U.S. Department of Homeland Security
United States Coast Guard

Commandant
United States Coast Guard

2100 2nd Street, S.W. Stop 7126
Washington, DC 20593-7126
Staff Symbol: CG-521
Phone: (202) 372-1353
Fax: (202) 372-1926

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CG-521 Policy Letter
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From: J. P. Nadeau, CAPT
COMDT (CG-521)

To: Distribution

Subj: EQUIVALENCY DETERMINATION – DESIGN CRITERIA FOR NATURAL GAS FUEL SYSTEMS

Ref: (a) International Maritime Organization (IMO) Resolution MSC.285(86) - Interim Guidelines on Safety for Natural Gas-Fuelled Engine Installations in Ships.

1. Purpose. This policy letter establishes design criteria for natural gas fuel systems that provide a level of safety that is at least equivalent to that provided for traditional fuel systems by existing regulations.

2. Directives Affected. None.

3. Action. Natural gas fuel systems designed and constructed in accordance with the enclosed criteria may be accepted by the Coast Guard Marine Safety Center and Officers in Charge, Marine Inspection (OCMI) for use on board certificated vessels. Other designs will continue to be considered by Commandant (CG-521) on a "case by case" basis.

4. Background.

   a. The use of natural gas as a shipboard propulsion fuel is a leading alternative to oil fuels for meeting domestic and international air emission requirements, including the limits for Emission Control Areas adopted in recent amendments to MARPOL Annex VI. Additionally, current pricing and availability makes natural gas competitive in comparison to more traditional marine fuels. Due to these factors, a number of companies have submitted design proposals for ships utilizing natural gas as fuel. With the exception of boil-off gas used on liquefied natural gas (LNG) carriers, existing U.S. regulations do not address the design and installation of natural gas fuel systems on commercial vessels.

   b. International standards for the design of natural gas-fueled ships are currently being developed by the International Maritime Organization (IMO). In June of 2009, the IMO published interim guidelines in reference (a), which is available on the CG-521 website at http://www.uscg.mil/hq/cg5/cg521/docs/msc_285_86.pdf.

c. Recently, the Coast Guard's Office of Design and Engineering Standards has received submissions from companies seeking approval for such systems. The Coast Guard has used the IMO interim guidelines as a baseline standard to evaluate the proposals and made equivalency determinations for gas-fueled ship designs. The experience gained while conducting these evaluations, coupled with expertise obtained from working with others to develop the IMO standards, has enabled the Coast Guard to establish the equivalency criteria contained within this policy letter.

5. Discussion.

a. Natural gas fuel systems designed and constructed in accordance with enclosure (1) are considered to provide a level of safety that is at least equivalent to that provided for traditional fuel systems by existing regulations. Accordingly, these systems may be accepted by the Coast Guard Marine Safety Center and Officers in Charge, Marine Inspection (OCMI) for use on board certificated vessels.

b. Fuel systems installed on uninspected vessels are typically not subject to plan review and inspection by the Coast Guard; however, existing regulations (e.g. 46 CFR 27.211) require Commandant acceptance of natural gas as a fuel. Conformance to the design criteria listed within enclosure (1) provides a means to obtain Commandant acceptance of natural gas as a fuel for uninspected vessels.

c. This policy is applicable to both new construction and modifications to existing vessels. However, this policy is not intended for gas carriers that utilize boil-off gas as fuel.

d. This policy does not provide guidance on the operational aspects associated with the use of natural gas as a fuel. This policy also does not address the crew proficiency standards for the handling of natural gas. Questions related to these subject areas should be directed to the Coast Guard's Office of Operating and Environmental Standards (CG-522).

e. The intent of this policy is to afford an avenue of compliance with regard to obtaining Coast Guard approval for the design of natural gas fuel systems. The Coast Guard fully recognizes that additional avenues may exist that would provide an equivalent level of safety to that of existing regulations. Accordingly, this office will continue to consider alternative design criteria.

6. Disclaimer. While the guidance contained in this document may assist the industry, public, Coast Guard, and other Federal and State regulators in applying statutory and regulatory requirements, the guidance is not a substitute for applicable legal requirements nor is it a regulation itself. Thus, it is not intended to, nor does it impose legally binding requirements on, any party outside the Coast Guard.

7. Changes. This policy letter will be posted on the web at http://www.uscg.mil/hq/cg5/cg521/. Changes to this policy will be issued as necessary. Suggestions for improvements of this policy should be submitted in writing to this office.

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Enclosure: (1) Design Criteria for Natural Gas Fuel Systems

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Design Criteria for Natural Gas Fuel Systems

The guidelines offered by IMO Resolution MSC.285(86), Interim Guidelines on Safety for Natural Gas-Fueled Engine Installations in Ships, as modified below[1], demonstrate an equivalent level of safety to that of existing federal regulations for traditional fuel systems installed on board vessels subject to inspection for certification:

CHAPTER 1 – GENERAL

1.3 Definitions

The following definitions are included in addition to those listed in Section 1.3:

Compressed natural gas (CNG) is natural gas (predominantly methane, CH4) that has been compressed to a pressure typically in the range of 2900-3600 psi (200-248 bar) for ease of storage or transport.

Explosion proof means electrical equipment approved as meeting UL 1203.

Flameproof means electrical equipment approved as meeting IEC 60079-1.

IECEx System means an international certification system covering equipment that meets the provisions of the IEC 60079 series of standards. The IECEx system is comprised of an Ex Certification Body and an Ex Testing Laboratory that has been accepted into the IECEx System after satisfactory assessment of their competence to ISO/IEC Standard 17025, ISO/IEC Guide 65, IECEx rules of procedures, IECEx operational documents, and IECEx technical guidance documents as part of the IECEx assessment process.

Independent laboratory means a laboratory that is accepted by the Commandant under 46 CFR Part 159 for the testing and listing or certification of electrical equipment.

Integral tank means a tank that is a structural part of the vessel's hull and is influenced in the same manner and by the same loads that stress the adjacent hull structure.

Intrinsically Safe means a protection technique for electrical equipment meeting the requirements specified in 46 CFR 111.105-11.

Liquefied natural gas (LNG) is natural gas (predominantly methane, CH4) that has been converted to liquid form by cooling to approximately -258 degrees F (-161 degrees C) for ease of storage or transport.

Natural gas fuel handling room means any enclosed space where natural gas is pumped, compressed or processed. Examples of natural gas handling rooms include pump rooms, compressor rooms, and natural gas valve rooms.

Non-hazardous means an area in which an explosive gas atmosphere is not expected to be present in quantities that require special precautions for the construction, installation and use of electrical equipment.

Shut-off valve is a valve that closes a pipeline and provides nominal metal to metal contact between the valve operating parts, including the disc and gate, and the valve body.

[1] The sections in this document are numbered to align with corresponding sections in IMO Resolution MSC.285(86). Unless otherwise specified in the text or by footnote, all references made are to IMO Resolution MSC.285(86).

Special Division 1 is a Class I, Zone 0 hazardous area in Article 505 of the National Electrical Code that may require special considerations for electrical equipment installed in such locations.

Tank room means the gastight space surrounding a natural gas fuel tank, containing all tank connections and all tank valves, which is designed to contain any leak of natural gas, including tank rooms configured as described in section 2.8.4.3 and 2.8.4.4 of IMO Resolution MSC.285(86).

CHAPTER 2 – SHIP ARRANGEMENTS AND SYSTEM DESIGN

2.2 Material requirements

In addition to Section 2.2, piping for natural gas fuel should meet the requirements of ASME B31.3.

Additional requirements for natural gas fuel tanks are listed within paragraph 2.8.

2.3 Location and separation of spaces

Natural gas fuel storage tanks must not be located below accommodation spaces, service spaces, or control stations, unless the arrangement is accepted by the Commandant (CG-521).

2.3.2 Gas compressor room

Gas compressor rooms must be located above the freeboard deck.

2.3.4 Tank rooms

Tank room boundaries should be arranged so that gas does not enter accommodation, service or control spaces upon the failure of a tank room boundary.

2.4 Arrangement of entrances and other openings

Where Section 2.4 specifies an airlock complying with chapter 3.6 (2 to 7) of the IGC Code, the Coast Guard applies the following additional provisions as an acceptable standard:

(1) Airlock consisting of two steel doors, at least 1.5 meters (4.9 feet) but not more than 2.5 meters (8.2 feet) apart: each gasketed and tight when tested with a fire hose at not less than 207 kPa gauge (30 psig), or verified by an alternative test method approved by the local Officer in Charge, Marine Inspection;

(2) A gas-safe (protected) space mechanically ventilated to make the pressure in the space greater than that in the air lock; and,

(3) Ventilation for the space meeting the provisions of Section 2.10.1.9 as modified by this document.

2.5 General pipe design

The wall thickness of pipes should conform to the ASME Code for Pressure Piping (ASME B31.3, Process Piping).

2.6 System configuration

2.6.1 Alternative system configurations

This equivalency determination assumes the use of the "gas safe" configuration as described in paragraph 2.6.1.1.1. "ESD-protected machinery space" configurations as described in paragraph 2.6.1.1.2 fall outside the scope of this policy letter and will be considered by Commandant (CG-521) on a case-by-case basis.

2.7 Gas supply system in gas machinery spaces

2.7.1 Gas supply system for gas safe machinery spaces

For fuel piping installed in accordance with the provisions of paragraph 2.7.1.1.2, the ventilation capacity within the annular space may not be reduced below 30 air changes per hour.

2.8 Gas fuel storage

Tanks used for the storage of natural gas fuel for propulsion and/or auxiliary systems that do not meet the requirements in Sections 2.8.1, as modified by this document, must be approved by the Commandant (CG-521).

2.8.1 Liquefied gas storage tanks

(1) In lieu of the provisions of paragraph 2.8.1.1, independent tanks used to store LNG must meet 46 CFR 154.401 through 154.476 as applicable.

(2) Type C independent tanks may, as an alternative, meet ASME Boiler and Pressure Vessel Code, Section VIII, Division 1 or 2.

2.8.2 Compressed gas storage tanks

Natural gas fuel for propulsion and/or auxiliary systems may not be stored as CNG unless the arrangement is accepted by the Commandant (CG-521).

2.8.4 Storage in enclosed spaces

In addition to the provisions of Section 2.8.4, tanks used to store liquefied natural gas fuel at a maximum allowable working pressure (MAWP) higher than 10 bar must not be located in enclosed spaces unless the arrangement is accepted by the Commandant (CG-521).

2.10 Ventilation system

2.10.1 General

The Coast Guard finds Section 2.10.1 as an acceptable standard, subject to the following additional provisions:

(1) A ventilation system should:

(a) Not recycle vapor from ventilation discharges;

(b) Have a protective metal screen of not more than 13 mm (0.512 in.) square mesh on each ventilation intake and exhaust; and

(c) If the system is mechanical, have its operational controls located outside of the ventilated space.

(2) Where mechanical ventilation is applied to spaces which are not separated by gastight boundaries, underpressure should be maintained in the hazardous enclosed spaces in relation to the less hazardous spaces, and an over-pressure should be

maintained in the non-hazardous enclosed spaces in relation to the adjacent hazardous spaces.

(3) Spaces made non-hazardous by the methods allowed in Section 2.10.1.9 should only contain electrical equipment and devices that are necessary for the operational purposes of the space.

(4) In addition to 2.10.1.9.1.1, the atmosphere is considered non-hazardous when the concentration of explosive gases or vapors is below 30 percent of the lower explosive limit at all points in the space, equipment enclosures and vent ducts.

(5) In addition to 2.10.1.9.2, a differential pressure monitoring device, a flow monitoring device, or both, should be provided for monitoring the pressurization of spaces having an opening into a more hazardous area. A running fan motor or a fan rotation monitoring device indication does not satisfy this requirement.

2.10.2 Tank room

In addition to the provisions of Section 2.10.2,

(1) The ventilation capacity within the space may not be reduced below 30 air changes per hour.

(2) The automatic fire dampers should be type approved by the Coast Guard.

CHAPTER 3 – FIRE SAFETY

3.3 Fire extinction

3.3.2 Water spray systems

Water spray systems should meet the following requirements in addition to the provisions of Section 3.3.2:

(1) Coverage for on-deck storage should include all exposed parts of the gas storage tank(s) located above deck and boundaries of the superstructures, compressor rooms, pump rooms, cargo control rooms, and any other normally occupied deck houses that face the storage tank.

(2) Except in the case of a vacuum insulated Type C fuel tank configured as described in sections 2.8.4.3 and 2.8.4.4 of IMO Resolution MSC.285(86), any below deck gas storage tank room should be provided with a water spray system complying with this section.

(3) Each pipe, fitting, and valve should meet 46 CFR Part 56.

(4) Water spray nozzles are not required to be type approved, but should be listed by a nationally recognized testing laboratory, as defined in 29 CFR 1910.7.

(5) On vertical surfaces credit may be taken for rundown if the nozzles are spaced no more than 12 feet (3.7 m) apart vertically.

(6) The coverage of nozzles protecting valves, piping and manifolds should extend at least 19 inches (0.5 m) in each direction, past the protected fittings or to the area of the drip tray, whichever is greater.

(7) The main fire pumps may be used to supply the system if their total capacity is capable of providing the required flow for both systems. The water supply for the water spray system should be adequate to supply all nozzles simultaneously.

(8) Controls to remotely start pumps supplying the water spray system and operate any normally closed valves to the systems should be located outside of the protected area

in a readily accessible position that is not likely to be cut off in case of fire in the protected areas.

(9) Each water spray system should have a means of drainage to prevent corrosion of the system and freezing of accumulated water in subfreezing temperatures.

3.3.3 Dry chemical powder fire-extinguishing system

Dry chemical powder fire extinguishing systems installed under the provisions of Section 3.3.3 should consist of at least one hand hose line unit that:

(1) Is listed for fire service by a nationally recognized testing laboratory, as defined in 29 CFR 1910.7;

(2) Meets the requirements of 46 CFR 154.1155 and 154.1165 – 154.1170; and

(3) Meets the requirement of MSC.1/Circ.1315 (10 June 2009).

Note: There are no dry chemical powder fire extinguishing systems currently approved by the Coast Guard, therefore detailed manufacturer's data and a maintenance manual for the system to be installed should be provided to MSC for review as part of the detailed plan review package. Additionally, details should be provided to demonstrate compliance with the unit's listing limitation for nozzle placement and coverage distance of the hand hose line.

3.4 Fire detection and alarm system

3.4.1 Detection

In lieu of the provisions of Section 3.4.1, fire detection systems should:

(1) Be provided in tank rooms and the ventilation trunks for tank rooms below decks.

(2) Be provided in machinery spaces containing gas-fueled engines.

(3) Be approved by the Commandant in accordance with 46 CFR 161.002 and installed in accordance with 46 CFR 76.27.

(4) Have fire detection cables routed such that fire or flooding in one space will not affect the ability to detect fire in another space or fire zone; and

(5) Use heat detection in addition to any other forms of detection used for the protected space.

CHAPTER 4 – ELECTRICAL SYSTEMS

4.1 General

(1) <u>General Requirements</u>.

Electrical installations should not normally be in hazardous areas. Where necessary for operational purposes, the equipment should be located in the least hazardous area practicable.

(2) <u>Equipment and Installation Standards</u>

Electrical installations in hazardous locations should comply with the standards listed either in sub-paragraph (a), (b) or (c), but not in combination in a manner that would compromise system integrity or safety:

(a) NEC 2011 (NFPA 70) Articles 500 through 504. Equipment identified for Class I locations should meet the provisions of Sections 500.7 and 500.8 of

the NEC 2011 and be tested and listed by an independent laboratory as meeting the current version of any of the following standards:

(i) ANSI/UL 674, ANSI/UL 823, ANSI/UL 844, ANSI/UL 913, ANSI/UL 1203, UL 1604 (Division 2), and/or ANSI/UL 2225;

(ii) FM Approvals Class Number 3600, Class Number 3610, Class Number 3611, Class Number 3615, and/or Class Number 3620; or

(iii) CSA C22.2 Nos. 0-M91, 30-M1986, 157-92, and/or 213-M1987.

Note: See Article 501.5 of the NEC for use of Zone equipment in Division designated spaces.

(b) NEC 2011 (NFPA 70) Article 505. Equipment identified for Class I locations should meet the provisions of Sections 505.7 and 505.9 of NEC 2011 and be tested and listed by an independent laboratory as meeting one or a combination of the ANSI/ISA 60079 Series of standards incorporated in NEC 2011.

Note: See Article 505.9(c)(1) of the NEC for use of Division equipment in Zone designated spaces.

(c) IEC 60092-502, except the following[2]:

(i) Ventilation alone may not be used as a means for reducing the classification of a hazardous space as indicated in Clause 4.1.4, and Table 1.

(ii) Sections 2.4 and 2.10.1.9 of IMO Resolution MSC.285(86), as modified by this document, apply in lieu of Clause 4.1.5.

(iii) The hazardous areas defined under section 4.3 Definition of hazardous area zones in this document apply in lieu of Clause 4.3.

(iv) Paragraph (6) Cable and wiring, of this section, applies in lieu of Clause 7.3.1.

(v) Electrical apparatus in hazardous locations should meet one or the combination of IEC 60079-1, -2, -5, -6, -7, -11, -13, -15, -18 and/or -25 in lieu of Clause 6.5.

(vi) Certified safe-type equipment should be tested by an IECEx System Testing Laboratory (ExTL), and certified by an IECEx System Ex Certification Body (ExCB), both accepted by the Coast Guard under 46 CFR 159.010 in lieu of Clause 6.3. Certification under the European Union's (EU) ATEX Directive (94/9/EC) is not acceptable.

In addition to paragraph (2)(a) of this section, electrical equipment that complies with NFPA 496 is acceptable for installation in Class I, Divisions 1 and 2. The Marine Safety Center (MSC) will evaluate equipment complying with this standard during plan review.

For the standards in paragraphs (2)(b) and (2)(c) of this section, the compound of encapsulated type equipment tested and certified to ANSI/ISA 60079-18 or IEC 60079-18 (Ex "ma") for installation in Class I Special Division 1 (Zone 0) hazardous locations should be compatible with LNG.

[2] References here using the term "Clause" are to IEC 60092-502

(3) Lighting Systems

Lighting circuits serving flameproof or explosion proof lighting fixtures in an enclosed hazardous space or room should:

(a) Have at least two lighting branch circuits;
(b) Be arranged so that there is light for relamping any deenergized lighting circuit;
(c) Not have the switch and overcurrent device within the space for those spaces containing explosion proof or flameproof lighting fixtures.
(d) Have a switch and overcurrent protective device that should open all ungrounded conductors of the circuit simultaneously.

(4) Submerged Pumps

Submerged pump motors in tanks with flammable or combustible liquids with closed-cup flashpoints not exceeding 60 degrees C (140 degrees F), and liquefied natural gas tanks, must receive concept approval by the Commandant (CG-521). Installation should include:

(a) A low liquid level, low motor current, or low pump discharge pressure that will automatically shutdown power to the motor if the pump loses suction;
(b) An audible and visual alarm actuated by the shutdown of the motor;
(c) A lockable circuit breaker or lockable switch that disconnects power to the motor; and,
(d) Plan approval by the Commanding Officer, Marine Safety Center.

(5) Internal Combustion Engines

Internal combustion engines installed in Class I, Divisions 1 and 2 (Zones 1 and 2) should meet the requirements in ASTM F2876–10 “Standard Practice for Thermal Rating and Installation of Internal Combustion Engine Packages for use in Hazardous Locations in Marine Applications.”

(6) Cable and Wiring in Hazardous Locations

(a) Cable and wiring should comply with the cable construction and testing requirements of IEEE Std 1580 (2001); UL 1309; MIL-C-24640B; MIL-C-24643A, or IEC 60092-350 (2008)/IEC 60092-353 Amendment 1, Annex A (2001), including the respective flammability tests contained therein, and should be of a copper-stranded type.
(b) For intrinsically safe systems, the wiring methods should meet Sections 504.20 and 504.30 of NEC 2011.
(c) Conduit and cable seals and sealing methods should meet Clause 6.8 of API 14F (1999).
(d) Type MC cables, when installed, should meet the requirements in 46 CFR 111.60-23.

(7) Electrical Bonding

(a) Natural gas tanks or natural gas piping systems that are separated from the hull structure by thermal isolation should be electrically bonded to the hull structure by a method under paragraph (c) of this section.

(b) A pipe joint or a hose connection fitting that has a gasket should be electrically bonded by a method under paragraph (c) of this section that bonds:
(i) Both sides of the connection to the hull structure; or
(ii) Each side of the connection to the other side.

(c) An electrical bond should be made by at least one of the following methods:
(i) A metal bonding strap attached by welding or bolting;
(ii) Two or more bolts that give metal to metal contact between the bolts and the parts to be bonded; or
(iii) Other metal to metal contact between adjacent parts under designed operating conditions.

4.3 Definition of hazardous area zones

In lieu of Section 4.3, hazardous areas are defined as noted below.

4.3.1 Hazardous area Zone 0

The following are Class I Special Division 1 (Zone 0) locations:

(1) Interiors of LNG tanks, and any pipework of pressure-relief or other venting systems for the LNG tanks.

(2) A natural gas pump room or compressor room*.

(3) Areas on an open deck, or semi-enclosed spaces on open deck, within 0.5 meters (1.6 feet) of any natural gas pump room or compressor room entrance, and pump room ventilation inlet or outlet.

(4) An enclosed or semi-enclosed space having an opening into a Class I Special Division 1 (zone 0) location.

*The following are additional standards pertaining to hazardous locations for natural gas pump and compressor rooms:

(a) Providing ventilation to re-classify enclosed hazardous areas containing devices handling natural gas fuel is not allowed. These areas should comply with Clauses 6.3.1.2 of API 500 (2002) and 6.6.1.2 of ANSI API RP 505 (2002).

(b) Where fitted, natural gas fuel pump and compressor rooms shall be isolated from all sources of vapor ignition by gastight bulkheads. Cable penetrations of gastight bulkheads should be provided with the appropriate cable sealing fittings. The gastight bulkhead between the pump room and the pump-engine compartment may be pierced by fixed lights, drive shaft and pump-engine control rods, provided that the shafts and rods are fitted with fixed oil reservoir gland seals, or pressure grease seals where they pass through the gastight bulkheads. Other types of positive pressure seals should be specially approved by the Commandant (CG-521). Access to a natural gas pump or compressor room should be from the open deck.

(c) Fixed lights in natural gas fuel pump and compressor rooms should meet the arrangement and construction requirements in 46 CFR 111.105-31(g).

(d) A natural gas pump room or compressor room that precludes the lighting arrangement of paragraph (c) of this section, or where the lighting arrangement of paragraph (c) of this section does not give the required illumination level, should have explosion proof, flameproof (Ex “d”) or flameproof-increased safety (Ex “de”) lighting fixtures.

4.3.2 Hazardous area Zone 1

The following are Class I Division 1 (Zone 1) locations:

(1) A tank room.

(2) A zone on the weather deck or a semi-enclosed space on the weather deck within 3.0 m (10 feet) of any LNG tank outlet, gas or vapor outlet, gas fuel pipe flange, valve, manifold, and machinery room ventilation hood or gas fuel piping ventilated pipe or duct outlet.

(3) Areas on an open deck, or semi-enclosed spaces on open deck, 1.0 meter beyond the areas in item (3) of the Class I Special Division 1 (Zone 0) locations listed above.

(4) Areas on the open deck within spillage coamings surrounding gas bunker manifold valves and 3 meters (10 feet) beyond these, up to a height of 2.4 meters (8 feet) above the deck.

(5) An enclosed space or semi-enclosed space having an opening into any Class I Division 1 (zone 1) location.

(6) Enclosed or semi-enclosed spaces in which pipes containing gas are located, e.g., ducts around gas pipes, and semi-enclosed bunkering stations.

4.3.3 Hazardous area Zone 2

The following are Class I Division 2 (Zone 2) locations:

(1) A zone on the weather deck or a semi-enclosed space on the weather deck within 1.5 meters (5 feet) of the areas in items (2) through (4) of the Class I Division 1 (Zone 1) locations listed above.

(2) A zone within 2.4 meters (8 feet) of the outer surface of a LNG tank where the surface is exposed to the weather.

(3) An enclosed space that shares a boundary with a tank room containing a tank required to have a secondary barrier.

CHAPTER 5 – CONTROL, MONITORING AND SAFETY SYSTEMS

5.1 General

Where IMO Resolution MSC.285(86) requires components in remote systems to be designed with redundancy or to be independent of each other, redundancy or independence shall also be provided in the control system.

5.3 Gas compressor monitoring

In addition to the provisions of Section 5.3, the gas compressor monitoring system should include the alarms and actions listed in the following table:

Table 1. Gas compressor monitoring system requirements

	Alarm	Automatic Stop
Gas heater outlet, high temperature	X	
Gas compressor outlet, high temperature	X	X
Gas compressor inlet, low pressure	X	
Gas compressor outlet, high pressure	X	
Gas compressor outlet, low pressure	X	
Control system failure	X	

	Alarm	Automatic Stop
Sealing gas, low pressure	X	
Lubrication oil, low pressure	X	X
Lubrication oil, high pressure	X	
Master gas valve close	X	
In addition high-pressure gas compressor shall stop automatically in the event of: - Control air pressure loss - High Gas concentration in the compressor room - Automatic stop or emergency stop of gas supply to the engine.		

5.5 Gas detection

(1) General

(a) Except as modified below, fixed gas detection systems on gas-fueled vessels should meet the applicable provisions of Section 5.5.

(b) The fixed automatic gas detection and alarm system should meet the performance requirements in IEC 60079-29-1

(c) The installation, selection, safe use and maintenance should meet IEC 60079-29-2.

(2) Location of Detectors

Gas detectors should be permanently installed in the locations identified in Section 5.5.1. In addition, for LNG fuel containment systems following the arrangement described in Section 2.8.4.4, gas detectors should be permanently installed in the space surrounding the LNG fuel tank and where the opening to the tank room is located.

(3) Plan Submittal

In addition to the submission of typical new construction drawings, including such drawings reflecting the installation of an LNG fueled propulsion system, the following gas detection system plans must be submitted for review in accordance with 46 CFR 110.25-3:

(a) Elementary and isometric or deck wiring plans, a list of symbols, and manufacturer's name and identification of each item of electrical equipment.

(b) System's instruction manual, including information concerning installation, programming, operation, and troubleshooting.

(c) The name, model number, and function of each major component and accessory, such as the main control cabinet, remote annunciator cabinet, gas detector, zone card, isolator, central processing unit, zener or intrinsically safe safety barrier, special purpose module, or power supply.

(d) Independent laboratory certifications and applicable test reports of the gas detection system.

(4) Gas detection system certification

(a) All fixed gas detection systems, including associated devices, and portable detectors should be listed or certified by an independent laboratory accepted by the Commandant under 46 CFR Part 159 as meeting the following standards:

(i) IEC 60079-29-1(2007). If installed in hazardous locations, the detector should be labeled and marked to comply with the requirements of IEC 60079-0.

(ii) The environmental testing standards for control and monitoring equipment, in Clause 5 of IEC 60092-504.

(b) When an approved fire detection system under the approval series 161.002 incorporates gas detectors, the manufacturer of the fire detection system should specifically list the gas detector by manufacturer's name and model identification, for compatibility with the type approved fire detection system.

(5) Additional requirements for gas detection systems

(a) Gas detection systems should be designed such that when a detector actuates, the vessel operator is able to identify the specific gas detector and its location.

(b) Gas detection cables should be routed such that a fire or flooding in one space will not affect the ability to detect gas in another space.

(c) Gas detection system shall be designed such that failure of one component or sub-system will not unduly affect any other system, sub-system or component and, as far as practicable, shall be detectable.

(d) Gas detection should be continuous without delay.

(e) Simultaneous activation of gas detectors shall not impair the operation of the system.

(f) There should be at least two independent sources of power for the fixed gas detection system. The normal source should be from the main power source. The other source should be the emergency power source or an automatically charged battery. Upon loss of normal power the system should be automatically supplied from the other source.

(g) The automatic shutdown functions of the gas detection system should be independent from the gas detection monitoring and alarm functions of the gas detection system. Power failure should not result in activation of the gas detection system shutdown function.

(h) Power supplies and electric circuits necessary for the operation of the system shall be supervised for loss of power and ground fault.

(i) Each flammable gas detection system should allow calibration of the equipment with span gas.

(6) Portable Gas Detectors

Each vessel should have at least two portable gas detectors that meet the applicable standards under paragraph (4) of this section.

5.6 Safety functions of gas supply systems

(1) The Coast Guard applies the following table as adapted from Table 1 in Section 5.6 as an acceptable standard:

Table 2.

Parameter	Alarm	Automatic shutdown of main tank valve	Automatic shutdown of gas supply to machinery space containing gas-fuelled engines	Comment
Gas detection in tank room above 20%LEL	X			
Gas detection on **second detector** in tank room **above 20% LEL**	X	X		
Gas detection in space surrounding LNG fuel tank and where opening to tank room is located above 20%LEL	***X***			***For LNG fuel containment systems following arrangement described in Section 2.8.4.4 of IMO Resolution MSC.285(86).***
Fire detection in tank room[1)]	X	X		
Bilge well high level tank room	X			
Bilge well low temperature in tank room	X	X		
Gas detection in duct between tank and machinery space containing gas-fueled engines above 20% LEL	X			
Gas detection on **second detector** in duct between tank and machinery space containing gas-fueled engines **above 20% LEL**	X	X[2)]		
Gas detection in compressor room above 20% LEL	X			
Gas detection on **second detector** in compressor room **above 20% LEL**	X	X[2)]		
Gas detection in duct inside machinery space containing gas-fueled engines above 30% LEL	X			If double pipe fitted in machinery spaces containing gas-fueled engines

Gas detection **on one detector** in duct inside machinery space containing gas-fueled engines above 40% LEL	X		X[3)]	If double pipe fitted in machinery spaces containing gas-fueled engines
Loss of ventilation in duct between tank and machinery space containing gas-fueled engines[6)]	X		X[2) 4)]	
Loss of ventilation in duct inside machinery space containing gas-fueled engines[6)]	X		X[3) 4)]	If double pipe fitted in machinery spaces containing gas-fueled engines
Fire detection in machinery space containing gas-fueled engines[1)]	X		X	
Abnormal gas pressure in gas supply pipe	X		X[4)]	
Failure of valve control actuating medium	X		X[5)]	Time delay as found necessary
Automatic shutdown of engine (engine failure)	X		X[5)]	
Emergency shutdown of engine manually released	X		X	
Rupture detection in gas supply piping for high pressure gas supply	**X**		**X**	

1) Ventilation to the space shall stop automatically and fire dampers shall close.

2) If the tank is supplying gas to more than one engine and the different supply pipes are completely separated and fitted in separate ducts and with the master valves fitted outside of the duct, only the master valve on the supply pipe leading into the duct where gas or loss of ventilation is detected is to close.

3) If the gas is supplied to more than one engine and the different supply pipes are completely separated and fitted in separate ducts and with the master valves fitted outside of the duct and outside of the machinery space containing gas-fueled engines, only the master valve on the supply pipe leading into the duct where gas or loss of ventilation is detected is to close.

4) This parameter is not to lead to shutdown of gas supply for single fuel gas engines, only for dual fuel gas engines.

5) Only double block and bleed valves to close

6) If the duct is protected by inert gas, then loss of inert gas overpressure shall lead to the same actions as given in this table.

(2) Gas fuel pumps and compressors should shut-down automatically when the quick-closing shut-off valves are closed as required by Table 2 above.

CHAPTER 6 – COMPRESSORS AND GAS ENGINES

6.2 Gas engine design general

Gas turbine engine installations using natural gas as fuel should meet the requirements in Section 6 of the ABS Guide for Propulsion and Auxiliary Systems for Gas Fuelled Ships.

CHAPTER 7 – MANUFACTURE, WORKMANSHIP AND TESTING

7.2 Gas tanks

In addition to the requirements of 7.2, independent tanks should meet the testing requirements of 46 CFR 154 or the ASME Boiler and Pressure Vessel Code, Section VIII, Division I or II, as applicable.

7.3 Gas piping systems

In addition to the requirements of 7.3, gas piping systems should meet the testing requirements of ASME B31.3, Process Piping.

CHAPTER 8 – OPERATIONAL AND TRAINING REQUIREMENTS

The contents of Chapter 8 are outside the scope of this equivalency determination. Additional or alternative operational and training provisions may be required by the Coast Guard's Office of Operating and Environmental Standards (CG-522), or the cognizant Officer in Charge, Marine Inspection.