Methanol Bunkering
Green Methanol OGV Workshop

Onur SEMIZ | October 22, 2024

Part I
ABS Energy Transition

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Objectives:

- Clean energy transition
- ABS fuel mix projection
- ABS publications
- ABS activities
- Fuel comparison table

Clean Energy Transition

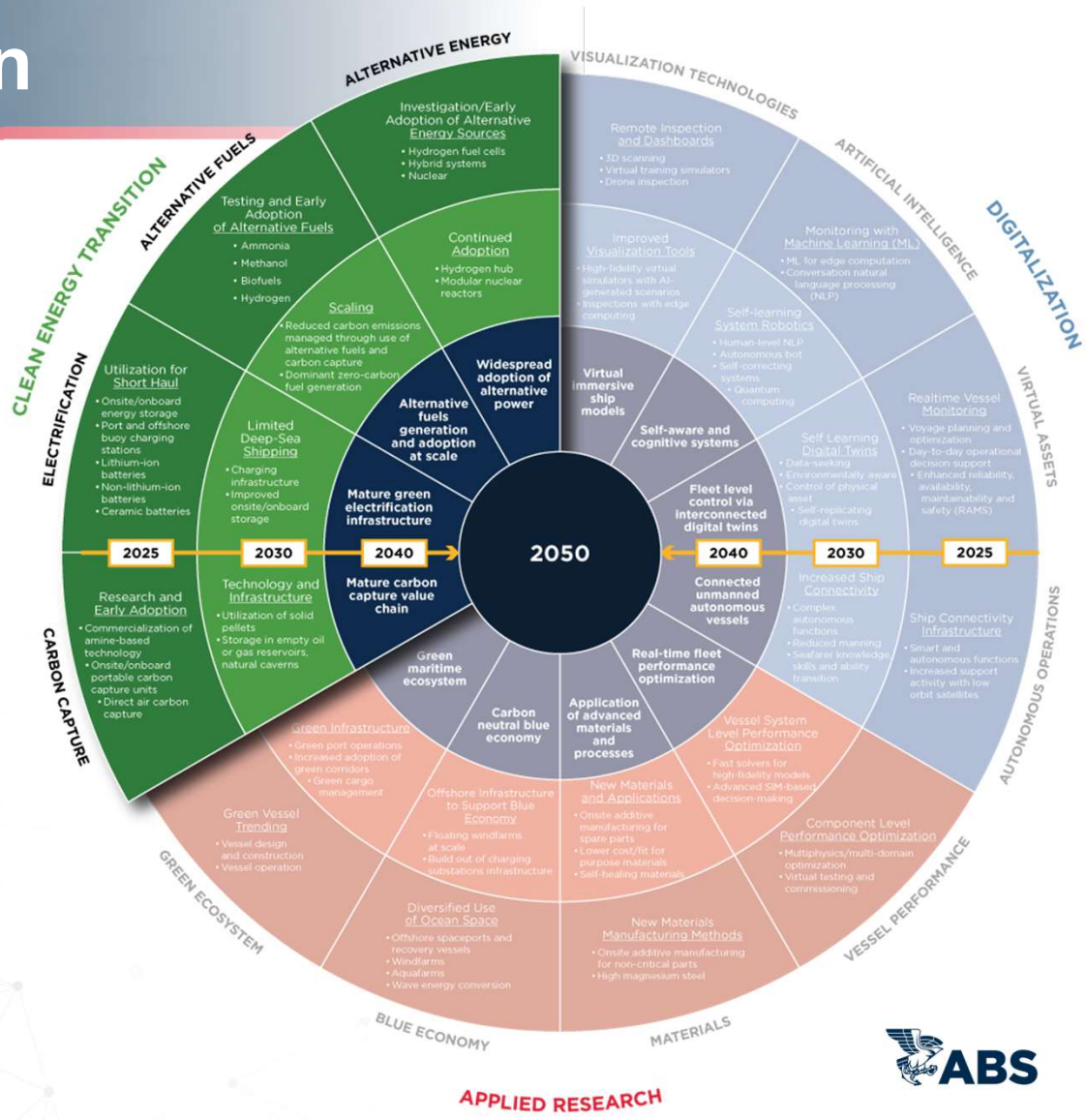
ABS' Mission for a Sustainable Future

TECHNOLOGY ENABLERS

- Alternative Energy (Nuclear)
- Alternative Fuels
- Electrification Developments
- Carbon Capture Technology

DRIVERS

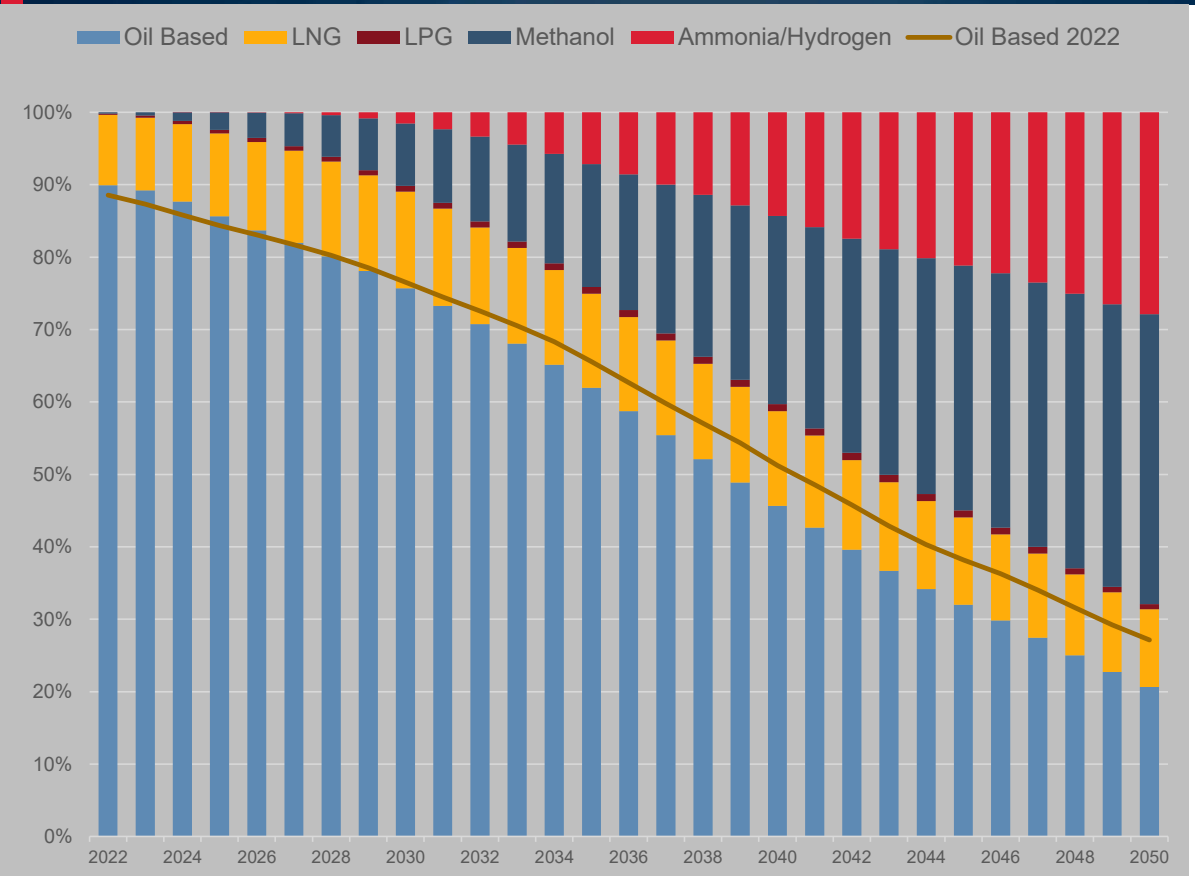
- Regulatory Targets
- Societal Pressures
- Finance Requirements
- Corporate Governance



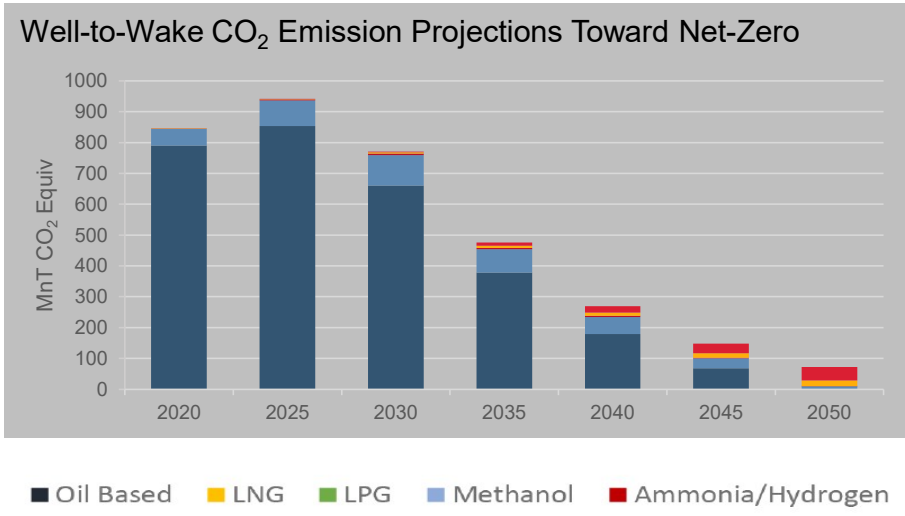
Decarbonization Solutions

OPERATIONAL MEASURES	TECHNOLOGY IMPROVEMENTS	ALTERNATIVE FUELS & ENERGY
➢ Speed optimization	➢ Hull coating & Hull form optimization	➢ LNG, LPG, Ethane
➢ Vessel utilization	➢ Air lubrication	➢ Biofuels
➢ Alternative routes	➢ Wind/solar power	➢ Methanol
➢ Vessel performance reporting	➢ Fuel Cells	➢ Ammonia
➢ Smart vessel	➢ Cold ironing	➢ Hydrogen
	➢ Carbon capture	➢ Nuclear

Annual Outlook — Fuel Mix Projections



- ***Ship types included: Oil and chemical tankers, dry bulk carriers, containerships, LPG, LNG, car carriers, general cargo, ro/ro, RoPax and cruise.***
- ***Source: ABS Sustainability Outlook V***



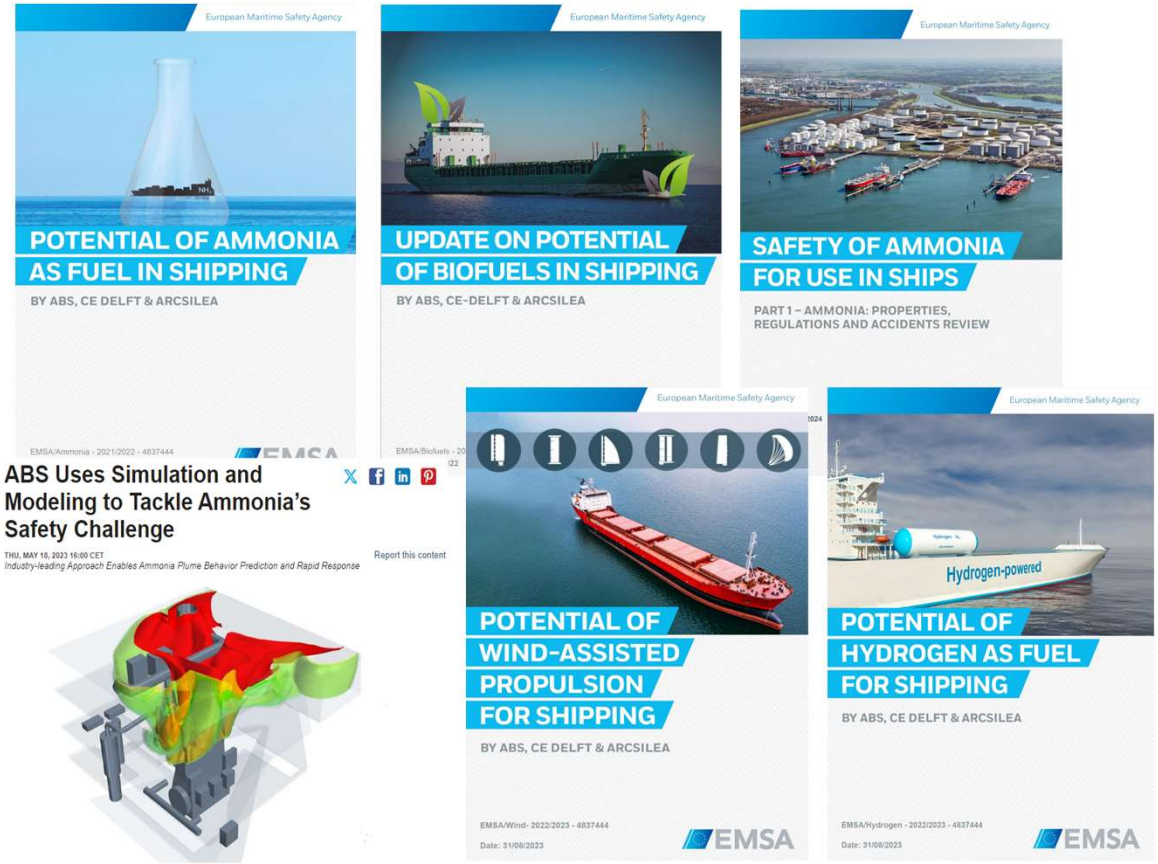
Recent ABS Publications

- **REQUIREMENTS**
  - Requirements for Methanol and Ethanol Fueled Vessels
  - Requirements for Ammonia Fueled Vessels
  - Requirements for Hydrogen Fueled Vessels
  - Requirements for Onboard Carbon Capture and Storage
  - Requirements for Liquefied Hydrogen Carriers
  - Requirements for Liquefied Carbon Dioxide Carriers
  - Requirements for Bio-Fuel Notation
- **ADVISORIES**
  - Methanol Bunkering Advisory (Technical & Operational)
  - Ammonia Bunkering Advisory (Technical & Operational)

Recent ABS Activities

R&D and Technology Projects

- EMSA Update on potential of biofuel in shipping (SEP 2022)
- EMSA Potential of ammonia as fuel in shipping (SEP 2022)
- EMSA Potential of wind-assisted propulsion for shipping (AUG 2023)
- EMSA Potential of hydrogen as fuel for shipping (AUG 2023)
- EMSA Safety of ammonia for use in ships (JUN 2024)
- ABS and Texas A&M University collaboration to do ammonia leakage and dispersion studies
- ABS specialists studied CFD simulation and modeling for ammonia leakage in engine room



Fuel Comparison Table

Fuel	Storage Condition		Specific Energy (MJ/Kg)	Energy Density (MJ/L)	Carbon Content (%)	Storage Vol^{m} (Compare to MGO)
	T (ºC)	P (bar)				
MGO	Atm	Atm	42.7	35.7	87	1
LNG	-162	Atm (or ~5-7 bar)	48	21.2	75	1.8
LPG	-48	Atm (or up to ~18 bar)	~46	26.7	82	~1.7
Ethane	-89	Atm (or ~5 bar)	47.8	25.8	80	1.4
DME	-25	Atm (or ~5 bar)	28.7	19.2	52	2.0
Methanol	Atm	Atm	19.9	14.9	37	2.4
Hydrogen	-253	Atm (or ~100 – 300 bar)	120	8.5	0	Liquid > 4.5
Ammonia	-33	Atm (or up to ~18 bar)	18.6	12.7 (-33ºC) 10.6 (45ºC)	0	3.0

Part II
Methanol Fueled Vessels

Objectives:

- Regulatory
- Fuel containment
- Fire & explosion
- Fire fighting
- Fuel piping
- Other design parameters

Regulatory

Methanol Fueled Vessels are to be constructed per;

- IMO IGF Code
- IMO MSC.1/Circ.1621, Interim Guidelines for the Safety of Ships Using Methyl/Ethyl Alcohol as Fuel
  (Draft amendments are under process)
- ABS Requirements for Methanol and Ethanol Fueled Vessels

Fuel Containment

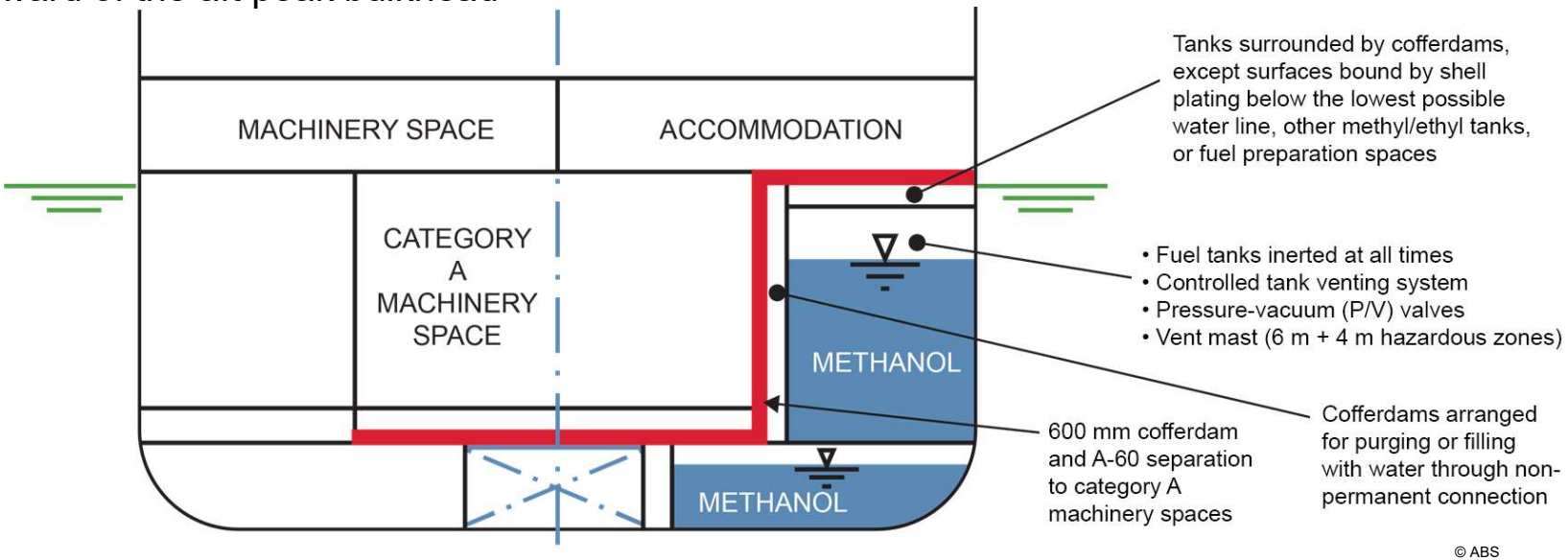
- Methanol can be stored in conventional (non-pressurized integral) tanks
- Methanol fuel stored at ambient temperature
- Interim Guidelines MSC.1/Circ.1621 includes functional requirement

  " … *located in such a way that the probability for the tank(s) to be damaged following a collision or grounding is reduced to a minimum* …"
- Material to be compatible with methanol
  - Stainless steel
  - Coatings, typically zinc
- Nitrogen blanket to vapor space

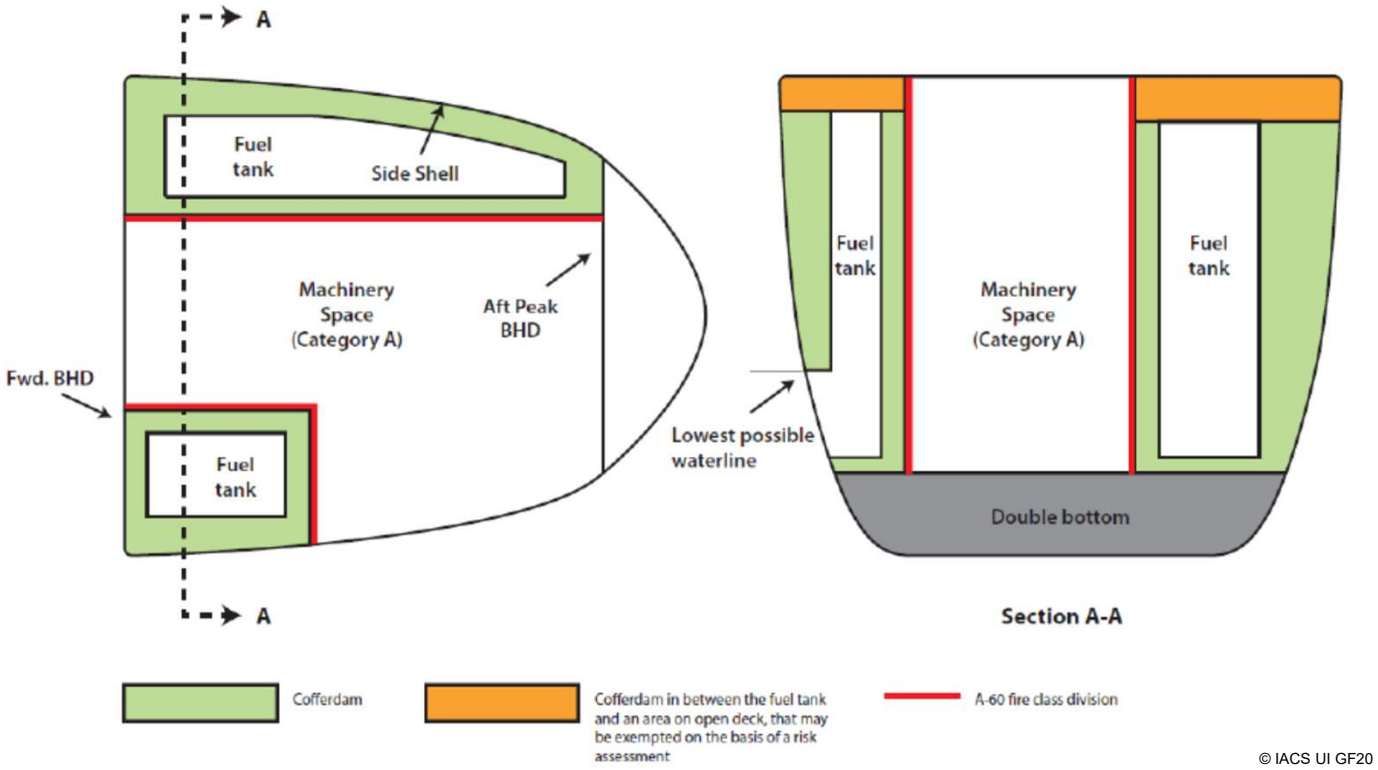
Location of Methanol Fuel Tanks

- Fuel tanks not be located:
  - accommodation spaces
  - machinery spaces
- Fuel containment system:
  - abaft of the collision bulkhead
  - forward of the aft peak bulkhead

- Fuel tanks on open decks:
  - Located ≥ 800 mm of vessel's side
  - Protected against mechanical damage
  - Having coamings, spill collection
  - Water spray system
  - With tank connection spaces



Integral Fuel Tanks



IACS UI GF20 (June 2024)

Applicable to ships contracted for construction on or after 1 July 2025

- Cofferdam between the open deck and tank top may be exempted subject to risk assessment.
- Integral tanks arranged according to this UI are not regarded as being within Machinery Space of Category A.

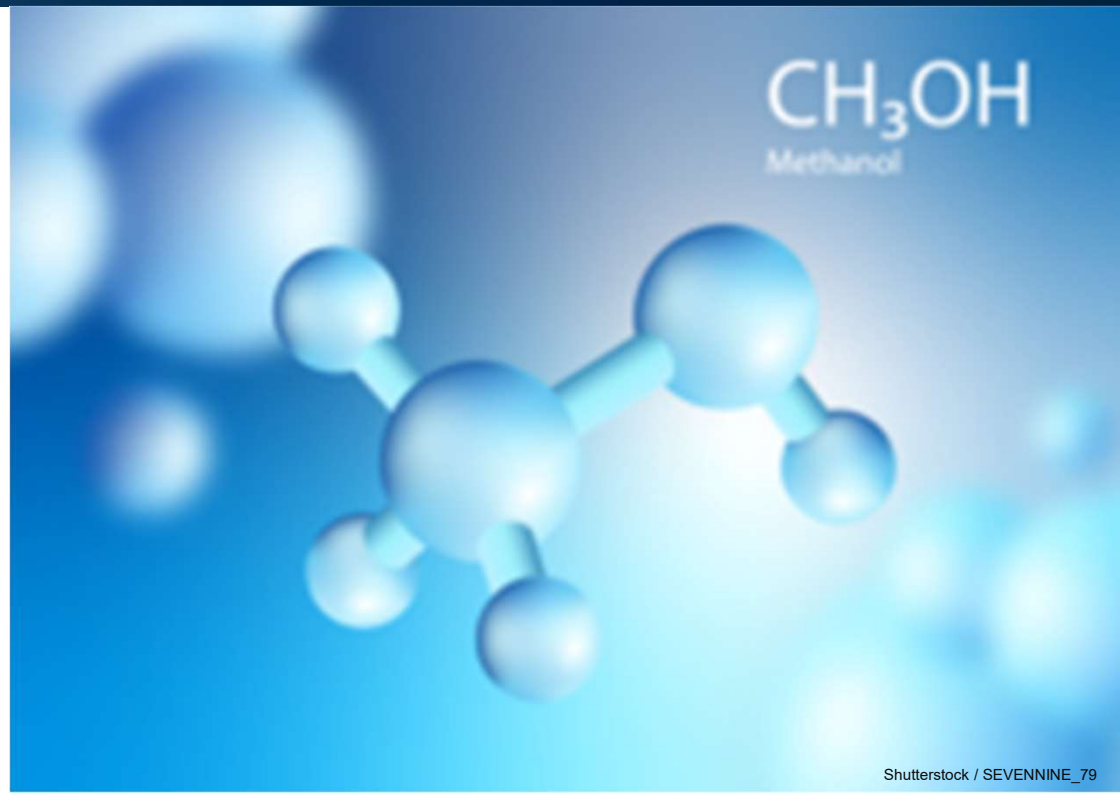
Methanol Tank Vents

Rupture discs

- Deck vent lines must be of type that cannot easily leak in service
- Rupture discs are arranged on the vent lines as a secondary barrier before the PV valves
- Rupture discs pressure setpoint and pressure switches for audible and visible alarm on deck to be selected ensuring sufficient time delay to:
  - alert all crew and crane operators on the imminent risk
  - allow them to stop work
  - evacuate to safe place until situation can be assessed by trained crew

Fire & Explosion

- Methanol liquid and vapor are highly flammable and are easily ignited by heat, sparks or flames
- Methanol in enclosed areas may explode
- Methanol burns with a near invisible flame and produce no smoke
- Capacity of CO2 fire-extinguishing systems increased to 50-55% from 40% applicable to traditional fuels
- Around 80% of dilution is necessary to extinguish methanol fires
- Higher foam/water application rates are more effective than lower rates



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Provisions for Firefighting

Fi-fi – Fire fighting
ER – Engine Rom
FPR – Fuel Preparation Room
FSS – Fire Safety Systems

- Fuel Tank (Open deck):
  - Fixed fi-fi system of alcohol-resistant foam type (covering the area below the fuel tank)
  - Fixed water spray system for diluting eventual spills, cooling and fire protection
- Bunker Station:
  - Fixed fi-fi system of alcohol-resistant foam type
  - Portable dry chemical powder extinguisher (near the entrance of the bunkering station)
- ER & FPR:
  - Fixed fi-fi systems (SOLAS II-2/10 & FSS Code)
  - Fixed fi-fi system of alcohol-resistant foam type (covering the tank top and bilge area)
- Additional Provisions
  - Fixed fire detection and fire alarm system per FSS Code
  - Smoke Detectors + detectors for methanol fire

Methanol Fuel Piping

- Gas safe machinery space
  - Fuel piping within gastight and liquid-tight secondary enclosure
- Double-walled piping not required:
  - in cofferdams surrounding fuel tanks,
  - fuel preparation spaces, or
  - spaces containing independent fuel tanks
- Fuel piping also includes:
  - Bunkering lines
  - Fuel vent piping from tank pressure relief valves, block and bleed valves, and relief valves, or
  - Vent lines from other fuel supply system components

Other Important Design Parameters

ACH – Air Changes/Hour
FPR – Fuel Preparation Room

- Single failure on methanol fuel system not to lead to an unacceptable loss of power
- Permanent, continuous, self-monitoring gas detection
- Extractive mechanical exhaust type ventilation
  - Gas detector location based on airflow – gas dispersion/smoke test
  - Ventilation monitoring
- Liquid leak detection
  - Cofferdams, fuel pipe ducts, FPR, bunker station
- Airlocks between hazardous and non-hazardous spaces
- Segregation of bilge system

Industry Questioning

1. Can ballast tanks replace cofferdams required around the fuel tanks?
2. What should be the capacity of the CO2 fire extinguishing system?
3. Can tank pressure relief valves be led under water?
4. Is there an environmental impact of methanol release on water?

Part III
Bunkering Operations

Objectives:

- Bunkering options
- Regulatory
- Bunkering equipment
- Risks on bunkering operation
- Release mitigation
- Emergency response
- Bunkering zones
- Simultaneous operations
- Risk assessment
- Bunkering operations parameters
- Distribution of responsibilities

Bunkering Options

Bunkering options:

- Truck to ship: Experience in place – Low rates
- Ship to ship: High flexibility – High investment
- Terminal to ship: Fast bunkering – Fixed location

	Truck to Ship	Ship to Ship	Terminal to Ship
Advantages	• Bunkering directly at berth • Low investment • Experience in place	• High flexibility • High bunkering rates • High bunkering volume • Bunkering directly at berth or anchor	• High tank capacity • Fast bunkering
Disadvantages	• Low bunkering rates • Low volumes	• High investment	• Fixed location • High investment

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Regulatory

IBC – International Code for the Construction and Equipment of Ships Carrying Dangerous Chemicals in Bulk
ISO – International Organization for Standardization

Bunkering facility:

- Bunkering vessels conform to:
  - requirements of Flag State and Classification Society
  - IBC code, for handling methanol
- Bunker terminals conform to:
  - local port requirements & codes
- Mobile facilities such as road trucks, rail cars and portable tanks and equipment conform to:
  - industry standards recognized by local authorities, such as ISO
  - additional requirements of port authorities

Transfer equipment and bunkering connections:

- All components on the methanol transfer system fabricated to meet:
  - IMO MSC.1/Circ. 1621
  - IBC Code, Chapter 5

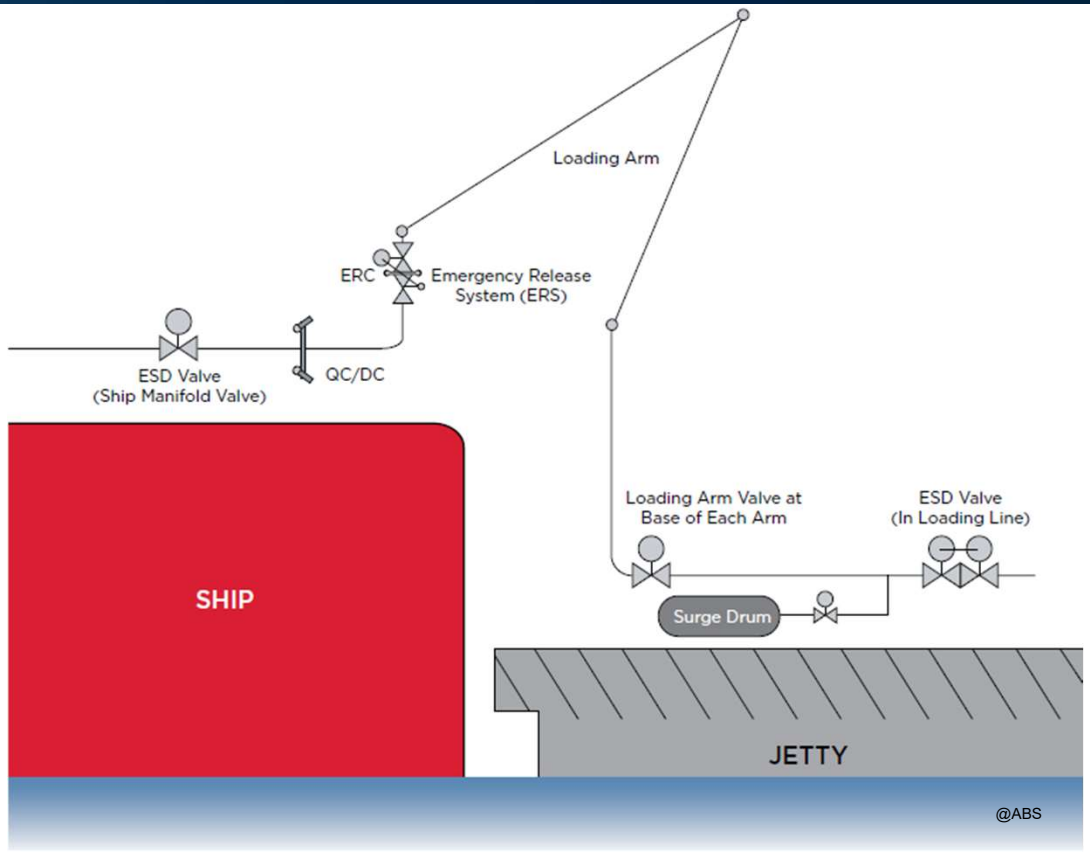
- Normative references may be forced by the local authority
  - OCIMF - ESD connection function and physical interface
  - NATO STANAG 3756 - Dry disconnect QCDC couplings

Methanol bunkering procedures:

- SIS-CWA 17540:2020 – Specification for bunkering of methanol fueled vessels
- Port of Gothenburg – Bunker Operations Regulations

Methanol Interface Equipment

- Emergency release system (ERS)
- Break-away coupling or quick connect - disconnect coupling (QCDC)
- Loading arm or bunker hose
- ESD valves
- Ship/Shore or Ship/Ship Link



Ship/Shore or Ship/Ship Link (SSL)

SSL link to ensure:

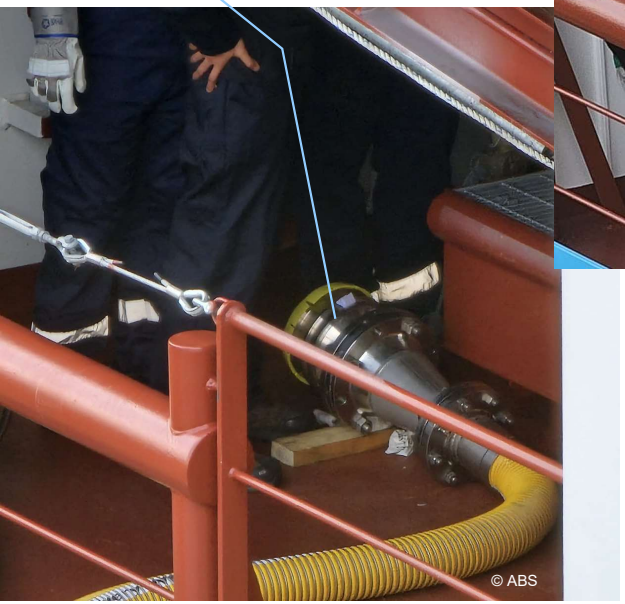
- the coordination of both delivering and receiving ESD system
- automatic and manual ESD of bunkering operations
- stopping pumps and closing the manifold valves

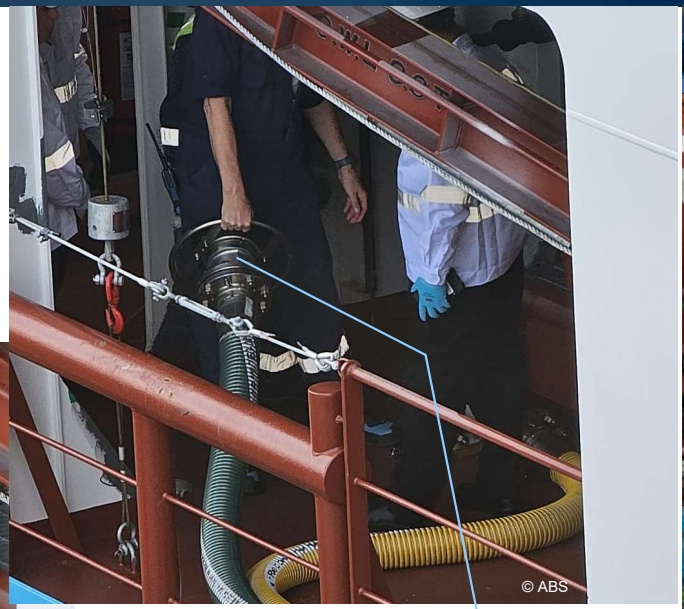
SSL link to be in accordance with a recognized standard:

- OCIMF - Linked Ship/Shore Emergency Shutdown Systems
- SIGTTO - Recommendations for Emergency Shutdown and Related Safety Systems

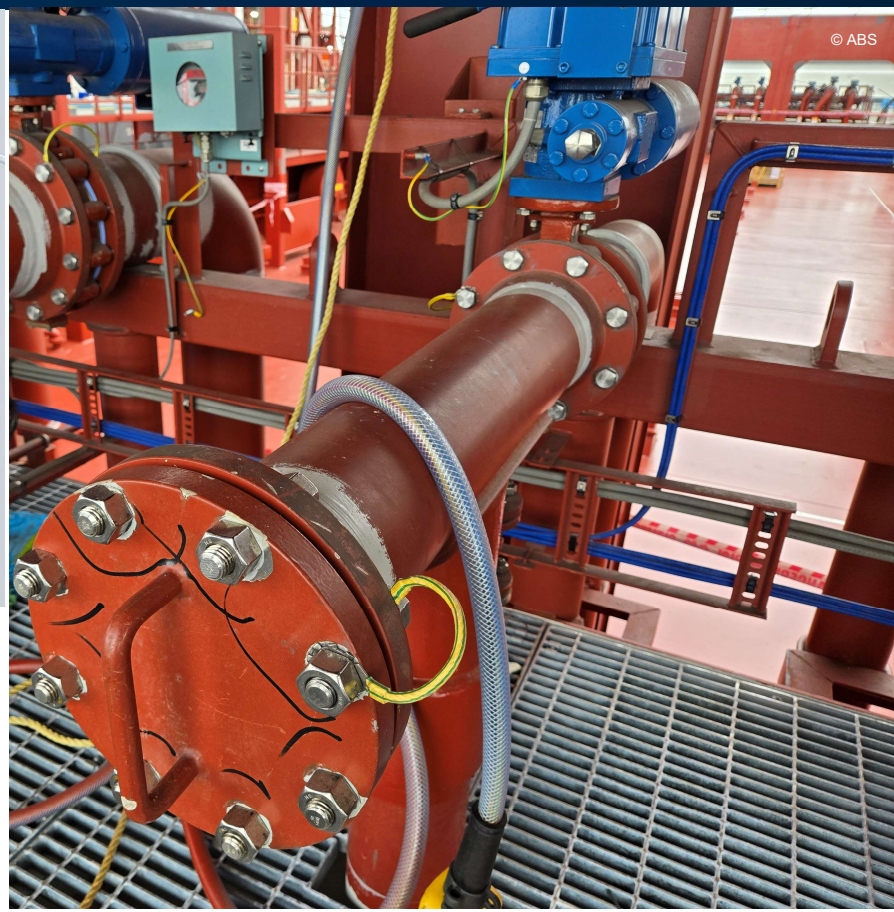
Receiving Vessel Manifold

Vapor Return QCDC

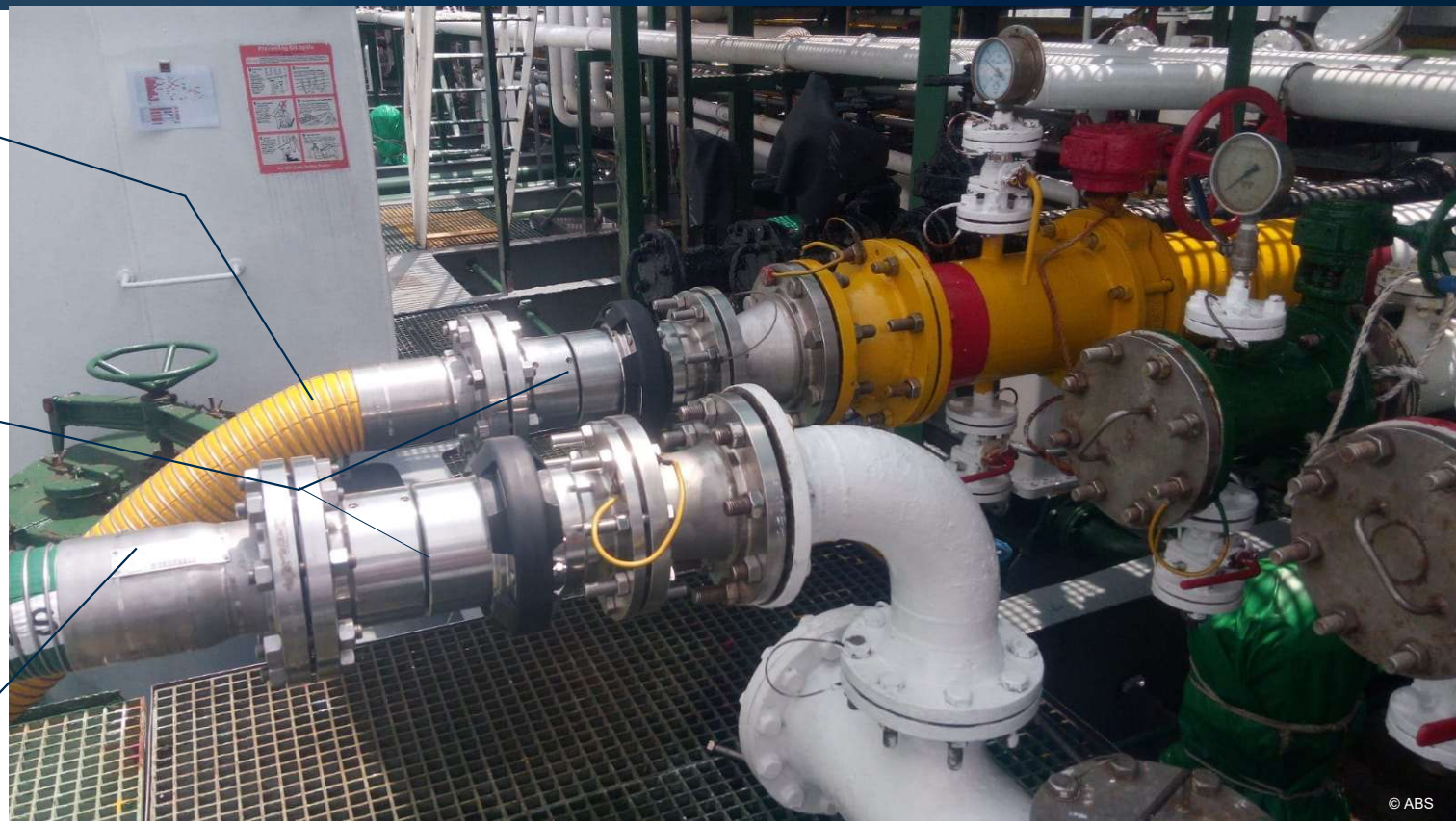




Methanol hose QCDC



Supply Vessel Manifold



Bunker Hoses (1/2)

Production

- Suitable material for methanol
- Type approved, including the end fittings
- Prototype test to demonstrate a bursting pressure of at least 5 times its specified maximum working pressure
- Hoses used for prototype testing never be used for service

Bunker Hose (2/2)

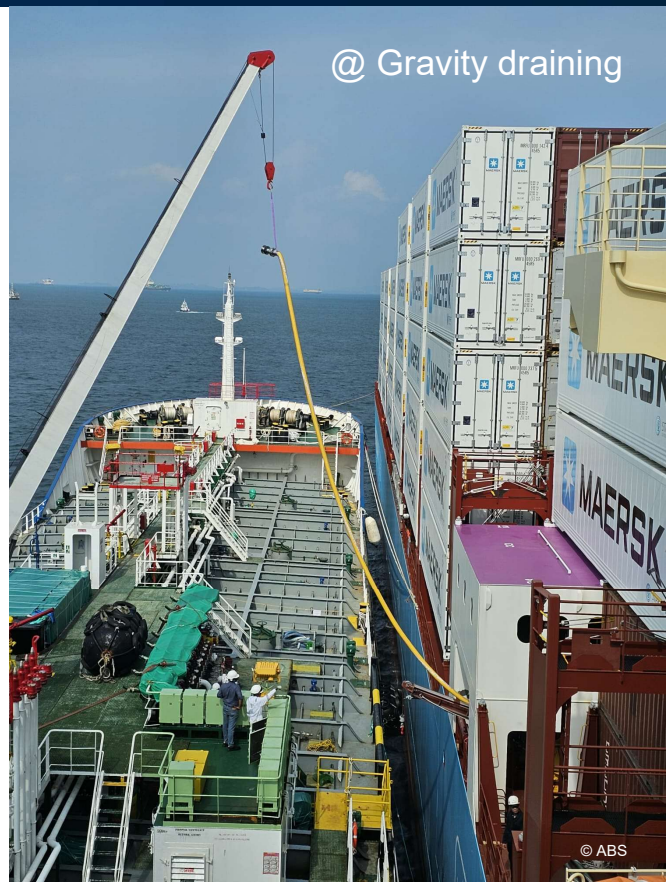
ACH – Air Changes/Hour

Use

- Hose with the date of testing and specified maximum working pressure
- Nitrogen purging
- Pressure and leak test
- Methanol transfer
- Nitrogen purging

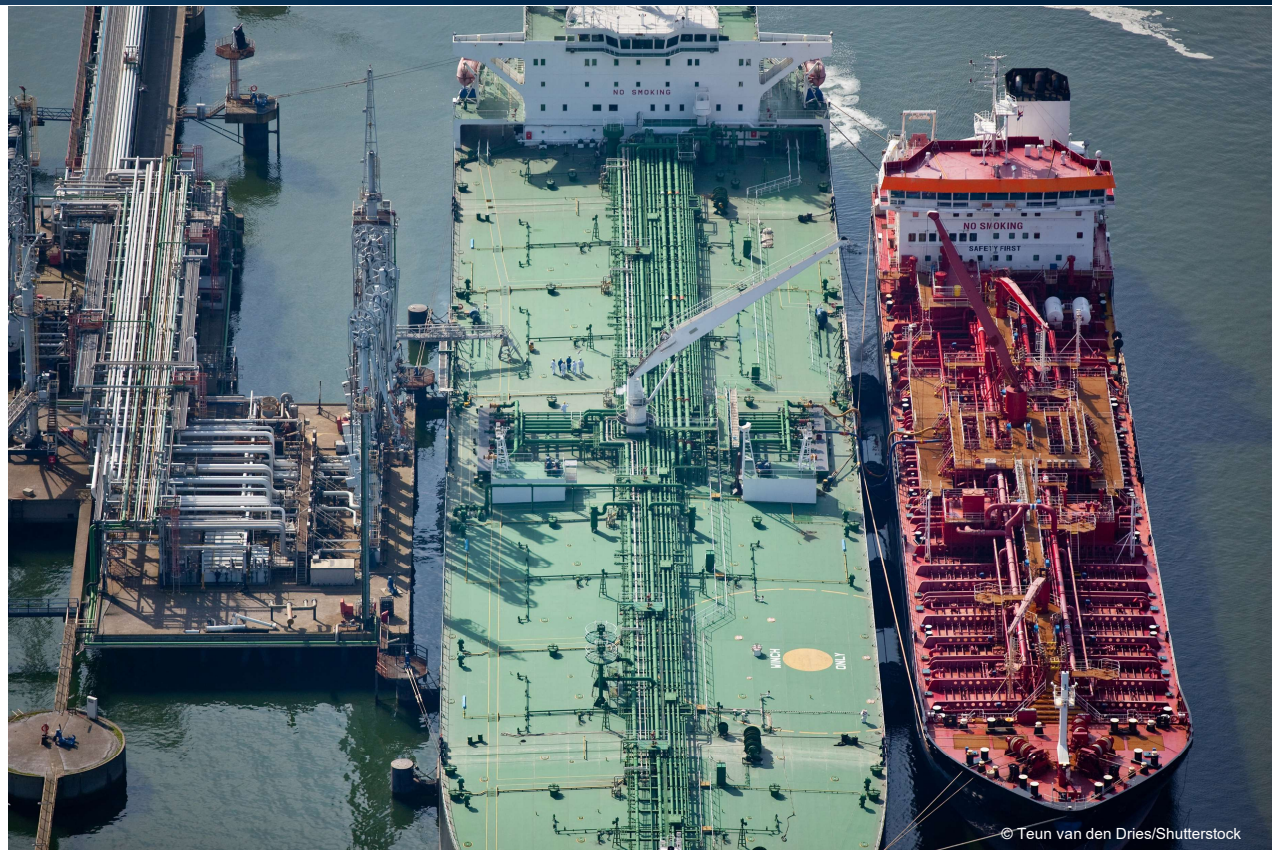
Drain & Storage

- Drain fuel from hoses upon completion of operation
- Nitrogen blow through process (two times)
    - <100ml methanol in drip trays upon disconnection
- Safe storage on the vessel
- Stored on the open deck or in a storage room with an independent mechanical extraction ventilation system, providing a minimum of six ACH



Bunkering Operation: High Potential for Release

- External intervention
- Incomplete preparation
- Improper installation or excessive vibration
- Wear and tear on bunkering equipment
- Risk of mechanical damage on bunkering equipment on deck
  - Simultaneous cargo operation
  - Dropped object



Toxicity

NIOSH – United States National Institute for Occupational Safety and Health
OSHA – Occupational Safety and Health Administration

- NIOSH recommended airborne exposure limit:
  - 200 ppm averaged over a 10-hour workday
  - 250 ppm not to be exceeded during any 15-minute work period
- OSHA permissible exposure limit is:
  - 200 ppm time weighted average over an 8-hour period
- Research studies on methanol leaks:
  - MAERSK methanol specification: Estimated evaporation rates from pool spills and pressurized spray leaks
  - DHI Denmark (ABS): Critical no effect limits for methanol, ammonia and VLSFO on spills during bunkering in Port of Rotterdam

Environment

- Fully miscible in aquatic environments and biodegradable
- Would last 1-7 days in surface water
- Less harmful in the event of a spill
- Toxic to aquatic organisms at concentrations above 1000 mg/l
- Only high concentrations alter local marine life
- Consumed by bacteria microbes taking a part in the food chain
- Effects of short-term methanol exposure on marine life are temporary and reversible

- Need to spill 200 times more methanol than HFO to kill the same number of fish

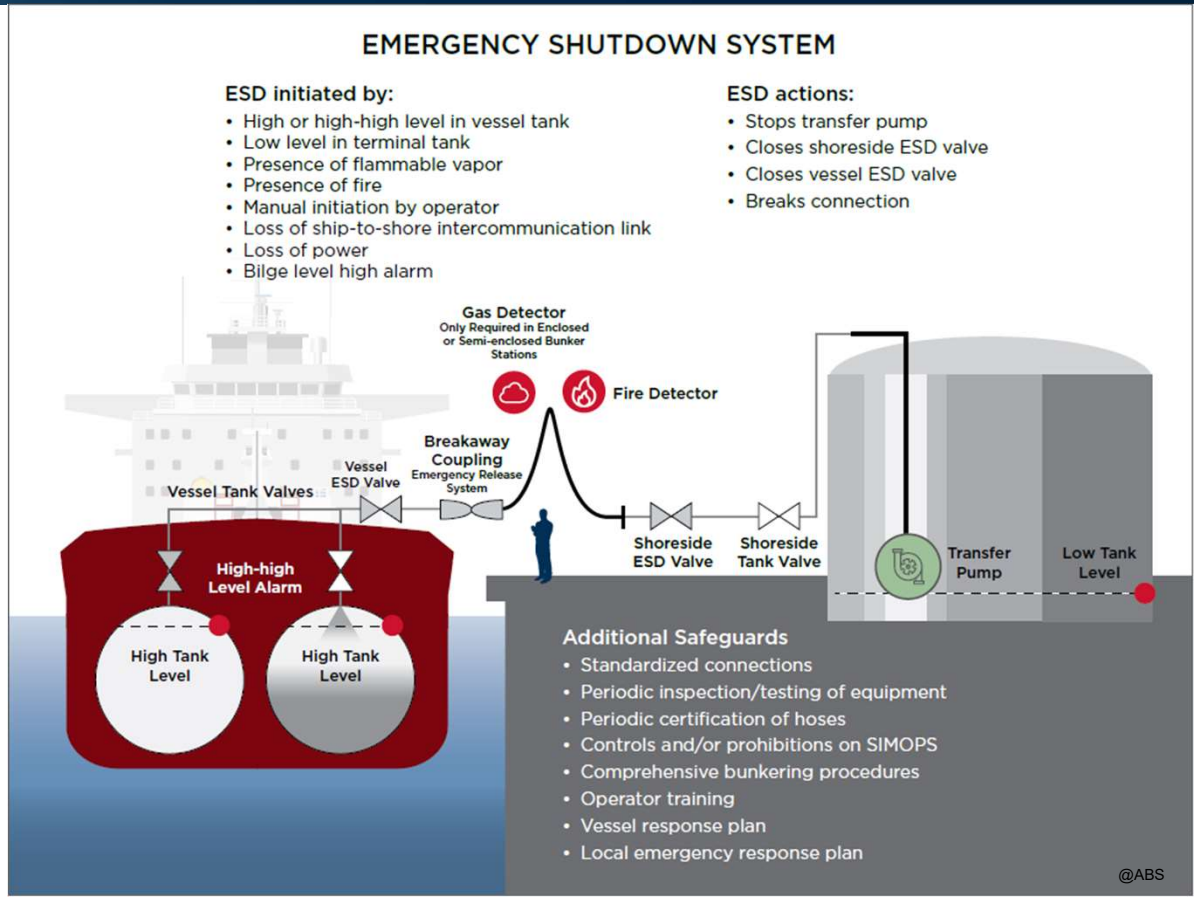
Provisions for Firefighting

FSS – Fire Safety Systems

- Bunker station onboard the bunker vessel provided with:
  - a fixed fire-extinguishing system of alcohol resistant foam type
  - a portable dry chemical powder extinguisher or an equivalent extinguisher, located near the bunkering station
  - a fire hose connected and available for immediate use if not a fixed water spray system is available near the bunker station
  - a fixed fire detection and fire alarm system complying with FSS Code
- Suitable fire detectors to be used: Smoke detectors may be used in combination with detectors which can more effectively detect methyl/ethyl alcohol fires

Release Mitigation During Bunkering

- Double walled piping
- Manifold
  - Vapor return
  - Emergency Release System (ERS)
  - Dry breakaway couplings
  - Inerting (nitrogen) system
- Monitoring, Emergency Shutdown (ESD) system
- Ship-shore link (SSL) for automatic and manual ESD communication



Emergency Shut Down (ESD)

Typical reasons to activate ESD:

- High or high-high level in the receiving tank
- Low level in terminal tank
- Leak or vapor detection
- Fire detection
- Loss of SSL
- Power failure
- Manual initiation by operator
- Excessive ship movement or abnormal pressure in transfer system

Gas Detection System

LEL – Lower Explosion Limit

Toxic gas detectors:

- Portable or fix on supplier

Permanent LEL gas detectors*:**

- Enclosed or semi-enclosed bunker stations

Fuel vapor concentration limits:

  - @ 5% of LEL - audible and visible alarm
  - @ 10% of LEL - safety system or ESD

- Ducts around fuel bunker pipes

Fuel vapor concentration limits:

- @ 20% of LEL - audible and visible alarm
- @ 40% of LEL - safety system or ESD

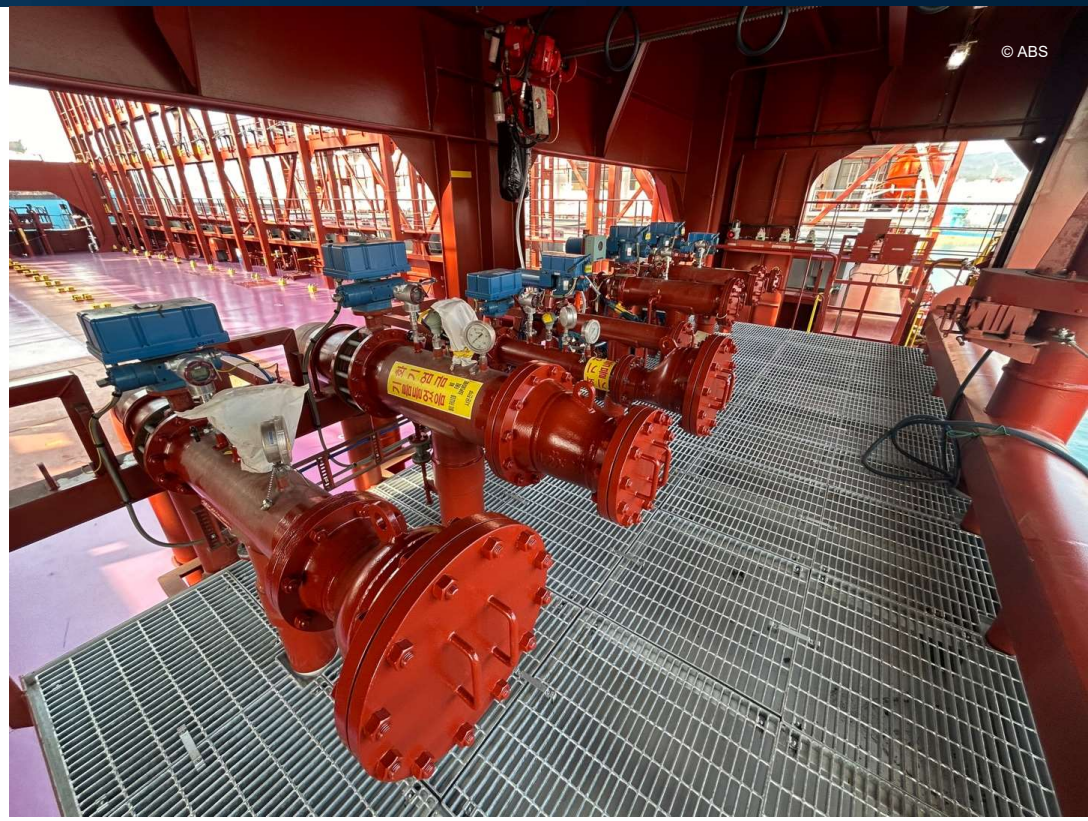
Placement of detectors:

- Gas dispersion analysis
- Physical smoke test.

*** required on methanol fueled vessel

Emergency Response

- Spill management
  - Coamings or drip tray
  - Drainage and management of spills
- Alcohol resistant foam fire extinguishing system and portable dry chemical
- Eyewash and decontamination showers in vicinity
- Requirements for PPE
- Access to enclosed spaces for emergency evacuation

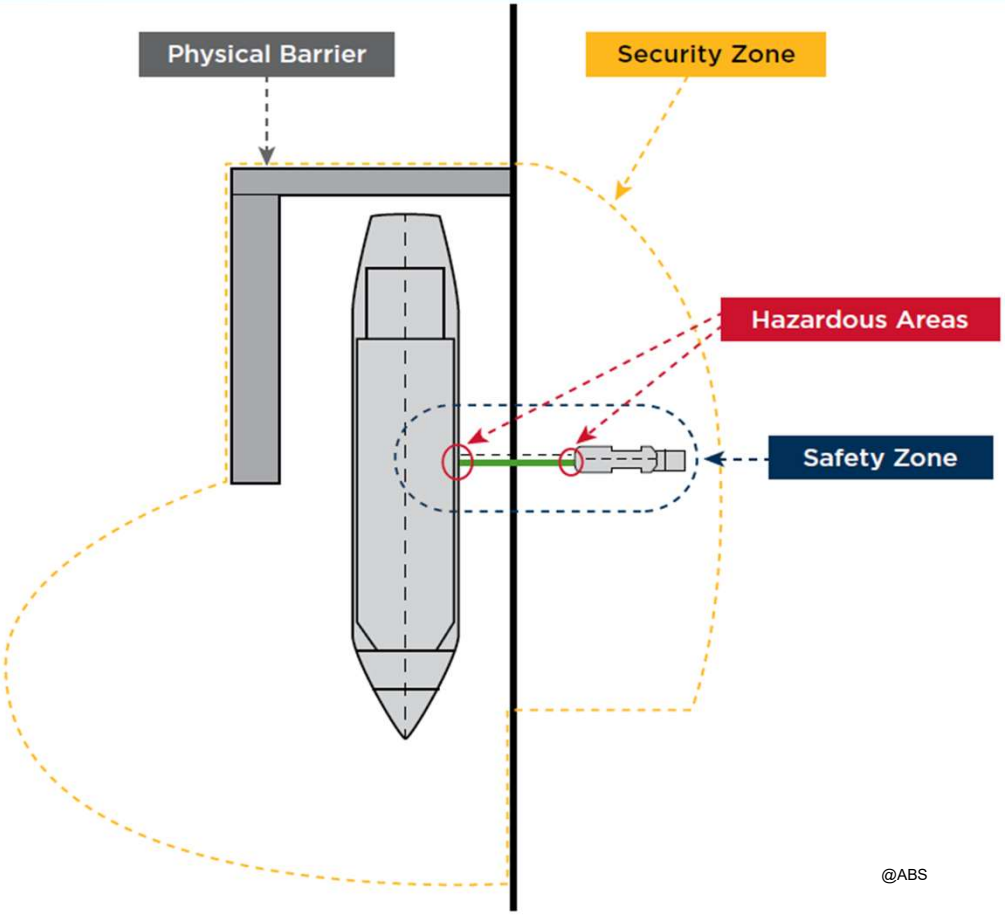


Portable Gas Detector

- Crew to carry alcohol sensing portable methanol detectors during:
  - methanol bunkering operations
  - methanol fuel operations
  - entering FPR
- Bunker surveyors to carry personal methanol detectors

Bunkering Zones

- **Hazardous zone:** Explosive gas mixture is expected to occur during normal handling
- **Safety zone:** Area established to control ignition sources (only qualified personnel and activities are allowed during bunkering)
- **Security (no movement) zone:** Area defined and established to monitor and control external activities that can lead to incidents that threaten the operation



Simultaneous Operations (SIMOPS)

- SIMOPS may include:
  - Cargo handling
  - Bunkering of other fuel or lube oil
  - Delivery of stores
- Criteria:
  - Operation to be outside the safety zone
  - Operation to be allowed in the risk assessment
  - Operation to be well-defined in the bunker procedures of both receiving vessel and barge or terminal

Risk Assessment

- Conducted before bunkering operations are allowed at a specific location
- Carried out by contracted parties
- National or local authorities have jurisdiction over safety and security at bunkering site
- Remains valid if conditions and presumptions remain unchanged

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Distribution of Responsibility

PIC – Person In Charge

- Responsible person for bunkering
  - Receiving or bunker vessels: master or the appointed officer
  - Tanker trucks: truck driver
  - Shore-to-ship facility: person-in-charge (PIC) of facility
- Before any bunkering operation commences, PICs from supplier and receiving side to:
  - agree in writing the transfer procedure including the maximum transfer rate at all stages
  - volume to be transferred
  - agree in writing action to be taken in an emergency
  - complete and sign the bunker safety checklist
- Upon completion of bunkering operations, the receiving side PIC should receive and sign documentation:
  - containing a description of the product and the quantity delivered

Industry Questioning

1. Are gas dispersion analysis is enforced by local authority?
2. How the hose connections to be arranged per the bunkering option? What is the estimated time for connecting bunkering lines.
3. Are there differences between loading to a methanol cargo tank and bunkering methanol as fuel?
4. Are there differences between methanol and VLSFO bunkering for a container vessel terminal?


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