UNITED STATES COAST GUARD

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MARINE SAFETY ALERT

Inspections and Compliance Directorate

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Got Gas? In the Wrong Place?

Don't allow corrective actions to create additional hazardous conditions!

Recently Coast Guard Port State Control Officers performed an examination on board a Liquefied Natural Gas (LNG) carrier. While onboard the inspectors discovered a significant and potentially dangerous modification within a Gas Valve Unit (GVU) room. This room is located within the machinery space of the dual fuel, diesel-electric propelled vessel. These engines can burn petroleum oil or LNG in gaseous form. The GVU is a multi-component device which manages the liquefied natural gas pressure supplied to the propulsion engines. The GVU room has an air intake and exhaust system designed to continuously ventilate and exchange the air within the space to reduce fire, explosion, and hazardous atmosphere risks from developing if gas leaks should occur from the equipment. The atmosphere of the room is monitored by a catalytic methane sensor located near the inlet to the room's ventilation exhaust trunk. The GVU room's ventilation creates a vacuum within the room when the two access doors are shut.

External to the GVU room the gas supply piping to the main engines is double walled including through manifolds and expansion bellows all the way to each cylinder. The purpose of this double walled construction is to contain any leakage of gas and return it back to the GVU room via a small gas evacuation fan assembly. The discharge outlet of the gas evacuation fan is simply an opening in the bulkhead of the GVU room. The system is designed so that any gas entering the outer wall of the piping gets drafted to the GVU room and exits via the exhaust duct after passing by the methane sensor.

During a repair on one cylinder of a main engine vessel, engineers had to remove an expansion bellows. Upon replacement of the bellows an O-ring, separating its inner and outer sections, was damaged. This error went unnoticed until a crew member was making a round in the enclosed GVU room while the engine had been operating on gas. After entering the GVU room he was overcome by methane gas and nearly lost consciousness. Fortunately, he was able to exit the space into a safe atmosphere. After the incident the GVU room atmosphere was measured to be 22% methane and 17% oxygen by volume. Methane is an asphyxiant which displaces oxygen and is extremely flammable. The installed methane sensor failed to detect the accumulation of gas despite not having malfunctioned.

Engineers traced the methane leakage to the recently removed bellows and replaced the damaged O-ring. To prevent future accumulation of gases they rigged a hose from the outlet of the gas evacuation fan, across the GVU room to the sensor at the entrance exhaust duct. This unauthorized arrangement, which was identified during a Coast Guard examination, could have likely disabled the sensor's ability to detect methane leakages from other components within the GVU room. (See image at right.)

The causal factors in this case include:

- an inadequate fix of a component leading to the dislodging of an O-ring;
- gas leakage captured and returned back to the GVU room but not removed from the room;
- an accidental exposure / personnel casualty caused by a lack of oxygen and excessive gas accumulation; and
- a second potentially hazardous condition due to the unapproved installation of the exhaust hose, which would likely disable the methane sensor's effectiveness in monitoring other components for leaks within the GVU room.

Coast Guard examiners also noted that a second exhaust hose was similarly installed in the vessel's second GVU room. These hoses were in place for about eight years. It is also important to note the engine manufacturer's manual highlights the need for caution when replacing the bellows and to use care when installing the O-rings. The manufacturer also emphasizes the need to check for gas leaks after repairs or maintenance are performed.

As a result of this discovery, the Coast Guard **strongly recommends** that owners and operators in all segments of the maritime industry *with a special emphasis on conventional LNG fueled vessels and Liquefied Gas Carriers*:

- Emphasize to their organization's technical shore side and vessel personnel the importance of following:
    - Manufacture guidance;
    - Recommendations in terms of maintenance and repair procedures;
    - Methods to validate successful repairs involving critical systems, including leakage detection; and
    - Procedures to evaluate corrective modifications (e.g., the use of the exhaust hose), even if intended to be temporary, to ensure they do not create additional safety hazards.

- Urge their vessel personnel to request additional expertise such as classification societies and manufacturer representatives when technical issues arise (e.g., the failure of the GVU room sensor to detect gas leakage or potential inadequate diffusion and circulation of air exchanges within the GVU room) to ensure the most effective corrective actions and system alterations take place as needed.

- Make notifications to the proper Flag State authorities and classification societies regarding potentially hazardous conditions before making any modifications to existing approved installations, arrangements, or proceedures.

The Coast Guard **strongly recommends** to Flag States, classification societies, underwriters and insurers that respective examiners, surveyors, and inspection personnel maintain an acute awareness regarding any system modifications, whether deemed potentially hazardous or not, to ensure such modifications have received the proper engineering reviews, approvals, and supporting documentation.

This Safety Alert is provided for informational purposes only and does not relieve any domestic or international safety, operational or material requirement. Developed by Sector Boston Prevention, LNG SME, Liquefied Gas Carrier National Center of Expertise (LGC NCOE) and Coast Guard Headquarters Office of Investigations and Casualty Analysis, Washington DC. Questions may be sent to HQS-PF-fldr-CG-INV@uscg.mil.