GCMD studies ship-to-ship ammonia transfer in Singapore

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The Global Centre for Maritime Decarbonisation (GCMD) and its appointed consultant, DNV Maritime Advisory (DNV) supported by Surbana Jurong (SJ) and the Singapore Maritime Academy (SMA) at the Singapore Polytechnic (SP), have completed an ammonia bunkering safety study that was commissioned in January 2022.

According to GCMD, despite its toxicity and associated risks, green ammonia is one of the potential fuels that can decarbonise the shipping industry. With the completion of this study, local regulatory authorities will be able to use the report and its guidelines to deliberate the undertaking of an ammonia bunkering pilot. The study found that the risks identified for conducting pilots in the Port of Singapore were found to be low or mitigable, thus paving the way for a pilot project to take place at three identified sites.

The analysis showed that individual **fatality and injury risks depend on:**

- the flow rate of ammonia,
- the number of transfer operations,
- duration per transfer operation
- the length of piping and transfer arms.

Because ammonia-fuelled vessels are not available today, ammonia transfers in the port waters of Singapore will be first carried out with ammonia carriers to ready stakeholders of the ecosystem for an actual bunkering pilot when ammonia-fuelled vessels are on the water, GCMD highlights .

> "This report will inform and enable a GCMD pilot involving ship-to-ship transfer of ammonia in the port waters of Singapore. We are aiming for the first transfer of ammonia to take place by end 2023, subject to obtaining the greenlight from the relevant regulatory agencies."

... said Professor Lynn Loo, CEO of the Global Centre for Maritime Decarbonisation

A robust set of safety guidelines and operational envelopes

The 9-month-long study has resulted in a report titled "Safety and Operational Guidelines for Piloting Ammonia Bunkering in Singapore". The study analysed capacity needs and feasible operating concepts; it recommends suitable sites for pilots, and identifies hazards, key risks and mitigation measures. The report also estimated the total capital expenditure for the additional infrastructure buildout needed to operationalise ammonia bunkering at two land-based sites.

For the study, the DNV consortium consulted extensively with 22 Study Partners and obtained feedback from more than 130 Industry and Consultation Alignment Panel (ICAP) members. Conversations with relevant regulators helped refined the analyses. Given the Port of Singapore's proximity to dense residential areas and operations that see more than 1,000 ships a day, the stringent guidelines to pilot ammonia bunkering that were developed in this GCMD study will likely be applicable to piloting ammonia bunkering at ports elsewhere.

Safety risks can be mitigated

More than **400 potential risks were identified** and assessed based on four technically feasible operational concepts: breakbulk and bunkering at anchorage, as well as shore-to-ship transfer and cross-dock transfer at two land-based sites for potential ammonia bunkering. The consortium found the identified risks to be **manageable with mitigation measures**.

Given the small number of ammonia bunkering pilots that would be carried out annually, the individual risks thresholds set by the Major Hazards Department of the Ministry of Manpower are not expected to be triggered. Coarse Quantitative Risk Assessment (QRA) using a deterministic dispersion model revealed a safety zone of 200 to 400 m for breakbulk and bunkering operations at anchorage with flowrates up to 700 cbm/hr.

> " Safety lies at the heart of the guidelines that DNV helped to develop for this pilot in Singapore. Further pilots and studies are key to understand, assess and mitigate safety risks associated with using ammonia fuel onboard the world fleet. "

... said Knut Ørbeck-Nilssen, CEO of DNV Maritime

Beyond the study

In preparation for the next phase of the GCMD project to execute an ammonia bunkering pilot in Singapore, GCMD is working with SMA to operationalise the manpower development framework for training operators to handle ammonia as a marine fuel. Already, SMA has incorporated elements from the study to develop the first training course on the handling of ammonia under the International Code of Safety for Ships Using Gases or Other Low-flashpoint Fuels (IGF Code) and industry guidelines. This course took place for the first time in March 2023, and registration is open for its next intake.

> "This study gives authorities a very practical, comprehensive view of the costs associated with designing a port that supports the safe transfer and storage of this toxic but game-changing alternative fuel."

... said Tan Wooi Leong, Managing Director, Energy & Industrial, Surbana Jurong

GCMD is also working closely with Oil Spill Response Limited to develop emergency response procedures, and will be sharing the full report with the Singapore Standards Council to support the development of a technical reference on ammonia bunkering.

> "SMA is committed to contributing in the efforts towards green shipping and using ammonia as a future source of clean energy for the maritime industry. We hope to upskill more maritime talents to meet the needs of the industry's changing landscape."

... said Capt Chatur Wahyu, Acting Director of Singapore Maritime Academy (SMA), Singapore Polytechnic (SP)

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