Operationalising Methanol Bunkering

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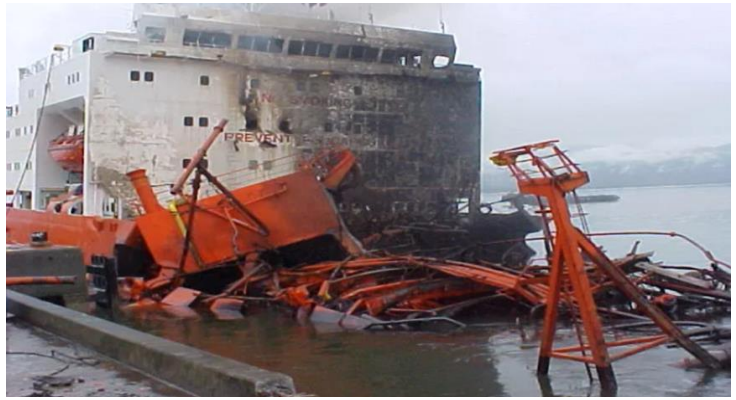
If not handled properly, an accidental release of methanol would pose safety risks



MT Vicuna (2004)
Methanol unloading operation
4 lives lost

Possible causes:
- Leakage in manifold of terminal and spark from electrical installation of pier
- Ignition of methanol in cargo tank due to abnormal pump conditions generating spark

Bunga Alpinia (July 2012)
Methanol loading operation
5 lives lost

Root Cause:
- Lightning strike and earthing mechanism not functioning

Kandla Port, India (2019)
Methanol related incident
4 lives lost

Storage tank containing 1,700 tonnes of methanol caught fire following an explosion

Possible cause:
Unknown

A practical methodology developed for the safe bunkering of methanol; applicable for other alternative fuels

- Although methanol has been handled and carried onboard ships as cargo – **bunkering** and the use of methanol as a marine fuel is still developing
  - Attention to the properties of methanol: different vessel / crew competency / environment

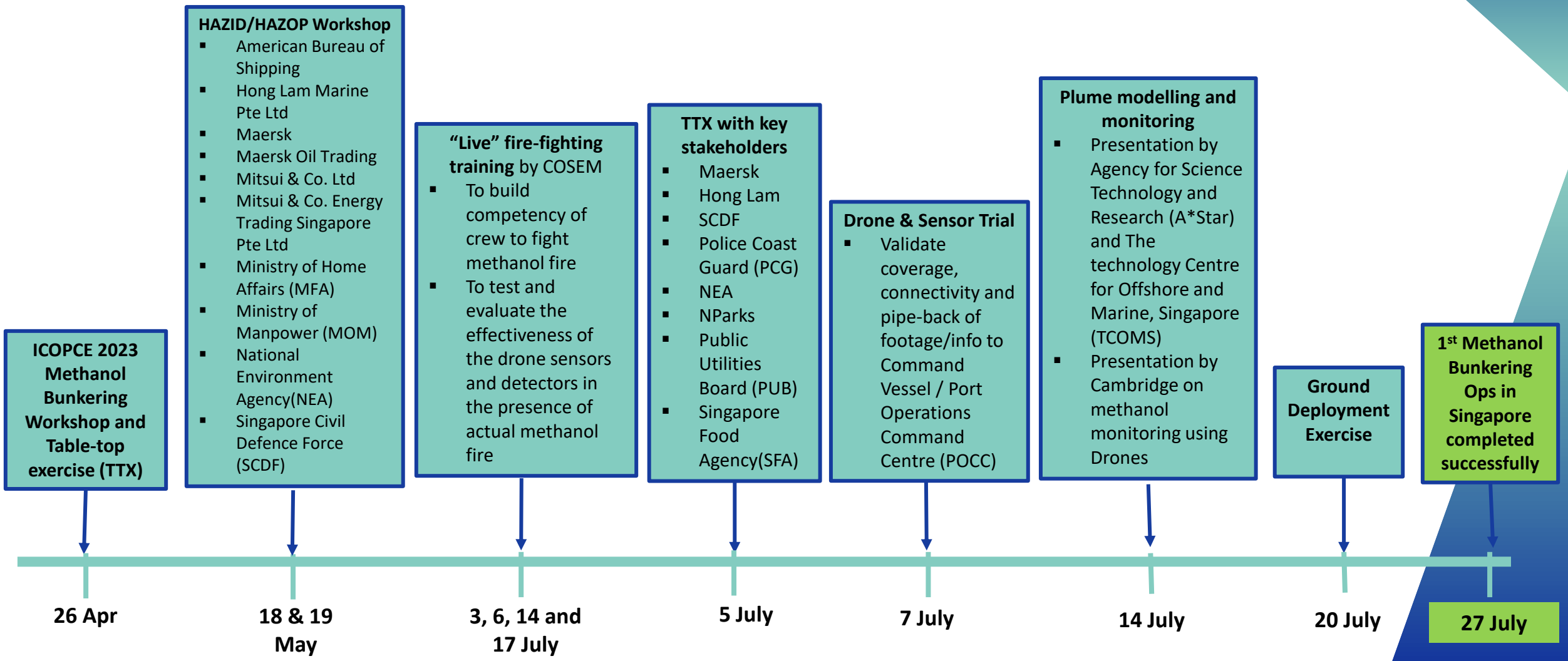
- For safe and efficient bunkering, we developed the following methodology:

  - Conduct thorough end-to-end operational and other risk assessments
  - Conduct safety assessments of the bunkering and of the receiving vessels
  - Develop emergency response plans that are coordinated across relevant government agencies, maritime port users and the local community
  - Deployment of a validated dispersion model with an aim that it will run 24/7 (as such bunkering becomes routine)
  - Designing and mandating training programmes to ensure that seafarers, operators and engineers are well equipped to safely handle the new fuels

- Methodology can be adapted and applied for the bunkering of other alternative fuels

- Gives assurance to shipowners, crew, and the port authorities themselves, that the bunkering operations in port are carried out safely. Any incident that occurs can be handled safety and promptly also.

Key preparatory activities for first methanol bunkering, over three months, applying the methodology developed



ICOPCE: International Chemical and Oil Pollution Conference and exhibition. The theme of the 13th edition held on 26 April 2023 was "Spill strategies in a decarbonization era".

COSEM: Co-operative of SCDF Employees Ltd

Robust multi-stakeholder discussion and exercises

26 April 2023 – ICOPCE 2023 Methanol Bunkering Workshop and Table-top exercise (TTX)

- Conducted by MPA to review existing safety measures and standards, clarify roles and responsibilities, and strengthen cross-agency coordination for an effective response to a methanol spill incident at sea

5 July 2023 – TTX on Emergency Response

- Conducted by MPA to familiarise stakeholders on the methanol bunkering processes and procedures, evaluate communication workflows including decision-making processes and develop safeguards and emergency responses.

18 and 19 May 2023 – HAZID and Hazard and HAZOP workshop

- Conducted by MPA to identify potential risks, and develop corresponding prevention, control, and mitigation methods.

20 July 2023 – Ground Deployment Exercise (GDX)

- Conducted by MPA to ensure operational readiness and coordination with stakeholders and government agencies during a methanol bunkering incident, the GDX simulated a methanol bunkering spill into the water and air.

3,6, 14 and 17 July 2023 – Methanol Firefighting Awareness Programme

- Conducted by the Co-operative of SCDF Employees Ltd (COSEM) in July 2023 for MPA staff and Hong Lam Marine crew members to appreciate risks and challenges with a methanol fire, and equip themselves with the right knowledge and skill-sets to detect and respond effectively to a methanol fire.

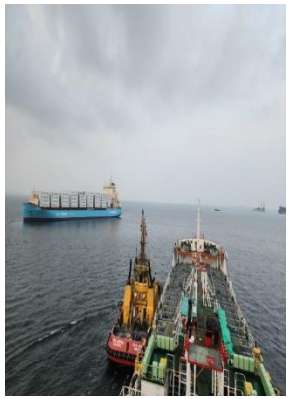
Methanol as a Maritime Fuel – *High Flammability*

	Methanol	Ammonia	LNG	VLSFO (residual)
Storage	**Liquid at ambient temperature**	21 °C under 8.8 bar, -33°C under atmospheric pressure	-163 °C (Pressurized or unpressurized)	Liquid at ambient temperature
Energy Density MJ/Kg	**22.7**	18.6	50 – 55	41.6
Flammability* (% air volume)	**6.7 – 36**	15 – 28	4 – 15	1 – 5
Flash Point (°C)**	**11**	132	-188	>60

Fire Triangle

- *Flammability Range – the minimum and maximum concentrations at which a given vapourous substance will ignite or combust with air – else, the mixture is too lean or too rich to ignite
- **Flash Point – lowest temperature at which there will be enough flammable vapour to induce ignition when an ignition source is applied

IN PICTURES: First Methanol Bunkering Operation in the Port of Singapore

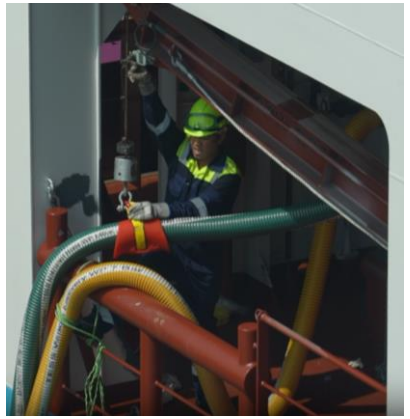
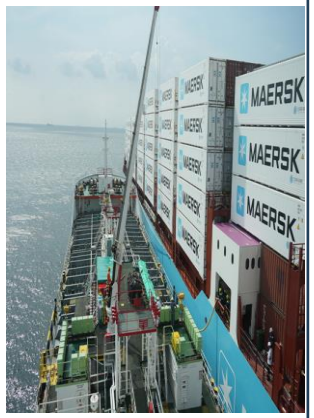




Tugboat bringing Agility alongside


Hose Connection

Pre bunkering meeting

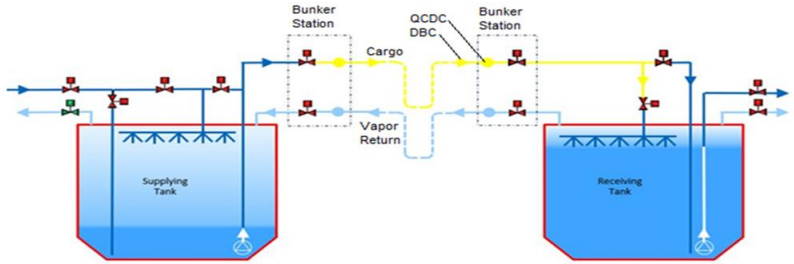
EOC

Line blow and hose disconnection

First Methanol Bunkering Operation in Singapore – Detailed risk assessment done

- Maersk's container vessel, which is the world's first container vessel sailing on green methanol, was refuelled with approx. 300 metric tonnes of green bio-methanol via a ship-to-ship transfer (STS) from Hong Lam Marine's Singapore-registered tanker, MT Agility.
- The bunkering operation was aimed to generate public awareness surrounding methanol as a fuel and prepare for future methanol bunkering operations.



	Maersk Container Vessel	MT Agility
IMO Number	9944546	9449546
Flag	Denmark	Singapore
Type of vessel	Container / Dual Fueled	Oil Chemical Tanker / IMO Type II
Class	ABS	BV
Cargo Capacity	2121 TEU	9906.128 m3 (98%)
Length overall	172.0 m	114.90 m

- All mitigating measures of the risks identified during the extensive preparations have been implemented onboard:
  - **I.** **Arrival, approach and mooring** - including receiving vessel entry into the port, transit to anchorage and preparation for bunkering, mooring of bunker vessel to receiving vessel
  - **II.** **Connection and testing** of piping and system - covering connection between bunker vessel and receiving vessel, pipe lay out on deck, vapour return line, leak test, purging of the system, ESD testing, QCDC, human and subsequent bunker transfer
  - **III.** **Bunkering operation** – covering spill, detection of fire, firefighting preparedness, PPE, human safety, static electricity, tank gauging and sampling
  - **IV.** **Line draining, purging and disconnection** of the bunker transfer hoses in normal and emergency scenarios
  - **V.** **Departure and unmooring**
  - **VI.** **Others** – such as crew competency and training as applicable
- Operation specific methanol bunkering manual has been prepared and checklists drafted to ensure all the critical items are verified before, during and after the bunkering operation

Developing interim guidelines, technical references - Contributions and information sharing with the maritime community

Submission to IMO CCC 9

- Paper was submitted for the amendment to the interim guidelines for the safety of ships using methanol as fuel (MSC.1/Circ.1621).
- The submission includes discussion on:
  I. Ventilation for fuel preparation spaces
  II. Venting arrangement for fuel tanks
  III. Fire detection system
  IV. Preparation of methanol bunkering in Singapore
- Lunch time presentation on Singapore's first Ship to Container Ship Methanol Bunkering attended by over 100 delegates

Technical reference (Methanol Bunkering)

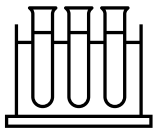
- Taking onboard the learning points from the bunkering operation, a Technical Reference (TR) for methanol bunkering will be developed in 2024 in consultation with MPA and the Singapore Chemical Industry Council.
- The TR will cover key aspects such as:
  I. Operational and safety requirements for methanol bunkering
  II. Custody transfer
  III. Crew training and competency

Key takeaways - Challenges that need to, and can be, addressed for safe regular bunkering

- **Risks associated with methanol**

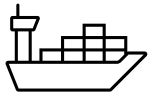
I. Methanol is a widely traded commodity (cargo) but the receiving vessel crew do not have much experience handling methanol as a fuel
II. The lack of exposure and knowledge on methanol increases the risk associated with handling of the product
III. Colourless flame
IV. Crew training – STCW training requirements may need model courses for methanol when used as fuel and bunkering
V. SIMOPS - simultaneous operations

- **Quality testing of Methanol**



I. Methanol standards such as IMPCA are available, but used for methanol as a cargo rather than as a fuel
II. ISO methanol quality standards expected to be ready in 2024
III. Accreditation of test labs to test for chemical contaminants within methanol and a standardised test method required.

- **Vessel compatibility**



I. Future bunker tanker will have to cater to the needs of various types of receiving vessel, as the world fleet changes to meet emissions targets.
II. Flow boom must be capable of transferring bunkering hose between the vessels / smart hose system
III. Inert gas generator / N_2 generator should be in place to ensure smooth and safe operation
IV. Pumping rate given the higher volume of bunkers to be delivered, coupled with vapour recovery line – slow pumping rate
V. Proper handling of collected methanol vapour
VI. Lighting detection
VII. Thermal cameras
VIII. Proper ship shore link (SSL) and emergency shut down (ESD) – compatible with the receiving ship

CCC 9/3/6 (Singapore) - Technical considerations when transposing the Interim guidelines for the safety of ships using methyl/ethyl alcohol as fuel (MSC.1/Circ.1621) into mandatory instruments under the IGF Code

- **Ventilation for fuel preparation spaces**
  - Further investigation and consideration would be needed on the ventilation rate for fuel preparation space for ships using methanol as fuel, including the possibility of installing automatic variable ventilation system that would increase the ventilation rate when leakage is detected
- **Venting arrangement for fuel tanks**
  - It could be challenging for container ship to meet the requirements of MSC.1/Circ.1621 - *"hazardous areas should be restricted, as far as practicable, to minimize the potential risks that might affect the safety of the ship, persons on board and equipment"*
  - Pragmatic solutions to meet the intent on the requirement needs to be developed
- **Fire detection system**
  - Methanol has a low flash point / high flammability range / colourless flame / soluble in water
    - Risk of spreading the fire when fire fighting with water
  - Ships would need to be equipped with infrared device that would allow the remote monitoring of heat and relative temperature for early detection of any methyl alcohol fires onboard during bunkering operations
- **Methanol bunker tankers**
  - **I**n addition to being a chemical tanker constructed in accordance with the IBC code, need to take into consideration all additional safety and operational aspects during their design phase

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Thank You