MARITIME TECHNOLOGIES FORUM

LEADING THE MARITIME WORLD FORWARD

GUIDELINES FOR DEVELOPING AND IMPLEMENTING A SAFETY MANAGEMENT SYSTEM FOR METHANOL-FUELLED SHIPS

Executive Summary

The Maritime Technologies Forum (MTF) is a group of Flag States and classification societies which aims to bridge the gap between technological progress and regulatory process. To encourage safe application of alternative fuels for industry-wide application, acceptance, and consistent development and implementation; MTF has already published guidelines to support development of new Safety Management System (SMS) and/or strengthen the existing SMS for alternative fuels onboard ships and across the company fleet, including when using ammonia as fuel and when wind assisted propulsion systems (WAPS) are used. These guidelines represent MTF's latest edition addressing methanol as a fuel.

As the maritime industry transitions towards low carbon alternative fuels driven by decarbonisation measures, low carbon methanol (also known as methyl alcohol) has emerged as one of the future scalable options, with favourable environmental characteristics. Its liquid state at ambient conditions, better compatibility with existing infrastructure, and rapid uptake position it as a practical near-term fuel, while its toxicity, low flashpoint, and invisible flame characteristics require enhanced procedural and safety management measures.

MTF brought together industry experts on methanol fuel and experts on the International Safety Management (ISM) Code, merging the necessary competencies to develop the recommendations provided in these new guidelines. Various industry stakeholders representing different maritime sectors contributed towards the development of these guidelines. A list of these industry stakeholders can be found at the end of this document.

These guidelines expand upon the ISM Code's existing structure and the already published interim guidelines for methyl alcohol[1], providing methanol fuel-specific recommendations across all functional SMS areas. Recognising that usage of methanol as fuel is still at an early-stage, emphasis is placed on risk-based decision-making, iterative improvement, and organisational agility. Companies are encouraged to interpret traditional ISM requirements through a methanol specific lens to ensure that hazards related to toxicity, vapour dispersion, flammability, and compatibility with materials are systematically addressed.

Proposed guidelines can be used to develop new or strengthen existing SMS:
Companies can utilise these guidelines to develop new SMS and/or strengthen their existing SMS covering methanol as fuel onboard their fleet. MTF recommends that these guidelines may be used in addition to other similar existing and/or upcoming guidelines (of which some are already referenced within this document) to ensure safe operations when using methanol fuel onboard ships.

Experience from operating with methanol as fuel will initially be limited:
MTF recognises that the use of methanol as fuel in the maritime industry has elevated operational and environmental risks relative to fossil fuels. These specific risks which include toxicity, wide flammability range, invisible flame characteristics and corrosivity need to be properly addressed. Due to the limited experience and operational data that is available, it should be recognised that a gap will exist in the initial stages of deployment of methanol as fuel. Therefore, a structured risk management approach within the SMS would be beneficial to proactively identify and close those gaps, strengthening the system in managing anticipated risks including risks from the deployment of methanol as fuel.

SMS should be versatile to accommodate mixed fuel operations:
During the initial stages, when there may be a fuel-mix onboard which is likely to include both fossil fuels and methanol, the SMS needs to be versatile enough to meet various fuel scenarios, with a focus on implementing safe fuel changeover procedures and providing comprehensive dual-fuel engine training programs to ensure safe methanol-fuelled operations.

Human factors considerations should be understood, helping to address the associated risks:
Careful consideration needs to be given to the evaluation of the competency, training, familiarisation and resources relevant to methanol as fuel. The required level of competence, training and upskilling should be determined by the role, task or responsibility assigned to a person. It is crucial that the various methanol related risks associated with human factors are understood so that appropriate processes and procedures are put in place to enhance the overall SMS.

SMS should learn from hazardous occurrences and accidents with methanol as fuel:
The strength of the company's SMS should be in the ability to proactively identify improvements in the SMS through learning from non-conformities, accidents, and hazardous occurrences (including near-misses) related to methanol as fuel, and facilitate the closing of the gaps that would exist initially due to lack of operational data. The lessons learnt, audit findings, and new best practices should be rapidly incorporated into the SMS.

Figure 1: Some of the aspects covered in these guidelines

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List of acronyms

AEGL	Acute Exposure Guideline Level
BASiL	Bunkering Area Safety Information LNG
CII	Carbon Intensity Indicator
DP	Designated Person
EEDI	Energy Efficiency Design Index
EEXI	Energy Efficiency Existing Ship Index
EMSA	European Maritime Safety Agency
ESD	Emergency Shutdown
ETS	Emissions Trading Scheme
GHG	Greenhouse Gas
HAZID	Hazard Identification
HAZOP	Hazard and Operability Study
HSSE	Health, Safety, Security and Environment
ICS	International Chamber of Shipping
IGF Code	International Code of Safety for Ships Using Gases or Other Low-Flashpoint Fuels
IMO	International Maritime Organization
ISM Code	International Safety Management Code
JSA	Job Safety Analysis
LEL	Lower Explosive Limit
LNG	Liquefied natural gas
LOTO	Lock Out Tag Out
MGO	Marine gas oil
MI	Methanol Institute
MJTTF	Maritime Just Transition Task Force
MoC	Management of Change
MSC	Maritime Safety Committee
MTF	Maritime Technologies Forum
NOx	Nitrogen oxides
OCIMF	Oil Companies International Marine Forum
OEM	Original Equipment Manufacturer
PMS	Planned Maintenance System
PPE	Personal Protective Equipment
PPM	Parts per million
SDS	Safety Data Sheet
SEP	Safety and Environmental Protection Policy
SGMF	Society for Gas as a Marine Fuel
SIMOPS	Simultaneous Operations
SMS	Safety Management System
SOx	Sulphur oxides
STCW Convention	The International Convention on Standards of Training, Certification and Watchkeeping for Seafarers, 1978
STCW Code	Seafarers' Training, Certification and Watchkeeping Code

Background and Objective

The Maritime Technologies Forum (MTF) has been established to provide technical and regulatory expertise for the maritime industry. MTF's role is to publish research based on its members' expertise and offer unbiased advice to the maritime industry to promote safe adoption of alternative fuels and new technologies.

The maritime industry is experiencing a significant shift towards alternative fuels, driven primarily by increasingly stringent International Maritime Organization (IMO) emissions regulations.

Methanol (CH_3OH) has emerged as a particularly attractive option due to its environmental credentials and practical advantages. It is a well-established fuel that ship operators can already deploy today to reduce pollutant emissions and support the transition towards carbon neutrality. Methanol engines, fuel supply systems and bunkering solutions are already commercially available[2]; and uptake within the shipping industry is growing. In 2025, 66 methanol dual-fuel ships were ordered, with reports of up to 822 methanol-ready ships in the pipeline [3].

Unlike many other alternative fuels, methanol remains liquid at ambient temperature and pressure. This significantly simplifies storage, transportation, and bunkering arrangements and allows much of the existing fuel infrastructure to be utilised with relatively minor and cost-effective modifications, reducing technical complexity and enabling more rapid deployment. However, there are risks that should be properly addressed for safe use of methanol as fuel. To encourage safe application of alternative fuels for the maritime industry's acceptance and consistent development and implementation; MTF had published 'Guidelines to develop and implement a Safety Management System for alternative fuels onboard ships'[4].

Like conventional ships, methanol-fuelled ships will be subject to compliance with applicable class rules and statutory regulations. Several safety procedures relevant to methanol are already in place and incorporated into the IMO's Code of Safety for Ships using Gases or other Low Flashpoint Fuels (IGF Code). The risk assessments that are required should be conducted during the design and retrofit stages of the vessel. The risk management measures identified during the design phase should be integrated into the operational phase of the vessel's lifecycle and updated regularly based on operational feedback.

While regulatory frameworks, class requirements, design approvals and manufacturer instructions provide an essential basis for the safe use of methanol as fuel, they do not by themselves ensure consistent day-to-day implementation onboard and ashore. Companies still need to translate those requirements into practical safety management system arrangements covering bunkering, routine operation, maintenance, emergency preparedness, reporting, roles and responsibilities, and continuous improvement throughout the vessel lifecycle. This is particularly important as industry experience with methanol-fuelled operations is still developing, and early operational lessons need to be systematically captured and reflected in company procedures and shipboard practice.

A number of industry stakeholders representing different maritime sectors contributed towards the development of these guidelines. Their contributions were in the form of workshop discussions and document reviews, representing input from different sectors, which helped to strengthen these guidelines. MTF is grateful for their contribution, and the full list of these industry stakeholders can be found at the end of this document.

Disclaimer

The findings and recommendations in this report represent a collaborative effort between participating MTF members. While the advice given in this report has been developed using the best currently available information, it is intended to be used solely as guidance. No responsibility is accepted by MTF or its members for any consequences resulting directly or indirectly from the adoption of any of the recommendations in this report. This report does not stop MTF members from having independent opinions or conclusions.

Methanol Properties and Characteristics

Methanol (CH_3OH), also known as methyl alcohol, is a simple aliphatic alcohol comprising one carbon atom bonded to three hydrogen atoms and one hydroxyl (OH) group. At ambient temperature and atmospheric pressure, it exists as a clear, colourless liquid with a distinctive alcoholic odour and is completely miscible with water.

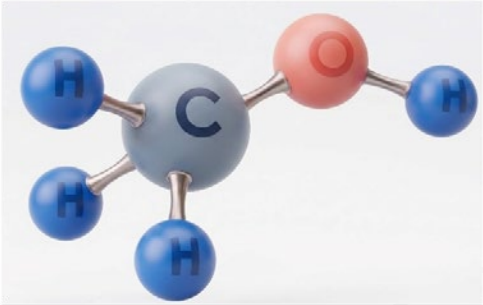

Figure 2: Methanol molecule illustrated

From an energy perspective, methanol has a higher energy density than other alternative fuels such as ammonia and hydrogen. However, its energy density remains lower than that of conventional marine fuels. For example, marine gas oil (MGO) has an energy density of approximately 36.6 GJ/m³, compared with 15.8 GJ/m³ for methanol [5]. As such, the methanol-fuelled vessels require approximately 2.4 times more fuel storage volume than comparable vessels operating on MGO. This has implications for ship design and operational planning that should be considered as part of the overall safety and environmental management approach. Below is a comparison of methanol with other marine fuels[6]:

Properties	Methanol	MGO	Methane/LNG	Ammonia
Chemical Formula	CH_3OH	$C_{10} – C_{22}$	CH4	NH_3
Flash Point (°C)	12	> 60	N/A	N/A
Boiling Point (°C)	64.6	170 - 350	-161.5	-33
Auto-ignition Temperature (°C)	470	250	539	651
Flammable range in dry air (%)	6 to 36	0.7 to 5	5 to 15	15 to 28
Energy Density (MJ/Kg)	19.7	42.7	48	18.6
Energy Density (GJ/m³)	15.8	36.6	20.4	12.7

Table 1: Properties of some maritime fuels (at 0.1 MPa)

Methanol has poor warning properties, in that its vapour is invisible, its liquid is clear, it is colourless and easily mistaken for water. Furthermore, methanol's odour threshold is significantly higher than its safe exposure limits, as such relying on the sense of smell is an unreliable safety measure that typically indicates toxic levels have already been reached. Methanol burns with low light and mostly invisible in daylight, making methanol fires a significant risk that could require the use of thermal imaging cameras to complement the conventional firefighting requirements. Moreover, the odour threshold of methanol vapour is high, meaning that the presence of methanol vapour may not be detectable below 5,900 ppm [7].

Depending on the extent of exposure, methanol presents considerable health risks, particularly in enclosed or poorly ventilated spaces. The severity of the health effects depends on the concentration of methanol, duration or frequency of exposure, route of exposure and the individual's vulnerability due to pre-existing health conditions. Several global agencies and organisations have established exposure limits and guidelines to ensure the safety of workers and the public who may be exposed to methanol in various work, industrial, or other settings.

Levels (Exposure)	10 mins	30 mins	1 hr	4 hrs	8 hrs	Sign and Symptoms
AEGL 1 (Non-disabling) In ppm	670	670	530	340	270	Notable discomfort, irritation, or certain asymptomatic non sensory effects. **Reversible**
AEGL 2 (Disabling) In ppm	11,000*	4,000	2,100	730	520	Serious, long-lasting adverse health effects or an impaired ability to escape. **Irreversible**
AEGL 3 (Lethal) In ppm	40,000**	14,000*	7,200*	2,400	1,600	Life-threatening health effects or **fatal**

* indicates value is 10-49% of LEL. Safety considerations against explosion should be taken into account.

** indicates value is 50-99% of LEL. Extreme safety considerations against explosion should be taken into account.

Table 2: AEGL Levels for Methanol - U.S. Environmental Protection Agency [8]

Methanol is a conductive polar solvent, as such galvanic and dissimilar metal corrosion in methanol service may be high if incompatible materials are used. Therefore, confirming material compatibility is important when selecting appropriate materials to be used with methanol. Considerations such as type of equipment (e.g. pump, engine, pipeline, storage tank), process conditions (normal, abnormal, or emergency), anticipated inspection and maintenance program, service conditions, flow, temperature, etc. should be taken into account[7].

Methanol serves as a crucial industrial chemical feedstock, with its largest application being the production of formaldehyde, accounting for approximately 30% of global methanol consumption[9]. It is a fundamental component in manufacturing various products including plastics, resins, and biodiesel, while also being commonly used in everyday applications such as paint removers and cleaning products. In the energy sector, methanol plays a significant role as a fuel additive, in power generation, and as a fuel source for automotive and lately for marine ships.

Figure 3: Typical chemical/product tanker, with a hint! (AI-created)

Noting both the benefits and challenges of using methanol as fuel, it is crucial for companies to not only look to safely utilise methanol as fuel but to also understand the hazards associated with handling methanol in order to incorporate suitable and adequate measures within the SMS to protect the health of crew and shore-side personnel, minimising the risks associated with methanol exposure.

Introduction to the Guidelines

These guidelines are developed following a review of each section of the ISM Code's Part A. The section numbers within these guidelines therefore mirrors the same layout to help the reader. The structure of these guidelines can be summarised as follows:

1. General,
2. Safety and Environmental Protection Policy,
3. Company Responsibilities and Authority,
4. Designated Person(s),
5. Master's Responsibility and Authority,
6. Resources and Personnel,
7. Shipboard Operations,
8. Emergency Preparedness,
9. Reports and Analysis of Non-conformities, Accidents and Hazardous Occurrences,
10. Maintenance of the Ship and Equipment,
11. Documentation, and
12. Company Verification, Review and Evaluation.

Each section provides assessments and recommendations for implementing SMS when considering the use of methanol as fuel onboard ships. The reader should note that some sections provide more detailed content due to the specific aspects associated with using methanol as fuel onboard ships, while others remain high-level to address general considerations in SMS implementation.

It should be noted that the guidance provided in this document is based on the current state of play of regulatory development as well as early industry experience. As such these guidelines should be seen as a progressive step in the interim to identify and fill operational gaps onboard methanol-fuelled ships; Once the regulatory requirements and industry best practices are published, they should take precedence.

While some content within these guidelines may be considered generic and business as usual, MTF believes that it is crucial to interpret these sections through the lens of methanol as a fuel. This ensures that safety, environmental, and operational considerations specific to methanol are emphasised in the context of ship operations.

Application scope:
These guidelines are for ships using methanol as fuel. Where methanol cargo is used as fuel, further considerations are needed, which are out of the scope of these guidelines. Cargo transfer operations that are carried out at sea differ from bunkering in terms of risk profile, equipment, and procedures and therefore are not addressed in these guidelines.

1. General

In an operational environment, it is difficult to achieve a process devoid of risks, especially when dealing with new or unfamiliar operations where operational experience may be limited.

The use of methanol as fuel in the maritime industry requires assessment of safety and environmental risks that differ from those associated with conventional fossil fuels. These risks may be significant, depending on the operating scenario, ship design and control measures in place, particularly during early deployment where operational experience is limited. While many of these risks can be identified and mitigated through operational procedures and contingency planning, operational experience with methanol-fuelled ships is still developing and remains limited across ship types, system designs and operating conditions. Companies should therefore apply a structured risk-based approach and ensure that operational procedures, contingency measures and review processes are updated as further experience is gained.

Regulatory requirements for ships using methyl/ethyl alcohol as fuel are already addressed in IMO interim guidelines (MSC.1/Circ.1621)[1], approved by MSC 102 in 2020. Those guidelines are currently under revision within the IMO framework, with ongoing work considering, inter alia, the differing characteristics of methanol, including toxicity-related aspects, and consistency with relevant provisions of the IBC Code, as appropriate. Given the current lack of fully matured formal requirements for methanol fuel, the approval should follow the applicable IMO instruments, class and flag requirements, and, where relevant, the approval process outlined in the IMO guideline MSC.1/Circular.1455 (Guidelines for the Approval of Alternatives and Equivalents). This necessitates proactively identifying and mitigating the operational risks through a risk-based approach (in accordance with appropriate international standards) rather than relying on a compliance route with formal regulatory requirements.

The practical and pragmatic approach of managing risk in an operational environment can be achieved through risk management i.e. proactive risk assessment, risk mitigation and continual improvement of the operational processes. It is recommended to use risk management tools and methodologies, such as HAZID (Hazard Identification), HAZOP (Hazard and Operability Study)[10], or bowtie analysis for identifying and mitigating the risks associated with methanol fuel handling. The measures that would be beneficial for safe operations when using methanol as fuel could include but are not limited to:

- Identification of potential safety and environmental risks associated with the use of methanol as fuel, including the toxic and corrosive properties of methanol and its environmental impact, particularly on marine life.
- Development of operational procedures for operations involving methanol as fuel based on assessment of known and anticipated risks, ensuring that methanol's specific hazards are accounted for.
- Development of contingency plans for addressing unintended operational outcomes, such as methanol leaks, spills, or combustion-related incidents.
- Proactive risk assessment and implementation of appropriate control measures to mitigate the identified risks prior to operations.
- Diligent reporting of non-conformities, accidents, and hazardous occurrences (including near misses) noted by personnel in the operational procedures ensuring they are logged, analysed, and addressed appropriately.
- Continuous assessment of operational procedures and contingency plans, incorporating corrective actions and update protocols as needed, based on reported gaps, incident reports and lessons learned.
- Training for crew members should include scenario-based exercises to prepare for potential methanol-related risks, including leak detection, spill management, and emergency response to methanol-related incidents.

One key objective of the ISM Code is that all identified risks should be assessed and mitigated with appropriate control measures put in place. Although the ISM Code is not applicable during the design phase, the IGF Code mandates risk assessments during the design and retrofit stages of the vessel. The risk management measures identified during the design phase should be integrated into the operational phase of the vessel's lifecycle and updated regularly based on operational feedback.

Methanol's inherent flammability, toxicity and potential impact on the marine environment underscores the importance of implementing appropriate risk controls at every phase of the vessel's lifecycle. The findings from the design/retrofit phase, particularly regarding safety measures, operating limitations and key risk controls should be retained as living documents, kept up to date, and made readily accessible during the operational phase. These documents should also accompany the vessel if it changes ownership or Company.

In addition to addressing risks identified during the design or retrofit stage, procedures should also consider any new operational risks that arise once the vessel is in service. The introduction of methanol fuel represents new technology and will necessitate updated operational procedures, as well as a shift in organizational mindset and safety management practices.

The strength of the Company's SMS lies in its ability to continuously improve the operational processes by proactively identifying any gaps through reporting, analysing and learning from non-conformities, accidents, and hazardous occurrences (including near-misses). It is recommended implementing digital tools for tracking and analysing trends in safety performance. These tools may allow for real-time monitoring of safety performance, improving the ability to identify areas of concern early and make adjustments to prevent unintended outcomes. Agility in amending the processes and maintaining a strong safety culture throughout the organisation would show the strength of the SMS in preventing the recurrence of unintended outcomes.

Until operational experience is gained within each organisation, the SMS can also consider learnings from additional sources of information, including risk evaluations from the design or retrofit stage, learnings from other companies or pilot projects

The deployment of methanol as fuel is expected on newbuilds as well as existing assets through suitable retrofits. During the early stages of this transition, it is likely that a fuel mix, including both methanol and fossil fuels, may be used. This mixed-fuel approach should be incorporated into the SMS, with procedures specifically addressing the handling and operation of both fuels. As the industry evolves, the SMS should remain flexible and adaptable to accommodate these changes rapidly at all levels of management. Digital document control has become a widely accepted practice in safety management and will be crucial in managing changes as companies implement methanol fuel on their vessels.

2. Safety and Environmental Protection Policy

As methanol is adopted as a marine fuel, companies should ensure that their Safety and Environmental Protection (SEP) policy is updated, where necessary, to remain aligned with the International Safety Management (ISM) Code and to address the specific characteristics and hazards associated with methanol. Several safety procedures relevant to methanol are already in place and incorporated into the International Maritime Organization's (IMO) Code of Safety for Ships using Gases or other Low Flashpoint Fuels (IGF Code), including the interim guidelines for the safety of ships using methyl/ethyl alcohol as fuel (MSC.1/Circ.1621).

In accordance with Chapter 2 of the ISM Code, the SEP policy should clearly articulate the company's commitment to the safe, environmentally responsible, and compliant operation of methanol-fuelled vessels. This policy framework provides the foundation for integrating methanol into the company's Safety Management System (SMS) in a structured and consistent manner.

The policy should also articulate how methanol-fuel operations support the company's broader environmental strategy, as well as recognising the role of methanol in meeting current and future decarbonisation targets both at a global and regional level such as those within the Emissions Trading Scheme (ETS) and FuelEU Maritime. This includes acknowledging lifecycle environmental considerations, the potential use of renewable or bio-methanol, and the company's commitment to proactive alignment with emerging IMO sustainability measures and regional fuel-carbon regulations.

The SEP policy should remain dynamic and responsive, taking account of evolving regulatory requirements, classification society rules, and global decarbonisation frameworks, such as the Energy Efficiency Design Index (EEDI) and Carbon Intensity Indicator (CII), where applicable.

An updated SEP policy should clearly define the company's approach to the safe integration, handling, storage and use of methanol as a marine fuel. This includes establishing a structured risk assessment process associated with operations to identify and evaluate methanol-specific hazards such as low flashpoint, toxicity, vapour expansion, flammable atmospheres, and leakage potential. Appropriate risk control measures should then be incorporated into all relevant operational procedures. These measures should be embedded across the full operational lifecycle, including vessel design, bunkering operations, normal operation, maintenance activities, and emergency response.

Given the goal-based approach to designing and certifying methanol-fuelled vessels, the SEP policy should emphasise continual improvement, such as continuous risk assessments, incorporating feedback from operational incidents and current best-practice. The policy should focus on actively reducing risk levels associated with the vessel's operation and ensuring that both onboard and shore-side personnel are adequately trained, equipped and prepared to manage these risks. The policy should prioritise a proactive approach to risk management, fostering a culture of safety, continuous learning and environmental responsibility across all operational levels.

The safety culture elements described in this chapter provide the behavioural foundation for effective implementation of the company's SEP policy. While the SEP policy outlines organisational commitments for methanol operations, a strong safety culture ensures these commitments are translated into everyday behaviour, informed decision making, open reporting, and effective learning across shipboard and shore-based functions.

By updating the SEP policy in this way, the Company demonstrates a clear commitment to the safe and sustainable adoption of methanol and other alternative marine fuels. Through the consistent identification, assessment, and mitigation of methanol related risks within the SEP framework, methanol-fuelled operations can be conducted safely, responsibly, and in full compliance with the ISM Code and other relevant industry guidelines for methanol.

No.	Recommended actions
2.1	The Company should update its SEP policy to expressly address the safe and environmentally responsible integration, handling, storage and use of methanol as fuel, taking into account relevant regulatory, technical and operational developments.
2.2	The Company should ensure that the SEP policy recognises the unique safety and environmental risks associated with methanol and commits to implementing appropriate controls through strict adherence to SMS protocols and procedures.
2.3	The Company should include within its SEP policy a clear commitment to the prevention of spills, leaks, releases, fire and personnel exposure, supported by appropriate safeguards, preparedness and response arrangements for normal operations, maintenance, bunkering and emergency situations.
2.4	The Company should establish arrangements for the monitoring, reporting and review of methanol-related operations, incidents, near misses and system performance, in order to support continuous improvement of the SMS.

3. Company Responsibilities and Authority

The ISM Code requires companies to develop, implement and maintain an SMS that includes the functional requirements listed in section 1.4 of the Code [11]. When methanol is introduced as a marine fuel, the Company's responsibility and authority, particularly that of shore-based senior management, and Designated Person(s)(DP), become critical in ensuring that the SMS remains effective for safety and pollution prevention.

Active involvement and visible support from senior management are essential to the development, implementation, and maintenance of a robust and adaptive SMS. Senior management should lead by ensuring comprehensive safety reviews, appropriate resource allocation, adequate technical support with competent shore-based oversight including OEM/manufacturer expertise (especially during introduction and early service), and risk management measures that explicitly address the hazards associated with methanol-fuelled operations. Methanol's toxicity due to exposure, flammability and spill consequences introduce specific risks related to personnel, which require dedicated technical and operational controls to be embedded within the SMS [12]. In support of this, the IMO has issued Interim Guidelines for the safety of ships using methyl/ethyl alcohol as fuel, which establish a goal-based framework and functional requirements for managing these risks and minimising impacts to the ship, its crew, and the environment [1].

The Company holds overarching responsibility for ensuring that SMS processes and procedures remain fit for purpose throughout the vessel's lifecycle. This includes establishing and maintaining methanol specific procedures and controls for bunkering, operation, maintenance, and emergency response, and ensuring that authority levels and communication pathways between ship and shore are clearly defined [11]. Industry guidance is already available to support safe methanol bunkering practices, including standardised checklists and process flows for shipowners, operators, ports, and fuel suppliers[13].

In line with the ISM Code's risk based and continuous improvement principles, a lifecycle approach should be applied to the management of methanol-fuelled operations:

Lifecycle approach

- **Design/Retrofit Phase**: Conduct detailed, methanol-specific risk assessments during design or retrofit to anticipate hazards and system interactions, and use outcomes to inform procedures, training, and emergency preparedness [1].
- **Operational Phase**: Implement monitoring and reporting mechanisms to capture lessons learned (e.g. non-conformities, incidents, near-misses) and update procedures to address evolving risks [11].
- **Decommissioning Phase**: Establish protocols for safely handling residual methanol and decommissioning or disposing of associated equipment in a manner that protects personnel and the environment.

The SMS should include a clear description of authority, roles and the allocation of responsibilities, as well as communication arrangements for methanol-specific tasks such as fuel handling, bunkering supervision, equipment isolation, maintenance and emergency response, including ship-shore escalation. This prevents ambiguity in process execution, enhances accountability, and supports effective resource allocation [11].

The Company should recognise that managing the risks associated with methanol, including its toxicity, flammability, vapour release, fire and personnel exposure, requires appropriate competence, training and methanol specific personal protective equipment (PPE) for both shipboard and shore-based personnel, particularly in relation to leak response, exposure control, emergency situations and safe handling practices. In addition to regulatory requirements, industry initiatives highlight the need for dedicated competence frameworks for methanol as fuel [14].

The Company should ensure the personnel involved in methanol operations should receive role specific training that reflects the fuel's properties, risks, and operational requirements. Given the relatively new technologies associated with the safe use of methanol as fuel, the Company should involve relevant stakeholders such as OEM suppliers when developing and conducting specific training [15]. This should

be in addition to utilising the Interim Guidelines published by the IMO on training seafarers [16]. These arrangements should reinforce the ISM Code's expectations relating to competence, safety culture, and preparedness, and complement operational guidance developed elsewhere in the SMS. This would encompass the training which should align with the IGF Code Part D, as this ensures that the SMS remains compliant with the mandatory competence requirements.

The Company should ensure that interfaces with shipboard personnel, shore-based management, and relevant third parties (OEMs, service engineers, bunker suppliers etc.) are clearly defined and effectively managed.

Finally, the strength of the SMS relies on a proactive culture of safety and environmental responsibility. The Company should encourage open reporting of non-conformities, accidents and near-misses; conduct regular internal audits and management reviews; and use feedback loops to drive continuous improvement [11].

No.	Recommended actions
3.1	The Company should ensure that its safety management system clearly addresses the specific hazards, operational requirements and pollution-prevention measures associated with the use of methanol as marine fuel.
3.2	The Company should provide adequate resources, competent personnel, technical support and maintain strong senior management oversight to support safe implementation and methanol-fuelled operations at every stage of the vessel's lifecycle.
3.3	The Company should establish clear roles, responsibilities, authority levels and communication pathways for methanol fuel-related operations and should ensure that procedures are reviewed and updated in light of operational experience, incidents, near misses, industry best practices and relevant technical or regulatory developments.

4. Designated Person(s)

The Designated Person (DP) plays a pivotal role in the facilitation of the development, implementation, maintenance, and continual improvement of a company's SMS, providing the formal link between shipboard operations and shore-based management, as required by the ISM Code. This DP link, beyond ordinary communication, should have direct access to the highest level of management and should support effective escalation, resource allocation and follow-up of safety and pollution-prevention matters. This is particularly important to establish, support and maintain a strong safety culture, especially during the introduction of methanol as fuel, where operational experience and historical data may be limited.

The introduction of methanol as a marine fuel represents a significant change to vessel operations and associated risk profiles. Given methanol's toxicity, vapour behaviour, corrosivity, and flammability, companies should review and, where necessary, strengthen the role, responsibilities, and support arrangements associated with the DP to ensure methanol specific risks are effectively managed within the SMS.

This section provides recommendations for enhancing the DP's role in the safe adoption of methanol as fuel, grounded in the ISM Code principles, MSC-MEPC.7/Circ.6 [18], and the relevant industry guidelines.

A key requirement of the ISM Code is that the Company, through its DP, provides sufficient resources and support to ensure the safe operation of its vessels, including those fuelled by methanol. This support should extend to safe bunkering, fuel system operation, maintenance, and emergency preparedness, and should include:

- Access to appropriate technical expertise
- Training
- Operational guidance
- Financial resources

Robust shore-based systems should be in place to monitor methanol related performance, analyse incidents and near misses, and respond promptly to identified deficiencies. The DP should ensure that these systems support trend monitoring, timely escalation, follow-up of corrective actions and verification of their closure, while also capturing feedback from shipboard personnel to support continuous improvement of the SMS.

The DP's job description should be reviewed and amended to explicitly reference methanol as a marine fuel. The DP's responsibilities should include oversight of methanol related operations, emergency preparedness, and SMS compliance supported by clearly defined and consistently applied communication pathways and escalation protocols . These arrangements should ensure effective reporting, coordination and timely decision-making across all parties involved in methanol operations and should be established from shipboard personnel to the DP and from the DP to the highest level of management, particularly in relation to safety, environmental, and operational concerns.

The DP should also ensure that the SMS incorporates relevant international and industry guidance, including the IMO Interim Guidelines for the safety of ships using methyl/ethyl alcohol as fuel (MSC.1/Circ.1621), class rules, and recognised industry best practice. Methanol specific risks should be reflected in risk assessments, operational procedures, drills, and audit programmes.

The Company should incorporate modern learning methods that strengthen the DP's ability to manage methanol related scenarios effectively. Simulation based learning may form part of the DP's development programme. Scenario driven exercises, such as simulated methanol leaks, bunkering deviations, fuel system alarms, and emergency shutdown events, allow the DP to practise complex decision making in realistic conditions. These exercises enhance understanding of system behaviour, reinforce emergency coordination skills, and improve the DP's capacity to oversee methanol operations safely and confidently.

Industry initiatives underline the importance of specialised competence frameworks for methanol as a marine fuel, highlighting the need for informed DP oversight at both shipboard and shore-based levels[14].

To manage the risks associated with methanol as a marine fuel, the suitability criteria for the DP role should include appropriate qualifications, training and experience, which should be expanded beyond traditional requirements and may include (but is not limited to):

Qualifications

- The DP should have a comprehensive understanding of methanol's key characteristics, including its physical and chemical properties, associated safety hazards, and operational considerations, to effectively oversee its safe use as a marine fuel.
- The qualifications of a DP should be as per the guidance provided in MSC-MEPC.7/Circ.6 [18].
- Noting the emerging regulatory landscape for methanol-fuelled ships, the DP should have knowledge of emerging requirements and familiarity with industry pilot projects using methanol as fuel, as well as familiarity with risk-based decision-making tools, such as Bowtie Analysis, HAZID, or HAZOP, specifically applied to methanol operations.

Training

- Completion of specific training for methanol as fuel as per the guidance on training provided in MSC-MEPC.7/Circ.6, including any relevant industry publications such as the basic[19] and advanced[15] training frameworks.
- Familiarity with the Interim Guidelines on Training for seafarers on ships using Methyl/Ethyl alcohol as fuel [16].
- Simulation-based training to build and enhance skills and knowledge with methanol specific scenarios, such as handling leaks, fires, or spills in operational contexts and training on methanol bunkering procedures and methanol's interaction with other fuels in mixed-fuel operations.
- Knowledge of methanol's physical and chemical properties associated hazards, and implications for shipboard operations, emergency response, and pollution prevention.
- A regular review of the DP's training criteria ensures that the training remains suitable, taking into account lessons learned from operational experience and emerging industry guidance.

Experience

- The DP should have prior appropriate involvement in implementing SMS for methanol or other alternative fuels.
- Familiarity with the technical, operational, and safety characteristics of methanol-fuelled systems or similar alternative fuels, including system functionality, operating limits, associated hazards, maintenance requirements, and human element considerations[17].
- Having the knowledge or experience to implement an SMS to safely manage toxic fuel is beneficial.
- Ability to interpret methanol related technical and regulatory information, support ship and shore personnel, and ensure that methanol specific considerations are fully integrated into the SMS.

It remains the responsibility of the Company to provide the DP with sufficient authority, resources, and direct access to senior management, enabling decisive action in safety critical situations and effective escalation of concerns.

As methanol transitions from pilot projects to early commercial deployment across multiple vessel types, industry assessments highlight the importance of robust SMS's and competent shore-based oversight, including effective DP arrangements.

No.	Recommended actions
4.1	The SMS should specifically outline the DP's responsibilities related to methanol, making sure the DP has clear oversight of methanol risks, compliance, and emergency preparedness.
4.2	The DP should be equipped with sufficient resources and granted the necessary authority to address methanol safety matters effectively, as well as having clear lines of communication to escalate any concerns directly to senior management.

4.3	The competence requirements for the DP should encompass methanol-specific knowledge and training. The DP should demonstrate an understanding of methanol's hazards, fuel system characteristics, applicable regulations, and safety considerations, all supported by relevant training that reflects current industry guidance.
4.4	The DP should ensure methanol related risks are properly integrated into the SMS, including through methanol specific risk assessments, procedures, drills, audits, and defined operational limits, and should verify alignment with applicable IMO guidelines, class rules, and industry best practice.
4.5	The DP should ensure that robust shore-based monitoring and feedback systems are maintained, supported by structured processes to track methanol related performance, review incidents and near misses, monitor trends and ensure timely implementation and closure of corrective action to support continuous safety improvement across the fleet.
4.6	Ensure the DP participates in industry-level alternative fuel working groups, staying updated on regulatory changes, incidents, and innovations related to methanol.
4.7	Facilitate regular simulation-based training for DPs and key personnel to address methanol specific emergency scenarios, bunkering deviations, and system alarm responses.

5. Master's Responsibilities and Authority

The Master has the overriding authority and responsibility for the safety of the ship and protection of the environment as defined in the ISM Code, which should be explicitly captured in the SMS. In addition, the Master is responsible for promoting safety culture onboard and for implementing company policies and procedures, including those related to methanol as fuel.

The Master while retaining the overall responsibility of the vessel, can delegate the management associated with methanol as a fuel to the role documented in the SMS, as the "person with immediate responsibility". The Company should clearly identify personnel with immediate responsibility for fuel-related decision-making, including the handling, transfer, storage and operational management of methanol. Their roles, authority and competence requirements should be defined and documented within the safety management system, commensurate with the risks identified for the vessel's operational profile.

It is the responsibility of the Master to ensure that the person with immediate responsibility for managing methanol fuel-related operations onboard(including methanol and any other alternative fuels used onboard) has the appropriate qualifications and adequate practical experience. However, the Master retains the overriding authority to suspend or restrict methanol/other fuels operations where safety or pollution prevention may be compromised, irrespective of commercial considerations and this should be explicitly reflected in the SMS. To support consistent decision making, the SMS should define the circumstances in which this authority may be exercised, the actions available to the Master, and the associated escalation and reporting requirements.

The Master should fully understand the revised SEP policy and procedures covering methanol, and ensure that all crew members are appropriately briefed, trained and compliant with the associated requirements. The Master should ensure that explicit references have been included to cover methanol fuel, detailing any additional procedures, precautions, or responsibilities that arise from its integration into vessel operations. The Master is responsible for overseeing the effective communication, rollout, and comprehension of all SMS updates related to methanol. Regular monitoring and review of these changes are essential to identify any gaps in understanding and to support safe and consistent implementation as operational experience evolves.

The Master is responsible for ensuring that methanol specific operating limits, precautions and emergency actions are clearly reflected and kept up to date in the vessel's documented procedures and requirements. Furthermore, the Master should ensure that the crew clearly understands how methanol-fuelled operations differ from those associated with conventional fuel operations or other alternative fuels onboard, particularly with regard to flammability, toxicity, fire behaviour, vapour behaviour, and emergency response actions.

The Master should ensure that their exchange with the Pilot covers methanol specific considerations such as tank configuration, spill risk areas, hazard zones, alarm systems, and emergency shutdown or isolation procedures.

Regular review of the effectiveness of methanol related procedures is fundamental to maintaining high safety standards. The Master should promptly report methanol-related deficiencies, operational challenges, or recurring incidents to shore based management, so that root cause analysis, corrective action and continuous improvement measures can be applied.

Effective communication, a well-defined command hierarchy and a strong onboard safety culture are essential for the safe operation of methanol-fuelled vessels. Crew members should also be encouraged to promptly report unsafe conditions, abnormalities and non-routine situations to the Master. In this way, the Master plays a pivotal role in maintaining operational safety, supporting regulatory compliance, and ensuring environmental protection in methanol-fuelled ship operations.

No.	Recommended actions
5.1	The SMS should define the Master's authority for methanol-fuelled operations. It should clearly state the Master's overriding authority when methanol risks arise, including to restrict or suspend bunkering, isolate methanol systems or take necessary action to ensure safety and pollution prevention.
5.2	Onboard role(s) should be identified as having immediate responsibility for methanol related systems and operations, reporting directly to the Master. This should ensure clear delegation of specific duties to qualified personnel during methanol bunkering, monitoring, maintenance, and emergency situations.

6. Resources and Personnel

Unlike conventional fossil fuels, methanol introduces distinct operational, safety and environmental risks. This increases the importance of competence, training and risk awareness of both shipboard and relevant shore-based personnel. The Company should ensure that all personnel involved in methanol-fuel related activities, both shipboard and shore-based, are competent, appropriately trained and familiar with the risks and procedures relevant to their assigned roles.

The IGF Code (Part D) and STCW Code (Part A V/3) together establish competence requirements for personnel serving on ships using gases and low flashpoint fuels. The Company should ensure that the competence, familiarisation and training arrangements for methanol-related operations are aligned with applicable mandatory requirements and supplemented, where necessary, by ship-specific procedures and additional company requirements.

Training, Familiarisation and Competence

As the training framework for ships using methanol as fuel continues to develop[16], the Company should ensure that all relevant shipboard and shore-based personnel receive adequate training and familiarisation in accordance with the requirements of the ISM Code and the STCW Convention, as applicable, and when necessary, supplement the minimum standards to reflect the vessel's operational profile, systems design and identified risks. The MJTTF Training Frameworks (Basic [19] and Advanced [15]) for Methanol as Marine Fuels, developed in collaboration with the IMO, provide additional competence guidance and could be used as a reference when developing and reviewing training programmes.

All relevant ship and shore-based personnel should receive role-appropriate and ship specific familiarisation in accordance with ISM Code (Chapter 6.3) and STCW Convention (Reg. I/14) requirements, as applicable. The MJTTF Guidelines for Developing Familiarisation Programmes for Alternative Fuels [20], developed in collaboration with the IMO, could be used as a reference when developing ship-specific familiarisation programmes. This should include awareness of the hazards specific to methanol, the location and function of relevant equipment and alarms, emergency actions, PPE requirements and the precautions applicable to the individual's area of work and level of exposure, commensurate with the scale and risk profile identified by the Company.

Training effectiveness should be periodically evaluated through drills, exercises or onboard demonstrations. Training content should be regularly reviewed and updated in light of incidents, near misses, significant system changes, identified deficiencies, and relevant operational experience and industry best practice.

Structured briefings should be conducted to reinforce methanol fuel-related procedures, precautions and expectations during voyage planning, bunkering preparations, and routine operational activities. This approach helps maintain procedural discipline, supports a strong safety culture and ensures that all personnel remain actively aware of methanol fuel-specific risks and controls.

Training should include, as appropriate to the person's role, but not be limited to:

- Hazardous material handling protocols;
- Understanding methanol and/or other alternative fuel behaviour during leaks, spills and vapour release, fire scenarios across various operating and environmental conditions;
- Selection and correct use of appropriate PPE.

Training should include scenario based exercises, reflecting credible methanol fuel-related situations, including but not limited to:

- Bunkering deviations;
- Leaks (detection and response);
- Spills;
- Vapour release;
- Alarm response;
- Evacuation from high risk/affected areas;
- initial emergency actions.

Training scenarios should be adapted to the vessel type, system design and operational profile. The Company should proactively consider the human factors aspect to reduce the likelihood of unintentional errors by implementing preventive measures, including but not limited to:

- appropriate supervision;
- effective shift and task handover;
- regular drills and refresher training focused on fuel systems and emergency responses;
- minimising crew presence in spaces containing methanol related equipment where feasible;
- ensuring clear and consistent communication protocols during routine and emergency operations.

The Company should also ensure that crewing levels allow for sufficient qualified personnel to be available during bunkering, emergency response and other critical methanol-related activities, so that workload, fatigue and task overload do not undermine safe performance.
Competence programmes may be used to identify and address competence gaps through structured assessments, follow up actions and periodic review. Relevant personnel should have the competence to:

- understand operational differences between methanol and any other fuels used onboard;
- recognise methanol fuel-related hazards and operational risks to personnel, equipment and the environment;
- perform assigned operational, maintenance and inspection tasks safely;
- understand the characteristics, limitations, systems and equipment specific to methanol where applicable, relevant to their duties, and the differences from any other fuels used onboard;
- respond appropriately to equipment malfunctions, leaks, alarms, human exposure, environmental pollution and other abnormal situations.

Shore-based personnel involved in methanol-related activities, including operational support, technical management, bunkering coordination, emergency response and oversight functions, should be familiar with the relevant hazards, procedures, escalation arrangements and communication protocols applicable to their assigned responsibilities.

Roles and Responsibilities
Tasks specific to methanol should be assigned to a person with immediate responsibility, as defined in STCW Code, Section B-V/3. This individual should have decision making authority and documented competence in methanol fuel handling, emergency response and operational oversight. Due to the hazardous nature of methanol, some tasks may require specifically certified personnel.

Methanol associated roles and responsibilities for deck and engine crew should reflect their operational responsibilities and associated hazards, including but not limited to:

- **Deck crew**: bunkering operations, leak detection, safety barriers and emergency procedures.
- **Engine crew**: bunkering operations, system integrity, maintenance of fuel systems, operational monitoring and emergency response.

No.	Recommended actions
6.1	The Company should develop and maintain a competence matrix covering certification, training and experience for all personnel involved in methanol fuel-related operations and should apply systematic gap analyses and follow-up actions to identify and address competence gaps.
6.2	The Company should establish and implement training procedures covering the hazards and risks associated with methanol as fuel, including simulated exercises with credible scenarios where appropriate, and should ensure that personnel receive the level of training and certification that is needed for their role and emergency responsibilities.
6.3	The Company should establish procedures ensuring that all personnel involved in methanol-related operations are adequately trained and are familiar with the associated hazards, equipment, PPE and safe-working practices. These procedures should include assessing the need for additional personnel during bunkering and other critical activities to maintain safe and compliant operations, while also minimising personnel exposure in methanol-related spaces wherever practicable.

7. Shipboard Operations

Ship-specific operations directly related to the use of methanol as fuel should have documented procedures for covering bunkering, transfer, storage and handling of methanol, and operation, monitoring, isolation and maintenance of methanol fuel-related systems, to minimise the risk to personnel, the ship and the environment. These procedures should reflect the ship's approved design, applicable regulatory requirements for methanol fuel systems, including those outlined in MSC.1/Circ.1621[1], Interim guidelines for the safety of ships using methyl/ethyl alcohol as fuel and relevant industry guidelines [21] and best-practices associated with methanol.

Being a relatively novel fuel technology in maritime applications, there may be limited operational data to develop robust operational procedures for methanol as fuel. However, extensive experience exists from shore-based methanol operations and methanol cargo handling, which can facilitate the development of operational procedures. Additionally, understanding the characteristics of methanol may help reduce operational risks, and it can be beneficial to be guided by established practices for other alternative fuels such as LNG in developing operational procedures and contingency plans. However, such established practices should be adapted carefully to the ship specific methanol fuel-system, operational profile and identified methanol-specific risks.

Relevant industry guidance on chemical cargo transfer and marine terminal interface management may be used [22][23], where appropriate, to inform the development of methanol-fuel transfer procedures.

Methanol bunkering, transfer, storage, handling, operation and maintenance procedures should be tailored to the specific ship's design and arrangement of the methanol system. The procedures should consider the full cycle of the operations including planning for the activities - before and during the ship's arrival, approach, and mooring; the preparation, testing, and connection of equipment; the methanol transfer process; the completion of the bunkering and disconnection of equipment:

- Planning Stage: Risk and compatibility assessment, regulatory approval, planned schedule and location,
- Planned activities onboard during bunkering and, if applicable, simultaneous Operations (SIMOPS) assessment
- Arrival at bunkering position, approach and mooring plan
- Pre-transfer Stage: Safety checks, communication checks, pre-operational checklist, final inspection of bunkering systems, mooring and access setup, systems connection and tightness test
- Transfer Stage: Transfer monitoring, periodic checks, methanol flow control, defined stop/suspend criteria, topping off and, where necessary, ballasting
- Post-transfer Stage: Drain and purge lines, disconnect systems and cables, post-transfer meeting, access removal, unmooring and departure.

Shipboard procedures should also address work authorisation, isolation, purging, testing, reinstatement and return to service for methanol-related systems, particularly where maintenance, inspection or fault response may affect containment, detection, alarms, protective functions or ventilation arrangements.

Consideration should also be given to the safe containment, handling and disposal of methanol leaks, spills and contaminated materials, including methanol-contaminated water, absorbents and residues, with due regard to personnel safety, environmental protection and applicable disposal requirements.

The following industry guidelines may be used for the handling of methanol and developing the operational procedures for methanol as fuel:

- Methanol – Safety and Operational Guidelines – Bunkering [24]
- EMSA Study on Safe Bunkering of Biofuels [25]
- MSC.1/Circ.1621 Interim Guidelines For The Safety of Ships Using Methyl / Ethyl Alcohol as Fuel
- EN 12115:2021 Rubber and thermoplastics hoses and hose assemblies for liquid or gaseous chemicals - Specification (primary standard for chemical resistant hoses)[26]
- DNV-ST-0687 Competence related to the use of methanol as fuel [14]

The operational risks associated with methanol as fuel arise not only from its characteristics (including flammability, vapour formation, invisible flame, miscibility with water and material compatibility concerns), but also from its interactions with the operational environment. The additional risk could arise due to:

- Possible mixing of methanol with other fuels (dual-fuel operations),
- Varying operational environment (significant temperature and/or ventilation variations),
- Vapour accumulation in enclosed or poorly ventilated spaces, and
- Human factor issues (such as mis identification of lines, incorrect valve operation etc.).

Because methanol burns with a pale flame that may be difficult to detect visually, operational procedures should emphasise early detection (gas/vapour detection, temperature and pressure monitoring, alarm management), effective ventilation, ignition source control, and appropriate PPE for splash, inhalation and ingestion hazards, in addition to general fire safety measures.

The hazardous zones (primarily associated with explosion or fire risk) and toxic zones (primarily associated with toxicity exposure risk) include areas with potential toxic, combustible, or explosive atmospheres, necessitating strict safety measures. The hazardous area and toxic area assessments (identified in the design stage) should be utilised (using results from the gas dispersion analysis) to establish and verify the safety boundaries for methanol bunkering and other methanol fuel-related operations. These assessments should inform zoning and classifying hazardous areas based on methanol concentrations, similar to SGMF's (The Society for Gas as a Marine Fuel) BASiL (Bunkering Area Safety information LNG) approach used in LNG bunkering [27] access control, ventilation precautions and operational risk controls.

Management of Change (MoC)

Where modifications are introduced to methanol fuel-related equipment/system, the existing procedures and personnel may create risks which should be identified through a formal MoC process. This process should form an integral part of the shipboard procedures and include but not be limited to the following items:

- A risk assessment is conducted in the planning phase of the modification which addresses the full range of hazards and consequences of the implementation of methanol as fuel.
- The MoC identifies all personnel involved or affected by the change.
- The training needs arising from the implementation of methanol as fuel for both shipboard and shore-based personnel should be identified in the MoC.
- All procedures, documentation, records, manuals, drawings and templates that need to be updated, including emergency response plans, when necessary, should be identified in the MoC.
- Any change in technology should undergo thorough evaluation, ensuring appropriate certification for the changed equipment, particularly regarding material compatibility with methanol.
- Changes in applicable regulatory or local requirements should also trigger a review to identify any deviation from the original risk basis and any resulting need to revise procedures, controls or operating limits.
- Effective communication and coordination among all relevant stakeholders is essential, keeping the impacted parties updated on the resulting changes.

No.	Recommended actions
7.1	A ship-specific methanol fuel handling manual should be developed and maintained detailing the ship and its system layout, roles and responsibilities, fuel characteristics, storage conditions, bunkering and onboard transfer procedures, checklists, SIMOPS procedures and controls, emergency response and contingency plans.
7.2	Management of Change (MoC) process should be integral to the development and maintenance of shipboard procedures to address changes resulting in the deployment of methanol as fuel. The MoC process should assess and address the impact on personnel safety, training requirements, documentation, emergency preparedness and regulatory compliance.
7.3	The Company should establish ship specific procedures for structured risk assessments of the methanol fuel-related shipboard operations, including risk identification, risk analysis, and risk evaluation for normal, abnormal and emergency conditions.

7.4	The analysis of the identified risks should be carried out specifically to the operational environment in which methanol fuel is being deployed. A plan to mitigate the identified risks should be followed to ensure the safe deployment of methanol as fuel. In addition, and if applicable, the analysis should consider the effects of the interactions with other fuels that may be part of the fuel mix onboard, system configurations, environmental conditions and operational interfaces that may affect the safe use of methanol as fuel.
7.5	Training drills and exercises should be carried out to familiarise personnel with anticipated methanol-related operational scenarios and to improve response times and procedural effectiveness in relation to flammable, toxic and other hazardous situations.
7.6	Operation, maintenance and work-authorization procedures for methanol associated systems should minimise personnel presence in hazardous or toxic areas where feasible and should include appropriate controls for access, isolation, testing and reinstatement.
7.7	The Company should develop specific procedures for normal methanol fuel system operations including fuel transfer, tank management, monitoring and, where applicable, dual-fuel engine changeover procedures, with clearly defined operational limits, alarms and monitoring requirements.
7.8	The Company should establish and implement structured communication protocols for methanol operations, including ship-shore coordination during bunkering, emergency escalation procedures, and clearly defined authority levels for operational decisions, suspension of operations and safe resumption.

8. Emergency Preparedness

While robust design and operational controls can mitigate many risks associated with the use of methanol as fuel, it is essential to have comprehensive emergency response measures to manage residual risks effectively and minimise harm to personnel, the ship, and the environment. Emergency preparedness becomes crucial because of methanol's low flashpoint, wide flammability range, invisible flame characteristics and toxicity.

Emergency preparedness for methanol-related operations should address two closely linked elements: contingency planning and emergency training:

- Contingency planning, including but not limited to:
  - Development of methanol-specific emergency response plans to protect personnel, the ship and the environment.
  - Procedures for reporting methanol fuel-related emergencies, including rapid communication with shore-based responders.
  - Procedures for identifying, describing, and responding to potential shipboard emergency situations involving methanol fuel, clearly specifying individual roles, and
  - Procedures for the maintenance and readiness of the emergency response systems and associated plans.

- Emergency training, including but not limited to:
  - Training for shipboard personnel and relevant shore-based personnel about methanol-specific emergency procedures to be followed in the event of an emergency, clearly informing them of their roles during emergencies.
  - Onboard familiarisation of shipboard personnel with methanol emergency systems and plans. Proper selection, use and maintenance of PPE compatible with methanol.
  - Regular drills and exercises for methanol-related emergencies, including firefighting training considering the unique behaviour of methanol flames.
  - Effective coordination of crew and the company's actions during methanol associated emergencies, and
  - Effective, transparent, and practical feedback mechanisms to improve emergency response procedures.

The SMS should identify and prepare for potential emergency shipboard situations and containment failures associated with methanol; these may include, but not be limited to:

- Methanol spills, sprays, or vapour release in enclosed/semi-enclosed spaces and on open decks.
- Leakage due to hose, pipe, or structural failure, including double-walled pipe leaks.
- Formation of flammable vapour clouds in machinery spaces, bunkering stations, fuel preparation rooms, or poorly ventilated areas.
- Overfilling or over pressurisation of methanol tanks or piping systems, including surge pressures in transfer systems.
- Bunkering incidents: hose rupture, communication failure, overflow, fender or mooring line failure.
- Fire involving methanol pools or sprays, including fires with nearly invisible flames.
- Personnel exposure to methanol through skin contact, inhalation or ingestion, including contamination of PPE or clothing.
- Failures of ventilation or gas detection systems.
- Blackout or propulsion/control loss caused by methanol system malfunction.
- Collision, grounding, or heavy contact while methanol tanks are loaded.
- Methanol leakage near accommodation spaces.
- Activation of Emergency Shutdown Systems (ESD).
- SIMOPS incidents during bunkering.
- Communication system failures during critical fuel operations.

The SMS should incorporate detailed response procedures, tailored to the identified methanol-specific risks, including but not limited to:

- **Spill Response**: Develop spill containment strategies prioritizing confinement and controlled dilution with water, avoiding spread of the methanol pool and preventing ingress into enclosed spaces, bilges, drains or seawater inlets.
- **Fire response**: Implement procedures for detecting methanol fires (which may be nearly invisible), using appropriate extinguishing agents (water spray, foam, or CO_2), and ensuring personnel safety during firefighting operations.
- **Vapour Management**: Procedures when methanol vapours are detected, ensuring adequate ventilation, and evacuating personnel from affected areas to safe zones.
- **Emergency Shutdown (ESD)**: Procedures for activating emergency shutdown systems for methanol fuel supply and related equipment, including procedures for safe restoration after an ESD or blackout (treating it as a controlled operation and not a routine restart).
- **Bunkering Emergency Response**: Protocols for radio, signalling and emergency procedures for disconnections of bunkering systems and coordination with shore facilities.
- **First aid for exposure**: First aid procedures should address methanol exposure, recognising that symptoms may be delayed. They should include immediate decontamination measures, removal of contaminated clothing, use of the relevant SDS, and prompt medical escalation, with clear recognition that ingestion or significant inhalation constitutes a medical emergency.
- **Decontamination**: Procedures for the removal, isolation and safe handling of contaminated clothing, PPE and response materials, together with appropriate decontamination and disposal arrangements to prevent further exposure and secondary contamination

Equipment and systems identified in the emergency procedures should be maintained and inspected regularly. Well maintained emergency kits are essential to effectively deal with methanol incidents, including spill control materials, absorbents compatible with methanol, and appropriate extinguishing media.

Emergency drills and exercises should be conducted regularly, simulating methanol-related scenarios including fires, spills, vapour releases, bunkering failures, evacuation, and ESD activation. Incident and near-miss reporting should explicitly capture methanol-specific hazards with lessons learned analysed and shared across the fleet to enhance emergency preparedness and risk controls.

Where relevant, drills and exercises should include coordination with port authorities and shore-based responders to test alignment between shipboard and shore-based emergency arrangements. Each exercise should be followed by a structured debrief, analysis of performance, and revision of procedures where necessary.

The operational procedures should ensure that monitoring and alert systems are integrated with emergency response procedures to reduce response time during emergencies. IMO Resolution A.1072(28) provides guidelines to assist in the preparation of an integrated system for shipboard emergencies and may be particularly beneficial in integrating the assessed emergency preparedness with other established procedures.

No.	Recommended actions
8.1	The Company should establish ship-specific emergency response procedures associated with methanol covering spills, vapour clouds, invisible-flame fires, system failures, leaks and personnel exposure, with clear crew actions, roles, equipment use, containment methods, escalation steps and integration with the company and external emergency support.
8.2	Emergency procedures should incorporate ESD, gas detection, fire detection, ventilation controls, and real-time monitoring of critical locations (tanks, piping, vent systems etc.). They should be regularly tested (especially before bunkering) and fully aligned with defined emergency actions.

8.3	A structured contingency planning system should be maintained that aligns shipboard preparedness with shore-based support teams, port/terminal stakeholders, and relevant government or coastal authorities, with clear criteria for coordination, escalation and transfer of responsibility during major methanol-related events.
8.4	Routine drills and exercises should be conducted to simulate realistic methanol emergency scenarios and involve shipboard personnel and, where relevant, shore based teams. Exercises should include structured debriefing and lead to updates in emergency procedures, equipment readiness and response arrangements.
8.5	Incident and near-miss reporting should explicitly capture methanol-specific hazards (flammability, toxicity, material compatibility, system behaviour), with lessons learned analysed and shared across the fleet to enhance emergency preparedness and risk controls.

9. Reports and Analysis of Non-conformities, Accidents and Hazardous Occurrences

The company's SMS should include clear procedures for reporting and investigation of all non-conformities, incidents, accidents, and hazardous occurrences, including safeguard failures, related to methanol handling and storage. Given that industry experience with methanol as a marine fuel is still limited, all incidents and hazardous occurrences in relation to methanol use should be recorded, reported and reviewed in a consistent manner [28].

Reports should capture methanol specific data, regarding functional, technical and operational non-conformities. The SMS should define reporting responsibilities, reporting lines and timeframes to ensure consistent documentation across the fleet. Crew members should be encouraged to participate actively in reporting observations, concerns and improvement suggestions, fostering a no blame culture that supports transparency and proactive risk management.

An effective feedback mechanism should be integrated into the SMS to ensure timely review and analysis of reports submitted from vessels. Personnel should have a structured channel for raising concerns related to methanol procedures, equipment, or operational challenges. This ensures that shipboard operational knowledge contributes directly to continuous improvement efforts at the organizational/management level.

All methanol related incidents should undergo a thorough investigation. Investigation teams should include individuals with relevant technical and operational knowledge of methanol systems [10], ensuring that unique hazards—such as flammability, explosive vapour formation, gas dispersion, and toxicity are assessed properly. Investigations should apply structured root cause analysis to identify not only the immediate cause but also underlying contributing factors, whether technical, procedural, organizational or human. Key operational parameters such as temperature, pressure, equipment performance, and ventilation effectiveness should be evaluated as part of the fact finding process.

The Company should maintain a database of methanol-related reports, enabling trends to be monitored and systemic issues to be identified. Identified trends should be used to update procedures, training, detection systems, technical barriers and emergency preparedness measures.

Investigation findings should be incorporated into the continuous improvement of the SMS. Procedures, contingency plans, and emergency response strategies should be revised whenever new risks, deficiencies or recurring issues are identified. As technology and operational experience evolve, the SMS should remain adaptive and capable of incorporating changes in equipment, operational methods, safety barriers, and competence requirements.

All relevant events should be evaluated, where appropriate, against the original design acceptance criteria and assumptions for the methanol systems. Any deviation between expected and actual system performance should trigger clearly defined corrective actions. Their effectiveness should be verified and documented to ensure long term reliability, safety and compliance.

Investigation findings should distinguish, where relevant, between immediate causes, failed or degraded barriers, underlying organisational contributors, and any design, operating limit or interface assumptions that did not hold in service.

Reporting and investigation procedures should also capture relevant contractor, supplier and ship-shore interface issues where these contribute to methanol-related events or near misses.

No.	Recommended actions
9.1	The Company should implement a unified reporting system covering all methanol related non-conformities, incidents, near misses, and hazardous occurrences, using methanol specific data fields and defined reporting responsibilities.

9.2	The Company should ensure that effective investigations apply structured root cause analysis, consider performance against original design acceptance criteria, where relevant, and include verification of corrective action effectiveness and closure.
9.3	The Company should maintain a central incident database and perform regular trend analysis to identify systemic issues, recurring deficiencies and emerging methanol specific risks.
9.4	The Company should continuously update SMS procedures and emergency/contingency plans and arrangements based on investigation findings, operational data, lessons learned and industry best practices.
9.5	The Company should strengthen organizational learning and preventive measures through targeted training, improved technical barriers, follow-up of identified trends, and fleet wide distribution of lessons learned.

10. Maintenance of the Ship and Equipment

The introduction of methanol as a marine fuel does not change the fundamental principles of maintenance management under the ISM Code. However, methanol's characteristics - flammability, vapour formation, toxicity, corrosivity, and the potential for undetected leakage due to its clear appearance and low odour - elevate the operational risk profile. These risks should be explicitly considered during planning, execution, verification and improvement of maintenance activities.

Personnel involved in maintaining methanol fuel systems require enhanced awareness of fuel specific hazards, competence in isolation and handling procedures, and clear procedural guidance. Relevant requirements in the IGF Code [29] concerning maintenance, inspection and operational controls for low-flashpoint fuels should be integrated into the vessel's Planned Maintenance System (PMS) and made traceable through audit and review.

This section applies to all company and shipboard activities relating to the maintenance of equipment used for storing, transferring, conditioning, monitoring and utilising methanol as a marine fuel. It covers shipboard personnel, relevant shore based staff, OEM representatives and contractors, and should be read in conjunction with the relevant requirements of the classification societies rules and statutory instruments.

The objectives of this Chapter are to:

- maintain methanol related equipment in full operational readiness through structured inspection and maintenance;
- provide a systematic framework for managing risks associated with methanol handling, storage and utilisation;
- ensure that personnel responsible for maintenance are competent and supported by clear procedures;
- promote continuous improvement through reporting, analysis and feedback within the SMS.

OEM-specific maintenance instructions should be used, where applicable, to support the correct handling, inspection, testing and maintenance of methanol-related equipment, and should be properly integrated into the PMS and associated work instructions.

Training & Competence

Roles and responsibilities for methanol related maintenance activities should be defined within the company's established organisational structure. The Company should ensure appropriate shore-based oversight, onboard supervision, technical support and specialist input, including OEM support where necessary, while maintaining clear accountability for planning, execution, verification and follow-up of maintenance activities.

Personnel involved in methanol related maintenance should be trained and competent in the hazards and risks associated with methanol systems, including flammability, toxicity, vapour cloud formation, static discharge and confined space risks. Maintenance personnel should be trained in safe isolation and Lockout Tagout (LOTO), spill response, purging and draining, gas testing, calibration and verification of detection devices, and the operation of protective functions such as emergency shutdown and ventilation interlock systems. Training for critical equipment and systems should be delivered or approved by the OEM to ensure appropriate technical competency is maintained.

Maintenance work on methanol fuel systems should be planned and executed using a risk based approach aligned with OEM guidance, equipment criticality etc. Personnel should be competent to develop and follow method statements, apply appropriate hazard controls and PPE, verify zero energy states, maintain Explosion Protection (EX) integrity through bonding and grounding, and conduct leak testing and functional checks and reinstatement verification as part of post maintenance commissioning and return to service.

Competence requirements for methanol related PMS tasks should be clearly defined in the PMS, including where specific qualifications, OEM approved training or engineering expertise are needed. PMS records

provide the traceable evidence confirming that methanol related maintenance is performed by suitably trained personnel and support continuous improvement within the Safety Management System.

Records, Oversight and Supporting Processes
Records associated with methanol related maintenance - such as permits to work, JSAs (Job Safety Analysis), calibration certificates, inspection reports, parts used and as found/as left conditions - should be accurate, complete and retained in accordance with regulatory and company requirements. In addition to managing spare parts onboard, the Company should carefully consider the availability of safety critical spare parts onboard their ships, ensuring that the safety critical spares are available for use at any time.

All methanol system maintenance should be monitored and periodically reviewed to confirm effectiveness. Defects, non conformities and near misses should be analysed, with resulting improvements incorporated into PMS tasks, procedures and work instructions. Audit scope, auditor competence and management review arrangements should follow the requirements set out in Chapter 12 but should explicitly address methanol specific maintenance controls and protective functions.

Any changes affecting methanol fuel system equipment, protective features, maintenance intervals or associated procedures should follow the company's Management of Change (MoC) process, including updated risk assessments and briefing or retraining of personnel where necessary. Maintenance activities should not compromise the availability of critical safety systems. Spill kits, neutralising agents and methanol appropriate firefighting systems should be verified as available and functional prior to commencing work, and suitable compensatory measures should be defined and approved where temporary isolation of safety systems is unavoidable.

Where methanol-related maintenance is carried out by contractors or OEM representatives, the Company should ensure that such work is subject to the same permit-to-work, isolation, competence, supervision and verification requirements as equivalent work performed by ship or company personnel.

No.	Recommended actions
10.1	The Company should integrate all methanol specific maintenance tasks, controls, and acceptance criteria into the PMS and ensure personnel performing such work are trained and competent in methanol hazards, safe isolation, purging, leak response, and emergency actions and return-to-service verification.
10.2	The Company should ensure that clear isolation, draining, and purging procedures are established for all methanol related maintenance, with mandatory pre and post work gas testing for tanks, piping, valves, enclosed spaces, and interstitial areas.
10.3	The Company should implement routine verification of all protective devices, including vapour detectors, ESD valves, interlocks, ventilation systems, double walled pipe monitoring arrangements, and explosion protected electrical equipment in hazardous areas.
10.4	The Company should establish regular inspections for chemical attack, swelling, degradation, corrosion, or insulation breakdown on methanol wetted components, seals, gaskets, hoses, and thermal insulation, together with routine leak checks recognising methanol's low visibility and low odour characteristics.
10.5	The Company should apply MoC to any change involving methanol equipment, maintenance intervals, safety system logic, operating limits, or ventilation performance, ensuring risks are evaluated, controls approved and affected documentation and competence requirements updated before implementation.

11. Documentation

The Company should establish document-control procedures to ensure that all methanol-related documents remain current, relevant and subject to controlled revision. Reviews should take account of operational experience, regulatory developments, class requirements and recognised industry guidance. Obsolete documents should be promptly removed from use, and current controlled versions should be available at the point of use in relevant shipboard and shore-based locations.

As already partly covered in Chapter 7, the implementation of methanol as fuel should be supported by an effective Management of Change (MoC) process which should identify all documentation requiring revision or development. Such documents include, as appropriate, certification and approval of equipment and vessel, technical descriptions of the ship and fuel system , procedures that cover all aspects of methanol handling and storage, bunkering and emergency checklists, training and familiarisation records of crew and shore-side personnel, operational records, checklists, data sheets and logs related to methanol, as well as the regulatory framework applicable to methanol.

In conjunction with the incidents and near–misses reporting and analysis, the SMS procedures covering the use of methanol as fuel should be regularly updated to include the improvement suggestions, lessons learned and preventive actions identified in the investigation analyses. The same applies to industry recommendations and best practices, and class and statutory guidance, as further operational experience from using methanol as fuel is gained. Benchmarking against relevant safety performance indicators may also be used to identify improvements, helping to enhance the SMS against other industry stakeholders. Ship personnel involved in methanol handling should be encouraged to review the relevant procedures and contribute to each revision, fostering a stronger safety culture and sense of ownership.

The documentation associated with methanol fuel-related operational procedures should be vessel-specific, reflecting the characteristics, layout and operational limits of each fuel system used onboard and distinguishing between methanol-related procedures and controls from those applicable to conventional fossil-fuel systems, to avoid procedural ambiguity and reduce the risk of error.

Maintaining up-to-date documentation is critical, given the evolving regulatory landscape for methanol as fuel. Maintaining up-to-date documentation is particularly important in view of the evolving regulatory framework for ships using methanol as fuel. The Company should monitor relevant IMO developments, class rules, flag requirements and recognised industry guidance, and should update controlled documentation accordingly to maintain alignment and compliance.

Furthermore, the complexity of methanol-fuelled systems requires detailed, accurate and accessible records of system designs, safety assessments, operating limits, protective functions, crew training programs and related approvals. This level of detail in documentation supports effective risk management, safe operation, effective maintenance and regulatory compliance throughout the ship's lifecycle.

Operational records should be developed to cover the monitoring of all methanol-related equipment and activities as per manufacturer's recommendations and design assumptions. Experience from methanol handling as cargo would be beneficial when developing these records, as it can provide practical insights into safe and efficient management of methanol systems. When developing the operational records, the Company where possible should streamline the record keeping to minimise undue effect on the ship personnel. Temporary instructions, standing orders and interim notices relating to methanol fuel operations should also be subject to document-control procedures, including version control, communication to affected personnel and timely withdrawal once superseded.

No.	Recommended actions
11.1	The Company should maintain, as part of its MoC process, a documented list identifying all documentation that needs to be updated or created to support the implementation of methanol as fuel. Input from equipment manufacturers and, where relevant, experience from methanol cargo handling should inform the development of such documentation.

11.2	The Company should ensure effective document control for methanol-related information, including revision, approval, distribution and withdrawal of obsolete documents, so that only current and relevant documentation is used.
11.3	The Company should ensure that the current controlled methanol-related documents are available at relevant shipboard and shore-based locations, including points of use where they are needed for operations, maintenance, emergency response and oversight.
11.4	The Company should maintain procedures for the timely review and update of all relevant documentation in response to regulatory developments, class or flag requirements, design or equipment changes, and relevant industry guidance or best practice.
11.5	The Company SMS should be regularly updated to incorporate the preventive actions, lessons learned and procedural improvements arising from audits, reviews, the investigation of incidents and near-misses, and operational experience.

12. Company Verification, Review and Evaluation

Regular shore-based and onboard management meetings involving relevant departments and functions should include a dedicated review of methanol-related HSSE performance, risk controls and operational experience. These meetings should provide a structured process for reviewing performance, documenting feedback, identifying corrective and preventive actions, assigning responsibilities and following up on implementation. A formal feedback mechanism should support the collection, analysis and closure of methanol-related suggestions, concerns and improvement opportunities.

The Company should maintain a plan for continual improvement of methanol-related HSSE performance, supported by defined objectives, measurable indicators and periodic review. This should include suitable leading and lagging indicators, such as methanol-related incidents, near misses, audit findings, corrective-action closure, drill performance and relevant compliance metrics, to assess progress and identify areas requiring further attention.

Verification arrangements should include monitoring of both leading and lagging indicators, together with follow-up and documented closure of methanol-related corrective and preventive actions.

Methanol fuel-related matters should be explicitly addressed in a separate section, as appropriate in the following procedures:

- Master's review of SMS
- Management review
- Onboard safety meetings
- Officers' forums

The Company should be able to demonstrate that appropriate methanol fuel-related training and familiarisation have taken place for shipboard and shore-side personnel involved in methanol handling operations, and that such training remains current, role-appropriate and effective in practice. Proactive feedback should be encouraged between shore-side personnel, ship personnel and relevant third parties, including industry and fleet incidents, alert bulletins, customer and contractors feedback and seminars, to foster a culture of continuous improvement.

All onboard inspections and audits by shore-side personnel should include a dedicated and separate section to review methanol fuel-related equipment and procedures including risk assessments and permit to work arrangements and operational practices. Verification should address not only documentation, but also practical implementation onboard, including equipment condition, crew understanding, compliance with procedures and readiness for abnormal or emergency situations.

Vessel personnel should be encouraged to contribute to the company's verification and review processes by reporting methanol fuel-related incidents, unsafe acts, identified hazards, best practices and improvement suggestions. This approach supports ongoing operational refinements and heightened awareness of methanol's potential risks.

Auditor competence should be reviewed to ensure that personnel conducting methanol-related internal audits have sufficient methanol-specific knowledge, experience or training to assess compliance effectively. Auditors should be able to evaluate relevant IGF Code requirements, methanol-specific procedures, hazard controls and corrective actions, and should remain independent of the areas being audited.

Incorporating scenario-based evaluations and methanol-specific hazard reviews within the framework ensures that audits confirm practical readiness and verify that shipboard procedures remain effective, properly implemented and aligned with the ship's operating context. A proactive audit strategy will foster safety and compliance for ships operating with methanol.

Relevant findings from external audits, third-party inspections, class surveys, flag or port State inspections, and specialist reviews should be considered as part of the company's verification and improvement

processes. Such an approach reinforces confidence in the robustness of the company's verification and highlights openness to external expertise.

Finally, there should be a formalised process for sharing relevant findings from internal and external audits, flag and port state inspections across the fleet to ensure that lessons learned on one vessel are communicated and applied elsewhere in a timely manner, accelerating knowledge transfer and best-practice adoption.

No.	Recommended actions
12.1	The Company should ensure that methanol-related handling, storage and operational performance are explicitly addressed within the regular management meetings, Master's review of the SMS, Management Review, onboard safety meetings and Officers' Forums.
12.2	The Company should maintain and be able to demonstrate methanol fuel-related training and familiarisation records for all personnel onboard and shore-based personnel related to methanol handling and storage and should be able to verify that such training remains current and effective.
12.3	Inspections and audits by shore-based personnel should include dedicated review of methanol-related equipment, procedures, risk assessments, permit-to-work controls and practical implementation onboard, with appropriate reporting of findings and follow-up actions.
12.4	Internal auditors involved in methanol-fuel related verification should be duly trained on aspects associated with methanol, and internal audits (carried out independently) should focus on verifying the effective implementation of corrective and preventive actions onboard. Scenario-based evaluations, methanol-specific hazard reviews, and alignment with IGF Code requirements are recommended.

Conclusions

The safe integration of methanol as a marine fuel requires an adaptive, risk-based and continuously improving SMS that fully reflects methanol's unique operational, technical, environmental and human-element challenges. As highlighted throughout this report, methanol fuel presents both opportunities and elevated risks when compared with conventional marine fuels. Its safe adoption will depend on the company's ability to proactively identify, assess, and mitigate those identified risks through structured and disciplined safety management practices.

MTF recognises that the maritime industry's experience of using methanol as fuel is at an early stage and may greatly differ for each company. As such the transition to methanol fuel will require robust risk assessment methodologies, a strong safety culture, and active engagement from all levels of shipboard and shore-based management.

The relevant Codes, Interim Guidelines, IMO circulars and industry best practices should be consulted in developing the procedures related to methanol fuel within the SMS. Companies are encouraged to interpret ISM Code requirements through a methanol specific lens and to utilise these new guidelines to ensure that hazards relating to toxicity, flammability, vapour behaviour, material compatibility, and system complexity are systematically addressed across various operational aspects.

Based on MTF's review, highlights may be drawn and are listed below:

- The ultimate responsibility lies with the Company's shore based senior management; as such the drive should come from the top level in the Company, with active involvement and support in the development, implementation, and maintenance of a robust and adaptive SMS.
- The strength of the company's SMS should be in the ability to proactively identify improvements in the SMS through learning from non-conformities, accidents, and hazardous occurrences (including near-misses) related to methanol as fuel, and facilitate the closing of the gaps that would exist initially due to lack of operational data. The lessons learnt, audit findings, and new best practices should be rapidly incorporated into the SMS
- The possible methanol fuel-mix onboard with fossil fuels necessitates integration of a structured risk management within the SMS. As such the SMS should be versatile enough to meet the fuel scenarios onboard Company's ships.
- The limited availability of operational experience data for equipment using methanol as a fuel is an acknowledged gap that is expected during the initial stages of methanol fuel deployment.
- The effective control of documents within the SMS is important, including the continuous verification and review of methanol-related performance and this can be emphasised further given the associated elevated operational risk with methanol fuel.
- A recurring theme across the guidelines is the importance of competence, training and preparedness. Methanol introduces new operational behaviours and requires enhanced training, familiarisation, and human-factor awareness. The Company's ability to provide appropriate resources, ensure qualified and trained personnel, and maintain clear lines of communication are fundamental to safe methanol operations.

Overall, the adoption of methanol as a fuel represents a significant advancement in the maritime sector's decarbonisation pathway. By applying the structured recommendations in this document, companies can ensure that the deployment of methanol-fuelled vessels is undertaken safely, responsibly, and with the organisational agility needed to keep pace with evolving technologies, regulatory developments, and industry experience.

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