INTERIOR GAS UTILITY

CLEAN LOW COST NATURAL GAS FOR THE INTERIOR

LNG Truck Loading Skid –
Request for Proposal

BRAEMAR

COFFMAN ENGINEERS

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Acronyms, Abbreviations	
BAT	best available technology
Bcf	billion standard cubic feet
BPCS	Basic process control system
CCTV	closed-circuit television
CFR	Code of Federal Regulations
CO_2	carbon dioxide
DCS	distributed control system
EPC	engineering, procurement, and construction
ESD	Emergency shutdown
F&G	fire and gas
FEED	Front End Engineering and Design
FID	Financial Investment Decision
FNSB	Fairbanks North Star Borough
gpd	gallons per day
HHV	higher heating value
H_2S	hydrogen sulfide
HMI	human machine interface
IGU	Inter Gas Utility
IPL	Independent protection layer
LHV	lower heating value

LIN	liquid nitrogen
LNG	liquefied natural gas
MCR	main control room
MEA	Matanuska Electric Association
MDEA	N-methyl-diethanolamine
MSB	Matanuska-Susitna Borough
NFPA 59A	National Fire Protection Association's "Standard for the Production, Storage, and Handling of Liquefied Natural Gas (LNG)"
O&M	Operations and maintenance
PHMSA	Pipeline and Hazardous Materials Safety Administration
PFD	Process Flow Diagram
P&ID	Process Piping and Instrument Diagram
ppm	parts per million
psig	gauge pressure in pounds per square inch
SCADA	supervisory control and data acquisition
SIS	Safety Instrumented System
TSA	temperature swing absorption
VDTR	Vapor dispersion and thermal radiation

1. GENERAL SCOPE

1.1. PURPOSE

Interior Gas Utility (IGU) is planning to expand the existing Titan LNG liquefaction facility in Wasilla, Alaska. The LNG facility is located at 25849 W Ayrshire Ave, Wasilla, AK 99654. The facility was constructed in 1997 and has been in continuous operation since 1998. The existing liquefaction train, Titan 1, has expanded since its original installation to its current daily production capacity of approximately 50,000 gallons per day (gpd). IGU's plan for expansion is phased and involves two (2) new liquefaction trains, Titan 2 and Titan 3, with nominal 100,000 gpd capacities each (Figure 1). The only item in this RFP is the LNG Truck Loading Skid(s).

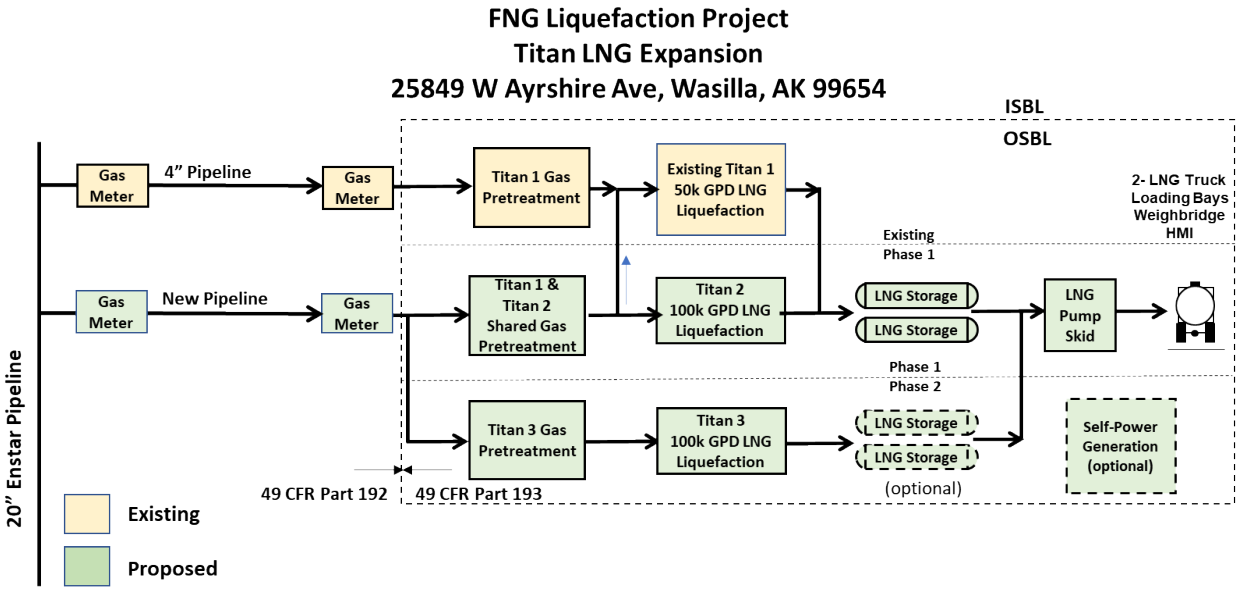


Figure 1 - Titan Phased Approach Block Diagram

The project will be completed in two phases; Phase 1 - Titan 1 and 2 with a production capacity of 150,000 gpd, and Phase 2 - Titan 3 with a production capacity of an additional 100,000 gpd. Additional Loading Skids may be required for Titan 3 but a separate RFP will be issued in the future.

1.2. SCOPE OF WORK

The scope of work includes the design, fabrication, assembly, shipment, support of final assembly at the site and commissioning of the LNG Loading Skids as complete packages. The LNG Truck transfer station will provide for loading LNG supply to DOT MC-338, cryogenic, highway semi-trailers and ISO containers from the onsite LNG storage tanks.

Provisions shall be included to allow reverse flow and use LNG pumps to transfer LNG trailers to onsite LNG storage. Examples for when LNG trailer unloading capability may be required includes an overfilled trailer where some LNG is removed, to allow maintenance where an empty LNG trailer is required, or other unloading cases. Unloading mode will only be required on an infrequent basis where simultaneous truck loading and unloading is not required for this system.

The desired flowrate is approximately 350 gallons per minute (or about 30 minutes per tanker). This design should assume that there will be two nominally 13,000-gallon tankers filling at the same time. The vendor shall also supply the custody transfer scale and controls to automate the loading, protect against overfill and provide shut-down in emergency situations. The owner is willing to consider packages that are joint ventures provided they are integrated by the vendor team. Additional details can be found in Section 2.

The Loading Skids should be self-contained units with required piping attachments to support their use in a liquefaction plant. As-built drawings of the Loading Skid structure, mechanical, and electrical systems are to be provided at the completions of fabrication to the owner by the vendor.

The vendor will be responsible for packaging the system and shipping to port of Seattle or Tacoma, Washington. Packaging will be appropriate for shipping on a barge and truck all the way to site in Wasilla. Concrete support foundations will be installed in advance by others in accordance with weights, dimensions, spacing, foundation loads, and service, provided by the vendor. The vendor shall be responsible for providing support to the contractor in final assembly and commissioning at the operational site.

The vendor shall include the following services in the delivered price. Vendor will be given 10 working day notice prior to requiring these services:

a. Two (2) days of onsite technical assistance and inspection of the erected Loading Skid.
b. 24-hour performance test
c. Review and approval of the foundation plans and shop drawings prior to installation

1.3. EXCLUDED FROM SCOPE OF WORK

- Soil improvement, grading, foundations, surfacing material, foundation design as indicated in the General Arrangement drawing (see Appendix B).
- Design and installation of connections to the Loading rack and components including electrical, LNG supply and vapor piping, utilities, fire & gas detection, existing LNG facility ESD system interface and communication service to the equipment, and area lighting. However, the truck loading skid should provide all these components specific to the provided equipment and interface with these facility services. Truck Rack SHALL contain rack specific ESD controls.
- Site Loading Skid and LNG pump skid installation, to be completed by others.
- Two (2) Custody measurement weigh scales (supplied by vendor in scope) site foundations and installation to be completed by others.
- Utilities; instrument air, nitrogen, vent piping.
- LNG supply and vapor return piping from LNG storage to the truck loading bays will cross under the access road below grade in a structural box with heavy duty open grating provided by others. Piping interface with vendor equipment will be at the truck loading skid interface flanges
- Buildings or Shelters not included with vendor standard offering

1.4. REFERENCE PUBLICATIONS

The codes, standards, and specifications included in Appendix A shall be considered as part of this specification. The codes and standards that are referenced in the specification for other equipment shall be considered part of the requirements.

1.5. VENDOR RESPONSIBILITY

By submitting a proposal for the LNG Loading Skids, Vendor agrees to furnish the equipment, with stated Comments and Exceptions allowed; but in strict accordance with all other requirements of the Bid Package Scope and referenced Codes and Standards. No additional exceptions shall be allowed without mutual agreement after the award of the contract.

a. Vendor shall be responsible for coordination of all Sub-Vendors and for overall guarantees relating to mechanical, process, control and electrical compatibility of all equipment including the installation and proper functioning of all vendor supplied instrumentation, control valves and the interaction of Vendor supplied items and the overall system.

b. Compliance by Vendor with this specification neither relieves Vendor of the responsibility of furnishing the LNG Loading Skids and accessories and connections of proper design, mechanically suited to meet operating guarantees at the specified service conditions, nor does it relieve Vendor of the responsibility of furnishing equipment assembled and prepared for shipment in a professional manner.

c. Vendor shall assume both unit responsibility and guarantee the entire package including piping between vendor fabricated skids (if applicable).

1.6. CONFLICTING REQUIREMENTS

In the event of conflicts within this Specification Package or between the specifications, the inquiry, or Purchase Order (P.O.), the accompanying Data Sheets and drawings, and any other supplemental specifications, the Vendor shall immediately submit the matter in writing to the Owner who will make a determination and provide written clarification.

1.7. INSPECTION AND OBSERVATION

In addition to the manufacturer's inspection and Quality Control program, the Owner may accomplish inspection using third party inspectors. Vendor shall coordinate access for inspectors and provide notification for scheduled inspections. Vendor and Owner shall work together to establish an inspection schedule and hold points for inspection during fabrication, factory testing, and packaging. Owner requires at least 20 days notice in advance to listed inspections to accommodate resource planning and travel arrangements. In addition to general progress inspections, Vendor should anticipate the following specific items:

- Periodic inspection during all Loading Skid fabrication.
- Periodic inspection during all piping fabrication.
- Periodic inspection during all cleaning and coating application.
- Periodic inspection during all I&C fabrication and installation.
- Observation of Functional Check-Out, testing, and preparation for shipment.

1.8. DESIGN REQUIREMENTS

Specific standards are included in discipline specific subsequent sections of this document.

a. It shall be the responsibility of the Vendor to select the proper combination of components and to assemble them into coordinated connected units, which shall withstand the environmental and pertaining conditions stated herein. Equipment to be supplied shall be the standard design of the manufacturer.

b. The Vendor shall be responsible for detailed engineering and design of the equipment skid or module structure as well as the electrical and mechanical equipment in the module or on the skid. Engineering calculations shall be provided as part of the final documentation.

c. Design shall be prepared under the supervision of an engineer(s) licensed in the state of Alaska for each discipline. Final drawings shall bear the seal and signature of the engineers of record.

d. Owner will provide final connections to the module for gas, external power, control, monitoring, instrumentation, communication, foundation attachment, and other sources required to support the equipment. External connections will be coordinated to interface at the edge of the equipment with the terminations provided by the Vendor.

e. A written functional description of the systems, addressing procedures for start-up activities, normal operation and safe operating limits, shall be submitted to the Owner by the Vendor as part of the Operation and Maintenance Manual.

f. Owner shall provide instrumentation and equipment tags to be used in all drawings and physical tagging.

g. O&M Manual should include troubleshooting, repair and replacement procedures.

1.9. CODE COMPLIANCE

The existing Titan LNG facility is currently under federal jurisdiction by PHMSA, the Matanuska-Susitna Borough, State of Alaska, and the local Fire Marshall. The new LNG Loading Skids inside the battery limits (ISBL) of the LNG facility shall meet requirements of this specification as well as applicable codes and standards, which include but are not limited to: 49 CFR Part 193, NFPA 59A 2001 edition, State of Alaska statutes, regulations and requirements; Alaska Occupational Safety and Health (AKOSH); International Building Code (IBC); International Fire Code (IFC); International Mechanical Code (IMC); Occupational Health and Safety Administration (OSHA); National Fire Protection Association (NFPA) (including the National Electric Code [NEC]). The engineers responsible for the design of the Loading Skids shall assure that the new LNG Loading Skids are designed and constructed in accordance with all applicable codes and regulations.

2. GENERAL REQUIREMENTS

2.1. LNG TRUCK LOADING/LOADING

An LNG Truck transfer station will be provided at the Titan LNG facility for loading LNG supply to DOT MC-338, cryogenic, highway semi-trailers and ISO containers from the new onsite LNG storage tanks.

Provisions shall be included to allow reverse flow and use LNG pumps to transfer LNG trailers to onsite LNG storage. Examples for when LNG trailer unloading capability may be required includes an overfilled trailer where some LNG is removed, to allow maintenance where an empty LNG trailer is required, or other unloading cases. Unloading mode will only be required on an infrequent basis where simultaneous truck loading and unloading is not required for this system.

Features of the truck-transfer bay shall include:

a. Two (2) bays for loading two (2) highway LNG trucks or ISO containers
b. LNG truck loading pump skid.
c. Thermally insulated LNG truck loading piping and isolation valves.
d. Thermally insulated vapor return piping and isolation valves.
e. Liquid and vapor cryogenic 3” hoses to connect facility piping to the truck manifold with hose support arms.
f. After truck filling is complete, isolate and drain 3” hoses of LNG without spillage
g. Nitrogen supply for hose and purge and blow-down to vent/flare header.
h. Truck loading control system with HMI for load authorization, custody transfer recording, and interfaces to plant controls.
i. Safety systems; ESD safety systems for truck loading skid and LNG pump skid, shutdown and independent isolation valves of the liquid and vapor lines and drive-off prevention.
j. Inline LNG custody flow meter and automatic overfill prevention
k. Two (2) weighbridges, one for each bay for custody transfer and overfill prevention
l. Retractable grounding cable
m. Drive-off prevention
n. HMI Interfaces, server, workstations, software

The maximum LNG liquid loading rate is approximately 350 gal/minute per bay that corresponds to a typical 13,000-gallon highway loading tanker being filled in 30 minutes (both bays may be filling trucks simultaneously). The LNG loaded to the truck shall flow by LNG truck loading pumps from the LNG storage tank piping through a 3” cryogenic hose to LNG tanker trucks. Displaced vapor from LNG storage tank(s) is returned to the truck loading skid by a 3” cryogenic vapor return line. During peak periods LNG trucks will be loaded continuously where little time lapse occurs from filling one truck to the next.

For code siting compliance, the truck loading bay area is provided with a spill collection system installed by others. This is to direct potential accidental spills to the shared facility

impoundment by open channel flow that is based on a 10-minute spill scenario at max loading rate (guillotine failure) in accordance with NFPA 59A design guidelines.

2.2. LNG TRUCK LOADING PUMPS & MANIFOLD

Two (2) Truck Skid or ISO Container loading bays with dual hose manifolds utilize two (2) dedicated LNG transfer pumps and headers that operate independently. Stop, start, and loading of one LNG trailer is not associated or impacted by loading of the other LNG trailer. Cold retention in loading facility piping and pumps is provided by thermal insulation of piping and pumps. If warm between uses, truck loading area piping shall be designed to be cold shocked with LNG.
Crossover lines will run to the suction side of the pumps shall be provided in the event a pump is not working or down for maintenance. The valve in the crossover line is normally closed and only opened to allow other bays to share a pump. Simultaneous loading of two (2) loading tankers with only one (1) pump may result in longer loading time. Custody transfer measurement is required, onsite weigh scales will be utilized to gauge LNG volumes before and after loading. Design and construction of weigh scales is to be included with this RFP response.

The Loading Skids will be founded on a concrete slab provided by others. The connection points will be coordinated between Vendor and Owner as part of the design process. The Vendor will be responsible to supply the Loading Skid to foundation reaction loads. Provisions shall be made in the module design to restrict heat flow from the module to the foundation/pile.

a. Piping and electrical interface connection points shall be coordinated with the Owner as part of the design process.

b. Interface piping connections shall be flanged. Piping services shall be consolidated to single point connection (i.e. relief system, supply line.).

c. Reference attached general arrangement drawing for preferred orientation of module connections.

2.3. GENERAL REQUIREMENTS

The scope of work includes the design, fabrication, and assembly of an LNG Truck Loading Skid supported on structural steel base frame provided by vendor.

a. Design and fabricate complete structural frame, primary and secondary framing members as required to provide complete gravity, lifting and lateral load resisting systems. Lifting shall be provided by means of lifting lugs (four-point lift).

b. Anchoring of equipment for overturning due to transportation and seismic loads shall be included in the design.

c. PSV’s shall be accessible by fixed access platform.

d. Other elevated items shall be made accessible.

e. Main system components and operational items shall be located within operator access (3 to 5 feet above grade)

2.4. DESIGN STANDARDS

a. American Institute of Steel Construction (AISC)

b. API RP 520, Sizing, Selection and Installation of Pressure Relieving Devices in Refineries

c. API RP 521, Guide for Pressure-Relieving and Depressuring Systems

d. ASCE 7-10 Minimum Design Loads for Buildings and Other Structures

e. ASCE Design of Blast Resistant Buildings in Petrochemical Facilities

f. ASME Boiler & Pressure Vessel Code

g. ASME B16.5, Pipe Flanges and Flanged Fittings: NPS 1/2 through 24, 2003

h. ASME B16.9; Factory Made Wrought Steel Buttwelding Fittings

i. ASME B16.11, Forged Fittings, Socket-Welding and Threaded

j. American Welding Society (AWS)

k. Factory Mutual (FM)

l. NFPA 59A, Standard for the Production, Storage, and Handling of Liquefied Natural Gas (LNG)

m. National Institute of Standards and Technology *Handbook 44, Specifications, Tolerances and Other Technical Requirements for Weighing and Measuring Devices*

n. Underwriters Laboratory (UL)

2.5. WELDING/FABRICATION STANDARDS

The welding of structural steel shall be in accordance with the American Institute of Steel Construction (AISC) and the American Welding Society (AWS) D1.1 Standards. The Vendor shall submit welding procedures and maintain welder qualification records for each person performing the welding.

Welding procedures for low-temperature structural service shall require procedures qualified with Charpy impact tests per ASTM A 370 and AWS D1.1. Low-temperature Charpy impact tests (25 ft-lb minimum) shall be conducted at -50°F as defined by Table 1.

Welding procedures for other than low-temperature service structural steel, stud-to-steel-plate or member welding may be in accordance with prequalified procedures in AISC Manual of Steel Construction or AWS D1.1.

Cryogenic piping shall be welded, NDT and pressure tested in accordance with 49 CFR Part 193, NFPA 59A 2001 edition, and ASME B31.3. The Vendor shall reference the applicable welding procedure specifications on shop drawings to be reviewed and approved by Owner prior to the start of fabrication. A nondestructive examination (NDE) and welding procedure specification number or identification shall be shown either in the fabrication drawing notes or on the applicable weld joint.

The Vendor shall reference the applicable welding procedure specifications on shop drawings prior to the start of fabrication. A nondestructive examination (NDE) and welding procedure specification number or identification shall be shown either in the fabrication drawing notes or on the applicable weld joint.

2.6. SITE ENVIRONMENTAL CONDITIONS

Table 1 Environmental Design Basis

Alaska Geographical Data			
Coordinates			61°25'35.88"N 150° 5'41.63"W
Elevation			129 FT
Meteorological Data			
Normal Temperature Range	Summer	Average Maximum	60° F to 67° F
		Average Minimum	42° F to 52° F
		Record Maximum	85° F
	Winter	Average Maximum	20° F to 28° F
		Average Minimum	6° F to 16° F
		Record Minimum	-34° F
Design Temperatures		Summer	68° F (58° F wet bulb)
		Winter	-30° F
Typical Relative Humidity		Summer	56% to 78%
		Winter	67% to 74%
Wind Velocity		Sustained Wind Speed (PHMSA)	150 MPH
		Design 3 Second Wind Speed (ASCE 7-05)	183 MPH
Design Ground Snow Load			50 psf
IBC Maximum Considered Earthquake Ground Motion, 5% damping, Site Class B		USGS Design Maps (ASCE 7-10)	S_s = 1.500 S_1 = 0.710

2.7. EQUIPMENT SIZE, SHAPE AND APPEARANCE

The size and shape of the equipment skid will be determined by the function of the equipment. Truckability of the equipment skid shall be required in design process. Size and weight constraints will be based on trucking limits. To avoid excessive shipping costs, effort should be made to keep broken down and individually shipped component dimensions less than 12-feet wide and high, and less than 60-feet long.

Vendor shall provide the recommended foundation pad size (beyond extents of Loading Skid limits) as required to access Loading Skid, accessories and associated components.

2.8. DESIGN LOADS

2.8.1. Design Category: III

2.8.2. Importance Factor:

Snow Importance Factor, I_s: 1.10

Seismic Importance Factor, I_E: 1.25

2.8.3. Gravity Loading:

- Grating, stairs, and catwalks shall be designed for 100 psf live load, unless larger load is required for module function. Maintenance platforms shall be designed for 125 psf light storage live load.
- No area reduction for live loads allowed.

2.8.4. Environmental Loading:

- Design for snow, wind and seismic load shall be per IBC, PHMSA and ASCE 7-10. See Table 1 for site specific criteria.
- Wind Exposure Category: C

2.8.5. Transportation Loading:

- The equipment shall be designed to accommodate transportation loads of 0.5 g horizontal in any direction and 0.33 vertical, up or down.

2.8.6. Ladders, Guardrails, Handrails:

- Per OSHA.

2.9. MATERIAL REQUIREMENTS

2.9.1. Base Loading Skid:

- Design shall conform to American Institute of Steel Construction (AISC) requirements. Materials shall conform to American Society for Testing and Material (ASTM) standards approved for structural use by AISC.
- Low temperature steel is required for all exposed structural framing.

2.9.2. Piping Materials

- All piping materials shall be standard English units (inches, feet, psi, etc.).
- Fittings shall follow standard recognized by ASME B31.3; ASME B16.5, ASME B16.9, B16.11, B16.49
- All materials shall have documentation traceable to their location of origin and heats.
- Unless otherwise specified in this document connecting piping shall be ASTM A105/106 for carbon steel piping and fittings or approved equal. Low temperature piping shall be ASTM A182 F304/304L or approved equal.

2.10. LIFTING AND TRANSPORTATION

The module shall be designed to be trucked to the site and lifted by crane onto the foundation. Components shall be designed to withstand all loads associated with transportation and delivery methods.

a. Lifting lugs shall be provided on the module for transportation and field handling by crane. Lifting lugs shall be designed for 100-percent impact or a load factor of 2.0 and utilizing a four-point lifting arrangement.

b. Allowable stress shall not be increased for load combined with impact/lifting.

c. Lifting lugs shall be designed and fabricated with low-temperature service steel in accordance with ASTM International (ASTM) A673 of 15 foot-pounds (ft-lbs) average/12 ft-lbs minimum at a temperature of -50 °F. (Charpy V-Notch [CVN] = 15/12 ft-lb @ -50 °F).

d. The equipment skid will be lifted from the carrier to final position using a four-point lift. Vendor shall provide overall shipping weight, center of gravity, lifting point reactions.

e. Vendor shall prepare module for transportation from the point of fabrication to Seattle or Tacoma, Washington. The design shall include means for transporting the module without damage. If intermediate transfers are required, the Vendor shall supply the spreader bar and rigging to be shipped with the module, as well as loading module and materials on trailers.

f. Prior to shipping, the equipment must be thoroughly cleaned inside and outside. Grit, scale, sand, water, moister, and all foreign material must be carefully removed.

g. The vendor is responsible for loading and anchoring all transportation components to prevent any damage during shipment including the installation of shipping supports as required. Adequate protection must be included to prevent the entry of dirt and contamination during shipment over land and sea including installation of shrink wrap around each module.

h. Remove and package securely external items that may be damaged in shipment such as exterior lights and instrumentation.

i. Provide protection under tie-downs to prevent damage to coated surfaces

j. Pack and crate all small parts. Provide Owner with list of contents and include in crate.

k. Provide assembly instructions, drawings and contractor support for on-site/destination assembly.

l. Design connections of shipped loose components to be flanged for ease of removal and reconnection.

2.11. COATING AND FINISHES

All structural steel surfaces shall be coated. The Vendor shall provide an industrial quality coating system that includes suitable surface preparation (cleaning and blasting), an inorganic zinc prime coat, epoxy intermediate coat, and urethane top coat. The system shall be in accordance with Section 6.1. Application shall be in accordance with manufacturer's requirements. Submit color for approval by Owner.

a. Heater, valves, instruments, light fixtures, heating and ventilation equipment, etc. shall be factory coated by manufacturer's standard coating systems. When available, coatings suitable for marine environment shall be selected.

b. Steel plate floor shall have non-slip additive in coating.

c. Steel grating shall be galvanized.

2.12. SIGNAGE AND MARKING

a. Piping shall be marked to show service and flow direction in accordance with ASTM standards (see Appendix A).

b. Name plates on vessels and equipment shall be oriented to be visible as installed and through/on top of insulation.

c. All instruments, valves, equipment and vessels shall be visibly marked with tag numbers using stainless steel tags.

d. At each piping connection point to equipment skid, provide marking indicating service and flow direction (in or out).

3. PROCESS SYSTEMS

3.1. SCOPE OF WORK

All piping, fittings, valves, equipment and vessels required to perform the outline process, including but not limited to, natural gas system, instrument air system, nitrogen system, blowdown/isolation system, and overpressure protection system.

3.1.1. LNG Pumps

New dedicated LNG truck loading pumps are envisioned to be external LNG pumps (not pot mounted submerged pumps) that may warm up between uses. During peak periods LNG pumps will run for extended periods without warm up between uses.

The LNG loading pump skid(s) shall include all framing, LNG pump and motor, associated valves, cool-down piping and overpressure protection. The LNG pump is designed to provide a minimum flow rate of 350 gallons per minute to each loading bay. The LNG pump skid will be located between the new LNG storage tanks and loading bays within the LNG secondary containment area noted on the preliminary layout drawing. Inlet and outlet block valves, check valve, recycle valve, and flow control valve are be required. The LNG transfer pump drive, located on the skid, shall be an inverter-duty motor (480v, 3Ph) with variable frequency drive included in this scope. Motor size to be determined by Contractor based on LNG facility design. The pump performance curve data shall be provided with vendor RFP proposal.

3.1.2. Truck Scales

Two truck scales are requested with this RFP. They shall be rated to operate in -30ºF temperature and shall meet section 2.20 of the National Institute of Standards and Technology (NIST) publication entitled *Handbook 44, Specifications, Tolerances and Other Technical Requirements for Weighing and Measuring Devices.*

The design truck should be assumed to be 53-feet long (does not include cab) and 42,000-pounds. Appendix B shows a site layout which will be finalized during detailed design.

Additional guidance can be found at:
http://dot.alaska.gov/mscve/assets/webdocs/17AAC25.pdf

3.1.3. Controls Kiosk (Optional)

A small kiosk is requested for the Operators to control the system to fill their trucks. As envisioned, this would be an approximately 6-foot x 6-foot enclosure, insulated and conditioned against the environmental conditions shown in Section 2.6. The vendor may choose to bid on this item if it is part of their standard offerings. It's absence in the bid package will not be weighed against prospective vendors. If excluded, controls for drivers should be configured and mounted so that they can be enclosed once delivered to the site.

3.2. DESIGN AND FABRICATION STANDARDS

Design and fabrication standards include the US national and Alaska state standards and regulations that govern design, fabrication and installation of the process systems. These specifications also include requirements specific to the Owner that are in addition to the national standards referenced.

- Where needed, vessels shall be designed and fabricated to requirements for ASME Boiler and Pressure Vessel Code Section VIII Division 1.

- The State of Alaska requires pressure vessels to be ASME stamped and registered with the State. Vendor shall provide required name plate data and documentation including U1-A data sheets with national board numbers. Owner shall be responsible for registering all pressure vessels.
- Process systems shall be tested in accordance with B31.3 and ASME Section VIII.
- Relief and depressing system shall be designed in accordance with API RP-520, API RP-521, and API STD-2000.
- Vessel materials of construction for sour service shall meet the requirements of NACE MR-0175/ISO 15156

3.3. DESIGN REQUIREMENTS

The schematic process layout is provided on the attached drawings (Appendix B).

3.3.1. Process Vessels

- Nameplates shall be of corrosion resistant material. On insulated vessels, nameplates shall stand-off a minimum of 1" beyond the insulation. The following information shall be stamped on the nameplate in addition to the ASME Code requirements:
  - Vessel name and equipment number
  - Purchase order number
  - National Board registration number
  - Vessel size, wall thickness, and head thickness
  - Shell material and head material
  - Design Temperature
  - Design Pressure
  - Manufacturer name and address
- The minimum documentation required for all pressure vessels shall include the following:
  - Vendor's Data Report Form U-l, U-lA, or UM Certificate of Compliance, as applicable.
  - Pressure relief calculations indicating the worst-case over-pressure scenario and sizing basis.

3.4. RELIEF AND DEPRESSURIZATION REQUIREMENTS

Relief and depressuring systems shall be designed in accordance with API RP-520 and API RP-521. Each cause of overpressure in API RP-521 shall be considered in determining the need for relief devices. Any relief device that is identified as "safety critical" in the Hazard Analysis shall be a required relief device. Each scenario for which that relief device has been identified as "safety critical" shall be included in the sizing basis for that relief device. Maximum flow loading scenarios shall be developed for each common-mode initiating event such as fire, ESD/OSD, utility failure, or overpressure relief. While most initiating events will result in either relief or depressuring but not both, a fire may result in combined relief and depressuring loads. Loads from events without a common-mode cause should not be combined. Depressurization and blowdown to the flare system shall be designed by the vendor with coordination from the owner. All relief valves on the truck skid shall be piped to a common header with a single flanged interface to the LNG facility vent/flare system, installed by others.

3.4.1. Relief Systems:

This overpressure relief protection will be in accordance with the American Society of Mechanical Engineers (ASME) pressure vessel code, API RP 520, API RP 521, API RP 14C and API RP 14J.

3.4.2. Emergency De-pressuring System:

Emergency De-pressuring (EDP) systems shall perform the following prioritized functions:

- De-inventory pressurized hydrocarbons to minimize the possibility of a stress rupture or Boiling Liquid Expanding Vapor Explosion.
- Reduce the intensity and duration of a possible fire or release from loss of containment.
- Protect equipment such as compressor seals.

The EDP system shall be fail-safe and include a fire sensitive element on the actuator supply for immediate de-pressuring. All emergency de-pressuring shall go the Flare or owner defined relief system. Primary design guidance is API 521.

3.4.3. Emergency De-pressuring Valve:

EDP valving shall be a fail open, actuated ball or gate valve. A restriction orifice shall limit the de-pressuring rate to within the capabilities of the downstream flare equipment, where required, while still meeting criteria for duration of de-pressuring. Special tight shutoff, tortuous path valves, or actuated chokes may be used for high pressure drop de-pressuring. The valve testing regiment will be finalized in final negotiations with Vendor. All EDP stations shall be reviewed for the potential for back flow and the results of the review will be included in the HAZOP findings.

3.4.4. Depressuring Requirements:

Depressuring requirements are defined individually for each segment of a system that would be automatically isolated during an ESD. At a minimum, depressuring capability shall be provided for all such segments within the battery limits of the plant (i.e. excluding pipelines) that, in normal operation, contain at least 200 lb of gas-phase material, and that meet any one of the following criteria:

- Systems that contain more than 4 tons of hydrocarbon or other flammable material.
- Pressure vessels that operate at or above 75 psig
- Piping 4" and larger that operates above 300 psig
- When performing hydraulic calculations to establish a relief load, the upstream system pressure may be assumed to be at the upstream system’s normal operating limit.
- Required blowdown rates shall be evaluated separately for each ASME Section VIII covered vessel, and the blowdown system design shall ensure that the pressure in each such vessel remains below the limits shown in API-521, Figure A.5 during the first 30 minutes after the initiation of a blowdown. Piping smaller than 24” shall be blown down to 35% of its MAOP in 20 minutes or less.
- Note that the above criteria represent maximum permissible depressuring times. The sizing of depressuring valves and staging controls shall be optimized for the shortest overall blowdown without exceeding any flare system piping or equipment design limits.

- New systems should always be designed for inlet losses below 3%.
- Where remote sense lines are used with redundant PSVs in new construction, independent sense lines and taps shall be provided for each PSV. Pilot operated PSVs shall be designed or equipped with devices to prevent opening in reverse pressure conditions.
- Set points of multiple relief valves shall be staged to reduce chattering. If the set point of any of the valves in a set is higher than the nominal system design pressure, the designer shall ensure that full flow requirements are reached without exceeding allowable overpressures.
- Temperatures due to auto-refrigeration from the pressure drop across relief, depressuring, or vent valves shall not exceed the equipment design limits at any point in the disposal system.
- All control valves discharging to the flare system and/or atmosphere shall be specified as tight-shut-off (TSO) to prevent wet gas leaks into the flare system or atmosphere. ESD valves shall be matched to the line size and shall also be tight shut off.

4. PROCESS INSTRUMENTATION

4.1. SCOPE OF WORK

The Instrumentation scope of work includes the design, construction, pre-commissioning and packaging for delivery of the of the Loading Skid instrumentation and control system. The design shall include all instrumentation and controls required for safe operation, overfill avoidance, custody transfer accounting and user authorization.

The Instrumentation and Control system shall be tested, inspected, and functionally checked before transport. Before transport, all instruments are to be removed and securely packaged for transport.

4.2. DESIGN STANDARDS

4.2.1. Industry Codes and Standards

a. NFPA 70, National Electrical Code (NEC), 2017 Edition as amended and adopted by 8 AAC 70.025.

b. NFPA 70E, Standard for Electrical Safety in the Workplace

c. API RP 500, Recommended Practice for Classification of Locations for Electrical Installations at Petroleum Facilities Classified as Class I, Division 1 and Division 2 (2012)

d. NFPA 496, Standard for Purged and Pressurized Enclosures

e. NFPA 497, Recommended Practice for the Classification of Flammable Liquids, Gases, or Vapors and of Hazardous (Classified) Locations

f. API RP 500, “Recommended Practice for Classification of Locations for Electrical Installation at Petroleum Facilities Classified as Class I, Division 1 and Division 2.”

g. API RP 521, “Guide for Pressure – Relieving and Depressuring Systems.”

4.2.2. National Organizations

- IEEE, Institute of Electrical and Electronics Engineers
- ISA, Instrument Society of America
- NFPA, National Fire Protection Association
- NEMA, National Electrical Manufacturers Association
- FM, Factory Mutual
- UL, Underwriters Laboratories, Inc.
- OSHA, Occupational Safety and Health Administration

4.2.3. Labeling

a. All electrical instruments and conductors shall be labeled by a Nationally Recognized Testing Laboratory, (NRTL) and suitable for installation in Class I, Division 2, Group D hazardous locations. The NRTL label shall be based on Occupation Safety and Health Administration (OSHA) approved National Standards Testing Laboratories.

4.3. DESIGN REQUIREMENTS

4.3.1. Control System

a. Vendor shall be responsible for providing a complete and operable control system in accordance with applicable industry codes and standards, government regulations, state codes and regulations and project technical requirements.

b. Vendor is responsible for developing a complete system operating philosophy, including safe charts, in accordance with applicable industry codes and standards, recommended practice, and project technical requirements. The control philosophy is to be submitted to the Owner for review and approval.

c. All alert, alarm and shutdown functions for the control system to provide safe and reliable operation, personnel protection, and equipment protection shall be provided.

d. Devices shall read and transmit in US customary units (psig, degrees F, etc).

4.4. PREFERRED MANUFACTURERS

Vendor is responsible for confirming suitability of instrumentation; alternate instrument selections may be used with approval from Owner.

4.4.1. LNG loading pumps

- Cyrostar
- ACD

4.4.2. Pressure Transmitters:

- Rosemount 3051 Series

4.4.3. Temperature Transmitters:

- Rosemount 644 Series

4.4.4. Flow Transmitters:

- Rosemount 3095 Series

4.4.5. Level Switches:

- Linc L471 Series

4.4.6. Pressure, Temperature Gauges:

- Ashcroft

4.4.7. Solenoid valves:

- ASCO

4.4.8. Stainless Steel Tubing, valves, and fittings:

- Swagelok

4.4.9. Pressure Safety Valves:

- Anderson Greenwood

4.4.10. Control Valves:

- Fisher with DVC6200 I/P Converter

4.4.11. Valve Actuators:

- Bettis (pneumatic)

4.4.12. Valve Position Switches:

- Topworx Valvetop series

4.4.13. Instrument Isolation Valves and Manifolds:

- Anderson Greenwood

4.4.14. Terminal Boxes

- Hoffman, NEMA 4X, stainless steel, continuous hinge or approved equal

4.4.15. Ground Assurance

- Skully Groundhog or approved equal

5. MECHANICAL PIPING SYSTEMS

5.1. SCOPE OF WORK

All piping, fittings and valves required to perform the process required, including but not limited to, natural gas system, connection to flare system, instrument air system, utility air system and nitrogen system on the LNG loading skid and LNG pump skid.

a. Routing and design of piping.

b. Support and anchoring of piping, vessels and equipment.

c. Fabrication and erection of piping on provided skids.

d. Coating on pipe, vessels and supports.

e. Insulation on piping, vessels and equipment.

f. Heat trace.

g. Markings and tagging, to include arrows on process piping depicting direction of flow.

h. System integrity inspection and tests.

i. Process safety equipment (shut-down, PSV etc.)

j. Required pumps

Process and utilities on the truck skid; LNG, LNG vapor, natural gas system, connection to vent/flare system, instrument air system, and nitrogen system each shall be piped to a common header on the LNG truck loading skids with a single flanged interface for each utility. Utility supply from existing LNG facility utility systems will be piped to the truck skid by others.

5.2. DESIGN STANDARDS

Design and fabrication standards include the US National and Alaska state standards and regulations that govern design, fabrication and installation of the piping and process systems. These specifications also include requirements specific to the Matanuska-Susitna Borough that are in addition to the national standards referenced.

5.2.1. Piping Systems

Piping systems shall be in accordance with ASME B31.3. Vendor piping should be compatible with their service and tie-ins where connecting to plant piping. A summary of the anticipated plant facility line classes is included below:

Table 2:Piping Line Class Summary

CLASS	SERVICE	Design Code	Design Press.	Min./Max. Des. Temp	Corrosion Allowance	Material Type
A	Flare Lines	ASME 31.3	ANSI 150	-20 º F / 800 º F	0.125 inches	ASTM A 182 316L
B.6	Moderate Temperature process piping – Natural gas, utility gas	ASME B31.3	ANSI 600	-20 º F / 150 º F	0.063 inches	ASTM A105/106

B.6	High Temperature process piping – Natural gas	ASME B31.3	ANSI 600	-20 º F / 600 º F	0.125 inches	ASTM A105/106
C.3	Low temperature piping – Natural gas/LNG, cryogenic Nitrogen	ASME B31.3	ANSI 300 (1)	-320º F/ 100º F	0.031-inches	ASTM A182 304/304L
C.6	Low temperature piping – Natural gas/LNG, cryogenic Nitrogen	ASME B31.3	ANSI 600 (1)	-320º F/ 100º F	0.031-inches	ASTM A182 304/304L
WL	Plant Air, Instrument Air, Nitrogen	ASME B31.3	ANSI 150	-20 º F/ 150 º F	0.063 inches	ASTM A105/106
Notes: Use of flanges should be minimized or avoided in piping associated with LNG.						

Pipe, vessel, equipment supports and anchoring shall be designed to meet the requirements of B31.3 and the International Building Code (IBC).
Piping, vessels and structure shall be coated, insulated and jacketed in accordance with this specification (see Section 6).

5.3. DESIGN REQUIREMENTS

5.3.1. Routing and Design

Piping systems shall be designed with reference and adhere to CFR: 29.1910 OSHA Standards, MSS: SP58 Pipe Hanger and Supports, ICC: IBC (Seismic and Wind Loading),

a. Lines shall be spaced to allow sufficient clearance for installation, inspection, maintenance and retrofit. Flanges, valves, instrumentation, insulation, hold downs, module-to-module assembly requirements, etc. shall be considered.

b. Spacing and routing of piping shall be such that expanding lines (including insulation) do not touch an adjacent line, utility line, instrument tubing, electrical conduit, equipment or structures.

c. Tie-in points for piping on packaged skids should be brought to the edge of the skid and terminate in flanged connections.

d. PSV discharge lines should be self-draining and connections to headers shall be to the top of pipe. Elevation of Module header and interface flange connection orientation to be coordinated with the Owner.

5.3.2. Support and Anchoring

The piping system should be designed to have adequate flexibility to prevent pipe movement from causing overstress of pipe or support material, leakage at joints, or distortion of connected equipment due to excessive forces or moments and thermal expansion. Piping should be supported to minimize vibration and piping stresses by using anchors, guides, supports, and structural bracing.

a. Maximum support spacing on packaged skids should be 8 feet.

b. Consideration should be given to piping flexibility on package equipment due to weight and stiffness caused by short runs and close connections of flanges, valves and other piping components.

c. Pipe support structures on a skid may be combined with support structures for other services such as instrumentation lines and electrical conduit to promote an orderly layout.

d. Adjustable supports should be provided for both inlet and outlet piping connected to heat exchangers and similar equipment on which the manufacturer has imposed limits on nozzle loads, and elsewhere when growth or movement from thermal expansion is required. Use of expansion joints requires owner's approval.

e. Relief discharge piping and supports should be so designed that stresses induced by connecting lines should not overstress the relief valve body (consider reactive forces during discharge). Supports and connections should be arranged to facilitate removal and replacement of the relief valve.

f. All lines in modules and skids should be tied down for shipping to minimize the excessive forces encountered in shipping or transport.

5.3.3. Fabrication

Welding and fabrication of the piping and equipment shall be in accordance with: ASME B31.3 "Process Piping"; ASME Section II Part C "Material Specification, Welding Rods, Electrodes, and Filler Metals"; ASME Section VIII, DIV 1 "Pressure Vessels"; ASME Section IX "Welding and Brazing Qualifications"; and this specification. Skilled welders only shall be employed; each shall hold a currently active certificate, dated within 12 months, from a recognized testing laboratory, indicating satisfactory welding test results. Retest is required if welder has not performed welding for a period of 90 days. Submit welder qualifications for owner approval prior to welder performing any welds.

a. Adjacent girth butt welds shall be separated by a minimum of 3/4" or 3 times the wall thickness, whichever is greater.

b. For nozzle or branch connections (non-pressure containing portions such as reinforcing pads are not included) that are on or are separated from a pressure containing butt weld by less than 3/4" or 3 times the wall thickness, whichever is greater, the butt weld shall be radiographed.

c. All socket welds shall have a minimum of 2 pass fillet welds.

d. Backing rings shall not be used.

e. Filler metal shall be added for all weld passes. Fusion only root pass welding is prohibited.

f. SMAW stringer bead width is restricted to a maximum of 3 times the electrode core diameter.

g. Weave or cap bead passes may be up to ¾" maximum.

h. Arcs shall be struck only on fusion faces. Accidental contact of the electrode shall be avoided. If accidental contact occur, the areas of contact shall be repaired.

i. All weld examinations shall be in accordance with ASME B31.3.

j. All NDE operators shall be certified in accordance with ANST standard SNT-TC-1A Level II. All Welding inspection personnel shall be certified in accordance with AWS QC-1.

5.3.4. Markings and Tagging

Listed in Appendix A is designation of a color band indicator for each type of piping system. Each pipe should have an arrow next to the color band depicting the direction of flow.

5.4. INSPECTIONS AND TESTING

All inspection and examination of welds will be provided by the Vendor. Welding inspections shall adhere to ASNT SNT-TC-1A "Recommended Practice for the Qualification and Certification of NDE Personnel"; ASTM A370 "Standard Test Method and Definitions for Mechanical Testing of Steel Products"; ASTM E10 "Test for Brinell Hardness of Metallic Material";

5.4.1. Weld Examinations

- Weld examination levels shall be based on service class as follows:

  Group 1 - Non Pressure Piping
  Group 2 - Utility Piping
  Glycol (except where part of process such as gas dehydration), Potable Water, Air, Nitrogen, Fire Water, Seal Oil, Lube Oil, Halon and all ASME B31.3 Category D Fluid Service.
  Group 3 - 600# ANSI and Lower Process Piping
  All Hydrocarbon Fluids and Gases, Chemicals (Corrosion Inhibitor, Scale Inhibitor, Methanol, etc.), Produced Water, Seawater, Miscible Injectant.

- Branch Connection Welds

  Group 1 - Non Pressure Piping
  No additional requirements.
  Group 2 - Utility Piping
  No additional requirements.
  Group 3 - 600# ANSI and Lower Process Piping
  Ten percent of the completed welds shall be examined by the Dye Penetrant or Magnetic Particle method. For each weld found unacceptable, two additional welds will be examined.

- Radiographic Examination (RT)

Welds to be radiographed shall be representative of each welder's work, each welding procedure, each welding position, and each pipe size. Additional RT due to unacceptable welds shall be in accordance with ASME B31.3, Para. 341.3.4. Weld repairs to base material and completed welds shall be 100 percent radiographed. The entire circumference of joints made with different nominal bores shall be radiographically examined. Girth Welds shall be examined in accordance with the requirements of Table 4.

5.4.2. Material testing

Table 3: Inspection Requirements

INSPECTION AND ACCEPTANCE REQUIREMENTS			
SERVICE	SHOP GIRTH WELDS	FIELD GIRTH WELDS	O-LET BRANCH CONNECTIONS AND SOCKETWELDS
GROUP 1 Non Pressure Piping	• 100% Visual	• 100% Visual	• 100% Visual

GROUP 2 Utilities Piping	• 100% Visual • 10% RT (see note 2)	• 100% Visual • 10% RT (see note 2)	• 100% Visual
GROUP 3 600# and Lower Process Piping	• 100% Visual • 10% RT (see note 2)	• 100% Visual • 10% RT (see note 2)	• 100% Visual • 10% PT/MT (see note 3)

Notes:

(1) Except as specified for Extreme Service, acceptance criteria for B31.3 piping to be for "Normal Service Conditions" as per Table 341.3.2.a, except for stainless: no incomplete penetration.

(2) The following conditions shall apply throughout:

- A minimum of 10% of each welders work shall be radiographed.
- Additional radiographic coverage shall be dependent upon individual welder's performance in accordance with ANSI B31.3, Paragraph 341.5.
- All tie-in welds shall receive the following:

For B31.3 piping, “In-Process” weld examination as defined in B31.3 Section 344.7.

(3) Group 3 and Group 4 socket welds require 100% visual only, unless otherwise specified by the Owner.

5.4.3. Material Testing

Table 4:Material Testing Requirements

CHARPY V-NOTCH IMPACT TEST REQUIREMENTS		
Type of Steel	Wall or Plate Thickness (in.)	Impact Values (ft-lb)
Low Yield – SMYS < 52,000 psi	< 1” 1” – 2” > 2”	15/12 20/16 25/20
High Yield – SMYS ≥ 52,000 psi	All	30/25
Austenitic Stainless Steel	All	Minimum 0.015 in lateral expansion

Notes:

(1) In the notation such as 15/12, the first number is the minimum average energy in ft-lb of three specimens while the second number is the minimum for one specimen when full-size specimens are used, i.e., a 10 mm x 10 mm cross-section.

(2) Impact values are applicable to the base metal, weld metal, and heat affected zones.

(3) Impact test specimen shall be oriented parallel to the longitudinal axis of the pipe with a notch oriented through the pipe wall thickness.

5.4.4. Hydrostatic Pressure Testing

Hydrotest will be performed on all module process piping in accordance with ASME B31.3. For new module construction, pressure testing shall be done at the fabrication site.

- Before testing, piping systems shall be inspected to ensure:
  - All work on piping system is complete.
  - Piping system can be completely drained after testing (including equipment, valve bodies, etc.).
  - All welds have passed all required inspection and examinations.
  - Test blinds are installed at the correct locations.

- Test equipment set-up is correct.
- All joints are uncovered.

- All process piping shall be pressure tested at the minimum test pressure (not less than 1.5 times design pressure hydrostatically). The test pressure shall be maintained for a sufficient time to determine that there are no leaks, but shall not be less than 10 minutes.

- Where a grouping of pipe systems and equipment are tested as a system, the determination of the minimum test pressure shall take into account the maximum permissible test pressure of all lines and components in the system.

- During pressure tests of the main process piping systems, the impulse piping or tubing that supplies instruments downstream of the primary block valves shall be disconnected. The primary block valves shall be in the opened position, with the open end plugged or blinded.

  The effect of hydrostatic head shall be considered when determining correct pressure reading and safe and/or effective test pressure of any element within the system.

- The test pressure shall not be applied until equipment, the piping, and its contents reach approximately the same temperature.

- The minimum test temperature is dependent on the type of materials in the system being tested and the test medium being used, and shall be considered in each case to ensure against brittle fracture during test.
  - When testing through vessels, the metal temperature shall not be less than 60°F. Deviation from this requirement requires Owner approval.
  - Piping systems shall be tested at metal temperatures 30°F or more above their lower operating temperature, unless otherwise directed by the Owner.

- The following items shall be removed from the line:
  - Filters or the filtering element.
  - Expansion joints which cannot be secured against deformation during testing.
  - Orifice plates.
  - Thermometers and thermal elements from thermowells.

- The following items shall not be subjected to pressure testing and shall either be disconnected from the piping or isolated by blinding or by other means during the test:
  - Pressure safety valves.
  - Pressure gauges. (Gauges shall be installed after the pressure test.)
  - Pressure Transmitters
  - Gas Analyzers
  - Rupture discs.
  - Flame arrestors.
  - Sight glasses.
  - Positive displacement meters.
  - Turbine type flow meters.
  - Vane type flow switches.
  - Pressure regulators.
  - Vessels and heat exchangers which have been shop hydrotested need not be included in the system test. System hydrostatic testing through vessels is

strongly discouraged and may only be performed with the direct participation of the Owner's 'Authorized Pressure Vessel Inspector'.
    - Other sensitive equipment.
    - Equipment that cannot be drained.
    - Equipment that will be deleteriously affected by the testing medium.
    - Other equipment designated by the Owner.
- The following records shall be retained and provided (in English) to the owner
    - Test records for temperature and pressure (circle chart or equal).
    - Records of test equipment calibration. Must be within 6 months of test.
    - Name of operator, the name of the person or company responsible for the test.
    - The date and time of the test.
    - The minimum test pressure.
    - A description of the test facility and testing apparatus.
    - A description of any pressure discontinuities if any.

6. THERMAL INSULATION

6.1. EXTERNAL COATINGS

All carbon or low alloy steel exposed to the atmosphere shall be coated. Flanges shall be coated.

a. Unless otherwise specified do not coat non-metallic surfaces, metal jacketing or weatherproofing on insulation, stainless steel, galvanized surfaces (nickel, aluminum and copper) alloys, or grease fittings.

b. Do not coat surfaces within 2" of edges to be welded.

Coating types will vary depending on the design parameters (operating temperature range, whether above or below grade, if the structure is insulated, color coding requirements/requests, products that the coatings may be exposed to, type of materials they will be applied to, etc.) of each system (piping, tanks, structural steel, etc.) they will be applied to. Vendor to provide proposed specific coatings to be finalized during final negotiations with Vendor.

6.1.2. Insulation and jacketing

Valves, flanges, man-ways and similar item shall have removable covers.

a. All materials shall be free from asbestos and chemically neutral.

b. Insulation for piping ductwork and equipment made from austenitic stainless steels shall conform to the requirements of ASTM C795.

c. Straight run pipe insulation and elbows shall be secured with 16 gauge stainless steel wire installed on maximum 18" centers (elbows minimum 3 wires per elbow).

d. Equipment sidewall insulation shall be secured with ¾" stainless steel bands on maximum 180" centers.

e. Metal jacketing shall be applied over all insulated surfaces. All seams shall overlap minimum of 2" and arranged to shed water. All outdoor seams shall be sealed.

f. Straight run pipe and elbow jacketing shall be secured with ½" wide stainless steel bands on maximum 12" centers (elbows secured on each end). Screws shall be used on the longitudinal seams as necessary to prevent "fish mouthing"

g. Equipment insulation jacketing shall fit the contour of the head and overlap to shed water. Seams shall be secured with sheet metal screws on 4" centers. The head jacket shall overlap the shell jacket and be secured with ¾" stainless steel bands. All outdoor seems shall be sealed.

6.2. COLD INSULATION

Modules and interconnecting pipe spools that require cold insulation shall be insulated during final assembly at the shop prior to shipping.

Prior to insulating, the pipe exterior surfaces shall be cleaned and coated.

Commercially available cold service thermal insulation recommended for cold preservation and personnel protection of process piping for the LNG truck loading process:

- PIR – TRYMER 3000, ASTM C591, Grade 2, Type III, thermal Polyisocyanurate (PIR) insulation, R-factor 5.3/inch for piping and equipment.
- Cryogel Z ASTM C 1728, Type I, Grade 1, Category B

The following products are suitable weather jacketing:

- INSUL-MATE ™ Stainless Steel Jacketing
- ITW Pabco/Childers Painted Aluminum Roll Jacketing

Exceptions to the above coatings, insulation, and jacketing will be considered on a case by case basis.

7. ELECTRICAL SYSTEMS

7.1. SCOPE OF WORK

The Electrical scope of work includes the design, construction, pre-commissioning and packaging for delivery of the Loading Skid electrical distribution system. The design shall include all electrical interconnections on the skids.

All 480V and 208Y/120V powered devices shall be wired to UL 1773 listed termination boxes located at the edge of each skid. There shall be one termination box per voltage. Power supply to the termination boxes from the facility power distribution system will be provided by Others. Power supply for 4160V motors will be provided directly to the motor terminal boxes by Others.

The Electrical system shall be tested, inspected, and functionally checked before transport to Point MacKenzie. Owner shall approve all testing reports prior to shipment.

7.2. DESIGN STANDARDS

7.2.1. Industry Codes and Standards

a. NFPA 70, National Electrical Code (NEC), 2017 Edition as amended and adopted by 8 AAC 70.025.

b. NFPA 70E, Standard for Electrical Safety in the Workplace

c. API RP 500, "Recommended Practice for Classification of Locations for Electrical Installations at Petroleum Facilities Classified as Class I, Division 1 and Division 2," 3rd Edition

- NFPA 497, Recommended Practice for the Classification of Flammable Liquids, Gases, or Vapors and of Hazardous (Classified) Locations

7.2.2. National Organizations

a. IEEE, Institute of Electrical and Electronics Engineers

b. ISA, Instrument Society of America

c. NFPA, National Fire Protection Association

d. NEMA, National Electrical Manufacturers Association

e. FM, Factory Mutual

f. UL, Underwriters Laboratories, Inc.

g. OSHA, Occupational Safety and Health Administration

h. AKOSH, Alaska Occupational Safety and Health Section

7.2.3. Electrical Equipment and Wiring

a. All electrical equipment and wiring shall be labeled by a Nationally Recognized Testing Laboratory (NRTL). The NRTL label shall be based on Occupation Safety and Health Administration (OSHA) approved National Testing Laboratories.

b. The electrical installation shall comply with the National Electrical Code (NEC) and National Electrical Contractors Association (NECA) standards of installation (90-2015, 120-2012, 202-2013, 230-2016, etc.).

c. Provide conduit and cable seals at all hazardous location boundaries and as required per NEC Article 501.

d. Special care shall be taken to ensure that the furnished equipment and components are suitable for sub-Arctic duty. During normal operation the module will be heated to a minimum 40 °F. However, during transit, storage, nonoperational periods prior to commissioning, power outage, or shut-down the temperature inside the module may reach the minimum design temperature (-30°F). During these conditions, the equipment and components shall be capable of withstanding (without damage) this temperature. The Vendor shall state in detail what special precautions shall be taken, if any, and the time required to recommission the equipment from this state.

7.3. DESIGN REQUIREMENTS

7.3.1. Area Classification

All electrical equipment located shall be suitable for installation in a Class I, Division 2, Group D, outdoor, unheated location.

7.3.2. Power Requirements

- Power will be provided by others from the Point Mackenzie electrical distribution system. The following voltages are available:

Voltage	Available Fault Current
480Y/277V, 3P, 4W	35,000A
208Y/120V	10,000A

- Power for motors above 1 HP: 480VAC, 3-Phase, 60 Hz. Power for motors 1 HP and lower: 120VAC, 1-Phase, 60 Hz.
- Vendor shall provide explosion proof, combination motor starters with circuit breaker disconnects for all motors. Provide (3) interposing relays for remote shutdown signal inputs.

7.3.3. General Requirements

a. Conduit and cable seals will be poured by Others once the skid is installed on site.

b. All equipment, instrumentation, conduit, cable and wiring must have a form of identification in reference to Vendor provided shop drawings and terminal layouts.

c. Service receptacles and area lighting will be provided by Others once the skids are installed on site.

7.3.4. Grounding

a. All electrical equipment and enclosures shall be effectively grounded to skid steel according to the requirements of the NEC.

b. Each skid shall include two grounding tabs to allow the skid to be bonded to the site grounding system using cables terminated with two-hole lugs with ½” holes spaced 1-3/4” on center.

c. Insulated equipment grounding conductors shall be installed in all conduits and cables.

7.4. MATERIALS

7.4.1. Conduit, Wiring and Cable

a. The use of MC-HL type cable is preferred.

b. All low voltage power cable and conductor wiring insulation shall be XHHW-2, 600V.

c. All wire and cabling shall be copper.

d. Power conductors shall be #12 AWG, minimum.

e. Cable terminator fittings used for exterior terminations shall be nickel-plated brass.

f. Normal polyvinyl chloride (PVC) material deteriorates at temperatures below minus 20°F. Normal PVC material shall not be used.

g. Conduit shall be 3/4" (minimum) aluminum or galvanized steel RMC.

h. All conduit and cable shall be secured and supported per NEC with vibration isolation support clamps.

i. ½" explosion proof flex couplings may be used for connections to field devices with ½" entry holes.

j. Where flexibility is required, flexible-steel conduit shall be "liquid tight." Strict adherence to the manufacturer's bending radius shall be observed. All instruments and vibrating equipment shall be connected with flexible conduit. Only low-temperature Listed liquid-tight flexible-metal conduit shall be used. Fittings shall be listed for use with liquid-tight flexible-metal conduit.

k. All fittings, seals, breathing vents, drains, junction boxes, and conduit bodies shall be copper free aluminum, Crouse Hinds or approved equal.

l. The use of any type of pipe or pipe fittings for supports, conduit or cable sleeves is not acceptable.

m. All mounting hardware (nuts, bolts, etc) shall be stainless steel.

7.4.2. Terminations

a. Wire-nuts are unacceptable.

b. Control wiring may terminate at screw-clamp type terminals specifically designed to accept stranded wire without lugs attached.

c. All wire terminations for stranded wires #10 AWG and smaller shall be either at terminals or compression type, single bolt lug, tinned copper only, T&B Sta-Kon, with nylon insulation.

d. All wire termination for stranded wires #8 AWG and larger shall be Burndy Type YA, tinned copper compression type lugs only.

7.4.3. Motors

a. Motors provided with over-temperature switches must have the over-temperature switch wired into the control circuit.

b. Motor starters must come equipped with all needed cable penetrations pre-drilled from the factory.

c. Motors located within hazardous areas shall be listed and labeled for the area classification.

7.5. PREFERRED MANUFACTURERS

7.5.1. Terminations

a. Motor terminations shall be made with Thomas & Betts Motor Pigtail connectors for low voltage motors.

b. Compression lugs shall be installed using ratcheting type compression tool approved for use with specific lugs.

7.5.2. Safety Switches and Disconnects

a. For circuits rated 20A and less: Cooper Crouse-Hinds EDS or EFD series or approved equal

b. For circuits rated 30A and greater: Cooper Crouse-Hinds EBMXD series or approved equal

7.5.3. Combination Motor Starters

Cooper Crouse-Hinds EBMXS or approved equal series

7.5.4. MC-HL Cable and Wire

a. Okonite or approved equal

7.5.5. Conduit bodies

a. Cooper Crouse-Hinds EAB or GUA series or approved equal

7.5.6. Junction Boxes

a. Hoffman, NEMA 4X, stainless steel, continuous hinge or approved equal

8. CONTROL SYSTEM

Control systems for LNG Truck and pump skids are included by vendor with the prefabricated modules and will interface with the existing LNG facility control systems for monitoring and safety systems. This includes:

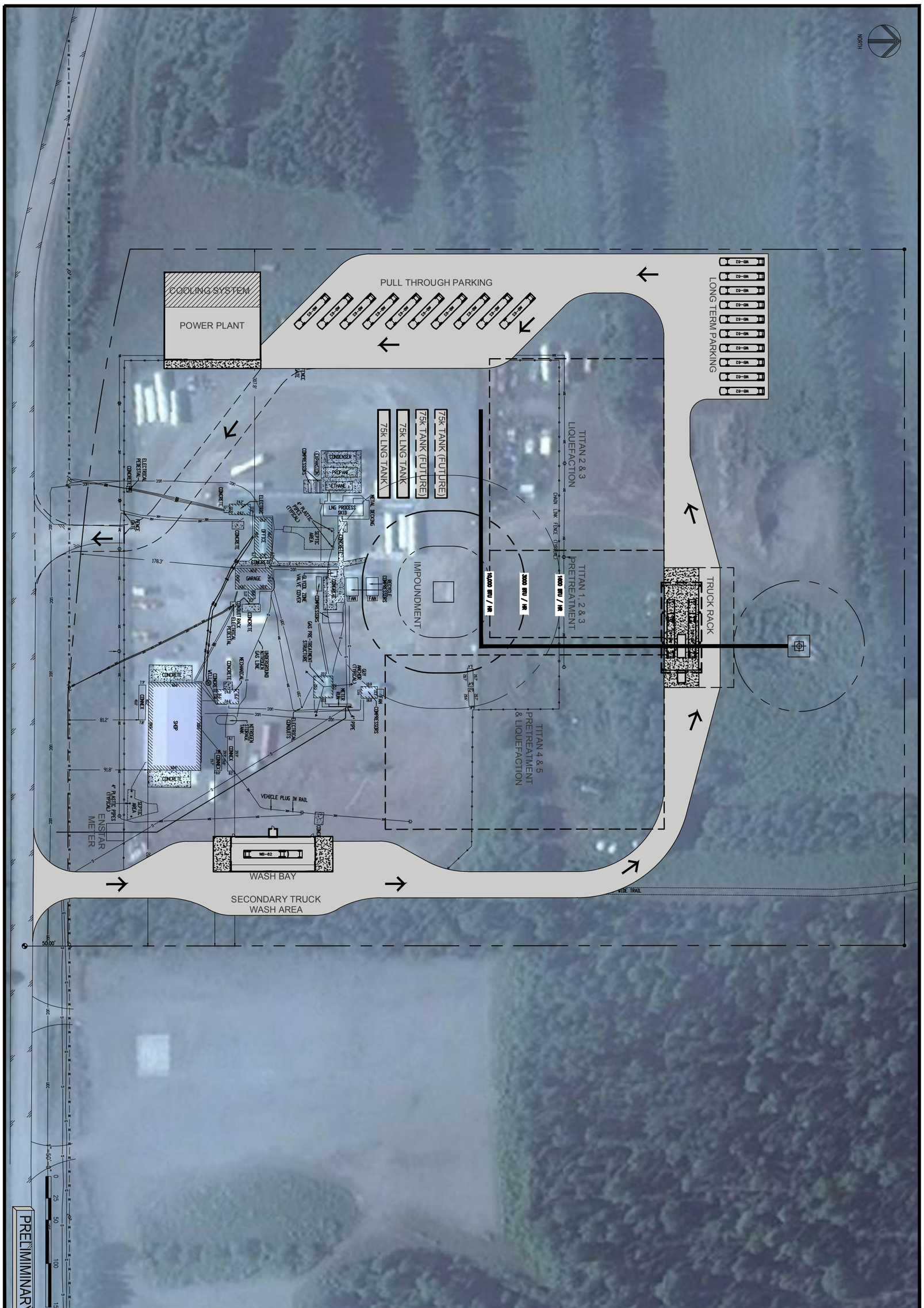
- PLC Plant Controls
- ESD shutdown and isolation
- Fire & Gas Hazard detection system
- Custody Transfer Monitoring, Historian, and Truck Loading area HMI
- CCTV
- Intercom

APPENDIX A: PIPING SYSTEMS

A.1 PIPING SYSTEMS COLOR CODING

Piping Systems Color Coding	
Air – Plant or Instrument	Green
Chemicals – Special Service	Yellow
Firefighting – Water, Halon, Chemical	Red
Gas – Fuel	Yellow
Gas – Produced or Flare	Orange
Gas – LNG	Blue
Hydrogen Sulfide	Orange w/Black Stripes @ 45°
Methanol	Pink
Nitrogen – Liquid or Gas	Tan

APPENDIX B: GENERAL ARRANGEMENT DRAWING



SHEET NO.	C1.00	INTERIOR GAS UTILITY POINT MACKENZIE - TITAN LNG EXPANSION SITE PLAN			COFFMAN ENGINEERS 800 F Street Anchorage, AK 99501 ph 907.276.6664 www.coffman.com AECC249	REV	DATE	REVISED	DRWN BY	REV BY	CHK BY
SCALE	AS NOTED		INTERIOR GAS UTILITY 2449 INTERNATIONAL WAY FAIRBANKS, ALASKA 99701 (907) 488-7544 FAX (907) 457-8444			A	XX/XX/XX	DESC	XXX	XXX	XXX
DRAWN	FRISON										
DESIGN	FRISON										
DATE	04/XX/2019		CLIENT JOB NUMBER 000000		JOB NUMBER 190440						