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Homeland Security

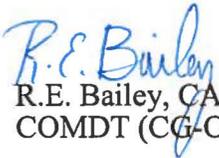
United States
Coast Guard



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CG-OES Policy Letter
No. 01-15
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From:  R.E. Bailey, CAPT
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To: Distribution

Subj: GUIDELINES FOR LIQUEFIED NATURAL GAS FUEL TRANSFER OPERATIONS
AND TRAINING OF PERSONNEL ON VESSELS USING NATURAL GAS AS
FUEL

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

1. Purpose. This policy letter provides guidance to Coast Guard Captains of the Port (COTPs)/Officers in Charge, Marine Inspection (OCMIs) regarding vessels that use natural gas as fuel and engage in liquefied natural gas (LNG) fuel transfer operations. It addresses fuel transfer operations and training of personnel working on U.S. and foreign vessels that use natural gas as fuel and conduct LNG fuel transfer operations in waters subject to U.S. jurisdiction. This policy does not apply to vessels regulated as LNG carriers that utilize their boil-off gas as fuel.
2. Action. Cognizant COTPs/OCMIs should use this policy as a guide to evaluate whether natural gas fueled vessels are operated, and affiliated personnel are trained, in a manner that provides a level of safety that takes into account characteristics specific to LNG fueled ships and LNG fuel transfer operations.
3. Directives Affected. None.
4. Background.
 - a. Natural gas is considered by the maritime industry to be a prominent future fuel source for commercial vessels. The International Maritime Organization's designation of the North American Emission Control Area under MARPOL Annex VI has imposed stringent emissions limitations on marine engines. Because use of natural gas as ship's fuel would substantially reduce carbon emissions, sulfur emissions, and nitrogen oxide emissions, the shipping industry is exploring conversion from oil-based bunker fuel to much cleaner burning natural gas.
 - b. Existing regulations cover design, equipment, operations, and training of personnel on vessels that carry LNG as cargo and facilities that handle LNG in bulk. However, the use

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GAS AS FUEL

16715
CG-OES Policy Letter
No. 01-15

of LNG as fuel is a relatively new concept in the United States. Although some existing regulations apply to LNG fuel transfer operations, the Coast Guard has not established regulations specifically for vessels that receive LNG for use as fuel.

- c. As a result, the maritime industry is looking to the Coast Guard to fill the “gap” by recommending appropriate safety measures for the safe transfer of LNG and use of LNG as a marine fuel. This policy letter contains recommendations for LNG fuel transfer operations on vessels using LNG as fuel, and for the training of personnel on such vessels.
- d. The existing regulation at 46 CFR 15.405 requires that each credentialed mariner be familiar with the relevant characteristics of the vessel appropriate to his or her duties and responsibilities prior to assuming those duties and responsibilities. Additionally, Enclosure (3) provides training guidance, familiarization training, and information on emergency exercises for personnel who will work aboard vessels using gases or low flashpoint fuels, which includes the use of LNG as fuel.

5. Discussion.

- a. Waterfront facilities handling LNG in bulk are subject to existing regulations at 33 CFR part 127. Vessels carrying LNG that is intended for transfer to other vessels for use as fuel also are subject to existing regulations, notably 46 CFR subchapter D, and in most cases 46 CFR part 154, and 33 CFR parts 155 and 156. This policy letter and Enclosure (1) provide guidance for COTPs/OCMIIs on how these existing regulations apply to LNG fueling operations. COTPs/OCMIIs must ensure that LNG fuel transfer operations comply with existing applicable and enforceable regulations.
- b. Additionally, this policy letter and Enclosures (1) and (2) provide guidance on recommended safety procedures that COTPs/OCMIIs should consider when evaluating proposed LNG as fuel transfer operations so that these transfers can occur safely and securely. As a reminder, it is the responsibility of the operator of the facility and/or the supplying vessel to ensure that the receiving vessel has the necessary personnel and equipment to safely and securely participate in the conduct of an LNG transfer operation, as set forth in 33 CFR Part 127. However, each person in charge on both the receiving vessel and the supplying vessel or facility must complete the declaration of inspection required by applicable federal regulations and verify that all requirements are met.
- c. Existing regulations at 33 CFR parts 127, 155, and 156 require transfer procedures be provided. Enclosures (1) through (3) provide recommendations on transfer procedures and training specific to use of LNG as fuel and recommendations for bunkering systems on vessels using LNG as fuel.

Subj: GUIDELINES FOR LIQUEFIED NATURAL GAS
FUEL TRANSFER OPERATIONS AND TRAINING
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GAS AS FUEL

16715
CG-OES Policy Letter
No. 01-15

- d. The existing regulation at 46 CFR 15.405 requires that each credentialed mariner be familiar with the relevant characteristics of the vessel appropriate to his or her duties and responsibilities prior to assuming those duties and responsibilities. Additionally, Enclosure (3) provides training guidance for personnel who will work aboard vessels using gases or low flashpoint fuels, which includes the use of LNG as fuel.
- e. Existing regulations at 33 CFR 156.118 allow the COTP to require at least 4 hours advance notice of the time and place of a transfer operation involving certain facilities and/or self-propelled vessels. The COTP should require this notice where applicable, because this may help the COTP/OCMI ensure that transfer procedures and a declaration of inspection are provided as required by the applicable regulations.
- f. While in waters subject to the jurisdiction of the United States, vessels should only receive LNG for use as fuel from the following sources:
 - (1) Waterfront facilities that meet the applicable requirements of 33 CFR Part 105 and 127, which includes LNG transfers from tank trucks and rail cars;
 - (2) Vessels that meet the applicable design requirements of 46 CFR Subchapter D and, if applicable, 46 CFR Part 154; or alternate design standards approved by Commandant, U.S. Coast Guard Headquarters, Office of Design and Engineering Standards, (CG-ENG). Please see Enclosure (1), footnote 1, for supplemental information regarding use of manned and unmanned non-self-propelled tank barges.
- g. Transfer of LNG from a vessel using natural gas as fuel should not be conducted, except in the case of emergencies that may endanger the safety of life, property, or the environment, or as otherwise authorized by a COTP for tank cleaning, repair, and similar procedures. This guidance does not pertain to vessels that are built and operated to carry LNG as a cargo.
- h. This policy letter does not provide guidance on vessel design criteria for natural gas fuel systems. For policy guidance related to the design criteria of such systems on U.S. certificated vessels, please refer to: CG-521 Policy Letter No. 01-12, dated April 19, 2012. It may be accessed at: <http://www.uscg.mil/hq/cg5/cg521/docs/0112.pdf>. This policy letter does not apply to uninspected vessels; however, the guidance it contains may be considered useful to owners and operators of uninspected vessels desiring to use LNG as fuel. Questions related to LNG fuel use on uninspected vessels should be directed to the local COTP in the zone where the vessel would intend to operate. Foreign vessels operating in U.S. waters should provide documentation indicating that the design of its natural gas fuel system complies with reference (a) and has been reviewed and approved by its flag administration or a class society authorized to act on the flag administration's behalf. Questions related to the design of these systems should be referred to the Coast Guard Marine Safety Center.

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16715
CG-OES Policy Letter
No. 01-15

- i. Except for the guidance on training, this policy letter does not provide guidance on other gaseous fuel systems such as Compressed Natural Gas (CNG) or Liquefied Petroleum Gas (LPG). At this time and unlike LNG, there appears to be little interest in the use of these commodities as a marine fuel. Accordingly, the Coast Guard will evaluate proposals for using these and other gaseous fuel systems on a case-by-case basis. Owners and operators interested in using gaseous fuels other than LNG should contact the Coast Guard Marine Safety Center.
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. Each COTP has discretionary authority on how best to address specific safety and security concerns within his/her area of responsibility. Nothing in this policy letter is meant to override or subvert the discretion of the COTP when addressing the unique safety and security concerns for an LNG operation.
7. Changes. This policy letter will be posted on the web at www.homeport.uscg.mil. Changes to this policy will be issued as necessary. Suggestions for improvements of this policy should be submitted in writing to Commandant, U.S. Coast Guard Headquarters, Office of Operating and Environmental Standards, (CG-OES) at the address listed on the first page.

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- Encl: (1) Guidance for LNG Fuel Transfer Operations and Training of Personnel on Vessels Using Liquefied Natural Gas as Fuel
(2) Excerpts of Resolution MSC.285(86), Chapters 2, 5, and 8
(3) Interim Guidance on Training for Mariners on Vessels using Gases or Other Low Flashpoint Fuels

Guidance for LNG Fuel Transfer Operations on Vessels Using Natural Gas as Fuel

The guidelines described below are derived from the Coast Guard's regulations governing the safe design, construction, equipment, inspection, testing and operation of vessels that carry oil and hazardous materials in bulk. As used in this policy letter, "bulk" means without mark or count and directly loaded into a hold or tank on a vessel without containers or wrappers. With regard to procedures for fuel transfer operations and specialized equipment on vessels using natural gas as fuel, the guidelines below may be used to achieve a level of safety that takes into account characteristics specific to LNG fueled ships and LNG fuel transfer operations. Although low pressure natural gas is the end product used for combustion in a vessel's engine, it is normally transferred and stored aboard the vessel as either a cryogenic liquid or a highly pressurized compressed gas. Accordingly, special consideration must be given to the differences that exist between various types of fuel used and handled by vessel personnel. More information and specific details related to natural gas and other alternative fuels can be obtained by visiting the U.S. Department of Energy's Alternative Fuels Data Center website at: <http://www.afdc.energy.gov>

Existing Regulations for Vessels and Facilities Providing LNG as Fuel

Existing 46 CFR Chapter I, Subchapter D prescribes the rules and regulations for tank vessels, including manned and unmanned tank barges, and provides for the uniform administration of vessel inspection requirements applicable to tank vessels carrying regulated cargoes listed in 46 CFR Table 30.25-1. Existing 46 CFR Part 154 prescribes safety standards for self-propelled vessels carrying bulk liquefied gas cargoes including natural gas.¹

46 CFR Subchapter D and 46 CFR Part 154 set forth comprehensive regulatory schemes that include requirements for vessel design, construction, equipment, inspections, tests and operations for vessels carrying LNG as cargo. These regulations direct the owner and operator of the vessel, and agent(s), to ensure that personnel involved in transfer operations possess the appropriate qualifications and understand the procedures to complete a safe transfer. To accomplish this, 46 CFR Subchapter D and 46 CFR Part 154 apply certain requirements of 33 CFR Part 155 Subpart C.

Existing 33 CFR Part 127 governs the designation and qualifications of the person in charge of a facility transfer operation and sets forth natural gas transfer procedures, noting that transfer requirements applicable to the vessel are published in 46 CFR Part 154 (see 33 CFR 127.319).

Existing regulations also provide for implementation of safety and security measures by the COTP, such as limited-access safety and security zones, where appropriate (see, generally, 33 CFR part 165).

¹ Manned and unmanned non self-propelled barges are subject to the requirements of 46 CFR Subchapter D. In accordance with 46 CFR 30.01-5(g), manned barges carrying any of the cargoes listed in Table 30.25-1 are considered individually by the Commandant and may be required to comply with the requirements of 46 CFR Subchapter O, as applicable, as well as the requirements of 46 CFR Subchapter D. The U.S. Coast Guard, Headquarters Office of Design and Engineering Standards, Commandant (CG-ENG), has determined that unmanned barges proposed to carry LNG in bulk should also be reviewed under 46 CFR Subchapter O as novel vessel designs that require concept approval.

Operations, Emergency, and Maintenance Manuals

Existing regulations at 33 CFR 127.305 - 127.309 outline the requirements for having operations and emergency manuals at waterfront facilities handling LNG. Additionally, existing regulations at 46 CFR 154.1810 require vessels carrying LNG as cargo to maintain a cargo manual which lists specific details relative to the cargo, cargo systems, emergency measures, symptoms, and corrective actions to be taken in the event of an emergency. To help ensure LNG operations are conducted safely, each owner or operator of a vessel using natural gas as fuel should develop similar information which is based on specific details of their vessel and their intended operations. Each vessel should have an LNG fuel transfer system operations manual and an emergency manual which includes, but is not limited to, the information below. The master of a vessel using LNG as fuel should ensure that all personnel involved with LNG fuel use, transfer, or emergency response are familiar with the contents of the LNG fuel transfer system operations manual and meet the basic standard of competence or advanced standard of competence outlined in Enclosure (3) as appropriate for the duties to which they are assigned.

- a. Each LNG fuel transfer system operations manual should contain vessel-specific information, which includes, but is not limited to, the following as applicable:
 - (1) A description of LNG, its handling hazards as a liquid or as a gas, including frostbite or asphyxiation, its safety equipment, personal protection equipment (PPE), and necessary first aid measures;
 - (2) A description of the dangers of asphyxiation from inert gas on the vessel;
 - (3) Identification of the locations where the risk of an LNG leak and damage to steel structures is high and the measures in place (e.g. water curtains, drip pans, spill trays, specialized materials, etc.) to mitigate embrittlement of the steel structures as a result of leakage of LNG during transfer operations;
 - (4) A description of the LNG containment system, including pressure and temperature ranges and relief valve settings;
 - (5) A description of the LNG tank measurement and instrumentation system for level, pressure, and temperature control.
 - (6) A description of the operational conditions (including normal operations and bunkering) of the LNG fuel tanks, including pressures and temperatures for expected operating conditions and associated monitoring equipment;
 - (7) A definition of the operating envelope for which safe transfer operations can and cannot occur.
 - (8) Descriptions and diagrams of the components of the LNG fuel transfer system, including, but not limited to, the following as applicable:
 - (i) Recirculating, vapor, or condensate return system;
 - (ii) LNG fuel tank cool down system;

- (iii) LNG fuel tank warm-up or vaporization system;
- (iv) Gas main system;
- (v) LNG fuel tank or compressor relief system and blocked liquid or gas relief system;
- (vi) Inerting system;
- (vii) Boil-off gas compressor or reliquefaction system;
- (viii) Gas detection systems;
- (ix) Alarm or safety indication systems;
- (x) Systems for venting or using boil-off gas as fuel;
- (xi) Inert gas and natural gas return tank system (if any);
- (xii) LNG fuel tank filling sequence;
- (xiii) Maximum oxygen content after inerting and maximum Nitrogen content after purging; and
- (xiv) Emergency Shutdown System.

(9) A detailed diagram of the LNG fuel transfer area identifying:

- (i) Electrical ignition sources;
- (ii) Rating of all electrical components;
- (iii) Emission sources for gas;
- (iv) Air intakes, vents, and securing arrangements;
- (v) Fire suppression and detection equipment;
- (vi) Loading arms, manifold, and valves;
- (vii) Hose connections and couplings including emergency release coupling; and
- (viii) Emergency shutdown control locations and emergency shutdown devices.

(10) A description of the following conditions and their symptoms, including emergency measures and corrective actions:

- (i) LNG fuel transfer or ballast valve malfunction;
- (ii) Low and high LNG fuel tank gas pressure and temperature;
- (iii) High LNG fuel tank fill level alarms and shutdowns;
- (iv) Gas compressor shutdown;
- (v) Hull cold spot detection;
- (vi) LNG and natural gas piping leaks (including ignited leaks);
- (vii) Primary or secondary LNG tank or pipe barrier failures;
- (viii) Hold boundary structural failure;
- (ix) Fire in vent mast head;
- (x) Reliquefaction plant failure;
- (xi) Vaporizer malfunction or failure;
- (xii) LNG piping or valve freeze-up;
- (xiii) Failure of emergency shutdown system devices; and
- (xiv) Fire on the supply side of the LNG fuel transfer.

(11) The maximum relief valve setting or maximum allowable working pressure of the LNG fuel transfer system.

(12) The procedures for:

- (i) LNG fuel transfer operations which should include, but not be limited to the following:
 - (a) Verifying advance notice (e.g. time and place) of transfer has been provided to the local COTP (if required);
 - (b) Ensuring personnel have appropriate PPE and gas detection equipment;
 - (c) Ensuring weather is within safe operating limits to allow a safe LNG transfer;
 - (d) Setting, securing, and clearing safety and security areas around the LNG bunkering area.;
 - (e) Conducting a pre-transfer inspection (see Conduct before a LNG Fuel Transfer below);
 - (f) System cool-down;
 - (g) Connection of systems;
 - (h) Inerting before transfer;
 - (i) LNG transfer and vapor return;
 - (j) Conducting inspections during transfer (see Conduct during a LNG Fuel Transfer below)
 - (k) System draining and purging;
 - (l) Inerting after transfer; and
 - (m) Shut down and disconnection of systems (see Conduct after a LNG Transfer below).
 - (ii) LNG fuel transfer operations start-up and shutdown;
 - (iii) Communications systems used during LNG fuel transfer operations;
 - (iv) Gas freeing of tanks and piping systems containing residual natural gas for the purpose of conducting hot work;
 - (v) Procedures for testing and entering enclosed and/or confined spaces where gas or flammable vapors may accumulate;
 - (vi) Performing operations simultaneously while LNG transfer operations are taking place (see paragraph (e) under section heading "Transfer Operations"); and
 - (vii) Handling emergencies during the LNG transfer operations.
- (13) Any other safety matters relating to operation of the LNG fuel transfer equipment, systems, or piping;
- (14) The duties and responsibilities of each person assigned for LNG fuel transfer operations; and
- (15) A definition and description of the LNG bunkering safety and security areas.
- b. Each emergency manual should contain the following information, as applicable:
- (1) LNG spill and ignited leak response procedures, including contacting response organizations and evacuation or relocation of persons onboard;
 - (2) Emergency LNG fuel transfer system shutdown procedures;
 - (3) A description of the fire equipment and systems, and their operating procedures;

- (4) A description of the emergency lighting and emergency power systems;
- (5) Emergency contact information for local Coast Guard units, hospitals, fire departments, police departments, and other emergency response organizations;
- (6) First aid procedures and, if there are first aid stations, the locations of each station; and
- (7) Contingency plans for handling the following emergencies:
 - (i) Fire in or near the vicinity of the location where LNG is being transferred;
 - (ii) LNG or natural gas leakage;
 - (iii) Hose, coupling, or loading arm failure;
 - (iv) Mooring line or mooring equipment failure;
 - (v) Communication failure;
 - (vi) Power failure;
 - (vii) Personnel injuries (frost burns, suffocation, etc.);
 - (viii) Emergency departure procedures;
 - (ix) LNG spills that come into contact with the deck or hull;
 - (x) Breaches in safety or security areas;
 - (xi) Trapped liquid or blocks in LNG transfer lines; and
 - (xii) Rollover within LNG tanks.

c. Each maintenance manual should meet the guidelines specified in Chapter 8, Section 8.3, of IMO Resolution MSC.285(86), "Interim Guidelines on Safety for Natural Gas-Fuelled Engine Installations in Ships." (See Enclosure (2) to CG-OES Policy Letter 01-14)

The LNG fuel transfer system operations manual, emergency manual and maintenance manual should be kept up to date and maintained aboard the vessel such that they are readily available to vessel personnel and Coast Guard marine inspectors upon request.

The LNG fuel transfer system operations manual, emergency manual and maintenance manual(s) should be reviewed by the COTP/OCMI for accuracy prior to the first transfer of LNG and periodically during scheduled inspections and cargo transfer monitors. COTPs/OCMIs should discuss and become familiar with intended operations, emergency response actions, and plans for periodic maintenance with vessel owners and operators well in advance of any intended operations.

Transfer Operations

- a. Person In Charge (PIC): LNG fuel transfer procedures should designate, either by name or by position in the crew, the person in charge of each transfer operation.
- b. Qualifications of PIC: Each person designated as a person in charge of a LNG fuel transfer operation should meet the following qualifications:
 - (1) Holds an MMC with an appropriate officer endorsement issued under 46 CFR part 10 and 11, or STCW Chapter II or III for foreign flag vessels, authorizing service on board the vessel; and

- (2) Meets the training guidance of IMO's, STCW.7/Circ.23, or Enclosure 3, for Advanced training.
- c. Notification of Transfer: LNG fuel transfer operations should not be conducted without advance notice given to the local COTP. The time and place of each transfer operation should be provided at least 4 hours before it begins.
- d. Transfer Procedures: Vessels using natural gas as fuel should have transfer procedures that meet the appropriate requirements of 33 CFR 155.720 through 155.760, and 33 CFR Part 156 when transferring LNG:
- (1) To or from the vessel; and
 - (2) From tank to tank within the vessel.
- e. Simultaneous Operations: The Coast Guard recognizes that simultaneous operations may be necessary in certain situations in order to allow for a non-disruptive flow of ship and port operations. Currently there is limited experience addressing the concept of conducting simultaneous shipboard operations (e.g., passenger, cargo, or ship store loading operations, etc.) while LNG fuel transfer operations are taking place. If simultaneous operations are to occur during LNG fuel transfer operations, a formal operational risk assessment may be conducted by the facility owner to address the added hazards and evaluate the potential risks. The results of the assessment may be used to help the COTP determine whether the operations may be conducted safely. Guidance for conducting risk assessments found in Det Norske Veritas - Germanischer Lloyd's, DNVGL-RP-0006: 2014-01, "Development and Operation of LNG Bunkering Facilities," and ISO's ISO/TS 18683:2015, "Guidelines for Systems and Installations for Supply of LNG to Ships" may be used to help guide the risk assessment process. Vessel owners/operators considering the need to conduct simultaneous operations should contact and discuss their intentions with the local COTP having jurisdiction over the area where the operation will be conducted. Local COTPs should contact Commandant, U.S. Coast Guard Headquarters, Office of Operating and Environmental Standards, (CG-OES) for assistance when considering simultaneous operations in their areas of responsibility.
- f. Safety and Security areas: In order to reduce the potential for the introduction of uncontrolled events and ignition hazards, safety and security areas should be established as recommended by ISO/TS 18683:2015, Guidelines for Systems and Installations for Supply of LNG as Fuel to Ships, (2013).
- g. Conduct before a LNG Fuel Transfer: The following pre-transfer actions should be conducted by the person in charge of a vessel receiving LNG for use as fuel:
- (1) Inspect the transfer piping system and equipment to be used during the transfer and ensure that any worn or inoperable parts are repaired or replaced;
 - (2) Review and agree with the person in charge of transferring LNG to the vessel as to:
 - (i) The sequence of transfer operations;

- (ii) The transfer rate and duration;
 - (iii) The duties, location, and watches of each person assigned for transfer operations;
 - (iv) Emergency procedures; and
 - (v) For each of the tanks from which LNG will be transferred, note the pressure, temperature, and volume to ensure that they are safe for transfer to the vessel's tanks and piping systems;
- (3) Ensure that transfer connections allow the vessel to move to the limits of its moorings without placing strain on the loading arm or transfer piping system;
- (4) Ensure that each part of the transfer system is aligned to allow the flow of LNG to the desired location;
- (5) Ensure that warning signs are displayed;
- (6) Eliminate all ignition sources in the LNG fuel transfer area;
- (7) Ensure that personnel are on duty in accordance with the LNG fuel transfer system operations manual;
- (8) Ensure that safety and security areas are set and clear;
- (9) Ensure firefighting equipment is ready for use;
- (10) Test the following to determine that they are operable:
- (i) The sensing and alarm systems;
 - (ii) The emergency shutdown system; and
 - (iii) The communication systems;
- (11) Ensure climatic conditions are within the established safe operating envelope; and
- (12) Ensure appropriate paper work has been completed (e.g. Declaration of Inspection required by 33 CFR 127.317 and 33 CFR 156.150).
- h. Conduct during a LNG Fuel Transfer: During the LNG fuel transfer operation, the person in charge of receiving LNG for use as fuel should:
- (1) Be in continuous communication with the person in charge of transferring LNG to the vessel;
 - (2) Have continuous control of system pressure, temperature, and tank levels;
 - (3) Ensure that an inspection of the transfer piping and equipment for leaks, defects, and other symptoms of safety and operational problems is conducted at regular intervals during transfer; and

- (4) Ensure that the transfer operations are discontinued before electrical storms or upon notification of any contingency identified in the emergency manual.
- i. Conduct after a LNG Fuel Transfer: After a LNG fuel transfer, the person in charge of receiving LNG for use as fuel should ensure that the hoses, manifold, and piping used during the transfer operation are purged so that natural gas levels are below the lower flammability level and are:
- (1) Properly drained and inerted prior to disconnecting;
 - (2) Free of residual LNG; and
 - (3) Securely blanked.
- J. Job aides: In an attempt to establish standardized procedures associated with LNG bunkering operations, several industry organizations have developed or are developing job aides that owners and operators of vessels using LNG as fuel may find useful. Names and links to some of the organizations are listed below:
- (1) World Ports Climate Initiative (WPCI);
<http://www.lngbunkering.org/>
 - (2) Society of International Gas Tanker and Terminal Operators (SIGTTO);
<http://www.sigtto.org/publications/publications-and-downloads>; and
 - (3) International Organization for Standardization.
<http://www.iso.org/iso/home.html>

Owners and operators of vessels intending to use natural gas as fuel are encouraged to become familiar with available industry standards and guidelines. Standards and Guidelines for Natural Gas Fueled Ships, produced by the LNG Ship Fuel Advisory Group and published on its behalf by SIGTTO and the Society for Gas as a Marine Fuel (SGMF) provides a comprehensive listing of the standards and guidelines that are currently available. The list may be viewed at the following web address:

<http://www.sgmf.info/media/5637/standards-guidelines-natural-gas-fuelled-v5k1.pdf>

Vessel Equipment

- a. Bunkering Systems: A vessel's bunkering station and bunkering system should comply with Chapter 2, Sections 2.9.1 and 2.9.2, of IMO Resolution MSC.285(86). (See Enclosure (2) of CG-OES Policy Letter 01-14)
- b. Deck Lighting: A vessel engaged in transfer operations between sunset and sunrise should have deck lighting that illuminates the transfer area, and is suitable for service in the intended location including meeting any applicable hazardous area equipment requirements. Lighting should be located or shielded so as not to mislead or otherwise interfere with navigation on the adjacent waterways. Lighting should adequately illuminate:

- (1) Each transfer operation's work area and each transfer connection point in use on the vessel; and
- (2) Each transfer operation's work area and each transfer connection point in use in the transfer system transferring to the vessel.

Where the illumination is apparently inadequate, it may be verified by instruments that measure the levels of illumination. On a horizontal plane 3 feet above the deck the illumination should measure at least:

- (1) 5.0 foot-candles at transfer connection points; and
 - (2) 1.0 foot-candle in transfer operations work areas.
- c. Personnel Protection: Personal protective equipment should be provided to protect personnel involved with LNG handling and transfer operations from exposure to cryogenic liquid. The following personal protective equipment should be provided in a place where it is readily available to personnel:
- (1) Gloves;
 - (2) Full face shields;
 - (3) Fit-for-purpose clothing;
 - (4) Protective footwear such as leather, safety-toed work boots (no canvas sneakers should be worn during LNG fueling or transfer operations); and
 - (5) Hard hats.
- d. Portable Gas Detectors: Each vessel using LNG as fuel should have at least two portable gas detectors capable of measuring 0-100% of the lower flammable limit of methane and be readily available for use by personnel engaged in LNG fuel transfer operations.
- e. Radio and Communication Equipment: Radio and communication equipment should meet the following specifications:
- (1) Radio and communication equipment with antennas located where flammable gas may accumulate should be secured prior to transfer;
 - (2) Portable radio devices for use during the LNG fuel transfer operations should be tested and listed or certified intrinsically safe (UL 913 or IEC 60079-11, Ex "ia") by an independent laboratory accepted by the Commandant under 46 CFR part 159;
 - (3) Portable electronic devices such as mobile phones, cameras, and other devices using batteries should not be allowed in hazardous areas unless they are listed or certified intrinsically safe (UL 913 or IEC 60079-11, Ex "ia") by an independent laboratory

accepted by the Commandant under 46 CFR part 159; and

(4) Antennas of radio and communication equipment should be located in non-hazardous locations when possible. The antenna location should not pose an obstruction to helicopter landing areas, platform cranes, or other unit operations, and antenna feed lines should be protected from possible physical damage.

- f. LNG Fuel Transfer Hoses: LNG fuel transfer hoses stored on the vessel for the purpose of transferring LNG for use as fuel on the vessel should meet the requirements of 46 CFR 154.551.

Transfer hose connections should include provisions to prevent electrical flow during connection or disconnection of the transfer hose string through the hose string or the loading arm. Insertion of one short length of non-conducting hose without internal bonding in each transfer hose string or installation of an insulating flange should be addressed.

Each transfer hose string should contain only one electrically discontinuous length of hose or insulating flange to prevent electrostatic build-up in the hose string.

- g. LNG Bunkering Manifold: The LNG bunkering manifold should be designed to withstand the external loads during bunkering. The connections at the bunkering station should be of a dry-disconnect type equipped with additional safety dry break-away coupling/self-sealing quick release.
- h. Spill Protection: Areas of the LNG transfer system where the potential for spillage of LNG is high should be provided with drip trays, spill pans, and/or other means (e.g. water curtains) to protect steel structures of the vessel from coming in contact with LNG.
- i. Emergency Shutdown: An emergency shutdown system should be provided for the LNG fuel transfer system at each transfer control location. The transfer operation should be capable of being stopped safely and effectively without release of liquid or vapor by an emergency shutdown device (ESD) signal. The ESD signal should be transmitted both to the ship and to the supplier to ensure that appropriate actions are taken both on the delivering bunkering system as well as on the receiving ship. The system should include multiple barriers to ensure system shutdown in the event of primary component failures (e.g. ESD1, ESD2, and break-away couplings). The system should be capable of manual, remote, and automatic operation of the shutdown valve recommended in IMO Resolution MSC.285(86), Chapter 2, Section 2.9.2.2, (Enclosure 2 to CG-OES Policy Letter 01-14), and may be integrated with the safety systems described in 46 CFR 62.35-50. Owners and operators are encouraged to incorporate ESD arrangements meeting the Society of International Gas and Tanker Terminal Operators (SIGTTO) publication, "ESD Arrangements & Linked Ship/Shore Systems for Liquefied Gas (2009)." The ESD system should be appropriate for the size and type of vessel and should be activated by some or all of the following:

(1) gas detection;

(2) leak detection;

- (3) fire detection;
 - (4) manual activation from ship and facility;
 - (5) ship drift/movement of supply vehicle;
 - (6) power failure;
 - (7) high level in receiving tank; and
 - (8) abnormal pressure in transfer system.
- j. Alarms and Indicators: Alarms and indicators should be installed as outlined by IMO Resolution MSC.285(86), Chapter 2, Sections 2.9.1.3, 2.9.2.3, 2.9.2.4, and Chapter 5, Section 5.2.2 (Enclosure 2 to CG-OES Policy Letter 01-14), and should be co-located with the controls for manual activation of the emergency shutdown system. Remote indicators for pressure in the transfer lines and between the stop valve and connection to shore at each transfer pipe should also be provided at the transfer control location.

Miscellaneous

Hot Work: Hot work must be conducted in accordance with the regulations to which the vessel is inspected. Alternatively, where no regulations are specified, the requirements outlined in 46 CFR 91.50-1 should be followed. For inspected vessels see: 46 CFR 35.01-1, 71.60-1, 91.50-1, 109.573, 115.710, 126.160, 148.405, 151.50-30, 154.1800, 167.30-10, 176.710, and 189.50-1. Additionally, facility operators must ensure that the requirements of 33 CFR 154.735(l) are met as applicable.

No person should conduct welding, torch cutting, or other hot work on a vessel moored at a facility subject to the requirements of 33 CFR Part 127 unless:

- (1) The COTP has issued a permit for that hot work; and
- (2) The conditions of the permit are met.

In accordance with 33 CFR 156.120 (dd), welding and hot work are prohibited on vessels during the transfer of flammable or combustible liquids.

**RESOLUTION MSC.285(86)
(adopted on 1 June 2009)
(Excerpt of)**

**INTERIM GUIDELINES ON SAFETY FOR NATURAL GAS-FUELLED ENGINE
INSTALLATIONS IN SHIPS**

This excerpt (Chapter 2, Sections 2.9.1 and 2.9.2, Chapter 5, Section 5.2.2, and Chapter 8, Section 8.3 of MSC.285(86)) constitutes a fair use of copyrighted material as provided for in Title 17 of the United States Code, § 107 of the Copyright Act of 1976, as amended.

For the complete text of MSC.285(86), please visit <http://www.imo.org/KnowledgeCentre>.

CHAPTER 2

2.9 Fuel bunkering system and distribution system outside machinery spaces

2.9.1 *Fuel bunkering station*

2.9.1.1 The bunkering station should be so located that sufficient natural ventilation is provided. Closed or semi-enclosed bunkering stations should be subject to special consideration. The bunkering station should be physically separated or structurally shielded from accommodation, cargo/working deck and control stations. Connections and piping should be so positioned and arranged that any damage to the gas piping does not cause damage to the vessel's gas storage tank arrangement leading to uncontrolled gas discharge.

2.9.1.2 Drip trays should be fitted below liquid gas bunkering connections and where leakage may occur. The drip trays should be made of stainless steel, and should be drained over the ship's side by a pipe that preferably leads down near the sea. This pipe could be temporarily fitted for bunkering operations. The surrounding hull or deck structures should not be exposed to unacceptable cooling, in case of leakage of liquid gas. For compressed gas bunkering stations, low temperature steel shielding should be provided to prevent the possible escape of cold jets impinging on surrounding hull structure.

2.9.1.3 Control of the bunkering should be possible from a safe location in regard to bunkering operations. At this location tank pressure and tank level should be monitored. Overfill alarm and automatic shutdown should also be indicated at this location.

2.9.2 *Bunkering system*

2.9.2.1 The bunkering system should be so arranged that no gas is discharged to air during filling of storage tanks.

2.9.2.2 A manually-operated stop valve and a remote operated shutdown valve in series, or a combined manually-operated and remote valve should be fitted in every bunkering line close to the shore connecting point. It should be possible to release the remote-operated valve in the control location for bunkering operations and or another safe location.

2.9.2.3 If the ventilation in the ducting around the gas bunkering lines stops, an audible and visual alarm should be provided at bunkering control location.

2.9.2.4 If gas is detected in the ducting around the bunkering lines an audible and visual alarm should be provided at the bunkering control location.

2.9.2.5 Means should be provided for draining the liquid from the bunkering pipes at bunkering completion.

2.9.2.6 Bunkering lines should be arranged for inerting and gas freeing. During operation of the vessel the bunkering pipes should be gas free.

CHAPTER 5

5.2.2 Each tank should be monitored with at least one local indicating instrument for pressure and remote pressure indication at the control position. The pressure indicators should be clearly marked with the highest and lowest pressure permitted in the tank. In addition, high-pressure alarm, and if vacuum protection is required, low pressure alarm should be provided on the bridge. The alarms should be activated before the set pressures of the safety valves are reached.

CHAPTER 8

8.3 Maintenance

8.3.1 A special maintenance manual should be prepared for the gas supply system on board.

8.3.2 The manual should include maintenance procedures for all technical gas-related installations, and should comply with the recommendations of the suppliers of the equipment. The intervals for, and the extent of, the replacement/approval of gas valves should be established. The maintenance procedure should specify who is qualified to carry out maintenance.

8.3.3 A special maintenance manual should be prepared for electrical equipment that is installed in explosion hazardous spaces and areas. The inspection and maintenance of electrical installations in explosion hazardous spaces should be performed in accordance with a recognized standard.

8.3.4 Any personnel that should carry out inspections and maintenance of electrical installations in explosion hazardous spaces should be qualified pursuant to IEC 60079-17, item 4.2.

TRAINING GUIDANCE FOR MARINERS ON VESSELS USING GASES OR OTHER LOW FLASHPOINT FUELS

This interim guidance is based upon STCW.7/Circ.23, *Interim guidance on training for seafarers on board ships using gases or other low-flashpoint fuels* as amended by STCW.7/Circ.23/Add.1, *Amendments to the interim guidance on training for seafarers on ships using gases or other low-flashpoint fuels*.

1 GENERAL

1.1 This training guidance recommends the level of competence necessary for the safe operation of natural gas fuel systems. This guidance is consistent with the IMO's STCW.7/Circ.23, *Interim guidance on training for seafarers on board ships using gases or other low-flashpoint fuels*. Accordingly, each mariner onboard a natural gas-fueled vessel should meet the training guidance appropriate for the position they fill on the vessel. This applies equally to inspected and uninspected vessels on domestic or international voyages.

1.2 Mariners on U.S. vessels must comply with requirements in 46 CFR 15.405 (Familiarity with vessel characteristics) and 46 CFR 15.1105 (Familiarization and basic training), as appropriate, before assuming their duties and responsibilities. Mariners on non-U.S. vessels should receive familiarity training required by the International Convention on Standards of Training, Certification and Watchkeeping for Seafarers, (STCW) Regulations I/14, *Responsibilities of companies*.

1.3 In addition, mariners employed on these vessels should receive appropriate training on the risks and emergency procedures associated with the use of gases or other low flashpoint fuels, in accordance with their duties and responsibilities. On that basis, the following training levels have been identified:

- .1 basic training for mariners responsible for designated safety duties associated with the care, use or in emergency response to gases or other low flashpoint fuels; and
- .2 advanced training for the masters, engineer officers and all personnel with immediate responsibility for the care and use of the fuel and fuel systems onboard vessels using gases or other low flashpoint fuels.

1.4 For the purpose of these guidelines, "*gases or low flashpoint fuels*" means gaseous or liquid fuel having a flashpoint lower than otherwise allowed under 46 CFR 58.01-10(a)(1).

2 TRAINING GUIDANCE

2.1 Prior to being assigned duties on board a vessel using gases or other low flashpoint fuels, all mariners should receive appropriate training in accordance with this section. Mariners trained in accordance with earlier standards should compare those standards with the training provisions in this guidance to determine the need, if any, to update their qualifications.

2.4 Basic and advanced training should be given by qualified personnel experienced in the handling of gases or other low flashpoint fuels and the safety procedures involved.

2.5 It is important to emphasize the value of risk analysis to the mariner. All relevant risk analyses should be made available during training with the intent of improving the student's future decision making so that it results in the mitigation or elimination of any adverse effects during an unplanned event or emergency.

2.6 Reducing training may be appropriate for vessel personnel onboard non-passenger vessels of less than 200 GRT/500 GT using gases or other low flashpoint fuels if there are other appropriate safety precautions in effect. These reductions should be recorded in the documentary evidence listed in Section 5 of this document. These precautions may include, but are not limited to, limiting the quantity of fuel carried to less than 10 cubic meters, the immediate availability of appropriate shore based emergency response, routes limited to within 1 hour of properly trained maintenance personnel, methods of bunkering that include multiple levels of safety under the supervision of someone fully trained in accordance with the advanced standards or a tankerman PIC (LG) and other provisions that adequately allow for safe operations. The company should consider the ability of its shipboard personnel to safely and comprehensively respond to emergency situations and the ability of those personnel to safely operate the equipment, keeping in mind specific hazards associated with using gases or other low flashpoint fuels. Any questions regarding the reduction in training should be directed through a formal request to:

Commandant (CG-OES-1)
Attn: Maritime Personnel Qualifications Division
US Coast Guard Stop 7509
2703 Martin Luther King Jr Ave SE
Washington, DC 20593-7509

CGOES1@uscg.mil

3 STANDARDS OF COMPETENCE

3.1 Standard of competence for basic training

3.1.1 Mariners responsible for designated safety duties associated with the care, use or in emergency response to the fuel on board vessels using gases or other low flashpoint fuels should, before being assigned to shipboard duties:

3.1.1.1 receive basic training or instruction on the use of gases or other low flashpoint fuels so as to:

3.1.1.1.1 contribute to the safe operation of a vessel using gases or other low flashpoint fuels;

3.1.1.1.2 take precautions to prevent hazards on a vessel using gases or other low flashpoint fuels;

3.1.1.1.3 apply occupational health and safety precautions and measures;

3.1.1.1.4 carry out firefighting operations on a vessel using gases or other low flashpoint fuels;

3.1.1.1.5 respond to emergencies; and

3.1.1.1.6 take precautions to prevent pollution of the environment from the release of gases or other low flashpoint fuels;

3.1.1.2 be required to provide documentary evidence of having achieved the required standard of competence to undertake their duties and responsibilities through:

3.1.1.2.1 demonstration of competence in accordance with the methods and criteria for evaluating competence; and

3.1.1.2.2 examination or continuous assessment as part of a training program.

3.1.2 Mariners responsible for designated safety duties associated with the care, use or in emergency response to the fuel on board vessels using gases who have been qualified and certified according to the standards of competence as specified in 46 CFR Part 13 for service on liquefied gas tankers, as Tankerman PIC (LG), Tankerman Engineer (LG) or Tankerman Assistant (LG), should be considered as having met the recommendations specified in this subsection, provided they have also met the requirements of 46 CFR 15.405 and 46 CFR 15.1105.

3.2 Standard of competence for advanced training

3.2.1 Masters, engineer officers and any person with immediate responsibility for the care and use of gases or other low flashpoint fuels being used as fuel serving on board vessels using this fuel, before being assigned to shipboard duties should:

3.2.1.1 receive advanced training on the use of gases or other low flashpoint fuels so as to:

3.2.1.1.1 be familiar with physical and chemical properties of gases or other low flashpoint fuels;

3.2.1.1.2 operate controls of fuel related to propulsion plant and engineering systems and services and safety devices on vessels using gases or other low flashpoint fuels;

3.2.1.1.3 be able to safely perform and monitor all operations related to the fuels used on board vessels using gases or other low flashpoint fuels;

3.2.1.1.4 plan and monitor safe bunkering, stowage and securing of the fuel on board vessels using gases or other low flashpoint fuels;

3.2.1.1.5 take precautions to prevent pollution of the environment from the release of fuels from vessels using gases or other low flashpoint fuels;

3.2.1.1.6 monitor and control compliance with legislative requirements;

3.2.1.1.7 take precautions to prevent hazards;

3.2.1.1.8 apply occupational health and safety precautions and measures on board vessels using gases or other low flashpoint fuels; and

3.2.1.1.9 have knowledge of the prevention, control, firefighting and extinguishing systems on board vessels using gases or other low flashpoint fuels;

3.2.1.2 be required to provide documentary evidence of having achieved the required standard of competence to undertake their duties and responsibilities through:

3.2.1.2.1 demonstration of competence in accordance with the methods and criteria for evaluating competence; and

3.2.1.2.2 examination or continuous assessment as part of a training program.

3.2.1.3 Masters, engineer officers and any person with immediate responsibility for the care and use of fuels on vessels using gases who have been qualified and certified according to the standards of competence specified in 46 CFR Part 13 for service on liquefied gas tankers as Tankerman PIC (LG) or Tankerman Engineer (LG) should be considered as having met the recommendations specified in this subsection, provided they have also met the requirements of 46 CFR 15.405 and 46 CFR 15.1105, and have completed sea going service of three months in the previous five years on board a tanker carrying gases.

4 DOCUMENTARY EVIDENCE

4.1 Documentary evidence such as course completion certificates, company letters, etc. should be issued indicating that the holder has successfully completed the basic or advanced training, as appropriate.

4.2 Mariners working on board an inspected natural gas-fueled vessel who have responsibility for bunkering and/or the operation of natural gas fuel systems must hold a Merchant Mariner Credential (MMC) with an appropriate endorsement as required under 46 CFR 15.401 authorizing service on board the vessel and should hold documentary evidence of meeting the advance training contained in paragraph 3.2 above.

4.3 Mariners working on board an uninspected natural gas-fueled vessel who have responsibility for bunkering and/or the operation of natural gas-fuel systems should either comply with paragraph 4.2 above or be issued a letter of designation by the company listing them as a person-in-charge (PIC) of the transfer of natural gas as fuel and/or the operation of the natural gas-fuel system aboard the vessel or class of vessels upon which they are serving. The letter of designation should state that the holder has received formal advance instruction in accordance with paragraph 3.2 above to ensure his or her ability to safely and adequately carry out his or her duties and responsibilities as PIC. Also, mariners working on board uninspected natural gas-fueled vessels who are not required to hold an MMC but who have designated safety duties associated with the care, use or emergency response to the fuel on board should hold documentary evidence that the holder has received sufficient formal basic training in accordance with paragraph 3.1 above, to ensure his or her ability to safely and adequately carry out his or her duties and responsibilities.

4.4 The Coast Guard will review courses submitted on a voluntary basis that are designed to meet the training guidance outlined in paragraphs 3.1 and 3.2. These courses will be issued a letter attesting to the review and its conformance with the training, as appropriate, in this guidance. If training regulations are published, courses that were subject to this review will have to be re-submitted for approval in accordance with the regulations in 46 CFR 10.402. Course providers may submit the course information to the National Maritime Center, either by mail or electronically. The course information should include: the course name, the name of the

organization providing the instruction, a general description of the course and its objective, and the course content/curriculum, and be directed to:

National Maritime Center
Training & Assessment Division (NMC-2)
100 Forbes Drive
Martinsburg, WV 25404
ATTN: NMC Course Approvals

NMCCOURSES@uscg.mil

4.5 The Coast Guard will not be issuing endorsements to seafarers meeting the training in this guidance.

5 FAMILIARIZATION TRAINING AND EMERGENCY EXERCISES

5.1 A training manual should be developed and a training program and exercises should be specially designed for each individual vessel and its gas installations.

5.2 Emergency exercises on board vessels using gases or other low flashpoint fuels should be conducted at regular intervals (e.g. quarterly). Such gas-related exercises could include for example:

- 5.1.1 tabletop exercise;
- 5.1.2 review of fueling procedures based in the fuel handling manual;
- 5.1.3 responses to potential contingences;
- 5.1.4 tests of equipment intended for contingency response; and
- 6.1.5 reviews that assigned seafarers are trained to perform assigned duties during fuelling and contingency response.

5.3 Gas related exercises may be incorporated into periodical drills required by regulation and/or SOLAS. The response and safety system for hazard and accident control should be reviewed and tested.