surrounding area of the accident as protected as possible. The severity of an emergency may range from an incident, which can be dealt with by local personnel, to one for which effective response and containment requires assistance from the community's emergency services. The plan therefore will give clear directions for the mobilization of emergency services support, with clear guidance as to how, when and what to communicate and which is the responsible party in order that immediate decision making processes can be effective and appropriate to the emergency being managed.

Marine Security

Maritime security plans and established operational procedures will be in place that comply with new IMO security requirements, the Government of Canada's National Security Policy and the requirements of the *Marine Transportation Security Act* as it relates to ports and port facilities. Under the approved security plan the Project's security program will include:

- surveillance equipment, including cameras and closed-circuit TV systems;
- improvements to dockside and perimeter security and access control, such as fencing, gates, signage and lighting;
- command, control and communications equipment, such as portable and vessel-to-shore radios; and
- infrastructure security protective measures, such as security guards and arrangements with local police departments.

Following the planned port facility security assessment/risk analysis a security plan will be developed in agreement with the current IMOs Security Code requirement. If, on completion of the analysis, it is determined that the level of risk is sufficient, Keltic will appoint a Port Facility Security Officer to prepare the Port Facility Security Plan. This plan will indicate the operational and physical security measures the port facility should take to meet the various required security levels. This plan will also develop the appropriate control inspections and additional control measures for evaluating incoming vessel security information.

2.5.10 Petrochemical Facility

2.5.10.1 Primary Components

Overview and Schematic

The overall scheme is depicted in Figure 2.5-9. This schematic indicates the interface between the petrochemical plants and the LNG terminal, LNG storage, extraction plant and power plants.

2.5.10.2 Process Description

LNG Extraction/Regasification

The purpose of the LNG extraction plant is to recover ethane and propane from “hot” LNG pumped from the LNG storage area. The plant will effect a deep recovery of ethane (90%+) and all of the propane.

A key feature of the extraction plant is heat integration which is optimized by using the cold temperature LNG for low temperature users, and low quality waste heat from nearby power plant for all heating requirements.

A demethanizer is used to separate methane from the heavier components in the “hot” LNG feed stream.

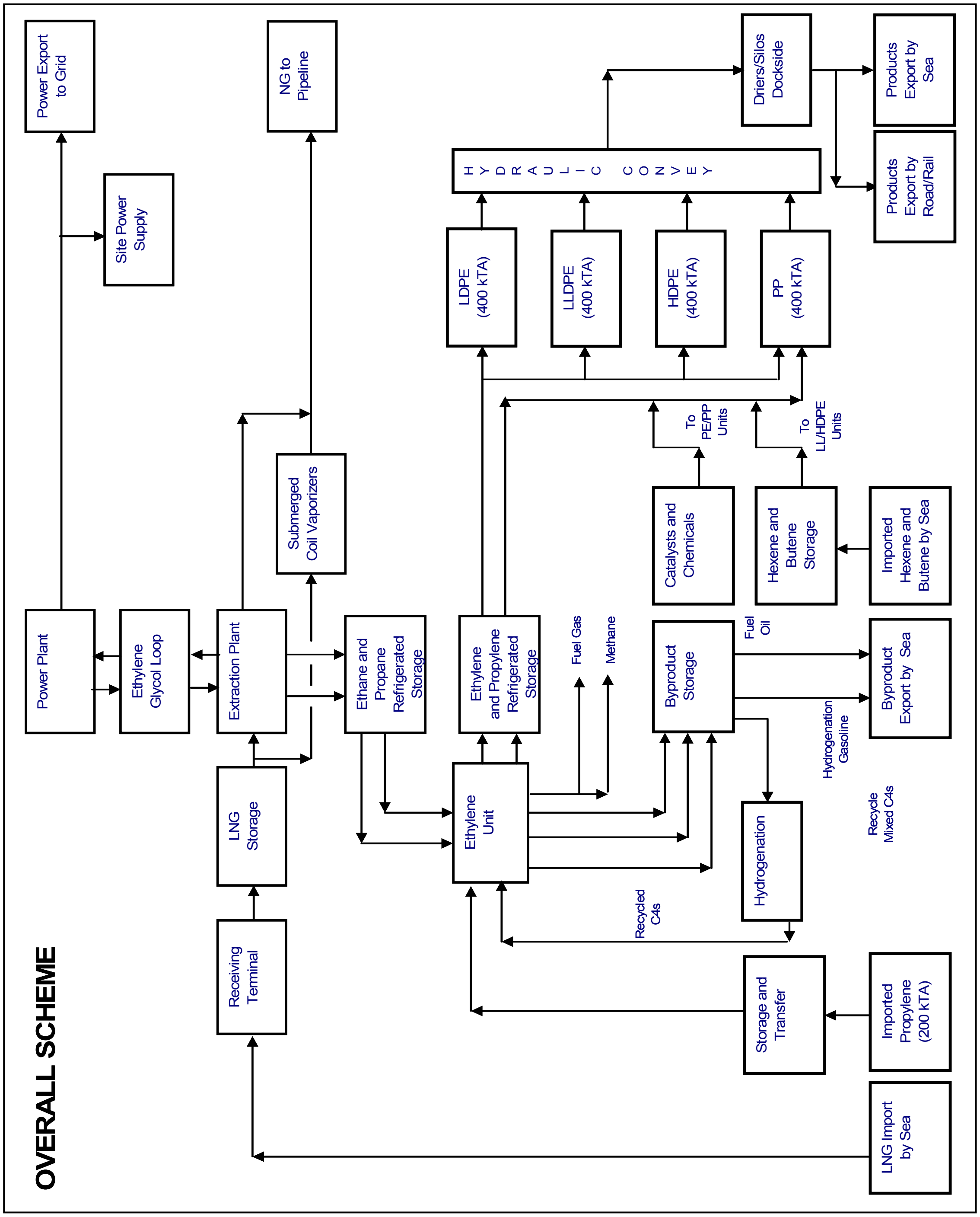
To facilitate separation and to reduce the cost of the demethanizer column, the column is operated at approximately 30 kg/cm^2(g). At this pressure level and an ethylene composition of 99 mol%, the reflux temperature is approximately -92°C. The LNG feed (-160°C) can be used to provide the necessary cooling.

The bottoms product from the demethanizer is a mixture of mostly ethane and propane which is fed to the de-ethanizer. The overhead product from the demethanizer is fed to the expander/recompressor.

De-ethanizer Distillation System

A deethanizer column is used to separate the ethane/propane mixture from the demethanizer bottoms product. The top product is liquid ethane with a purity of 99 mol% and the bottom product liquid propane with purity of 95 mol%. Both products are refrigerated/chilled by integration with the low temperature LNG feed stream and sent to the refrigerated storage area.

FIGURE 2.5-9 Overall Schematic



Expander/Recompressor

The methane gas from the demethanizer is brought back to pipeline pressure before it can be exported to the natural gas pipeline. A compressor is used to repressurize the natural gas from the column pressure of 425 psig to pipeline pressure of 1210 psig. The power required for compression is provided by direct coupling with an expander turbine located upstream of the demethanizer.

Heat Integration (Cold Temperature LNG/Power Plant Waste Heat)

Cooling required for demethanizer condenser, deethanizer condenser, and product chilling is provided by the cold temperature LNG from the storage tanks. The cold temperature is utilized first by the demethanizer condenser since the demethanizer operates at the lowest temperature of all users. Next, the LNG is passed through the ethane and propane chillers. Finally the LNG is fed to the deethanizer overhead system. Pinch analysis can be used to determine the most economical method for heat integration taking into account the size of the required heat exchangers.

This has the added benefit of preheating the cold LNG prior to the distillation columns. Additional heat required to warm up and vapourize the LNG is provided by low quality waste heat from the power plant/ethylene glycol loop. Since the compression power required (to recompress the natural gas to pipeline specification) is provided by the expander, the temperature of the vapourized gas from the glycol loop can be adjusted to provide the necessary expansion power to drive the compressor.

Additional low quality waste heat from the power plant/ethylene glycol loop is used to superheat recompressed natural gas prior to export, and may also be used to provide heat for the distillation column reboilers.

Ethylene Unit

The Keltic Petrochemicals ethylene unit will have a design capacity of 1500 kTA but an initial operating capacity of 1200 kTA and a propylene capacity of approximately 200 kTA. Supplementary propylene will be imported to make up the total propylene feedstock requirement of 400 kTA for the polypropylene unit.

The design is based upon S&W ethylene technology and is similar to that currently being designed for Eastern Petrochemicals Company (SHARQ) in the Kingdom of Saudi Arabia. The SHARQ ethylene unit cracks ethane and propane. The Keltic design also has considerable similarity with the NOVA Chemicals ethylene unit in Joffre, Alberta. This unit with a capacity of 1250 kTA cracked ethane and was successfully started up in 2001.

The products from the ethylene plant will be polymer grade ethylene, polymer grade propylene, Raw Pyrolysis Gasoline and Pressure Swing Adsorption high purity hydrogen. Waste fuels will be burned in the cracking furnaces (tail gas) or in power generation facilities (tail gas or fuel oil). The tar produced in the quench section will be disposed of in the site waste incinerator.

The highlights of the processing scheme of the ethylene unit are:

- feed and vapourization;
- pyrolysis furnaces;
- quench exchangers;
- quench tower;
- circulating quench water (QW);
- process water treatment;
- CG compression;
- caustic wash, dehydration, regeneration and final compression;
- dethanizer and ethylene stripper;
- C2 hydrogenation;
- demethanizer;
- ethylene fractionation;
- refrigeration (ethylene and propylene);
- depropanizer;
- C3 hydrogenation;
- propylene fractionation;
- debutanizer; and
- spent caustic treatment (optional);

The design of the feed vapourization system is still under review and will be completed as part of the FEED work.

Feed Preparation

Feedstocks for the ethylene unit are ethane and propane extracted from LNG and SOEI gas and stored in refrigerated above ground double walled tanks located OSBL. These feedstocks are pumped vapourized and pipelined to the ethylene unit.

The pyrolysis furnaces are designed to crack gaseous feedstock.

Cracking Furnaces

The processing scheme consists of furnaces designed for 1200 kTA ethylene production.

The furnaces can be operated on an ethane, propane or a mixed feed. However, the predominant feed will be ethane.

The pyrolysis of hydrocarbons within the furnace tubes result in a large quantity of coke which deposits on the radiant coil. This coke must be periodically removed by steam/air decoking. This procedure oxidizes and spalls the coke from the coil. The decoke effluent is directed to the radiant fire boxes where it is incinerated before being discharged to atmosphere.

The pyrolysis products from the furnace must be rapidly quenched to terminate pyrolysis reactions.

The CG from the furnaces in quench in the transfer line exchangers and enters the QW tower. In the QW tower the upward flowing CG is cooled by direct contact with multiple stages of QW. Gas from QW tower overheads goes to the CG compressor.

Cracked Gas (CG) Compression

The CG compression system utilizes a four stage centrifugal compressor to increase the pressure of the furnace product gases before drying and cooling (i.e. to prepare the product gases for recovery and separation).

Cracked Gas (CG) Compression/Caustic Wash System

On the third stage of the compressor systems there is a caustic wash system to remove acid gases such as CO_2 and hydrogen sulphide. Such treatment is necessary to meet ethylene product specifications, and to protect the acetylene hydrogenation catalyst from H_2S poisoning.

A two stage caustic treatment system is provided to insure that the low CO_2 specification of the ethylene product is met.

Spent caustic is degassed, stored and is either treated or incinerated. The decision on the disposition of spent caustic will be made during the FEED stage of the Project.

High Pressure De-ethanizer and Acetylene Hydrogenation

The product gases from the fourth stage of the CG compressor are then cooled and refrigerated to knock out heavy hydrocarbons and water.

The light hydrocarbon product gases are then dehydrated in a fixed bed molecular sieve unit before being chilled and fed to the high pressure de-ethanizer.

The high pressure de-ethanizer in operated so that there are no C3s in the overhead product of the tower.

The overhead product from the de-ethanizer is heated and then passes to the acetylene converter reactors where acetylene is hydrogenated to ethylene.

Demethanizer

After acetylene conversion the light hydrocarbon product gases are chilled and then enter the demethanizer. The demethanizer separates methane, hydrogen and light gases from C2s (ethane and ethylene).

The demethanizer overhead gases pass through and expander for energy recovery before the hydrogen is recovered and the methane discharged to the fuel gas system for use as fuel in the cracking furnaces.

Ethylene Fractionation

The ethylene-ethane superfractionator actually receives two feeds: a liquid stream from the demethanizer bottoms which serves as the top feed and a vapour stream (via the high pressure deethanizer condenser) also from the bottoms of the demethanizer which serves as the lower feed to the tower.

The ethylene product is withdrawn as a liquid. It can then be either chilled against two levels of ethylene refrigeration to be sent to refrigerated storage or pumped and then heated to a pressure suitable for direct use by the polyolefin units.

Depropanizer System and C3 Hydrogenation

The bottom stream from the de-ethanizer system flows to the high pressure depropanizer. This tower produces a mixed C3 overhead stream and C4 plus stream with some C3s as bottom stream. Liquid from the high pressure depropanizer reflux drum flows to the C3 splitter via the C3 hydrogenation system. The purpose of the C3 hydrogenation system is to fully hydrogenate the methylacetylene and propadiene in the C3 stream.

The bottom from the high pressure depolarizer is fed to the low pressure depropanizer where remaining C3s are separated from the C4 plus feed. Liquid from the low pressure depropanizer reflux drum also flows to the C3 splitter drum passes to the C3 splitter. The C4 plus bottom product from the low pressure depropanizer tower is discharged to the debutanizer tower.

C3 Splitter System

The C3 splitter is a low pressure tower integrated with a heat pump compressor and works as a closed-loop heat pump system. The C3 splitter feed is from the high pressure and low pressure depropanizer. The fractionation in the C3 splitter separates the propylene/propane feeds into a high purity propylene overhead vapour and a propane bottom stream for recycle cracking.

The propylene product is withdrawn as a liquid. It is then chilled and sent to refrigerated storage or heated and pumped as a pressurized liquid to the propylene unit.

Debutanizer System and C4 Hydrogenation

The bottom stream from the low pressure depropanizer flows to the debutanizer. This tower produces a mixed C4 overhead stream, low in C5s, and a debutanizer raw C5+ gasoline net bottom stream.

The overhead stream is totally condensed in the debutanizer condenser against C3 refrigerant, before flowing to the debutanizer reflux drum. The mixed C4 product is then sent to the C4 hydrogenation unit. The purpose of the C4 hydrogenation unit is to fully hydrogenate the raw C4 stream from the debutanizer. The required product specification is reached in a two stage reaction system. The hydrogenated mixed C4 product is then pumped to a pressurized storage tank.

Outputs of the ethane process include:

- energy (steam, tail gases, heat) to run process;
- pure hydrogen (99.9+% pure) used to satisfy the downstream derivative units;
- ethylene product taken off as a liquidgas or refrigerated liquid;
- propylene product pump taken off as a gas or refrigerated;
- mixed C4 product sent as a pressurized liquid;
- polymer grade butene-1 Hydrogenated gasoline as a liquid;
- high purity hydrogen; and
- excess steam and fuel gas.

Linear Low Density and HDPE, the UNIPOL™ polyethylene process, which includes all facilities from receipt of raw materials through pelleting is based on a gas phase fluidized bed process with complete back mixing. The reaction system can be subdivided into several parts:

- reaction loop;
- catalyst;
- feed; and
- product discharge and resin purging with vent recovery.

Photos of typical facilities are shown in Figures 2.5-10 to 2.5-12.

FIGURE 2.5-10 Typical Ethylene Unit

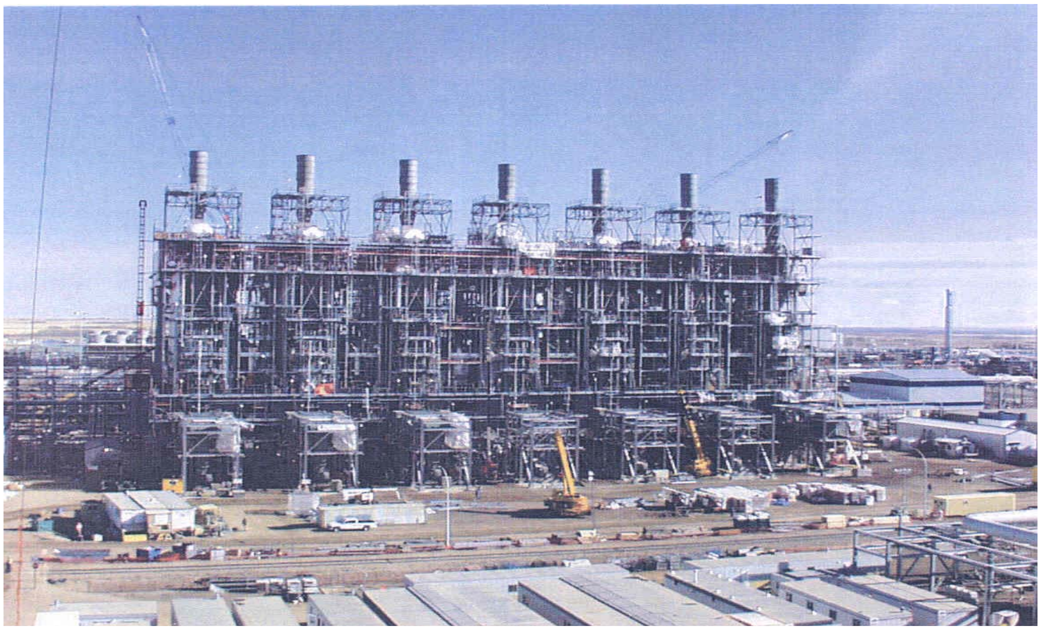
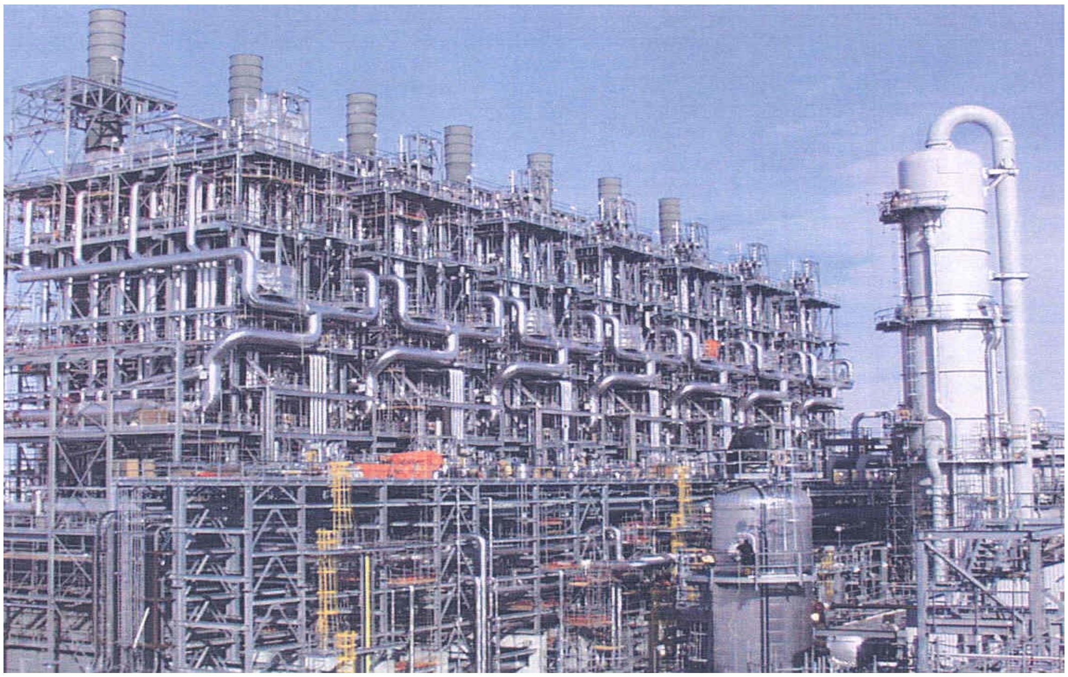


FIGURE 2.5-11 Typical Cracking Furnaces

FIGURE 2.5-12 Typical Furnaces and Quench Tower



As catalyst and raw materials are fed to the reactor, polyethylene is produced and accumulates in the fluidized bed contained within the reactor. At predetermined volume a discharge valve opens allowing a portion of the fluid bed to pass into the discharge system allowing a quantity of resin to exit the reactor. Resin purging of residual hydrocarbons is accomplished. The polymer in the form of a granular powder, is sent to the finishing section of the plant.

The degassed granular powder is gravity fed to the mixer feed for mixing with additives. Additives are metered by feeders and flow by gravity to the resin/additive conveyor where they are combined with the main resin stream and fed to the mixer. The product slurry (water/pellet mix) is transferred to the hydraulic conveying system. Pelletizer pellets are dewatered in a centrifugal dryer and the transferred to conventional commercial resin handling system. The pelletizer (to be further developed) releases pellets that are dewatered in a centrifugal dryer and then transfers product to the conventional commercial resin handling system. Shipment of product will normally be made in bulk containers (van boxes, hopper cars, etc.) or small packages. Product storage depends on the results of the FEED process.

The production of LDPE by high pressure polymerization can be divided into the following sections.

- ethylene compression;
- polymerization;
- initiator handling;
- high pressure separation and recycle;
- low pressure separation and recycle;
- extrusion, additives dosing and palletizing;
- product blending and degassing;
- Chain Transfer Agent (CTA) handling;
- mineral oil handling;
- effluent systems; and
- utility systems.

The polymerization of ethylene takes place in a tubular reactor at a pressure of approximately 2500-3100 bar and at temperatures between 160 and 300°C, depending on the grade being produced. In a preheater the ethylene is preheated to the initiation temperature by means of high pressure steam. From the preheater, ethylene enters the reactor, where adding initiator starts polymerization. The initiator solutions are pumped to the injection points on a tubular reactor.

At the end of the reactor, the mixture of polyethylene and unconverted ethylene is expanded through the reactor pressure control valve and enters the high pressure separator. From the low pressure separator the polyethylene flows by gravity to the hot melt extruder. The hot melt extruder is provided with an underwater pelletizer. The product pellets leaving the pelletizer with the pelletizing water are normally dried in the centrifugal dryer. Then the pellets are conveyed through the product buffer hopper to the blending and storage area which will be located on the Marginal Wharf's logistics and storage area.

Linear Low Density and High Density Polyethylene – Univation (UNIPOL)

The UNIPOL™ LLDPE and HDPE process, which includes all facilities from receipt of raw materials through pelleting is described below.

The fluidized bed reactor system consists of a vertical pressure vessel with an expanded upper section for de-entrainment of polymer particles. The reactor is operated at low pressure and temperature (21 kg/cm^2(g) and <80°C). The reactant gas stream circulates through the bed and is cooled in an external heat exchanger, thus removing the exothermic heat of reaction. A blower in the recycle loop provides the pressure increase to overcome the differential pressure of the loop reactor.

The fluidized bed reaction is characterized by a long residence time and extensive back mixing. Product polymer is drawn off periodically and depressurized into the product degassing tanks. The exiting gas from the degasser is recycled to the reactor. The reactor residence time is a function of product and capacity. It ranges from 1.5 hour to 3 hours, depending on the product and capacity.

The polymer granules leaving the product degassing tank are delivered to the purge bin, where the residual hydrocarbons are stripped with nitrogen and the catalyst is deactivated with a very small quantity of dilute steam. The purge tower provides about three hours of powder hold-up. The polymer from the purge bin, in the form of a granular powder, is sent to the finishing section of the plant.

In the finishing section the degassed granular powder is gravity fed to the mixer feed for mixing with additives. Additives are metered by feeders and flow by gravity to the resin/additive conveyor where they are combined with the main resin stream and fed to the mixer. The pelletizer consists of a twin screw mixer to melt the polymer, followed by a gear pump to pressurize it through an underwater, die-face cutter. The pellet water mixture from the pelletizer is fed directly into the hydraulic conveying system.

The hydraulic conveying system first concentrates the slurry from 6-10% to 30% in a two stage system. The resultant slurry is pumped using a specially designed centrifugal pump equipped with a unique impeller design (i.e. gentle product handling at a high conveying efficiency). The pumped slurry flows through a conveying line to the Marginal Wharf area. At the end of the conveying line the slurry first enters a dehydration unit and is then discharged into a conventional centrifugal drier at a temperature of 60-70°C. After drying, the pellets are routed over a short distance to the storage silos using dilute phase pneumatic conveying techniques.

Low Density Polyethylene - ExxonMobil

ExxonMobil high capacity LDPE tubular reactor technology will be utilized by Keltic. A similar design (capacity and configuration) is currently in the detailed design phase and being licensed to Huntsman Chemicals for its Wilton, UK facilities.

The technology for the production of LDPE can be divided into the following sections.

- ethylene compression;
- polymerization;
- initiator handling;
- high pressure separation and recycle;
- low pressure separation and recycle;
- extrusion, additives dosing and palletizing;
- product blending and degassing;
- (CTA handling;
- mineral oil handling;
- effluent systems; and
- utility systems.

Gaseous ethylene from the ethylene unit is pressurized using two compressors in series:

- A primary two stage reciprocating compressor
- A secondary five stage reciprocating compressor

The polymerization of ethylene takes place in a tubular reactor at a pressure of approximately 2500-3100 kg/cm^2(g) and at temperatures between 160 and 300°C, depending on the grade being produced. For different grades, different combinations of temperature and initiators may be chosen and different amounts of CTA (propylene and/or propane) may be added.

The tubular reactor consists of a preheater and polymerization sections. Ethylene compressed to the polymerization pressure is fed to the preheater. In the preheater the ethylene is preheated to the initiation temperature by means of high pressure steam.

From the preheater, ethylene enters the reactor, where the addition of an initiator starts polymerization.

The reactor tubes are cooled externally in order to remove the exothermic heat of reaction. Cooling is effected by way of a recirculating demineralized water system.

At the end of the reactor, the mixture of polyethylene and unconverted ethylene is expanded through the reactor pressure control valve and enters the high pressure separator.

The mixture of polyethylene and ethylene enters the high pressure separator at approximately 275 kg/cm^2(g) and 240°C.

Several photos of typical facilities are shown in Figures 2.5-13 to 2.5-15.

FIGURE 2.5-13 Typical LLD or HDPE Reactor

Typical LLD or HDPE Reactor

FIGURE 2.5-14 Typical LDPE Overview

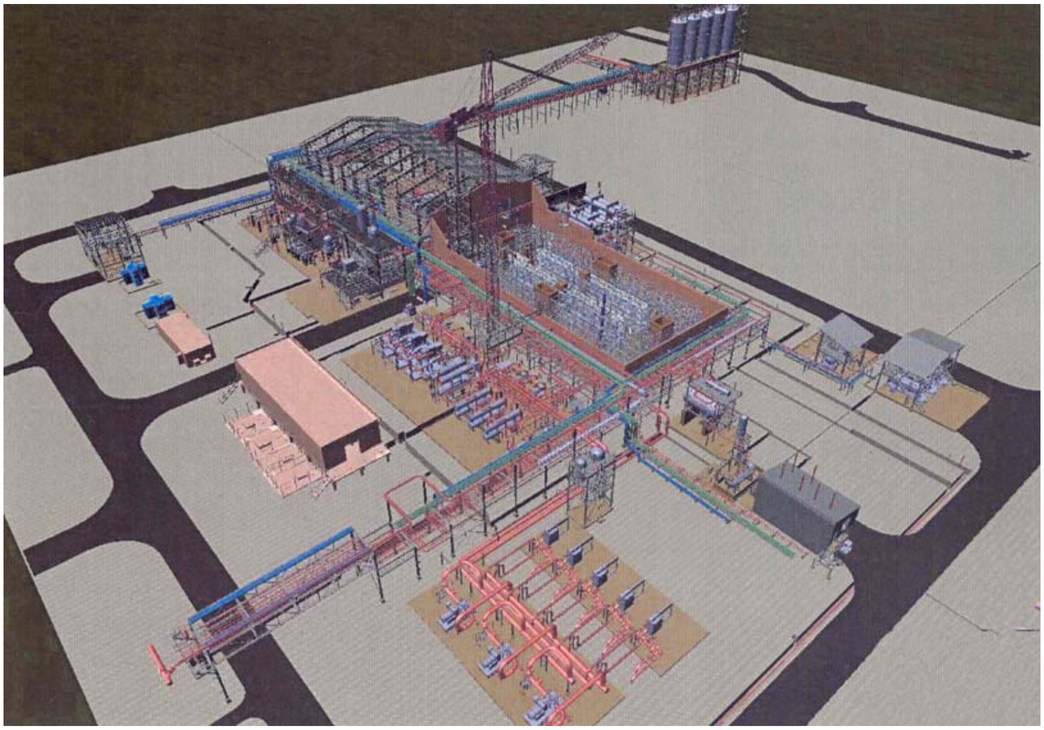
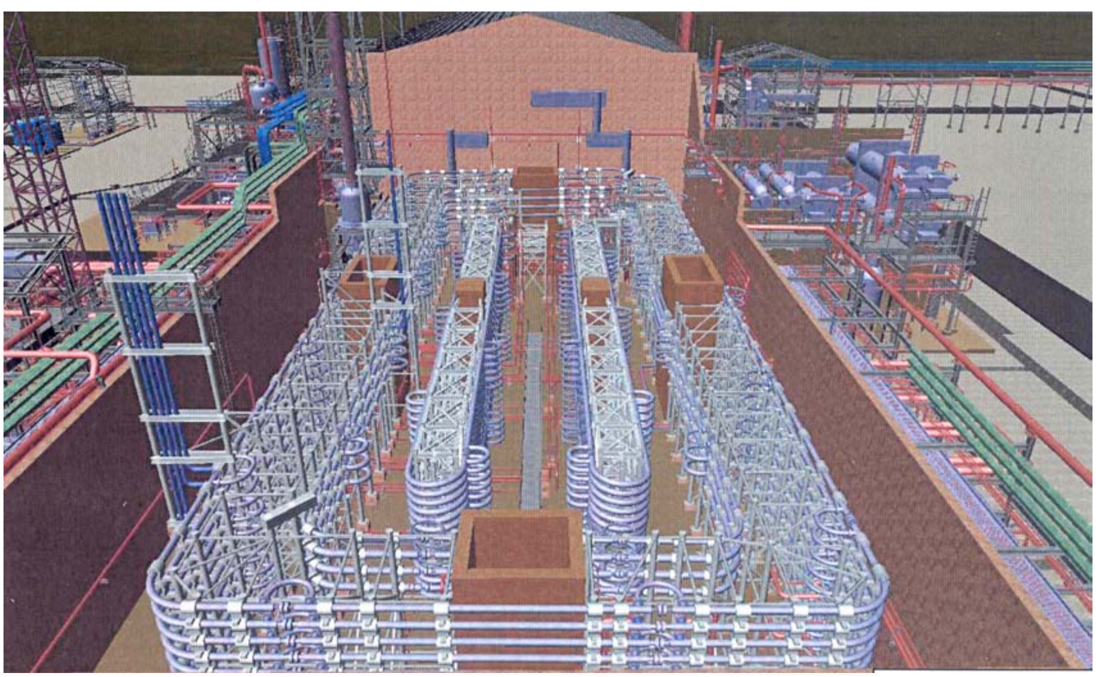


FIGURE 2.5-15 ExxonMobil Typical - LDPE Reactor Bay



The polymer from the high pressure separator is expanded and introduced into the low pressure separator. Ethylene still dissolved in the polyethylene is separated in the low pressure separator at approximately 2 kg/cm^2(g) and 220°C. The low pressure separator is the feed bin for the hot melt extruder.

The hot melt extruder is provided with an underwater pelletizer. From the pelletizer the product slurry (water/pellet mix) is transferred to the hydraulic conveying system. The hydraulic conveying system is analogous to that described above for the LLDPE and HDPE units.

For product grades requiring additives these are metered into the hot melt extruder as a master batch or as a mixture of additives and base pellets, by means of a side arm extruder.

<u>Polypropylene</u>

The UNIPOL™ Polypropylene process, includes all process facilities from receipt of raw materials through pelletizing. The key elements of the process are:

Again the polypropylene process includes all process facilities from receipt of raw materials through pelleting in the same manner as the Polyethylene. The reaction system for polypropylene can be subdivided into several parts:

- primary reaction;
- impact reaction;
- product discharge and separation; and
- finishing.

The primary reaction loop, used for producing homopolymer, random copolymer and the homopolymer segment of impact copolymer, consists of a reactor, a cycle gas compressor/turbine and a cycle gas cooler. The reactor is a continuous back mixed fluid bed reactor. The reactor operates at moderate pressure and low temperature (35 kg/cm^2 and <80°C). The cycle compressor circulates reaction gas through the bed, fluidizing it and providing the agitation required for excellent back mixing and removal of the heat of reaction. The reaction heat is removed from the circulating gas by an external shell and tube, gas/water heat exchanger.

Impact (or block) copolymers are prepared in a second fluid bed reactor operating in series with the primary reactor. The impact reaction loop, which is a smaller replica of the primary loop including a reactor, compressor and cooler; operates at moderate pressure and low temperature (35 kg/cm^2(g) and 60-75°C). Homopolymer resin containing active catalyst is transferred from the first reactor to the second where an ethylene/propylene polymeric mixture dispersed in the homopolymer base segment is produced.

Product polymer is drawn off periodically and depressurized into the product degassing tanks. The exiting gas from the degasser is treated and recycled back to the reactor.

The polymer granules leaving the product degassing tank are delivered to the purge bin where the residual hydrocarbons are stripped with nitrogen and a very small quantity of dilute stream.

The polymer from the purge bin in the form of a granular powder is sent to the finishing section of the plant.

In the finishing section the degassed granular powder is gravity fed to the mixer feed for mixing with additives. Additives are metered by feeders and flow by gravity to the resin/additive conveyor where they are combined with the main resin stream and fed to the mixer. The pelletizer consists of a twin screw mixer to melt the polymer, followed by a gear pump to pressurize it through an underwater, die-face cutter.

The hydraulic conveying system is analogous to that described above for the low liner density and high density units.

Reaction gas is circulated through a bed of fluidized resin with a trace of catalyst; the product is then passed through a similar Impact Reaction Loop and then discharged and separated for Resin Degassing and Vent Recovery, separation. Finally resin additive handling, pelleting then into the typical resin handling, storage, blending and shipping processes, similar to the polyethylene process. The typical reactor and plant facilities for the polypropylene process is shown in Figures 2.5-16 to 2.5-18.

Two further facilities are proposed, first being a butene-1 plant to supply butene-1 comonomer to the downstream polyethylene units (LLDPE and HDPE) and secondly a hexene-1 plant will supply hexene-1 comonomer to the downstream polyethylene unit (LLDPE).

<u>Comonomers</u>

The production of LLDPE and to some extent HDPE requires the use of comonomers such as 1-butene and 1-hexene (1-C_4 and 1-C_6).

There are two options open to Keltic for the supply of these comonomers:

- import by sea; and
- manufacture at site using simply dimerization (1-C_4) and trimerization (1-C_6) technologies from IFD and possibly Phillips.

Sea imports will be off-loaded at the Marginal Wharf and pumped to pressurized storage tanks near the polyolefin units.

Manufacture plants will be integrated with the ethylene unit and will discharge product into pressurized storage tanks near the polyolefin units.

The demand for 1-C4 is 100 kTA and for 1-C6 50 kTA.

<u>Intermediate Storage</u>

To facilitate the high onstream times of the ethylene unit and to continue operation of the polyolefin unit during furnace decoking operations or abnormal/unusual start duration shutdowns of the ethylene unit, intermediate storage tanks are required:

FIGURE 2.5-16 Typical Polypropylene Reactors

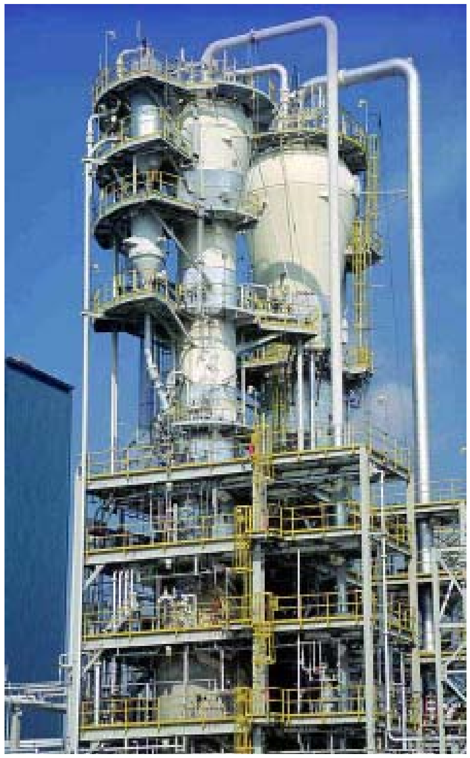


FIGURE 2.5-17 Typical Polypropylene Licensee Plant

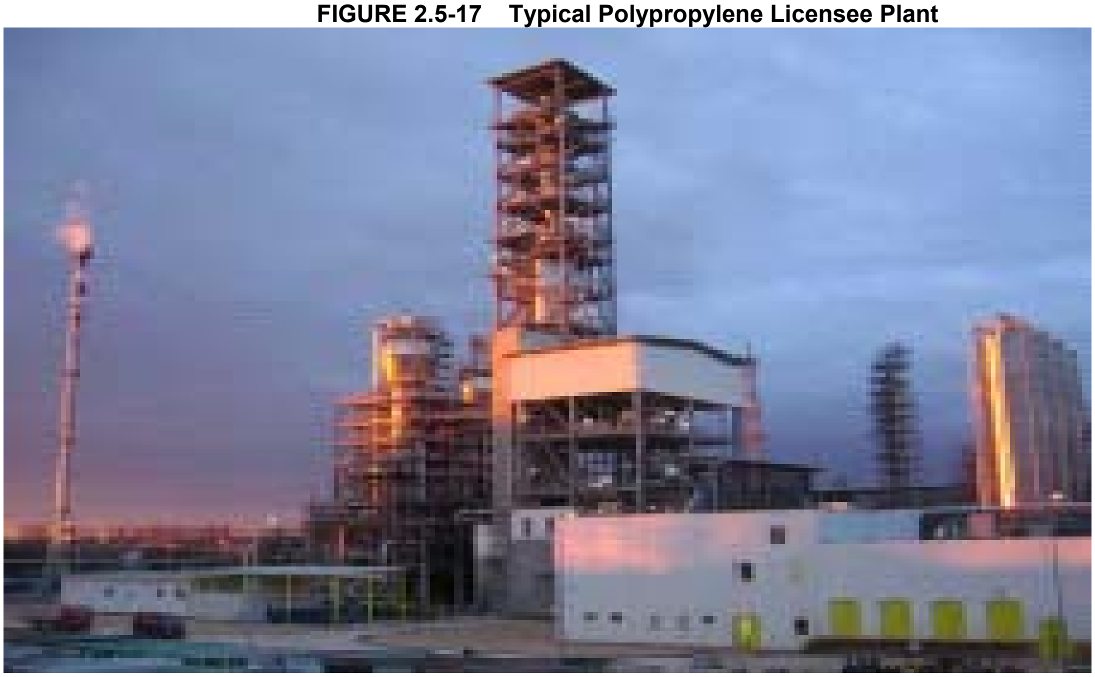


FIGURE 2.5-18 Typical Ethylene and Propylene Storage Tank

- for ethane and propane feedstock seven days; and
- for ethylene and propylene seven days.

The storage tanks will have capacities of:

- ethane 2 x 25,000 m^3;
- propane 2 x 10,000 m^3;
- ethylene 2 x 25,000 m^3; and
- propylene 2 x 10,000 m^3;

The sizing of these tanks is still under review.

The tanks will be insulated double wall atmospheric tanks and refrigerated to keep the contents at approximately -105°C for ethane/ethylene and -45°C for propane/propylene. All tanks will have concrete shell protection.

The system will include compressor/refrigeration systems and pumping/vapourization facilities.

2.5.10.3 Material Import/Product Export

The majority of catalysts and chemicals used within the petrochemical complex will be imported by sea (over 90%).

The majority of products and byproducts will be exported by sea.

All of the petrochemical material imports and exports will be through the Marginal Wharf.

Imported materials are:

- Propylene in either pressurized liquid or in a refrigerated state in Liquefied Petroleum Gas carrier ships and approximately 200 m^3.
- Possibly 1-butene and 1-hexene in liquid form. Shipment could be bulk or in iso-containers.
- Gas phase LLDPE and HDPE and polypropylene catalysts which are in solid form and shipped in special containers under a nitrogen blanket.
- Gas phase LLDPE and HDPE and polypropylene co-catalyst which are in liquid form and shipped in iso-containers under a nitrogen blanket.
- For LDPE small quantities of unused peroxide initiators which are shipped in drums.
- For all polyethylene and polypropylene technologies additives (i.e. anti-oxidants, ultraviolet stabilizers, anti-block, anti-stock, etc.) which are added to the final product in the finishing section of each unit to meet specific application/customer needs.
- Iso-pentane supplied in iso-containers and used as an intent heat transfer agent in the gas phase LLD and HDPE units.

- Lubricating and seal oils used by all processes (*).
- Cryogenic nitrogen (*).

(*) These materials will likely be supplied by truck.

Exported materials are:

- LLDPE, LDPE, and HDPE and polypropylene pellets shipped in bulk containers ship to USA destinations;
- LLDPE, LDPE, and HDPE and polypropylene pellets transported by truck to regional Canadian destinations;
- LLDPE, LDPE, and HDPE and polypropylene pellets shipped either in stretch wrapped pallets or bulk bags to foreign destinations (i.e. Latin America);
- hydrogenated gasoline and mixed C4s which will be shipped in liquid form to local refineries in Canada or the USA; and
- possibly treated spent caustic soda (*).

(*) Shipped by truck to the regional pulp and paper industry.

2.5.10.4 Ethylene Unit

The Keltic ethylene unit will have a design capacity of 1500 kTA but an initial operating capacity of 1200 kTA and a propylene capacity of approximately 200 kTA. Supplementary propylene will be imported to make up the total propylene feedstock requirement of 400 kTA for the polypropylene unit.

The design is based upon S&W ethylene technology and is similar to that currently being designed for SHARQ in the Kingdom of Saudi Arabia. The SHARQ ethylene unit cracks ethane and propane. The Keltic design also has considerable similarity with the NOVA Chemicals ethylene unit in Joffre, Alberta. This unit with a capacity of 1250 kTA cracked ethane and was successfully started up in 2001.

The products from the ethylene plant will be polymer grade ethylene, polymer grade propylene, and raw pyrolysis gasoline and Pressure Swing Adsorption high purity hydrogen. Waste fuels will be burned in the cracking furnaces (tail gas) or in power generation facilities (tail gas or fuel oil). The tar produced in the quench section will be disposed via trucks. The highlights of the processing scheme of the ethylene unit are:

- feed and vapourization;
- pyrolysis furnaces;
- quench exchangers;
- quench tower;
- circulating QW;

- process water treatment;
- CG compression;
- caustic wash, dehydration, regeneration and final compression;
- dethanizer and ethylene stripper;
- C2 hydrogenation;
- demethanizer;
- ethylene fractionation;
- refrigeration (ethylene and propylene);
- depropanizer;
- C3 hydrogenation;
- propylene fractionation;
- debutanizer; and
- spent caustic treatment (optional).

The design of the feed vapourization system is still under review and will be completed as part of the FEED work.

2.5.10.5 Feedstock Preparation

Feedstocks for the ethylene unit are ethane and propane extracted from LNG and SOEI gas and stored in refrigerated above ground double walled tanks located OSBL. These feedstocks are pumped to the ethylene unit.

Ethane is fed to the cracking furnaces via the ethane feed heater. Fresh liquid propane is supplied from storage and mixed with recycle propane then vapourized using waste heat. The mixture is then superheated and fed to the cracking furnaces.

The pyrolysis furnaces are designed to crack gaseous feedstock.

2.5.10.6 Cracking Furnaces

The processing scheme consists of furnaces designed for 1200 kTA ethylene production. The furnaces can be operated on an ethane, propane or a mixed feed. However, the predominant feed will be ethane.

Convection Section

Heat is recovered from the flue gases leaving the radiant section in a convection section. Feedstock is first preheated in the hydrocarbon Preheat-1 and Preheat-2 banks prior to mixing with dilution steam. The preheated hydrocarbon parallel passes at the outlet of Preheat-2 bank are combined in a header and mixed with dilution steam.

Additional heat is recovered from the furnace flue gas by superheating SHP steam to 500°C at 1525 psig in the SHP steam superheat convection bank. SHP steam is generated by heat recovery from the furnace effluent in the quench exchangers.

Radiant Section

The preheated hydrocarbon/dilution steam mixture is combined at the convection outlet to ensure uniform temperature of mixture and then distributed to the radiant coils.

Firing System

The radiant section is 100% floor fired using low nitrous oxides (NO_x) burners to minimize NO_x emissions. The burners are designed to fire plant tail gas at 10% excess air and are equipped with continuous pilots to ensure that the burner remains safely alight at all times. An induced draft fan mounted at the convection section outlet on the furnace superstructure produces the draft required for combustion.

Quench/Steam Generation System

Furnace effluent is rapidly cooled in USX-D quench exchangers. These are double pipe exchangers with a minimal adiabatic volume and heat is exchanged against boiler feedwater to generate SHP steam. Effluent is then further cooled in a horizontal shell and tube transfer heat exchanger quench exchanger. In the first part of the transferline quench exchanger, heat is exchanged against boiler feedwater to generate SHP steam. In the second part of the transferline exchanger, effluent is further cooled against the incoming boiler feedwater.

Decoke System

The pyrolysis of hydrocarbons forms a large quantity of coke which deposits on the radiant coil. This coke must be periodically removed by steam/air decoking. This procedure oxidizes and spalls the coke from the coil. The decoke effluent is directed to the radiant fire boxes where it is incinerated.

Quench Water (QW) System

The CG from the furnace area transferline exchangers feeds the QW tower via a transfer line. In the QW tower the upward flowing CG is cooled by direct contact with multiple stages of QW. Any water carryover from the water wash section is knocked out in the top section of the tower which contains a demister pad. Gas from QW tower overheads goes to the CG compressor.

The condensed water from the first four stages of compression is returned to the middle section of the QW tower and the hydrocarbon drips from the CG compressor section are returned to the bottom section of the QW tower.

The water/hydrocarbon mixture, which collects in the bottom of the QW tower flows by gravity to the Oil/Water Separator No. 1 (OWS-1). The vessel separates the heavy phase, which contains tar and coke particles, from the bulk stream. A water/hydrocarbon interface is established which allows separation of the remaining two phases.

OWS-1 is a long horizontal vessel. The feed from the QW tower enters at one end of the vessel. There are vertical baffles located near the end of the separator. All of the heavy material has settled to the bottom of the vessel before the first baffle is reached so there should be no tar compounds in the next compartment. There are no pump suction lines on the "tar" side of this baffle. The aim of this system is to produce a lower QW circulation loop which cools the CG to condense the heavy hydrocarbon compounds, not condense the steam, and remove coke fines and tar from the CG. This lower loop is not used to provide QW heat to the plant as it contains naphthenic, asphaltic and polymeric compounds which foul heat exchanger surfaces with tar and heavy oils.

Throughout the length of OWS-1 there is a water/hydrocarbon interface. The hydrocarbon layer overflows the second baffle in OWS-1. The pyrolysis gasoline pumps take suction from the last compartment in the separator and deliver the stream as a product to battery limits.

The QW is used to provide heat to several process users. Excess heat not removed by the process users from the primary QW is removed using cooling water in the primary QW cooler. QW, free of dispersed and emulsified hydrocarbons and solids, feeds the dilution steam system.

Dilution Steam Generation System

QW from the QW coalescer system feeds the high pressure water stripper after it is preheated in the high pressure water stripper feed heater against high pressure steam. The high pressure water stripper serves two functions: to preheat the water and to strip dissolved hydrocarbons and acid gases such as H_2S and CO_2. The system is designed to reduce the amount of styrene in the feed to the Dilution Steam Generator, by stripping it and recycling the styrene to the QW tower.

The water from the bottom of the high pressure water stripper is pumped to the Dilution Stream Generator feed heater where it is preheated against Medium Pressure (MP) condensate before it is sent to the Dilution Stream Generator. MP steam is used to reboil the generator and raise dilution steam. The dilution steam is superheated by heat exchange with incoming MP steam.

Cracked Gas (CG) Compression

The CG compression system utilizes a four stage compressor. The overhead from the QW tower is fed to the CG first stage compressor suction. The top of the tower acts as the first stage suction drum. The first stage discharge is cooled by cooling water and fed to the CG second stage suction drum along with a small methane recycle from the demethanizer cold boxes. Hydrocarbon liquid from the drum is sent to the bottom of the QW tower where the light gases are stripped and the heavy components leave with the pyrolysis gasoline. The condensed water returns to the middle section of the QW tower. The vapour proceeds to the second stage of the CG compressor. The second stage compressor discharge together with the recycle from the high pressure C2 stripper is cooled against cooling water and fed to the CG third stage suction drum. The liquid is returned to the CG second stage suction drum and the vapour proceeds to the third stage of the CG compressor. The third stage compressor discharge is combined with vents from the C2 splitter system and any off-spec ethylene from the refrigeration compressor, cooled against cooling water, and is then fed to the CG third stage discharge drum. The liquid is returned to the CG third stage suction drum, and the vapour proceeds to the caustic tower.

Cracked Gas (CG) Compression/Caustic Wash System

The acid gases must be removed from the process gas to meet ethylene product specifications, and to protect the acetylene hydrogenation catalyst from H_2S poisoning. Compressed vapour from the third stage discharge drum feeds the caustic wash system.

The caustic tower consists of three sections. The two lower ones are used for caustic scrubbing and the top section is used for washing the treated gas with cooled, deaerated, boiler feedwater to avoid caustic carryover into the downstream equipment. A two stage caustic treatment system is provided to insure that the low CO_2 specification of the ethylene product is met.

The spent caustic is sent to the spent caustic degassing drum, where the light hydrocarbon and light gases are removed from the liquid and sent to the flare. The degassed spent caustic liquid is sent to the spent caustic storage tank in the spent caustic treatment unit (See Section 2.5.10.12) which is described in the attachment to this process description.

Dehydration, Regeneration and Final Compression

The overhead from the caustic tower passes through the fourth stage of the CG compressor before being cooled against cooling water and propylene refrigerant. It is then fed to the drier feed knockout drum. The liquid water/hydrocarbon is sent to the CG third stage discharge drum. The vapour from the drier feed drum is fed to the dehydrator system.

The CG dehydrator system has two vessels containing 3A molecular sieves, one in operation and one on regeneration.

Heating the bed with warm tail gas, passed through a regeneration gas feed heater, reactivates the molecular sieves. The vapour proceeds to the fuel gas drum. After heating, the drier is cooled and kept in a standby mode. The reactivation gas is also used to reactivate the secondary drier.

High Pressure Deethanizer and Low Pressure C2 Stripper System

The dried vapour is chilled initially by a pump-around from the high pressure deethanizer which recovers the refrigeration in the bottom section of the tower and by the coldest level of propylene refrigerant before it is fed to the high pressure deethanizer. The tower bottom feeds the high pressure C2 stripper. The overheads stream is partially condensed against the demethanizer tower bottoms stream. The uncondensed vapour, consisting of C2s and lighter passes to the acetylene hydrogenation reactor system.

The high pressure C2 stripper overheads vent is recycled to the CG compressor second stage discharge. The bottom stream is cooled and sent to battery limits as a C3+ product.

The high pressure deethanizer is operated such that there are no C3s in the overhead product of the tower. The bottom of the tower is operated with enough C2 leakage to maintain the bottoms temperature at a point where the fouling is minimized.

The C2s lost in the bottoms of the high pressure deethanizer are easily recovered in the high pressure C2 stripper. The high pressure C2 stripper is run at a much lower pressure than the high pressure deethanizer tower. This ensures that the C2s vapourize and can be easily stripped from the feed. These C2s are recycled to the CG compressor.

Hydrogenation

The high pressure deethanizer overhead is heated against secondary drier effluent and high pressure steam before passing to the first acetylene reactor. There are two reactors operating in series. The effluent of the first reactor is cooled with cooling water before entering the second reactor. The effluent of the second reactor is cooled against cooling water. These reactors convert the acetylene to ethylene/ethane. The gas is then dried using a molecular sieve dehydrator and chilled against the high pressure deethanizer overheads before being sent to the demethanizer feed chilling train. The secondary drier removes trace water which may have formed in the reactors.

Demethanizer System

The dry CG enters the chilling train and is cooled and partially condensed against the warmest levels of ethylene refrigerant before entering the demethanizer feed Separator No. 1 drum.

The vapour from the first drum is chilled by the two coldest levels of ethylene refrigerant, the methane recycle stream, the tail gas and the hydrogen product stream before going to the Demethanizer Feed Separator No. 2 drum. The vapour from the second drum is chilled against the liquid and vapour from the Demethanizer Feed Separator No. 3, methane recycle and tail gas before passing to the third demethanizer feed drum. The vapour from the third drum either mixes directly with demethanizer overheads to feed Expander No. 1, or is heated in the cold box and taken off as hydrogen feed to the Pressure Swing Adsorption unit. In the Pressure Swing Adsorption unit, a pure hydrogen stream (99.9+% pure) is produced to satisfy the downstream derivative units. The purge gas stream from the Pressure Swing Adsorption unit is sent to the fuel gas drum.

The demethanizer overheads pass to Expander No. 1 via a suction drum. The effluent from the first stage expander proceeds to the Expander No. 2 suction drum. The vapour from the drum is fed to the second stage of the expander. The effluent from the second stage expander is fed to its discharge drum. The vapour stream is heated in the demethanizer core exchanger. The vapour is then recompressed in the second stage recompressor, ready for use for drier regeneration. Excess tail gas sent directly to the fuel gas mixing drum on split pressure control.

The liquid from the Expander No. 2 suction drum is fed to Expander No. 2 discharge drum. The liquid from Drum No. 2 is recycled to the CG compressor second stage suction after being heated in the demethanizer core exchanger.

The feeds to the demethanizer are essentially ethylene and lighter material. Thus, the bottom from this column does not need deethanization and can feed the C2 splitter directly. The demethanizer is reboiled with propylene refrigerant vapour and the reflux is condensed against low temperature ethylene refrigerant. Part of the demethanizer bottom product is vapourized in the high pressure deethanizer condenser before being sent to the C2 splitter. The remainder feeds the C2 splitter directly.

Ethylene Fractionation

The ethylene-ethane superfractionator receives two feeds: a liquid stream from the demethanizer bottoms which serves as the top feed and a vapour stream (via the high pressure deethanizer condenser) also from the bottoms of the demethanizer which serves as the lower feed to the tower. The tower overhead is reheated and fed to an open loop heat pump system. The heat pump discharge is desuperheated against cooling water and tower overheads before being condensed in the bottom reboiler as well as in the recycle ethane vapourizer.

The ethylene product is taken off as a liquid. It can then be either chilled against two levels of ethylene refrigeration to be sent to liquid storage or pumped and then heated against ethane feed and methanol to reach the ISBL as a vapour at 38°C and 945 psig. The ethane from the tower bottom is vapourized in the recycle ethane vapourizer and superheated in the C2 heat pump suction heater. It is then combined with the fresh feed and heated before entering the furnace area to be cracked to extinction.

Refrigeration

The refrigeration demands of the process are supplied by various levels of cascaded propylene and ethylene refrigeration, supplemented by refrigeration from matched internal process streams. Lowest level refrigeration is supplied by the turbo-expanders. A three-stage ethylene machine supplies refrigeration to the demethanizer chilling train. Condensation is provided by fresh ethane feed and propylene refrigeration. Three stages of propylene refrigeration are provided. Propylene is condensed against cooling water.

Depropanizer System

The bottom stream from the high pressure deethanizer flows to the high pressure depropanizer. This tower produces a mixed C3 overhead stream and C4 plus stream with some C3s as bottom stream. The overhead stream is totally condensed in the high pressure depropanizer condenser against CW, before flowing to the high pressure depropanizer reflux drum. Liquid from the high pressure depropanizer reflux drum flows to the C3 splitter

The bottom from the high pressure depolarizer is fed to the high pressure depropanizer where remaining C3s are separated from the C4 plus feed. The tower overheads are condensed in the high pressure depropanizer condenser against C3R before flowing into the overhead drum. Liquid from the drum is pumped by high pressure depropanizer overhead pump to the C3 splitter. The C4 plus bottom product from the high pressure depropanizer tower is sent to the debutanizer tower.

By using the split tower design, the reboilers have very low temperatures such that fouling is not an issue.

C3 Hydrogenation System

The purpose of the C3 hydrogenation unit is to fully hydrogenate the methyl acetylene and propadiene in the raw C3 product stream from the high pressure depropanizer. The required specification is reached in a one stage reaction section using a high liquid recycle rate to smoothly control the reaction exotherm, limiting oligomers formation, ensuring long cycles and safe operation and ensuring that the polymer grade propylene product meets the methyl acetylene and propadiene specifications.

Reaction Section

The C3 splitter bottom is mixed with hydrogen make-up, before entering the reactor.

C3 Splitter System

The C3 splitter is a high pressure tower integrated with a heat pump compressor and works as a closed-loop heat pump system. The C3 splitter feed is from the high pressure and high pressure depropanizer. The fractionation in the C3 splitter separates the propylene/propane feeds into a high purity propylene overhead vapour and a propane bottom stream for recycle cracking.

The overhead vapour of the C3 splitter is fed to the C3 heat pump compressor via suction drum. The C3 heat pump compressor discharge vapour is desuperheated and condensed against C3 splitter reboiler and against propylene refrigerant in the C3 heat pump trim condenser. The condensed propylene flows to the C3 splitter reflux drum.

Part of the liquid is withdrawn from the reflux drum and pumped by propylene product pump to OSBL as polymer grade propylene product. The system is designed to export up to 100% of the design propylene make as liquid product. The liquid from the reflux drum is also returned to the top tray of the C3 splitter as reflux.

Debutanizer System

The bottom stream from the high pressure depropanizer flows to the debutanizer. This tower produces a mixed C4 overhead stream, low in C5s, and a debutanizer raw C5+ gasoline net bottom stream. The overhead stream is totally condensed in the debutanizer condenser against C3 refrigerant, before flowing to the debutanizer reflux drum. The mixed C4 product is sent OSBL where it is partially hydrogenated in the C4 hydrogenation unit for butane-1 production.

C4 Hydrogenation

The purpose of the C4 hydrogenation unit is to fully hydrogenate the raw C4 stream from the debutanizer. The required product specification is reached in a two stage reaction system.

2.5.10.7 Linear Low Density and High Density Polyethylene – (Univation)

The UNIPOL™ polyethylene process, which includes all facilities from receipt of raw materials through pelleting is described below. The gas phase fluidized bed process with complete back mixing and unparalleled stability, produces a very uniform product quality while being inherently safe, simple and environmentally friendly.

Catalysts

This UNIPOL™ process is based on the use of Zeigler-Natta, metallocene LLDPE and chromium type catalysts. Since these types of catalysts are poisoned by moisture and oxygen, the feeds to the reactor including ethylene, comonomer, nitrogen and hydrogen pass through guard beds to remove these impurities, depending on the quality of the feedstock. The comonomers are subject to degassing prior to being fed to the guard beds. Feed purification requirements will be evaluated as part of the integration concepts to be evaluated in detail as part of FEED work activity.

All polymerization catalysts are shipped ready to use in special shipping containers under a nitrogen blanket.

Reaction

The reaction system can be subdivided into several parts:

- reaction loop;
- catalyst;
- feed; and
- product discharge and resin purging with vent recovery.

Reaction Loop

The fluidized bed reactor system consists of a vertical pressure vessel with an expanded upper section for de-entrainment of polymer particles. The reactor is operated at 185 to 230 degrees Fahrenheit (^{o}F) (85 to 110°C) and 350 psig (24.1 bar (b)). The reactant gas stream circulates through the bed and is cooled in an external heat exchanger, thus removing the exothermic heat of reaction. A blower in the recycle loop provides the pressure increase to overcome the differential pressure of the loop reactor.

The initial UNIPOL™ plants kept the recycle reactants gaseous at all times. With the improvement in catalysts and the development of condensation mode operation, state-of-the-art UNIPOL™ plants now operate with the injection of liquefied condensing agent in order to significantly expand the capacity production for LLDPE and Ziegler-Natta (Z/N) HDPE. For chrome based HDPE increased throughputs with super condensing are in development. The removal of sensible heat by the evaporation of the induced condensing agent increases the output rate by approximately 35 percent. The Keltic plant incorporates all of these features.

The fluidized bed reaction is characterized by a long residence time and extensive back mixing, which yields a very uniform product. Product polymer is drawn off periodically and depressurized into the product degassing tanks. The exiting gas from the degasser is recycled to the reactor. The hydrostatic head across the reactor bed allows for recycle of the gas to the reactor without the need for gas recompression. A purge stream is necessary to prevent the build-up of inerts for some operating conditions. The reactor residence time ranges from 1.5 hour to 3 hours, depending on the product and capacity.

Catalyst Feed

Most UNIPOL™ polyethylene catalysts are fed to the reactor via the proven, proprietary design, dry catalyst feeder. However, some the UNIPOL™ polyethylene catalysts are pumped into the reactor as a slurry in mineral oil.

Product Discharge

As catalyst and raw materials are fed to the reactor, polyethylene is produced and accumulates in the fluidized bed contained within the reactor, causing the bed level to rise. When the bed level reaches a predetermined height, a product discharge sequence is automatically initiated. A discharge valve opens allowing a portion of the fluid bed to pass into the discharge system. The discharge system is designed to maximize the quantity of resin exiting the reactor while minimizing the amount of reactant gas that exits.

Resin Purging with Vent Recovery

The polymer granules leaving the product degassing tank are delivered to the purge bin, where the residual hydrocarbons are stripped with nitrogen and the catalyst is deactivated with a very small quantity of dilute steam. The purge tower provides about three hours of powder hold-up. The purge gas stream leaving this vessel is cooled and sent to a separator where the comonomer is recovered and recycled. The light gases are sent to the vent compression system. The polymer from the purge bin, in the form of a granular powder, is sent to the finishing section of the plant.

In the vent system, the vent stream is collected and fed to the compressor where it is cooled and condensed. It is then fed to the separator where the lights are taken overhead and the condensate is fed back to the reactor.

Additive Addition and Pelletizing

For the production of palletized product, the degassed granular powder is gravity fed to the mixer feed for mixing with additives. Additives are metered by feeders and flow by gravity to the resin/additive conveyor where they are combined with the main resin stream and fed to the mixer. The pelleting system consists of a twin screw mixer to melt the polymer, followed by a gear pump to pressurize it through an underwater, die-face cutter. The process takes advantage of thorough back mixing in the reactor and the high amount of sensible heat in the powder (since there is little powder storage upstream of the mixer). These features serve to minimize the amount of homogenization required in the mixer and reduce the heat requirement for melting, which results in a power saving, and less potential for product contamination.

Product Handling and Storage

From the pelletizer, the product slurry (water/pellet mix) is transferred to the hydraulic conveying system which is unique to the Keltic Petrochemical facility and still under design review. In most plants the pelletizer pellets are dewatered in a centrifugal dryer and the transferred to a resin handling system. Normal air conveying is used throughout the resin handling system. Two combination storage/continuous blending bins plus one (1) loading bin per reactor line are recommended for surge capacity and product change/off-grade recovery flexibility. Shipment is normally made in bulk containers (van boxes, hopper cars, etc.) or small packages. Product storage depends on the producer's marketing philosophy. The bagging lines are typically fed from the resin handling bins (see schematic Figure 2.5-19).

Additional Features

All recent UNIPOL™ polyethylene reactor lines have included a patented configuration with a standby expansion turbine connected to the cycle gas blower's motor. If power is lost the reactor is slowly vented down through the turbine to the flare in order to maintain gas circulation and bed fluidization while the reactor's catalyst is killed. Maintaining circulation improves the kill and reduces the sizing basis for the flare by nearly an order of magnitude. This reduces the OSBL investment and makes the facility a better neighbour. The reliability of the system has been proven in over 15 operating installations. The Keltic HDPE plant will have this feature.

2.5.10.8 Low Density Polyethylene (LDPE) – (ExxonMobil)

The selected technology has been operating at the Meerhout plant in The Netherlands since 1993. A similar design (capacity and configuration) is currently in the detailed design phase and being licensed to Huntsman Chemicals for its Wilton, UK facilities. The characteristics of the technology are:

- polymer conversion per pass across the reactor is 30-38%;
- operating pressure is 2500-3100 b;
- a tubular reactor layout with six reaction zones, four side streams and multiple internal diameters; and

EHSS design is to ExxonMobil standards.

FIGURE 2.5-19 Schematic Showing Loading Pellets to Trucks

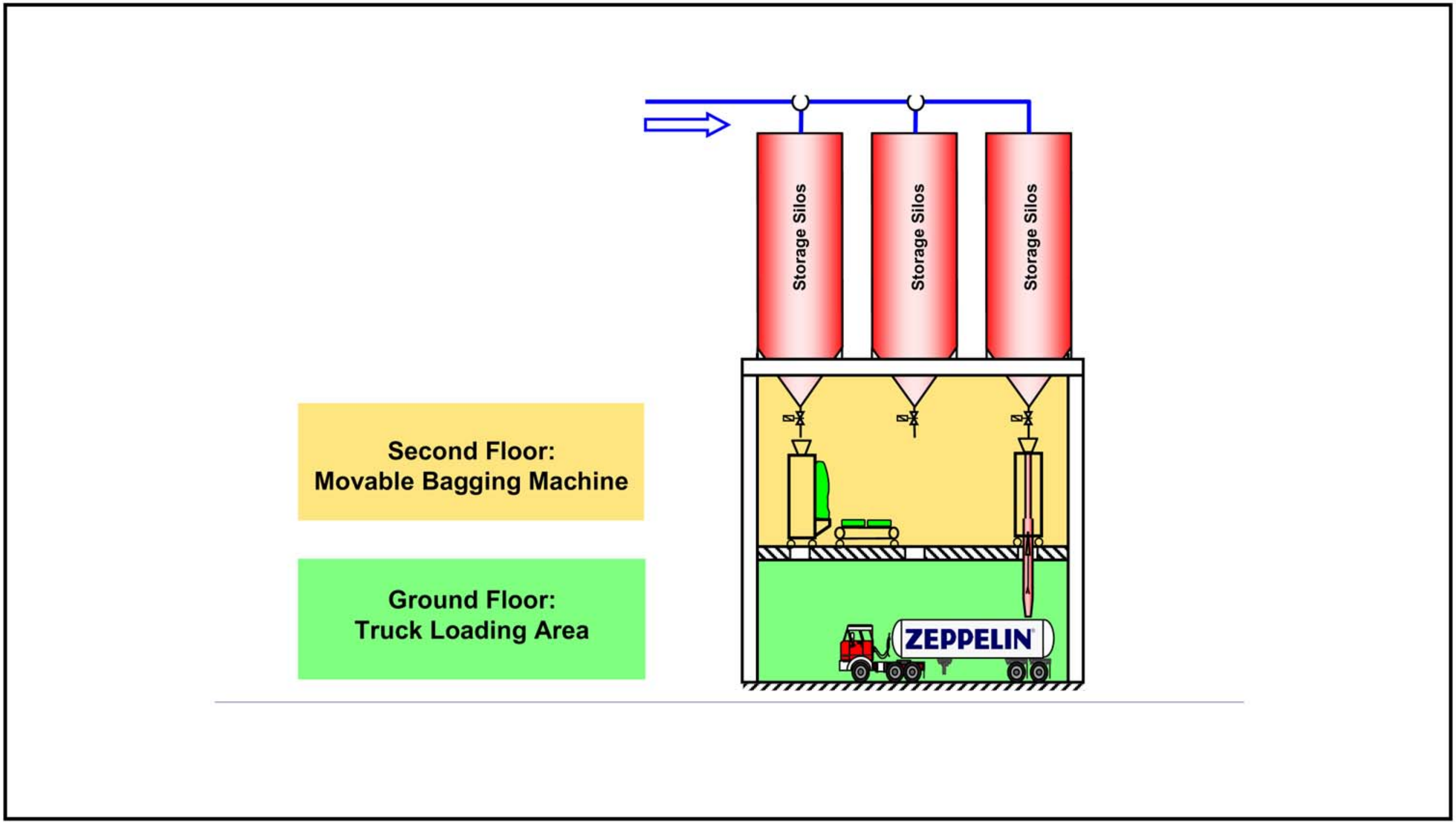


FIGURE 2.5-19
KELTIC PETROCHEMICALS INC.
SCHEMATIC SHOWING LOADING PELLETS TO TRUCKS
JULY 2006
Source: Zeppelin

The technology for the production of LDPE by high pressure polymerization can be divided into the following sections:

- ethylene compression;
- polymerization;
- initiator handling;
- high pressure separation and recycle;
- high pressure separation and recycle;
- extrusion, additives dosing and palletizing;
- product blending and degassing;
- CTA handling;
- mineral oil handling;
- effluent systems; and
- utility systems.

There are two compressors:

- a primary two stage reciprocating compressor; and
- a secondary five stage reciprocating compressor.

The polymerization of ethylene takes place in a tubular reactor at a pressure of approximately 2500-3100 b and at temperatures between 160 and 300°C, depending on the grade being produced. For different grades, different combinations of temperature and initiators may be chosen and different amounts of CTA (propylene and/or propane) may be added. The tubular reactor consists of a preheater and polymerization sections. Ethylene compressed to the polymerization pressure is fed to the preheater. In the preheater the ethylene is preheated to the initiation temperature by means of high pressure steam.

From the preheater, ethylene enters the reactor, where adding initiator starts polymerization. The initiator is supplied by means of a metering pump. The reactor tubes are cooled externally in order to remove the heat of reaction.

The primary compressor pressures:

- the ethylene feed from battery limit; and
- high pressure purge gas.

The pressure in the discharge of the primary compressor is 250 b. The compressor is equipped with a cylinder lubrication oil system. Each stage of the compressor is equipped with pulsation dampeners, oil separators, and intercoolers.

The secondary compressor pressures two streams:

- the net discharge from the primary compressor;
- the high pressure recycle gas from the high pressure separator.

The compressor is equipped with a complete cylinder lubrication oil system, crank lubrication system and a plunger coolant oil system.

The initiators used in the process are commercially available peroxides. The initiators are stored in conditioned storage rooms. Storage temperature, min./max., for the different types are:

- Initiator A: -25/+30°C;
- Initiator C: +10/+20°C; and
- Initiator S: =25/+10°C.

Within the initiator handling building, batches of diluted initiator are prepared in initiator preparation vessels which are pressurized with nitrogen. The initiator is diluted with solvent. After mixing, the initiator solutions are transferred to the initiator pump vessels. From these vessels the initiator solutions are pumped to the injection points on the tubular reactor.

The reactor is cooled by demineralized water circulated in a closed loop. At the end of the reactor, the mixture of polyethylene and unconverted ethylene is expanded through the reactor pressure control valve and enters the high pressure separator.

The mixture of polyethylene and ethylene enters the high pressure separator at approximately 270 b and 240°C. The level in separator is measured by means of radioactive type level measurement and controlled by the outlet valve to the high pressure separator. Most of the unconverted ethylene is separated by gravity from the polymer and cooled in recycle gas coolers.

After passing through the final separator the ethylene is recycled to the suction side of the secondary compressor. The polymer from the high pressure separator is expanded and introduced into the high pressure separator. Ethylene still dissolved in the polyethylene is separated in the high pressure separator at approximately 2.0 b and 220°C. The high pressure separator also serves as a feed bin for the hot melt extruder. The level in the separator is measured by means of a radioactive type level measurement.

Before sending the ethylene back to the primary compressor, the condensed oil, and wax is separated in the wax separator. The wax separator is periodically drained to remove low MW waxes.

From the high pressure separator the polyethylene flows by gravity to the hot melt extruder. The hot melt extruder is provided with an underwater pelletizer. The product pellets leaving the pelletizer with the pelletizing water are normally dried in the centrifugal dryer. Then the pellets are conveyed through the product buffer hopper B206 and rotary valve B203 to the blending and storage area.

For the Keltic plant a hydraulic conveying system will transfer products to the main product handling system. If the grades to be produced require additives these are metered into the hot melt extruder as a master batch or as a mixture of additives and base pellets, by means of a side arm extruder.

2.5.10.9 Polypropylene

The UNIPOL™ polypropylene process, which includes all process facilities from receipt of raw materials through pelleting, is described in this section.

Propylene and Raw Material Purification

All polymerization catalysts are sensitive to certain impurities in the raw material feed streams. The sensitivity depends on the catalyst in question and the particular impurity involved. Normally only molecular sieves for water removal from propylene are required. However, depending on the quality of the various materials being used, it may also be appropriate to include one or more additional purification steps for some raw materials to remove other impurities, thereby protecting catalyst productivity, and smoothing out the operation of the reaction system. Selection of the propylene and raw materials purification requirements will be made during FEED work activity. Additional purification may include one or more of the following:

- Propylene: Simple degassing column to strip carbon monoxide (CO), CO_2, and oxygen.
- Ethylene: Fixed bed catalyst for removal of oxygen.
- Hydrogen: Methanation for removal of CO, CO_2 and oxygen.
- Nitrogen (for reaction area use): Fixed bed catalyst for removal of oxygen.

These additional purification steps would typically only be used as guard beds to protect against impurity spikes. Bed life between regenerations is relatively long (measured in months, not days). Therefore, the cost of these facilities can be reduced by not including spare beds. The only exception may be the water removal for propylene. The polymerization catalysts are also sensitive to other traditional poisons like sulphur, carbonyls, etc., but these materials are rarely present in sufficient quantity to be of concern.

Catalyst

All polymerization catalysts are shipped and stored in special shipping containers under a nitrogen blanket. They are shipped in read-to-use form.

Reaction

The reaction system can be subdivided into several parts:

- primary reaction;
- impact reaction; and
- product discharge and separation.

Primary Reaction Loop

The primary reaction loop, used for producing homopolymer, random copolymer and the homopolymer segment of impact copolymer, consists of a reactor, a cycle gas compressor/turbine, and a cycle gas cooler. The reactor is a continuous back mixed fluid bed reactor. The bed of fluidized resin is contained in the straight section of the vessel while an expanded top section serves to disentrain resin from the cycle gas, allowing it to fall back into the fluidized bed. The reactor operates at about 500 psig (3500 kilopascals (kPa)) and contains the fluidized bed of granular polypropylene with a trace of catalyst. The cycle compressor circulates reaction gas through the bed, fluidizing it and providing the agitation required for excellent back mixing and removal of the heat of reaction. No significant temperature or composition gradients exist within the fluid bed. The reaction heat is removed from the circulating gas by an external shell and tube, gas/water heat exchanger.

Product properties are controlled by reaction conditions. Computer models are used to determine the required reaction conditions based on the catalyst type and specific product being produced. Melt flow is controlled by adjusting the amount of hydrogen in the cycle gas. Isotactic index is controlled by adjusting the amounts of cocatalyst and selectivity control agent in the system. For copolymers, ethylene incorporation is controlled by adjusting the ethylene content of the cycle gas. Gas composition is controlled via analyzers and by adjusting feed stream flow rates. System pressure is held constant by adjusting propylene feed rate. The reaction bed temperature is mild (<80°C) and temperature is controlled by adjusting the temperature of the cycle gas returned to the reactor.

Production rate is highly flexible and is controlled by adjusting the catalyst feed rate. Turndown of the UNIPOL™ reaction system is virtually unlimited; the turndown limitation of the plant is dictated primarily by pelleting which is typically 50% of nameplate rates. Resin properties do not vary with production rate. The various catalyst types offered by Dow can be used to tailor the product properties to meet specific customer product needs.

The polymerization reaction can be stopped or slowed down with a “kill” system. In case of an emergency such as electrical power failure, cycle gas venting from the reactor, through an auxiliary turbine, will drive the compressor at a reduced speed long enough for the “kill” gas to be dispersed in the reactor and stop the polymerization.

Impact Reaction Loop

Impact (or block) copolymers are prepared in a second fluid bed reactor operating in series with the primary reactor. The impact reaction loop, which is a smaller replica of the primary loop including a reactor, compressor, and cooler; operates at about 350 psig (2415 kPa) and 60-75°C. Homopolymer resin containing active catalyst is transferred from the first reactor to the second where an ethylene/propylene polymeric mixture intimately dispersed in the homopolymer base segment is produced. The impact reactor does not require additional catalyst feed.

Product Discharge and Separation

As catalyst and raw materials are fed to the reactor, polypropylene is produced and accumulates in the fluidized bed contained within the reactor, causing the bed level to rise. When the bed level reaches a predetermined height, a product discharge sequence is automatically initiated. A discharge valve opens allowing a portion of the fluid bed to pass into the discharge system, which is designed to maximize the quantity of resin exiting the reactor while minimizing the amount of reactant gas that exits. The polypropylene then flows to a transfer system which moves the resin to the purging system. Bed level is controlled by varying the product discharge frequency.

Resin Degassing and Vent Recovery

Resin leaving the reactor contains absorbed hydrocarbons. These hydrocarbons are purged and recovered from the resin to meet safety, environmental, monomer utilization, and product quality standards.

Granular resin is transferred from the reaction area to a small vertical product receiver. The granular resin flows down through the receiver by mass flow, closely approaching plug flow, and is purged with counterflow recycle nitrogen to remove the bulk of the hydrocarbons dissolved in the resin and carried out of the reactor with the resin. Resin flows by gravity from the receiver to the purge bin. The gases entering the product receiver with resin as well as the purge nitrogen pass overhead through a filter and flow to the vent recovery system.

Resin flows down through the purge bin by mass flow with minimal resin back mixing. Fresh nitrogen is injected into the bottom of the purge bin and flows upward to the purge hydrocarbon from the resin. The purge nitrogen containing a small amount of hydrocarbon is then vented to the flare. Resin reaching the bottom of the bin has been purged of absorbed hydrocarbons such that all safety, environmental and product quality requirements have been satisfied.

The purge gas flowing out of the product receiver enters the vent recovery system. The stream is compressed then chilled to condense the bulk of the hydrocarbon in the stream. The recovered hydrocarbon is fed to a simple column for rough separation into a monomer enriched stream and a propane rich stream. The monomer rich stream is returned to reaction while the propane rich stream is used as fuel or sold. A portion of the lean nitrogen stream from which hydrocarbon has been condensed is recycled to the product receiver and the reaction system and the remainder of the lean nitrogen is vented to the flare.

Resin Additive Handling

Facilities are provided for handling both solid and liquid additives. Solid additives are fed to the pelleting system in the form of master mix, which is a blend of granular resin and solid additives.

A small quantity of granular resin to be used for making master mix is periodically diverted from the primary resin feed to the pelleting system to a water jacketed vessel where it is fluidized and cooled, as required, to facilitate blending with the solid additive. The cooled resin flows by gravity to a conventional horizontal ribbon blender. Solid additives are charged by hand and blended with the cooled resin. The resin/additive mixture (master mix) is fed to the pelleting system by a loss-in-weight feeder. Liquid additive is pumped directly from the shipping container to the pelleting system.

Pelleting

The UNIPOL™ reactor produces a granular resin with a consistent particle size distribution which is readily pelletized. The stability and reliability of the UNIPOL™ process allows the pelletizing operation to be accomplished in the most economical fashion by “close-coupling” the mixer and pelletizing operations to the reaction system. Resin and additives flow directly to a low energy pelleting/controlled rheology system which utilizes a mixer/melt pump configuration.

Typical Resin Handling, Storage, Blending and Shipping

From the pelletizer the product slurry (water/pellet mix) is transferred to the hydraulic conveying system which is transferred to a hydraulic conveying system which is unique to the Keltic facility and still under design review.

2.5.10.10 Comonomers

Butene-1

The butene-1 plant will supply butene-1 comonomer to the downstream polyethylene units (LLDPE and HDPE). The butene-1 shall be designed for a nameplate capacity of 100 kTA (still under review).Polymer grade butene-1 will be produced by the dimerization of ethylene most likely using Institut Français du Pétrole technology.

Hexene-1

The hexene-1 plant will supply hexene-1 comonomer to the downstream polyethylene unit (LLDPE). The hexene-1 plant will have a capacity of 50 kTA (still under review).

Alternatively hexene-1 may be purchased and shipped to the site. If a separate hexene-1 plant is provided it will most likely use Phillips technology to produce the hexene-1 by the trimerization of ethylene.

2.5.10.11 Intermediate Storage

Today large capacity ethylene plants operate 4-5 years between major shutdowns. This level of reliability is made possible by the design of the plants systems, selection of plant equipment and the reliability and maintenance programs initiated in the operating facilities.

Derivative units (LDPE, LLDPE, HDPE, and polypropylene) are also designed and operated with similar requirements for high onstream times. However, the type of operation (i.e.

multiplicity of products) and inherent characteristics of the processes (i.e. powder handling, melt extrusion) places high demands on equipment performance with the result that the time between major shutdowns is typically two years.

To facilitate the high onstream times of the ethylene unit and to continue operation of the polyolefin unit during furnace decoking operations or abnormal/unusual start duration shutdowns of the ethylene unit intermediate storage tanks are provided.

- for ethane and propane feedstock seven days; and
- for ethylene and propylene seven days.

The sizing of the storage tanks is under review but the expected capacities are:

- Ethane 2 x 25,000 m^3;
- Propane 2 x 10,000 m^3;
- Ethylene 2 x 25,000 m^3; and
- Propylene 2 x 10,000 m^3.

The tanks will be insulated double wall atmospheric tanks and refrigerated to keep the contents at approximately -105°C for ethane/ethylene and -45°C for propane/propylene. All tanks will have concrete shell protection. The system will include compressor/refrigeration systems and pumping/vapourization facilities.

2.5.10.12 Flare and Thermal Oxidizer

There are two choices of flare system for the petrochemical complex but both have the same fundamental design basis. The fundamental design basis is:

- an emergency or High Pressure flare system which will only operate under infrequent emergency conditions; and
- a continuously operating low pressure flare system which will operate to handle all of the very low and low flow rates from a normally operating petrochemical complex.

There are then two choices of flare design.

1. A ground flare with both high pressure and low pressure capability. These types of facilities are costly and usually installed whenever noise or visual impact is a “local” community concern.

   The ground flare would consist of multiple burners arranged in stages. These stages open up to meet the demand as the pressure rises. The flare uses the waste gas pressure to aspire air to the flame bundle. The burners, to be selected for the ground flare, provide very high capacity along with a very compact and short flame. The burners are arranged in rows called stages, which are activated and deactivated by a staging control system. This system will be designed to cross light from one burner to the next. Since the burners require some minimum pressure for smokeless operation, a staging control system is provided to reduce the number of burners in service (de-stage) when pressure falls below a setting point. To protect the plant from overpressure, the control system will increase the number of burners in service (up-stage) when pressure rises above setting points.

2. An elevated flare stack with both high pressure and low pressure capability. This type of flare is typical of North American installations and is low cost.

There would be two elevated flare stacks and a “thermal oxidizer.”

- High pressure or emergency (60-72” dia. and 100 meters high).
- Low pressure or normal intermittent flaring (12-18” dia. and 100 meters high). This stack is used intermittently whenever the continuous recovery or thermal oxidizer capacity is exceeded.
- Low pressure or continuous recovery which in effect a “thermal oxidizer” as the firebox of the power generating plant will be used. A recovery blower collects all of the low level emissions to flare and discharges them into the air intake of the power plant fireboxes.

The final choice of flare systems will be made during the FEED phase.

2.5.10.13 Sea Water Cooling System

Sea water cooling has been selected as the preferred method of cooling for the petrochemical plant. The basis was the limited availability of fresh water make-up at the Keltic site.

The principle user of cooling water in the petrochemical facility is the ethylene unit (approximately 60-65%) of the total demand of 106,000 m^3/hr. This demand follows a cursory analysis of maximum air cooler usage in the ethylene unit.

A summary of the key options considered is presented below in Table 2.5-1. The sketch of the options is self-explanatory (see Figure 2.5-20).

FIGURE 2.5-20 Schematic Assessment of Cooling Water Options

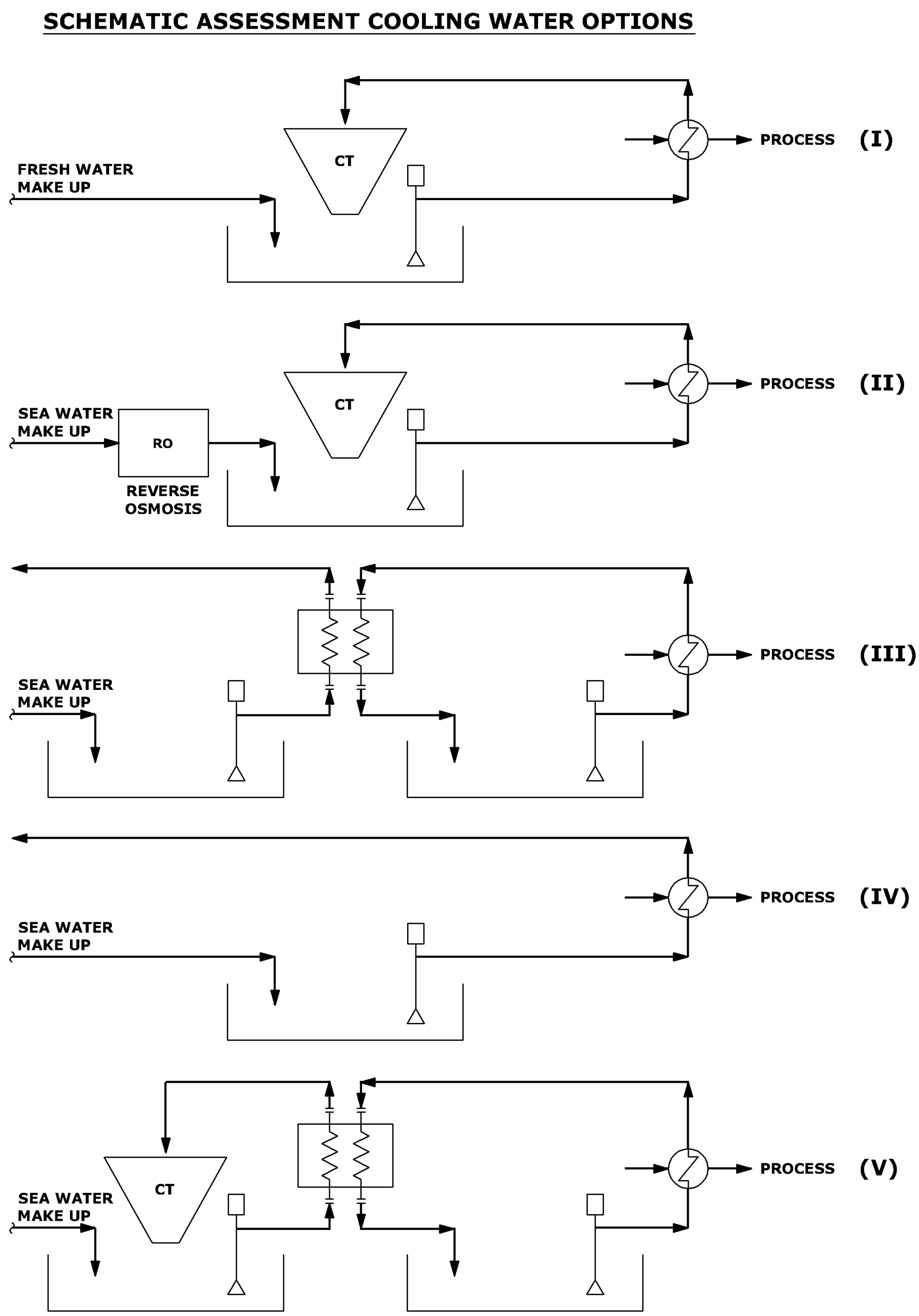


TABLE 2.5-1 Qualitative Assessment of Cooling Water Options

Consideration	I	II	III	IV	V
Fresh water make-up for site	Highest >2400 m3/hr	Moderate <1000 m3/hr	Lowest	Lowest	Lowest
Environmental impact	Lowest	Lowest	Highest – thermal	Highest – thermal	Low but chlorides in drift
Complexity	Lowest	Highest – RO unit	High – M of C	High – M of C	High – most equipment
Cost	Lowest	Moderate but RO unit	High – M of C	Highest – M of C	High – most equipment
Fouling	Lowest and understood	RO unit	Biological – sea water	Highest – impacts process	Biological – sea water
Overall	Best but lack of fresh water	Good but RO complexity	Poor – thermal plume	Worst – thermal plume and cost	Best all around
Choice (Preference)	X	2	X	X	1

RO = Reverse Osmosis
M of C = Materials of Construction

The most likely choice will be Option V as this minimizes environmental impact.

2.5.10.14 Marginal Wharf

Material Handling, Logistics

Materials handling and logistics for the marginal facilities will cover a myriad of activities in support of the petrochemical operations and continuing site activities. The handling and logistics area will be a land based area enclosed within the cribwork wharf, as noted in Section 2.3.2.2 Marginal Wharf. Activities planned for the marginal facility include as a minimum the following:

- a dewatering and drying facility for the Polyethylene and Polypropylene pellets that were slurried from the polyethylene and polypropylene production plants;
- pneumatic conveying system to transfer dried pellets into blenders and storage silos;
- storage silos for the polyethylene and polypropylene resins – quantity of 160 shown on the conceptual layout;
- pneumatic conveying systems to unload the silos;
- traveling conveying lines to bulk load the polyethylene and polypropylene resins into container ships;
- operations centre/control room/substation for all marginal wharf operations and security;
- utilities area for fire water pumps, plant and instrument air;
- waste water treatment facility;
- warehousing facility (marine, safety and process support equipment & consumables);
- miscellaneous OSBL facilities to be determined during the FEED Stage.

Material handling and logistics operations on the facility will include moving of product from the Polyethylene and Polypropylene processing units' onshore extruder by hydraulic conveyance to silo storage and eventually packaging, shipping and dispatch. Product slurry (water/pellet mix) is transferred to the hydraulic conveying system whose function is covered in three (3) phases; predewatering, impact dewatering and air drying. Following this activity, waste fluids are contained and returned back into the polypropylene and polyethylene processing systems and the pellets are discharged onto further conveyance and transferred to the silos awaiting bulk load-out.

Other products will also be maintained through the product storage and shipping logistics area including producton byproducts, feedstocks and catalysts. Handling of the liquids and gases will be through a designated loading arm transfer station situated on the marginal facilities. The product transfer and storage process (which will be developed through the FEED phase) will include as a minimum:

- ethane and propane refrigerated and regasification storage;
- ethylene and propylene refrigerated storage;
- hexene and butene storage and feed systems for LLDPE and HDPE units;
- chemicals and catalyst storage; and
- byproduct storage including fuel oil, hydrogenerated gasoline and mixed C4s.

<u>Vessels</u>

At the two-vessel proposed output scenario (2bcf/d vs. 1bcf/d) assuming a lower end of tanker capacity of 160,000m^3, one LNG tanker will arrive at the LNG terminal every 3.5 to 1.8 days. This will result in a total of 105 to 210 LNG tankers per year. This number can be marginally reduced if larger capacity LNG tankers (250,000 m^3) are made available. (5.4 to 2.7 days)

In support of the product output, marine traffic for the facility will include the trans-shipment of feedstocks, product components, and by-products. These shipments will increase traffic levels somewhere in the neighbourhood of 200 additional vessels entering the port per year. This means a yearly traffic flow into the harbour of 300 to 400 LNG and product carriers. The total number of ships accessing the zone equals approximately half the number of moves presently managed through the pilot authority. This number does not include the movement of harbour tug, offshore and inshore fisheries vessels or vessels of less than 100 m length overall.

<u>Non PetChem-related Use of Wharf</u>

The marginal wharf is required for receipt and shipment of products and by-products in support of the petrochemical plant and for receiving supplies and equipment during construction of the entire complex. It will be constructed as one of the first elements of the Project. It will function as follows:

- dockside space for product container ship(s);
- dockside space for ships delivering operating plant supplies/other feedstocks;
- dock side space for tugs and pilot boats;

- customs and immigration facilities for all shipping;
- supports along south east side for the LNG pipeline (42 inch) and vapour return pipeline (16 inch) and consideration for a future 42 inch line;
- roll off dock for unloading of equipment and materials from ships during construction; and
- containment structure for product servicing reclamation area

The north and western faces of this facility will be designed for berthing tugs, the pilot boat, supply ships, and product carrying ships. The eastern face will be enclosed behind an armour stone blanket, with the LNG transfer pipeline extending from the service trestle enroot to the LNG storage site along its deck. Navigation and berthing aids will be provided.

2.5.10.15 Air Emissions, Controls

<u>NO_x and CO Emissions From Furnaces and Power Generating Equipment</u>

Feedstocks for the ethylene unit are ethane and propane extracted from LNG and stored in refrigerated above ground double walled tanks located OSBL. These feedstocks are pumped vapourized and pipelined to the ethylene unit.

Ethane is fed to the cracking furnaces via the ethane feed heater.

Fresh liquid propane is supplied from storage and mixed with recycle propane then vapourized using waste heat. The mixture is then superheated and fed to the cracking furnaces.

The pyrolysis furnaces are designed to crack gaseous feedstock.

<u>Cracking Furnaces</u>

The processing scheme consists of furnaces designed for 1200 kTA ethylene production. The furnaces can be operated on an ethane, propane, or a mixed feed. However, the predominant feed will be ethane.

<u>Convection Section</u>

Heat is recovered from the flue gases leaving the radiant section in a convection section.

Feedstock is first preheated in the hydrocarbon Preheat-1 and Preheat-2 banks prior to mixing with dilution steam. The preheated hydrocarbon parallel passes at the outlet of Preheat-2 bank are combined in a header and mixed with dilution steam.

Additional heat is recovered from the furnace flue gas by superheating SHP steam to 500°C at 1525 psig in the SHP steam superheat convection bank. SHIP steam is generated by heat recovery from the furnace effluent in the quench exchangers.

Radiant Section

The preheated hydrocarbon/dilution steam mixture is combined at the convection outlet to ensure uniform temperature of mixture and then distributed to the radiant coils.

Firing System

The radiant section is 100% floor fired using low NO_x burners to minimize NO_x emissions. The burners are designed to fire plant tail gas at 10% excess air and are equipped with continuous pilots to ensure that the burner remains safely alight at all times.

An electrically motor driven induced draft fan mounted at the convection section outlet on the furnace superstructure produces the draft required for combustion.

Further controls will be implemented accordingly as required to meet NSEL requirements and compliance with the *CEAA* and as developed through the FEED process.

The cracking furnaces and the power operating plant are major sources of NO_x and CO emissions. Although detailed analysis has not been carried out for Keltic recent work by S&W has indicated that the Best Available Control Technology is:

NO_x Emissions

1. Pyrolysis Furnaces

   Ultra low NO_x burners will be provided in the cracking furnaces. These burners will provide a flame pattern and shape which is compatible with the furnace design requirements. Burners with staged fuel and controlled internal flue gas recirculation have been developed and installed in cracking furnaces at many other installations. Thus, the burner design has a proven track record and is now considered a commercially proven control technology. The burners will provide a 60 to 75 percent reduction in NO_x level over standard burner designs.

2. Power Plant/Boilers

   Ultra low NO_x burners will be provide in the power plant. The burners will be designed with staged fuel and internal gas recirculation.

Carbon Monoxide Emissions

1. Pyrolysis Furnaces

   A CO abatement unit could be added to each pyrolysis furnace to reduce the CO emissions that would result from using burners designed to minimize the NO_x emissions. This would involve adding a catalyst bed to each furnace convection section and installing larger induced draft fans. Power consumption would increase due to the added flue gas pressure drop through the catalyst bed.

However, no CO abatement unit will be provided since the CO emissions will be within acceptable industry standards.

2. Power Plant/Boilers

   As with the pyrolysis furnaces adding a CO abatement unit would involve modifications to the power plant equipment.

   However, no CO abatement unit will be provided since the CO emissions will be within acceptable industry standards.

Fugitive Emissions

Management of fugitive emissions through emission control will only be used when all efforts have been made to eliminate fugitive emissions. Where VOCs are emitted from processes and equipment, they will be collected and routed back to process if possible. If this cannot be achieved, the VOC stream will be managed through control systems.

Safety Relieving Devices

All hydrocarbon safety relieving devices will be routed to a totally closed blowdown and flare system.

Equipment Vents and Drains

Connections will be provided on all equipment in VOC to a lower pressure section of the plant or to a closed system such as the flare. Vents which cannot be connected to a close system or flare will be treated to remove or recover VOCs.

Drains from equipment in VOC service will be routed to a closed blowdown systems. All valves or lines in VOC service which open to the atmosphere will be equipped with a plug or blind flange.

All equipment in benzene service will be provided with connections to purge the equipment with non-benzene fluid to a lower pressure section of the plant or to a closed system such as the flare.

Sumps

All sumps in oily water services will be equipped with tight fitting covers and be vented to a vent gas control system or to the atmosphere. In addition, in-ground sumps in hydrocarbon services will be designed as double containment systems.

Pumps

All pumps in VOC service will be equipped with double mechanical seals, pressurized with an adequate inert barrier fluid or vented to a closed system, such as the flare.

Compressors

All compressors in VOC service will be equipped with a dry gas seal system. The dry gas seal system will vent directly to the flare.

Sample Connections

All manual sample connections for streams in VOC service will be designed and provided with equipment which minimizes the amount of fluid which must be purged prior to or after collection of the sample. In addition, all necessary sampling connections will be equipped to route all purged fluids back to the process or to a closed vent system.

Piping

Valves, flanges and other piping components will be designed, procured and installed such that they are capable of operating with fugitive emissions of less than 500 ppm(v). VOC containing valves and piping connections will be welded or flanged, but not screwed. To the extent that good engineering practice will permit, valves and piping connections will be reasonable accessible for leak detection during operation. Valves in VOC services which are not reasonably accessible will be identified on a list.

Each line or a valve which opens to the atmosphere will be equipped with a plug or blind flange.

Control Valves

VOC containing control valves will be equipped with dual packing and stuffing boxes to achieve maximum fugitive emissions of less than 500 ppmv.

Storage Tanks

Storage tanks in VOC service will be designed and constructed to minimize the VOC emissions. All storage tanks will be equipped with the following:

- Fixed roof tanks will have N2 blanket and be vented to an emission control device which operates with a minimum control efficiency of 98%.
- Fixed roof tanks with internal floating covers will be equipped with a primary seal around the rim of the floating cover. Provision will be made for venting to the atmosphere with possibility for venting into an emission control device.
- Open floating roof tanks will be equipped with a floating cover which has both primary and secondary rim seals.

2.5.10.16 Water and Steam Supply

Process water is supplied to the complex from the fresh water make-up source and/or by desalination of sea water (still under review). Some of the service water will be directly supplied to the users without any treatment. At present it will only be used as feedstock for the desalination plant and for the utility stations. Fire water make-up will be exclusively from the reclaimed water supply, which is collected storm-water from all areas that has been treated.

Potable water will be produced in a centralized treatment system consisting of sand carbon filters and chlorination. The potable water tank will be sized for a minimum of eight hours independent supply at normal demand. The potable water is also distributed to the safety showers, eye washes, drinking fountains, changing rooms, toilets, cafeteria, etc., within the area and exported to the interconnecting piping header for distribution to the rest of the complex.

Note that a "hold" has been placed on the process water since a decision is to be made during the FEED stage on the use of additional pretreatment to remove unsaturates and heavy organics before entering the low pressure water stripper.

Steam Distribution and Condensate Collection

VHP steam is produced in the power generation facility and collected in a common VHP steam header. The VHP steam is distributed within the utilities area and also feeds into two headers of the interconnecting piping system – dedicated header for the ethylene unit and a general distribution header for the rest of the complex. High pressure steam is let down to produce MP steam by the MP steam make-up valve. Low pressure steam is distributed within the utilities area and feeds into the interconnecting piping distribution header for low pressure steam supply to the rest of complex.

Low pressure condensate is collected in a dedicated low pressure condensate collection header and fed to the low pressure condensate drum.

Service Water Distribution

Process water is supplied to the complex from the fresh water make-up source and/or by desalination of sea water (still under review). Some of the service water will be directly supplied to the users without any treatment. At present it will only be used as feedstock for the desalination plant and for the utility stations. Fire water make-up will be exclusively from the reclaimed water supply, which is collected storm-water from all areas that has been treated.

Potable Distribution

Potable water will be produced in a centralized treatment system consisting of sand carbon filters and chlorination. The potable water tank will be sized for a minimum of eight hours independent supply at normal demand. The potable water is also distributed to the safety showers, eye washes, drinking fountains, changing rooms, toilets, cafeteria, etc., within the area and exported to the interconnecting piping header for distribution to the rest of the complex.

2.5.10.17 Cooling System

The overall site cooling water system is described in Section 2.5.10.13 Sea Water Cooling System.

2.5.10.18 Storm and Wastewater Management

Sources of Wastewater

Liquid wastes will be derived from various sources both in process units and utility and off-site facilities. The wastewater treatment unit will consist of wastewater collection and treatment systems. The wastewater collection system will segregate wastewaters according to the level of treatment required and the route of discharge. The expected liquid waste streams will be:

- clean storm-water;
- potentially contaminated storm-water/fire water;
- oily wastewater;
- benzene and toluene contaminated wastewater;
- spent caustic effluent (under review);
- non-oily process wastewater;
- sanitary wastewater; and
- clean saline water.

The aqueous discharges from the various sources will be released to treatment facilities or other locations as appropriate. The aqueous effluents from oily, non-oily, and benzene/toluene-contaminated streams will be pretreated as appropriate, combined, and pumped to the central treatment facilities for subsequent treatment. Clean storm-water will be routed to the surface drainage ditches via the perimeter channels. Potentially contaminated storm-water and/or fire water run-off will be collected, tested, and released, as appropriate to the surface drainage channels or central treatment facilities.

Utilities effluents from the water system (demineralization plant and condensate polisher regen wastes) and incinerator QW are relatively clean in terms of oils and organic contamination. However, these streams contain high levels of dissolved salts and if discharged to the central treatment facilities, will breach the standard on sodium absorption ratio. These streams will be routed to the sea water cooling return with appropriate pretreatment (pH neutralization) as required.

Sanitary waste will be pumped to the sanitary sewer for treatment at the central sanitary treatment plant.

2.5.10.19 Waste Management (Incineration)

Incinerator

The incinerator will process the following waste stream spent caustic.

- slop oil from ethylene unit;
- spent gasoline wash from ethylene unit;

- tars from ethylene unit;
- flare KO drum blowdown;
- waste polymeric materials;
- dewatered biological sludge; and
- laboratory wastes.

The spent caustic stream generated from the acid gas removal system is contaminated with high concentrations of organics and some sodium sulphides. This stream needs to be disposed in an environmentally acceptable manner or treated and sold as a by-product to the pulp and paper industry.

The latter modus operandi is used in several commercially operating ethylene unit including the ethylene unit in Montreal. However, for this EA we are only considering incineration (waste case).

If incinerated the spent caustic from the ethylene unit could be the main incinerator feed.

The incinerator will be a fluid bed or rotary kiln type with flue gas clean-up.

The incinerator flue gas resulting from incinerating spent caustic, slop oil and tar will be contaminated with high concentrations of SO_x, PM and NO_x. Therefore, the following Best Available Control Technology will be introduced in the incinerator specifications.

- Low NO_x burners with the provision for injecting urea to the combustion chamber to control the NO_x emission especially under operating conditions when the majority of the incinerator fuel requirement is provided by injecting slop oil and or pyrolysis tar as the primary fuel.
- Flue gas desulphurization (if required) in a smelter dissolver where the SO_x react with the alkaline liquor (NaOH and Na_2CO_3) trapping the SO_x as sodium sulphite/sulphate salts.
- The incinerator PM emissions is controlled using a Venturi scrubber followed by Wet Electrostatic Precipitator designed to operate in series.

2.5.10.20 Product and Material Storage and Handling

Materials handling and logistics for the marginal facilities will cover a mariad of activities in support of the petrochemical operations and continuing site activities. The handling and logistics area will be a land based area enclosed within the cribwork wharf, as noted in Section 2.3.2.2 Marginal Wharf. Activities planned for the marginal facility include as a minimum the following:

- a dewatering and drying facility for the Polyethylene and Polypropylene pellets that were slurried from the polyethylene and polypropylene production plants;
- pneumatic conveying system to transfer dried pellets into blenders and storage silos;

- storage silos for the polyethylene and polypropylene resins – quantity of 48 shown on the conceptual layout;
- pneumatic conveying systems to unload the silos;
- traveling conveying lines to bulk load the polyethylene and polypropylene resins into container ships;
- operations centre/control room/substation for all marginal wharf operations and security;
- utilities area for fire water pumps, plant and instrument air;
- waste water treatment facility;
- warehousing facility (marine, safety and process support equipment & consumables); and
- miscellaneous OSBL facilities to be determined during the FEED Stage.

Material handling and logistics operations on the facility will include moving of product from the Polyethylene and Polypropylene processing units' onshore extruder by hydraulic conveyance to silo storage and eventually packaging, shipping and dispatch. Product slurry (water/pellet mix) is transferred to the hydraulic conveying system whose function is covered in three (3) phases; predewatering, impact dewatering and air drying. Following this activity waste fluids are contained and returned back into the polypropylene and polyethylene processing systems and the pellets are discharged onto further conveyance and transferred to the silos awaiting bulk load-out.

Other products will also be maintained through the marginal loadout and transfer facilities, these will include producton byproducts, feedstocks and catalysts. Handling of the liquids and gases will be through a designated loading arm transfer station situated on the marginal facilities. The product transfer and storage process (which will be developed through the FEED phase) will include as a minimum:

- ethane and propane refrigerated and regasification storage;
- ethylene and propylene refrigerated storage;
- hexene and butene storage and feed systems for LLDPE and HDPE units;
- chemicals and catalyst storage; and
- byproduct storage including fuel oil, hydrogenerated gasoline and mixed C4s.

2.5.10.21 Malfunctions and Accidents

As a means to minimize, contain, and control potential releases of environmental contaminants, both a site specific Emergency Response and Contingency Plan will be developed reference the CAN/CSA Z731-03 standard. All personnel will be appropriately trained in the applications of first response measures and emergency communication requirements. A traffic management plan will be established under the umbrella of the EPC Contractor's Health & Safety and Security Program. This program will be developed to ensure personnel and asset safeguard against deliberate or unintentional anomalies.

2.5.11 CoGeneration Power Plant

2.5.11.1 Primary Components Cogeneration

The power generation plant concept is based upon a phased expansion.

Phase I (16 MWe)

Simple cycle gas turbine with the addition of a Heat Recovery Steam Generator for steam.

2 x GE LM2500 will most likely be used.

In the mature facility these turbines will be used for emergency/back-up power supply.

Phase II (180 MWe)

The configuration could be 4 x GE6000 or 2 x GE Frame 7 turbines.

A detailed techno-economic evaluation of the configuration and possible power export to the local grid is under investigation.

2.5.11.2 Process Description

The electric power for the Keltic Facility will be generated in the central utility area using a combined cycle arrangement and will have a nominal rated capacity of 200 MW. The electricity will be generated at 35 KVA, three phase and 60 Hz. This will enable possible connection to the Nova Scotia Power grid for purchase of incremental power required by the site and to provide some backup requirements. This will be further investigated during the FEED phase.

The Project consisted of four gas fired simple cycle General Electric Frame 7EA combustion turbine generators with a nominal rating of 80 MW each. This is complete with a heat recovery steam generator fitted to each gas turbine as after the hot, dense combustion gases are expanded through the turbine, they still retain much of their heat. Each heat recovery steam generator will provide approximately 60 metric tons per hour of steam at 4320 kPa and 400 degrees Celsius. Some 200 metric tons per hour of this steam will be fed to a 40 MW steam turbine electric generator set to generate additional electric energy. The excess steam from the heat recovery steam generator will be exported as process steam to meet some of the demand of the other processes in the complex such as heat for the regasification of LNG. A typical view of gas fired simple cycle General Electric Frame 7EA combustion turbine generators is shown in Figure 2.5-21

FIGURE 2.5-21 Typical View of Gas Fired Simple Cycle General Electric Frame 7EA Combustion Turbine Generators

As the FEED phase is initiated it is likely that power and process steam efficiency gains will be realized as the overall use in the various plants is integrated. This may result in some modifications to the co-generation design.

2.5.11.3 Utility Interconnections and Offsite Systems

Utilities and Off-Site Components

The utilities and off-sites are auxiliary facilities which support the operation of the proposed complex.

These comprise of the following:

- uninterruptible power system (Class II);
- power generation (Class IV);
- emergency power generation (Class III);
- steam distribution and condensate collection;
- demineralized water;
- plant air;
- instrument air;
- nitrogen;
- service water;
- potable water;
- fuel gas;
- caustic soda;
- sulphuric acid;
- cooling water;
- wastewater treatment;
- sea water cooling system;
- waste incineration; and
- flare and thermal oxidizer;

Process uses for utility area include but are not limited to:

- Plant air flows from the plant air receiver to the utilities area plant air distribution header. Plant air is distributed to users and utility stations within the utilities area and also connects to the interconnecting piping plant air header to the rest of the complex.

- Nitrogen is supplied to the utilities area distribution network from the interconnecting piping distribution header. Nitrogen is distributed to users and utility stations within the utilities area.
- VHP steam is distributed within the utilities area.
- Low pressure steam is distributed within the utilities area.
- Instrument air flows from the instrument air receiver to the utilities areas instrument air distribution header, where it is distributed to users within the area and also connects to the interconnecting piping instrument air header for distribution to the rest of the complex.
- Demineralized water is supplied to the utilities area distribution network from the demineralized water tanks. The demineralized water is distributed to users within the utilities area and to the rest of the complex.
- The main source of fuel gas for the site will be natural gas provided by the pipeline network and also the olefins unit. During normal operation, the fuel gas users will be from various buildings, polyethylene unit, flare, incineration unit and the boilers in the utilities area.
- Caustic soda solution is provided to the utilities header from storage within the utilities area.

All connections for components OSBL and especially within the utilities areas will be developed within the guidelines of Project controlling standards according to site development program produced within the FEED process.

2.5.11.4 Air Emissions/Emission Control Systems

See Section 2.5.10.15

2.5.11.5 Water and Supply

Sufficient supply water will be required to meet the process requirements of four (4) heat recovery steam generators, each being driven a 40 MW gas turbines. The expected output of each heat recovery steam generator is approximately 60 metric tons of steam per hour. Water input to support this process will be taken from a closed looped water cooling system. A separate water treatment plant is required to prepare demineralized water from the central water treatment plant for the auxiliary boiler feeds. Water make-up required to support this system and provide daily industrial needs will be drawn from the Meadow Lake impoundment. The overall estimated facility water requirement on the lake is for 1200 m^3/hr, from which the total need for cooling water will be secured.

2.5.11.6 Storm and Waste Water Management

Storm-water runoff from uncontaminated areas will be segregated from potentially contaminated areas and discharged through a storm-water outfall. These uncontaminated areas generally include roads, building roof drains, undeveloped areas, and uncontaminated areas in the utility and offsite units. The non contaminated runoff will generally flow through open site ditches with final disposal in Isaac's Harbour. Ditch checks, vegetation, and siltation ponds will be utilized to prep the storm-water before discharge, in accordance with established Waste Water Management Plans. The discharge location to Isaac's harbour will be south east of Dung Cove.

2.5.11.7 Chemical and Petroleum Storage and Handling

All chemical and petrochemical storage activity will be accomplished in accordance with the guidelines set-out in CSA Z276-01, 'Liquified Natural Gas (LNG)s – Production, Production, Storage, and Handling' and in compliance with NSDE Code of Practice – Liquified Natural Gas Facilities. Storage facilities will be required both ISBL and OSBL.

The overall Plant layout and design accomplished during the FEED process will establish the physical location and limits of the Process Unit Plots and associated storage facilities. Utilities and other infrastructure required for access, safe operation and environment concerns relating to the storage will be integrated through the Construction Execution Plan.

2.5.11.8 Malfunctions and Accidents

As a means to minimize, contain, and control potential releases of environmental contaminants, both a site specific Emergency Response and Contingency Plan will be developed reference the CAN/CSA Z731-03 standard. All personnel will be appropriately trained in the applications of first response measures and emergency communication requirements. A traffic management plan will be established under the umbrella of the EPC Contractor's Health & Safety and Security Program.

2.5.12 Utilities and Common Site Support

The utilities and off-sites are auxiliary facilities which support the operation of the proposed complex. These comprise of the following:

- service/freshwater supply (Meadow Lake)
- uninterruptible power system (Class II);
- power generation (Class IV);
- emergency power generation (Class III);
- steam distribution and condensate collection;
- demineralized water;
- plant air;
- instrument air;
- nitrogen;
- fuel gas;
- caustic soda; and
- sulphuric acid.

The key facilities out of the ones listed above have been described below.

2.5.12.1 Service/Freshwater Supply (Meadow Lake)

The Project will have an industrial water demand somewhere in the area of 1200m^3/hr. To meet this demand the intent is to create an impoundment. Water will be drawn from Meadow Lake to provide daily industrial needs. An impoundment of the lake will be accomplished with a concrete gravity dam to raise the water, and a 24.0 m wide spillway at elevation 36.25 m to provides relief for spring melt and likely larger summer storm flow events.

Submersible pumps (approximately 100 Hp each) positioned along the south-eastern portion of the lake extension will deliver the raw water to a central water treatment plant through a pipeline running parallel with the river flow corridor. The water treatment plant established OSBL, likely of the dissolved air floating design, will treat water to "Canadian Drinking Water Standards." Further water treatment (demineralization) will take place at the petrochemical complex for the boiler feed water.

<u>Primary Components, Layout, Appearance</u>

The Meadow Lake impoundment will require a concrete gravity dam to raise the water on the Isaac's Harbour River, with a 24.0 m wide spillway at approximately 2.5 m in height (elevation 36.25 m). The impoundment of Meadow Lake will flood approximately 295 ha of habitat, at least 122 ha of which is wetland. The dam will have a proposed footprint of about 170 m$^{2.}$

Additional features of the proposed dam include a 1 m wide flow section for a fishway. The fishway would also function as the primary source for make up water to the river. The fishway is located on the south side of the dam that is just upstream of a pool in the river where resident or migratory fish would normally hold or stage. Also, a second 1 m wide section next to the fishway is used to discharge frequent storm flows. This opening or sluiceway could be constructed such that the height is variable (i.e. use stop logs) and also function as a step pool type fishway under higher flow conditions. The proposed location of the dam and construction is shown in Figure 2.3.7 (Impoundment of the Lake) & Figure 2.3.8 (Preliminary Consept of the Dam).

<u>Operation of Dam and Intake Structure (Water volumes, seasonal variations)</u>

The 95% annual stream flow exceedance frequency at Isaac's Harbour River for the 2002 calendar year represents a withdrawal rate of 720 m^3/hr. With a dam, the flow characteristics of the River may be modified such that the 95% annual stream flow exceedance frequency with a dam in place could be roughly equal to the 90% annual (2002) stream flow exceedance frequency, which would represent a withdrawal rate of 1,260 m^3/hr as defined from the current Keltic study data.

Based on the historic low (June 1982-2002) monthly stream flow, allocation values above, and applying an appropriate safety factor, approximately 10 percent of monthly flow might be regarded as a "safe" monthly withdrawal rate from the system – the volume of water which could be placed into storage and/or removed from stream-flow to meet the proposed Keltic Facility demand. With proper flood-gate management practices, such withdrawals from the Meadow

Lake watershed would likely leave more than sufficient amounts of water for fisheries maintenance flow requirements.

Lake Water Fluctuations

Monthly figures showing net supply deficit (need for stored water) and surplus (water which can be placed into storage) and approximate flows remaining (subject to flood-gate controls) after storage, are summarized in Table 2.5-2. Based on an average proposed water demand of 1,200 m^3/hr, the Table suggests that without storage there would be net water supply deficits during the months of January, June, July, September, and October totalling 1,904,705 m^3. This would be the volume of water needed to be stored annually during periods of high flow, or the volume of the reservoir needed to be created by placing a dam across Isaac's Harbour River at Meadow Lake.

TABLE 2.5-2 Water Withdrawal Scenarios

Period	Column 1 Total Flow	Column 2 Proposed Withdrawal Allocation (m^3)	Column 3 Plant Demand (m^3)	Column 4 Net Surplus or Deficit (m^3) (col. 2 Minus col. 3)	Remaining Stream-Flow (m^3) (col. 1 Minus col. 2)
January	8,869,995	887,000	892,800	-5,801	7,982,996
February	14,553,131	1,455,313	806,400	648,913	13,097,818
March	16,378,389	1,637,839	892,800	745,039	14,740,550
April	11,170,939	1,117,094	864,000	253,094	10,053,845
May	8,970,270	897,027	892,800	4,227	8,073,243
June	1,578,400	157,840	864,000	-706,160	1,420,560
July	4,981,735	498,174	892,800	-394,627	4,483,562
August	9,126,733	912,673	892,800	19,873	8,214,060
September	3,096,361	309,636	864,000	-554,364	2,786,725
October	6,490,466	649,047	892,800	-243,753	5,841,419
November	11,402,344	1,140,234	864,000	276,234	10,262,110
December	10,065,137	1,006,514	892,800	113,714	9,058,623
Annual	106,683,900	10,668,390	10,512,000	156,390	96,015,510

Results of Withdrawing 1,200 m^3/hr from Isaac's Harbour River at Meadow Lake Based on 1982-2002 Data

Power Supply, Back-up

A screened intake structure consisting of three inlets; two in service and one to allow for maintenance will lead to a pump house facility. Submersible pumps (approximately 100 horsepower each) will deliver the raw water to the central water treatment plant through a pipeline. Initial power requirements for the pumps will be supplied from the local power grid according to temporary service planning. The power plant incorporating gas turbines and heat recovery steam generators from ISBL will provide power to continuously operate the facility.

Fuel Storage

The PMC contractor will have overall responsibility for the management and control of fuels and toxic consumables on the Project site. Depending on the volumes and types of product a storage site will be identified at the start of the construction process by the PMC contractor. All toxic/hazardous materials management plan will be developed and implemented which will be in accordance with relevant federal and provincial legislation pertaining to these materials. Spill contingency plans will be developed and appropriate equipment to implement such plans will be in place, including a program of training ensuring employees will be aware of such emergency procedures in the event of accidental spillage or tank malfunction. Fire protection equipment will be available onsite. As a general guideline as relating to the proposed dam works and operations the following principals will be observed:

- all fuelling and maintenance of construction equipment will be completed away from water to minimize the possibility of water contamination; and
- all on-site fuels, oils and chemicals should also be stored at least 50 m from any surface waters

Environmental Management (low flow conditions)

As evidenced in Table 2.5-2 and in compliance with design parameters, low flow conditions would be mitigated as sufficient waters to provide the 1200m^3 flow to the treatment facilities would be continuously maintained. As noted above, with proper flood-gate management practices, such withdrawals from the Meadow Lake watershed would likely leave more than sufficient amounts of water for fisheries maintenance flow requirements. This would be part of the EPP, water management process.

Malfunctions and Accidents (Dam Failure)

In the event of an uncontrolled dam failure, accumulated water contained in the dam reservoir (i.e. Meadow Lake) would flow to the most northwest inlet of the Isaac's Harbour by virtue of the surface topography of the region which would be routed via Isaac's Harbour River. As the harbour is approximately 1 km wide and the Keltic Complex Isaac's Harbour shoreline is more than 4 km from where the escaping water will be entering the harbour, no water or resulting damage is contemplated to impact the Keltic Complex given the harbour's inherent surge capacity.

2.5.12.2 Waste Management

All process activity wastes will be collected and managed according to the site 'Waste Management Plan'. Waste will be segregated as to recyclable and non-recyclable, with recyclable material collected and transported to a licensed recycling facility using authorized local services. All waste management procedures will comply with provincial solid waste management regulations as well as additional municipal and disposal facility requirements. Non-recyclable wastes will be transported offsite to a municipally approved landfill facility.

Hazardous wastes that are generated from Project operation sources will be minimal and includes small quantities of waste oils and chemicals. Hazardous waste will be stored onsite in a separate temporary hazardous waste storage area provided with full containment. Hazardous wastes will be removed from the site by a licensed contractor and disposed at an approved facility. Other control measures for hazardous waste will include the implementation of the 'Spill Management Plan' and 'Emergency Response and Contingency Plans' to avoid impacts from release of potentially hazardous materials.

2.5.12.3 Other Utilities and Support Systems

Other Facilities, including, but not limited to:

- cryogenic ASU with oxygen and nitrogen supply systems;
- plant air and instrument air supply systems;
- flare systems:
    - interconnecting piping and pipe racks;
    - maintenance shops;
    - receiving and stores;
    - firehouse and fire truck;
    - plant security and communications;
    - administration and laboratory facilities;
    - custody metering stations;
    - shipping and receiving terminals;
    - site roads; and
    - resin conveyance to wharf.

Many of these systems and activities require procedures and policies that need to be addressed further in order that the Project is able to support safe, efficient, reliable, and environmentally conscious operations. Some of these will also need to be submitted and approved by various federal and provincial agencies. For example, the spill response plan would have to ensure that the Certified Response Organization and the Atlantic Emergency Response Team (ALERT) has a Response Plan in order to respond to a spill, in accordance with the *Canada Shipping Act*. All components of the operations will be controlled in accordance with documented standard operating procedures and in accordance with industry and regulating body requirements.

<u>Uninterruptible Power (Class II)</u>

This is a battery back-up system to supply power to critical instrumentation system and electrical system to effect a safe shutdown of the plant. The batteries are immediately and automatically recharged once the Class III system is running (usually in less than five minutes) following a total Class IV power failure.

Emergency Power Generation (Class III)

The emergency power generator provides back-up power to operate the plant during a total failure of the Class IV system units in the event of an electrical power failure. It is diesel driven and provides 1 MWe to 2 MWe of electrical output. The system contains a day fuel tank, which is filled from a road tanker and all necessary coolers to cope with operation in the environment of Goldboro.

Steam Distribution and Condensate Collection

VHP steam is produced in the power generation facility and collected in a common VHP steam header. The VHP steam is distributed within the utilities area and also feeds into two headers of the interconnecting piping system – dedicated header for the ethylene unit and a general distribution header for the rest of the complex. High pressure steam is let down to produce MP steam by the MP steam make-up valve. Low pressure steam is distributed within the utilities area and feeds into the interconnecting piping distribution header for low pressure steam supply to the rest of complex. Low pressure condensate is collected in a dedicated low pressure condensate collection header and fed to the low pressure condensate drum.

Plant Air Distribution

Plant air and instrument air will be supplied to the Goldboro petrochemical complex by a set of four centrifugal compressors, three in regular operation, and one as a spare.

Plant air flows from the plant air receiver to the utilities area plant air distribution header. Plant air is distributed to users and utility stations within the utilities area and also connects to the interconnecting piping plant air header to the rest of the complex.

Instrument Air Distribution

Instrument air flows from the instrument air receiver to the utilities areas instrument air distribution header, where it is distributed to users within the area and also connects to the interconnecting piping instrument air header for distribution to the rest of the complex.

Nitrogen Distribution

Nitrogen is supplied to the utilities area distribution network from the interconnecting piping distribution header. Nitrogen is distributed to users and utility stations within the utilities area.

Demineralized Water Distribution

Demineralized water will be produced on site from service water by means of an ion exchange resin unit situated in the water systems area. This unit will include provision for the neutralization of both the acid and caustic regeneration effluents prior to discharge of the neutralized effluent to the wastewater area.

Demineralized water is supplied to the utilities area distribution network from the demineralized water tanks. The demineralized water is distributed to users within the utilities area and to the rest of the complex.

Fuel Gas Distribution

The main source of fuel gas for the site will be natural gas provided by the pipeline network and also the olefins unit. During normal operation, the fuel gas users will be from various buildings, polyethylene unit, flare, incineration unit and the boilers in the utilities area.

20% Caustic Solution Distribution

Caustic soda solution is provided to the utilities header from storage within the utilities area.

Spent Caustic Effluent

Spent caustic effluent from the olefins plant will be collected separately for treatment in the waste incinerator. QW from the incinerator shall be discharged to the sea water cooling return via a pH neutralization system.

Clean Saline Water

Liquid streams discharged from the utilities areas (water systems demineralized regenerated effluent) and incinerator QW are normally clean in terms of oil and organic contamination. However, they will contain high levels of dissolved salts therefore will be referred to as clean saline water. Dissolved salts, in particular sodium ion, result in a high sodium absorption ratio, it will not be sent to the central treatment facilities, instead it will be discharged as a variance stream to the sea.

Clean saline water will be segregated, collected, and discharged to the sea via a pH neutralization system.

2.6 DECOMMISSIONING AND RECLAMATION

The nominal design life of the process facilities will be twenty years. It is customary that with maintenance, technical upgrading and replacement, these facilities continue to operate well beyond the initial design life.

Should any part of the Keltic Facility become obsolete, be decommissioned or taken out of service for whatever reason, decommissioning and reclamation of the site and facilities would be undertaken in accordance with the regulatory process at the time. At that time a site reclamation plan would be developed and regulatory approval obtained before work would commence. The reclamation plan would consider any ongoing or future industrial use to which the site may be useful for or dedicated to and consider the baseline conditions that existed before site development took place. Any portion of the decommissioned facility or part thereof that may be of subsequent use for industrial development will be taken into consideration in the decommissioning plan.

Decommissioning and disposal of all equipment, material, and process units will consider environmental procedures for such disposal. A plan complete with schedule for dismantling and disposal, including location of disposal will be provided for approval at that time.

The plan will specify decommissioning objectives, approach, activities, schedules, and site rehabilitation and will be developed in consultation with the municipality and regulatory agencies. In particular, objectives of the decommissioning plan will be to:

- identify applicable municipal, provincial, and federal regulations and standards;
- identify and consider objectives of local municipality and adjacent landowners;
- define the decommissioning objective;
- protect public health and safety;
- rehabilitate the plant site in accordance with regulatory standards;
- reduce or eliminate potential adverse environmental effects beyond decommissioning; and
- develop a material management strategy to maximize reuse/recycling options on and off-site or via a material processing facility, and to avoid/minimize disposal in approved landfills.

As a minimum, the plan objectives will define the removal of all hazardous substances, production equipment, and storage tanks. Should the plan objective be the complete decommissioning of the plant site, activities will include the removal of all buildings, roads, storage facilities, and site services. Upon removal of all infrastructures, the site will be rehabilitated. Disposal of waste will be to NSEL and regulations at that time and place of disposal.

Prior to removal of the buildings and facilities, all remaining products and stored materials will be removed from the site in accordance with provincial and federal regulations and guidelines pertaining to handling of hazardous and non- hazardous materials. Materials will be sold to markets or properly disposed of through licensed waste operators.

If no suitable after use is identified, removal of all buildings and infrastructure will be undertaken in full compliance with existing regulatory standards. A demolition permit will be obtained from the municipality. Contractors will be required to follow applicable regulations for material separation, disposal at licensed waste sites, and sales to recycling markets.

The removal of products and storage materials, the demolition of the buildings and removal of infrastructure will be subject to environmental supervision and inspection for compliance with decommissioning plan and regulatory standards.

3.0 REGULATORY ENVIRONMENT

The Project is subject to a Class II Environmental Assessment under the Environmental Assessment Regulations made pursuant to the *Environment Act*, S.N.S. 1994-95, c.1 and Comprehensive Studies under the *Canadian Environmental Assessment Act* (CEAA), S.C. 1992, c.37. The scope for the provincial environmental assessment will include the entire Project and all its components as described in Section 2.0. The scope of the federal environmental assessments only includes specific components of the Project as detailed in Section 3.2. There are a number of federal and provincial laws and municipal by-laws which are applicable to the Project and these requirements are summarized in Section 3.4. In addition, there are a number of guidelines, codes, and/or industry standards relevant to the Project that will be used by the Proponent in the design, construction, and operation of the Project. These references are provided in Section 3.6.

3.1 PROVINCIAL ENVIRONMENTAL ASSESSMENT PROCESS

Under the Environmental Assessment Regulations passed under Nova Scotia's *Environment Act*, supra before proceeding with the final design of an undertaking or commencing work on an undertaking, the proponent of the undertaking is required to register with the NSEL.

A petrochemical plant is designated as a Class II undertaking. As a result, an extensive EA, including consideration by the Nova Scotia Environmental Assessment Board, is required. The provincial EA process is described below:

- Before proceeding with the final design of the undertaking or commencing work, the proponent must register the undertaking with the Department of Environment and Labour. The Proponent registered the undertaking on January 12, 2005.
- Within 7 days following the registration, the proponent must publish a notice in the newspaper giving certain prescribed information about the Project. The publications have been concluded.
- Within 12 days after the registration of the undertaking, the administrator under the Environmental Assessment Regulation is required to publish a notice inviting the public to submit written comments for consideration in preparation of the terms of reference for an EA Report. Comments must be received within 40 days of publication of the notice. The proponent is then given 21 days to respond to any public comments and following the final day for comments from the proponent, the administrator is required, within 14 days, to provide final terms of reference for the EA Report. Final terms of reference were issued to the Proponent on April 8, 2005, and are attached as Appendix 1.
- The proponent then must produce an EA Report which addresses all of the issues raised in the terms of reference.
- This report will be filed with the NSEL upon completion and the Department can either accept the report or require additional work.

Within 10 days following receipt of the final report, the Nova Scotia Minister of Environment and Labour is obliged to refer the report to the Environmental Assessment Board for consideration. The Board then holds public hearings to receive public comments on the EA Report and following the hearings, produces a report and recommendations to the Minister of Environment and Labour. Within 21 days after the receipt by the Minister of the Board's report and recommendation, the Minister then advises the proponent in writing whether the undertaking is approved or rejected.

3.2 FEDERAL ENVIRONMENTAL ASSESSMENT PROCESS

In addition to the provincial EA outlined above, the Project is also subject to assessment under the CEAA. Under Section 5 (1) of CEAA, an environmental assessment of a project is required if a federal authority exercises or performs one or more of the following powers, duties, or functions in relation to a project:

- proposes the project;
- grants money or any other form of financial assistance to the project;
- grants an interest in land to enable a project to be carried out; or
- exercises a regulatory duty in relation to a project, such as issuing a permit or license, which is included in the *Law List Regulations* (Canadian Environmental Assessment Agency (the Agency), 1994).

For this Project two federal departments, Transport Canada (TC) and DFO have been designated as Responsible Authorities (RA) under CEAA as each department will need to issue an authorization for components of the Project.

TC has determined its scope of the Project for the proposed undertaking to include shipping within a 25 km radius of Country Island, as well as construction, operation, maintenance, modification, and decommissioning of the following components:

- LNG terminal;
- marine transfer pipelines;
- LNG storage tanks;
- Marginal wharf;
- any temporary marine facilities and structures and equipment that are connected with the movement of goods between ship and shore; and
- regassification plant.

In addition, it is anticipated that the proposed dam to be constructed at Meadow Lake will also require approval under NWPA Section 5 (1)(a). However, this component of the Project will be subject to a separate screening under the CEAA using the information provided in this EA.

DFO has determined, on the basis that fish habitat may be altered disrupted, or destroyed (HADD) under Section 35(2) of the *Fisheries Act*, that there will be a trigger under the *Law List Regulations* of the *Act*. Therefore the scope of the Project, for the purposes of DFOs EA, will be the construction and operation of the marginal wharf. Operation of the marginal wharf does not include shipping, but does include docking and deberthing of vessels. In addition, the creation of the water supply for the Project will likely require an Authorization under Section 35(2) of the *Fisheries Act* and a screening level assessment under CEAA.

DFO has also declared itself an authority under the NWPA on the basis that the wharf would require an approval under this *Act*, and will continue to work with the Proponent to address the issues around fish habitat and navigation.

In addition to the RAs, Environment Canada (EC), Natural Resources Canada, and Health Canada have declared they can provide specialist or expert information and knowledge to support the comprehensive study process. In this role, the departments are working together with the Agency and the RAs to coordinate the federal response to the EA.

3.2.1 Comprehensive Study

Under the CEAA, a comprehensive study must take place where a project is described in the Comprehensive Study List. A comprehensive study is required for this Project for both the LNG terminal and marginal wharf, as it will be designed to accommodate vessels larger than 25,000 dead weight tonnes. TC and DFO will be preparing environmental assessments that will allow each to satisfy their respective responsibilities as Responsible Authorities under the CEAA.

To date, TC and DFO have provided the Proponent with guidance on the content of the forthcoming Comprehensive Study Report (CSR) being prepared by the Proponent. In addition, TC and DFO have reviewed a preliminary draft EA provided by the Proponent which allowed both RAs to provide additional input regarding their respective content expectations as the contents of the provincial EA document will be used by the Proponent in the preparation of the CSR and subsequent environmental screenings as noted above.

Following the submission of this EA, a CSR will be developed and subsequently submitted by the proponent to the RAs for review and comment. These comments will be provided to the Proponent for incorporation in the final CSR. A subsequent Final Draft of the CSR will be submitted by the Proponent to the RAs for review and then will be finalized by the RAs, translated and forwarded to the Agency. The Agency will then release the CSR for public comment via the Canadian Environmental Assessment Registry. Following the public review period, the Agency will provide the comments to the RAs for response and then provides the CSR together with public comments and responses to the Minister of Environment. The Minister of the Environment will review all the information provided by the Agency and render a decision on the process.

3.2.2 Screenings

As noted above, the Proponent has been advised that the construction of a dam and impoundment of Meadow Lake for the process water supply will likely require approvals from TC under the NWPA and DFO under the *Fisheries Act*. As the dam and impoundment were not envisaged by the Proponent at the time of the federal Scoping Document this component of the Project was not included in the scope of the Project for the Comprehensive Study. However, the water supply is still subject to an environmental assessment under CEAA. TC and DFO will address this component of the Project as a separate screening level assessment.

The screening for the dam and impoundment will be triggered when applications are made by the Proponent to TC to authorize the dam under the NWPA and DFO to authorize the HADD of fish habitat under the *Fisheries Act.* TC and DFO will issue a Federal Coordination Regulation notification for this component of the Project and post the results of the notification on the Canadian Environmental Assessment Registry. TC and DFO will complete their respective screenings based on this EA prior to issuing authorizations.

3.3 PROVINCIAL AND FEDERAL COORDINATION

As the Project is subject to both provincial and federal environmental assessments, the province and the federal government have agreed to coordinate the processes to the extent possible by their respective legislations and processes. While the processes will be coordinated, the Proponent will receive an independent decision from the federal Minister of Environment and provincial Minister of Environment and Labour as per each of their legislative mandates.

3.4 PROVINCIAL, FEDERAL, AND MUNICIPAL LEGISLATION APPLICABLE TO THE PROJECT

Table 3.4-1 sets out a list of the legislation relevant to the Project and notes where permits and approvals may be required. Additional information is provided below for key legislation.

3.4.1 Key Provincial Legislation

3.4.1.1 Environment Act

<u>**Activities Designation Regulations**</u>

The Province of Nova Scotia has jurisdiction over property and civil rights within the province as well as matters of a private and local nature. Section 50 of the *Nova Scotia Environment Act* prohibits the carrying out of certain activities designated by regulation without a person first obtaining an approval for the activity from the NSEL. The following activities likely to be carried out in connection with the Project are designated as activities requiring an approval:

- the withdrawal or diversion of greater than 23,000 litres (L) of water per day;
- the construction of a wharf;
- the construction or operation of a petrochemical manufacturing facility in which organic chemical substances produced from national organic or petroleum based material are produced, processed or handled;
- the construction or operation of a plant in which hot water, steam or thermo-electric power is produced with a total rate of thermal input of 25 MW or more; and
- the construction or maintenance of culverts at certain times of the year, a bridge, and other activities which alter a surface watercourse.

Each of the approvals required under the Activity Designation Regulation may be included in one combined approval for all of the designated activities (section 4 Activities Designation Regulation). The approvals procedure regulation sets out the procedure to be followed to apply for approvals for the designated activities.

Air Quality Regulations

The Air Quality Regulations passed pursuant to the *Environment Act* establishes maximum permissible ground level concentrations of contaminants. The Project will have to comply with the Air Quality Regulations.

Environmental Assessment Regulations

The Environmental Assessment Regulations passed pursuant to the *Environment Act* establishes lists (Class I and Class II) of undertakings that are required to undergo an environmental assessment. Class I undertakings are usually smaller in scale and may or may not cause significant environmental impacts or be of sufficient concern to the public. Class II undertakings, such as a petrochemical plant are typically larger in scale and are considered to have the potential to cause significant environmental impacts and concern to the public, thereby requiring an environmental assessment report and formal public review which may include hearings.

It should also be noted that a corridor for one or more electric power transmission lines with a cumulative voltage rating which equals or exceeds 345 kilovolts (kV) is also considered a Class II undertaking under these regulations and will therefore need to be considered if the Proponent pursues an opportunity to tie into the Nova Scotia Power Inc. (NSPI) grid, to provide secondary back-up power for the Project. The proponent will have to consider the intended carrying capacity of this connection (voltage) and how the potential export of power may affect the design of the connection.

Petroleum Management Regulations

Under the Petroleum Management Regulations made pursuant to the *Environment Act*, storage tank systems must be registered with the NSEL. The Proponent will be registering storage tank systems with the Department.

Dangerous Goods Management Regulation

Under the Dangerous Goods Management Regulation, written approval is required to store certain designated dangerous goods. To the extent applicable, the Proponent will be obtaining approvals under the Dangerous Goods Management Regulation.

Water and Wastewater Facility Regulations

This Regulation creates a classification system for wastewater treatment systems and operation certification requirements. To the extent that the Project requires a wastewater treatment system, the applicable requirements of the Water and Wastewater Facility Regulations will be followed.

Gas Plant Facility Regulations – *Energy Resources Conservation Act*

A Permit to Construct and a License to Operate from the NSUARB will be required pursuant to the Gas Plant Facility Regulations passed pursuant to the *Energy Resources Conservation Act*.

These regulations set out terms and conditions of construction and operation. The Proponent will apply for a Permit to Construct after all required federal and provincial environmental approvals are obtained and will follow the NSDE Code of Practice for LNG Facility dated July 2005.

The *Regulations* incorporate by reference CSA Z276-01, which is the current version (2001) of the CSA Liquefied Natural Gas standard. This Code of Practice provides requirements and guidance for the design, construction, operation and abandonment of land-based LNG plants and the associated jetty and marine terminal as defined under section 1.5. It is intended to supplement both the requirements in the *Gas Plant Facility Regulations* and CSA Z276-01. A central purpose in the application of the Code of Practice is the protection of the public through the appropriate design, construction, operation, and abandonment of LNG facilities. Whenever the Code of Practice mentions safety, it is addressing public safety, for which the Board has a specific role to look after that public interest. Some of the information required by this Code of Practice may also be required to meet other regulatory requirements, such as an Environmental Screening under the CEAA.

The Gas Plant Facility Regulations cover all gas plant facilities; however the scope of this Code of Practice is limited to LNG facilities. CSA Z276-01 encompasses all parts of a land-based LNG facility including the storage containers, systems that condition, liquefy or vaporize natural gas, and structures integral to the transfer of fluids between storage containers and points of receipt or shipment by pipeline, tank car, tank vehicle, or marine vessel. This includes the transfer piping beginning with the connection of the marine unloading arms to the LNG tanker piping. Support facilities covered by CSA Z276-01 are also encompassed including emergency systems.

This Code of Practice applies to all components of land-based liquefied natural gas plants and the associated jetties and marine terminals. The scope includes peak-shaving units and transfer piping to and from marine terminals. This Code of Practice covers LNG as well as any hydrocarbons contained in, extracted from, and used in processing of LNG at the facility, which may include natural gas, methane, natural gas liquids (ethane, propane, and butane), flammable refrigerants, and any other flammable or toxic materials.

The Code of Practice does not apply to:

1. offshore liquefied natural gas facilities;
2. liquefied natural gas marine transport vessels; and
3. liquefied natural gas dispensing facilities for motor vehicles or other uses.

The Code of Practice identifies minimum standards for design, construction, operation, and abandonment of LNG facilities. It also defines the information that must be submitted with any application to the Board for approvals to construct, operate, or abandon LNG facilities. Direction and non-prescriptive guidance are provided for an operator in the safe development and operation of its facilities. As acknowledged in Section 3.1 of CSA Z276-01, new concepts in the production, storage, and use of LNG are still evolving, and advancements in engineering and improvements in equipment may result in LNG facility design, equipment fabrication methods, and operating practices that differ from this Code of Practice.

3.4.2 Key Federal Legislation

3.4.2.1 Fisheries Act

Section 35 of the *Fisheries Act*, R.S.C. 1985, c. F-14 prohibits any person from carrying on any work or undertaking that results in the HADD of fish habitat, except in accordance with an authorization issued under Section 35(2). Two aspects of the Project may require authorizations under Section 35(2), specifically the marginal wharf, and the water supply for the Project.

Any structure built across or in any watercourse must allow fish passage through or around the obstruction when required by DFO, as stated in Section 20 of the *Fisheries Act*, R.S.C. F-14. The fish passage must be provided and maintained to allow the free passage of fish and the design must be approved by the minister prior to construction. The owner shall also keep the fish-way free of obstructions and ensure that there is enough water to allow fish to pass. If the construction of a fish way is unfeasible or the spawning grounds above the structure have been destroyed, the owner may be required to compensate the minister the cost of a fish hatchery that will maintain the annual return of migratory fish.

Section 22(1), (2) and (3) of the *Fisheries Act*, R.S.C. F-14 requires that sufficient flows must also be provided for the passage and migration of fish, and to adequately protect spawning grounds, eggs, and larval fish. A sufficient flow of water over the spillway or crest that allows the safe and unimpeded descent of fish must be provided, as well as free passage for migratory fish ascending and descending during the construction period. Furthermore, in the Minister's opinion there must be a sufficient amount of water allowed to reach the river bed below the obstruction that is safe for fish and allows the spawning grounds to be flooded to depths necessary for spawning.

For this Project, the fishway at the proposed Meadow Lake impoundment would need to take into consideration fish passage and minimum flow requirements of the *Fisheries Act*. Fish passage requirements will also have to be considered in the design, construction, and maintenance of pipeline or road watercrossings.

It is also important to note that Section 32 of the *Fisheries Act* prohibits destroying fish by any means other than fishing. This section is most relevant if blasting is required in or near waters containing fish or fish habitat. Should blasting be required, the Proponent will follow DFOs G*uidelines for the Use of Explosives In or Near Canadian Fisheries Waters.* These guidelines outline the methods to use that will help protect fish habitat and avoid any harmful effects that may be caused by the use of explosives. Based on these guidelines the proponent should inform DFO Regional/Area authorities early in the planning stage of their project to try and come up with an alternative to explosives, identify species or habitats at risk, and identify mitigation measures. If the administration of fisheries is by provincial resource management or aboriginal resource management boards they should also be consulted. Wherever possible, finding alternatives to blasting is encouraged. No explosive is to be detonated within 500 m of a marine mammal, or that causes a peak particle velocity greater than 13 millimetres per second (mm/s^{-1}) in a spawning bed during egg incubation.

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TABLE 3.4-1 List of Relevant Legislation

Statute/ Regulation	Section Reference	Requirement	Schedule	Data Requirements	Review Period and Contact
Provincial					
Environment Act	S. 50	Prohibits designated activities without holding appropriate approval.			
Environmental Assessment Regulation	Schedule A	Storage facility for liquid or gaseous substances including hydrocarbons with total capacity greater than 5000 m^3 designed as a Class I undertaking requiring registration for Environmental Assessment. Petrochemical Plant d85 Designated as Class II undertaking requiring a full EA. Project cannot proceed without Minister's approval under this Regulation.	Late Sept 06		
		A corridor for one or more electric power transmission lines with a cumulative voltage rating which equals or exceeds 345 kV is a Class II undertaking	N/A		
Activities Designation Regulations	S. 5(1)(a)	The withdrawal or division of greater than 23,000 L per day requires approval (under the Nova Scotia Guide for Surface Water Withdrawal Approvals)	Prior to construction activities for dam.	• Detail of proposed structures; • Storage volume; • Measures to protect watercourse during and after construction; and • Stamped plans, drawings, and specifications. In this case, detail on modifications to wetland habitat will be required. This will trigger a new wetland alteration approval process (see below).	60 days unless additional information required for Proponent. (Contact: Peter Mackenzie – NSEL Antigonish Office)

Statute/ Regulation	Section Reference	Requirement	Schedule	Data Requirements	Review Period and Contact
Activities Designation Regulations *(Continued)*	S.(1)(d)(e) and (o)	The installation of certain culverts, a bridge, or other watercourse alteration requires an approval.	Prior to construction of culvert crossings associated with Highway 316 realignment; send-out gas pipeline crossing of Betty's Cove Brook. Prior to construction of the dam.	• Details of proposed crossing, culvert sizing, fish passage requirements for realignment; • Pipeline crossing method; • Measures to protect the watercourse during and after construction; and • Stamped plans, drawings, and specifications. For Meadow Lake impoundment: (in addition to the above, extent of information required below to be discussed with NSEL and NSDNR; much of requested detail in EA or likely available in specialists information: • Wetland Delineation, watershed location, Nova Scotia theme region; • Species at Risk; • Fish and Fisheries; and • Ecological Character: fish and fish habitat, dominant vegetation, birds and critical nesting periods, other wildlife and habitat concerns Functions and values of concern to the local community; • Hydrological Character; • Hydrogeological Character; • Property Ownership: Municipal zoning requirements; • Reason for Alteration: description of proposed alteration; • Opportunities to Avoid the	As above, except wetland process is new and largely untested. (Contact: Peter Mackenzie – NSEL Antigonish Office)

Statute/ Regulation	Section Reference	Requirement	Schedule	Data Requirements	Review Period and Contact
				Impacts;	
Activities Designation Regulations *(Continued)*	S.(1)(d)(e) and (o) *(Continued)*	The installation of certain culverts, a bridge, or other watercourse alteration requires an approval. *(Continued)*	Prior to construction of culvert crossings associated with Highway 316 realignment; send-out gas pipeline crossing of Betty's Cove Brook. Prior to construction of the dam. *(Continued)*	• Alternative Methods to Minimize Impact on Wetland Function and Values; • Summary of Unavoidable/ Residual Impacts; • Mitigation and Monitoring; and • Compensation Proposal (currently there is not a consistent compensation approach)	
	S. 5(1)(g)	The construction of a wharf requires approval.			
	S. 10(1)(f)	The construction or operation of a site with a chemical storage tank in excess of 2000 L or 2000 kilograms (kg) requires approval (anticipated to be combined with industrial approvals for the petrochemical facility and LNG facility).	Prior to construction. Can be staged if required.	• Confirmation of legal right to conduct activity on the site; • Process description including: capacity, raw materials, water usage, discharges, quantities of dangerous goods, and Material Safety Data Sheets (MSDS); • Plans and drawings for structures and equipment used to treat wastes from process; • Demonstration of feasibility process to treat wastes; • Details on proposed treatment facilities such as flows and expected effluent characteristics; and • Scaled engineering drawings, plans, and specifications stamped by Nova Scotia Licensed Engineer.	Contact same as above.
	S. 12(f)	The construction or operation of a petrochemical manufacturing facility in which organic chemical substances produced from natural organic or petroleum-based material are produced, processed, or handled.			
	S. 12(f)	The construction or operation of a natural gas processing facility.			
	S. 20	The construction or operation of a plant in which hot water, steam, or thermal electric power is produced with a total rated thermal input of 25 MW or more requires an approval.			
	S. 21	The treatment or processing of wastewater or wastewater sludge is designated as an activity (anticipated to be combined with industrial approvals for the petrochemical facility and LNG facility).			

Statute/ Regulation	Section Reference	Requirement	Schedule	Data Requirements	Review Period and Contact
Air Quality Regulation	General	Establishes maximum permissible ground level concentrations of contaminants.	N/A		
Petroleum Management Regulation	S. 11	Storage tank systems must be registered.	Notify NSEL at least 3 days prior to construction of storage tanks. Within 30 days following installation file a report on the installation with NSEL.		Contact same as above.
Dangerous Goods Management Regulation	S. 6	Written approval required to store waste dangerous goods.	Prior to any construction activities.		Contact same as above.
Water and Wastewater Facility Regulation	S. 4-6	Creates classification system for wastewater treatment system and operation certification requirements.	Prior to any construction activities.		Contact same as above.
Energy Resources Conservation Act – Gas Plant Facility Regulations	S. 6 (1), (2), 7 (1), (2)	Requires a permit to construct and licence to operate to be obtained from the NSURAB	Prior to any construction activities.		
Pipeline Act – Pipeline Regulations	S. 4 (1), (2)	Requires permit or licence to construct or operate a pipeline. Establishes standards for design and construction.	Prior to any construction activities.		
Beaches Act	S. 6	Construction activities including trenching and infilling below the ordinary high water mark require permission (permit) from the Nova Scotia Department of Natural Resources (NSDNR).	Prior to any construction activities.		
Crown Lands Act	S 5, 13, 16 (1)	Governs the use and activities on lands owned by the province. Through the Act the province can make crown lands available for the Project through the use of easements, conveyances, leases, or licenses.	Prior to any activities on Crown Lands		

Statute/ Regulation	Section Reference	Requirement	Schedule	Data Requirements	Review Period and Contact
Forests Act – Forest Protection Regulations	S 6 (1), (2)	Requires fire suppression equipment as per the regulation when operating within 305 m of the woods.	During construction.		
Federal					
NWPA	S. 5 (1)	Approval of Minister of DFO to construct "work" in navigable waters.	Prior to any construction activities below the high watermark.		
Fisheries Act	S. 35	Approval required for HADD of fish habitat, specifically the marginal wharf and water supply impoundment.	Prior to any construction activities below the high watermark.		
	S. 20	Fish passage must be maintained. Applies to water supply impoundment and needs to be considered for pipeline and road crossings.	Prior to any construction activities.		
	S. 22 (1), (2), (3)	Minimum flows must be maintained for fish and fish eggs. Applies to water supply impoundment.	Prior to any construction activities.		
	S. 32	Prohibits destroying fish by any means other than fishing. Most relevant if blasting is required in or near waters containing fish or fish habitat.	Should blasting be required, the Proponent will follow DFOs *Guidelines for the Use of Explosives In or Near Canadian Fisheries* prior to construction activities.		
	S. 36	Prohibits deposit of deleterious substance in waters frequented by fish.	N/A		
CEAA	S. 5(1)	EA required before federal authority may issue "approval"/transfer land.	Prior to any construction activities.		
Law List Regulation	S. 6 and 11	S.5 of the NWPA and s. 22 (2), and s.35 of the *Fisheries Act* are "triggers" for application of CEAA.			
Comprehensive Study Regulation		Specifies whether or not a comprehensive study is required.			
Municipal					

Statute/ Regulation	Section Reference	Requirement	Schedule	Data Requirements	Review Period and Contact
NBCC		Applied by municipality.			
Other Federal Legislation to Note					
Species at Risk Act *(SARA)*.	General	Provides protection to listed species and their habitat.	N/A		
Petroleum Refinery Effluent Regulation	General	Sets minimum standards for effluent quality from "petroleum refinery" as therein defined.	N/A		
Canadian Environmental Protection Act (CEPA)	Part 5	Regulates the manufacturing and handling of "toxic substance".	Notification to EC within 90 days of acquiring a scheduled substance.		
Environmental Emergency Regulations		Requires notification to EC that Proponent has control of a scheduled substance. Also requires an environmental emergency plan for the facility that stores or uses the substance.			
Canada Marine Act	General	Regulation of marine transportation.	N/A		
Transportation of Dangerous Goods Act	General	Documenting handling and placard requirements for transport of dangerous goods.	N/A		
Pilotage Act - Atlantic Pilotage Authority Non-Compulsory Area Regulations	General	Establishes pilotage authorities and requirements outside areas where pilots are compulsory.	N/A		
Canada Shipping Act	General	Detailed code for all aspects of shipping in Canada.	N/A		
Canada Transportation Act	General	Applies to transportation matters under federal jurisdiction.	N/A		
Migratory Birds Convention Act	General	Enacts international treaty for protection of migratory birds.	N/A		
Marine Transportation Security Act	General	Regulatory measures for Marine and port security.	N/A		

3.4.2.2 Species at Risk Act (SARA)

The SARA came fully into force in June 2004, as part of a three part national strategy for the protection of wildlife species at risk, which also includes commitments under the Accord for the Protection of Species at Risk and activities under the Habitat Stewardship Program for Species at Risk. It applies to all federal lands in Canada; all wildlife species listed as being at risk; and their critical habitat. The Act provides federal legislation to prevent wildlife species from becoming extinct, to provide for their recovery, and support an ongoing process of monitoring, assessment, response, recovery, and evaluation to be undertaken to improve the species status and ecosystem.

The Canadian Endangered Species Conservation Council (the Council), which includes representatives from DFO, EC, Canadian Heritage, and provincial and territorial governments, coordinates government activities related to the protection of species at risk. The Council also provides direction on the activities of the Committee on the Status of Endangered Wildlife in Canada (COSEWIC), which is responsible for assessing and making a recommendation for the classification of individual species under SARA. Each assessment is reviewed by EC and the Council before the federal government makes a decision on whether or not to list a species. If placed on Schedule 1 as extirpated, endangered, or threatened, species and their habitats are protected. For all species listed in Schedule 1 (including those listed as Special Concern), a recovery strategy, and action plan is developed. This must include the identification of critical habitat.

Responsibility for enforcement of SARA is appointed according to major jurisdiction. Thus DFO is responsible for aquatic species at risk, Parks Canada is responsible for species at risk within national parks and federal protected areas, and EC is responsible for all other species at risk on federal land. With respect to provincial land, SARA is intended to complement existing laws and agreements to provide for the legal protection of wildlife species and conservation of biological diversity. The Province of Nova Scotia provides species protection through its *Endangered Species Act*. The Nova Scotia Species at Risk Working Group appointed by the Minister of Natural Resources meets regularly to assess and designate species for protection under the provincial legislation. Species listed provincially may or may not correspond to species listed under SARA, however, there is a reciprocity agreement built into SARA such that those species at risk identified by each province will be protected on federal land in the province in which it is listed.

3.4.2.3 Navigable Waters Protection Act (NWPA)

The Federal government has authority to protect the public right of navigation in navigable waters. This is accomplished pursuant to the NWPA, R.S.C. 1985, c. N-22 and is administered by TC.

The construction of a marine terminal facility and associated elements of the Project will trigger the requirement for an approval under Section 5(1) of the NWPA which requires an approval prior to construction of any work in navigable waters. Watercourse crossings for road construction and facilities related to water supply (i.e. the dam) may also require approval under

Section 5(1) of the NWPA and will be addressed in separate federal EA screenings utilizing the information from this EA.

3.4.2.4 Marine Transportation Security Act and Regulations

The *Marine Transportation Security Act* establishes regulatory measures to protect marine security. The International Port and Facility Security Code (ISPS Code) is the base line standard for port security for 164 member countries of the IMO. However, it should be noted that as of July 1, 2004, Canadian regulations have come into force and since then TC requires all security plans to be approved based on the Canadian regulations (not the ISPS Code). These regulations may affect the Project as some of the Canadian regulations are stricter than the ISPS Code, and amendments have been proposed to add substantive new Parts 5, 6, and 7 to the Regulations, to correct certain minor errors and inconsistencies that were inadvertently included in the Regulations and to clarify that certain existing provisions are mandatory. The changes will include:

- Part 5: implementation of a marine workers' security clearance program, hereafter referred to as the Marine Transportation Security Clearance Program (MTSCP);
- Part 6: implementation of an administrative monetary penalty (AMP) enforcement scheme; and
- Part 7: implementation of notice and service requirements applicable to that enforcement scheme.

The *Act* and its regulations, the Marine Transportation Security Regulations, will apply to the operation of the Project and will be followed.

3.4.2.5 Canada Shipping Act

This legislation governs marine navigation covering matters such as safety, collisions, and pollution prevention and governs the operation of Canadian vessels everywhere as well as foreign vessels in waters under Canada’s jurisdiction.

Ballast Water Control and Management Regulations

These regulations apply to shipping coming in from outside of Canadian waters. The current options for ships include:

- to exchange ballast water in deep water, mid-ocean;
- to retain the ballast water on board and not release or release only a minimal amount;
- discharge to reception facilities; or
- render the ballast harmless through treatment with new technologies or substances, such as chlorine.

The only practical option however, at the moment for commercial shipping is to consider ballast water exchange mid-ocean, as a primary means to reduce the risk of introducing new species into Canadian waters (Annex 5 addresses the Atlantic Region).

3.4.2.6 Canadian Environmental Protection Act (CEPA)

CEPA is the primary component of a group of inter-related laws, policies and institutions which, taken together, give all Canadians a shared responsibility in protecting the Canadian environment. The key purpose of the Act is the prevention and management of risks posed by toxic and other harmful substances. In addition, it manages the impacts on health and the environment of the products of biotechnology, marine pollution, disposal at sea, fuels, emissions from vehicles, engines and equipment, hazardous wastes, environmental emergencies and other sources of pollution.

National Pollutant Release Inventory (NPRI)

The National Pollutant Release Inventory (NPRI) was established under *CEPA* in 1992 to collect data on substances of concern in Canada and includes information-gathering provisions (Sections 46 to 53) that specifically address the creation of inventories of data (Section 46) and state that the Minister shall establish a national inventory of releases of pollutants (section 48). This inventory administered by EC is the only legislated, nation-wide, publicly accessible inventory of its type in Canada. Owners or operators of projects which meet certain reporting criteria for certain substances are obligated to report annually to EC.

It is likely that, based on a review of reporting from existing petrochemical facilities in Canada, the Proponent will also be responsible for reporting under the NPRI. Releases of substances that must be reported under the NPRI program provide a basis for identifying emissions that are of concern, assessing potential effects and developing mitigation and follow-up programs. If a facility meets the NPRI reporting thresholds for the list of substances specified in the *Canada Gazette*, the company must report the following:

- information about the company, its location and number of employees;
- information about each substance that meets the reporting requirements, including the substance name and Chemical Abstracts Service registry, the nature of the activities (such as whether the substance is manufactured, processed or otherwise used at the facility);
- the quantity of the substance that is released at the facility to water, air or land, underground injection;
- the quantity of the substance that is transferred off site to another location for final disposal or treatment prior to disposal and the nature of the treatment;
- the quantity of each reported substance that is transferred off-site for recycling and for energy recovery, and the address of the receiving facility;
- the reasons for year-to-year changes in releases, transfers and recycling;

- information on anticipated changes (mandatory for the three years following the reporting year) in releases, transfers and recycling; and
- information on the types of pollution prevention activities undertaken at the facility.

Environmental Emergency Regulations

The *Environmental Emergency (E2)* Regulations under Section 200 of *CEPA* apply to any person in Canada who owns, or has charge, management or control of, a substance listed on Schedule 1 of the regulations that is present in a quantity equal to or greater than that specified in the Schedule. The proponent will have storage capacities for the following substances that are above the thresholds listed on Schedule 1 of the Regulations:

- ethane;
- propane;
- ethylene;
- propylene;
- hexane; and
- butane.

The regulations identify the information that must be submitted to EC within 90 days after the regulations come into force or within 90 days after acquiring a scheduled substance at or above the specified threshold quantities. An environmental emergency plan will also be required for all facilities that store or use any of the scheduled substances at or above the specified threshold quantities and must include a description of:

- the properties and characteristics of the substance and the maximum expected quantity on site at any time;
- the commercial, manufacturing, processing or other activity in relation to which the plan is to be prepared;
- the characteristics of the place where the substance is located and of the surrounding area;
- the potential consequences from an environmental emergency on the environment and human health or life;
- any environmental emergency that can be reasonably expected to occur at the place and that would likely cause harm to the environment or constitute a danger to human life or health;
- the measures used to prevent, prepare for, respond to, and recover from any environmental emergency identified above;
- a list of individuals and their roles and responsibilities to carry out the plan in the event of an emergency, and the training required for those individuals;

- emergency equipment needed to implement the plan; and
- measures that would be taken to notify the public of any environmental emergency.

Schedules 1-6 under the environmental emergency plan outline the list of substances that are under this act, the information that should be included in various notices on the substances, and the correct people to contact in case of an environmental emergency.

Additional potentially relevant regulations under *CEPA* include:

- Canadian Fuels Regulations;
- Chlorobiphenyls Regulations;
- Contaminated Fuel Regulations;
- Disposal at Sea Regulations;
- Environmental Emergency Regulations;
- Export & Import of Hazardous Waste and Hazardous Recyclable Material Regulations;
- Export of Substances under the Rotterdam Convention;
- Federal Halocarbon Regulations, 2003;
- Federal Mobile Polychlorinated Biphenyls (PCB) Treatment and Destruction Regulations;
- Fuels Information;
- Interprovincal Movement of Hazardous Wastes Regulations;
- Masked Name Regulations;
- Order Adding Toxic Substances to Schedule 1 of CEPA;
- Ozone Depleting Substances Regulations;
- PCB Waste Export Regulations;
- Persistence & Bioaccumulation Regulations;
- Prohibition of Certain Toxic Substances, 2005;
- Solvent Degreasing Regulations;
- Storage of PCB Material Regulations; and
- Sulphur in Diesel Regulations.

3.4.2.7 Other Federal Legislation

The *Canada Marine Act*, the *Canada Shipping Act*, the *Transportation of Dangerous Goods Act*, 1992, the *Canada Transportation Act*, the *Pilotage Act*, the *Migratory Birds Convention Act*, and their respective regulations also may apply to the construction and/or operation of the Project.

3.4.3 Municipal

The site will be subject to municipal land use by-laws within the Municipality of the District of Guysborough. Land based facilities will be located in and around the Goldboro Industrial Park, currently zoned for industrial usage. Building Permits and other similar permits administered by the Municipality will be obtained in the ordinary course of development of the Project. Construction of works on the site will comply with the NBCC (2005), the National Fire Code of Canada, and the National Planning Code of Canada.

3.5 TERMPOL PROCESS

The TERMPOL is a review process, initiated by the Proponent, of marine terminal systems for trans-shipment sites. The purpose of this review process is to objectively appraise operational ship safety, route safety, management, and environmental concerns associated with the location, construction, and operation of a marine terminal. The review is coordinated by TC and DFO in conjunction with requirements of the *Canada Shipping Act*. The process is not necessarily limited to the scope of the CEAA review and may involve a more detailed assessment of shipping and navigation issues. Provisions of the review are not mandatory but criteria are used by TC to determine the need for making or revising specific regulations or for implementing special precautionary measures.

3.6 GUIDELINES, POLICIES AND CODES

In addition to complying with all aforementioned regulatory requirements, the Project will also be developed in accordance with all applicable international, federal, and provincial guidelines, industry standards, and codes of practice. Table 3.6-1 lists the applicable documents and provides a summary.

TABLE 3.6-1 Applicable Guidelines/Policies/Codes

Guideline/Policy/Code	Date	Governed under	Summary
PROVINCIAL			
Erosion and Sedimentation Control Handbook for Construction Sites	--	NSEL	Provides information on erosion and sediment control measures and requires proponents to develop a plan to be implemented during phases of the Project. Reference is made, but not limited to, clearing and grubbing, grading, culvert installation, hazardous materials and contingency planning.
Code of Practice: Liquefied Natural Gas Facilities	2005	NSDE	This Code of Practice provides requirements and guidance for the design, construction, operation and abandonment of land-based liquefied natural gas (LNG) plants and the associated jetty and marine terminal and is intended to supplement the requirements in the *Gas Plant Facility Regulations*. A central purpose in the application of the Code is the protection of the public through the appropriate design, construction, operation, and abandonment of LNG facilities. Whenever the Code of Practice mentions safety, it is addressing public safety, for which the Board has a specific role to look after that public interest.

Guideline/Policy/Code	Date	Governed under	Summary
			Some of the information required by this Code may also be required to meet other regulatory requirements, such as an Environmental Screening under the CEAA.
NATIONAL			
Guidelines for the Control of Ballast Water Discharge from Ships in Waters Under Canadian Jurisdiction	2001	TC	The purpose of these guidelines is the protection of waters under Canadian jurisdiction from non-indigenous aquatic organisms and pathogens that can be harmful to existing ecosystems These guidelines are intended to minimize the probability of future introductions of harmful aquatic organisms and pathogens from ships' ballast water while protecting the safety of ships.
National Emission Guideline for Stationary Combustion Turbines	1992	CCME	Encourages project proponents to develop and operate combustion turbine facilities in a manner that restricts emissions of oxides and NO_x, sulphur dioxide (SO_2), and CO. Emission targets are expressed by weight per unit of net energy output Proponents are required to account for their emissions and for the net useful energy output. Applies to all new combustion turbines defined in the National Emission Guideline Glossary of Terms section but does not apply to: combustion turbine turbines used for emergency or stand-by duty, turbines used in research, development, and field demonstration; and/or turbines under repair or being tested.
Canada-Wide Standards for PM and Ozone	2000	CCME	Call for significant reduction in PM and ground-level ozone by 2010. The Standards and related provisions are: • PM less than 2.5 microns ($PM_{2.5}$) of 30 µg/m^3, 24 hour averaging time, by 2010; and • 65 ppb, 8-hour averaging time, for ozone, by 2010.
LNG Production, Storage and Handling Standard	--	CSA	Applies to the following for facilities at any location for the liquefaction of natural gas and the storage, vaporization, transfer, handling, and truck transport of liquefied natural gas (LNG), as well as the training of personnel involved: 1. design; 2. location; 3. construction; 4. operation; and 5. maintenance.
National Ambient Air Quality Objectives	1999	CEPA	Identifies benchmark levels of protection for people and the environment. The objectives guide federal/provincial/territorial and regional governments in making risk-management decisions, play an important role in air quality management, and are viewed as effects-based long-term air quality goals.
Canadian Environmental Quality Guidelines	--	CCME	These guidelines provide: • national benchmarks to assess potential or actual impairment of socially relevant resource uses; • scientific basis for the development of site-specific criteria, guidelines, objectives or standard indicators for state-of-the-environment reporting; • science-based goals or performance indicators for regional, national, or international management strategies for toxic substances; • interim management objectives for persistent,

Guideline/Policy/Code	Date	Governed under	Summary
Canadian Environmental Quality Guidelines *(Continued)*			bioaccumulative, and toxic substances to track progress toward the virtual elimination; • scientific tools for assessing risks associated with existing concentrations of persistent, bioaccumulative, and toxic substances in the ambient environment; • indicators of ecotoxicologically relevant concentrations of persistent, bioaccumulative, and toxic substances for the purpose of improving analytical detection and quantification capabilities; • tools to evaluate the effectiveness of point-source controls; • the scientific basis for environmental regulations scientific benchmarks or targets in the assessment and remediation of contaminated sites; and • science-based assessments and tools for consideration in the development of Canada-wide standards under the Canada-wide *Accord on Environmental Harmonization*.
Environmental Guideline of Volatile Organic Compounds (VOCs) Process Emissions from New Organic Chemical Operations	1993	CCME	Based on studies and regulations of the US EPA and reflects the control efficiency of the EPA **New Source Performance Standards** (NSPS). This guideline is applicable everywhere in Canada to process vents from new facilities that use, handle, produce or release VOCs from the industrial manufacturing sectors covered by the standard industrial classification SIC numbers 3611, 3712 and 3731 (1980).
Environmental Code of Practice for the Measurement and Control of Fugitive VOC Emissions from Equipment Leaks	1993	CCME	The purpose of this document is to serve as a guideline for minimizing VOC emissions from fugitive sources of petroleum refineries and organic chemical plants through measurement, performance guidelines, record keeping, and work practices.
Environmental Guidelines for Controlling Emissions of VOCs from Aboveground Storage Tanks	1995	CCME	Advises environmental regulating authorities and owners of storage tanks of the means to reduce VOC emissions from tanks storing volatile organic liquids. These guidelines categorize tanks by diameter or capacity and by the vapour pressure of the stored liquid at 21.1°C, and then describe the equipment required to reduce VOC emissions. Due to the difficulty of measuring emissions from tanks storing volatile organic liquids, a maximum allowable emission rate was not assigned and guidelines specify technology standards instead of performance standard.
National Emission Guideline for Commercial/Industrial Boilers and Heaters	1998	CCME	Provides a consistent national basis for reducing emissions of NO_x, while encouraging greater energy efficiency in the operation of new and modified commercial/industrial boilers and heaters. All commonly available and applicable methods of NO_x emission reduction have been assessed as part of the development of the Guideline, including combustion technologies that reduce or prevent emissions at the point of generation, and post-combustion controls that reduce emissions after generation. The reference emission limits set out in the Guideline are based on proven compatibility with efficient combustion operation and the use of cost-effective technology such as low NO_x burners.

Guideline/Policy/Code	Date	Governed under	Summary
Freshwater Intake End-of-Pipe Fish Screen Guideline	1995	DFO	Assists proponents in the design and installation of fish screens for the protection of anadromous and resident fish where freshwater is extracted from fish-bearing waters. Also assists regulatory agencies in the review of fish screen proposals. Information that should be considered when evaluating an intake screen design includes: • fish presence, species, and possible fish size or fish habitat conditions at the Project site; • rate or ranges of rates of withdrawal from the watercourse; • screen open and effective areas; • physical screen open parameters with respect to the intake and the watercourse; • screen material, method of installation and supporting structures; and • screen maintenance, cleaning, or other special requirements.
INTERNATIONAL			
International Ship and Port Facility Security Code	2004	IMO	The objectives of this code are to establish an international framework involving co-operation between Contracting Governments, Government agencies, local administrators and the shipping and port industries to: • detect/assess security threats and take preventative measures against security incidents affecting ships or port facilities used in international trade; • establish the respective roles and responsibilities of all parties concerned, at the national and international level, for ensuring maritime security; • ensure early and efficient collation and exchange of security related information; • provide a methodology for security assessments so as to have in place plans and procedures to react to changing security levels; • ensure confidence that adequate and proportionate maritime security measures are in place. The objectives are to be achieved by the designation of appropriate officers/personnel on each ship, in each port facility and in each shipping company to prepare and to put into effect the security plans that will be approved for each ship and port facility.
British Standard Code of Practice for Marine Structures	--	BSI*	Provides guidance and recommendations on general criteria relevant to the planning, design, construction, and maintenance of structures set in the maritime environment. Information is provided for: • environmental factors; • methods of investigating and quantifying environmental effects; • consideration of operational requirements; • sea state; • selection and evaluation of design loadings; • geotechnical aspects; and • guidance on the use and specification of appropriate materials and protective measures.

Guideline/Policy/Code	Date	Governed under	Summary
Mooring Equipment Guidelines	--	OCIMF**	These guidelines represent a recommended minimum requirement and are intended to be useful to ship designers and surveyors as well as ship and terminal operators. Care has been taken to ensure that design performance of equipment is optimized, while not overlooking the equally important factors of ease of handling and safety of personnel.
Prediction of Wind Loads on Large Liquefied Gas Carriers	--	OCIMF SIGTTO	Presents coefficients and procedures for computing wind loads on carriers in the 75,000 to 125,000 m^3 classes, with both prismatic and spherical tanks. Wind force and moment coefficients are presented in non-dimensional form for moored vessels and are applicable to draught conditions ranging from ballasted to fully loaded vessels.
Prediction of Wind and Current Loads on Very Large-sized Crude Oil Carriers	1994	OCIMF	Current forces only. This version has been amended to include revised longitudinal current coefficient data as a result of recent research.
Site Selection and Design for LNG Ports and Jetties Information Paper No.14	2005-2006	SIGTTO	Revised version includes almost 200 new ports and terminals. Information contained in the report provides details of over 6,200 ports for ocean-going vessels, port information, terminal design, and port plans and mooring diagrams.
LNG Operations in Port Areas: Recommendations for the Management of Operational Risk Attaching to Liquefied Gas Tanker and Terminal Operations in Port Areas	2003	SIGTTO	Provides guidance to best practice for managing gas shipping operations within ports, and illuminates the profile of risk for gas operations. This document is essential guidance to best practice for those involved with the design and operation of new LNG terminals and for existing terminals who wish to re-assess risk due to the dynamic nature of operating environments.

Notes:
* British Standards Institute (BSI)
** Oil Companies International Marine Forum (OCIMF)

3.6.1 Voluntary Guidelines, Policies and Codes

The Proponent will seek membership in the Canadian Chemical Producers Association (CCPA) whose standards require adherence to all applicable guidelines, policies and codes as well as voluntary initiatives, listed under the standards. Table 3.6-2 provides a summarized list of voluntary initiatives.

TABLE 3.6-2 Voluntary Guidelines/Policies/Codes

Guideline/Policy/Code	Summary
Responsible Care Charter and Codes of Practice and Guideline for Quantifying Emissions from Chemical Facilities	Includes 6 codes that must be met by member companies by the 3rd year of membership: 1. **Community Awareness and Emergency Response** which requires the facility to address the public's concerns on an ongoing basis and to have the emergency plan tested with the community's plan. 2. The **Research and Development Plan** which covers the full lifecycle of the chemicals that the company deals with to ensure that risks are minimized that may arise from new chemicals or new uses for chemicals. 3. The **Manufacturing Code** deals with the operation of chemical plants including the design of new and decommissioning of old plants. The goal of this code is to protect the employees, environment, and community from harm. 4. The **Transportation Code** requires that each company ensures that the transportation of goods are done in a way that minimizes harm to the environment and risk of injury to the people along the routes. 5. The **Distribution Code** requires that there be standards, procedures, and training regarding the storage and handling of chemical products. 6. The **Hazardous Waste Management Code** discourages the production of waste by promoting recycling, reuse, or recovery, but where waste is produced the site should be soundly managed. Previously contaminated sites should be assessed, reported to authorities, and cleaned up. Every 3 years there is an inspection of each member facility to ensure the codes are being met. If a facility does not comply with the codes of practice membership can be revoked. CCPA Members must also track, improve, and report to the public on their health, safety, environmental, and social performance.
Guideline for Quantifying Emissions from Chemical Facilities	Provides potential methods for quantifying emissions from a Canadian chemical facility for reporting to the various inventory programs, and provides guidance to ensure that relevant significant sources are considered and that appropriate assumptions and methodologies are used in quantifying the emissions. The Guideline is intended to improve consistency and inter-company comparability of the emission inventory data by reducing non-performance related variability of the emissions data.
CCPA Memorandum of Understanding (MOU)	The objective of this MOU is to reduce the release of chemical substances through voluntary, non-regulatory action under CCPA Responsible Care by encouraging and publicly recognizing progress on the part of the CCPA and its member companies. The MOU establishes an understanding and process involving the CCPA, CCPA member companies, and the Governments of Canada, Ontario and Alberta with respect to environmental protection that: • will contribute to achievement of Canadian environmental and population health objectives through voluntary, non-regulatory actions by CCPA member companies under Responsible Care; • will contribute to Canada's long-term prosperity by promoting the progressive implementation of pollution prevention measures and of management practices that are environmentally sound and promote eco-system and population health; and • will build mutual trust in dealing with environmental protection issues between CCPA and its member companies and the participating governments.

4.0 NEED FOR THE PROJECT

The primary purpose of developing a world class petrochemical industry in Nova Scotia is to create added value to the natural gas found offshore Nova Scotia. In fact, the Nova Scotia Energy Strategy (NSDE, 2001) notes that “One reason for seeking access to natural gas liquids in Nova Scotia is to develop a petrochemical industry.”

Forecasts indicate that natural gas demand in eastern Canada and the northeastern US will grow over the next several years and that LNG will be an important part of the energy supply chain. Similarly, the demand for petrochemical products, such as polyethylene and polypropylene, continues to grow in North America as the use of plastic in many industries increases. As natural gas is a cleaner burning fuel than some other fossil fuels, an LNG regasification terminal in Nova Scotia will provide supply options to existing energy consumers in Nova Scotia and elsewhere in North America to help them reduce air pollution.

The joint Federal Provincial Environmental SOEP Panel felt that the significant long-term impact of that project for Nova Scotia and Canada would be found in the area of “other benefits” rather than in direct expenditures for labour and material. The obvious sources are derived from use of other products. The liquids alone could form the base for a provincial petrochemical industry. The SOEP Panel recommended that the Province examine options for an industrial strategy that would include hydrocarbon-based development saying that “if SOEP is truly a seed project for the petrochemical industry then all of the available physical and human resources have to be brought together to make the seed grow.”

To meet the growing demand for natural gas, polyethylene, and polypropylene, Keltic proposes to import LNG, extract the natural gas liquids from the LNG (primarily ethane and propane), convert the liquids into various grades of polyethylene and polypropylene, and export the residual natural gas and polyethylene and polypropylene to customers in eastern Canada and the northeastern US. Keltic will require a cogeneration plant to provide power to the Project. Additional utilities and common support facilities will also be required, including a water supply reservoir in Meadow Lake, a water treatment plant, a wastewater/storm-water collection & treatment system, central administration/maintenance buildings, and emergency medical facilities/fire station/helipad.

This Project is expected to create several thousand direct jobs at the peak of Project construction and several hundred direct jobs at the various facilities during operation. Keltic expects that many other economic spin-off opportunities will be created in the area as a result of a world-scale LNG and petrochemical facility being built in Goldboro, Guysborough County. These direct jobs and economic spin-off opportunities will be created in a region of Nova Scotia that has an unemployment rate well above the provincial and national average. Furthermore, the population of Guysborough County has been in steady decline as a result of the employment situation; this trend is expected to be reversed with the establishment of this industry. This Project will improve the overall employment rate from both a local and provincial perspective.

4.1 NATURAL GAS MARKET

As reported in the National Energy Board's Short-term Outlook for Natural Gas and Natural Gas Liquids (2005), "North American natural gas markets have experienced an extremely close balance between supply and demand in recent years. Since 2001, supply growth has not kept pace with growth in demand. These tight market conditions have contributed to high and volatile natural gas prices.". This price volatility has been experienced on both sides of the US-Canadian border.

As can be seen in Figures 4.1-1 and 4.1-2 (National Petroleum Council's Balancing Natural Gas Policy Volume I (2003)), the forecast for natural gas demand and supply is expected to remain tight over the long term and LNG will be an important source of supply growth for North America.

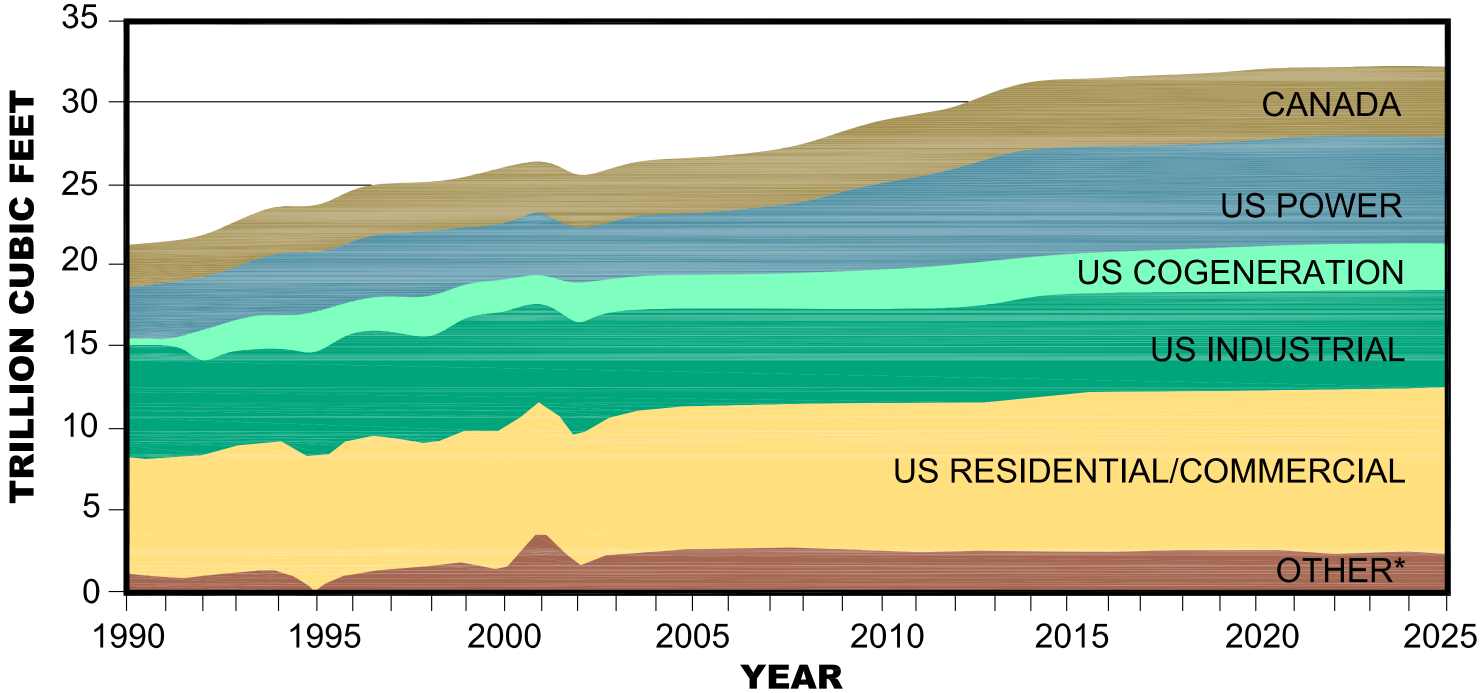
Natural gas demand in Canada and the US is expected to grow by approximately 25% over the next 20 years as depicted in Figure 4.1-1. These data are corroborated by the Energy Information Administration's Annual Energy Outlook 2006 [Energy Information Administration, 2006] which predicts natural gas consumption increasing from 22.4 trillion cubic feet (tcf) in 2004 to 26.9 tcf in 2030. Recent spikes in natural gas prices are evidence of an extremely close balance between the supply of and demand for natural gas in North America. A key driver of this extremely close balance in North America has been the flattened and, in some cases, reduced profile of Canadian and US natural gas production combined with the growing natural gas consumption in all sectors of the economy. LNG offers North America an opportunity to import natural gas from stranded sources in other regions of the world (i.e., areas where natural gas cannot be feasibly utilized) to offset the flattened profile of natural gas production in North America and meet growing demand.

Figure 4.1-2 shows that LNG is expected to be a growing source of supply for North America over the next 20 years and beyond. The National Petroleum Council predicts that LNG will constitute between 14% and 17% or between 4.5 tcf and 5.5 tcf annually of natural gas supply by 2025. The LNG regasification terminal at Goldboro will provide access for additional supplies of natural gas from other geographic regions of the world to enter North America and lower pressure on the supply-constrained market. As well, the Project is close to existing pipeline infrastructure, thereby reducing the capital cost associated with getting the gas to market.

Total operating or approved LNG projects in eastern North America will account for an estimated 4 tcf of annual supply. This demonstrates that there is capacity in the North American gas supply for the Project. Keltic expects to earn an economic return by providing the regasification terminal necessary for LNG to enter the North American market.

The Keltic Project also enhances the economics of Nova Scotian projects based on offshore gas because the increased volumes of gas moving within the pipeline will result in greater downstream pressure and thus more favourable transportation toll prices. Projects such as EnCanas' Deep Panuke will benefit from lower transportation tolls. Commitments made to M&NP by current offshore producers will be able to be met or supported by LNG volumes.

FIGURE 4.1-1 US and Canadian Natural Gas Demand



* Includes net Mexico exports, lease/plant/pipeline fuel, and net storage.

-Natural gas demand for power generations increases, reflecting future utilization of recent, significant additions of natural gas-fired generation.

-Natural gas use in industrial sector erodes, illustrating projected losses in industrial capacity in most gas-intensive industries.

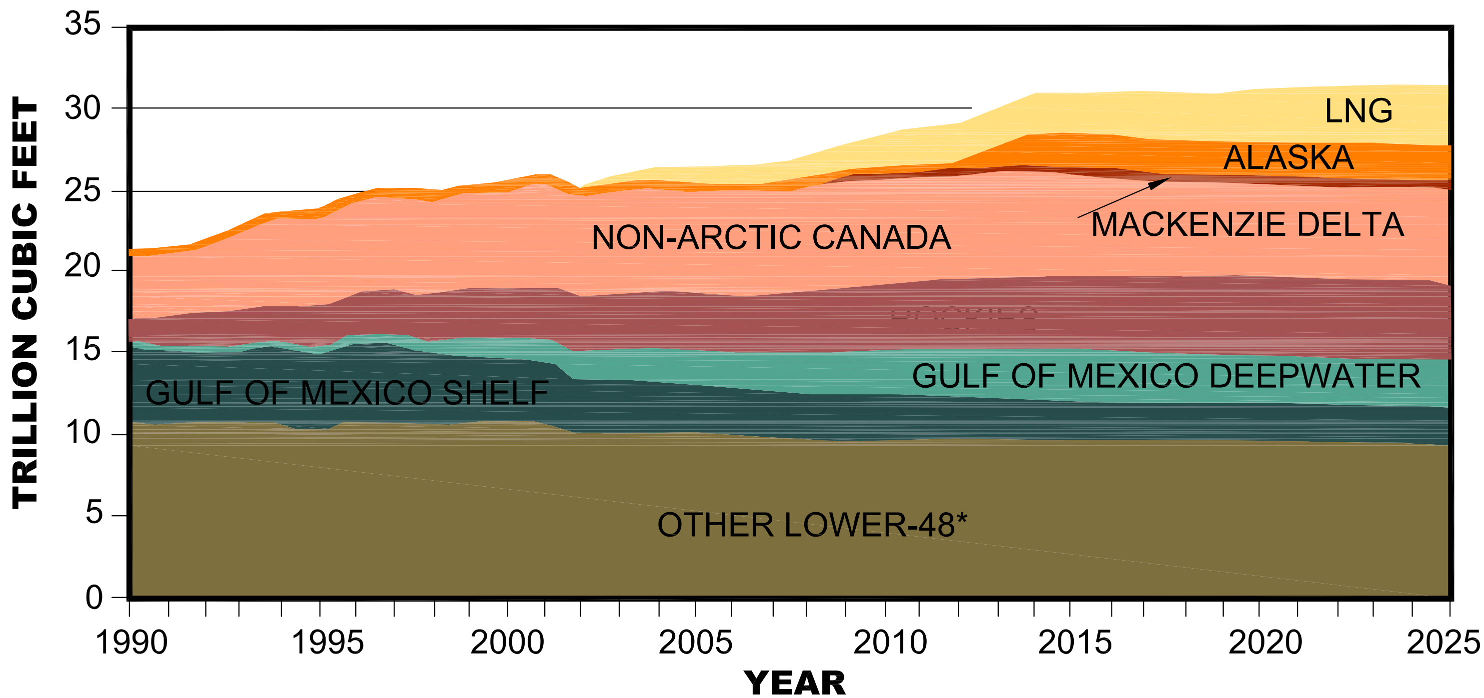
FIGURE No. 4.1-1

KELTIC PETROCHEMICALS INC.

US AND CANADIAN NATURAL GAS DEMAND

JULY 2006

FIGURE 4.1-2 US and Canadian Natural Gas Supply



* Includes lower -48 production, ethane rejection and supplemental gas.

-Production from traditional basins remains strong but has plateaued; Rockies and deepwater Gulf of Mexico offset deadlines in other areas.

-Growth is driven by LNG imports and Arctic supply

FIGURE No. 4.1-2

KELTIC PETROCHEMICALS INC.

US AND CANADIAN NATURAL GAS SUPPLY

JULY 2006

The Keltic Project provides the further additional benefits of ensuring the diversification of the energy supply and long term viability of the natural gas industry in Nova Scotia. From an environmental standpoint, natural gas provides a clean source of energy and presents an opportunity to improve air quality through the potential to convert coal or oil fired power generating facilities.

4.2 POLYOLEFINS MARKET

Slower than anticipated development of the offshore oil and gas industry in Nova Scotia delayed the development of any downstream value-added industries due to insufficient volumes of natural gas resources. It became evident that the additional natural gas and feedstock could be imported from many sources worldwide. Many of the worldwide sources of natural gas contain higher levels of the feedstock (i.e. ethane and propane) required for petrochemical production. The additional or alternative source of natural gas through the importation of LNG is the only alternative to making the Project viable.

The Keltic Project is in keeping with the Provincial Energy Strategy which supports the convergence of supply at a single location to build the critical mass to enable the development of a world class petrochemical industry (NSDE, 2001).

The proposed LNG facility at Goldboro will not only provide the critical mass of feedstock necessary for development of value added components, such as the petrochemical complex and co-generation facilities, but also provide residual LNG that would be re-gasified and supplied to the M&NP transmission pipeline for distribution to eastern Canada and the US Northeast.

The Province of Nova Scotia made it clear in their Energy Strategy that the province wants to realize value-added benefits from the energy industry. For Nova Scotian's to truly benefit from the energy industry the opportunities must happen in Nova Scotia and jobs must be created in Nova Scotia. To this end, the Province enacted the Petrochemical Supply Agreement which ensures that natural gas liquids from offshore Nova Scotia gas are made available to companies prepared to establish a petrochemical industry in Nova Scotia.

To make such a petrochemical facility and related industry feasible, economies of scale are required. Unfortunately, the discoveries offshore of Nova Scotia have not yielded sufficient volumes of natural gas liquids for a viable petrochemical industry. Keltic's approach is to supplement the natural gas liquids from offshore Nova Scotia with those derived from imported LNG to make the petrochemical industry viable in Nova Scotia.

From a market perspective, there is increasing demand for plastic resins in North America. Nexant Chem Systems has reported in their Outlook for Polyolefins (Nexant, 2004) that the demand for chemicals and plastics has been increasing faster than supply in recent years and that this trend is expected to continue for the next few years. Many proposed expansions are delayed globally and there are no new crackers under construction in most countries. As further investigation into the various processes to be utilized in the proposed petrochemical plant was undertaken, it became evident that the economical capacity for a world-class facility is 1,500,000 metric tonnes per year (t/year). This total output is a combination of ethylene and propylene to produce Polypropylene, LLDPE, HDPE, and LDPE.

Global polyethylene demand is projected to increase to approximately 87 million metric tonnes (mmt) in 2010 from roughly 54 mmt in 2002 as depicted in Figure 4.2-1 (Nexant, 2004).

Similarly global polypropylene demand is expected to grow by about 8% per year globally as seen in Figure 4.2-2 (Nexant, 2004).

Goldboro, Nova Scotia is geographically closer to markets in eastern Canada and the northeastern US than many other production facilities in North America. Furthermore, Goldboro's ice-free, deep water access provides the opportunity for the reliable marine transportation of goods to target markets. These factors contribute to Goldboro's transportation advantage over other facilities in North America. Facilities in the US Gulf Coast are further away from eastern Canada and the northeastern United States than Goldboro, and exposed to a more prevalent hurricane season than Nova Scotia.

Keltic's Petrochemical complex will meet the growing demand for plastic resins by providing additional supply to North American markets and provide an economic benefit to the company.

4.3 COGENERATION PLANT

There is currently insufficient electrical infrastructure in the Goldboro area to support the Keltic Project. Simply upgrading the existing NSPI grid is not sufficient for Keltic's needs as a project of this magnitude requires backup power to safeguard against power failure.

Cogeneration of electrical power at the Keltic site for use in the various process facilities is the most economical approach. The co-generation provides other benefits: reduced air emissions in comparison to other fossil fuel fired generation; optimum use of the waste heat generated at the petrochemical facility; and further use of the waste heat for the regasification of LNG. Cogeneration of electricity applies the philosophy of eco-efficiency by reducing both economical and environmental costs.

As a result, Keltic has planned an electric power cogeneration unit for the integrated facility at Goldboro to provide the primary supply of power to the overall complex. The cogeneration unit will be sized for 200 MW and use natural gas to generate electricity.

There are certain economic efficiencies that can be achieved by having a petrochemical complex, an LNG terminal and a cogeneration unit integrated on a common site. "LNG can be used as a cold heat sink in power generation, which would increase power production efficiency and replace the conventional regasification processes. There are also economic benefits of extracting the heavier hydrocarbons from LNG as the liquid components can be sold at a premium price over natural gas," (Mak, 2004 and 2005). Keltic plans to apply these eco-efficiencies in the design of the integrated complex at Goldboro which will be the first of its kind in North America.

FIGURE 4.2-1 Global Polyethylene Demand

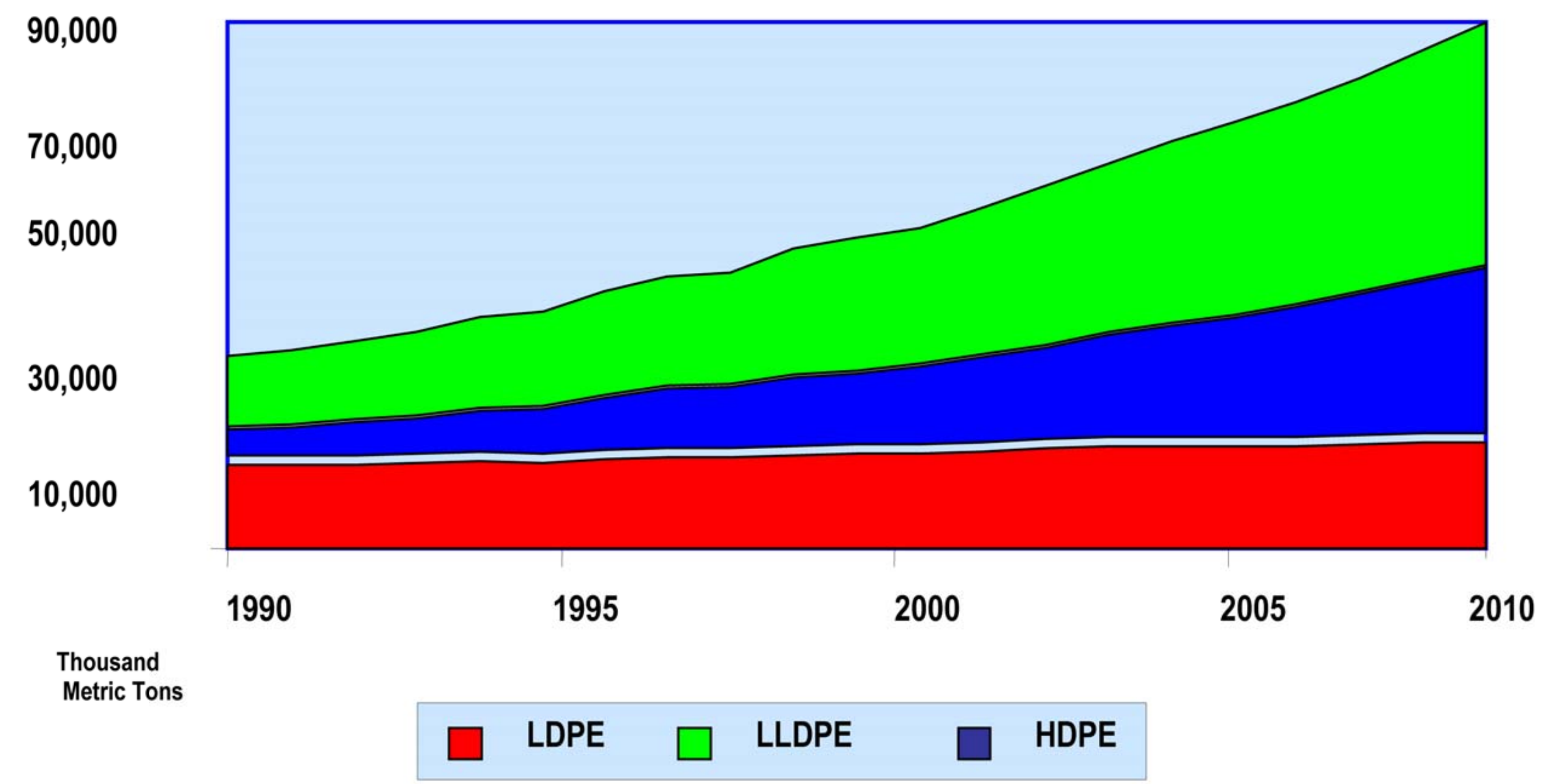


FIGURE No. 4.2-1

KELTIC PETROCHEMICALS INC.

GLOBAL POLYETHYLENE DEMAND

JULY 2006

FIGURE 4.2-2 Global Polypropylene Demand

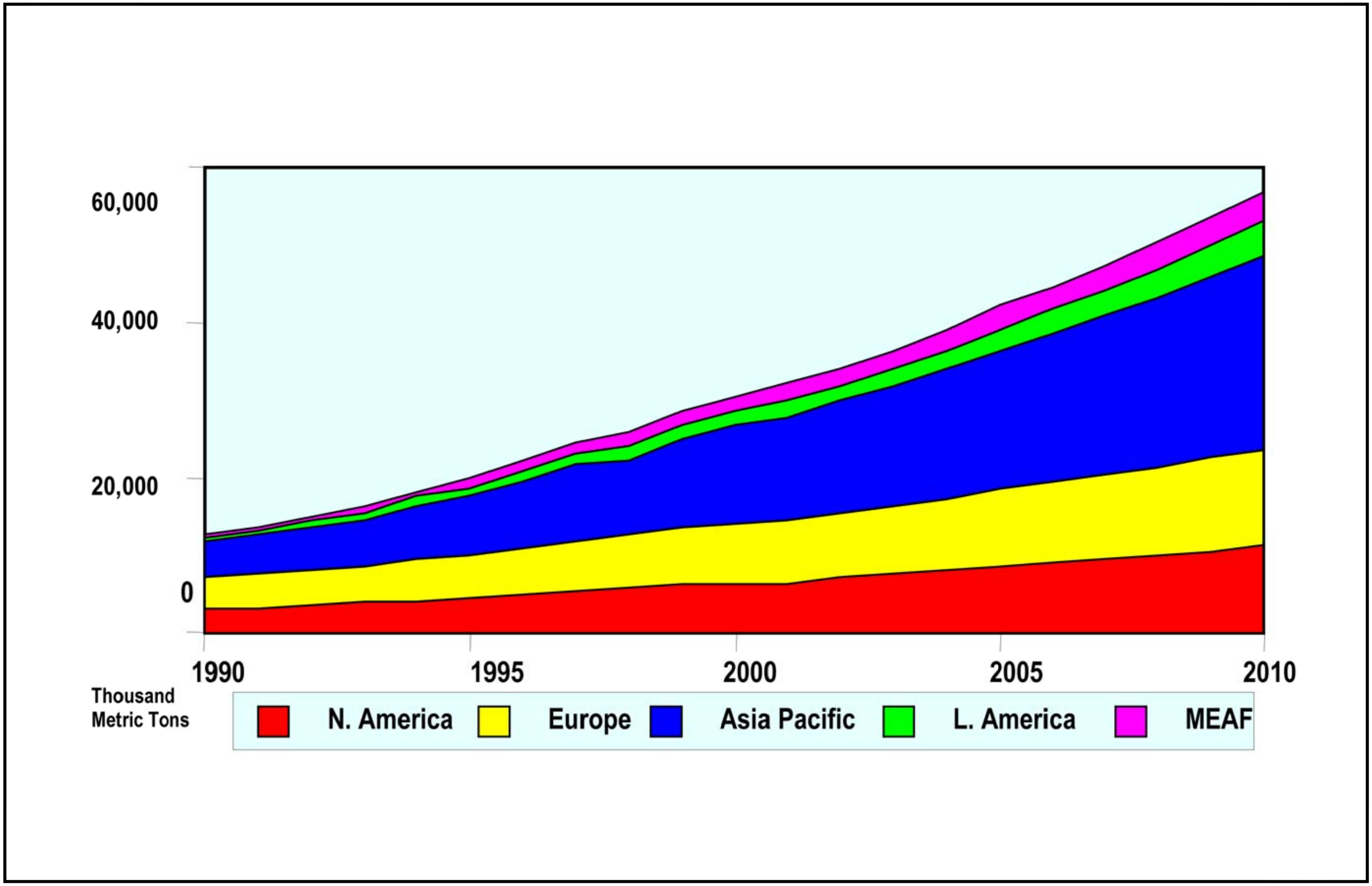


FIGURE No. 4.2-2

KELTIC PETROCHEMICALS INC.

GLOBAL POLYPROPYLENE DEMAND

JULY 2006

4.4 UTILITIES AND COMMON SUPPORT FACILITIES

The Keltic Facility will have a significant industrial water requirement. Water will be drawn from Meadow Lake to provide daily industrial needs. The present estimated demand is 1200 m^3/hr which would include domestic demand for an estimated work force of 600. The domestic demand is calculated at 75 m^3 per day (m^3/day).

Initial assessment suggested that Meadow Lake could provide adequate water supply without a need for the construction of a dam if Goldbrook and/or Ocean Lake could be considered as a supplementary supply during prolonged periods of dry weather conditions. It was intended that during these periods, water would be pumped from these lakes to meet the daily demand of the complex. Further analysis indicated that there would not be sufficient water resources from Goldbrook and/or Ocean Lakes to supplement Meadow Lake; thus an impoundment of Meadow Lake is proposed as the preferred solution considering environmental and socio-economic impacts.

The Project will also necessitate the construction of emergency medical and fire control facilities, which will benefit the surrounding communities through economic spin-offs and improved access to emergency services.

4.5 CONCLUSION

Based on above discussion, it can be concluded that the Project has a defined purpose and pubic need. Creation of a value-added industry utilizing the existing offshore infrastructure and supplementing with LNG imports creates long-term sustainable economic benefits to the local area of Goldboro and the Province. The need for long-term hydrocarbon based development with the development of a petrochemical industrial complex has been identified by the Province of Nova Scotia in their 2001 Energy Strategy and in the SOEP Panel, as well as welcomed by public and municipalities for its economic benefit and supporting infrastructure.

Each Project component works together to make the Project technically and economically viable. The primary purpose for each of the four main components is summarized as follows:

<u>LNG regasification facility:</u>

- Allows natural gas to enter North American market and meet strong demand for cleaner energy sources.
- Provides critical mass of feedstock to petrochemical and electrical cogeneration plants.

<u>Petrochemical plant:</u>

- Allows the creation of value-added product from the offshore industry via output of polyolefins.
- Satisfies a key strategy objective of the Nova Scotia Energy Strategy (2001).
- Meets global demand for plastic resins, such as polyethylene and polypropylene.

Electrical cogeneration plant:

- Provides sufficient magnitude of power supply and allows backup power.
- Uses principles of eco-efficiency by integrating components to produce electricity at lower economic and environmental costs.

Utilities and common support facilities:

- Support the requirements of all other Project components, including water demand.

5.0 A DESCRITPION OF ALTERNATIVES TO THE PROJECT

The purpose of developing a world class petrochemical industry in Nova Scotia was based on the goal of creating added value to the natural gas found offshore Nova Scotia. The Keltic petrochemical plant would require a natural gas supply that could provide sufficient feedstock needs such as ethane, propane, and butane. In addition, the natural gas source would be used to fire the various petrochemical processes such as cracking of hydrocarbons under VHP and heat as well as firing the cogeneration plant to produce the electrical energy requirements for the Project.

5.1 ALTERNATIVES TO LNG

The potential to use compressed natural gas (CNG) was considered as an alternative to LNG. However, CNG is stored at VHP and for reasons of safety would require a much more stringent inspection and maintenance regime. Also, CNG requires greater storage area since it cannot be compressed to the same extent as LNG, although major technical research is ongoing to improve CNG storage options. One of the potential benefits of using CNG is that the regasification process would not be required to produce natural gas for market.

5.2 ALTERNATIVES TO LNG IMPORTATION

The creation of a petrochemical facility has been suggested as a value-added energy project since the development of natural gas reserves offshore of Nova Scotia began. The benefits of a petrochemical facility to the Province were stated clearly in the Nova Scotia Energy Strategy (2001), and recommended by the SOEP Panel (1997). Yet development of a petrochemical plant has been impeded to date by the insufficient volumes of feedstock from the Nova Scotian offshore natural gas supply alone.

The alternative to importation of LNG would have been to continue to develop and export the natural gas which was expected to be available offshore Nova Scotia at the height of exploratory work being undertaken in the late 1990s. The Pre-Feasibility Study carried out for the petrochemical plant, identified the potential for offshore Nova Scotia natural gas resources to provide the total required feedstock for 500,000 t/year of both ethylene and polyethylene. The constraint was the time required to develop those offshore resources.

An alternative source of feedstock would be to import LNG by special vessels designed for this purpose. The Project will utilize over 220,000 million cubic feet per day (mmcfd) (about 6.000 million m^3/day) of natural gas and natural gas liquids obtained from the imported LNG in its proposed petrochemical plant, cogeneration electrical power plant, and supporting infrastructure, thus overcoming the current shortfall.

5.3 ALTERNATIVES TO ON-SITE POWER GENERATION

Use of NSPI for the Project's power needs was considered early in the Project design. It was determined that existing NSPI infrastructure cannot meet the demand, will not offer a competitive price (compared to on-site power) and certainly will not allow for process integration (i.e., waste heat capture for warming up LNG).

Cogeneration of electrical power at the Keltic site for use in the various process facilities is the most economical approach. The generation provides other benefits such as: reduced air emissions in comparison to other fossil fuel fired generation; optimum use of the waste heat generated at the petrochemical facility; and further use of the waste heat for the regasification of LNG. By cogenerating electricity within the processes, both environmental and financial costs are minimized. This approach fits with the Province's encouragement of pollution prevention which shows that environmental sustainability can be well matched with economic prosperity. Keltic intends to use the eco-efficiency approach wherever possible as it continues through the detailed engineering stages of the Project.

5.4 ALTERNATIVES TO PETROCHEMICAL PRODUCTION

The large scale industrial production of polyethylene and polypropylene is the key element of the proposed undertaking with respect to its character as a value-added energy project. This Project component aims at an economic return through the supply of polyethylene and polypropylene to the North-American market and its increasing demand for plastic resins. In theory, the demand side of this market could also be addressed through such approaches as:

- increasing efficiency of existing petrochemical productions;
- recycling of petrochemicals; and
- reducing petrochemical demands.

These alternatives to the Project are largely outside of the Proponent's corporate mandate and control. Easing market demands through these alternative approaches is dependent on political and regulatory initiatives. In addition, they are considered long-term responses to the identified need for the Project.

5.5 CONCLUSIONS

Based on the above discussion, it is concluded that the identified alternatives to the proposed Project do not meet the Project objective(s), are not economically feasible, are less preferred from an environmental point of view, or are outside of the Proponent's corporate mandate. The "Do-Nothing" or "Null-Alternative" to the Project proposal would be to continue to export natural gas presently available from offshore Nova Scotia, as well as any new sources developed offshore. Without the importation of LNG and the petrochemical plant, Nova Scotians will not see any value added to its natural gas industry.

Offshore Nova Scotia natural gas projects have and can create considerable economic benefit to Nova Scotia during development and production. Similarly, this Project will create significant economic benefits during construction of the components and provide sustained economic benefits during operations. The petrochemical component of this Project provides new value added industry to Nova Scotia and is a long term alternative to Nova Scotia being solely an exporter of natural gas.

6.0 OTHER METHODS FOR CARRYING OUT THE PROJECT

This section provides a discussion of other methods for meeting the Project objectives. This involved the discussion of alternative Project sites as an alternative mean for the Project as a whole. In addition, for the individual key Project components, one or more alternative methods were identified and reviewed.

Overall Project

- Alternative Project sites

LNG facility

- Storage tanks
- Marine terminal
- Regasification facility

Petrochemical Plant

- Polyethylene and polypropylene production process
- Export via (shipping and marginal wharf)

Power Production

- Cogeneration

Utilities and common support facilities

- Water supply
- Road access

Each of the alternative methods was investigated and evaluated on the basis of technical and economical feasibility. A summary of the alternative methods discussed and decisions made with respect to the preferred methods is provided in Table 6.0-1 (presented at end of Section 6.0).

6.1 OVERALL PROJECT

6.1.1 Alternative Project Sites

The initial site investigated for the petrochemical plant was along the western shore of the Strait of Canso, where there is a large area of land available for industrial development. The site, within the industrial reserve at Melford, Guysborough County, also has an ice-free, deep water port that would easily facilitate shipping.

Although this large reserve was set aside for industrial development, Keltic undertook a fish and fish habitat survey when initially considering the site. The survey found that the overall freshwater habitat is good for salmonid rearing and spawning. Initial site assessment also consisted of evaluating the cost for development due to the steep slopes within the large tract of land required. The assumed area requirements included space for future facility expansions that would permit a duplication of the process area. The resulting land tract that could become available for the Project was dissected by the fresh water stream that was surveyed. Because of the potential HADD, this stream was not viable for diversion from a cost point of view and unlikely to receive approval from regulatory agencies.

The site at the Strait of Canso offered advantages for proximity to the Trans Canada Highway (TCH) with necessary highway upgrading a possibility. The Strait of Canso Harbour was already accustomed and accepted as being a major shipping route for product ship out and importation of some feedstock. Development of an LNG terminal presently underway at the Strait of Canso indicates that the approval for a shipping terminal for the petrochemical plant would only have been subjected to a screening process simplifying the approval process.

This potential site would have also required construction of a pipeline to transport the required natural gas from Goldboro for a petrochemical plant and cogeneration power plant at the Strait of Canso.

When the potential for HADD; high costs for site development; and pipeline and transportation cost of natural gas to the Strait of Canso became a concern, alternative site selection was considered. A natural consideration would be to look at a site near the source of feedstock. Since all feedstock and fuel requirements were expected to be made available at Goldboro from offshore Nova Scotia, a location at Goldboro provided an alternative to be worth consideration.

The location at Goldboro offered the benefits of being at the existing offshore natural gas pipeline landfall, availability of large areas of undeveloped land, and a large, ice-free harbour for product ship out.

Preliminary baseline site assessment, “Environmental Assessment of Lands at Goldboro,” was carried out on a large tract of land at Goldboro in 2000 by the Municipality of the District of Guysborough. This study indicated favourable conditions for industrial development. The likelihood of public acceptance based on the existence of the SOEP gas plant was also a favourable asset to consider.

Keltic thus used the above study as well as site development cost analysis for comparison to alternative locations. Although the assessment was not at the present site of the proposed location of the Project, it addressed issues relevant to heavy industrial development in the area. The proposed site is zoned M-3 heavy industrial and adopted in the planning strategy and land use by-laws for the district.

The Goldboro site had the advantage of proximity to existing natural gas facilities. Although imported LNG is required, the site’s proximity to existing natural gas facilities remained desirable as it provided a means to send excess gas from the petrochemical process to market. Also locating the petrochemical plant that is accessible to marine traffic creates the necessary economy of scale for product shipment to large markets along the eastern US seaboard.

A third site was assessed at Bear Head, Richmond County due to the possibility to use the salt caverns for natural gas storage and because of an available tract of industrial land. The development of the salt caverns was not advanced enough; the site development cost was high due to the steep slopes and additional cost would be required to pipe the natural gas from Goldboro to the Strait of Canso as well as across the Strait of Canso.

Locating the Project near existing natural gas facilities was initially required to ensure a source for the petrochemical process. Although LNG was included and imports are required for a stable feedstock, the proximity to existing natural gas facilities is still valuable to allow excess natural gas to be delivered to market.

Other means of delivering excess gas to markets were considered, particularly the construction of a new subsea pipeline directly to the US. The major drawbacks to this would be that subsea infrastructure would not be within provincial jurisdiction and sending directly to the US would not add value to gas. Therefore, close proximity to existing natural gas facilities was determined to be the best overall location.

In summary, the Project site of Goldboro was selected above other alternatives as it:

- avoids significant environmental impact;
- is located adjacent to existing natural gas facilities;
- has a deep, ice-free port within Isaac's Harbour;
- is expected to be well accepted by the public;
- has an all-weather provincial highway suitable for road transportation requirements;
- has reasonable site preparation costs; and
- contains large undeveloped portions of land.

6.2 LNG FACILITY

6.2.1 LNG Storage Tanks

There are three types of LNG storage tanks used in the industry:

1. **Single Containment:** A single primary container designed to contain the LNG with a secondary outer shell to contain the insulation but not the refrigerated liquid if there is a failure of the inner tank. These tanks are surrounded by a dyke designed to contain 100% of the tank volume in the event of a spill. This requires a large thermal exclusion zone.
2. **Double Containment:** A double containment tank is designed such that both walls are capable of containing the refrigerated liquid. A secondary containment is provided by a reinforced concrete wall. The space between the tank and concrete containment presents safety and maintenance issues.
3. **Full Containment:** A full containment tank is designed such that both inner and outer tanks are capable of containing the refrigerated liquid. The advantage of full containment is that the outer concrete wall has a higher structural integrity and is able to contain the full capacity of the tank. As a result, the thermal radiation and vapour dispersion exclusion distances are considerably reduced.

For technical reasons outlined in Section 2.0, the use of tanks with a steel outer wall would negatively affect the achievable unloading rate. The use of concrete tanks would address this issue. Also, the structural integrity of a concrete outer tank is substantially higher than with a steel tank. In the case of concrete, potential failure of the outer wall due to accidental spillage is not an issue. The codes controlling LNG plants recognize this fundamental difference between the two types of tanks although, tanks with a concrete outer wall are treated more favourably than tanks with steel walls. Therefore, Keltic has optioned for the full containment tank. Further details on full containment tanks are provided in Section 2.0.

6.2.2 LNG Marine Terminal

This facility will be designed to allow two LNG tankers to berth at the same time in the future. The design of the terminal is to utilize pipe piling driven into the seabed to provide the berthing draft without requiring dredging and sea disposal of dredged spoils. The superstructure will consist of a combination of structural steel and concrete. Further details of the preliminary design and conceptual plans are provided in Section 2.0.

The alternative would be a long approach by placing fill on the seabed with the terminal constructed of concrete caissons. This approach was considered to cause greater adverse effects on fish habitat.

6.2.3 Regasification Facilities

For the regasification (vaporization), i.e., changing the LNG from a liquid state back into a natural gas, two principally different alternative methods are available:

- Open Rack Vaporization (ORV); and
- Submerged Combustion Vaporization (SCV).

The LNG terminal facility will have multiple parallel operating vaporizers with spares. ORV are common worldwide and use seawater to heat and vaporize the LNG.

Submerged Combustion Vaporizers (SCV) are also widely applied in LNG vaporisation in the USA, Europe, and Asia. It is often selected for its inherent safety and high operating efficiency. SCVs use send out gas as a fuel for the combustion that provides vaporizing heat. Due to the high cost of the seawater ORV, installations tend to have a higher installed capital cost while the SCV installations have a higher operating cost because of the fuel charge. At many facilities, an economic design can be achieved by using ORVs for the normal range of send out and SCVs as spares.

Other site factors also impact the decision of whether to use ORVs or SCVs. If the seawater temperature is below approximately five degrees Celsius, ORVs are usually not practical because of seawater freezing. At some sites, it is not practical to separate the seawater discharge from the seawater inlet and some SCVs must be installed to avoid recirculation problems.

Given the potential for severe and prolonged winter weather, seawater temperature is not considered compatible with ORV technology at the proposed LNG facility. In addition, it s not considered practical and cost effective to provide sufficient separation of the discharge waters from an inlet structure at the proposed marine site. The SCV system does not require any water (except for initial fill) and other advantages involve its quick start up ability, tolerance for load fluctuations, fuel flexibility, and high thermal efficiency.

Consequently, ORV technology was deemed neither technically nor economically feasible. The SCV technology was determined the preferred method for vaporization and forwarded for detailed assessment of its environmental effects.

6.3 PETROCHEMICAL PLANT

6.3.1 Ethylene and Propylene Production Process

No functionally different techniques for the production of polyethylene and polypropylene have been identified. Worldwide a number of vendors hold licenses for a variety of production processes.

These processes, however, involve comparable technologies and the decision on which technology is applied is determined by the desired final product, its quality and application. The Proponent intends to market polypropylene, LDPE, LLDPE and HDPE. The selected production process is tailored to manufacturing of these products.

6.3.2 Marginal Wharf

This marine facility will also include a marginal wharf to berth vessels for the importing of some types of feedstock required for the petrochemical processing. Use of highway for product shipment would be too expensive due to the distant markets for the major portion of the product. The area is not served by rail and the capital cost of new construction is considered high. The major portion of the resin production will thus be shipped out from the marginal wharf. The wharf is also the site of the storage of the resins. The resins that will be shipped by highway will also originate from the storage at the terminal.

The favourable options for the design and construction of the marginal wharf to minimize a HADD would be a pile structure. Due to the heavy loading from the resin storage structure, pile construction is not economical. Thus, the design will be based on fill contained by concrete caissons supported on a granular mattress. The location of the crib berthing face would be such that dredging and sea disposal of spoils would not be required.

One side of the marginal wharf will be designed to dock the pilot boat and tugs.

The alternative construction of both marine facilities would likely be more economical by construction of the facilities closer to the shore and dredging to create the required draft. The alternative chosen was in the interest to minimize HADD and not require sea disposal of dredge spoils.

6.4 POWER PRODUCTION

During operation, all Project components combined are estimated to require approximately 180 MW, of which the LNG and regasification facilities will consume about 16 MW. Power supply to the Project therefore was discussed early on in the conceptual design stage. Consideration was given to three alternative methods to supply the required electric power:

- on-site cogeneration power plant;
- on-site power generation (without steam generation); and
- import electrical power from the Provincial power supplier (NSPI).

These alternatives are briefly discussed below.

6.4.1 Alternative Methods for Power Supply

Power Cogeneration

Power cogeneration has been selected as the preferred method to provide the required electric power and steam to the facility. The proposed approach involves the generation of electric power through gas turbines fuelled by gas from imported LNG or the Sable gas plant. The hot exhaust gases from each gas turbine will pass through waste heat recovery boilers to produce steam for the petrochemical production processes. This approach is significantly more energy efficient than a separate generation of electric power and steam. As a result of the optimal use of waste heat, the anticipated air emissions per unit of energy produced is notably lower than in other fossil fuel fired generation. The cogeneration alternative uses the principles of pollution prevention. This approach is seen as the best alterative from both economic and environmental perspectives.

Separate Power and Steam Generation

Given today's cogeneration technology (see discussion above), this alternative is rather theoretic. It involves the generation of power in an on-site plant based on the combustion of gas fuel from imported LNG or the Sable gas plant. Steam required for the petrochemical production processes would be generated in a separate unit with boilers that operate with either electric power or gas fuel. This approach, although technically feasible, is not considered to be cost effective, and therefore, was rejected early on in the design process (Table 6.0-1).

Import of Electric Power

Import of electric power was considered a technically feasible option; however, the review of the economic feasibility concluded that this method would not be cost-effective (Table 6.0-1). The import of electric power via power transmission line would represent a low cost alternative. By importing electric energy, the cost advantages of the cogeneration technology (see discussion above) and the opportunity for power export to the local grid would be lost. In addition, import of electric power would diminish the operator's control over power generating cost and continuity of the supply.

6.5 UTILITIES AND COMMON SUPPORT FACILITIES

6.5.1 Water Supply - Raw Water Intake at Meadow Lake

Fresh water is required for the boiler feed for the petrochemical process and the cogeneration plant. Potable water would be required for operational personnel. Fire fighting water would be from large ponds that would be used for storm-water storage and polishing. Fresh or seawater could be used for the regasification of LNG.

The use of sea water for the regasification would require a large volume due to the low heat energy and the water would be returned to the sea at an elevated temperature and requiring a biocide to control marine organisms. Therefore, freshwater was determined to be most appropriate for the regasification process (see also discussion under 6.2.3).

Water will be drawn from Meadow Lake to provide daily industrial needs. Initial assessment suggested that Meadow Lake could provide adequate water supply without a need for the construction of a dam if Goldbrook and/or Ocean Lake could be considered as a supplementary supply during prolonged periods of dry weather conditions. It was intended that during these periods water would be pumped from these lakes to meet the daily demand of the complex. Further analysis indicated that there would not be sufficient water resources from Goldbrook and/or Ocean Lakes to supplement Meadow Lake. After review of environmental constraints associated with water withdrawal, an impoundment of Meadow Lake is proposed as the preferred solution to provide sufficient water for regasification.

6.5.2 Road Access

The proposed Project requires road access for purposes such as:

- worker and equipment access during construction activities;
- worker access to the LNG and petrochemical plants during operation of those facilities;
- transportation of maintenance equipment and production materials needed during operation; and
- transportation of finished products from the petrochemical plants to market.

The two principal alternative means for road access to the Project site discussed by the Proponent include

- construction of a new 56 km highway between the Keltic Facility at Goldboro and TCH 104 at Antigonish; and
- use of the existing road network together with some road upgrades.

Various route alternatives for a new highway between the Project site and the TCH were developed during the conceptual Project design stage. However, irrespective of the various route alignment options, the alternative of a new highway was not further pursued. The high development cost and schedule implications associated with the approvals process were not considered to be cost effective and, therefore, not economically feasible (see Table 6.0-1). Further implications such as the potential for HADD at the inevitable stream crossings, and legal issues with respect to land ownership and exploration licenses were identified as environmental issues, but were not further investigated given the concerns for the alternative's economic feasibility.

The use of the existing road infrastructure was identified as technically and economically feasible (Table 6.0-1). The site is located along Route 316. The existing road infrastructure most likely used for travel between the Project site and TCH is via Route 316, Route 276 and Trunk 7 (see Section 8.16). The total distance of this route is approximately 80 km. Key concerns associated with the use of this existing route during Project construction and operation relate to seasonal weight restrictions along sections of the trip and the relatively long travel time. Cost for road upgrades are expected to be less than the cost of a new highway and could be implemented progressively as the need arises and funds become available. Another consideration in support of the use of the existing road network has been the fact that the development of the Sable Gas Plant, located adjacent to the Keltic site, was also successfully realized with the existing road system as the only ground transport option. Further, for future material import and export to the Keltic site, the proposed marginal wharf will be available to facilitate ship-based transportation. The environmental concerns associated with this alternative relate to issues such as effects of increases in traffic volumes on road safety and level-of-service, and potential effects on the natural and socio-economic environment (i.e., habitat fragmentation, separation effects). A comprehensive assessment of environmental effects was undertaken and has been included with the relevant sections of the EA.

6.6 ALTERNATE METHODS EVALUTION

Each of the alternative methods was investigated and evaluated on the basis of the following criteria:

- **Technical feasibility**: Under this criterion, the alternative method was evaluated with respect to its technical suitability and whether or not the method would meet the need for and the purpose of the Project as formulated in Section 4.0.
- **Economic feasibility**: This evaluation addressed the relative cost of the alternative method (high, moderate, low) and its cost effectiveness. The cost effectiveness was determined based on a discussion of the ecological, economic, social, and cultural gains associated with the employment of a particular method against the actual monetary cost.

Both, the technical and the economic feasibility were conducted on a qualitative level, based on the team's professional judgement and experience with comparable projects. Technical and economic feasibility were employed as screening criteria, i.e., methods identified as not being technically feasible were immediately excluded from further investigations. If identified as technically feasible, the economic feasibility was discussed.

Alternative methods that passed the above screening process, i.e., those that were identified to be technically and economically feasible, were subsequently evaluated with respect to their potential environmental effects. This again involved a high level discussion of potential environmental effects based on the team's professional judgement and knowledge of the Project site. Alternative methods that were considered to have the obvious potential for greater adverse environmental impacts than other alternatives were eliminated from further discussion.

In situations where no such decision could be made without further investigations, the methods in question were carried through the EA process.

The following Table presents the results of the alternative methods evaluation.

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TABLE 6.0-1 Evaluation of Alternative Methods

#	Alternative	Technical Feasibility	Cost Feasibility		Environmental Effects
			Cost	Cost Effective	
1	**Overall Project –Project Sites**				
	Strait of Canso, Guysborough County	• **Technically suitable** • Ice free deep water of the Strait to facilitate shipping. • In close proximity to TCH. • Steeply sloping terrain making site preparation costly. • Transportation needed for natural gas from Goldboro to Strait of Canso.	High	No	• Environmental effects were not investigated since Alternative was screened based on technical and/or economic feasibility.
	Goldboro, Guysborough County	• **Technically suitable** • At the existing offshore natural gas pipeline landfall. • Large areas of undeveloped land available. • Large ice free harbour for shipping. • Public acceptance likely because of existing SOEP gas plant.	Moderate	Yes	• Addressed in detail in EA Report.
	Bear Head, Richmond County	• **Technically suitable** • Available tract of industrial land. • Possible use of salt caverns for natural gas storage. • Steeply sloping terrain making site development costly. • Transportation needed for natural gas from Goldboro to Strait of Canso.	High	No	• Environmental effects were not investigated since Alternative was screened based on technical and/or economic feasibility.
2	**LNG Facility – Storage**				
	Single Containment	• **Technically suitable** • Single primary container to contain the LNG. • Secondary outer shell only contains insulation but not the refrigerated liquid. • Requires large thermal exclusion zone.	Moderate	Yes	• Increased risk for human health and safety over two other alternatives. • Alternative not carried forward for detailed environmental assessment due to obvious higher potential for adverse environmental effects.
	Double Containment	• **Technically suitable** • Both walls are capable of containing a refrigerated liquid. • Safety and maintenance issues with the space between the tank and concrete containment.	Moderate	Yes	• Increased risk for human health and safety over full containment alternative. • Alternative not carried forward for detailed environmental assessment due to obvious higher potential for adverse environmental effects.

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#	Alternative	Technical Feasibility	Cost Feasibility		Environmental Effects
			Cost	Cost Effective	
	Full Containment	• **Technically suitable** • Both inner and outer tanks can contain the refrigerated liquid. • Outer wall can contain the full capacity of the tank and is of higher structural integrity. • The thermal radiation and vapour dispersion exclusion distances are considerably reduced.	High	Yes	• In comparison to single and double containment designs, lowest risk for human health and safety. • Risk to human health and safety and other potential environmental effects addressed in EA Report (see Sections 9.0 to 11.0); further risk assessment to be provided during the permitting phase and as part of TERMPOL assessment.
3	**LNG Facility – Marine Terminal**				
	Terminal with Pipe Piling	• **Technically suitable** • Provides the berthing draft without requiring dredging and sea disposal of dredged spoils.	High	Yes	• Not expected to create a HADD. • Alternative carried forward for detailed environmental assessment including assessment of HADD (see Sections 9.0 to 11.0). • Risk assessment to be provided during the permitting phase as part of TERMPOL assessment.
	Terminal with Concrete Caissons	• **Technically suitable** • An increased amount of construction on the seabed floor.	High	Yes	• Likely to result in a HADD. • Alternative not carried forward for detailed environmental assessment due to obvious higher potential for adverse environmental effects.
4	**Regasification and Demethanization Facility**				
	ORV	• **Not technically suitable.** • Low seawater temperatures not suitable for heating purposes. • Marine site geography challenge for sufficient separation of discharge from seawater inlet structure.	High	No	• Environmental effects were not investigated since Alternative was screened based on technical and/or economic feasibility.
	SCV	• **Technically suitable** • Commonly used and safe vaporisation technology.	Moderate	Yes	• Alternative carried forward for detailed environmental assessment (see Sections 9.0 to 11.0).

#	Alternative	Technical Feasibility	Cost Feasibility		Environmental Effects
			Cost	Cost Effective	
5	**Petro Chemical Plant – Polyethylene and Polypropylene Production**				
	Polyethylene and Polypropylene Production	• **Technically suitable** • No functionally different production technology has been identified. The decision for specific technologies is driven by the desired product, its characteristics and qualities. The proposed process is based on the objective to manufacture and market LDPE, and LLDPE, HDPE.	High	Yes	• The environmental effects of the proposed approach are presented in detail in the Sections 9.0 to 11.0.
6	**Petro Chemical Plant – Marginal Wharf**				
	Wharf with Pipe Piling	• **Not technically suitable** • Heavy loading from the resin storage structure.	NA	NA	• Environmental effects were not investigated since Alternative was screened based on technical and/or economic feasibility.
	Wharf with Concrete Caissons	• **Technically suitable** • Based on fill contained by concrete caissons supported on a granular mattress. • Dredging and sea disposal of spoils not required.			• Alternative carried forward for detailed environmental assessment including assessment of HADD (see Sections 9.0 to 11.0). • Risk assessment to be provided during the permitting phase as part of TERMPOL assessment.
7	**Power Generation**				
	Cogeneration	• **Technically suitable** • Generation of electric power by gas turbines (gas fuelled). • steam generation based on waste heat utilization from power generation process.	Moderate	Yes	• Alternative carried forward for detailed environmental assessment (see Sections 9.0 to 11.0).
	Separate Power and Steam Generation	• **Technically suitable** • Power generation based on gas fuelled (turbine) generators. • Separate steam generation by independent system based on either electric power or gas fuelled boiler system.	Moderate	No	• Environmental effects were not investigated since Alternative was screened based on technical and/or economic feasibility.

#	Alternative	Technical Feasibility	Cost Feasibility		Environmental Effects
			Cost	Cost Effective	
	Power Import through NSPI and on-site Steam Generation	• **Technically suitable** • Import of electric power via new high voltage power line. • On-site steam generation based on electric power or gas fuelled boilers.	Low	No	• Environmental effects were not investigated since Alternative was screened based on technical and/or economic feasibility.
8	**Utilities - & Common Support Facilities – Process & Cooling Water Supply**				
	Sea water supply	• **Technically suitable** • Would require a large volume of water due to the low heat energy. • Water would be returned to the sea at an elevated temperature. • Returned water would require a biocide to control marine organisms.	NA	No	• Environmental effects were not investigated since Alternative was screened based on technical and/or economic feasibility.
	Meadow Lake water supply	• **Not technically suitable** • Could not provide adequate water supply, even with Goldbrook Lake and/or Ocean Lake as supplementary supplies in prolonged dry weather.	NA	NA	• Environmental effects were not investigated since Alternative was screened based on technical and/or economic feasibility.
	Water Supply from Meadow Lake plus Impoundment	• **Technically suitable** • An impoundment of Meadow Lake could provide an adequate water supply.	High	Yes	• Alternative carried forward for detailed environmental assessment including assessment of HADD (see Sections 9.0 to 11.0).
9	**Utilities - & Common Support Facilities – Road**				
	New Highway Goldboro - Antigonish	• **Technically suitable** • A new 56 km long highway could be developed between the Keltic Facility at Goldboro and TCH 104 at Antigonish.	High	No	• Environmental effects were not investigated since Alternative was screened based on technical and/or economic feasibility.

#	Alternative	Technical Feasibility	Cost Feasibility		Environmental Effects
			Cost	Cost Effective	
	Use of existing road infrastructure	• **Technically suitable** • The site is located along Route 316. • Existing road most likely used for travel between the Project site and TCH is via Route 316, Route 276 and Trunk 7 (total distance approximately 80 km). • The existing road infrastructure was sufficient for the development of the Sable Gas Plant adjacent to the Project site. • Once completed, the marginal wharf will provide opportunities for material import and export by ship.	Low	Yes	• Alternative carried forward for detailed environmental assessment including (see Sections 9.0 to 11.0).

Notes:
NA = not assessed

7.0 ASSESSMENT METHODOLOGY

This section presents the study strategy, methodology, and boundaries, used for preparing the EA.

The approach has been developed in a manner which incorporates:

- the EA requirements formulated in the provincial Terms of Reference (NSEL, 2005) and the federal Scoping Document (TC and DFO, 2005)
- the identification of the environmental and socio-economic factors of greatest concern;
- the consideration of all issues raised by stakeholders;
- the incorporation of environmental management planning into the engineering design process;
- the inclusion of cumulative effects in all stages of impact prediction; and
- compliance with all applicable regulatory requirements.

The following subsections describe the approach and strategy to:

- the definition of study boundaries (temporal and spatial);
- VECs;
- investigation of the interactions between the Project and each VEC;
- prediction and evaluation of environmental effects;
- development of avoidance and/or mitigative measures; and
- determination of the significance of residual effects.

7.1 BOUNDARY DEFINITION

This EA Report is written to reflect a project description that includes the full development of all proposed facilities required for the importation of LNG by ocean-going tankers, storage, and re-vaporization of the LNG and the construction and operation of a petrochemical complex to produce polyethylene and polypropylene based on the use of the imported LNG as the primary feedstock. The Project description is defined in Section 2.0 and includes activities associated with construction, operation, maintenance, decommissioning/reclamation, and unplanned events. For some VECs, administrative boundaries apply, usually with respect to jurisdictions. Where such boundaries are relevant to a VEC, the limitations are noted within the applicable section.

7.1.1 Temporal Boundaries

Project timelines are based on an expectation of approximately three years to achieve regulatory approval for Project construction and commissioning. Construction activities will consume nearly three years (33 months). The nominal operating life of the Project is 20 years. Closure, decommissioning, and post-decommissioning would be protracted, and the timing of this Project phase is uncertain.

While the nominal design life of the process is twenty years, given normal maintenance, refinement, and re-investment, the operation and maintenance activities will likely extend well beyond the 20 year timeframe. As portions of the Project become obsolete over time they will be removed from service, and the Proponent will undertake decommissioning and reclamation for such portions of the Project as per the legislation and guidelines of the time. For the purposes of this EA, we have assumed an operating life of 50 years.

Temporal boundaries define the duration over which the Project activities and phases interface with each VEC. Specific aspects of temporal boundaries are addressed as part of the scope definition for each VEC (see Section 7.2.2).

7.1.2 Spatial Boundaries

The general study bounds of the EA are shown in Figures 2.0-1a and b and have been defined as comprising:

- the Project development site situated on the eastern side of Country Harbour in Goldboro, Nova Scotia;
- the area and properties within the community of Goldboro in central Guysborough County, Nova Scotia;
- the waters and shore of Isaac's Harbour and its extension into the area of Stormont Bay;
- Meadow Lake, Gold Brook Lake, and Ocean Lake including their respective catchment areas; and
- any area defined as being potentially within an air emission plume originating from the Project site or other Project-related facilities;

Spatial boundaries establish the limits within which the Project interacts with the surrounding environment. The Zone of Influence reflects an area beyond the Project footprint and incorporates aspects such as airborne plumes which can act to expand the physical area over which Project features interact with the receiving environment. The spatial boundaries will also vary in accordance with each VEC. Such variations are discussed in the following sub-section, and defined more precisely as needed, within individual VEC chapters.

7.2 VEC SELECTION

The EA of the Project has been undertaken in a comprehensive manner, with the analysis quality assurance /quality control (QA/QC) focused on VECs. VECs have been identified to focus the EA on particular issues, as identified by members of the public, government departments and agencies, other experts, and other interested parties, as well as direct consultation with Aboriginal Peoples.

7.2.1 Methods

It is widely recognized that there is a need to focus on those environmental components, known as VECs, which have the greatest relevance to the final EA decision (CEAA, 1996; Beanlands and Duinker, 1983). VECs are generally defined as environmental attributes or components of the environment that are valued by society as identified through issues scoping. They are determined on the basis of perceived public concerns. For this Project, VECs were selected from the issues identified and intended to reflect the concerns expressed by regulators, technical specialists and the interested public.

For the Project at hand, the VEC selection process involved the following steps and considerations:

- review of requirements of the Terms of Reference and scoping document;
- review of the baseline studies;
- review of Project works and activities;
- identification of public, stakeholder, and government concerns;
- consideration of potential Project-environment interactions; and
- identification of public, stakeholder, and government concerns.

As defined in the Terms of Reference (NSEL, 2005), VECs "are interpreted as environmental; socio-economic; human health; reasonable enjoyment of life and property; and cultural, historical, archaeological, paleontological, and architectural features that may be impacted, whether positive or negative, by the proposed Project." The federal scoping document (TC and DFO, 2005; provided in Appendix 1) requires the consideration of all environmental components that are of legal, scientific, ecological, cultural, and economic value.

From these definitions, the EA team and the Proponent drew on their collective knowledge and experience to further define specific VECs. This included the review of general information and baseline data, legislation and guidelines, the proposed Project works and activities, and potential Project-environment interactions. In addition, extensive consultation was undertaken with the public at large, government department and agencies, stakeholder groups, and First Nations (see Section 14.0).

Environmental components that are represented in the area, potentially affected by the Project, of public concern, representative of one or more of the features listed in the Terms of Reference (NSEL, 2005), and/or addressing any of the values stated in the federal Scoping document (TC and DFO, 2005) were considered a VEC.

The VECs identified are presented in Table 7.2-1. The "X" in the Table identifies the values and environmental features that the individual VEC represents. The Table also includes a brief listing of plausible potential interactions of the Project with the VEC through direct effects and/or impact pathways. These are discussed in further detail in the subsequent section (Section 7.2.2).

TABLE 7.2-1 Basis for Selection of VECs

Environmental Category	VEC	Relevance to Environmental Features (as per Provincial Terms of Reference) and/or Values (as per federal Scoping Document)							Potential Interaction of the Project with the VEC
		Legal	Scientific	Environmental/ Ecological	Socio-Economic	Human Health	Reasonable Enjoyment of Life and Property	Cultural	
Socio-Economic and Cultural	Land Use – Existing and Planned	X		X	X		X	X	• Potential for conflict with current planning strategy and zoning by-laws. • Potential for conflict with existing (actual) land uses (incompatibility; minimum separation distance).
	Aboriginal Use of Land and Resources	X			X			X	• Potential for conflict with traditional land uses and land claims.
	Socio-Economic: Population, Economic Conditions, Employment, Tourism				X	X		X	• Short term employment opportunities (construction). • Long-term employment opportunities (operation). • Economic spin-off effects. • Effects on demographics. • Contributions to municipal tax base. • Contribution to Provincial energy strategy. • Effects on attractiveness for wilderness/nature oriented tourism • Improved economics leading to improvement of tourism infrastructure
	Residential Property Values				X		X		• Potential for changes in property values (increase and decrease dependent location of property).
	Recreational Opportunities and Aesthetics				X	X	X	X	• Potential for impairment through adverse visual impacts and emissions (i.e., Project-related noise, dust, odours).
	Forestry	X		X	X				• Reduction in area available for forestry.
	Fisheries, Aquaculture and Harvesting	X			X	X			• Potentially reduced (local) production rates/ sales volumes as a consequence of adverse effects on resource. • Potential for impaired marketability (perception product quality).
	Road Transportation	X			X	X	X		• Impaired road infrastructure. • Impaired local traffic.

Environmental Category	VEC	Relevance to Environmental Features (as per Provincial Terms of Reference) and/or Values (as per federal Scoping Document)							Potential Interaction of the Project with the VEC
		Legal	Scientific	Environmental/ Ecological	Socio-Economic	Human Health	Reasonable Enjoyment of Life and Property	Cultural	
Socio-Economic and Cultural *(Continued)*	Human Health and Safety	X				X			• Potential effects on health of workers. • Potential effects on residents (as a consequence of water and/ or air quality impairments).
	Archaeological Resources	X						X	• Potential for disturbance of archaeological site(s) and resources.
Biophysical Environment	Air Quality and Climate Change	X		X		X	X		• Potential for local air quality impairments. • Potential for contributions to local and global climate change.
	Noise	X		X		X	X		• Potential for changes in existing acoustic environment. • Potential for changes in the existing lighting conditions.
	Surface Water (Quality, Quantity, Sediment Quality and Transport)	X		X		X			• Potential for adverse effects on lake water quality from Lake impoundment and lake water intake withdrawal of lake water. • Potential surface water quality as a result of acid generating rock (construction phase). • Potential for effects on hydrology (lake environments and connecting water courses due to Meadow Lake impoundment and withdrawal of lake water. • Potential for water quality impairments in marine environment due to waste water and/or cooling water discharges and/or re-suspension of contaminants from sediments during marine works. • Potential for alteration of sediment transport and beach formation/erosion
	Groundwater – Quality and Quantity	X		X		X			• Potential for groundwater quality impairment. • Potential for impacts on local water supply wells.

Environmental Category	**VEC**	**Relevance to Environmental Features (as per Provincial Terms of Reference) and/or Values (as per federal Scoping Document)**							**Potential Interaction of the Project with the VEC**
		Legal	**Scientific**	**Environmental/ Ecological**	**Socio-Economic**	**Human Health**	**Reasonable Enjoyment of Life and Property**	**Cultural**	
Biophysical Environment *(Continued)*	Freshwater Aquatic Species and Habitat (incl. Species at Risk)	X		X	X			X	• Potential for HADD (fish habitat alteration, deterioration, and destruction). • Potential for adverse effects on fish species and populations as a result of HADD. • Potential for effects on aquatic species at risk as a result of HADD
	Wetlands	X		X					• Potential for adverse effects on extent and functions of local wetland habitat due to site development, lake impoundment, and lake water withdrawal.
	Agriculture				X	X			• Potential for displacement of agricultural production • Potential for deposition of contaminants on agricultural fields
	Geology, Soil Quality					X			• Potential for acid drainage generation • Potential for soil quality impairment via air quality pathway
	Marine Species and Habitat (incl. Species at Risk)	X	X	X		X		X	• Potential for HADD (marine fish habitat alteration, deterioration, and destruction). • Potential for adverse effects on marine fish species and populations as a result of HADD. • Potential for adverse effects on marine species at risk as a result of direct impact or HADD.
	Flora, Fauna and Terrestrial Habitat (incl. Species at Risk)	X	X	X		X		X	• Potential for terrestrial habitat removal and/or alteration. • Potential for adverse effects on terrestrial species as a result of effects on changes in terrestrial habitat. • Potential for adverse effects on terrestrial (including wetland) species at risk as a result of direct impact or habitat changes

7.2.2 VEC Description

The following is a summary of the scope of each VEC, and a rationale for selection. VECs as presented are not ranked by importance.

Within the **Socio-Economic and Cultural Environment**, eleven VECs have been identified.

Land Use

A major development such as the proposed Project can affect existing as well as planned land uses. Obviously existing on-site land uses will likely be replaced by the proposed new use. Existing and planned land uses on adjacent properties or within the zone of influence of the Project can be affected because of such factors as visual intrusion, noise, air and water quality impairments, and public perceptions.

Particular land use related concerns expressed in the provincial Terms of Reference relate to the Project interactions with contaminated sites, former mine sites, and mine disposal areas at or near the Project site.

Land use is regulated by the Province, with delegation to municipal governments. The municipal objectives and policies are typically defined in planning strategies and zoning by-laws. New developments will need to comply with these regulations. In addition, licenses and permits (i.e. for mineral exploration, for wood harvesting) are issued for particular uses such as mineral exploration and wood harvesting.

Aboriginal Use of Land and Resources

Aboriginal Culture is valued greatly in Nova Scotia. Many Aboriginal people continue to pursue elements of a traditional lifestyle, spending time in the country harvesting fish, game, berries, and firewood. Aboriginal land/resource use and culture could be affected by the Project development through such effects as the loss or alteration of harvesting areas and reduced access to traditionally used lands. Aboriginal Land claims can affect the establishment of clear title for land designated for industrial development and exclusive use. Both Federal and Provincial Governments have responsibilities with respect to Aboriginal peoples and the settlement of outstanding Land Claims.

Population, Economic Conditions, Employment, Tourism

Local, Regional, and Provincial economies are important for residents of the Province. Residents within the Project area rely on a traditional economy that can include forestry, agriculture, and fisheries. Project revenues and expenditures may affect both traditional and wage economies. The Project will also affect the municipal tax base.

Economic conditions at the regional level can affect population levels in areas adjacent to a development as people choose to re-locate as a consequence of employment opportunities.

Employment and Business are valued by individuals who may benefit directly or indirectly from cash income generated by the Project. Changes in the level of employment and business activity affect the standard of living of individuals and can result in a change of the entire community.

The Project will require a temporary labour force during Construction, and a smaller but significant labour force during Operations. In addition to direct hires, the Project will generate employment and economic activity through contracting for goods and services.

The development of a large scale industrial complex will likely change the visual landscape character in the site vicinity. This could reduce the attractiveness of the area for wilderness/nature oriented tourism. The expected overall improvement in the local and regional economy on the other hand is likely to improve the regional tourism infrastructure, which may have a positive effect on visitor numbers.

Residential Property

Changes in population levels because of migration and reproduction can affect the demand for, and therefore the price of, residential property. The Project requirement for labour, especially during Construction, may induce people to relocate to Goldboro or other nearby communities. This could lead to increases in residential property prices within daily commuting distance to the Project site. Project infrastructure can alter accessibility to land areas, which in turn can affect actual or potential future uses of these lands with potential for changes in property value.

Recreational Opportunities and Aesthetics

The land and water of the region provide opportunities for residents and visitors to pursue outdoor recreational activities (hunting, fishing, berry picking, hiking, and boating). Climate, terrain, and access all affect the quantity and quality of use. For many outdoor recreational activities, enjoyment is enhanced by the rural nature of the region, i.e. the absence of heavy industrial infrastructure. The presence of an industrial facility can influence perceptions through noise/activity levels and visually. Project infrastructure (access roads) can affect accessibility of land and water for recreational use.

Forestry

An important, sustainable resource use in the region is forestry. An industrial activity will impact an area of land as represented by the Project footprint. In addition, less direct interactions can occur. Increased labour demand for a Project can act to increase pressure to zone forestry land to supply residential needs. Increased employment opportunities can produce a shift in labour away from wood harvesting and milling. Forestry is regulated by the Province. The Federal Government carries out research to support the industry.

Fisheries, Aquaculture, and Harvesting

An important, sustainable resource use in the region is fisheries, including potential aquaculture. An industrial activity will impact an area of shoreline as represented by the Project dock facility and mooring areas. Marine traffic has the potential to interact with harvesting activities. In addition, less direct interactions can occur. Planned and unplanned discharges to the aquatic environment can alter water quality and physical habitat characteristics, which in turn can affect life-cycle stages of target species and their food supply. In particular, aquaculture enterprises require pristine water quality in order to establish or maintain operations. Increased employment opportunities can produce a shift in labour away from fisheries and potential aquaculture operations. Fish harvesting is regulated by the Federal Government under the *Fisheries Act*. Aquaculture operations are regulated by the Province. Both levels of government carry out research to support the industry.

Ground Transportation

A principal mechanism of transport is provided by a highway network throughout Nova Scotia. This network enables the movement of goods and people for a wide variety of purposes. The quality and capacity of transportation services in a region contribute to the overall standard of living and quality of life available to residents. The Project will call on the existing road network to deliver workers to the Site and for the supply of an array of goods and services needed to support the Construction Operations phases. Increased traffic associated with the Project can be expected to result in changes in traffic density and movement patterns in the area. These changes could affect adjacent residential and commercial areas. Highways are regulated and administered by the Province.

Human Health and Safety

Protecting human health and safety is a priority for this Project. Humans that may be potentially affected by construction, routine facility activities, as well as accidents, malfunctions, and unplanned events are primarily those that work at the facility or live in or near the Study Area. Through pathways, Human Health and Safety is also potentially affected by Project-related changes to other VECs such as air quality, groundwater, and surface water quality.

Archaeological Resources

Historic Resources are important because of the information they reveal about past and contemporary ways of life, cultural identity, and relationships and interactions with other cultures and with the biophysical environment. Project development could result in the loss or alteration of historic resources. Historic resources in the province are protected under provincial legislation.

Within the Biophysical Environment nine VECs have been identified. These are briefly described below.

Air Quality and Climate

The quality of our atmosphere is important for the health and safety of people living and working near the Project site, as well as to local wildlife and vegetation. Climate change has become an important consideration in EA and for Project planning. Design criteria based on a calculated return period for natural events may be suspect if the underlying assumptions about climate prove to be inaccurate. Conversely, the reduction and control of air emissions has become one ingredient of a needed effort to address global warming and greenhouse gas emissions.

The Project will produce air emissions such as oxides, PM, and VOCs. These discharges will include exhaust from engines and ventilation, as well as dust from blasting, excavation, processing, vehicle operation, road use, and other Project activities. The atmospheric environment is a pathway for contaminants to the food chain due to the transport of particles to the surrounding vegetation and water. Air quality and climate conditions are important to overall ecosystem health and to other VECs. Air emissions are regulated federally and provincially.

Noise

Changes in the acoustic environment (i.e., changes in noise levels) can affect humans as well as wildlife. Human responses to changes in noise levels can include general disturbance phenomena, reduced enjoyment of property, disruption of sleep, and health effects. Wildlife can be affected through in its daily activities such as resting and feeding/foraging. Acclimation can occur in cases of constant, steady-state levels. In other cases, an avoidance response is elicited such that exclusion occurs from habitat which would otherwise be suitable for occupancy. Noise is regulated by the Province.

Surface Water (Quantity and Quality)

Surface water provides drinking water, as well as habitat for a wide variety of species – aquatic vegetation, plankton, fish, waterfowl, and furbearers. Human uses include recreation – boating, swimming, hunting, and fishing. The quality and quantity of surface water is an important ingredient in ecosystem health. The Project will extract, consume, treat, and discharge surface water during Construction and Operations. Airborne dust and contaminants could become transported to enter the surface waters surrounding the Site during Construction and, to a lesser extent, during Operations.

Marine water quality including sediment quality is of concern with respect to marine biota and coastal fisheries. Sediment transport is of significance from a navigational point of view and for coastal protection. The construction of the Marginal Wharf and the LNG Terminal has the potential to affect water and sediment quality through disturbance of contaminated near-shore marine sediments. During operation, spills and other accidental events can lead to temporary water impairment. Once completed, the wharf and terminal could affect near-shore sediment transport, sedimentation within navigable waters, beach formation and erosion along the shoreline. Marine resources and navigable waters are protected by federal legislation.

Resource management of surface water is a Provincial responsibility.

Groundwater

Groundwater is important for drinking water and as a recharge source for surface water. The Project will involve extractions, diversions, effluent discharge, and modification to groundwater flow. In addition to its use as drinking water and as habitat, water is a pathway for contaminant transport to the food chain and therefore, relevant for human health. Groundwater quality and quantity is regulated by the Province.

Geology, Soil Quality

Contaminated sites are known to occur within the Project footprint. Such areas can contain soil contaminated with heavy metals from mining and waste production (tailings). Other contaminants which are typical of mineral extraction activity can be present, including potentially acid generating rock. In some cases, sites may have been improperly de-commissioned; alternately the standards for de-commissioning may not reflect current standards or knowledge. During Construction there is potential to disturb contaminated sites and mobilize contaminants. Depending on land ownership, both the federal and provincial levels of government have regulatory control over contaminated sites.

Freshwater Aquatic Species and Habitat

Aquatic species and habitat are important since many aquatic species, especially fish, provide food for people and wildlife. The Project will alter aquatic habitat and restrict fish movement within some watershed(s). Freshwater fish and fish habitat are addressed by federal legislation. Aquatic (freshwater) species at risk are of concern due to their ecological functions, scientific and cultural value. Species at risk are protected under the federal SARA and could occur in or near the Project area. Project development may disrupt freshwater habitat and could affect species at risk that may utilize these habitats. The protection of rare species is addressed by federal and provincial legislation.

Wetlands

Wetlands act as a source of water and moderate hydrological conditions within watersheds. They provide valuable habitat for waterfowl, furbearers, and other aquatic species. Project Construction will interact directly (through removal) and indirectly (through altered surface and groundwater flows) with wetlands. The Province has regulatory responsibility for wetlands.

Marine Species and Habitat

Marine species and Habitat are important since many species support commercial, subsistence, and recreational fisheries. During Construction, marine habitat will be disrupted as a consequence of dock construction and associated marine traffic. During Operations, marine traffic and cargo transfer at dockside will interact with the marine environment. Species at risk are of concern due to their ecological functions, scientific and cultural value. Marine species at risk are protected under SARA and can be found in or near the Project area. Project development may disrupt some marine habitat and could affect species at risk that may utilize these habitats. The protection of rare species is addressed by federal and provincial legislation. Marine fish and habitat is regulated by the Federal Government.

Flora, Fauna, and Terrestrial Habitat

Flora, fauna, and terrestrial habitat are primarily of concern as a food source and as an economic and recreational resource. Project development will diminish or eliminate the productive capacity of some terrestrial habitat in the Project footprint. Other indirect interactions (airborne dust, emissions, noise, vibration, light, water extraction, and consumption) may affect species and habitat within the zone of influence of the Project. Most terrestrial species and habitat are regulated by the Province. Migratory bird species are regulated at the Federal level. Species at risk are of concern due to their ecological functions, scientific and cultural value. Species at risk are protected under SARA and can be found in or near the Project area. Project development may disrupt terrestrial habitat and could affect species at risk that may utilize these habitats. The protection of rare species is addressed by federal and provincial legislation.

7.3 STRATEGY FOR DETERMINING VEC – PROJECT INTERACTION

Project- environment interactions include direct and indirect effects of the Project. Determining these interactions involved:

- review of Project works and activities;
- analysis of direct effects;
- identification of pathways; and
- assessment of effects through pathways.

Plausible Project-environment interactions were identified based on professional judgement and a preliminary knowledge of the Project and the environmental characteristics of the site and the surrounding areas. These considerations contributed to the determination of the VECs (Section 7.2). Subsequently, as part of the effects assessment (Section 9.0) and for each VEC, these interactions were analyzed in detail. For example, it is plausible to assume that terrestrial habitat is affected by the Project as a consequence of habitat removal on site. During the effects assessment, this interaction was analysed in detail and the type and geographic extent of the affected habitat specified.

In a subsequent step for each VEC, the potential for Project-related effects through pathways was analyzed. VECs are typically interacting via pathways. Air quality, for example, represents a pathway in that it provides a link between a source (i.e., an exhaust stack) to a receptor (i.e., flora, wildlife, and human). Some VECs can function as both a pathway and a receptor. For example, soil quality can be affected by the Project via air quality (deposition of air-born contaminants). Soil quality also becomes a pathway through contaminant uptake via plant roots and subsequent human or animal consumption.

This understanding of the links between sources for environmental change and VECs as pathways and receptors was the basis for the assessment of effects associated with pathways. It required that the effects assessment for each VEC also reviewed and incorporated the effect predictions established for other VECs.

The approach to actual effects assessment is described in the following section.

7.4 IMPACT PREDICTION

In accordance with the provisions of the provincial Terms of Reference (NSEL 2005) and the federal scoping document (TC and DFO, 2005; provided in Appendix 1) the environmental effects assessment was conducted in a step-wise fashion involving:

- prediction and evaluation of Project-related environmental effects;
- identification of necessary avoidance, mitigation, remediation, and/or compensation; and
- determination of residual effects and their significance.

7.4.1 Environmental Effects Assessment

The potential effects resulting from interactions with the Project, either directly or indirectly via pathways, were investigated in detail for each VEC. This effects assessment involved qualitative and, where possible, quantitative analyses using existing knowledge, professional judgement, and computer modeling where appropriate and feasible.

7.4.2 Mitigation

Where an adverse environmental effect was identified, mitigation was proposed. Where possible, mitigation measures were incorporated into the Project design and implementation in order to eliminate or reduce potential adverse effects. Mitigation at the receptor end was considered if avoidance and mitigation at the source of the effect was deemed not feasible or not sufficiently effective.

In those instances where an adverse effect is unavoidable and cannot be mitigated to insignificant levels, options for remediation and/or compensation were investigated.

For interactions where positive effects are anticipated, opportunities were determined for maximizing the positive effects.

7.4.3 Residual Effects and Determination of Significance

Residual impacts refer to those environmental effects predicted to remain after the application of all proposed mitigation measures. The predicted residual effects are considered for each Project phase (construction, operation, decommissioning) and for potential accidental events.

In accordance with the Provincial EA regulations and Canadian Environmental Assessment Agency guidelines (1994, 1997), the significance of the residual effects is evaluated for each VEC. For adverse impacts, significance is determined based on the following criteria:

- magnitude;
- geographic extent;
- timing, duration and frequency;
- reversibility; and
- ecological and socio/cultural context.

For magnitude a relative rating was established as defined in Table 7.4-1. The evaluation applied absolute values for the geographic extent, frequency, and duration. Reversibility was considered as the ability of a VEC to return to an equal or improved condition once the interaction with the Project has ended. The judgement about the reversibility was based on previous experience and research and stated as “reversible” or “irreversible.” Subsequently, those effects considered significant would undergo an additional consideration of the likelihood of their occurrence and the level of confidence underlying the effects prediction.

TABLE 7.4-1 Definitions for Levels of Magnitude

Rating	Magnitude*
High	An environmental effect affecting a whole stock, population, or definable group of people, or where a specific parameter is outside the range of natural variability determined from local knowledge over many seasons.
Medium	An environmental effect affecting a portion of a population, or one or two generations, or where there are rapid and unpredictable changes in a specific parameter so that it is temporarily outside the range of natural variability determined from local knowledge over many seasons.
Low	An environmental effect affecting a specific group of individuals in a population in a localized area, one generation or less, or where there are distinguishable changes in a specific parameter; however, the parameter is within the range of natural variability determined from local knowledge over many seasons.
Nil	No environmental effect.
Unknown	An environmental effect affecting an unknown portion of a population or group or where the changes in a specific parameter are unknown.

*Note: Definitions for magnitude for air and water quality are specific and addressed separately in the respective section of Section 9.0.

For adverse residual effects, the evaluation for the individual criteria was combined into an overall rating of significance:

- **Major:** Potential impact could jeopardize the long term sustainability of the resource, such that the impact is considered sufficient in magnitude, aerial extent, duration, and frequency, as well as being considered irreversible. Additional research, monitoring, and/or recovery initiatives should be considered.
- **Medium:** Potential impact could result in a decline of a resource in terms of quality/quantity, such that the impact is considered moderate in its combination of magnitude, aerial extent, duration, and frequency, but does not effect the long term sustainability (that is, it is considered reversible). Additional research, monitoring, and/or recovery initiatives may be considered.
- **Minor:** Potential impact may result in a localized or short-term decline in a resource during the life of the Project. Typically, no additional research, monitoring, and/or recovery initiatives are considered.
- **Minimal:** Potential impact may result in a small, localized decline in a resource during the construction phase of the Project, and should be negligible to the overall baseline status of the resource.

An adverse impact was considered “significant” where its residual effects were classified as major; while they were considered “not significant” where residual effects were classified as medium, minor, or minimal.

8.0 EXISTING ENVIRONMENT

8.1 AREA GEOGRAPHY

The proposed Keltic Site and water supply Study Area (the Keltic Study Area) is found in Guysborough County, covering a total surface area of approximately 300 square km (km^2) near Goldboro, Nova Scotia and surrounding areas in the south.

The Keltic Study Area is located within the Southern Upland physiographic region (see Figure 8.1-1).

The topography in this region is somewhat varied. The surface is much like a plateau with long, low ridges running southeast-northwest. The soil is generally thin and acidic. The intervening hollows are swampy flats that have their long axes generally oriented parallel to the strike of bedrock strata. Drainage is poor because of deposits of glacial drift. Peat bogs are common and in some areas there are wide level expanses of heath and meadow.

Chains of lakes, streams, and still-water occur. River channels are shallow because the streams run down tilted erosion plains, across bedrock folds, and layers of resistant strata. The area is mainly forest country.

8.1.1 Population Distribution

The communities present within the Southern Upland in the Keltic Study Area are mostly small hamlets consisting of few homes, a gas station, and a general store which service a greater population that is distributed primarily along the major paved roads, Route 316 mostly.

8.2 EXISTING AND PLANNED LAND USE

8.2.1 Proposed Keltic Industrial Site

Prior to the Keltic proposal, the Municipality of Guysborough County was instituting an industrial strategy for the region. Construction of the SOEP gas plant in the Goldboro Industrial Park has spurred expansion of the current industrial site to include land for the proposed Keltic development, which includes a Petrochemical Complex and LNG Importation and Vaporization Facility. The proposed Marginal Wharf is located on Red Head and is a marine facility.

Goldboro and the proposed petrochemical site are covered under the District 7 Planning Strategy and Land Use Bylaws (see Figure 8.2-1). The proposed site was previously zoned M-2 (Industrial Resource) and Residential R-1. The M-2 zoning permitted uses, such as quarry development, that were not deemed suitable for extension to shoreline properties. Zoning has been amended to an M-3 designation that targets the marine aspect of the Keltic development. This designation encompasses an area between 2833 and 3238 ha, of which approximately 300 has been allocated to Keltic. The area includes the shoreline of Red Head to Betty's Cove, including the existing pipeline and Nova Scotia Power Inc. line corridors. The adjoining Sable gas complex has a footprint between 40.5 and 48.6 ha, of which 20.2 ha has been fenced (G. Cleary, pers. comm., 2005).