APPENDIX B

Design Basis Report – CBCL Ltd

Truck Loading Rack Project – Design Basis Report

Contents

Chapter 1 General Description

1.1 Scope and Introduction

The Truck Loading Terminal Project involves the construction of an all-new facility on a green-field site located south of the Butane Storage Facility. The new terminal will replace the existing gasoline and distillate loading facilities at the Refinery. The new facility will not include capabilities for loading Propane. The loading facilities for these two products will remain in their current location. The project will also include upgrades to the product supply pumps, pipelines, tanks, electrical system and controls in the Refinery Offsites Area.

The new Terminal will consist of two individual loading islands. Each loading island will be capable of loading two trucks simultaneously (one on each side). Each loading island will have five loading arms. Loading Island #1 will contain two dedicated Regular Gasoline loading arms, two Low Sulphur Diesel loading arms and one Marine Diesel loading arm. Loading Island #2 will contain two dedicated Jet Fuel loading arms and three Furnace/Diesel/Stove loading arms. All loading arms will be 4-inch A-Frame style bottom loaders, which will be designed to permit loading from either side of the island.

The terminal access and terminal automation systems will be designed to permit unattended loading of trucks. The system will be capable of identifying and admitting authorized drivers to the terminal as well as controlling which products these drivers load. The system will automatically start the appropriate refinery pumps and, blend the various refinery components to achieve the desired product. Various additives will be injected automatically at the appropriate dosing rates. The system will also print the bill of lading for the driver as well as maintain inventory control for invoicing purposes.

Upgrades in the Refinery Offsites Area will include the Regular Gasoline Supply System, the Low Sulphur Diesel System, the High Sulphur Diesel System, the Jet Fuel System and the Isomax Kerosene System.

The electrical system in the Refinery Offsites Area will require an expansion to Sub #8, an Upgrade of Equipment in Sub #6 and the installation of new equipment in Sub #9.

The control system in the Refinery Offsites Area will also require an upgrade to accept the additional I/O required for the new Terminal.

This report provides additional descriptive details of all the Terminal and Refinery Offsites Systems as well as Preliminary Piping and Instrumentation Diagrams, Plot Plans, Block Diagrams and Single Line Diagrams, intended to describe the design basis for this project.

1.2 Design Basis

The primary objective of this project is to construct a terminal capable of loading the products and product volumes identified by North Atlantic Petroleum within a time frame that would be considered the norm for the industry. The design is based on a truck "turn-around time" of 45 minutes. Based on [redacted] ted. A-Frame bottom loading arms were selected due to their ability to swing from one loading position to the other allowing all products on a single island to be loaded from either side.

1.3 Governing Standards

The following standards and Recommended Practices shall be followed during the design and construction phases of the project:

- API Standard 2610 - Design, Construction, Operation, Maintenance, and Inspection of Terminal & Tank Facilities
- ASME B31.3 - Process Piping Code
- API Recommended Practice 2003 - Protection Against Ignitions Arising Out of Static, Lightning, and Stay Currents
- API Manual of Petroleum Measurement Standards
- ASME Section VIII - Non-Fired Pressure Vessels
- API 1581 - Specification and Qualification Procedures for Aviation Jet Fuel Filter/Separators
- API Recommended Practice 1004 - Bottom Loading and Vapour Recovery for MC-306 & DOT-406 Tank Motor Vehicles
- API 610 – Centrifugal Pumps for Petroleum, Heavy Duty Chemical and Gas Industry Services
- ULC-S610-00 – Standard for Shop Fabricated Steel Aboveground Horizontal Tanks For Flammable and Combustible Liquids
- ULC-S630-00 – Standard For Shop Fabricated Steel Aboveground Vertical Tanks for Flammable and Combustible Liquids
- Consolidated Newfoundland Regulation 775/96 – Storage and Handling of Gasoline and Associated Products Regulations under the Environment Act
- National Fire Code of Canada 1995
- National Building Code of Canada 1995
- Canadian Electrical Code 2002
- Occupational Health and Safety Branch, Department of Government Services, Newfoundland and Labrador

- API 2000 Venting Atmospheric and Low Pressure Storage Tanks
- Measurement Canada
- CAN/CSA S600 Canadian Highway Bridge Design Code (wheel loads)

2.1 Truck Loading Terminal

2.1.1 Loading Racks

There will be two (2) Loading Racks installed in the terminal. Rack 1 will supply primarily road fuels and Rack 2 will supply primarily distillates. Each rack will have five (5) A-frame loading arms capable of loading trucks from both sides of the rack. Each loading train will contain a strainer, meter and control valves for flow control and measurement. Injection points for lubricity, gasoline, and dye additives are located at the loading positions as required. Each rack will have a slop connection and pump for truck compartment flushing.

The new Truck Loading Racks have been designed to fit on the site bordered by the Butane Storage Facility, Refinery Road and the existing Employee Parking Area. Any additional expansion, requiring a third or fourth loading island, will encroach on the existing Employee Parking Area.

The products available for loading at the racks are blended using five main components. These components are Regular Gasoline (RUL), Low Sulphur Diesel (LSD), High Sulphur Diesel (HSD), Isomax Kerosene (Kero), and Jet Fuel (Jet). The following table provides component flow rates based on the number of loading arms, which may be operating simultaneously. A diversity factor of 75% has been applied to any product that has more than two loading arms. The maximum allowable loading rate of 2,250 litres per minute for a single 4 inch loading arm has been assumed.

FLOW RATES TO LOADING TERMINAL		
PRODUCT	**# OF LOADING ARMS**	**FLOW RATE (Litres per Minute)**
Reg. Gasoline	2	4,500
LSD	2	8,440
Jet	5	8,440
HSD	3	6,800
Kero	2	4,500

There will be nine (9) products available at the new racks. The Table below indicates the available products from each arm.

- Regular Gasoline
- Low Sulphur Road Diesel
- Hibernia Blend (HIB)
- High Sulphur Diesel (HSD)
- Furnace (FUR)
- Arctic Diesel (Arctic)
- Marine Diesel
- Stove Oil (Stove)
- Jet Fuel (Jet)

LOADING RACK #1		
ARM NUMBER	**PRODUCT**	**BLEND COMPONENTS**
#1	Reg. Gasoline	RUL
#2	Reg. Gasoline	RUL
#3	Road Diesel	LSD/Kero
#4	Road Diesel	LSD/Kero
#5	Marine Diesel	HSD

LOADING RACK #2		
ARM NUMBER	**PRODUCT**	**BLEND COMPONENTS**
#6	Jet Fuel	Jet
#7	Jet Fuel	Jet
#8	Stove/FUR/HIB/HSD/Arctic	Jet/HSD
#9	Stove/FUR/HIB/HSD/Arctic	Jet/HSD
#10	Stove/FUR/HIB/HSD/Arctic	Jet/HSD

2.1.2 Additive Systems

There will be five (5) new additive systems installed in the terminal. The five additive systems will be NARL Gasoline Detergent, Customer 'A' Gasoline Detergent, Conductivity Additive, Lubricity Additive, and Dye Additive. Each system will consist of a storage tank, two (2) 100% Duty injection pumps, piping, automatic injectors, tubing and loading facilities to fill the storage tanks. Each additive system is described in further detailed below.

NARL Gasoline Detergent

The Gasoline detergent used by NARL is UltraZol 8219D and is manufactured by Lubrizol Corp. The Gasoline detergent will be delivered to site in 45 US gallon drums. The detergent will be injected at the Regular Gasoline Arms on Rack 1, Loading Positions 1, and 2.

The detergent will be stored in a 3,800 litre (1,000 US gallon) tank. The tank will be a horizontal double wall ULC-S-610 design that meets secondary containment requirements. The largest monthly volume for NARL Gasoline requires 953 litres (252 US gallons) of Gasoline detergent based on an injection rate of 125 ppm. The 3,800 litre tank will provide approximately four (4) months supply of detergent when full.

The storage tank will be filled using a positive displacement pump. This pump will transfer Gasoline detergent from the barrels into the tank. The pump will have a capacity of 80 litres per minute (21 usgpm) and be driven with a 1 HP explosion proof motor. The pump suction line will have a flexible stainless steel hose and a dip tube to insert into the barrels.

Two (2) 100% Duty, positive displacement, additive injection pumps will supply detergent to the additive injectors. The pumps will have a capacity of 11 litres per minute (2.8 usgpm) and a discharge pressure of 1380 kpag (200psig). The pumps will utilize explosion proof motors.

The additive injectors will be mounted in stainless steel enclosures on steel supports at the end of the Loading Rack. Detergent will be delivered to the individual loading arms through ½ inch stainless steel tubing.

Customer 'A' Gasoline Detergent

The Gasoline detergent used by Customer "A" is HiTEC 6560 and is manufactured by Afton Chemical Corp. It is currently unknown by what method the detergent will be delivered to the site. For the preliminary design, it is assumed it will be delivered in 45 gallon drums. The delivery method (truck versus drum) will be confirmed during detailed design and the detergent offloading system revised if required. The detergent will be injected at the Regular Gasoline Arms on Rack 1 Positions 1, and 2.

The detergent will be stored in a 7,500 litre (2,000 US gallon) tank. The size of this tank has been selected based on the sizes of third party Gasoline detergent tanks at other loading terminals in Atlantic Canada. The tank will be a horizontal double wall ULC S-610 design that meets secondary containment requirements. The largest monthly volume for customer 'A' Gasoline requires 1,100 litres (288 US gallons) of Gasoline detergent based on an injection rate of 96 ppm. This provides approximately seven (7) months supply of Gasoline detergent when the tank is completely full.

The storage tank will be filled using a positive displacement pump. This pump will transfer Gasoline detergent from the barrels into the tank. The pump will have a capacity of 80 litres per minute (21 usgpm) and be driven

with a 1 HP explosion proof motor. The pump suction line will have a stainless steel flexible hose and a dip tube to insert into the barrels.

Two (2) 100% Duty, positive displacement, additive injection pumps will supply detergent to the additive injectors. The pumps will have a capacity of 11 litres per minute (2.8 usgpm) and a discharge pressure of 1,380 kpag (200 psig). The pumps will utilize explosion proof motors.

The additive injectors will be mounted in stainless steel enclosures on steel supports at the end of the Loading Rack. Detergent will be delivered to the individual loading arms through ½ inch stainless steel tubing.

Conductivity Additive

The conductivity additive to be used is Stadis-450 and is manufactured by Dupont Canada. The additive will be delivered in 5 US gallon drums. The additive will be diluted with Jet Fuel at a ratio of 1:20. The additive will be delivered to the Low Sulphur Diesel Fuel, High Sulphur Diesel Fuel, Isomax Kerosene, and Jet Fuel pipelines at injection points downstream of the filter separators.

The conductivity additive will be stored in a 7,500 litre (2,000 US gallon) tank. The tank will be a horizontal double wall ULC S-610 design that meets secondary containment requirements. The tank will have a 0.5 HP tank mixer to blend the additive with the Jet Fuel. The largest monthly volume for products with conductivity additive requires 2,600 litres (685 US gallons) of conductivity additive based on an injection rate of 50 ppm. This provides approximately three (3) months supply of conductivity additive when the tank is completely full.

The tank will be filled using a loading pump. This pump will transfer conductivity additive into the tank from 19 litre (5 US gallon) drums. The pump will be capable of transferring 80 litres per minute (21 usgpm) and will be driven by a 1 HP explosion proof motor. The pump suction line will have a stainless steel flexible hose and a dip tube to insert into the 19 litre (5 US gallon) drums. The Jet Fuel will be transferred into the storage tank by a home heating oil truck with onboard pump, hose and nozzle. This truck will load the required Jet Fuel at the rack and drive to the storage tank location to add the Jet Fuel to the blend tank. A North Atlantic Operator will coordinate this activity.

Two (2) 100% Duty, positive displacement additive injection pumps will be used to supply conductivity additive to the injectors. The pumps will have a capacity of 11 litres per minute (2.8 usgpm) and a discharge pressure of 1,380 kpag (200 psig). The pumps will utilize explosion proof motors.

The additive injectors will be mounted in stainless steel enclosures on steel supports near the Filter Separators. Conductivity Additive will be delivered to the individual lines through ½ inch stainless steel tubing. Turbine meters, located in the main product lines, will control the additive injectors.

Lubricity Improver

The lubricity improver to be used is HiTEC 4140 and is manufactured by Afton Chemical. The improver will be delivered in bulk by a truck with an onboard offloading pump. The improver will be injected at the Marine Diesel and Low Sulphur Diesel arms on Rack 1 and Rack 2.

The improver will be stored in a 19,000 litre (5,000 US gallon) tank. The tank will be a horizontal double wall ULC S-610 design that meets secondary containment requirements. The tank will be electrically heated and insulated due to the high pour point temperature of the lubricity improver. The capacity of the tank is based on the delivery volume expected. The largest monthly volume for products that require lubricity improver requires 3,300 litres (879 US gallons) based on an injection rate of 175 ppm. This provides over five (5) months supply of lubricity improver when the tank is completely full.

A delivery truck equipped with a pump and delivery hose will fill the tank. The tank fill line will have a camlock truck connection and a spill preventer.

Two (2) 100% Duty, positive displacement, lubricity injection pumps will supply additive to the injectors. The pumps will have a capacity of 11 litres per minute (2.8 usgpm) and a discharge pressure of 1,380 kpag (200 psig). The pumps will utilize explosion proof motors.

The additive injectors will be mounted in stainless steel enclosures on steel supports at the end of the Loading Racks. This supply piping will be electrically heat traced and insulated. The Additive will be delivered to the individual loading arms through ½ inch stainless steel tubing. This tubing will also be electrically traced and insulated.

Dye Additive

The dye additive to be used is X-1033R1 TEF Red FF 30 and is manufactured by BASF. The dye concentrate will be delivered in 45 US gallon drums. The detergent will be diluted at a ratio of 1:1 with Jet Fuel. The dye will be injected at the Marine Diesel, Furnace Oil, Stove Oil, High Sulphur Diesel, Hibernia Blend, and Artic Diesel loading arms on Rack 1 and Rack 2.

The dye will be stored in a 3,800 litre (1,000 US gallon) tank. The tank will be a horizontal double wall ULC S-610 design that meets secondary containment requirements. The tank will have a 0.5 HP mixer to blend the dye and Jet Fuel. The largest monthly volume for dyed products requires 860 litres (227 US gallons) of dye based on an injection rate of 28 ppm. This provides approximately four (4) months supply of dye when the tank is completely full.

The storage tank will be filled using a positive displacement loading pump. This pump will transfer dye concentrate into the tank from 45 US gallon drums. The pump will have a capacity of 80 litre per minute (21 usgpm) and be driven by a 1 HP explosion proof motor. The suction line will have a stainless steel flexible hose and a dip tube to insert into the barrels. The Jet Fuel will be transferred into the storage tank by a home heating oil truck with onboard pump, hose and nozzle. This truck will load the required Jet Fuel at the rack and drive to the storage tank location to add the Jet Fuel to the blend tank. A North Atlantic Operator will coordinate this activity.

Two (2) 100% Duty, positive displacement, additive injection pumps will be used to supply dye to the additive injectors. The pumps will have a capacity of 11 litres per minute (2.8 USGPM) and a discharge pressure of 1,380 kpag (200psig). The pumps will utilize explosion proof motors.

The dye injectors will be mounted in stainless steel enclosures on steel supports at the end of the Loading Racks. Dye will be delivered to the individual loading arms through ½ inch stainless steel tubing.

2.1.3 Slop Systems

The slop system consists of a single 19,000 litre (5,000 US gallon) storage tank and three pump systems one located at each Loading Rack and a third located at the truck offloading pad.

The systems located at the Loading Racks provide facilities for compartment flushing or drain dry activities. Trailers preparing to load Jet Fuel, which previously carried other products, are required to carry out a Jet Fuel flush of each compartment. Trailers preparing to load LSD into a compartment, which previously carried another product, must be drained dry prior to loading. The two slop pump systems located at the Loading Racks provides these capabilities.

The Slop Pump located at the Truck Offloading Pad provides two functions. This pump can be used to empty the slop tank by pumping into

a truck for transfer back to the Refinery or it can be used to empty a truck of offspec fuel without tying up a Loading Position at the Loading Rack.

The slop system will have a 19,000 litre (5,000 US gallon) storage tank. This tank will be a horizontal double wall ULC S-610 design that meets secondary containment requirements. The size of the tank is based on industry standards for slop tanks.

Each rack will have slop funnel, spill preventer, and a transfer pump. The pumps located at the Loading Racks will have a capacity of 80 litres per minute (21 usgpm) and will be driven by a 1.5 HP explosion proof motor.

The pump located at the Truck Offloading Pad will have a capacity of 730 litre per minute (193 USGPM) and will be driven by a 7.5 HP explosion proof motor. The truck transfer lines will have a flexible hose, camlock fitting and spill preventer.

2.1.4 Vapour Recovery

The vapour recovery system will be required at Loading Rack 1 for trucks that are loading the Regular Gasoline. The vapour recovery system will have two (2) vapour recovery arms at the rack. This system will send vapour back to an absorption type vapour recovery skid, which will recover the Gasoline vapour displaced from the truck compartments and send it back to the Regular Gasoline storage tank located in the refinery. This system will require a constant supply of Gasoline from the same tank for the absorber tower, which strips the hydrocarbon from the waste stream.

2.1.5 Filter/Separators

The five (5) main product components entering the terminal will pass through filter separators to ensure clean, water free fuel at the Loading Racks. Each product will require a single filter separator.

The design pressure and design temperature of the vessels will be 200 psig and -20/150 degrees F respectively. Each filter/separator will have a pressure differential indicating gauge to measure the pressure drop across the filter elements. The vessels will have a pressure drop of 3 – 5 psig when the elements are clean and a pressure drop of 15 psig when the elements are fouled. Each vessel will be fitted with an air eliminator, pressure safety valve, and sample points.

The maximum flowrate through each filter is based on the maximum flowrates for each product component as stated in section 2.1.1.

2.2 Refinery Offsites Upgrades

The proposed project for the installation of a new Truck Loading Rack south of the butane storage facility requires modifications within the refinery offsites areas. The upgrades are required to the five (5) products, which will supply the new truck rack. The five products are Regular Gasoline, Low Sulphur Diesel, Isomax Kerosene, Jet Fuel, and High Sulphur Diesel. Each of these five (5) systems will require modification to deliver the products to the new truck rack at the required flow rates.

The flow rates for the various products listed above will vary depending on the number of loading arms operating at any particular point in time. Variable frequency drives will be installed on the five product supply pumps to help address this large variation in flow. The variable frequency drives will also address the pressure limitations of some loading rack components, as well as minimum flow requirements for the pumps, by reducing pump speed during low flow conditions. Details on the control of the variable frequency drives are provided in the Controls Section of this document.

The design of the new truck rack and refinery modifications must be completed so as to minimize downtime during construction. All systems have a maximum allowable shutdown time of 48 hours. This means all current systems inside the refinery fence and the existing Truck Loading Racks, must remain operational until construction, testing and commissioning are complete and the new truck rack is ready for operation.

2.2.1 Regular Gasoline System

The Regular Gasoline system will deliver product from a new tank (TK-NEW1) to the new truck rack. The new truck rack will require the installation of a new loading pump located near the new tank. New suction and discharge piping will be required from the new tank to the new truck rack site. A supply and return system will also provide gasoline to the vapour recovery system located in the Terminal from the new tank.

The new gasoline tank (TK-NEW1) will be a 15,000 BBL single wall field erected tank. The tank will have a 48 ft diameter and a 48 ft height. A full contact-floating roof will be installed to minimize vapour loss. The tank will be installed within a new dike meeting secondary containment requirements. A cathodic protection system will be provided for the tank. The proposed location for the new tank is north of gasoline hill. The installation of this tank is necessary to provide uninterrupted supply of product to the Loading Racks while Tank 413, the existing supply tank, is being refilled and re-certified.

Product will be supplied to the new gasoline tank from Tank 413 through a new supply line. Pump P-5140, the existing loading pump supplying the existing Loading Rack, will be used to transfer product from Tank 413 to the new Tank at a rate of 2,250 litres per minute (600 usgpm). The discharge of Pump P-5140 will also be tied-in to the new truck rack supply pipeline. This will allow pump P-5140 to provide product to the new truck rack directly from Tank 413 at a reduced flow if the new Regular Gasoline pump, or the new Regular Gasoline tank are out of service for any reason.

A new Regular Gasoline loading pump (P-NEW1) will be installed to deliver product from the new Tank to the new truck rack at a rate of 4,500 litres per minute. The pump operating point determined during preliminary design is 4,500 litres per minute at a total dynamic head of 88 meters (290 ft). The preliminary motor size is estimated to be 125 HP. The consultant shall determine the final operating point and horsepower during detailed design.

A new VRU Supply Pump (P-NEW2) will also be installed near the new Regular Gasoline tank to supply a stream of gasoline to the vapour recovery unit located in the Terminal. The pump operating point determined during preliminary design is 300 litres per minute at a total dynamic head of 107 meters (350 ft). The preliminary motor size is estimated to be 15 HP. The consultant shall determine the final operating point and horsepower during detailed design. This new pump will be connected to the new tank by a dedicated suction line and will supply the Regular Gasoline stream to the vapour recovery absorption tower through a dedicated line. A second pump located at the vapour recovery unit in the Terminal will return product from the base of the absorption tower back to the new tank through a dedicated supply line.

2.2.2 Isomax Kerosene System

The Isomax Kerosene system will deliver product from tank TK-342 to the new truck rack. The existing system is capable of supplying the existing low sulphur road diesel truck rack located near Tank 342 at a flow rate of 2,250 litres per minute (600 usgpm). The new truck rack will require a flow of 4,500 litres per minute (1,200 usgpm). The new Isomax Kerosene system will supply two (2) loading arms on Rack 1. Based on the increased flow rate requirement, and the distance to the new Loading Rack, the existing pump cannot be reused.

A new Isomax Kerosene loading pump (P-NEW6) will be installed near Tank 342 to supply the new truck rack. The pump operating point determined during preliminary design is 4,500 litres per minute at a total dynamic head of 111 meters (363 ft). The preliminary motor size is

estimated to be 150 HP. The consultant shall determine the final operating point and horsepower during detailed design.

The new Pump will require a new 8" suction line from tank TK-342. This suction line will connect to the tank through an existing manway. A new manway cover will be required. A new discharge pipeline from the new pump to the new truck rack will be required.

The existing Loading Rack is supplied with Isomax Kerosene by pump P-5157. This pump is to remain in service until the new rack is commissioned and ready for service. When this switch has occurred, pump P-5157 will be tied into the new supply pipeline to the new truck rack. This will allow pump P-5157 to provide reduced flow to the new truck rack if the new pump is out of service.

2.2.3 Jet Fuel System

The Jet Fuel system will deliver product from tanks TK-523 and TK-524 to the new truck rack. The existing Jet Fuel loading system supplies the existing truck rack from these tanks at a flow rate of 2,250 litres per minute (600 usgpm). The new truck rack will require a flow of 8,440 litres per minute (2,250 usgpm). The Jet Fuel system will provide flow to five (5) loading arms on Rack 2. Based on the increased flow requirement the existing loading pump and pipelines are not suitable for re-use.

A new Jet Fuel loading pump (P-NEW4) will be installed near Tank 524 to supply the new truck rack. The pump operating point determined during preliminary design is 8,440 litres per minute at a total dynamic head of 94 meters (307 ft). The preliminary motor size is estimated to be 200 HP. The consultant shall determine the final operating point and horsepower during detailed design.

The new Jet Fuel Pump will require a new 10" suction line from tanks 523 and 524. This suction line will connect to the tanks through an existing manway. The manway covers on each tank will be modified to accommodate two (2) connections. One of these connections will be the new suction line and the other will be an existing 6" line. The existing 6" line will need to be modified to make physical space for the new connection. A new discharge pipeline from the new pump to the new truck rack will be required.

The existing Loading Rack is supplied with Jet Fuel by pump P-5142. This pump is to remain in service until the new truck rack is commissioned and ready for service. When this switch occurs, pump P-5142 will be tied into the new supply pipeline to the new truck rack. This will allow pump

P-5142 to provide reduced flow to the truck rack if the new pump is out of service.

2.2.4 Low Sulphur Diesel Fuel System

The Low Sulphur Diesel Fuel system will deliver product from tanks TK-521 and TK-522 to the new truck rack. The existing system supplies the existing truck rack at a flow rate of 2,250 litres per minute (600 usgpm) from Tank 518. The new truck rack will require a flow of 4,500 litres per minute (1,200 usgpm). The LSD system will initially provide product to only two (2) arms on Rack 1. The pump, driver and piping will, however be sized to provide product to all diesel arms (Low and High Sulphur) on the two loading racks to meet the future requirement when High Sulphur Diesel is eliminated.

A new Low Sulphur Diesel Fuel loading pump (P-NEW3) will be installed near Tank 522 to supply the new truck rack. The pump operating point determined during preliminary design is 8,440 litres per minute at a total dynamic head of 92 meters (300 ft). The preliminary motor size is estimated to be 200 HP. The consultant shall determine the final operating point and horsepower during detailed design. The new pump will be located outside the dike near tank TK-522.

The new pump will require a new 10" suction line from tanks TK-521 and TK-522. These suction lines will connect to the tanks through the existing manways. The manway covers on each tank will be modified to accommodate two (2) connections. One of these connections is the new suction line and the other is an existing 6" line. The existing 6" line will need to be modified to make physical space for the new connection. A new discharge pipeline will be required from the new pump to the new Loading Rack.

2.2.5 High Sulphur Diesel Fuel System

High Sulphur Diesel Fuel will be supplied to the new truck rack from Tank 518. High Sulphur Diesel will be delivered to the refinery by tanker and supplied to Tank 518 from the jetty. The existing system supplies the existing truck rack at a flow rate of 2,250 litres per minute (600 usgpm) from Tank 518. The new truck rack will require a flow of 6,800 litres per minute (1,800 usgpm). The HSD Fuel system will provide flow to one (1) loading arm on Rack 1 and three (3) loading arms on Rack 2. Based on the increased flow requirement the existing loading pump and pipelines are not suitable for re-use.

A new High Sulphur Diesel Fuel loading pump (P-NEW5) will be installed near Tank 518 to supply the new truck rack. The pump operating point determined during preliminary design is 6,800 litres per minute at a total

dynamic head of 99 meters (323 ft). The preliminary motor size is estimated to be 200 HP. The consultant shall determine the final operating point and horsepower during detailed design.

The new pump will require a new dedicated suction line from Tank 518. The new suction line will be tied into an existing suction line near the tank nozzle. A new discharge supply line will be routed from the new pump to the new Loading Racks. The new supply line shall be tied into the existing salt filter (D-5104) located north west of Tank 518. The ability of the existing salt filter to handle the increased flow shall be assessed by the consultant during detailed design.

The existing Loading Rack is supplied with Diesel Fuel from Tank 518 by pump P-5141. This pump is to remain in service until the new truck rack is commissioned and ready for service. When this switch has occurred, pump P-5141 will be tied into the new discharge pipeline to the new truck rack. This will allow pump P-5141 to provide reduced flow to the truck rack if the new pump is out of service.

2.3 General

The criteria/considerations described below shall be included.

2.3.1 Site Conditions

Design Temperatures at Site per the National Building Code of Canada are as follows:

- Extreme Low -25 C
- Design Low -22°C
- Extreme High 25 C
- Design High 21°C

Design metal temperatures shall be as determined using the methodology of the applicable design codes.

2.3.2 Maximum Operating Pressure

Due to the pressure limitations of Loading Rack components, the system shall be designed to operate at no more than 140 psi at upset conditions. Upset Conditions shall include tanks full of product and pumps at minimum flows (i.e. backed up on their operating curves).

All piping and equipment shall be protected from over pressure caused by thermal expansion by the installation of thermal safety valves (TSV's) to prevent pressure accumulation in any portion of piping potentially isolated between valves. TSV's shall cascade overpressure back to the product

storage tank. The selection of TSV set points shall consider the above maximum operating pressure.

2.3.3 Piping Material Specifications

Project Specific Piping Specification shall be developed for the project and shall be in accordance with ASME/ANSI B31.3.

- Flange Class 150 except Class 300 at pumps
- Corrosion allowance 1/16"
- Piping 1½" diameter and smaller shall be socket weld
- Use Schedule 160 pipe where required for threaded equipment connections
- Piping 2" diameter and larger shall be butt welded
- Piping shall be ASTM A-106 Grade B or ASTM A53 Grade B depending on service

2.3.4 Pump Motors

Pump motor power shall not exceed the motor nameplate rating at any point within the expected operating range. The pump motor power shall not exceed the nameplate rating plus service factor at any point on the operating curve. All pump motors shall be suitable for operation with variable frequency drives.

3.1 Truck Loading Terminal

3.1.1 General

Refer to the Truck Loading Rack P&ID's and the Control System Block Diagram for the Instrumentation & Controls equipment required for the new truck loading terminal. Generally, the instrumentation and controls equipment required shall be such as to permit truck loading of the various products, 24 hours a day, 7 days a week, in an unattended truck loading facility, and to provide the owner with the required operations/accounting information.

Rack Operation

A truck driver will approach the entrance gate, and swipe his card through the entrance gate badge reader. After being recognized by the Terminal Automation System (TAS) as a valid driver, the entrance gate will open, and the driver can enter the staging area. The driver then moves to the first available loading position for the product/products required, connects to the loading position Ground Service Unit, swipes his card through the rack badge reader, types in the required quantity of product/products into the Load Control Unit, and with the approval of the TAS, then proceeds to load the approved product/products. After loading is complete the driver then proceeds to the exit staging area, enters the controls Kiosk, swipes his card through the bill of lading (BOL) printer badge reader, the TAS prints the BOL, and the driver is free to leave the facility via the exit gate.

Controls

Refer to the "Control System Block Diagram", Drawing D-1364-2XXX-1, for the proposed truck loading terminal control system architecture. The main components are as follows:

- Terminal Automation System. This system tracks the drivers/trucks entering the facility, monitors the truck loading, prints the BOL's, produces operations and accounting reports, and monitors additive tank level inventories.
- Terminal PLC. This PLC is used to gather any miscellaneous terminal information, perform miscellaneous terminal I/O logic, and is to be used to communicate the required "product pump start/stop status" information back to the main Refinery DCS (via fibre communications).
- Rack mounted Load Control Units (refer to section 3.1.2 on Loading Racks).
- Terminal Crash System. This system will stop the main product flows by closing motor operated valves located on the main

incoming product lines, and remove 120 VAC power from the Loading Racks in the event that someone activates one of the six Emergency Stop pushbutton stations, to signal an emergency condition.

The truck loading terminal shall communicate any required information to the main refinery DCS control system (Honeywell TDC-3000) via a fibre communications link.

3.1.2 Loading Racks

There are two Loading Racks, with a loading position on each side, for a total of four loading positions. There are five loading arms on each rack, each of which can be moved to either loading position for that rack. Each Loading Rack will have the following controls equipment:

- Two Load Control Units to control the truck loading operation. Two per rack are proposed for redundancy purposes. If one fails, the rack is not shut down. Loading can still be done from the remaining Load Control Unit. Rack product arm assignment shall be split between the two Load Control Units such that the loss of one of the Load Control Units does not eliminate the ability to load any one product.
- Two Ground Service Units, used for truck identification, grounding, and overfill protection. One for each loading position.
- Two Rack Crash Buttons to stop product flow, and remove 120 VAC power from both Loading Racks. One located at each end of the Loading Rack.
- One Badge Reader to permit truck loading via the Terminal Automation System located beside one of the Load Control Units.
- Additive Injectors (see Additive section).

Each Load Control Unit, Ground Service Unit, and Badge Reader will communicate via serial link to the Terminal Automation System (TAS) for truck loading authorization, product monitoring, and bill of lading printing. In the event of a problem with the TAS, a locked cabinet located in the electrical room will contain "Override Switches", one for each Load Control Unit, to override the TAS permissive required for truck loading. The required main product pump start/stop signals, from the Load Control Units, are hardwired back to the Terminal PLC to be communicated to the refinery DCS system, to start and stop the required product pumps. The required additive pump start/stop signals, from the Load Control Units, are hardwired back to the Terminal MCC to start and stop the required additive pumps. The Load Control Units also communicate to the additive injectors as required.

Each loading position will have access to all five loading arms. Each loading arm will have the following instrumentation:

- Flow control valve
- Positive displacement type flow meter
- 4-wire RTD
- Test well
- Electrically actuated block valves with limit switches on sequential blending or multi-product arms (five sequential blending or multi-product arms in total)
- Additive injectors as required (see Additive section)
- Arm position limit switches to determine which loading position each arm is in

All instrumentation for each loading arm shall be wired to its corresponding Load Control Unit using armoured Instrumentation cables.

3.1.3 Additive Systems

Tank Instruments

Each additive tank is to be equipped with a level transmitter, and leakage detection sensor, to be wired back to an additive tank level monitoring system. The level monitoring system shall then communicate additive tank level status and alarms back to the Terminal Automation System, which shall monitor additive tank inventories. Each additive tank shall also be equipped with a high level displacer type switch which will turn off its associated additive truck offloading pump to prevent overfilling of the additive tanks. In the cases where no truck-offloading pump exists, the tank high-level switch will turn on a light and horn to notify personnel that the tank is full.

Injector Pumps

The additive injector pumps shall be started directly from the load control units (hardwired) when requested (with associated motor starter selected to "AUTO"). Each injector pump motor starter shall be equipped with "H/O/A" selector switches to facilitate manual operation, as well as having a "Pump A/B" selector switch to select the duty pump for each additive.

Injectors

The additive injectors required for the loading arms will be 316 SS construction, injector block type with integral solenoid and flow meter. The injectors required for each Loading Rack will be mounted in 316 SS enclosures, and located on their corresponding Loading Racks.

The injectors will be wired to their corresponding Load Control Units via serial communication. All injector tubing will be 316 SS.

Each dye injection line will also be equipped with an automated shut-off solenoid at the injection point to prevent contamination of batches not requiring dye. These solenoids will be controlled directly from the Load Control Units.

Conductivity Additive

The conductivity additive shall be injected into the Jet, Isomax, LSD, & HSD supply lines, just downstream of their respective filters. Turbine flow meters shall monitor incoming flow rates, which will be wired to a flow controller with integral injector block assembly, to meter the appropriate amount of additive to their associated supply lines.

3.1.4 Slop System

The Slop Tank will collect flow from the product line filters/separators, and from the slop pumps located at each Loading Rack. The collection line from the filters/separator air eliminators shall be fitted with a flow switch and a shutoff solenoid. A continuous flow in the Filter/Separator air eliminator line indicates a failure of an air eliminator head and requires that the flow be shutdown. In the event that a flow is detected for a predetermined amount of time, the Terminal Crash System will be activated, and the shutoff solenoid will be closed. The shutoff solenoid will be re-opened once the Terminal Crash System has been reset and the reason for the Crash has been determined and corrected.

The Slop Tank will also be fitted with a displacer type-high tank level switch, which will also activate the Terminal Crash System if a high level is detected in the Slop Tank.

3.1.5 Vapor Recovery System

The Vapor Recovery System will be a packaged system, and used on Loading Rack 1 only. The system shall be wired to dry contacts at the Loading Rack Ground Service Units, indicating a truck is ready for loading, to start/stop the Vapor Recovery System accordingly. The Vapor Recovery System "running," will also be a permissive for loading. This will be assured by having a vapor flow sensing system located at the Loading Rack.

3.1.6 Terminal Crash System

The Terminal Crash system will be activated if any one of the following occurs:

- Activation of any one of the six Emergency Stop pushbuttons. Two are located at Loading Rack 1, two are located at Loading Rack 2, one is located in the controls Kiosk, and one is located on the Crash System panel in the Electrical Building.
- A high level is detected in the Slop tank.

- A high flow is detected going into the Slop tank from the filter/separators for more then a predetermined amount of time.

Activation of the Crash system closes all of the incoming product line motor operated valves, and turns off all 120 VAC power to the Loading Rack controls equipment. A "crash system initiated" warning light is also activated (located on outside of electrical room). To restore normal facility operation, an operator needs to hit the "Reset" pushbutton located on the Terminal Crash System control panel.

3.1.7 Motor Operated Valves

Incoming product line motor operated valves (MOV's) shall be fire safe, high performance butterfly shut-off valves complete with 600 VAC electric actuators, fail in last position, with lockable Local/Remote and Open/Off/Close selector switches, and complete with manual override hand wheels.

3.1.8 Truck Loading Terminal Miscellaneous

Electrical Room

The new truck loading terminal electrical room will contain all of the new controls equipment:

- Terminal Automation System Hardware.
- Terminal PLC Control Panel.
- Terminal Crash Panel.
- Additive Tank Monitoring Controller
- Vapor Recovery Control Panel
- TAS "Override Switch" Panel.

Kiosk

The new truck loading terminal controls kiosk will contain the following controls equipment:

- TAS Operator Interface Station
- Badge Reader for BOL Printer
- BOL Printer
- TAS Report Printer

Truck Gates

There will be a gate entry badge reader before the entry gate that will open the gate for incoming drivers. The gate exit will be controlled with vehicle detection loops.

3.2 Refinery Offsites Upgrades

3.2.1 General

Refer to the "Offsite and Storage Facilities" P&ID's for the Instrumentation and Controls equipment required within the "Refinery Offsite" area, to provide the required product flows to the new truck-loading terminal.

Generally, when a truck driver requests a product from the new truck loading terminal, the following shall occur: a dry contact signal is closed in the associated load control unit, which is wired to a digital input on the new loading terminal PLC cabinet. From the terminal PLC cabinet, the signal is communicated to the existing refinery TDC-3000 control system via a fiber cable communications link. From the refinery TDC-3000 control system, this signal is transferred to a digital output signal, and then hardwired to it's associated substation. There is some existing wiring in place now with some spare digital signals available. These shall be utilized for any digital I/O required in substations #6 and #9. Substation #8 I/O requirements shall be handled through a new TDC-3000 remote I/O panel (referred to in section 3.2.2 below). This digital output signal shall be wired to its associated new product supply pressure loop controller (refer to P&ID's). There shall be a separate digital output signal for every loading arm in operation for a particular product. For example, there are two loading arms for Regular Gasoline, so there would be two digital outputs required from the TDC-3000 that would be wired to it's associated product supply pressure loop controller. If anyone of these signals is activated, the loop controller will activate a digital output signal, which shall open the requested product pump suction line Motor Operated Valve (MOV). Once the MOV is opened, the requested product pump motor starter shall be enabled via an "opened" limit switch on the MOV (with the requested product pump motor starter in "Auto").

The product pump motors shall be equipped with variable frequency drives (VFD), and the speed of the pumps shall be varied to control the pump supply pressure at a predetermined set-point value. To accomplish this, a pressure transmitter will be installed on the product pump outlet piping, and wired back to a standalone product supply pressure loop controller, located in it's associated substation building. The supply pressure set-point value required will vary depending on the number of product arms in operation, for a particular product, at any one time. The higher the number of product arms in operation for a particular product, the higher the discharge pressure required to overcome the increased piping pressure losses (due to the increased flow demand). Therefore, the pressure loop controller will need to know how many product arms, for a particular product, are in operation at any one time, and to change the discharge

pressure set-point accordingly. This will be accomplished by providing the loop controller with as many digital input signals from the TDC-3000, as there are product arms available for a particular product (refer to description in paragraph above). The actual number, and value, of the pressure set-points required for each product will be determined during the detailed design.

When the new Truck Loading Rack no longer requires product flow, the truck loading terminal load control unit "product pump start" dry contact signal is opened, thus the digital output signal from the TDC-3000 holding the product tank MOV open is opened, and the product tank MOV closes. When the MOV opened limit switch is lost, the product pump motor starter is disabled. During this time, the product pump VFD will drop the motor speed to zero (no longer required to maintain a supply pressure).

Provision shall also be made to open/close the pump suction line MOV, and to start/stop the product pump locally when required. To accomplish this, the MOV's shall be supplied with locally mounted lockable Local/Remote and Open/Off/Close selector switches, and the product pump motor starters shall be supplied with a H/O/A selector switch with a field mounted start/stop pushbutton station (complete with speed pot for variable frequency drive motors).

3.2.2 Refinery Controls Infrastructure

The existing refinery Distributed Control System (DCS) is a Honeywell TDC 3000 system. In order to accommodate the new refinery tank field I/O required for this project, one new TDC 3000 remote I/O panel will be required, and shall be located in the new addition to substation #8. The new remote I/O panel shall be tied to the existing refinery communications network via a fiber cable link. An existing refinery communications network fiber interface junction box is located in substation #9. The design of the new TDC 3000 remote I/O panel shall conform to the existing remote I/O panels. The refinery communications protocol shall be confirmed during detailed design.

All TDC 3000 logic additions/changes, and any refinery HMI additions/changes, required to accommodate the new tank field I/O, and the new Truck Loading Rack I/O, shall be done by refinery personnel, in close coordination with the design Engineer.

3.2.3 Isomax Kerosene

Refer to "Offsites and Storage Facilities" P&ID drawing number 30.0051-1X (10 of 16), and section 3.2.1 above, for the instrumentation and controls equipment required to accommodate the changes to the Isomax Kerosene system to facilitate the new supply requirements of the new truck-loading

terminal. The motor starter required for the new Isomax Kerosene product pump feeding the new Truck Loading Rack shall be located in the existing substation #6. All Isomax Kerosene related field instrumentation and control wiring shall be brought into a new substation #6 "Isomax junction box", which will also house the new Isomax supply pressure loop controller. From this new junction box, all required I/O interface wiring with the TDC 3000 system shall be hardwired back to the TDC-3000 Via the existing substation #6 marshalling panel #MB6 (existing spare digital I/O available).

3.2.4 Jet Fuel

Refer to "Offsites and Storage Facilities" P&ID drawing number 30.0051-1X (6 of 16), and section 3.2.1 above, for the instrumentation and controls equipment required to accommodate the changes to the Jet Fuel system to facilitate the new supply requirements of the new truck loading terminal. The motor starter required for the new Jet Fuel product pump feeding the new Truck Loading Rack shall be located in the new addition to substation #8. All Jet Fuel related field instrumentation and control wiring shall be brought into a new substation #8 "Jet Fuel junction box", which will also house the new Jet Fuel supply pressure loop controller. From this new junction box, all required I/O interface wiring with the TDC 3000 system shall be hardwired to the new TDC-3000 remote I/O panel, also located in the new addition to substation #8.

The Jet Fuel system has two storage tanks (TK-523 & TK-524), only one of which can be used at any one time. Each tank will have its own suction line MOV. The "Open MOV" control signal will be wired in parallel to both valves, therefore, to prevent the MOV on the inactive tank from opening, the operator will be required to "lock-out" the 600VAC power supply to the inactive tank MOV at its associated MCC breaker (refer to the Electrical Single Line drawings).

3.2.5 Low Sulphur Diesel Fuel (LSD)

Refer to "Offsites and Storage Facilities" P&ID drawing number 30.0051-1X (6 of 16), and section 3.2.1 above, for the instrumentation and controls equipment required to accommodate the changes to the Low Sulphur Diesel Fuel system to facilitate the new supply requirements of the new truck loading terminal. The motor starter required for the new LSD product pump feeding the new Truck Loading Rack shall be located in the new addition to substation #8. All LSD related field instrumentation and control wiring shall be brought into a new substation #8 "LSD junction box", which will also house the new LSD supply pressure loop controller. From this new junction box, all required I/O interface wiring with the TDC 3000 system shall be hardwired to the new TDC-3000 remote I/O panel, also located in the new addition to substation #8.

The LSD system has two storage tanks (TK-521 & TK-522), only one of which can be used at any one time. Each tank will have its own suction line MOV. The "Open MOV" control signal will be wired in parallel to both valves, therefore, to prevent the MOV on the inactive tank from opening, the operator will be required to "lock-out" the 600VAC power supply to the inactive tank MOV at its associated MCC breaker (refer to the Electrical Single Line drawings).

3.2.6 High Sulphur Diesel Fuel (HSD)

Refer to "Offsites and Storage Facilities" P&ID drawing number 30.0051-1X (5 of 16), and section 3.2.1 above, for the instrumentation and controls equipment required to accommodate the changes to the High Sulphur Diesel Fuel system to facilitate the new supply requirements of the new truck loading terminal. The motor starter required for the new HSD product pump feeding the new Truck Loading Rack shall be located in the new addition to substation #8. All HSD related field instrumentation and control wiring shall be brought into a new substation #8 "HSD junction box", which will also house the new HSD supply pressure loop controller. From this new junction box, all required I/O interface wiring with the TDC 3000 system shall be hardwired to the new TDC-3000 remote I/O panel, also located in the new addition to substation #8.

3.2.7 Regular Gasoline

Refer to "Offsites and Storage Facilities" P&ID drawing numbers 30.0051-1X (8 of 16) and (16 of 16), and section 3.2.1 above, for the instrumentation and controls equipment required to accommodate the changes and additions to the Regular Gasoline system to facilitate the requirements of the new truck loading terminal. A new Regular Gasoline storage tank (TK-NEW1) shall be constructed to supply the new truck loading terminal. This is required because the existing Regular Gasoline storage tank (TK-413) can be out of service for up to three or four days while a new batch is being processed. The new tank #TK-NEW1 shall be filled from the existing tank #TK-413 by using the existing tank discharge pump P-5140, as long as there is usable product in tank #TK-413. An operator from the control room shall initiate the tank filling operation.

The motor starter required for the new Regular Gasoline product pump feeding the new Truck Loading Rack from the new Regular tank #TK-NEW1, shall be located in the new addition to substation #8. All related pump and storage tank field instrumentation and control wiring shall be brought into a new substation #8 "Gasoline junction box". From this new junction box, all required I/O interface wiring with the TDC 3000 system shall be hardwired to the new TDC-3000 remote I/O panel, also located in the new addition to substation #8.

3.2.8 Vapour Recovery

Refer to "Offsites and Storage Facilities" P&ID drawing number 30.0051-1X (16 of 16), and section 3.2.1 above, for the instrumentation and controls equipment required for the new Vapor Recovery system requirements to facilitate the requirements of the new Truck Loading Terminal. The motor starter required for the new Vapor Recovery system Regular Gasoline supply pump feeding the new Truck Loading Rack shall be located in the new addition to substation #8. All Vapor Recovery related field instrumentation and control wiring shall be brought into the new substation #8 "Gasoline junction box". From this new junction box, all required I/O interface wiring with the TDC 3000 system shall be hardwired to the new TDC-3000 remote I/O panel, also located in the new addition to substation #8.

3.3 Miscellaneous

3.3.1 Hazardous Area Classification

All field mounted instrumentation and controls equipment shall be rated for their applicable hazardous area classification, as specified on the electrical drawings. Field mounted equipment enclosure ratings shall be NEMA 4X as a minimum.

3.3.2 Instrumentation and Controls Cabling

All instrumentation and controls cabling shall be armoured instrumentation cables.

Chapter 4 Electrical

4.1 Power Distribution

Preliminary substation loading including the new loads has been found to be acceptable by NARL but shall confirmed during detail design.

4.1.1 Truck Loading Terminal

The North Atlantic Refining Limited's new Truck Loading Terminal will be fed from the existing 600V 1600A Allen Bradley Centerline 2100 MCC located in SUB 9. The existing MCC was measured to be carrying a load of approximately 425A. A new 400A main circuit breaker will be added to the existing MCC to feed a new truck loading MCC in the new Electrical Building of the Truck Loading Terminal.

The new truck loading MCC will be rated 600V, 1200A, 3-phase, 3-wire, with an 800A main circuit breaker with a 400A trip.

The MCC will feed all 600V motors associated with truck loading within the terminal:

- 4 x 1 HP Additive loading pumps located at the truck offloading pad.
- 10 x 2 HP Additive Injection pumps located at the additive systems pad.
- 1 x 7.5 HP Slop tank pump located at the additive systems pad.
- 1 x 0.5 HP dye tank mixer located at the additive systems pad.
- 1 x 0.5 HP Conductivity additive mixer located at the additive systems pad.
- 2 x 1.5 HP Slop pump located at the loading apron.
- 5 x 1 HP MOV's located at the MOV pad, located just inside the terminal fence.

The Vapour Recovery Unit (VRU) will be fed by a 150A breaker in the MCC. The VRU Control Panel will be located in the electrical room and will feed the following motors:

- 1 x 50 HP vacuum pump located on the Vapour Recovery pad.
- 1 x 5 HP absorbent pump return located on the Vapour Recovery pad.
- 1 x 2 HP pump located on the Vapour Recovery pad.
- 8 x 1 HP MOV located on the Vapour Recovery pad.

The VRU Control Panel will be supplied with the VRU but wired by the installation contractor.

The MCC will also feed 3 panels:

- One 225A, 66 cct, 120/208V panel, fed via a 45 kVA, 600-120/208V transformer. This transformer and panel is located in the electrical room and also feeds a 100A, 24 cct, 120/208V panel located in the Kiosk. These panels will feed instrumentation, lights, receptacles and miscellaneous loads in the electrical room, Kiosk and on the site.
- One 100A, 30 cct, 347/600V panel, fed via a 15 kVA, 600-347/600V transformer. This transformer and panel are located in the electrical room. The panel feeds yard lights and miscellaneous loads around the site.
- One 10.5 kVA UPS panel fed via a 15 kVA, 600-120/208V transformer. This transformer and UPS panel are located in the electrical room. The UPS panel feeds the control panel for the CRASH system, the CCTV cameras, multiplexer, DVR and monitor.

Drawing D-1264-2XXX-1 Revision A details MCC loads.

4.1.2 Offsites Substation #6 (Isomax Kerosene System)

Substation 6 will service the following new load:

- 1 x 150 HP Isomax Kerosene pump.
- 1 x 1 HP (approx) MOV for Isomax Kerosene Tank 342.

The pump motor will be fed from a variable frequency (speed) drive (VFD) to allow product flow control and to limit shock loading during pump starts and stops.

The existing MCC lineup in substation #6 does not have adequate space to contain the new VFD required for the 150 HP Isomax Kerosene pump. To address this problem a new 2400 A, 600 V MCC will be installed to service all the existing loads and the new VFD as well. The new MCC is anticipated to be smaller than the existing due to design changes in MCC's since the installation of the existing MCC. This will allow the addition of the VFD in the same MCC footprint.

The loads serviced by the existing MCC #6 cannot be interrupted for any period of time. To allow a changeout of MCC #6 additional MCC sections and a generator will be provided. These temporary MCC sections and generator will feed the MCC #6 loads during the period of time MCC #6 is being replaced. Temporary cables will be required to run between the loads termination points at MCC #6 and the temporary MCC.

Modifications to the MCC are detailed on drawing D-1200-4 Revision A.

4.1.3 Offsites Substation #8 (Diesel, Jet, New Tank Regular Gas System, and Vapor Recovery)

Substation #8 will be the service point for the following new motors:

- 1 x 200 HP Low Sulfur Diesel pump for tanks 521-522.
- 1 x 200 HP Jet pump for tanks 523-524.
- 1 x 125 HP Regular Gas pump for a new tank.
- 1 x 200 HP High Sulfur Diesel pump for tank 518.
- 1 x 15 HP gas vapour recovery pump.
- 9 x 1 HP (approx) MOVs for associated MOV's for above products.

The pump motors will be fed from a variable frequency (speed) drives (VFD) to allow product flow control and to limit shock loading during pump starts and stops.

The existing motor control centre #8 at substation #8 has inadequate space for these new VFD's. A new 20' x 20' electrical building will be constructed adjacent to the existing substation #8 to house a new 1200 A, 600 V MCC fed from MCC #8. A new 1000 A fusible disconnect or circuit breaker will be installed in MCC #8 as a connection point for this new MCC. The new building will also house marshalling cabinets for the control system.

The building will be a prefabricated metal building prewired complete with all services. This will include all transformers, distribution panels, lights, heating and receptacles. The source for all building power will be the new MCC. The new MCC and marshalling cabinets will be installed in the building prior to arrival at site such that only connection of the main MCC feed and motor loads will be required at site to complete the installation.

Modifications to the MCC are detailed on drawing D-1200-43F Revision A.

4.1.4 Offsites Substation #9 (Truck Loading Rack Feeder)

Substation #9 will service the following load:

- 1 x 400 A feeder for Truck Loading Rack MCC.

Substation #9 has recently been expanded with new 600V switchgear and a new Allen Bradley MCC #9B. The 400 A feeder to the Truck Loading Rack MCC will be installed in this Allen Bradley MCC.

Modifications to the MCC are detailed on drawing D-1200-52 Revision A.

4.2 Motor Control Centers

Motor control centers, MCC equipment and sections will be rated for the calculated bus load and the fault current at each location.

Variable frequency drives shall be housed inside MCC sections complete with input and output filters to limit harmonics and voltage spikes to motor loads.

4.3 Cables and Raceways

All of the distribution at North Atlantic Refining Limited will use 1000V aluminum armored Teck90 cable. All cables used will be rated for hazardous locations with rated terminations. The Teck cables will be in cable tray. The cable tray will be hot dipped galvanized B-line cable tray. All cables in cable tray have been de-rated by an ampacity correction factor of 0.5 to account for the number of cables present in the tray.

The installation of new underground cables will avoid disturbing the existing underground 13.8 kV main power loop to the substations.

New main cable tray will be installed on top of the Truck Loading Rack pipe bridge, and branches will extend off the main tray to feed the various motor loads.

New cable tray will be installed at the offsite substations to extend or increase the capacity of existing tray. As well, some damaged existing tray may need to be replaced.

The new cable tray will be supported from the pipe supports and with dedicated cable tray support pedestals to limit cable tray spans. No cable tray will be supported directly from process piping.

Complete new runs of cables and cable tray will be required between substation #9 and the new Loading Rack.

New cable and tray will also be required from the location of the new regular tank to substation #8 with a new road crossing required. New cable and tray or duct will also be required from the existing substation #8 to new substation #8 extension building.

A combination of new and existing tray will be required for the new cables for the Isomax Kerosene pump motor from substation #6.

Complete determination of new and existing tray and supports and entries into existing substations will be carried out during detail design.

Control and instrumentation cables will be separated from power cables, either by using separate cable trays or placing a barrier between the two.

4.4 Grounding

All cable trays will be grounded throughout their runs. Motors will be grounded at their base and through the feeder conductors. Product pipes will be grounded at the rack. A ground inspection point will be located at each Rack. There will be a static ground system to ground the trucks at the Loading Rack before loading.

The new electrical building at substation #8 shall have a perimeter ground loop and be connected to the offsite ground grid.

Conductors shall be minimum #2/0 AWG for main ground loop and #2 AWG from all branch connections to equipment and structures.

4.5 Hazardous Locations

Offsite area classification shall be as indicated on drawings "Area Classification Offsite (North) 59-1200-8" and "Area Classification Offsite (South) 30-1200-7M".

The following locations at the Truck Loading Rack shall be classified as a Class 1, Division 1 hazardous locations:

- All catch basins that flow into the oil-water separator.
- Within a 36" sphere around truck vents.
- Within a 60" sphere around all vents on the additive tanks.

All equipment located in these areas is to be rated for a Class 1, Division 1 hazardous location.

The following locations at the Truck Loading Rack shall be classified as a Class 1, Division 2 hazardous locations:

- The Loading Apron.
- The Truck Offloading Pad.
- The Vapor Recovery Pad.
- The Additive Systems Pad.
- The Filters Pad.
- The MOV's Pad.
- The area extending between 36" and 60" of a truck vent opening and extending in all directions.
- The area extending between 60" and 177" of all additive tank vent openings and extending in all directions.

All equipment located in these areas is to be rated for a Class 1, Division 2 hazardous location.

4.6 Truck Loading Terminal Yard / Offsites Lighting

The North Atlantic Refining Limited's new Truck Loading Terminal will have yard lights located approximately every 200 feet around the exterior of the site. The yard lights will be mounted on a 30' long galvanized steel 6" square pole (2 fixtures per pole, except at the entrance where there will only be one fixture the pole). Each light pole will be mounted on a concrete foundation. The light level in the yard was designed to be 1 footcandles. At the Loading Rack, there will be 8 (one in each corner of each of two racks) fixtures built onto the pipe rack. The light level at the Loading Racks will be designed to be 10 footcandles.

The light fixtures will be, 400W metal halide flood type. A 4-pole lighting contactor located in the electrical room will control the yard lights. The lighting contactor will be equipped with a hand-off-automatic selector switch. The automatic signal will come from a photocell located on the roof of the electrical building pointing north. The yard lights will be fed by a 100A, 347/600V panel located in the electrical room.

The new regular tank area will have three new yard lights on poles to illuminate the area around the tank.

4.7 Truck Loading Terminal Closed Circuit TV System

The North Atlantic Refining Limited's new loading facility will be monitored by 6 CCTV cameras. One camera will be located in each of the following locations:

- Exit Gate.
- Entrance Gate.
- Loading Apron Rack 1, Loading Position 1.
- Loading Apron Rack 1, Loading Position 2.
- Loading Apron Rack 2, Loading Position 3.
- Loading Apron Rack 2, Loading Position 4.

Each camera will be stationary (no pan-tilt-zoom) and will be enclosed in a housing complete with heater. The cameras will be powered by a 120-24V power source located in the Kiosk. This 120-24V power source shall be fed by a 10.5 kVA UPS power source located in the Terminal electrical room.

The cameras will be connected to a Digital Video Recorder (DVR) located in the Kiosk. RG6U coax cables will be used to connect the cameras to the

DVR. The DVR will have 250 Gb recording memory. The DVR will provide storage capacity for continuous 48 hours of recording. The DVR will send the signal onto a monitor located in the Kiosk. The DVR and monitor will all be fed from the 10.5 kVA UPS panel located in the electrical room.

4.8 Truck Loading Terminal Entrance and Exit Automatic Gate Controllers

There will be 2 automatic gate controllers at The North Atlantic Refining Limited's new Truck Loading Terminal. One will be located at the entrance gate, the other at the exit gate. Each controller will control a 20' sliding gate. The gate controller will control a 1/3 HP motor, which will slide the gate open. A 100A 120/208V panel in the Kiosk will feed the controller and motor.

Both gate controllers will be equipped with a pressure sensor on the end of the gate and two photo eyes located at either end of the gate to prevent the gate from closing when there is an obstruction in the gates path. The gate controller will also be equipped with a safety loop on the inside of the fence, and one on the outside of the fence to detect trucks. The gate controller at the entrance will also be equipped with a card reader on a pedestal. The truck drivers will use their unique cards to gain entry to the site. There will also be an Emergency Stop pushbutton stations and keyed switch to override located at both gates.

5.1 Truck Loading Terminal Upgrades

5.1.1 Yard Preparation (Field to Asphalt)

The new site will be grubbed to ensure that all organic material is removed. As per the geotechnical investigation, the existing glacial till material must be excavated out to a minimum depth of 1.0 metres below the final design grades. The till shall be replaced with structural blast rock. Once this till material is removed, the resulting surface must be proof-rolled to ensure that no soft areas exist. If soft areas are found to exist, they must be removed and replaced with structural blast rock. The structural blast rock will be overlain by a minimum of 400 mm of well-graded gravels.

It will be assumed that all paved areas could potentially be subjected to heavy traffic loads. The paved areas will be designed with 100 mm of asphalt. All pavements and granular materials will be specified to the standards of Newfoundland and Labrador's Municipal Specifications.

Any areas that will not be subjected to vehicular travel will be finished with a compacted gravel surface. This includes the area to the north of the existing employee parking lot, which will be used primarily for storage of snow from plowing activities.

5.1.2 Fire Water System

The firewater protection system will be an extension of the existing system, which is located adjacent to the new terminal site. One connection will be made at the Employees Parking Lot on the main supply to the Refinery, and a second connection made to the north of the new terminal, on the butane facility site. These connections will create a loop in the system, ideal for flushing and system flexibility.

The fire water main will be made up of ductile iron piping and fittings. There will be several fire hydrants installed around the perimeter of the terminal yard, complete with isolation gate valves and fixed monitors. These fire hydrants will be protected from truck traffic with 200 mm diameter steel pipe bollards, filled with concrete and painted safety yellow.

5.1.3 Oily Water Sewer System

Storm water and potential leakage resulting from petroleum product transfer operations will be collected in the new oily water sewer system. The system will be comprised of a series of catchbasins, which will be installed in the various concrete environmental slabs. These catchbasins will connect to a buried piping system, which will drain by gravity through

a coalescing oil-water separator before discharging onto refinery property south of Refinery Road. The oil/water separator will be a single-wall fibreglass structure, which conforms to ULC-S615. A ductile iron post-indicator valve will be installed downstream of the oil/water separator, which can be used to close the gate valve, in case of a major spill. The oil/water separator will be design to meet provincial environmental guidelines of 15 ppm of oil in the effluent.

A new truck off-loading facility will be constructed adjacent to the terminal yard. The new facility will allow trucks to align themselves on a concrete pad in order to unload product into the tanks. A new reinforced concrete pad will be installed beneath the nozzle connections to serve as an environmental containment pad. The concrete pad will have a containment curb (speed bump construction) on four sides and will drain to a precast concrete catchbasin. The sewer piping will drain into the oily water sewer system.

5.1.4 Storm Water Management

Storm water on site will be predominantly handled overland. It is the intent to slightly build up the site, resulting in the ability to grade the terminal toward the existing ditch system along the Refinery Road.

5.1.5 Kiosk Potable Water

Water service will be supplied from the existing refinery water system. The tie-in will be located under the Employee Parking Lot east of the proposed kiosk. The water supply will be a 25 mm diameter high-density polyethylene pipe, complete with a curb stop to allow for isolation of the water service.

5.1.6 Kiosk Sanitary Sewer

Sanitary sewer service will be required only at the kiosk building. The sewer line from the building will drain by gravity into a nearby holding (septic) tank. This tank must be pumped out periodically by a vacuum truck, and must be fitted with an alarm, which indicates high liquid levels. This design philosophy will be subject to approval by the Newfoundland and Labrador Department of Environment.

In addition, waste oil from the kiosk's lab facility will be drained into a separate waste stream and into another underground storage tank. The tank will hold the lab waste until it can be removed by a vacuum truck and returned to the Refinery. The tank will be constructed of double-wall fibreglass, complete with sensors to indicate high internal liquid levels.

5.1.7 Site Security Fencing and Gates

To maintain site security, a 2.4 m high chain link fence, complete with barbed wire, will be installed around the perimeter of the terminal. To protect the fence, guide rail will be installed at select location around the terminal, namely, in areas where there is potential for the trucks to come in contact with the fencing.

There will be two vehicle access points - an entrance gate and an exit gate. Each vehicle gate will be an automatic gate, fitted with a chain-driven gate operator. The entrance gate will open with a card reader system. Premature closing of this gate will be prevented by using a loop detection system and electric eyes. The entrance gate will also have a small sign indicating the phone number for the guardhouse, in case of any malfunction with the card reader. The exit gate will by opened automatically by the trucks driving onto a loop detector. The exit gate will be fitted with the same protection device against premature closure.

5.1.8 Truck Movement and Queuing

The new facility will be accessed via a new driveway from the Refinery Road. The terminal's main entrance will be immediately east of the employee parking lot. The driveway will continue around the parking lot to allow truck access to the terminal yard. A truck queuing area will be available immediately inside the entrance gate to provide trucks with an area to wait until their loading position becomes available.

Trucks will proceed to their designated Loading Rack position, and will travel through the terminal yard in order to orient the truck with the truck manifold facing the Loading Rack. Upon completion of the loading procedure, trucks will pull out of the loading position and proceed to the exit queuing area, where they can park and obtain their necessary documentation from the kiosk building. After returning to the truck, the driver will proceed across the loop detector, the gate will open and the truck will exit the site.

Four parking spots will be provided adjacent to the kiosk building for staff, maintenance contractors or other terminal users with automobiles or pick-up trucks.

5.2 Refinery Offsites Upgrades

5.2.1 Tank Foundation and Dike

The new 15,000 BBL Regular Gasoline tank will require a foundation and dike. The new dike will hold 110% the storage capacity of the tank per provincial regulations. The dike will meet all regulations for secondary

containment of storage tanks. No soil report is available at this time, however it is assumed that soil quality and rock formation will be the same as the butane storage facility. A geotechnical survey will be required on this site prior to design of the foundation. The dike and tank foundation will be located at the north end of gasoline hill in the refinery offsites area.

5.2.2 Fire Protection System

A new fire hydrant is needed in the new Regular Gasoline tank area. This fire hydrant will be connected to the existing fire main for the tank farm. The piping will be made up of ductile iron piping and fittings. The fire hydrant will have isolation gate valve and a fixed monitor. The fire hydrant will be protected from truck traffic with 200 mm diameter steel pipe bollards, filled with concrete and painted safety yellow.

The new 15,000 BBL Regular Gasoline tank will be equipped with foam fire protection. The system will have a truck connection outside the dike near the road. The plot plan and P & ID show the proposed foam protection system.

Chapter 6 **Structural**

6.1 Truck Loading Terminal

6.1.1 Truck Loading Islands and Apron

Two structures will be constructed to support the mechanical, electrical and instrumentation systems required for the Truck Loading Racks. The rack structure will be fabricated from open structural steel sections and feature multi layer pipe supports. The racks will be supported on concrete spread footings that are to be founded at sufficient depth to avoid the effects of frost penetration.

A raised cast-in-place island will be constructed to provide protection for the mounted equipment and load rack structures from vehicle traffic. A concrete slab-on-grade apron will be provided surrounding the truck loading islands. The apron shall be sufficiently large to accommodate all anticipated truck and trailer sizes. The apron will be configured to contain any product spill and collect it for proper disposal.

6.1.2 Overhead Pipe Bridge and Foundations

A multi span pipe bridge will be constructed to carry pipes and cable trays overhead to allow clear passage of vehicles. The bridges will span approximately 120 feet from the end of the low pipe racks to the truckload Rack 1 and continue with another 45 foot span to load Rack 2. The bridges will be three tiered trussed structures fabricated from open structural steel sections. The cross section of the truss bridge will be approximately 7 feet deep and 7 feet wide. The bridge will be supported on concrete spread footings that are to be founded at sufficient depth to avoid the effects of frost penetration.

6.1.3 Pipe Rack

Approximately 10 low-level pipe supports will be constructed to support pipes and cable trays from the road crossing to the end of the overhead pipe bridge. The two tiered pipe rack will be fabricated from open structural steel sections and founded on full depth sono-tube foundations.

6.1.4 System Pads

New reinforced concrete pads for the systems will be constructed to provide structural support for the mounted equipment and additive tanks. The slab-on–grade pads will be protected from the effects of frost heave by casting the slab on free draining backfill and may be further protected with the addition of rigid insulation. Separate pads will be provided for:

- Additive System.
- Vapour Recovery System.

- Truck Offloading.
- Filter Separators.

6.2 Refinery Offsites Upgrades

6.2.1 Pipe Supports

New pipe supports are required in some locations to support the new piping and cable trays. These are indicated on the attached Plot Plans with a designation "TS". These supports will require new concrete foundations and support steel.

Existing pipe supports will require modification to accommodate the new piping and cable trays. These are indicated on the attached Plot Plans with the designation "PS". The existing pipe support foundations have been reviewed and are deemed sufficient to handle the additional load associated with this project. The consultant shall confirm this during detailed design. These supports will require additional structural steel supported by the existing foundations to accommodate the new piping and cable tray.

6.2.2 Cable Tray Supports

New cable tray supports are required in some location where no pipe supports are existing or required. In these areas new cable tray support structures complete with foundations shall be installed. See site plan.

6.2.3 Pump Pads

New reinforced concrete foundations will be constructed for the six (6) new pumps to be added in the refinery modifications. These foundations shall be protected from the effects of frost heave by casting on free draining backfill and/or the addition of rigid insulation.

6.2.4 Pipe Bridge Extension

The existing pipe bridge located near the existing Loading Rack does have sufficient room nor capacity to accommodate the piping and cable tray associated with this project. A new pipe bridge structure is required to support the product lines, cable trays, and vapour recovery pipelines in this area. The new pipe bridge will be constructed north of the existing pipe bridge.

7.1 Driver Kiosk

The building, approximately 15' x 30', will be a steel structure, metal clad construction and founded on a frost protected slab-on-grade. The building will house a BOL printer area, office, driver's washroom facility complete with emergency shower, and a lab.

7.2 Electrical Building

A building will be constructed to house the electrical and instrumentation equipment. The building, approximately 15' x 20', will be constructed from load bearing masonry exterior walls and metal roof trusses and founded on a frost protected slab-on-grade foundation. The building will be located in the Terminal as indicated on the site plan.

7.3 Extension to Substation No. 8

Substation No. 8 will be extended by the addition of a new pre-fabricated metal building (approximately 20' x 20'). This will be fabricated off site complete with a steel floor to be set on a concrete slab. All electrical equipment will be installed and wired prior to delivery. The building will be shipped complete with lighting, heating and ventilation as required by the National Building Code of Canada.

8.1 Piping and Instrumentation Diagrams

Drawing No.	Rev.	Description
D-0064-2XXX-1	A	Loading Rack #1 P& ID
D-0064-2XXX-2	A	Loading Rack #2 P & ID
D-0064-2XXX-3	A	Filter/Separator P & ID
D-0064-2XXX-4	A	Product Additives P & ID
30.0051-1X (5 of 16)	A	Offsites – TK-518 HSD
30.0051-1X (6 of 16)	A	Offsites – TK-521/522 Jet and TK-523/524 LSD
30.0051-1X (8 of 16)	A	Offsites – TK-413 RUL
30.0051-1X (10 of 16)	A	Offsites – TK-342 KERO
30.0051-1X (16 of 16)	A	Offsites – TK-NEW1 RUL

8.2 Site Plans

Drawing No.	Rev.	Description
D-0100-2XXX-1	A	Refinery Site Plan
D-0100-2XXX-2	A	Refinery Site Plan
D-0100-2XXX-3	A	Refinery Site Plan
D-0164-2XXX-1	A	Truck Rack Site Plan