MB05. RESPOND TO EMERGENCIES

BASIC KNOWLEDGE OF EMERGENCY PROCEDURES, INCLUDING EMERGENCY SHUTDOWN

Interreg Baltic Sea Region
EUROPEAN UNION
EUROPEAN REGIONAL DEVELOPMENT FUND

Content of the lecture

1. **DRILLS AND EMERGENCY EXERCISES (general requirements)**
2. **Emergency procedures and requirements**

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1. **Fire organization and action to be taken on ships subject to the IGF Code**
2. **Special hazards associated with fuel systems and fuel handling on ships subject to the IGF Code**
3. **Firefighting agents and methods used to control and extinguish fires in conjunction with the different fuels found on board ships subject to the IGF Code**
4. **Firefighting system operations**

DRILLS AND EMERGENCY EXERCISES

- Drills and emergency exercises on board shall be conducted at regular intervals.
- gas-related exercises could include for example:

1. tabletop exercise
2. review of fuelling procedures based in the fuel handling manual
3. responses to potential contingences
4. tests of equipment intended for contingency response, like water spray
5. reviews that assigned seafarers are trained to perform assigned duties during fuelling and contingency response

EMERGENCY PROCEDURES/REQUIREMENTS

(cont.1/7)

EMERGENCY PLAN

The plan should be directed at achieving the following aims:

- Rescuing and treating casualties
- Safeguarding others
- Minimizing damage to property and the environment
- Bringing the incident under control

EMERGENCY PROCEDURES/REQUIREMENTS

(cont.2/7)

ALARM PROCEDURES

1. Fire-fighting plans and muster lists should be prominently displayed and sign by all personnel
2. Guide in case of LNG fire should cover the following:
   - Raise the fire alarm
   - Assess the fire's source
   - Implement suitable emergency plan
   - Stop the spread of the fire by isolating the source of fuel
   - Cool down surfaces under radiation or flame with water
   - Extinguish the fire with appropriate equipment

FIRE ORGANIZATION AND ACTION TO BE TAKEN ON SHIPS SUBJECT TO THE IGF CODE

EMERGENCY ORGANIZATIONAL STRUCTURE:
(cont.3/7)

1. Emergency Command Centre
2. Emergency Party
3. Back-up Emergency Party
4. Engineers Group

EMERGENCY PROCEDURES/REQUIREMENTS

(cont.4/7)

EMERGENCY ORGANIZATIONAL STRUCTURE

1) Emergency Command Centre, should:

- In a port be established in the Cargo Control Room
- The senior officer in control of the emergency, supported by another officer and a crew member acting as a messenger
- Communication maintained by portable radio or telephone

EMERGENCY PROCEDURES/REQUIREMENTS

(cont.5/7)

2) Emergency Party, should:

- Pre-designated group
- The first team sent to the scene and reports to the Emergency Command Centre on the extent of the incident
- Recommends the action to be taken and the assistance required
- The Party is under the control of a senior officer and comprises officers and other suitable personnel trained to deal with rescue or fire-fighting

EMERGENCY PROCEDURES/REQUIREMENTS

(cont.6/7)

3) Back-up Emergency Party, should:

- Assist the Emergency Party under the direction of the Emergency Command Centre
- Led by an officer and comprises selected personnel

EMERGENCY ORGANIZATIONAL STRUCTURE
(cont.7/7)

4. Engineers Group, should:
   - Act under the leadership of the chief engineer
   - Responsible for dealing with an emergency in the main machinery spaces
   - Provides emergency engineering assistance as directed by the **Emergency Command Centre**

FIRE AND EMERGENCY BREAKAWAY

- All cargo/bunker operations must be stopped
- Emergency signals must be sounded as agreed
- All ship’s personnel should be removed from manifold area
- Detailed ship and shore emergency procedures will be started
- From ashore ESD system will be activated
- Ship/Shore IMO water spray system will be activated in case of fire
- Fire parties will attempt to start commence firefighting actions
- Vessel must depart from the berth with pilot/tugs or other support
- All interested parties should be informed

EMERGENCY SHUTDOWN (ESD) SYSTEM
(cont.1/3)

- ESD (Emergency Shutdown System)
- Requirement of the IMO code and recommendation of SIGTTO
- ESD is fitted to protect the ship and the terminal in the event of cryogenic or fire risk, on the ship or at the terminal
- ESD system is fitted to shut down the pumps, gas compressors, manifold and ship-side valves to stop the flow of LNG and vapor

EMERGENCY SHUTDOWN (ESD) SYSTEM
(cont.2/3)

THE GUIDING RULES FOR LIMITING PRESSURE SURGE ON LOADING OR DISCHARGING ARE:

(1) To stop the cargo/bunker pump

(2) First close the ESD valve nearest to the pump

(3) Finally, close other ESD valves

EMERGENCY SHUTDOWN (ESD) SYSTEM
(cont.3/3)

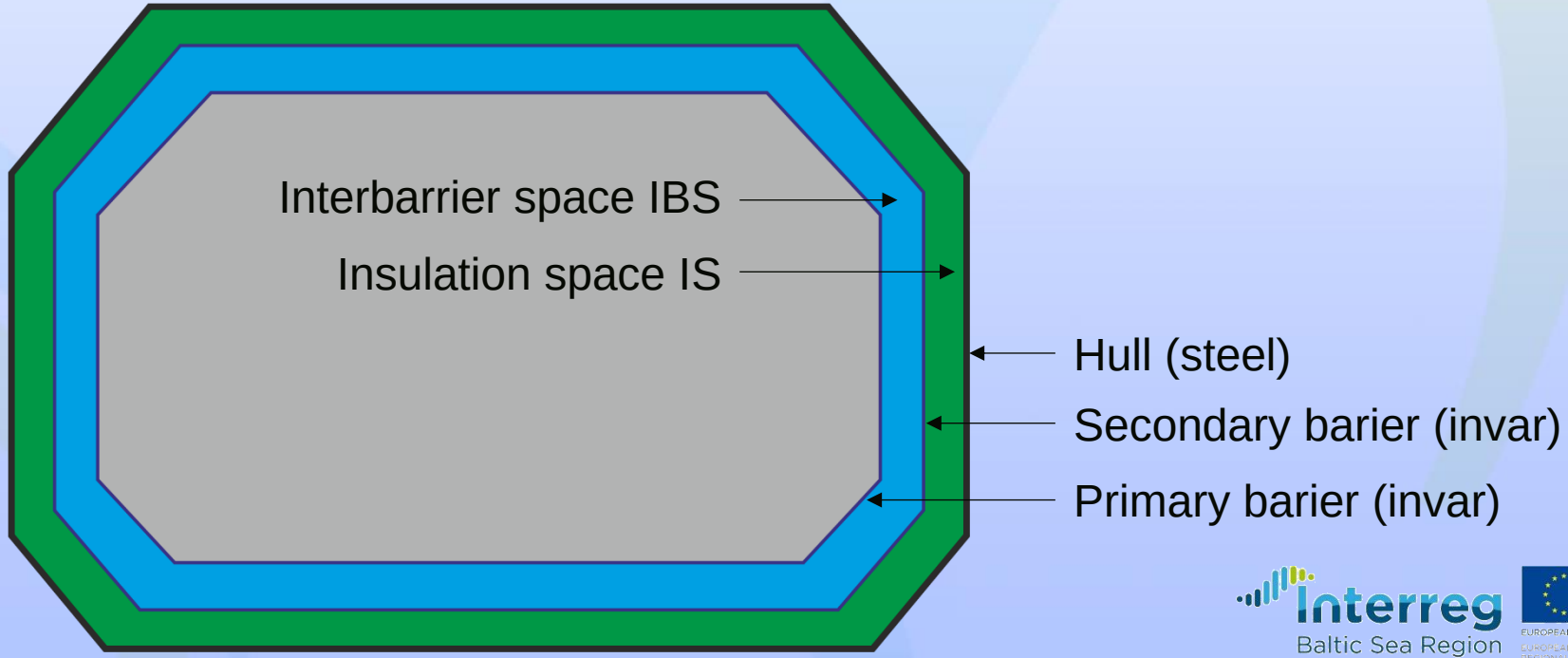
ESDs may be split into various groups:

1. ESD system at the manifold area
2. ESD system at the cargo/bunker tanks
3. ESD system at the gas heater
4. ESD in Cargo machinery room
5. ESD in Electric motor room

LNG VAPOUR LEAKAGE TO BARRIER

(cont.1/5)

- IBS and IS barrier spaces continuously swept with N_2
- Detection of vapor leakage by gas sampling analyzer



LNG VAPOUR LEAKAGE TO BARRIER

(cont.2/5)

POSSIBLE LEAKAGE INDICATORS:

1. A sudden rise in the percentage of methane vapor in one primary insulation space
2. Steady increase of vapor concentration when fracture is below the liquid level
3. Fluctuating increase of concentration when the fracture is above the liquid level

LNG VAPOUR LEAKAGE TO BARRIER

(cont.3/5)

LEAKAGE OF METHANE VAPOUR-DETERMINING THE RISK

Maintain continuous record all pressure changes occurring in the bunker tank and primary insulation space and additionally:

1. No change of flow of N_2 to the primary insulation space > record hourly for 8 hrs: gas concentration and temperature

2. Adjust N_2 to maintain gas concentration below 30% (vol) > record every 4 hrs: gas concentration and temperature

LNG LIQUID LEAKAGE TO BARRIER

(cont.4/5)

LNG LIQUID LEAKAGE TO PRIMARY BARRIER (MEMBRANE) indicators:

1. A rapid increase in the methane content of the affected space
2. A rise in pressure in the primary insulation space
3. Low temperature alarms at all temperature sensors
4. A general lowering of inner hull steel temperatures

WATER LEAKAGE TO BARRIER (cont.5/5)

- The pressure differential caused by the head of water building up in the insulation space may be sufficient to deform or even collapse the membrane into the tank
- Each tank insulation space is provided with water detection units
- A bilge piping system is used for the removal of any water

MB 04: CARRY OUT FIREFIGHTING OPERATIONS ON A SHIP SUBJECT TO THE IGF CODE

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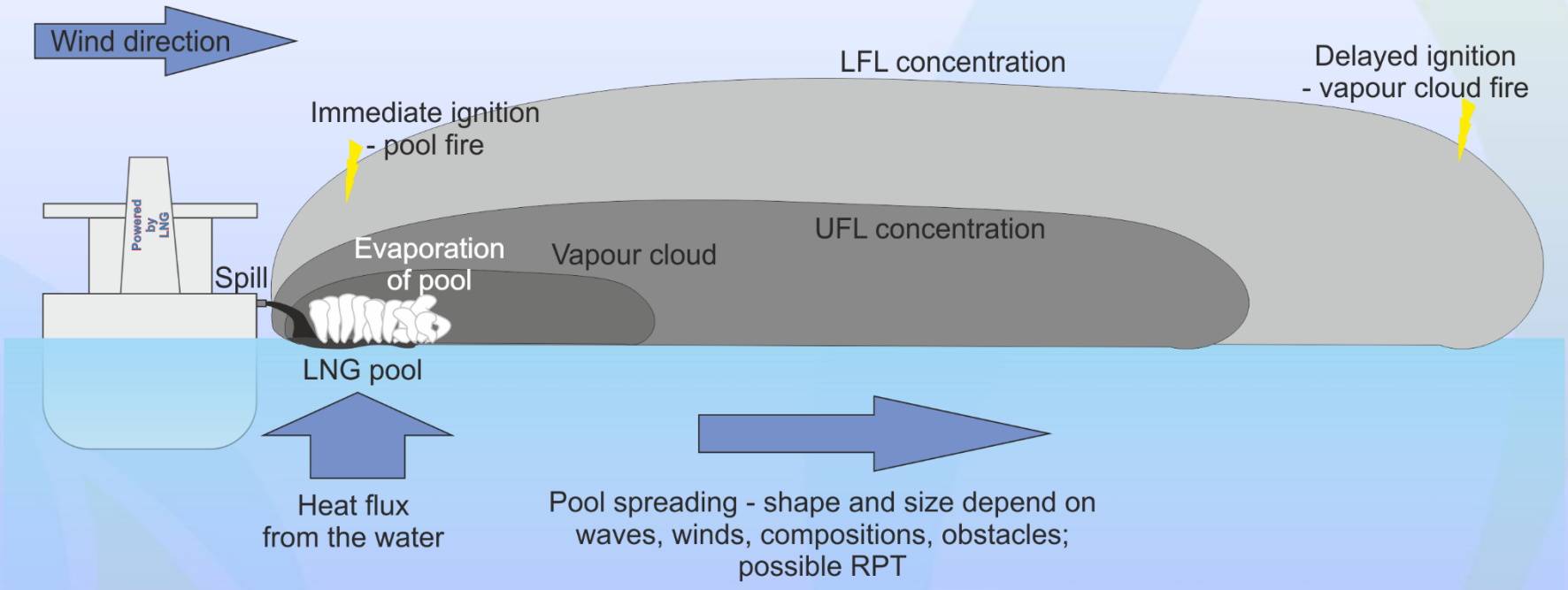
Fire categories

FIRES MAY BE BROADLY CATEGORISED AS FOLLOWS:

- Minor fires at pump glands, pipe flanges and relief valves
- Fires from confined liquid pools
- Fires from unconfined spillages
- Fires in confined space

Possible fire scenarios when LNG is spilled on water



FIRE

Fighting LNG fire:

- Fire-fighting plan
- Dry powder
- Water
- CO_2
- Fire-fighters protection

Fire-fighting plan:

- Well prepared
- Avoid ‘hit and run’ tactics
- Consider controlled burning
- Cool down surroundings

Dry Powder

1. Use all possible dispensers
2. Causes the flame to go out almost at once
3. No cooling effect
4. Avoid direct pressure of powder jets on to the surface of LNG
5. Kick-back effect

Dry powder system

source: Danfoss SemCo Fire protection Manuals

Water

1. NEVER hit LNG fire directly with water
2. Cool down surrounding bulkheads and decks.
3. No water to be mixed with burning LNG.
4. Essential for protecting steel work

Firefighting boats

source: LNG Masterplan for Rhine-Main-Danube, ver1.0 , April 2015

CO_2

CO2 extinguisher system used for closed areas

high-pressure carbon dioxide displaces

source: Pacific maritime magazine, 2016

FIRE-FIGHTERS PROTECTION

1. Full PPE
2. Approach the fire with Water spray jets
3. Consider weather conditions

Minimum number of Firefighter's outfits required:

Total cargo / bunker capacity	Number of outfits
5000 m^3 and below	4
Above 5000 m^3	5

Firefighter's outfit consist of:

1. One set of breathing apparatus:
   - self-contained compressed air-operated
   - min capacity 1,200 ℓ free air
   - incorporating full face mask
2. Full PPE
3. Rescue line with belt
4. Torch/lamp

GENERAL PROCEDURE FOR FIGHTING LNG FIRES

1. Isolate the source of leak
2. Sound the alarm
3. Fire fighters teams on stand-by
4. Use dry powder
5. Stand-by for re-ignition

LNG FIRE-FIGHTING AGENTS

- Water spray systems
- Dry chemical powder
- Gas smothering systems (CO_2 or N_2)

WATER SPRAY SYSTEMS

Requirements for WATER SPRAY SYSTEMS on a LNG tanker:

- Location of water spray nozzles
  - each tank liquid and vapor dome
  - at the midships manifold
  - on the compressor house
  - on the forward bulkhead of the accommodation block
  - and around the midships cargo control room if applicable
- Spay nozzles are fed from an independent water pump and line system
- Cross connected with the ship's fire main

DRY CHEMICAL POWDER

Requirements for DRY CHEMICAL POWDER on gas tankers:

- Follow Manufacturer's instructions
- Clear dry powder hose with N_2 after each use
- Use at max rate
- Attack the fire down-wind direction
- Avoid direct impact of powder jets on pool surfaces or leaks

GAS SMOTHERING SYSTEMS

Requirements for GAS SMOTHERING SYSTEMS on gas tankers:

- CO_2 and nitrogen are the most efficient agent for fighting liquid and vapor fires
- Lower the oxygen content
- Reduced the boil-off rate

FIRE IN THE MACHINERY

REQUIRED SAFETY ACTIONS AT FIRE DETECTION IN THE MACHINERY SPACE:

- alarm
- automatic shutdown of main tank valve
- automatic shutdown of gas supply to machinery space containing gas-fueled engines
- Ventilation Stop and Fire Damper Close (either automatic or simple action')

REGULATIONS FOR FIRE DETECTION AND ALARM SYSTEM (cont.1/6)

Fire alarm system

FIXED:

- fuel storage hold spaces
- ventilation trunk for fuel containment system below deck,
- other rooms of the fuel gas system

SMOKE DETECTORS:

- alone not sufficient for rapid detection of a fire

REGULATIONS FOR FIRE DETECTION AND ALARM SYSTEM

(cont.2/6)

REGULATIONS FOR FIRE DETECTION AND ALARM SYSTEM:

1. Gas sampling piping system for toxic gases
2. Continuous gas detection type with immediate response
3. Gas detection equipment requirements
   - each sampling head located sequentially at intervals not exceeding 30 min
   - individual sampling lines from sampling heads
   - no sampling pipes in non-hazardous spaces

EXCEPTION:

1. Fully enclosed steel cabinet with automatic SHUT DOWN system
2. Steel sample pipes in forward bulkhead

REGULATIONS FOR FIRE DETECTION AND ALARM SYSTEM

(cont.3/6)

4. Flame arrester and a manual isolating valve for Non-hazardous space gas sampling lines
5. Audible and visible alarm:
   - on the navigation bridge
   - at control station(s)
   - at the gas detector readout location
6. Gas detection equipment for flammable products:
   - inerted hold spaces and interbarrier spaces measuring gas concentrations of 0% to 100% by volume

REGULATIONS FOR FIRE DETECTION AND ALARM SYSTEM

(cont.4/6)

7. Alarms activated when:
   VAPOUR CONCENTRATION BY VOLUME REACHES THE EQUIVALENT OF 30% LFL IN AIR
8. For membrane containment systems:
   - Gas content analyzed individually from primary and secondary insulation spaces
   - For other spaces:
     - Alarms activated when the vapor concentration reaches 30% LFL
     - Safety functions shall be activated before the vapor concentration reaches 60% LFL
     - The crankcases of internal combustion engines that can run on gas shall be arranged to alarm before 100% LFL

REGULATIONS FOR FIRE DETECTION AND ALARM SYSTEM

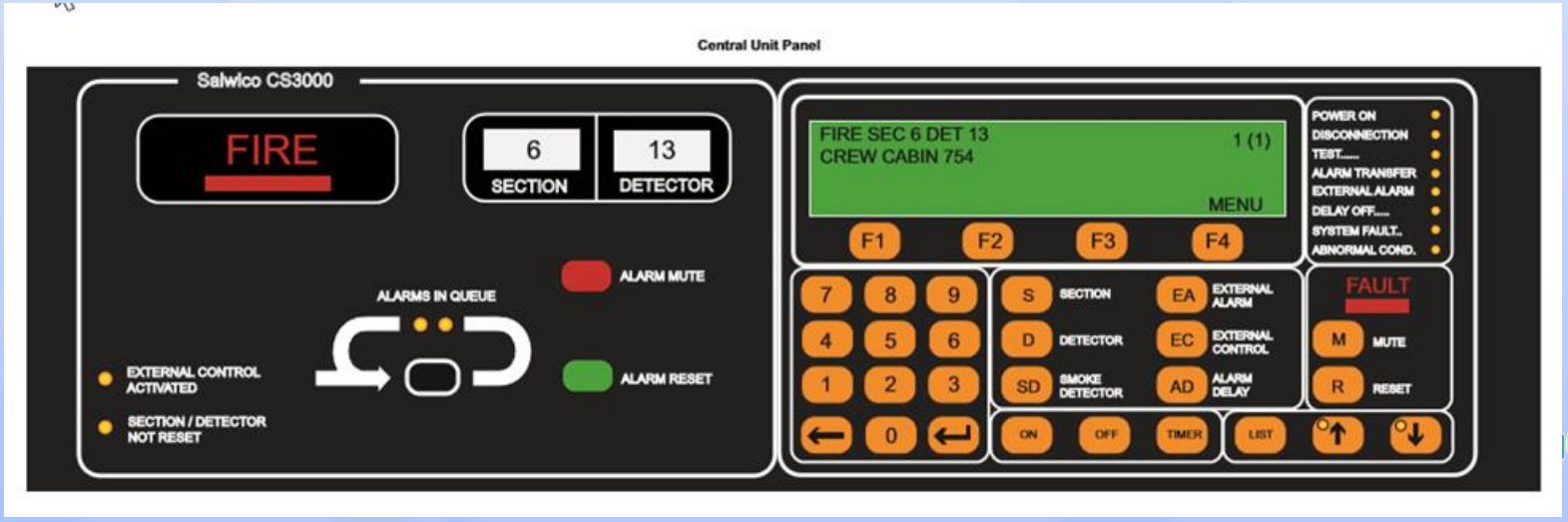
(cont.5/6)

9. Gas detection equipment shall be so designed that it may readily be tested

Testing and calibration shall be carried out at regular intervals.

Suitable equipment for this purpose shall be carried on board and be used in accordance with the manufacturer's recommendations. Permanent connections for such test equipment shall be fitted

Example of fire alarm panel



REGULATIONS FOR FIRE DETECTION AND ALARM SYSTEM

(cont.6/6)

10. Minimum 2 sets of portable gas detection equipment on ship
11. Oxygen levels in inert atmospheres detectors

Personal GAS monitor Riken GX2001

[source: http://www.rkiinstruments.com]

Gas Detector Riken RX41

[source: http://www.equipcoservices.com]

- Thank you for your attention