

Thermal Transient Control and Safety Validation During LNG Tank Cooldown Before First Marine Bunkering Operation

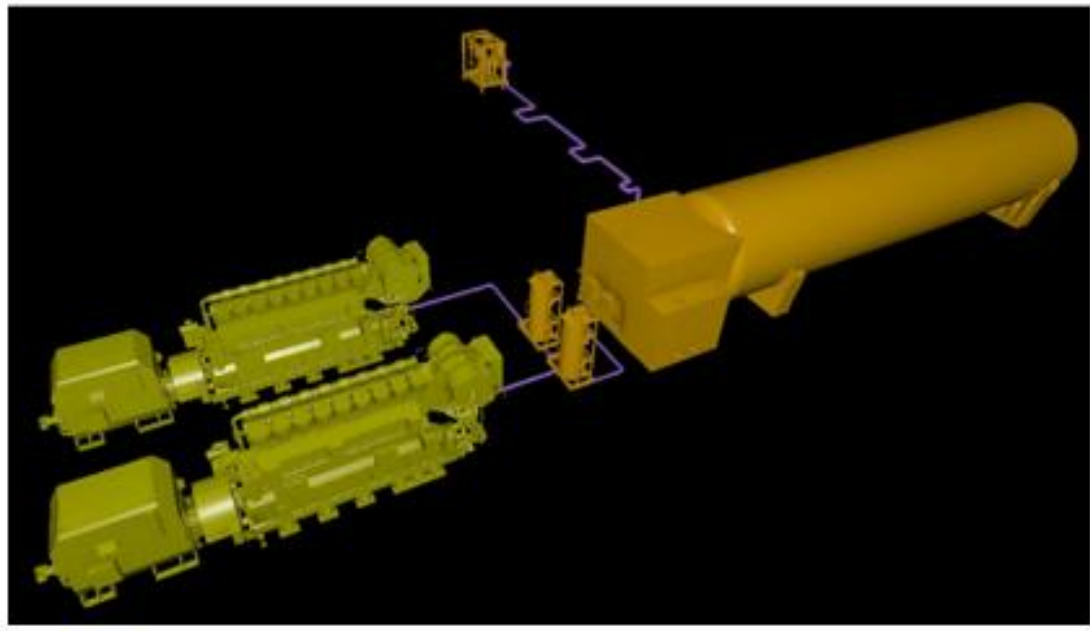
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INTRODUCTION & AIM

1. Introduction

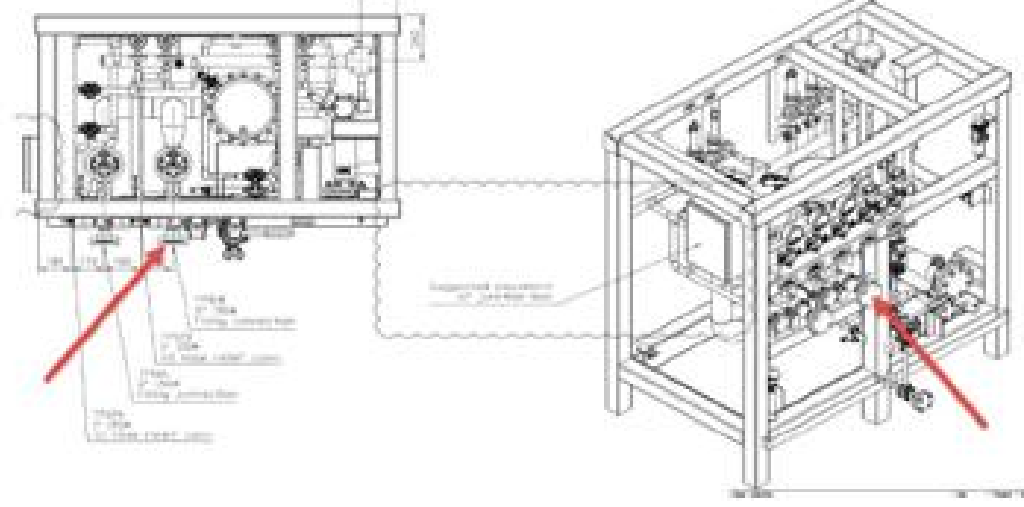
- The transition to LNG-fueled maritime propulsion requires stringent adherence to safety procedures, especially during the initial commissioning stages. This presentation outlines the operational framework used for cooling down an 209m3 LNG storage tank on a dual-fuel Ro-Ro vessel at Damen Shipyard, 2 Mai, Romania. The operation involved controlled use of vaporized and liquid nitrogen (LIN) to gradually reduce tank temperature, minimize thermal shock, and prepare the system for LNG bunkering.



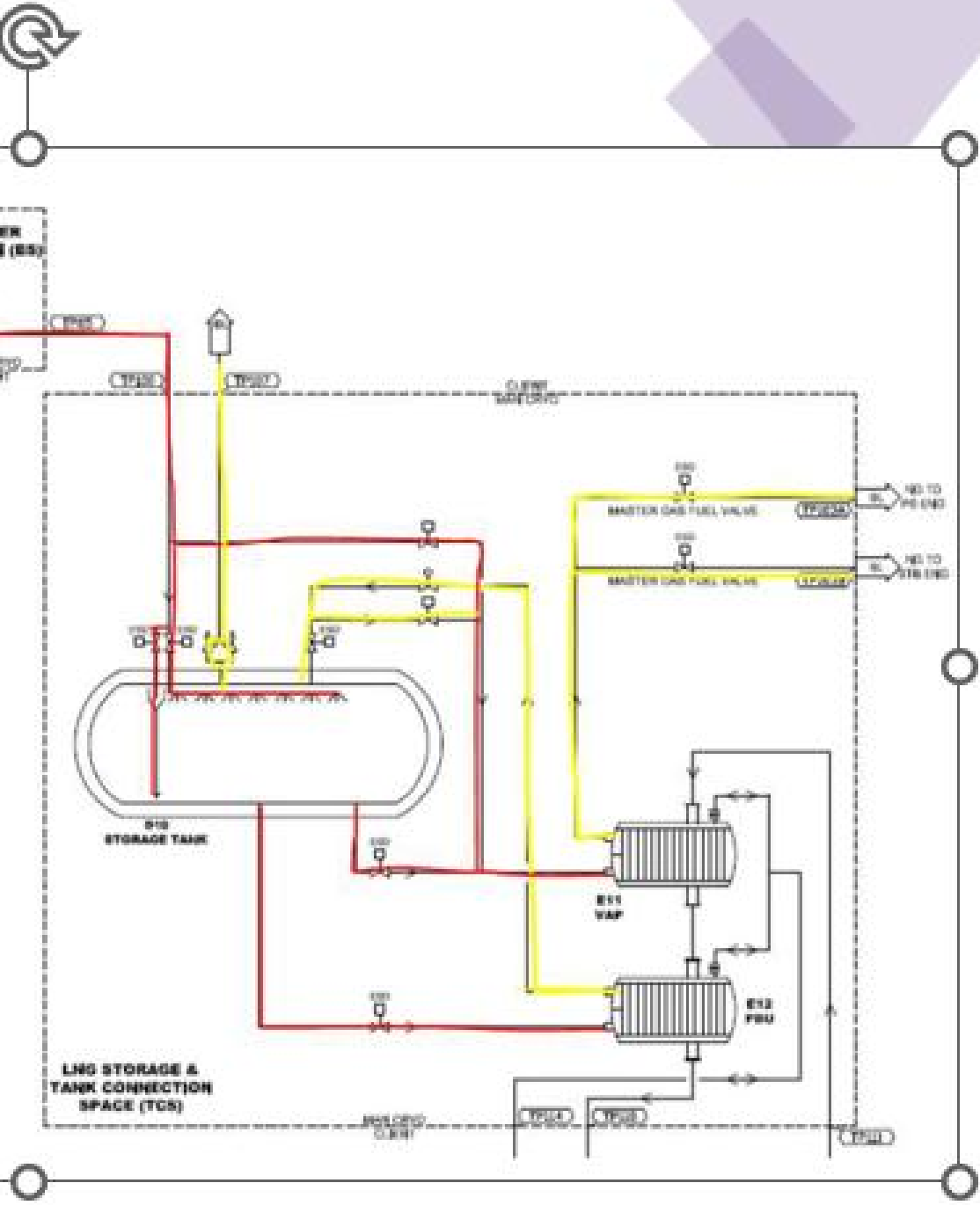
Location of Bunkering manifold for both LIN and LNG filling:



The manifold has 2 x flanged filling connections 2" -> only 1 will be used for all operations.



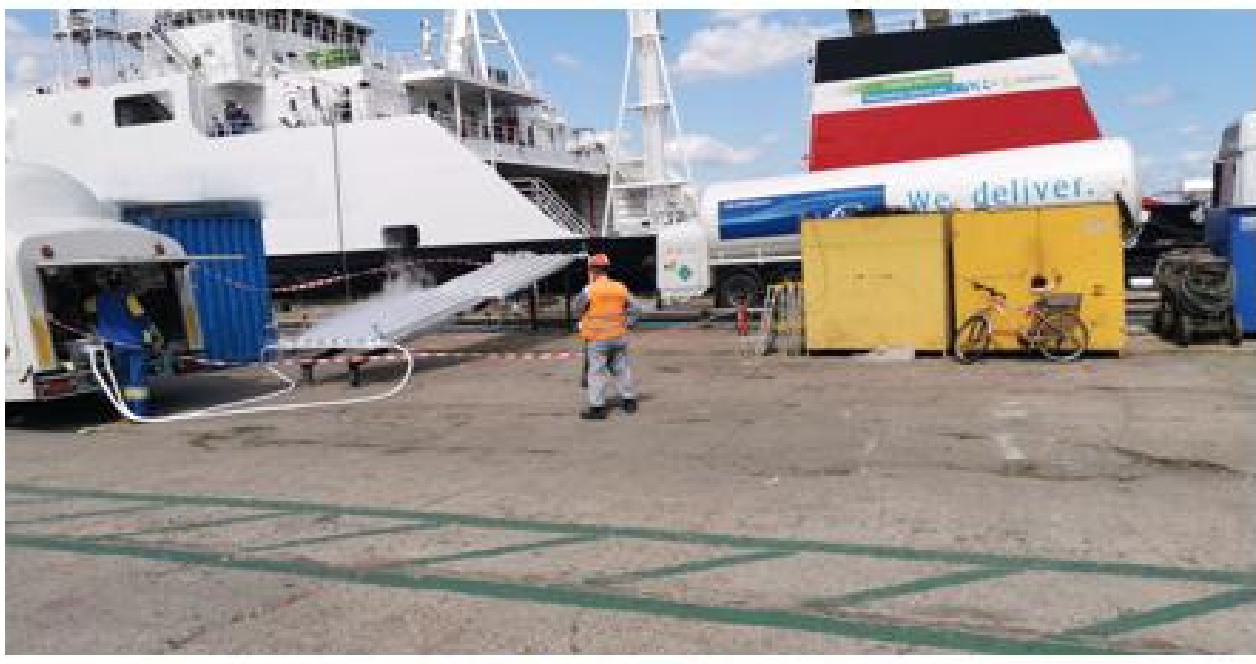
Tank Connection Space – PFD



METHOD

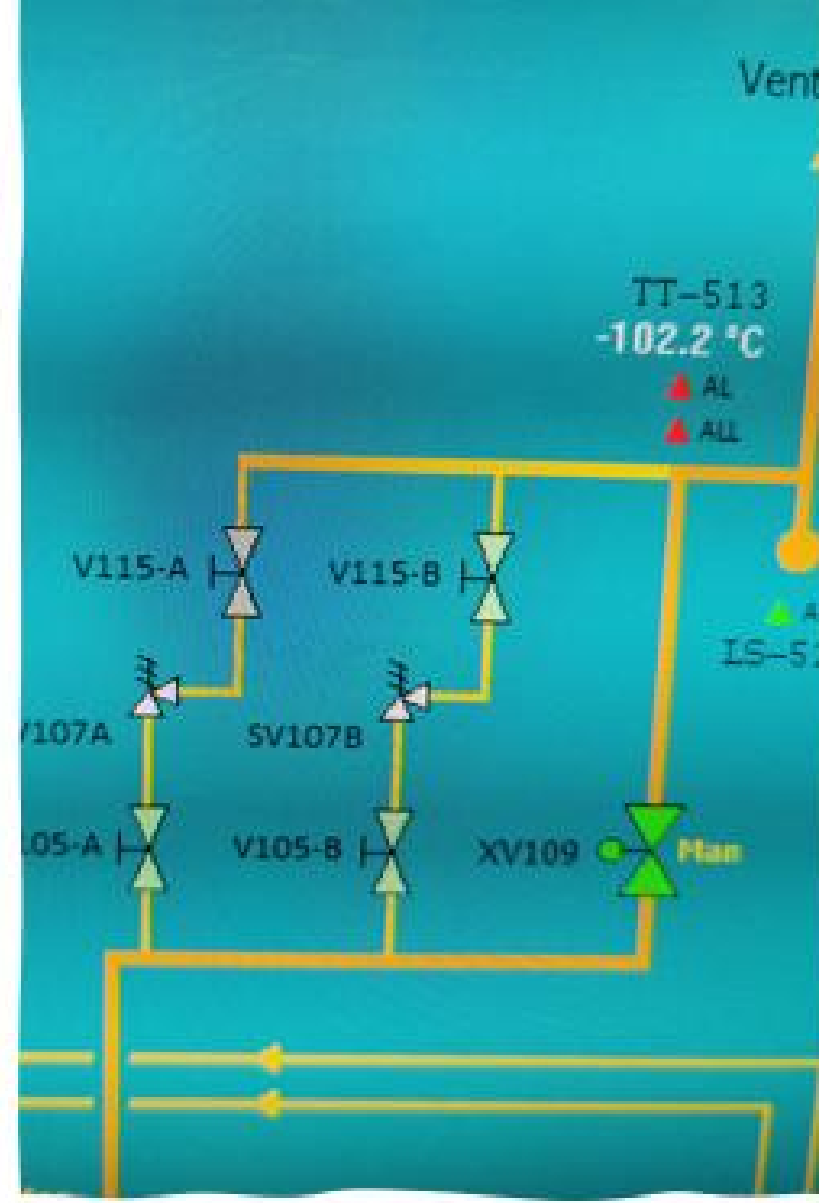
2. SET-UP BUNKERING OF VAPORISED NITROGEN

- After all the safety systems was tested by the protocol, the first step into cool down procedure of the tank is to connect the LIN truck with a PBU to the LNG bunker station of the vessel.
- Some area around the LIN truck, PBU, hose and LNG bunker station will be restricted for unauthorized persons and safety reasons.
- Will be installed also a drip-tray in case of LIN spillage with continuous flow of water to prevent any damage to the hull of the vessel
- The gaseous nitrogen will be used first to gradually drop the temperature in the tank at 0°C



3. START THE TRANSFER OF LIN

- After the temperature reaches below 0°C on the main vent of the tank, the PBU will be removed and direct transfer of LIN will start.
- Special attention should be paid to the contact surfaces of the hose with hull of the ship or other materials that may be affected by extreme cold, such as the quay crane rail.
- Transfer of the LIN will continue until total quantity of 50m³ from 2 trucks will be transferred to tank.



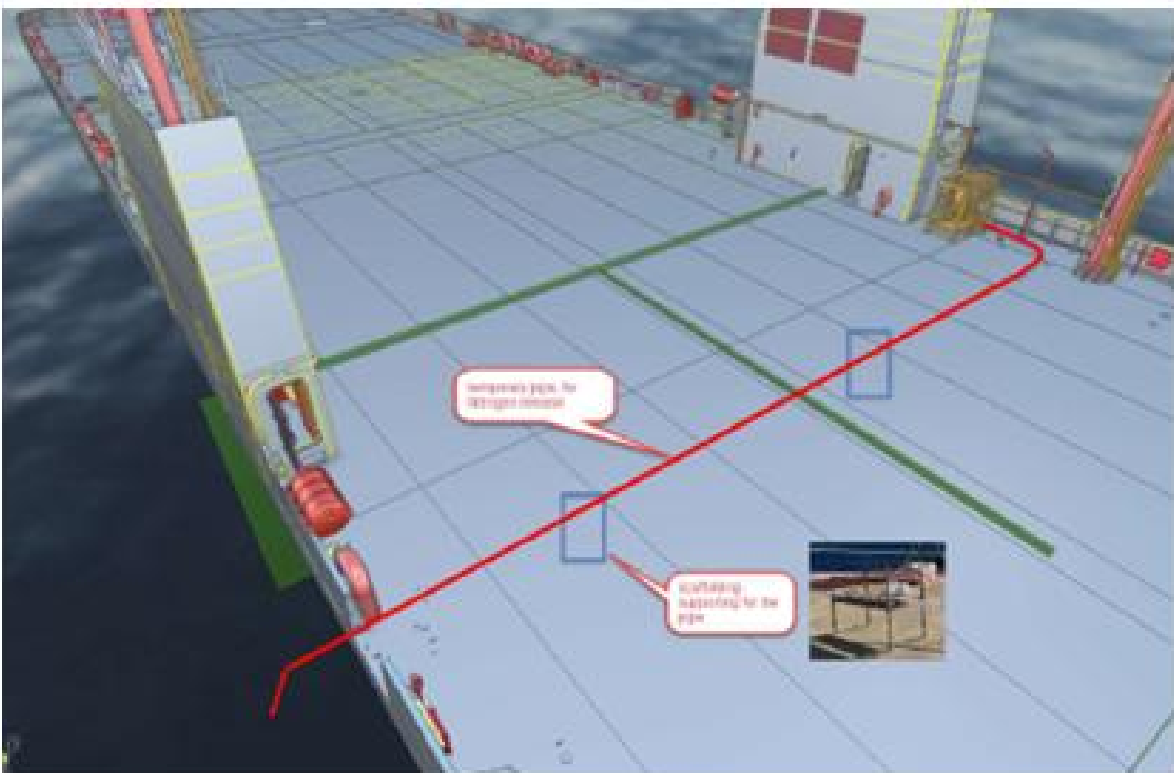
RESULTS & DISCUSSION

4. HOLDING TIME AND SET-UP FOR LIN RELEASE

After LIN was completely transferred, a holding time of 24H will follow together with testing the PBU of the vessel and other safeties.

A discharge SS pipe will be installed from the LNG bunkering station to the SB at a 2m height and care will be taken to ensure that the LIN release is not too close to the ship's hull

Some area will be restricted around the pipe and safe passage will be arranged on the vessel from AFT to FORE.



5. LIN DISCHARGE

- A large vapour cloud is foreseen when releasing LIN into the atmosphere.
- Wind direction must be considered
- The LIN discharge will be continuously monitored to avoid contact with the ship's hull
- The next step will be immediate bunkering with LNG



CONCLUSIONS

6. Conclusions

- The successful execution of the pre-bunkering cooldown operation illustrates the effectiveness of a well-orchestrated safety protocol, even in environments without permanent LNG infrastructure. These insights serve as valuable guidance for shipyards and operators conducting similar LNG-readiness operations, enhancing safety culture and promoting best practices for alternative fuel adoption in maritime applications.



FUTURE WORK/ REFERENCES/ACKNOWLEDGMENT

Future work: standardize a cooldown checklist with logged temperature points, hold-time acceptance criteria, wind-limit thresholds, vapour-cloud dispersion assessment and emergency actions for cold-spill scenarios.
References: IMO IGF Code; ISO 20519:2021 LNG bunkering specification; shipyard cooldown procedure and operational documentation for the dual-fuel Ro-Ro vessel.
Acknowledgment: The authors acknowledge the operational and safety teams involved in cooldown and first-bunkering preparation at Damen Shipyard, 2 Mai, Romania.