INTERIOR GAS UTILITY

CLEAN LOW COST NATURAL GAS FOR THE INTERIOR

RFP 13-2019
Liquefied Natural Gas Storage Tank(s) – Request for Proposal

BRAEMAR

COFFMAN ENGINEERS

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ABBREVIATIONS AND DEFINITIONS

Acronyms, Abbreviations	
CFR	Code of Federal Regulations
ESD	Emergency shutdown
gpd	gallons per day
IGU	Inter Gas Utility
LNG	liquefied natural gas
NFPA 59A	National Fire Protection Association's "Standard for the Production, Storage, and Handling of Liquefied Natural Gas (LNG)"
PHMSA	Pipeline and Hazardous Materials Safety Administration
ppm	parts per million
psig	gauge pressure in pounds per square inch

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 are the LNG storage tank(s) for Phase 1 with pricing option for a third tank.

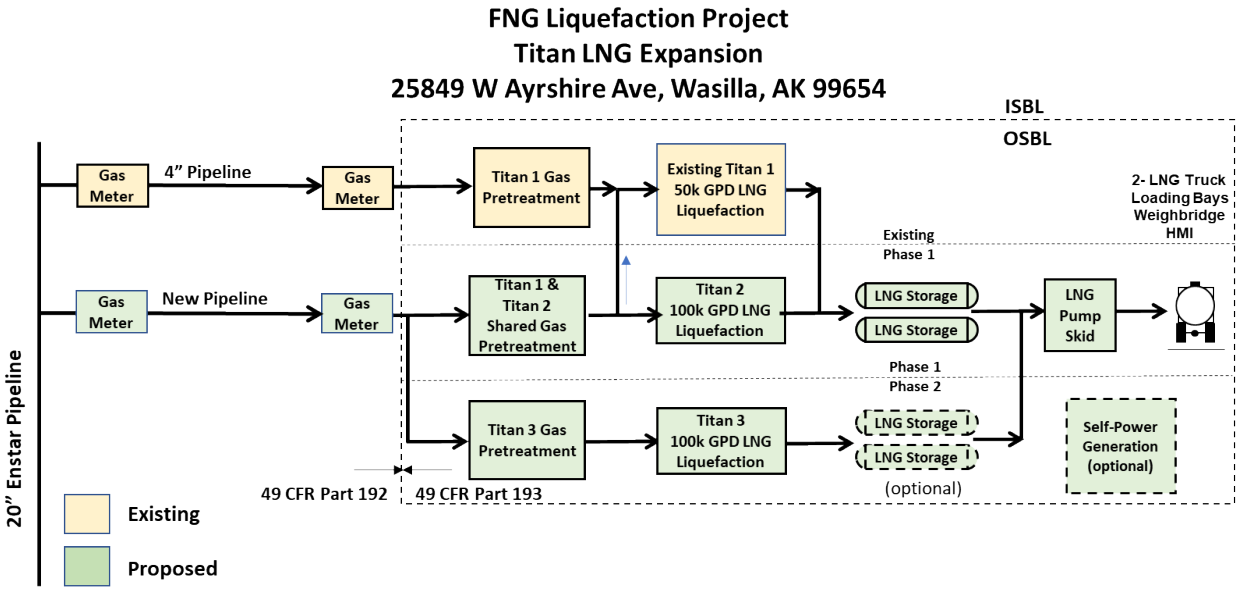


Figure 1 - Titan Phased Approach Block Diagram

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 tanks may be required for Titan 3 but a separate RFP will be issued in the future (in about 2 years).

A joint team of Braemar and Coffman Engineers has prepared this RFP package which provides the design philosophy and minimum design basis for 75,000 gallons of LNG storage. Single or multiple horizontal (bullet) tanks with net 75,000 gallon capacity each is preferred. Single 150,000 tank or additional tank sizes and configurations will be considered as options, provided they can be delivered to the site (can be trucked) and produce a cost savings. Barging to Point Mackenzie may be a possibility for suppliers to consider for tank size (trucking from Anchorage through Wasilla would not be required in that case). The project is requesting the following options in the quote:

Table 1: Tank Delivery Options

Option 1	One (1) 75,000-gallon tank
Option 2	Two (2) 75,000-gallon tanks

Option 3	Three (3) 75,000-gallon tanks phased in 2020, 2021 and 2022 (a year apart)

The project site is located in a high seismic region of Alaska where additional measures may be needed in the LNG tank design to comply with LNG code requirements for this location. The LNG tank and its supports shall be designed for the resultant seismic forces in combination with the operating loads, using the allowable stress increase shown in 49 CFR Part 193, NFPA 59A 2001 edition, Section 4.1.3.8, and ASME Boiler & Pressure Vessel Code Section VIII, Division 1, Mandatory Appendix 44, to design the tank or its supports.

1.2. SCOPE OF WORK

The scope of work includes the design, fabrication, assembly, shipment to the project site, support of final assembly at the site, and commissioning of the LNG Tanks as complete packages. The tanks should be self-contained units with required nozzles and relief valve piping to support their use when integrated with the balance of components in an LNG plant. The vendor should provide the tanks complete with valve or trim required for the first connection point to the tanks. As-built drawings of the tank structure, and mechanical control 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 the final destination. 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, mounting bolt locations and operational 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. Review and approval of the foundation plans and shop drawings prior to installation
b. One (1) day of onsite technical assistance and inspection of the erected tank.

1.3. WORK EXCLUDED FROM SCOPE

a. Soil improvement, grading, foundations, surfacing material, foundation design and external stairs and walkways indicated in the General Arrangement drawing (see Appendix B).
b. Exterior interconnecting piping other than piping supplied with tank PSV's.
c. Electronic transmitters; pressure, DP, level, temperature
d. Design and installation of electrical and communication service to the equipment, area lighting and fire detection and alarm.
e. Tank installation, to be completed by others.

1.4. REFERENCE PUBLICATIONS

The codes, standards, and specifications included in this document 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 Tanks, 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 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 Tanks 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 tank and appurtenances responsibility and guarantee the entire tank package.

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. In addition to general progress inspections, Vendor should anticipate the following specific items:

a. Periodic inspection during all tank fabrication.

b. Periodic inspection during all piping fabrication.

c. Periodic inspection during all cleaning and coating application.

d. Periodic inspection during all electrical fabrication and installation.

e. Periodic inspection during all I&C fabrication and installation.

f. 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. 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 tank 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 tag numbers to be used in all drawings and physical tagging provided by the Vendor.

1.9. ALASKA STATE FIRE MARSHAL REQUIREMENTS

Tanks shall also be such that they will be approved by Alaska State unfired pressure vessel inspector. Vendor shall address all Alaska State Inspector comments provided, at no cost to the Owner, and modify the system to comply with their requirements.

1.10. 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 tanks 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, ASME Boiler & Pressure Vessel Code Section VIII, Division 1, Mandatory Appendix 44, 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 tanks shall assure that the tanks are designed and constructed in accordance with all applicable codes and regulations.

2. GENERAL TANK REQUIREMENTS

2.1. TANK INTERFACE TO FACILITY

The tanks 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 tank to foundation reaction loads under full conditions. Provisions shall be made in the tank design to restrict heat flow from the tank to the foundation/pile (if any).

a. Piping connection points shall be coordinated with the Owner as part of the design process. See Nozzle Table Section 4.0.

b. Reference Figure 3 in Section 4.0 general arrangement drawing of nozzles and instruments for preferred orientation and minimum diameter of tank connections.

2.2. GENERAL REQUIREMENTS

The scope of work includes the design, fabrication, and assembly of an LNG storage tank supported on saddles for anchorage to concrete foundation with integral concrete support piers (other foundation support options can be proposed by vendor) (Figure 2).

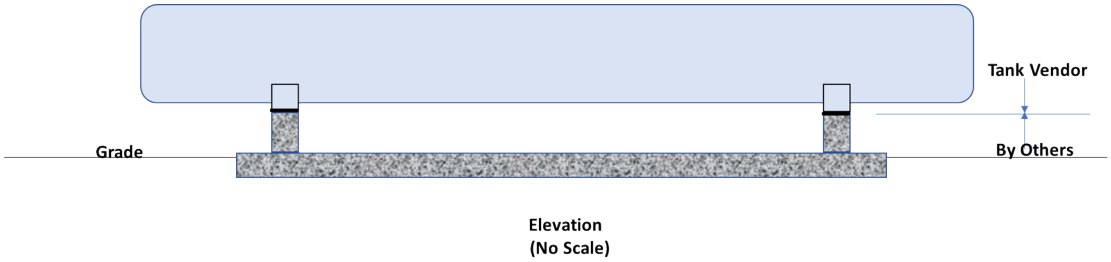


Figure 2 - LNG Tank Foundation Layout Elevation

a. Design and fabricate complete LNG tank, as required to provide complete gravity, lifting and lateral load resisting systems.

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

c. Saddles and legs shall be designed to withstand loads anticipated during shipping and installation, and seismic, wind, and thermal loads required by NFPA 59A 2001 edition for ASME VIII shop fabricated LNG tanks.

d. The LNG tank and its supports shall be designed for the resultant seismic forces in combination with the operating loads, using the allowable stress increase shown in the code or standard used to design the container or its supports.

e. LNG tank shall be shipped with a minimum internal pressure of 10 psi (69 kPa) inert gas.

f. PSV's shall be accessible from fixed access platform furnished and installed by others.

g. Other elevated items shall be made accessible by ladder at a minimum.

2.3. DESIGN STANDARDS

a. 49 CFR Part 193, Liquefied Natural Gas Facilities

b. CGA 341 -2008 (Outer Vessel)

c. ASME Boiler & Pressure Vessel Code Section VIII, Division 1, Mandatory Appendix 44 for LNG tanks operating > 15 psig. (Note: Mandatory Appendix 44 provides the requirements for design and construction of cold-stretched austenitic stainless-steel pressure vessels under the rules of ASME Boiler and Pressure Vessel Code, Section VIII, Division 1 2013 edition).

d. CGA S-1.3 2008 Edition - Pressure Relief Device Standards Part 3-Stationary Storage Containers for Compressed Gases

e. CGA P-40, Calculation Method for the Analysis and Prevention of Overpressure During Refilling of Cryogenic Storage Tanks,

f. American Institute of Steel Construction (AISC)

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

h. ASME B31.3 2016 edition (cryogenic and process gas piping)

i. NFPA 59A, 2001 edition, Standard for the Production, Storage, and Handling of Liquefied Natural Gas (LNG)

j. Underwriters Laboratory (UL)

2.4. WELDING/FABRICATION STANDARDS

2.4.1. LNG Storage and Piping

For ASME containers operating at 15 psig and greater, all piping that is a part of an LNG container, including piping between the inner and outer containers, shall be in accordance with either the ASME Boiler and Pressure Vessel Code VIII, or ASME B 31.3, Process Piping.

In accordance with ASME Boiler and Pressure Vessel Code VIII, UW-48, the tank vendor shall certify that the welding on a vessel has been done only by welders and welding operators who have been qualified under the requirements of Section IX and the Inspector shall assure himself that only qualified welders and welding operators have been used. The Manufacturer shall make available to the Inspector the record of the qualification tests of each welder and welding operator. The Inspector shall have the right at any time to call for and witness tests of the welding procedure or of the ability of any welder and welding operator.

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.

2.5. SITE ENVIRONMENTAL CONDITIONS

Table 2 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

2.6. EQUIPMENT SIZE, SHAPE AND APPEARANCE

The size and shape of the tank(s) will be determined by the function of the equipment. Truckability of the tank(s) shall be required in design process. Size and weight constraints will be based on transportation limits for clearance and weight. To avoid excessive shipping costs, effort should be made to keep overall height of shipped tank(s) to the following approximate maximum dimensions: 15-feet high, 15-feet wide, and 110-feet long. A transportation study by the owner will be completed determine the final shipping arrangements to the site. Other sizes will be considered as alternatives if they have reduced cost (single 150k tank), but they may carry additional Owner transportation costs and may not be preferred.

2.7. DESIGN LOADS

2.7.1. Design Category: III

2.7.2. Importance Factor:

Snow Importance Factor, I_s: 1.10

Seismic Importance Factor, I_E: 1.25

2.7.3. Gravity Loading:

2.7.4. Environmental Loading:

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

b. Wind Exposure Category: for LNG tanks >70,000 gal, wind speeds per ASCE-7 (shown in Table 1, Section 2.5).

2.7.5. Transportation Loading:

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

2.7.6. Seismic

Tank shall comply with NFPA 59A 2001 edition, Section 4.1.3.8 using installation site conditions

2.8. MATERIAL REQUIREMENTS

2.8.1. Support Saddles:

a. Low temperature steel is required for all structural support.

2.8.2. Tank Materials

a. Tank materials and components shall be appropriate for the temperature of LNG service in accordance with ASME Boiler and Pressure Vessel Code, Section VIII Division 1.

2.8.3. Piping Materials

a. All piping materials shall be standard English units (inches, feet, psi, etc.).

b. Fittings shall follow standard recognized by ASME B31.3;

c. All materials shall have documentation traceable to their location of origin and heats.

d. Seamless materials are preferred. Low frequency ERW will not be accepted.

2.9. LIFTING AND TRANSPORTATION

The tanks 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 tank(s) 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 minimum four-point lifting arrangement.

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

b. 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).

c. The tank(s) 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.

b. Vendor shall prepare tank(s) for transportation from the point of fabrication to Seattle or Tacoma, Washington. The design shall include means for transporting the tanks without damage. If intermediate transfers are required,

c. 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 caps for all appurtenances and installation of shrink wrap around each tank.

d. Remove and package securely external items that may be damaged in shipment such as exterior components.

e. 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.

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

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

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

i. Design connections of shipped loose components (not part of main LNG tank vessel) to be threaded or flanged for ease of removal and reconnection.

2.10. COATING AND FINISHES

All exposed surfaces of LNG tank shall be coated to prevent corrosion of tank components and suited to operating conditions and environmental conditions at the site. 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 or equivalent The system shall be in accordance with Section 2. Application shall be in accordance with manufacturer's requirements. Submit color for approval by Owner.

a. Ancillary equipment (valves, nozzles, attachments etc). shall be factory coated by manufacturer's standard coating systems. Coatings suitable for marine environment shall be selected.

b. Steel grating, ladders platforms etc. shall be galvanized if included.

2.11. SIGNAGE AND MARKING

a. Corrosion resistant Nameplates on vessels for inner tank shall be oriented to be visible as installed and through/on top of insulation in accordance with NFPA 59A 2001 edition Section 4.41 and ASME Boiler and Pressure Vessel Code, Section VIII, Division 1 "U-Stamp".

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

c. At each nozzle connection point to tank, provide marking indicating service and flow direction (in or out).

3. BASIS OF DESIGN

3.1. PROJECT DESIGN CAPACITIES

The tank volume desired for phase 1 is 150,000 gallons net minimum capacity. Owner preference is for two net 75,000-gallon horizontal tanks. Vendor may quote alternative configurations as options, provided they result in cost savings and can still be transported to the site. Option is requested for pricing of delivery of one (1) 75,000-gallon tank, or three (3) tanks (see Table 1 for requested options).

3.2. RELIEF REQUIREMENTS

3.2.1. Tank Over Pressure and Vacuum Pressure Protection

LNG tank overpressure and vacuum pressure protection shall be designed in accordance with CGA S1.3-2007, NFPA 59A 2001 edition, and ASME Boiler and Pressure Vessel Code, Section VIII, Division 1. Each cause of overpressure in CGA S1.3-2007 shall be considered in determining the need for relief devices. Maximum flow loading scenarios shall be developed for each common-mode initiating event such as fire, ESD/OSD, utility failure, or overpressure relief. Relief Systems:

This overpressure relief protection will be in accordance with CGA S1.3-2007, NFPA 59A 2001 edition, and ASME Boiler and Pressure Vessel Code, Section VIII.

a. 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.

b. Required blowdown rates shall be evaluated separately for each ASME Section VIII covered vessel and CGA S-1.3 2007 and sized for the maximum prevailing case.

c. 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.

d. 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.

e. Temperatures due to auto-refrigeration from the pressure drop across relief, or vent valves shall not exceed the equipment design limits at any point in the disposal system.

f. All tank relief devices must vent directly to the atmosphere and prohibited from venting to a vent header or flare header.

3.3. 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.

3.3.1. Piping Systems

a. Piping systems shall be in accordance with ASME B31.3 and 49 CFR 193. The following line classes will be used on the facility. Tank appurtenances should be compatible with mating pipe.

Table 3: 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
C.3	Low temperature piping – Natural gas/LNG, cryogenic Nitrogen	ASME B31.3	ANSI 300	-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	-320º F/ 100º F	0.031-inches	ASTM A182 304/304L
Notes: 1) Use of threaded connections and flanges should be minimized where practical or avoided in piping associated with LNG to minimize potential leak sources.						

b. Piping, vessels and structure shall be coated, insulated and jacketed in accordance with this specification (see Section 2).

3.4. DESIGN REQUIREMENTS

The LNG tank shall be designed in accordance with ASME Boiler and Pressure Vessel Code, Section VIII, Division 1 for cryogenic service with "U" Stamp nameplate to certify tank compliance to design and process requirements listed in this document.

3.4.1. Process Requirements:

- Tank Net Capacity (between Low and High level): 75,000 gallons
- Tank Gross Capacity: Up to High-High level TBD (provided by vendor)
- Inner Tank MAWP: 80 psig (minimum)
- Outer Tank design pressure: TBD (Vendor)/Full Vacuum
- Tank design temperature: -320 °F

Additional design requirements:

Tank design should include following:
- Cooldown capabilities
- Top Loading capabilities
- Bottom loading capabilities
- Nozzle isolation capabilities

3.4.2. Corrosion Prevention

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.

c. Coating types will vary depending on the design parameters and systems being coated. Variables include: 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, and type of materials they will be applied to. Coating shall be specified for piping, tanks, structural steel, etc. Vendor to provide proposed specific coatings to be finalized during final negotiations with Vendor.

3.4.3. Support and Anchoring

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

b. 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.

c. All lines piping should be tied down for shipping to minimize the excessive forces encountered in shipping or transport.

3.4.4. Markings and Tagging

a. 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.

3.5. INSPECTIONS AND TESTING

3.5.1. Welding Inspections

Welding Inspections shall adhere to ASME B31.3 for tank piping and ASME Boiler and Pressure Vessel Code, Section VIII, Division 1. Radiographic Examination (RT)

a. Pipe 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. For tank piping, compliance with this requirement shall be stated on or appended to the ASME Boiler and Pressure Vessel Code, Appendix W, Form U-1, “Manufacturer’s Data Report for Pressure Vessels.”

3.5.2. Weld Examination of Primary Vessel

Radiographic Examination of Welded Joints shall adhere to ASME Boiler and Pressure Vessel Code, Section VIII, Division 1. Radiographic Examination (RT) UW – 46 and UW-51. As an alternative to the radiographic examination requirements above, all welds in material 0.5 inch and greater in thickness may be examined using the ultrasonic (UT) method per the requirements of 7 .5 .5 of Section VIII, Division 2. A complete set of radio graphs and records, as described in Article 2 of Section V, for each vessel or vessel part shall be retained by the Manufacturer.

3.5.3. Material Testing

The inspection and testing of pressure vessels to be marked with the Certification Mark with the “U” Designator and the testing of vessels to be marked with the Certification Mark with the UM Designator shall conform to the general and specific requirements for Inspection and

Tests given in the applicable Parts of ASME BPVC VIII, Division 1 Subsections A, B and C by an accredited Inspector as defined in ASME BPVC VIII, Division 1, UG-91.

The vendor is to provide the ductilty information for all the steel components in a table similar to Table 4.

Table 4: Material Testing Requirements

CHARPY V-NOTCH IMPACT TEST REQUIREMENTS					
Steel Location	Type of Steel	Yield Stress (psi)	Maximum Thickness (in.)	Testing Temperature (F)	Required Impact Values (ft-lb)
Example	*ASTM A572*	*50,000*	*1"*	*-50 °F*	*15/12*

3.5.4. Hydrostatic Pressure Testing

For vessel construction, hydrostatic pressure testing shall be done at the fabrication site after: All fabrication 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.

a. All process piping shall be pressure tested at the minimum test pressure at least 1.3 times design pressure hydrostatically in accordance with ASME BPVC VIII Division 1, UG-97. 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.

b. 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.

c. 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.

d. 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.

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

f. 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 60F. 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.

g. 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.

h. 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.

i. The following records shall be retained and provided (in English) to the owner

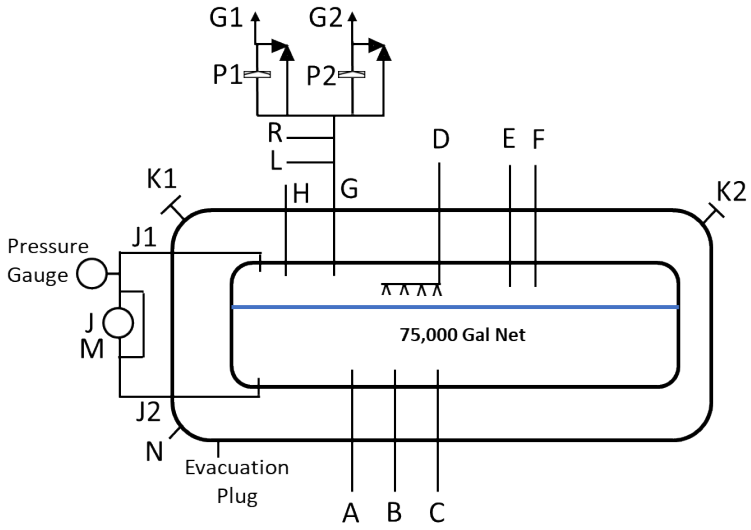
- Test records for temperature and pressure (circle chart or equal).
- Records of test equipment calibration. Must be within 6 months of test.
- Name of operator, the name of the person or company responsible for the test.
- The date and time of the test.
- The minimum test pressure.
- A description of the test facility and testing apparatus.
- A description of any pressure discontinuities if any.

4. PROCESS INSTRUMENTATION

4.1. SCOPE OF WORK

The LNG tank shall be equipped with a device(s) that prevents the container from becoming liquid-full or from covering the inlet of the relief device(s) with liquid when the pressure in the container reaches the set pressure of the relieving device(s) under all conditions.

Figure 3 provides an example of typical LNG tank nozzles and instruments. Additional nozzles may be provided from vendor standard design that if not used will be plugged or blinded. Vendor to provide tank specific information like below with submittal.



LNG Tank Nozzle and Instrument Schedule		
Mk#	Nozzle Description	Size
A	Withdrawal	3"
B	Withdrawal	3"
C	Pressure Buildup Coil Withdrawal	1-1/2"
D	Top Fill	2"
E	Vapor Return	3"
F	Pressure Buildup Coil Return	3"
G1	Pressure Relief Valve	2"
G2	Pressure Relief Valve	2"
H	Full Indicator Tri-Cock Valve	1/2"
J1	Liquid Level (Mechanical Indicator) Top	1/2"
J2	Liquid Level (Mechanical Indicator) Bottom	1/2"
K1	Outer Vessel Relief	TBD
K2	Outer Vessel Relief	TBD
L	Back Pressure Regulator	TBD
M	DP Liquid Level (DP Transmitter)	TBD
N	Vacuum Guage	TBD
P1	Rupture Disc	TBD
P2	Rupture Disc	TBD
R	Vent	TBD

Figure 3 - LNG Tank Nozzles and Instruments

LNG tank relief valve piping shall be fabricated of schedule 80 pipe and sized in accordance with CGA S-1.3, Chapter 6, “Design and Construction Requirements for Pressure Relief Devices” for Fire and Non-Fire Cases. Overpressure protection shall also meet the pressure relief valve requirements of ASME Boiler and Pressure Vessel Code, Section VIII, Division 1. If the insulation system is not equipped with a jacket that remains in place at 1200 °F (649 °C) and the insulation deteriorates below 1200 °F (649 °C), use the formula for uninsulated containers in 6.3.2;

Vendor is to provide all nozzle valves and instrumentation listed below unless specifically listed as not-included. External valves and instruments shall be shipped loose for site installation after placement on the permanent foundations. All valves and pipe required for level gauge and inner tank relief valves and rupture disks shall be provided. A pressure buildup coil will not be used for this installation.

Ancillary Tank Components Included by Tank Vendor:

1. Hand Valves for all nozzles except where Code prohibited
2. Inner vessel pressure relief valves
3. Rupture disks for inner tank
4. Outer vessel pressure relief

5. Tri-Cock valve
6. Mechanical level gauge
7. Tank vapor pressure gauge
8. Rupture Disk for outer tank

5. INSULATION AND JACKETING

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

d. Straight run pipe and elbow jacketing shall be secured. Screws shall be used on the longitudinal seams as necessary to prevent "fish mouthing"

e. Equipment insulation jacketing shall fit the contour of the head and overlap to shed water. All outdoor seems shall be sealed.

5.2. HOT INSULATION

Hot insulation is not anticipated to be required for the equipment covered by this RFP. Specifications for hot insulation can be provided upon request.

5.3. COLD INSULATION

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

Prior to insulating, the tank and pipe exterior surfaces shall be cleaned and coated and inspected by the Owner.
Commercially available cold service thermal insulation recommended for cold preservation and personnel protection of process piping and vessels for the liquefaction 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 only for proposed equal and specific details on alternate product and performance for Owner review.

Vendors may use proprietary insulation for the interstitial space of the tank which are not one of the above products, provided it is free from asbestos and other hazardous materials.

APPENDIX A: PIPING SYSTEMS

B.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
Hydrogen Sulfide	Orange w/Black Stripes @ 45°
Methanol	Pink
Nitrogen – Liquid or Gas	Tan

APPENDIX B: GENERAL ARRANGEMENT DRAWING