Fuel Storage and Distribution System Design Criteria

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1. General

1.1 Introduction

This document establishes the basis of design for the fuel systems for the Mary River Project, on north Baffinland Island, Nunavut Territory, Canada. Its purpose is to define the engineering standards and practices to be followed in the execution of the Fuel Systems Design and associated engineering activities. It describes the minimum requirements that will be taken into consideration during the design, selection and fabrication of all fuel system components.

Application of the criteria and best practice engineering shall help deliver the following project objectives:

1. Safe operations.
2. Uniformity of equipment and materials.
3. Uniformity of design documentation.
4. High level of piping equipment reliability.
5. Fit to purpose request.
6. Economic equipment.
7. Economic spares holding.
8. Compliance with statutory and code related requirements.
9. Compliance with statutory environmental requirements.
10. Compliance with specified process performance parameters and local operating conditions.

1.2 Safety

The consideration of personnel safety during construction, ongoing operation and maintenance, in the design, selection, and installation of equipment is paramount.

1.3 Protection of Personnel

Emergency showers and eye wash stations shall be designed, specified and located to suit each particular circumstance and to maximize their effectiveness. Water temperature, deluge rate and coverage, supply pressure, accessibility and remote indication of use shall be considered.

1.4 Units

System International unit of measurements (SI Metric units) shall be used exclusively.

1.5 Definitions

ANSI	American National Standards Institute
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
API	American Petroleum Institute
BOP	Bottom of Pipe
CCME	Canadian Council of Ministers of the Environment
CA	Corrosion Allowance
CL	Class
CS	Carbon Steel
D	Diameter, e.g. 3D = 3 times Diameter
DN	Nominal Diameter
kPa	kilopascal
kPa(g)	kilopascal (gauge)
NDE	Non-Destructive Examination
NPT	National Pipe Taper Thread
P&ID	Piping and Instrumentation Diagram
PFD	Process Flow Diagram
PWHT	Post Weld Heat Treatment
RF	Raised Face
SCRD	Screwed
SE	Screwed Ends
SI	International Standard Unit
SMLS	Seamless
SS	Stainless Steel
STD	Standard

1.6 Quality Assurance

Project approved design guidelines, methods and requirements for Quality Assurance shall be used to achieve the required level of quality.

Project Design Engineers and Supervisors shall monitor, review and control the design and planning activities of personnel assigned to the project to ensure that applicable codes, standards, practices, and specifications are being followed to meet project quality goals. Design verification, review and validation (where relevant) shall be in accordance with established design procedures.

Quality criteria shall be regularly reviewed during project execution.

2. Applicable Documents

2.1 Statutory Regulations

The design construction and manufacture of all related equipment and structures shall comply with all relevant Nunavut and Federal government Acts, By-laws, and Regulations of the Canadian Nunavut Territory. This includes:

- Boiler and Pressure Vessels Act (Nunavut) and Regulations; and
- Mine Health and Safety Act (Nunavut) and Regulations.

2.2 Standards and Codes

Fuel Systems, including pressure accessories, equipment, containment structures, tanks and safety accessories, shall conform, but not be limited to the latest revisions of the following:

2.3 Canadian Standards and Codes

1. CSA-B51 and amendment – Boiler, Pressure Vessel, and Pressure Piping Code.
2. CSA B149.1 – National Gas and Propane Installation Code.
3. CSA B149.2 – Propane Storage and Handling Code.
4. CSA B149.3 – Code for the Field Approval of Fuel-Related Components on Appliances and Equipment.
5. NBC – National Building Code of Canada.
6. NFC – National Fire Code of Canada.
7. NPC – National Plumbing Code of Canada.
8. ULC – Underwriters Laboratories of Canada.
9. ULC - Standard S601-00 Aboveground Horizontal Shop Fabricated Steel Tanks.
10. ULC - S652-93 Tank Assemblies for Collection of Used Oil.
11. All applicable Nunavut Territory and local codes. The latest revision of all standards, codes and laws shall be used.
12. CCME Environmental Code of Practice for Aboveground and Below Ground Storage Tank Systems containing Petroleum and Allied Petroleum.
13. CSA W47.1-09, Certification of Companies for Fusion Welding of Steel.
14. CSA W59-03 (R2008) – Welded Steel Construction (Metal Arc Welding).
15. CSA W178.2-08, Certification of Welding Inspectors.
16. CAN/CSA – B836-05 Storage, Handling and Dispensing of Aviation Fuels at Aerodromes.
17. B346-M1980 Power Operated Dispensing Device.
18. Canadian Environmental Protection Act 1999, (2008 Update), Storage Tank System for Petroleum Products and Allied Petroleum Products Regulations.

19. CSA C 22.1 -09 Canadian Electric Code (CEC).

2.4 American Standards

ANSI/ASME B73.1	Horizontal End Suction Centrifugal Pumps for Chemical Process
ANSI/ASME B73.1	Vertical In-Line Centrifugal Pumps for Chemical Process
ANSI Z358.1	American National Standard for Emergency Eyewash and Shower Equipment
ASME B31.1	Power Piping
ASME B31.3	Process Piping
ASME B16.5	Pipe Flanges and Flanged Fittings
ASME B16.9	Factory-made Wrought Steel Butt-Welding Fittings
ASME B16.11	Forged Steel Fittings, Socket-Welding and Threaded
ASME B16.21	Non-metallic Flat Gaskets for Pipe Flanges
ASME B16.25	Butt-Welding Ends
ASME B16.34	Valves – Flanged, Threaded, and Welding End
ASME B16.47	Large Diameter Steel Flanges
ASME B16.48	Steel Line Blanks
ASME B18.2.1	Square and Hex Bolts and Screws (Inch Series)
ASME B18.2.2	Square and Hex Nuts (Inch Series)
ASME B36.10M	Welded and Seamless Wrought Steel Pipe
ASME B36.19M	Stainless Steel Pipe
ASME BPVC I	Rules for Construction of Power Boilers
ASME BPVC II	Materials
ASME BPVC VIII Division	Rules for Construction of Pressure Vessels
ASME BPVC Section V	Non-destructive Examination
ASME BPVC Section IX	Welding and Brazing Qualification
API RP 520	American Petroleum Institute, sizing, selection and installation of pressure-relieving devices in refineries
API RP 521	American Petroleum Institute's pressure-relieving and depressuring systems
API 610	Centrifugal Pumps for Petroleum, Petrochemical and Natural Gas Industries

API 650	Welded Steel Tanks for Oil Storage, 11th Edition 2008
API 653	Tank Inspection, Repair, Alteration and Reconstruction 4th Edition, 2009
AWWA	American Water Work Association Standards
MSS SP-45	Manufacturer's Standardization Society of the Valve and Fittings Industry, Bypass and Drain Connection
NACE	National Association of Corrosion Engineering.
NFPA	National Fire Protection Association
NFPA 30, 2008 Edition	Flammable and Combustible Liquids Code

2.5 Conflicting Requirements

In the event of any conflict between this criteria and related documents and standards, it shall be referred to the client/consultant for clarification and implementation of the design/fabrication of items in question shall only proceed after approval.

3. Design Parameters

3.1 Plant Life Cycle

In general, Fuel Systems shall be designed to suit a twenty five year operating life. However, there is a recognition that some systems shall be subject to corrosion/erosion/mechanical failure requiring routine maintenance or replacement.

For this project, the design code for all piping shall be ASME B31.3, as allowed under CSA B51 and required under the National Fire Code of Canada.

3.2 Site Conditions

For general design conditions such as plant grade elevation, ambient temperature, rainfall, wind velocities, earthquake zone, process and utility conditions, refer to the project General Site Conditions Specification.

3.3 Design Pressure

Design pressure of the system shall never be less than the maximum pressure expected in service as specified in the project Line Designation Table (LDT, or line list). The design pressure for pump discharge lines shall be at least 1.2 times the shut-off head of the pump, plus the maximum static head condition. For positive displacement pumps, the casing design pressure shall be used. Where a relieving device limits the pressure, the design pressure shall not be less than the process set pressure of the relieving device.

The maximum design pressure for the Fuel System piping will be 1030 Kpa.

3.4 Design Temperature

Design temperatures shall be as indicated in the Project Line Designation Tables (LDT). For fuel system, the minimum design temperature shall be -45°C.

Maximum design temperature shall not be less than the Maximum Operating Temperature expected in service co-incident with the loading case under consideration. Where Process allowances over Maximum Operating Temperature have not been provided, a minimum design margin of 10°C shall be added to the Maximum Operating Temperature specified in the Process Flow Stream Tables for all process and high temperature utility lines.

Design margins, as applicable, shall be added to allow for solar radiation, ambient conditions, and start-up/shutdown conditions.

The design temperature shall be used to determine the design allowable stresses for the selected material in accordance with the applicable design code.

Minimum design temperature shall be 5°C less than the lowest expected operating temperature, but never below the minimum design outside temperature as listed in the project General Site Conditions Specification.

All piping and equipment material that will be subjected to outdoor temperature shall be suitable for use in arctic low temperature conditions as per the Site conditions.

3.5 Allowance for Variation from Normal Operating Conditions

For start-up, shutdown or abnormal operation, the pressure and temperature, or both, may be allowed temporarily to exceed the basic design parameters, as specified in ASME B31.3.

3.6 Corrosion and Erosion Allowances

The corrosion and erosion allowances shall be considered based on the process fluid conditions and shall be listed in the Technical Specifications for each component as required.

Piping, tanks, and equipment shall be protected from external corrosion through proper material selection, surface protection, cathodic protection, or a combination of these.

3.7 Design Flow Rates

Design flow rates given in the Process Flow Diagram Tables account for process variability. Additional factors or further allowances for design flow rates are not required.

Flow rates to the bulk fuel transfer stations (Truck Loading) will be limited to a maximum fill rate of 2,200 Lpm.

Light and Heavy commercial fuel loading will be limited to 50 and 150 Lpm respectively.

Marine Vessel unloading flow rates into land based storage tanks will be limited to 14-17,000 Lpm in accordance with desired ship offloading rates.

3.8 Fuel Specifications

3.8.1 Arctic Grade Diesel will be the main Fuel. Complete specifications are in Arctic Grade Diesel will have the following properties:

Property	Value
Flash Point	38°C
Freezing point	-47°C
Kinematic Viscosity @ 40°C	1.3 – 2.4 CST
Density @ 15^0C	810 Kg/m^3

3.8.2 Jet A-1 will be the Aviation Fuel for this project. Specifications for this product will be in conformance with the National Standard of Canada- Turbine Fuel Aviation Kerosene Type. The product will have the following properties:

Property	Value
Flash Point	38°C
Freezing point	-47°C
Kinematic Viscosity @ -20°C	2-8 CST
Density @ 150°C	775-840 Kg/m^3

3.8.3 Gasoline Stored at this facility will have the following properties:

Property	Value
Flash Point	-40°C
Freezing point	-47°C
Kinematic Viscosity@ 40°C	1 CST
Density @ 15^0C	720-760 Kg/m^3

3.8.4 Marine Gas Oil (MGO) Stored at this facility will have the following properties:

Property	Value
Flash Point	60°C
Pour Point	-6°C
Kinematic Viscosity@ 40°C	1.5 to 6 CST
Density @ 15^0C	890 Kg/m^3

3.9 Piping Design

For Detail pipe Design Criteria please refer to the Process and Utility Piping Design Criteria Document.

Lines shall be designed to convey the designated quantity of fluid so that the selected fuel system pumps are of minimum size and energy consumption.

Pipes shall be selected for minimum relative roughness (ε/d) to absorb the minimum energy and provide the least flow turbulence.

Piping material for the fuel systems shall be low temperature steel, Grade ASTM A333, Gr. 6, -50˚F, seamless or ERW. Refer to the steel pipe specification for detail.

Fittings - low temperature to ASTM A420.

Flanges – low temperature to ASTM A350 LF2.

The following velocities are a guide for initial line sizing. The Fuel Systems Group will finalize the velocities for each service to be considered:

3.10 Velocity Tables

Table 3-1: Velocity Limits for Initial Pipe Sizing

Service	Velocity Range (m/s)
Diesel Fuel Loading Systems	2.5 - 4.0
Jet Fuel Loading Systems	1.0 – 2.5
Marine Vessel Unloading	2.0 – 4.0
Gasoline Systems	0.6 – 2.0
Waste Oil and oily waste water	1.0 – 2.0

The finalized line sizes shall be determined based on the allowable pressure drop, pump sizing and other velocity information.

It should be noted that the above figures are not applicable for pressure relief systems which will be sized based on actual contents and pressure drop requirements.

3.11 Pipe Wall Thickness

Pipe wall thickness shall be Schedule 40 unless otherwise noted on the line list including allowances for corrosion, mill tolerance, threading, etc.

3.12 Protection of Personnel

Emergency showers and eye wash stations shall be designed, specified and located to suit each particular circumstance and to maximize their effectiveness. Water temperature, deluge rate and coverage, supply pressure, accessibility and remote indication of use shall be considered.

3.13 Insulation

Insulation is required for the following purposes:

- heat conservation of piping and equipment; and
- freeze protection for Fuel Systems potentially carrying quantities of water.

3.14 Heat Tracing

- Heat tracing shall be used on all lines that required Freeze protection and that are subject to outdoor conditions;
- Heat tracing shall be electrical heat tracing systems of the temperature self-limiting type; and
- Heat tracing on Critical services, such as fire water, shall be design to thawed complete frozen pipe.

3.15 Identification and Painting

Baffinland Iron Mines Corporation standards will be followed to determine which systems need to be identified. When required, piping systems shall have piping contents clearly marked, hazards indicated, and flow direction indicated.

Fuel System painting and coating systems shall be in accordance with CCME and National Fire Code regulations pertaining to the identification of Fuel Systems.

3.16 SP Items

All piping items not defined in the specification for piping material and indicated on the P&ID's are considered special piping items (SP's). Detailed specification for every special item shall be provided in special piping item document. Special items include hoses, strainers, expansion bellows loading arms and the like.

3.17 Buried Piping

Fuel System piping lines shall not be buried unless there is a specific project requirement.

All steel pipes, including buried pipe, insulated lines and pipes in covered trenches, shall be protected from external corrosion as shown in the individual piping material class. Buried steel piping shall have cathodic protection or a suitable protective coating.

4. Storage tanks

4.1 Aboveground Field Fabricated

4.1.1 General

Selection and specification of material shall take account of the following:

- The steel above ground tanks used for storage will be furnished to CSA G40.21-04 in Grade 260 WT – low temperature category 4 to -50°F, rolled, kilned and made to fine grain practice;
- The tank will be constructed vertically according to API standard 650;
- All shell, floor and roof attachments are to have doubler plates and all column bases are to have doubler plates with a minimum of 150 mm beyond column base plate bearing surfaces; and
- The roof to the shell joint shall be a frangible joint which in the event of excessive internal pressure will fail before failure in the tank shell joint or the shell to floor joint as described in API 650.

Final material selection to be confirmed by the Process Group.

Tank Design and Construction shall be to the seismic data of the National Building Code recorded for Arctic Bay.

Each of the above ground storage tanks shall be founded on a granular type structural base conforming to the design requirements of API 650.

Allowable tank base/sub-base soil bearing resistance shall be determined by geotechnical investigation at each site. Preliminary tank support column design shall utilize an allowable soil bearing resistance of 168 kpa (3,500 lb/ft^2).

Each tank base shall incorporate a Cathodic Protection system in conformance with CCME and NACE recommendations to provide corrosion protect to the tank floor steel.

Tanks shall be painted in conformance with NACE standards and recommendations. Identification shall also conform to the requirements of CCME and The National Fire Code.

All tanks shall incorporate inlet and outlet nozzles, two shell manway for tank inspection and maintenance, roof nozzles for exterior trim and appurtenances. Roof manway for inspection and tank maintenance.

Piping Material Specification for internal tank piping and nozzles shall be developed using the requirements of API 650 and Piping Design Criteria for this project.

Each Tank shall be equipped with External Isolation Valves on all inlet and outlet nozzles.

Electronic Tank Gauging of the Guided Radar Design shall be provided for all tanks.

Gauge Hatches, pressure relief vents, foam cambers and access platforms and stairs shall be provided on all Tanks.

4.2 Fittings

Fittings shall conform to the requirements of ASME B16.9 and ASME B16.11.

4.3 Blanking

Spectacle blinds shall be used in the following circumstances:

- All petroleum Storage Tanks requiring such to provide adequate safety for inspection/testing/maintenance;
- Equipment needs to be completely isolated for entry by personnel (the isolation shall be as close as possible to the equipment for positive isolation); and
- Piping systems that are not used during normal or emergency operation.

Blanking shall be shown on the P&ID's and requirements will be assessed on a case-by-case basis.

Jacking screws are required on flanges where piping system lacks sufficient flexibility for flange separation (normally DN150 and above).

4.4 Shop Fabricated Above Ground Tanks

4.4.1 General

Selection and specification of material shall take account of the following:

- The steel above ground tanks used for storage will be furnished to CSA G40.21-04 in Grade 260 WT, to category 4 50°F, rolled, kilned and made to fine grain practice;
- The tank will be constructed horizontally according to ULC Standard S601-00 Aboveground Horizontal Shop Fabricated Steel Tanks;
- All shell, and end shell attachments are to have doubler plates;
- Final material selection to be confirmed by the Process Group;
- Each of above ground storage tank shall be founded on a concrete foundation sized and designed to suit the imposed loads;
- Tank Design and Construction shall be to the seismic data of the National Building Code recorded for Arctic Bay;
- Structural bearing load will be determined by Geotechnical Investigations for each tank. Maximum design loads shall not exceed 168 kappa (3,500 lb/ft^2) for tank foundation support structures;
- Tanks shall be painted in conformance with NACE standards and recommendations. Identification shall also conform to the requirements of CCME and The National Fire Code;
- All tanks shall incorporate inlet and outlet nozzles, one shell nozzle for tank inspection and maintenance, necessary nozzles for exterior trim and appurtenances sized accordingly for each end use and storage requirement; and
- Piping Material Specification for tank internals and nozzles shall be developed using the requirements of API 650 and Piping Design Criteria for this project.

4.5 Fittings

Fittings shall conform to the requirements of ASME B16.9 and ASME B16.11.

4.6 Blanking

Spectacle blinds shall be used in the following circumstances:

- All petroleum Storage Tanks requiring such to provide adequate safety for inspection/testing/maintenance;
- Equipment needs to be completely isolated for entry by personnel (the isolation shall be as close as possible to the equipment for positive isolation); and
- Piping systems that are not used during normal or emergency operation.

Blanking shall be shown on the P&ID's and requirements will be assessed on a case-by-case basis.

4.7 Appurtenances

Each Tank shall be equipped with External Isolation Valves on all inlet and outlet nozzles.

Electronic Tank Gauging of the Guided Radar Design shall be provided for each tank.

Gauge Hatches, pressure relief vents, and access platforms and stairs shall be provided on all Tanks.

5. Secondary Containment

5.1 General

Each tank farm design shall include a secondary containment dyke of earthen/granular construction complete with berm walls and impermeable liner to prevent spill events from contaminating the surrounding environment. Each dyke will be sized to contain an effective volume of product designated under Part 4 of the National Fire Code. Typically this volume is in the range of 110% of the largest tank within the tank farm facility, plus 10% of the remaining tanks in the containment area.

5.2 Dyke

Secondary containment dyke structure will be comprised of multiple layers of various types of compacted granular material and an embedded impermeable liner. Granular material shall be obtained from bank or screened local sources.

5.3 Liner

Liner selection shall be in accordance to Part 4 of the National Fire Code of Canada and provide a level of impermeability to ULC/ORD C58.9. Liner shall consist of heavy duty PVC/HDPE panels with solvent welded seams to suit required placement area. Selected liner material will be suitable for use in an arctic environment and not inclined to excessive deterioration over time.

5.4 Floor slope

Secondary containment floor slope shall be as such as to direct run-off water and/or spilled product away from the storage tank bases and to a designed low-point. Collected liquid will then be pumped to an Oil/Water Separation unit prior to effluent release to the environment.

5.5 Piping penetrations

Penetrations of the secondary containment liner to accommodate distribution piping shall be kept to a minimum. Any/all required penetrations will be liquid-tight sealed using a collar - type connection approved and installed as per the liner manufacturer's recommendations.

5.6 Granular Construction

Secondary Containment dyke shall be constructed of shaped/compacted granular and in-situ materials in lifts not to exceed 200 mm. Unless otherwise noted all granular materials used in dyke construction shall be screened crushed rock or approved excavated/bank material. Required compaction densities shall be determined using the standard proctor test. Geotextile membranes will be required within the dyke construction to prevent granular migration to the succeeding layer.

5.7 Distribution Piping

All distribution piping required for tank farm loading/off-loading operations shall be epoxy coated carbon steel with girth-welded joints. Piping shall be run above grade on engineered supports

complete with pipe shoes, wear bars and anchors as needed. All piping shall be installed such that all joints and connectors are within the secondary containment area.

5.8 Fuel Transfer Areas

Fuel transfer areas shall consist of a reinforced concrete housekeeping/containment pad sized to suit the applicable vehicle/equipment design loads. Each area will be sloped to provide positive drainage into the secondary containment dyke.

5.9 Oil Water Separator

The oil water separator (OWS) will be an aboveground unit housed inside an insulated and heated building.

The building and OWS shall be capable container ship transport to the project location.

Piping connections to the OWS unit shall as per this document.

The OWS shall be corrosion resistant and utilized coalescing media to maximize efficiency.

The unit shall have an oil recovery tank complete with a discharge pump.

The design flow rate shall be based on the 1 in 10 year rain storm for the project area.

The OWS shall be able to be operated on gravity or pumped flow.

6. Fuel Transfer

6.1 General

Piping system shall be as per this document.

All fuel transfer areas will be provided with secondary containment for spill control and shall be drained to the Oily Water Handling system.

6.2 Rail Car Loading

Rail car fuel transfer rate shall limited to maximum 2200LPM, and shall provide minimum flow such that six cars can be filled in approximately one hour.

All loading will be through top loading arms from top of the car. Each load point shall be provided with access via structural steel gantry.

Fuel will be metered and controlled via a load control unit module located in proximity to the gantry.

Isolating valves shall be installed to isolate all major pieces of equipment such that failure of one component will not shut down the fuel loading system.

6.3 Rail Car Off Loading

The rail cars will be offloaded from the bottom connections on the rail tank car. An adaptor will be utilized for connecting the flexible hose. The adaptor on the hose will be a positive locking style.

The five diesel rail cars will connect to a common offload header. The jet fuel car will have dedicated offload system.

The rail cars will be offload at a rate of approximately 1,200 lpm each. The time required to offload the 6 rail cars will be approximately two hours.

6.4 Truck Loading

The fuel loading system shall be automated by a load control unit (LCU). The required fuel load and vehicle driver information will be manually entered in the LCU.

A positive displacement (PD) meter shall provide feedback to the LCU.

A control valve equipped with solenoids will regulate the flow rate into the tank vehicle. The solenoids will be controlled by the LCU based on feedback from the PD meter.

A ground verification system will be required for the bottom truck loading.

The truck loading shall be done using bottom load connection. The loading arms shall be equipped with API style dry break couplers.

Light truck vehicle loading shall be done using retail style fuelling nozzles. Hose reels will be utilized for light fuel dispensing.

7. Jet Fuel Storage and Handling

7.1 General

The jet fuel handling system and operations as a minimum shall follow the requirements of CAN/CSA - B836-05 Storage, Handling and Dispensing of Aviation Fuels at Aerodromes.

Purity standards for the Jet A-1 fuel for this project are critical.

The jet fuel systems shall utilize the following design requirements to ensure the quality of the jet fuel is maintained.

The pipe system at 100 mm diameter and larger for jet fuel shall be internally coated.

Pipe system below 100 mm diameter shall be stainless steel.

Jet fuel storage tanks shall use floating suctions. The floating suction will be swivel elbow design. The floating suction material of construction shall be stainless steel. The floating suction shall a have a means of verifying operation.

The jet fuel storage tanks shall have the floor and the first shell coarse white epoxy coated with a jet fuel resistant coating.

Water draw off systems shall be done from a central tank sump.

Filtration systems shall be used for filtering the jet fuel during rail car loading, offloading and truck loading. The filters shall meet the requirements of API 1581 5th Edition. The filter vessels will also be equipped with a water detection system that will stop fuel flow on high water level in vessel.

8. Pumps

8.1 General

Centrifugal style vertical inline pump will be used for main transfer pump and fuel loading pumps.

Positive displacement or self priming centrifugal pumps to be utilized for offloading.

Pump systems shall have redundancy for the main transfer pumps.

Pumps will be to ANSI B73.1/73.2 or API 610 standards where applicable.

Pump motor power shall be sized to be non-overloading for the complete pump curve.

Pumps shall be provided with fuel bypass system capable of handling pump design point output.

Positive displacement pumps shall also be equipped with internal relief system.

9. Fuel Control Systems

9.1 General

All vertical storage tanks shall be controlled via motor actuated valves, on the tank inlet and outlet piping.

Tank level shall be monitored via a tank level gauging system, these gauges shall be loop powered radar type. The control system shall use the level signal as the primary tank controls for filling and delivery limits.

Tanks shall have a secondary overfill prevention system that operates independent of the radar level controls. This system shall be self checking and suitably rated for overfill prevention.

Site based fuel receiving tanks shall have the tank inlet valve and receiving pumps interlocked with tank overfill prevention systems, tank receiving fuel from ship board pumps shall provide audible and visual alarms at the ship connection point for overfill warning conditions.

Truck and Rail Fuel loading shall be controlled via digital preset load controllers. The load controllers shall delivery the request amount product to the tanker vehicle as requested by the operator. The load controller shall signal motor controls to operate the required delivery fuel pumps, digital control valve, and Monitor loading permissive systems and halt loading on loss of any required permissive signal.

All fuel loading operation shall have a truck ground verification system and truck overfill prevention system interlocked to the preset load controller.

Temperature compensated volume correction and weights and measure approvals shall not be required.

An Emergency Shutdown (ESD) system shall shut down loading/unloading operations, stop all pumps and close all tanks valves for the fuel storage and handling site

10. Electrical Systems

10.1 General

All electrical power distribution shall be in accordance with the current revision of the Canadian Electrical Code Part 1, C22.1-09.

Primary power distribution for the fueling delivery system shall be 600 V 3 phase, secondary systems shall be 120/208 V 3 phase 4 wire system derived from 600 V system via locally installed dry type distribution transformers.

There shall be a standby diesel power generation system with automatic power transfer in event of a loss of power from the main service.

All feeder circuit protection shall be via circuit breakers, main incoming circuit breakers shall be solid state type with reduced arc flash capability mode.

All distribution panel shall have copper bus work and bolted breaker connections.

All motors 1HP or greater shall be 600 V 3 phase motors.

All motor controls shall be via motor control centers, motor less than 50 HP shall be NEMA full voltage line starters, motors greater than 50 HP shall be NEMA reduced voltage solid state soft start controlled. All motor protection relays shall be multifunction solid state with overload, phase loss, phase rotation, under voltage stall and underload protection.

Motor controlled valve operators shall be feed at 600 V 3 phase for all multi turn actuators, quarter turn actuators shall be feed at either 120 V or 600 V 3 phase depending on the application requirements.

All outdoor area lighting shall be high intensity discharge (H.I.D.) type serviced at 347/600 V.

Indoor building lighting shall be fluorescent type serviced at 120 V.

All power distribution cabling shall be copper Teck90 with steel armour, 600 V system shall have minimum insulation rating of 1000 V and 120/208 V system shall have a minimum insulation rating of 600 V.

All main runs power cable shall be run in cable tray system, cable tray shall be galvanized steel tray width as required with a minimum 125 mm load depth.

Interior building wiring and cable shall be copper RW 90 wire in conduit or Copper AC90 armoured cable.

All grounding conductor must be copper.

11. PLC/SCADA

11.1 General

Programmable logic control (PLC) shall monitor and control fuel storage and delivery systems, control system shall provide an operator interface (HMI) system that allows the operators to monitor and control the fuel storage and delivery operations.

The PLC system shall monitor all tank levels and provide a minimum of two non critical alarm points(Low and High level) and two critical alarm points (Lo-Lo and Hi-Hi level). A secondary overfill system shall directly control tank inlet valve independent of the PLC system but shall be monitored by the PLC and HMI systems.

All motors shall be monitored and controlled by the PLC system for automated operations, each motor shall be monitored for a mode of operation (Local-off-Auto), running feedback, and Fault Status. Field start and stop control stations shall operate motors via the PLC control sequence.

The PLC system shall provide the necessary logical interlocking between motor, tank and valve operations.

All PLC digital I/O signals shall be 120VAC, Digital I/O cabling shall be 600V Teck90 multi conductor cable run in cable tray. Field I/O points shall be marshalled together in field Junction boxes and home run multi conductor cables to main PLC location.

All PLC analog I/O signals (Level, flow, pressure) shall be 4-20mA (HART Compatible), analog signal cables to be Teck Armoured 300V insulation, minimum #18AWG Tinned Copper, twisted, individually shielded pair per device. Signal cables shall be marshalled together into mutli-pair cables via field Junction boxes. Analog signal cabling shall be run in cable tray separated from power cabling by either a metal barrier or separate tray system.

Temperature signals shall be via resistive thermal devices (RTDs) to RTD PLC inputs, signals shall be run via Teck Armoured 300V, #18AWG Tinned Copper, Twisted, shielded triads.

THE system shall incorporate redundant HMI interface systems. The HMI interface shall provide graphical representations of the fuel storage and delivery systems operation and alarms.

The PLC and HMI systems shall have UPS power systems.

12. Valves

12.1 General

Except for specialty valves, all shall be from a single manufacturer.

Valves to be individually tested during manufacture.

Valve material shall be cold weather cast steel material ASTM A352-LCB.

Pressure and temperature ratings to ANSI B16.34.

Face to Face dimension: ASME B16.10 for flanged valves.

Flange: 150 class raised face.

12.2 Control Valves

Control shall be globe style diaphragm operated.

Diaphragm material shall be Buna-N formulated for low temperature.

Control shall be equipped with field adjustable pilot systems and open and closing speed controls.

Control valves for pressure relief system shall be failing safe open.

Control valve for load control or overfill protection shall be failsafe close.

12.3 Motorized Valves

Motor operators shall be equipped with torque limiting control so valve cannot be damaged.

Motor operator shall be able to open of close valve against maximum pipe operating pressure.

Motor operator shall be capable of local and remote operation.

Motors operators shall be supplied with internal heaters to prevent condensation.

12.4 Valve Types

Double block and bleed style valves shall be used for tank isolation valves. The valve style shall be able to be serviced in place by removing slips from bottom of valves and be equipped with body drain.

Gates valves shall be used for equipment or pipe line isolation were equipment maybe removed for servicing. Gate valve shall be rising stem style with tapered.

Quarter turn style butterfly valves may be used where temporary equipment isolation is required.

Quarter turn style ball valves shall be using for vents and drains on pipe systems. Valve size for vents will be 25 mm and 50 mm for drains.

Check valves shall used to be prevented back flow at fuel offloading locations and pump discharges. Check valve shall be flanged swing style.

13. Site Services

13.1 Sanitary Sewer

For detailed sanitary sewer design information please refer to the applicable sections of the Process and Utility Piping Design Criteria document. In general all sanitary sewer system installations shall comply with applicable local codes, regulations and recognized industry standards.

13.2 Storm Sewer

For detailed storm sewer information please refer to the applicable sections of the Process Utility Piping Criteria, regulations and recognized industry standards. In general all storm sewer installations shall comply with applicable local codes, regulations and recognized industry standards.

13.3 Potable Water

For detailed potable water design information please refer to the applicable sections of the Process and Utility Piping Design Criteria document. In general all potable water systems shall be insulated and installed according to applicable local codes, regulations and recognized industry standards.

13.4 Access Roads and Parking

Gravel surfaced access roads are to be constructed at each tank farm site complete with entrance/exit points from the site access road. Limited parking for maintenance and operations staff will be provided at each facility. Surface drainage shall be by gravity flow to the adjacent undeveloped areas with no curbing, gutters or drainage ditching required. Travelled asphalted area will be adequate width, thickness and radii to accommodate mining trucks and fuel tankers.

13.5 Security Fencing

Security Fencing shall be provided around the perimeter of each tank farm facility of galvanized steel post and wire mesh construction. Sliding gates and main gates will be provided at each entrance point. Fence height and top rail dimensions shall be designed according to prevailing industry codes.

13.6 Signage

A system of signs shall be developed at each site for security, safety and function.

Signs shall be developed for:

- security fencing;
- site construction;
- traffic direction/control;
- parking;
- building identification;
- fire alarm system;
- fire extinguishers;

- foam system operations including fire monitor identification; and
- fuel tanks, equipment and piping labelling.

13.7 Fire Water System

Fire water will be supplied to the site by tanker truck and stored for use in designated storage tanks at each site. For detailed storage tank design information please refer to the applicable sections of the Process and Utility Piping Design Criteria document. Additional system components shall include; fire pump, foam storage, looped water main and associated monitors. Loops water main shall consist of 200mø pipe complete with associated heat tracing, valves, monitor connection and tie-in storage tank/pumps.

For valve selection and datasheets, refer to the Manual Valve Selection Specification and the Pipe Material Specification.

14. Pump House

14.1 General

The design and construction of the pump house structure shall be designed specifically for the Northern climate consistent with lowest life cycle costs and energy management integrated in the design.

14.2 Standards, Codes and Regulations

The pump house shall be designed and constructed to the following codes:

- The National Building Code of Canada;
- The National Fire Code of Canada;
- The Canadian Electrical Code; and
- Relevant Nunavut and Federal Government Acts, Codes and Regulations of the Canadian Nunavut Territory including all applicable Municipal By-Laws and Ordinances.

14.3 Building Design Construction

- The building shall be prefabricated metal structure on a concrete slab;
- The building foundation design shall be engineered to suit installation in permafrost soils;
- The concrete floor shall be designed to a factored floor load of 4.8 kpa; and
- Insulation shall be places under the flow slab to protect the permafrost from deterioration caused by building heat loss.

14.4 Heating and Ventilation

- The pump house is a non occupied space and required temperate heating only to protect equipment and fire fighting liquids;

- The heating and ventilation system shall be designed to provide the required air changes as per the Building Code of Canada requirements; and
- The building shall have an electrical classification of class 1 zone 1 in the area where diesel fuel and jet fuel fluid transfer occurs.

15. Fabrication and Installation

15.1 Field Welds

Field weld locations will not be shown on drawings. The Contractor shall locate field welds and add trim allowances as required, based on his planned erection sequence.

15.2 Temporary Piping

Temporary piping for steam blows, flushing tie-ins, and the like, must be identified during pipe modeling and placed and routed in the 3D model. It is subject to the same routing and configuration requirements as permanent plant pipe. The permanent plant pipe will be provided with whatever branch connections or tees necessary to perform the blows or flushing. The temporary pipe will be extracted onto isometric drawings so that it can be shop-fabricated and installed in conjunction with the permanent pipe. The isometric shall contain an adequate set of instructions to permit the piping crews to detach the temporary piping and return the permanent pipe to its planned in-service requirement.

15.3 Identification and Painting

Baffinland Iron Mines Corporation standards will be followed to determine which systems need to be identified. When required, piping systems shall have piping contents clearly marked, hazards indicated, and flow direction indicated.

Piping painting and coating shall be in accordance with the Mary River Project Painting and Coating standard specification.