SIRE 2.0 Question Library Part 2 – Chapters 8 to 12 Version 1.0

(January 2022)

The Oil Companies International Marine Forum (OCIMF)
Vision: A global marine industry that causes no harm to people or the environment.

Mission: To lead the global marine industry in the promotion of safe and environmentally responsible transportation of crude oil, oil products, petrochemicals and gas and to drive the same values in the management of related offshore marine operations. We do this by developing best practices in the design, construction and safe operation of tankers, barges and offshore vessels and their interfaces with terminals and considering human factors in everything we do.

Contents

8. Cargo and Ballast Systems

8.1. Oil

8.1.1. Were the Master and officers familiar with the company procedures for the use of the inert gas system, and had the inert gas system been used in accordance with ISGOTT guidance, with cargo tanks maintained in an inert condition at all times, except when it was necessary to be gas-free for entry?

Short Question Text
Inert gas system usage on oil tankers.

Vessel Types
Oil

ROVIQ Sequence
Cargo Control Room, Main Deck

Publications
IMO: ISM Code
IMO SOLAS
OCIMF/ICS: International Safety Guide for Oil Tankers and Terminals. Sixth Edition.
OCIMF: Inert Gas Systems. The use of inert gas for the carriage of flammable oil cargoes

Objective

To ensure the inert gas system is used in accordance with ISGOTT guidance, and cargo tanks are always maintained in an inert condition, except when it is necessary to be gas-free for entry.

Industry Guidance

OCIMF: Inert Gas Systems. The use of inert gas for the carriage of flammable oil cargoes

4. Guidance for the use of inert gas systems on oil tankers

All vessels fitted with an inert gas system should maintain it fully functional, use it in accordance with ISGOTT guidance, and maintain cargo tanks in an inert condition at all times, except when it is necessary to be gas-free for entry.

OCIMF/ICS: International Safety Guide for Oil Tankers and Terminals. Sixth Edition

11.1.3 Composition and quality of inert gas

SOLAS requires IG systems to deliver IG with an oxygen content in the IG main of not more than 5% by volume at any required rate of flow

SOLAS also requires that IG systems keep positive pressure in the cargo tanks and that they have an oxygen content of not more than 8% (except when it is necessary for the tank to be gas free).

11.1.5.1 Inert gas operations

Tankers using an IG system should maintain their cargo tanks in a non-flammable condition at all times:

- Tanks should be kept in an inert condition at all times, except when it is necessary for them to be gas free for inspection work, i.e. the oxygen content should be not more than 8% by volume and the atmosphere should be maintained at positive pressure.
- The atmosphere within the tank should transition from an inert condition to a gas free condition without passing through the flammable condition. In practice, this means that before any tank is gas freed it should be purged with IG until the hydrocarbon content of the tank atmosphere is below the critical dilution line.
- When an oil tanker is in a gas free condition before arrival at a loading port, the tanks should be inerted before loading.

11.1.6.1 Inerting empty tanks

When all tanks have been inerted, they should be kept common with the IG main and the system pressurised with a minimum positive pressure of at least 100mm Water Gauge (WG). If individual tanks have to be separated from a common line, e.g. for product integrity, the tanks should have an alternative means of maintaining an IG blanket.

11.1.9.2 Carrying products with a flashpoint above 60 degrees C

Tankers may carry petroleum products that have a flashpoint above 60 degrees C, e.g. lubricating oils, heavy fuel oils, diesel fuels, etc., without needing an IG system fitted or, if fitted, without having to keep the tanks inerted.

However, when cargoes with a flashpoint above 60 degrees C are carried at a cargo temperature higher than their flashpoint less 10 degrees C, e.g. some residual fuel oils, the tanks should be inert because they could become flammable.

If IG systems are fitted the cargo tanks should be inerted where there is a possibility that the ullage space atmosphere may become flammable.

When a non-volatile cargo is carried in a tank that has not been gas freed, the tank should be inert.

ISGOTT Checks pre-arrival Ship/Shore Safety Checklist

Part 1B. Tanker: checks pre-arrival if using an inert gas system

ISGOTT Checks pre-transfer Ship/Shore Safety Checklist

Part 7A. Tanker: general checks pre-transfer (item 86)

ISGOTT Checks during transfer Ship/Shore Safety Checklist

Part 8. Tanker: repetitive checks during and after transfer (Items 8, 9, 11, and 86)

11.1.11 Inert Gas system failure

SOLAS requires that each ship fitted with an IG system has detailed instruction manuals covering operations, safety and maintenance requirements and occupational health hazards, The International Code for Fire Safety Systems (FSS Code) states, ‘The manual shall include guidance on procedures to be followed in the event of a fault or failure of the IG system’.

11.1.11.1 Action to be taken should the Inert Gas system fail

If the IG system fails to deliver the required quality and quantity of IG, or to maintain a positive pressure in the cargo tanks and slop tanks, action must be taken immediately to prevent any air going into the tanks. All cargo and/or ballast discharge from inerted tanks must be stopped, the IG deck isolating valve closed, the vent valve between it and the gas pressure regulating valve opened and immediate action taken to repair the IG system.

National and local regulations may require the failure of an IG system to be reported to the harbour authority, terminal operator and to the port and flag state administrations.

Section 12.8.3.1 gives guidance on special precautions to take if the IG system fails when loading static accumulator oils into inerted tanks.

11.1.11.2 Follow-up action on crude oil tankers

Pyrophoric iron sulphide deposits (pyrophors, see section 1.5.3) may be present in the cargo tanks of crude oil tankers. If a tanker is carrying crude oil, the failed IG system must be repaired and restarted, or another source of IG provided before discharge from inerted tanks is resumed.

11.1.11.3 Follow-up action on product tankers

Tank coatings usually inhibit the formation of pyrophors in the cargo tanks of product tankers. If it is impracticable to repair the IG system, discharge may be resumed with the written agreement of all interested parties, as long as an external source of IG is provided, or detailed procedures are established to ensure the safety. The following precautions should be taken:

- Consult the manual referred to in section 11.1.11.
- Ensure that devices to prevent the passage of flame, or flame screens (as appropriate), are in place and check they are in a satisfactory condition.
- Open the valves on the vent mast riser.
- Permit no free fall of water or slops.
- Introduce no dipping, ullaging, sampling or other equipment into the tank unless essential for the safety of the operation. If it necessary for such equipment to be introduced into the tank, it should be done after at least 30 minutes after the injection of IG has stopped. See action 11.1.6.8 for static electricity precautions relating to IG, and section 12.8 for static electricity precautions when dipping, ullaging and sampling.
- Ensure that all metal components of any equipment to be introduced into the tank are securely electrically earthed. This restriction should be applied for at least five hours after the injection of IG has stopped.

TMSA 6.1.1 requires that procedures for cargo, ballast, tank cleaning and bunkering operations are in place for all vessel types within the fleet. The procedures include:

- Maintaining safe tank atmospheres.

IMO: ISM Code

7 The Company should establish procedures, plans and instructions, including checklists as appropriate, for key shipboard operations concerning the safety of the personnel, ship and protection of the environment. The various tasks involved should be defined and assigned to qualified personnel.

IMO: SOLAS

Chapter II-2 Regulation 4

5.5.1.1 For tankers of 20,000 tonnes deadweight and upwards constructed on or after 1 July 2002 but before 1 January 2016, the protection of the cargo tanks shall be achieved by a fixed inert gas system in accordance with the requirements of the Fire Safety Systems Code, as adopted by resolution MSC.98(73), except that the Administration may accept other equivalent systems or arrangements, as described in paragraph 5.5.4.

5.5.1.2 For tankers of 8,000 tonnes deadweight and upwards constructed on or after 1 January 2016 when carrying cargoes described in regulation 1.6.1 or 1.6.2, the protection of the cargo tanks shall be achieved by a fixed inert gas system in accordance with the requirements of the Fire Safety Systems Code, except that the Administration may accept other equivalent systems or arrangements, as described in paragraph 5.5.4.

5.5.1.3 Tankers operating with a cargo tank cleaning procedure using crude oil washing shall be fitted with an inert gas system complying with the Fire Safety Systems Code and with fixed tank washing machines. However, inert gas systems fitted on tankers constructed on or after 1 July 2002 but before 1 January 2016 shall comply with the Fire Safety Systems Code, as adopted by resolution MSC.98(73).

Inspection Guidance

The vessel operator should have developed procedures for the operation of the vessel's inert gas system which included:

- Inerting empty cargo tanks.
- Operation during discharge, de-ballasting, COW and tank cleaning.
- Purging tanks before gas freeing.
- Topping up the pressure in the cargo tanks when necessary during other stages of the voyage.
- Actions to be taken in the event of a failure of the inert gas system.

Suggested Inspector Actions

- Sight, and where necessary review, the company procedures for the operation of the inert gas system.
- Verify the oxygen content of inert gas being supplied to the cargo tanks was not more than 5% by volume.
- Verify that the inert gas pressure in the cargo tanks/inert gas main had been maintained within the range of values identified within the cargo and ballast transfer plan throughout the discharge operation.
- Where permitted, request the accompanying officer to measure the oxygen content in a randomly chosen cargo tank to verify that the oxygen content was less than 8% by volume.
- Review a sample of records for cargo, tank cleaning or gas-freeing operations from the previous three months and verify that the inert gas system had been used in accordance with the company procedures

- Interview the accompanying officer to verify their familiarity with the procedures for the operation of the vessel's inert gas system which included:
    - Inerting empty cargo tanks.
    - Operation during discharge, de-ballasting, COW and tank cleaning.
    - Purging tanks before gas freeing.
    - Topping up the pressure in the cargo tanks when necessary during other stages of the voyage.
    - Actions to be taken in the event of a failure of the inert gas system.

Expected Evidence

- The company procedures for the operation of the vessel's inert gas system.
- The detailed instruction manuals for the inert gas system.
- Cargo and inert gas records for the previous three months or three voyages whichever was greater.

Potential Grounds for a Negative Observation

- There were no company procedures for the operation of the vessel's inert gas system which included:
    - Inerting empty cargo tanks.
    - Operation during discharge, de-ballasting, COW and tank cleaning.

    - Purging tanks before gas freeing.
    - Topping up the pressure in the cargo tanks when necessary during other stages of the voyage.
    - Actions to be taken in the event of a failure of the inert gas system.
- The accompanying officer was not familiar with the company procedures for the operation of the vessel’s inert gas system.
- The accompanying officer was not familiar with the actions to be taken in the event of a failure of the inert gas system.
- The inert gas system was not in use at the time of the inspection, although its use was required by company procedures and/or ISGOTT guidance.
- Inerted cargo tanks were not being maintained at positive pressure of at least 100mm Water Gauge (WG).
- The inert gas pressure in the cargo tanks/inert gas main had not been maintained within the range of values identified within the cargo and ballast transfer plan throughout the discharge operation.
- Inert gas was being delivered to the cargo tanks with an oxygen content in the IG main of more than 5% by volume.
- The oxygen content of a randomly sampled cargo tank was more than 8% by volume.
- Periodic checks had not been performed on the oxygen content of cargo tanks.
- Sampling of cargo, tank cleaning and gas freeing records showed that the inert gas system had not been used in accordance with company procedures and/or ISGOTT guidance.
- Records of the operation of the inert gas system were missing or incomplete.

8.1.2. Were the Master and officers familiar with the company procedures and international regulations for the planning, preparation, conduct and documentation of crude oil washing operations (COW), and was the COW system in satisfactory condition and used in accordance with the company procedures for each COW operation?

Short Question Text
Crude Oil Washing operations (COW)

Vessel Types
Oil

ROVIQ Sequence
Cargo Control Room, Pumproom, Main Deck

Publications
IMO: ISM Code
OCIMF/ICS: International Safety Guide for Oil Tankers and Terminals. Sixth Edition.
IMO: MARPOL
IMO: Crude Oil Washing Systems

Objective

To ensure crude oil washing operations are always planned, prepared, conducted and documented in accordance with international regulation and industry best practice.

Industry Guidance

OCIMF/ICS: International Safety Guide for Oil Tankers and Terminals. Sixth Edition.

12.5 Crude Oil Washing (COW)

12.5.4 Control of tank atmosphere

The oxygen content of the tank must not exceed 8% by volume, as described in section 11.1.6.9

12.5.5 Precautions against leaks from the washing system

Before arriving in a port where it is intended to COW, the tank washing system should be pressure tested to normal working pressure and examined for leaks.

During COW, the system should be kept under constant observation so that any leak can be detected immediately, and action taken to deal with it.

12.5.6 Avoiding oil and water mixtures

Mixtures of crude oil and water can produce an electrically charged mist during washing. The electrical potential of these mixtures is higher than dry crude oil. The use of dry crude oil is therefore important. Before washing begins, any tank to be used as a source of crude oil for washing should be partly discharged at least by one metre of ullage to remove any water that has settled out during the voyage.

For the same reason, if the slop tank is to be used as a source of oil for washing, it should first be completely discharged ashore and refilled with dry crude oil.

12.5.7 Isolating the tank cleaning heater

If the tank washing water heater is fitted outside the engine room, it should be blanked off during COW to prevent any ingress of oil.

12.5.8 Supervision

The PIC (*person in charge*) of COW operations should be suitable qualified in accordance with the requirements laid down by the tanker's flag administration and any local port regulations.

ISGOTT Checks pre-transfer Ship/Shore Safety Checklist

Part 5A. Tanker and terminal: pre-transfer conference

Part 7B. Tanker: checks pre-transfer if crude oil washing is planned

IMO Crude Oil Washing Systems

Appendix 1 List of changes when applying the Specifications to new crude oil tankers of 20,000 tons deadweight and above *(i.e. delivered after 1 June 1982).*

6.1 Tankage to be crude oil washed

6.1.1 before departure on a ballast voyage:

(a) approximately one quarter of the cargo tanks shall be crude oil washed for sludge control purpose on a rotational basis in accordance with the procedures specified in the Operations and Equipment Manual. However, for these purposes, no tank need be crude oil washed more than once in every four months; and

(b) if it is considered that additional ballast in a cargo tank or tanks may be required during the ballast voyage under the conditions and provisions specified in regulation 18(3) of Annex I of MARPOL 73/78, the tank or tanks which may be used for this ballast shall be crude oil washed in accordance with the procedures specified in the Operations and Equipment Manual.

6.6 Use and control of inert gas

Before each tank is crude oil washed, the oxygen level shall be determined at a point 1 m from the deck and at the middle region of the ullage space and neither of these determinations shall exceed 8% by volume.

TMSA 6.1.1 requires that procedures for cargo, ballast, tank cleaning and bunkering operations are in place for all vessel types within the fleet. The procedures include:

- Roles and responsibilities.
- Cargo and ballast handling.
- Maintaining safe tank atmospheres.
- Tank cleaning.
- Record keeping.

The procedures clearly identify the designated person(s) in charge of cargo, ballast and/or bunkering operations.

IMO: ISM Code

7 The Company should establish procedures, plans and instructions, including checklists as appropriate, for key shipboard operations concerning the safety of the personnel, ship and protection of the environment. The various tasks involved should be defined and assigned to qualified personnel

IMO: MARPOL

Annex I

Regulation 33 - Crude oil washing requirements

1 Every crude oil tanker of 20,000 tonnes deadweight and above delivered after 1 June 1982, as defined in regulation 1.28.4, shall be fitted with a cargo tank cleaning system using crude oil washing. The Administration shall ensure that the system fully complies with the requirements of this regulation within one year after the tanker was first engaged in the trade of carrying crude oil or by the end of the third voyage carrying crude oil suitable for crude oil washing, whichever occurs later.

Regulation 35 - Crude oil washing operations

1 Every oil tanker operating with crude oil washing systems shall be provided with an Operations and Equipment Manual detailing the system and equipment and specifying operational procedures. Such a Manual shall be to the satisfaction of the Administration and shall contain all the information set out in the specifications referred to in paragraph 2 of regulation 33 of this Annex. If an alteration affecting the crude oil washing system is made, the Operations and Equipment Manual shall be revised accordingly.

3 Unless an oil tanker carries crude oil which is not suitable for crude oil washing, the oil tanker shall operate the crude oil washing system in accordance with the Operations and Equipment Manual.

Inspection Guidance

The vessel operator should have developed procedures for the planning, preparation, conduct and documentation of crude oil washing (COW) which included the:

- Roles, responsibilities and qualifications of those involved in COW operations.
- Requirement for crude oil washing of cargo tanks for:
    - Sludge control purposes.
    - Preparation for the carriage of ballast in a cargo tank or tanks.
- Suitability of crude oils for crude oil washing.
- Use of dry crude oil for washing.
- Inspection and testing of COW equipment.
- Planning of COW operations.
- Testing of cargo tank oxygen content prior to commencing COW in each tank.
- Provision and completion of COW checklists.
- Maintaining records of COW operations.

These procedures may refer to the Crude Oil Washing Operations and Equipment (COW) Manual.

A record should be maintained of all COW operations, including the tanks washed, the number of machines used, the time washing started and was completed, the washing pattern employed, the washing line pressure and the method employed to ensure that the tanks were dry.

The oxygen content of each cargo tank to be crude oil washed should be tested with portable equipment not more than 30 minutes prior to commencing COW in that tank and the results recorded in the appropriate COW records.

This question will be allocated to vessels where HVPQ question 9.15.20.1 is answered in the affirmative.

Suggested Inspector Actions

- Sight, and where necessary review the:
  - Company procedures for the planning, preparation, conduct and documentation of crude oil washing.
  - COW manual.
  - Records and checklists for previous COW operations.
- Where COW operations were planned or underway, review the:
  - COW plan for the current operation.
  - Completed COW checklists.
  - Ship Shore Safety Check Lists (SSSCL).
  - Records of the current COW operation.
  - Bridge and/or Cargo Log Book
- Inspect the crude oil washing system including the:
  - Remote and local pressure gauges for the tank cleaning line.
  - Tank cleaning line, including expansion joints and hydrant connections.
  - Tank cleaning machines.
  - Tank washing water heater, if fitted outside the engine room.

- Where COW operations were planned or underway, interview the person in charge of crude oil washing operations to verify their familiarity with company procedures for the planning, preparation, conduct and documentation of COW operations.
- Where no COW operations were planned or underway, interview the accompanying officer to verify their familiarity with company procedures for the planning, preparation, conduct and documentation of COW operations.

Where the vessel was not undertaking COW operations at the port of inspection, the inspector should:

- Review the records from the most recent COW operation.
- Conduct the interview(s) based on the potential for an upcoming COW operation.

Expected Evidence

- The company procedures for the planning, preparation, conduct and documentation of crude oil washing.
- The COW manual.
- The records and checklists for the current and previous COW operations.
- Ship Shore Safety Check Lists (SSSCL).
- The COW plan for the current operation.
- The Bridge and/or Cargo Log Book.
- The Oil Record Book Part II

Potential Grounds for a Negative Observation

- There were no company procedures for the planning, preparation, conduct and documentation of crude oil washing which included the:
  - Roles, responsibilities and qualifications of those involved in COW operations.
  - Requirement for crude oil washing of cargo tanks for:
    - Sludge control purposes.
    - Preparation for the carriage of ballast in a cargo tank or tanks.
  - Suitability of crude oils for crude oil washing.
  - Use of dry crude oil for washing.
  - Inspection and testing of COW equipment.
  - Planning of COW operations.
  - Testing of cargo tank oxygen content prior to COW.

    - Completion of COW checklists.
    - Maintaining records of COW operations.
- The person in charge of crude oil washing operations at the time of inspection was not familiar with the company procedures for the planning, preparation, conduct and documentation of crude oil washing or the contents of the COW manual.
- The person in charge of crude oil washing operations at the time of inspection was not suitably qualified in accordance with company procedures.
- The accompanying officer was not familiar with the company procedures for the planning, preparation, conduct and documentation of crude oil washing or the contents of the COW manual.
- The vessel did not have an approved COW manual.
- Alterations had been made to the COW system, but the COW Manual had not been updated to reflect these changes.
- The oxygen content of a tank being crude oil washed was more than 8% by volume.
- The oxygen content of each cargo tank being crude oil washed had not been tested with portable equipment within 30 minutes prior to commencement of COW and the result recorded in the appropriate COW records.
- Records had not been maintained of all COW operations.
- Cargo tanks had not been crude oil washed at the required frequency for sludge control purposes.
- The crude oil washing cycles and washing durations used for COW operations were not in accordance with the instructions in the COW manual.
- One or more of the operational checklists in the COW manual had not been completed as required.
- There was no evidence that, prior to arrival in port, the tank washing system had been pressure tested to normal working pressure, examined for leaks and any leaks rectified.
- There was a leak from the COW pipeline system during operation.
- A pressure gauge(s) on the tank cleaning line was missing, defective or inaccurate.
- The pressure in the tank cleaning line was not as required by the COW manual.
- COW machines were turning in tanks not being crude oil washed, indicating leaking valves to fixed tank cleaning machines.
- A cargo tank(s) had not been de-bottomed by at least one metre prior to being used as a source of crude oil for washing.
- A slop tank had not been completely discharged ashore prior to being used as a source of crude oil for washing. (A slop tank may be considered as a cargo tank if it had not contained slops since the previous occasion when it had been loaded with crude oil.)
- The tank washing water heater had not been blanked off before crude oil washing.
- Hydrants fitted to the crude oil washing line were not fitted with blanks or caps.
- There was significant corrosion, pitting, soft patches and/or other temporary repairs on the pipework or components of the COW system.
- The crude oil washing system was defective in any respect.

Where the vessel had not conducted or was not planning to conduct COW operations during the inspection the question should be addressed based on the records from the previous COW operation.

Where no COW operations had taken place during the previous six months, a **comment** should be made in the process drop down indicating the last time COW operations were recorded as having taken place.

8.1.3. Were the Master and officers familiar with the company procedures for the isolation of individual cargo tanks from the common venting system in accordance with SOLAS, and were these procedures being followed?

Short Question Text
Cargo tank isolation from venting system.

Vessel Types
Oil

ROVIQ Sequence
Cargo Control Room, Main Deck

Publications
IMO: ISM Code
IMO SOLAS
OCIMF/ICS: International Safety Guide for Oil Tankers and Terminals. Sixth Edition.

Objective

To ensure there are no incidences of cargo tank over or under pressurisation as a result of the mishandling or failure of vapour or inert gas isolating valves.

Industry Guidance

OCIMF/ICS: International Safety Guide for Oil Tankers and Terminals. Sixth Edition

11.2.2.2 Causes of tank over pressurisation

Over pressurisation usually occurs during ballasting, loading or internal transfer of cargo or ballast. It can be caused by one of the following:

- Incorrect setting of the tank's vapour or IG isolating valve to the vapour line or IG line.
- Failure of an isolating valve to the vapour line or IG line.

11.2.2.3 Tank over pressurisation – precautions and corrective actions

The best way to protect against over pressurisation is by following effective procedures:

- A procedure to control the setting of the isolating valves on the vent lines. The procedure should include a method of recording the current position of the isolating valves and a method for preventing them from being incorrectly or casually operated.
- Where isolating valves are fitted to the branch line of each tank, they should be provided with locking arrangements that are under the control of the ship's Responsible Officer.
- A method of recording the status of all valves in the cargo system and preventing them from being incorrectly or casually operated.
- Setting the valves in the correct position and making sure that they remain correctly set.
- Restricting the operation of the valves to authorised personnel only.
- Regular maintenance, pre-operational testing and operator awareness of isolating valves, P/V valves or high-velocity vents can guard against failure during operation.

11.2.2.4 Tank under pressurisation – causes

The causes of under pressurisation are similar to those of over pressurisation.

TMSA KPI 6.1.2 requires that procedures for pre-operational tests and checks of cargo and bunkering equipment are in place for all vessel types within the fleet. Tests and checks of equipment may include:

- Line and valve setting

IMO: ISM Code

7 The Company should establish procedures, plans and instructions, including checklists as appropriate, for key shipboard operations concerning the safety of the personnel, ship and protection of the environment. The various tasks involved should be defined and assigned to qualified personnel.

IMO: SOLAS

Chapter II-2 Regulation 4

5.3.2 Venting arrangements

5.3.2.1 The venting arrangements in each cargo tank may be independent or combined with other cargo tanks and may be incorporated into the inert gas piping.

5.3.2.2 Where the arrangements are combined with other cargo tanks, either stop valves or other acceptable means shall be provided to isolate each cargo tank. Where stop valves are fitted, they shall be provided with locking arrangements which shall be under the control of the responsible ship's officer. There shall be a clear visual indication of the operational status of the valves or other acceptable means. Where tanks have been isolated, it shall be ensured that relevant isolating valves are opened before cargo loading or ballasting or discharging of those tanks is commenced. Any isolation must continue to permit the flow caused by thermal variations in a cargo tank in accordance with regulation 11.6.1.1. For tankers constructed on or after 1 January 2017, any isolation shall also continue to permit the passage of large volumes of vapour, air or inert gas mixtures during cargo loading and ballasting, or during discharging in accordance with regulation 11.6.1.2.

Inspection Guidance

The vessel operator should have developed procedures for the isolation of individual cargo tanks from the common venting system which included:

- Maintenance and pre-operational testing of isolating valves.
- Checking the operational status of isolating valves prior to commencing operations.
- Locking arrangements for isolating valves, under the control of the responsible officer.
- Guidance on personnel authorised to operate the isolating valves.
- Provision of clear visual indication of the operational status of the valves or other acceptable means of isolation.
- A method of recording the current position of the valves/means at the cargo control room/position.

Suggested Inspector Actions

- Sight, and where necessary review, the company procedures for the isolation of individual cargo tanks from the common venting system.
- Sight the record or display of the current operational status of the isolating valves.
- During the course of the inspection, inspect the isolating valves and verify their operational status and condition, including locking arrangements.

- Interview the accompanying officer to verify their familiarity with the company procedures for the isolation of individual cargo tanks from the common venting system.

Expected Evidence

- The company procedures for the isolation of individual cargo tanks from the common venting system.
- The record or display of the current operational status of the isolating valves
- Cargo operation logbooks
- Records of checks, tests and maintenance of the isolating valves.

Potential Grounds for a Negative Observation

- There were no company procedures for the isolation of individual cargo tanks from the common venting system which included:
  - Maintenance and pre-operational testing of isolating valves.
  - Checking the operational status of isolating valves prior to commencing operations.
  - Locking arrangements for isolating valves, under the control of the responsible officer.
  - Guidance on personnel authorised to operate the isolating valves.
  - Provision of clear visual indication of the operational status of the valves or other acceptable means of isolation.
  - A method of recording the current position of the valves/means of isolation at the cargo control room/position.
- The accompanying officer was not familiar with the company procedures for the isolation of individual cargo tanks from the common venting system.
- An isolating valve was incorrectly set.
- The operational status of an isolating valve was not in accordance with the record or display of current status.
- There was no record or display of the current status of the isolating valves.
- There was no locking arrangement for an isolating valve or valves.
- An isolating valve was not locked in position.
- Locking arrangements for the isolating valves were not under the control of the responsible officer.
- There were no records of maintenance or testing of isolating valves.
- There were no records of pre-operational checks of isolating valves.
- There was no clear visual indication of the operational status of an isolating valve or valves.
- Operation of isolating valves was not restricted to authorised personnel.
- An isolating valve was defective in any respect.

8.1.4. Were the Master and deck officers familiar with the company procedures for planning and documenting cargo tank cleaning operations after the carriage of volatile products, and had these procedures been followed?

Short Question Text
Oil cargo tank cleaning procedures.

Vessel Types
Oil

ROVIQ Sequence
Cargo Control Room

Publications
EI: HM50 Guidelines for the cleaning of tanks and lines for marine tank vessels carrying petroleum and refined products 5th edition
OCIMF/ICS: International Safety Guide for Oil Tankers and Terminals. Sixth Edition.

Objective

To ensure that tank cleaning and gas freeing operations after the carriage of volatile products are always carefully planned, conducted and documented.

Industry Guidance

OCIMF/ICS: International Safety Guide for Oil Tankers and Terminals

12.3.2 Tank washing risk management

All tank washing operations should be carefully planned and documented. The potential hazards of planned tank washing operations should be systematically identified, and risk assessed. Appropriate preventative measures should be put in place to reduce the risk to ALARP.

12.3.3 Supervision and preparation

Supervision

A Responsible Officer should supervise all tank washing operations.

Before starting the operation, all the crew involved should be fully briefed by the Responsible Officer on the tank washing plans and their roles and responsibilities.

12.3.4 Tank atmospheres

12.3.4.1 Inert

This is a condition where the tank atmosphere is known to be at its lowest risk of explosion by virtue of the atmosphere being maintained at all times as non-flammable through the introduction of IG and the resultant reduction of the overall oxygen content in any part of any cargo tank to a level not exceeding 8% by volume while under a positive pressure.

The lowest risk comes from washing the tank in an inert atmosphere.

12.3.4.2 Non-inert

Non-inert cargo tanks should only be washed when a combination of measures control the flammability of the tank atmosphere and sources of ignition.

12.3.6.8 Special tank cleaning procedures

Steaming

Steaming may only be carried out in tanks that have either been inerted or water washed, and gas freed. Before steaming, the concentration of flammable gas should not exceed 10% of the LFL. Precautions should be taken to avoid the build-up of steam pressure within the tank.

The static electricity precautions in Chapter 3 should be strictly observed.

Using chemicals in wash water

Certain tank cleaning chemicals may introduce a toxic or flammable hazard. Personnel should be made aware of the OEL of the product. Detector tubes are particularly useful for detecting the presence of specific gases and vapours in tanks. Tank cleaning chemicals that can produce a flammable atmosphere should only be used when the tank is inerted.

Using chemicals for local cleaning

Some tank cleaning chemicals may be used to hand wipe bulkheads and blind spots, provided only a small amount is used and the personnel entering the tank observe all the requirements for entering an enclosed space.

An SDS for tank cleaning chemicals should be on board the ship before they are used. Its advice and precautions should be followed.

12.4 Gas freeing

12.4.1 General

Gas freeing is generally one of the most hazardous tanker operation, whether for entry, hot work or cargo quality control. The cargo vapours displaced during gas freeing are highly flammable so good planning and firm overall control are essential. The extra risk from toxic petroleum gas cannot be overemphasised and should be impressed on all personnel concerned. All operations connected with gas freeing demand the greatest possible care. Regional and local regulations may prohibit the release of cargo vapours when in coastal or port areas.

12.4.3 Procedures and precautions

The following recommendations apply generally to gas freeing:

- A Responsible Officer should supervise all gas freeing operations.
- Check all local, regional and national regulations on emissions of VOC or other limits.
- Notify all personnel on board that gas freeing is about to begin.

TMSA KPI 6.1.1 requires that procedures for cargo, ballast, tank cleaning and bunkering operations are in place for all vessel types within the fleet. The procedures include:

- Tank cleaning

IMO: ISM Code

7 The Company should establish procedures, plans and instructions, including checklists as appropriate, for key shipboard operations concerning the safety of the personnel, ship and protection of the environment. The various tasks involved should be defined and assigned to qualified personnel.

Inspection Guidance

The vessel operator should have developed procedures for planning and documenting cargo tank cleaning operations after the carriage of volatile products that address:

- Tank washing and gas freeing plans.
- Risk assessment.
- Record keeping requirements.
- Tank washing procedures and arrangements.
- The required atmosphere for tank washing.
- Special tank cleaning procedures including, where applicable:
    - Using chemicals in wash water.
    - Using chemicals for local cleaning.
- Managing slops retained onboard after completion of tank washing.
- Tank washing a slop tank on completion of slop discharge.
- Purging and gas freeing.

For all tank cleaning operations, the precautions set out in ISGOTT 12.3 Tank Cleaning must be strictly observed.

Procedures may refer to industry guidance such as:

EI: HM50 Guidelines for the cleaning of tanks and lines for marine tank vessels carrying petroleum and refined products 5th edition

This question will be allocated to oil tankers with an inert gas system which will be determined by HVPQ 9.15.1 answered in the affirmative.

Suggested Inspector Actions

- Sight, and where necessary review, the company procedures for planning and documenting cargo tank cleaning operations after the carriage of volatile products.
- Review available tank cleaning plans, risk assessments, log books and records to verify compliance with company procedures.

- Interview the officer responsible for tank cleaning operations to verify their familiarity with company procedures for planning and documenting cargo tank cleaning after the carriage of volatile products.

Expected Evidence

- Company procedures for planning and documenting cargo tank cleaning and gas freeing operations after the carriage of volatile products.
- Completed plans, risk assessments, log books and records for previous tank cleaning operations.

Potential Grounds for a Negative Observation

- There were no company procedures for planning and documenting cargo tank cleaning operations after the carriage of volatile products that addressed:
    - Tank washing and gas freeing plans.

  - Record keeping requirements.
  - Risk assessment.
  - Supervision.
  - Preparation.
  - The required atmosphere for tank washing.
  - Special tank cleaning procedures including, where applicable:
    - Using chemicals in wash water.
    - Using chemicals for local cleaning.
    - Steaming.
  - Purging and gas freeing.
- The officer responsible for tank cleaning operations was not familiar with the company procedures for planning and documenting cargo tank cleaning operations after the carriage of volatile products.
- Tank washing and gas freeing plans and supporting records were not available for recent tank cleaning operations.
- Records and interviews indicated that:
  - Tank cleaning operations had not been carefully planned.
  - A tank cleaning plan had not been followed.
  - Tank cleaning, including after discharge of a slop tank, had been conducted without the use of inert gas.
  - The potential hazards of planned tank washing operations had not been systematically identified and risk assessed, including the risks from any tank cleaning additives used.
  - Appropriate preventative measures had not been put in place to reduce the identified risks to ALARP.
  - Tank cleaning operations had not been documented in accordance with company procedures.
  - Tank cleaning operations had not been supervised by a Responsible Officer.
  - Officers and ratings involved in tank washing operations had not been briefed by the Responsible Officer on their roles and responsibilities.
  - Steam had been introduced into a tank that may have had a flammable atmosphere.

8.2. Chemicals

8.2.1. Were the Master and officers familiar with the company procedures for the operation of the inert gas system, and had the inert gas system been used in accordance with these procedures, industry guidance, and SOLAS and IBC regulations?

Short Question Text
Chemical tanker inert gas system usage.

Vessel Types
Chemical

ROVIQ Sequence
Cargo Control Room, Main Deck

Publications
IMO: ISM Code
IMO SOLAS
OCIMF/ICS: International Safety Guide for Oil Tankers and Terminals. Sixth Edition.
IMO: IBC Code
ICS: Tanker Safety Guide (Chemicals) - Fifth Edition
IMO: MSC.1/Circ.1501 Unified interpretation of SOLAS regulation II-2/16.3.3 for products requiring oxygen-dependent inhibitors

Objective

To ensure the inert gas system is always used in accordance with industry guidance, SOLAS and IBC regulations and company procedures to prevent fire and explosion.

Industry Guidance

ICS: Tanker Safety Guide (Chemicals) - Fifth Edition

4.5 Inert gas requirements for chemical carriers

The provision and use of an inert gas system is specified by the SOLAS Convention. To meet the SOLAS requirements for non-flammability, an inert gas system must be capable of delivering inert gas with an oxygen content of not more than 5% by volume in the inert gas main at any required flow rate. The system must also be able to maintain a positive pressure in the cargo tanks at all times, such that the tank atmosphere has an oxygen content of not more than 8% by volume.

5.13 Inert gas systems

5.13.1 Introduction

Inert gas systems on board chemical tankers can be used to:

- Prevent fire and explosion by maintaining the atmosphere in the tank below the LEL;
- Prevent a chemical reaction. The IBC Code specifies that certain products must be transported under an inert atmosphere; and
- Maintain cargo quality.

5.13.2 Oxygen content

SOLAS regulations require an inert atmosphere to be maintained with a maximum oxygen content of 8%, although some chemical cargoes will need a lower oxygen content to be maintained.

6.8.5 Maintaining an inert atmosphere during the voyage

A positive pressure of inert gas should be maintained in the ullage space of an inerted cargo tank at all times in order to prevent air from entering. If the pressure falls below the set level of the low-pressure alarm, action should be taken to repressurise the tank with inert gas. Pressure loss is normally associated with falling air and sea temperatures. The oxygen level in the ullage space should also be monitored regularly to ensure that it remains below 8%.

7.4.1 Inerting definitions

Inerting

Inerting is the displacement of air from a previously clean and gas free tank to create an inert atmosphere within the tank. Inerting ensures the tank atmosphere is incapable of supporting combustion by reducing the oxygen content. Inerting with nitrogen is also carried out to reduce the moisture content of the tank atmosphere for cargo compatibility and quality control reasons.

Padding

Padding means filling and maintaining the cargo tank and associated piping system with an inert gas, or other gas, vapour or liquid, in order to separate the cargo from air.

Purging

IMO defines purging as the introduction of inert gas into a tank which is already in an inert condition with the object of further reducing the oxygen content; and/or reducing the existing hydrocarbon or other flammable vapour content to a level below which combustion cannot be supported if air is subsequently introduced into the tank.

Purging utilises inert gas to reduce the concentration of hydrocarbon or other flammable vapours in the cargo tanks to less than 2% by volume.

The term purging is also used in the chemical tanker industry to describe the process of replacing the tank atmosphere in order to reduce oxygen content or dewpoint.

7.4.3 Inerting tanks containing cargo

When SOLAS requirements require tanks containing cargo to be inerted before discharge (see section 4.5), inert gas should be introduced into the tank through the distribution system while venting vapours in the tank to atmosphere. This operation should continue until the oxygen content is at or below 8% by volume.

It should be noted that the vapours vented during the inerting process may be both flammable and toxic.

OCIMF/ICS: International Safety Guide for Oil Tankers and Terminals. Sixth Edition

11.1.9.2 Carrying products with a flashpoint above 60 degrees C

Tankers may carry petroleum products that have a flashpoint above 60 degrees C, e.g. lubricating oils, heavy fuel oils, diesel fuels, etc., without needing an IG system fitted or, if fitted, without having to keep the tanks inerted.

However, when cargoes with a flashpoint above 60 degrees C are carried at a cargo temperature higher than their flashpoint less 10 degrees C, e.g. some residual fuel oils, the tanks should be inert because they could become flammable.

11.1.11 Inert Gas system failure

SOLAS requires that each ship fitted with an IG system has detailed instruction manuals covering operations, safety and maintenance requirements and occupational health hazards. The International Code for Fire Safety Systems (FSS Code) states, ‘The manual shall include guidance on procedures to be followed in the event of a fault or failure of the IG system’.

11.1.11.1 Action to be taken should the Inert Gas system fail

If the IG system fails to deliver the required quality and quantity of IG, or to maintain a positive pressure in the cargo tanks and slop tanks, action must be taken immediately to prevent any air going into the tanks. All cargo and/or ballast discharge from inerted tanks must be stopped, the IG deck isolating valve closed, the vent valve between it and the gas pressure regulating valve opened and immediate action taken to repair the IG system.

National and local regulations may require the failure of an IG system to be reported to the harbour authority, terminal operator and to the port and flag state administrations.

Section 12.8.3.1 gives guidance on special precautions to take if the IG system fails when loading static accumulator oils into inerted tanks.

11.1.11.3 Follow-up action on product tankers

Tank coatings usually inhibit the formation of pyrophors in the cargo tanks of product tankers. If it is impracticable to repair the IG system, discharge may be resumed with the written agreement of all interested parties, as long as an external source of IG is provided, or detailed procedures are established to ensure the safety. The following precautions should be taken:

- Consult the manual referred to in section 11.1.11.
- Ensure that devices to prevent the passage of flame, or flame screens (as appropriate), are in place and check they are in a satisfactory condition.
- Open the valves on the vent mast riser.
- Permit no free fall of water or slops.
- Introduce no dipping, ullaging, sampling or other equipment into the tank unless essential for the safety of the operation. If it necessary for such equipment to be introduced into the tank, it should be done after at least 30 minutes after the injection of IG has stopped. See action 11.1.6.8 for static electricity precautions relating to IG, and section 12.8 for static electricity precautions when dipping, ullaging and sampling.
- Ensure that all metal components of any equipment to be introduced into the tank are securely electrically earthed. This restriction should be applied for at least five hours after the injection of IG has stopped.

ISGOTT Checks pre-arrival Ship/Shore Safety Checklist

Part 1B. Tanker: checks pre-arrival if using an inert gas system

ISGOTT Checks pre-transfer Ship/Shore Safety Checklist

Part 7A. Tanker: general checks pre-transfer

ISGOTT Checks during transfer Ship/Shore Safety Checklist

Part 8. Tanker: repetitive checks during and after transfer

TMSA 6.1.1 requires that procedures for cargo, ballast, tank cleaning and bunkering operations are in place for all vessel types within the fleet. The procedures include:

- Maintaining safe tank atmospheres.

IMO: ISM Code

7 The Company should establish procedures, plans and instructions, including checklists as appropriate, for key shipboard operations concerning the safety of the personnel, ship and protection of the environment. The various tasks involved should be defined and assigned to qualified personnel.

IMO: SOLAS

Chapter II-2 Regulation 4

5.5.1.1 For tankers of 20,000 tonnes deadweight and upwards constructed on or after 1 July 2002 but before 1 January 2016, the protection of the cargo tanks shall be achieved by a fixed inert gas system in accordance with the requirements of the Fire Safety Systems Code, as adopted by resolution MSC.98(73), except that the Administration may accept other equivalent systems or arrangements, as described in paragraph 5.5.4.

5.5.1.2 For tankers of 8,000 tonnes deadweight and upwards constructed on or after 1 January 2016 when carrying cargoes described in regulation 1.6.1 or 1.6.2, the protection of the cargo tanks shall be achieved by a fixed inert gas system in accordance with the requirements of the Fire Safety Systems Code, except that the Administration may accept other equivalent systems or arrangements, as described in paragraph 5.5.4.

Chapter II-2 Regulation 16

3.3.1 The inert gas system for tankers required in accordance with regulation 4.5.5.1 shall be operated as to render and maintain the atmosphere of the cargo tanks non-flammable, except when such tanks are required to be gas free.

3.3.2 Notwithstanding the above, for chemical tankers, the application of inert gas may take place after the cargo tank has been loaded, but before commencement of unloading and shall continue to be applied until that cargo tank has been purged of all flammable vapours before gas-freeing. Only nitrogen is acceptable as inert gas under this provision.

IMO: MSC.1/Circ.1501 Unified interpretation of SOLAS regulation II-2/16.3.3 for products requiring oxygen-dependent inhibitors

When a product containing an oxygen-dependent inhibitor is carried on a ship for which inerting is required under SOLAS chapter II-2, the inert gas system shall be operated as required to maintain the oxygen level in the vapour space of the tank at or above the minimum level of oxygen required under paragraph 15.13 of the IBC Code and as specified in the Certificate of Protection.

IMO: IBC Code

15.13.5 When a product containing an oxygen-dependent inhibitor is to be carried:

1. in a ship for which inerting is required under SOLAS regulation II 2/4.5.5, as amended, the application of inert gas shall not take place before loading or during the voyage but shall be applied before commencement of unloading.

Inspection Guidance

The vessel operator should have developed procedures for the operation of the vessel’s inert gas system which included:

- Inerting empty cargo tanks.
- Padding
- Inerting tanks before commencement of unloading.

- Operation during discharge and tank cleaning.
- Purging tanks before gas freeing.
- Topping up the pressure in the cargo tanks when necessary during other stages of the voyage.
- Actions to be taken in the event of a failure of the inert gas system.

Chemical tankers built after 1 Jan 2016 and over 8000 dwt must be fitted with an inert gas system in compliance with the current FSS Code and must use it in any tank when carrying a flammable cargo, chemical or petroleum.

However, a flammable cargo may be loaded into a gas free tank and then inerted before commencement of unloading. In such cases, only nitrogen systems are acceptable.

Also, when carrying a product containing an oxygen-dependent inhibitor, the oxygen level in the vapour space should be maintained at or above the minimum level required by the IBC and the cargo specification and the inert gas should not be applied before the commencement of unloading.

Chemical tankers built **before 1 Jan 2016 and over 20,000 dwt**, and carrying flammable petroleum cargo, must be fitted with and utilise an inert gas system approved by their flag administration.

This inert gas system need not be used in any tank carrying flammable chemical cargoes provided the capacity of the tank is not more than 3000 m^3, the individual nozzle capacity of the tank washing machines does not exceed 17.5 m^3/hr, and the total combined throughput of the machines in use at any one time does not exceed 110 m^3/hr.

The means of providing inert gas as declared though HVPQ question 9.31.1 will be inserted in the inspection editor and the final report.

Suggested Inspector Actions

- Sight, and where necessary review, the company procedures for the operation of the inert gas system.
- Verify the oxygen content of inert gas being supplied to the cargo tank(s) is not more than 5% by volume.
- Verify that the inert gas pressure in the cargo tanks/inert gas main had been maintained at the value identified within the cargo and ballast transfer plan throughout the discharge operation.
- Where permitted, request the accompanying officer to measure the oxygen content in a randomly chosen inerted cargo tank to verify that the oxygen content was less than 8% by volume.
- Review a sample of records for cargo, tank cleaning and gas freeing operations from the previous three months and verify that the inert gas system has been used in accordance with the company procedures.

- Interview the accompanying officer to verify their familiarity with the procedures for the operation of the vessel’s inert gas system which included:
    - How to identify when the inert gas system must be used with each potential cargo and operation.
    - Inerting empty cargo tanks.
    - Inerting tanks before commencement of unloading.
    - Operation during discharge and tank cleaning.
    - Purging tanks before gas freeing.
    - Topping up the pressure in the cargo tanks when necessary during other stages of the voyage.
    - Actions to be taken in the event of a failure of the inert gas system.

Expected Evidence

- The company procedures for the operation of the vessel’s inert gas system.
- The detailed instruction manuals for the inert gas system.
- Cargo and inert gas records for the previous three months or three voyages whichever was greater.

Potential Grounds for a Negative Observation

- There were no company procedures for the operation of the vessel’s inert gas system which included:
  - Inerting empty cargo tanks.
  - Inerting tanks before commencement of unloading.
  - Operation during discharge and tank cleaning.
  - Purging tanks before gas freeing.
  - Topping up the pressure in the cargo tanks when necessary during other stages of the voyage.
  - Actions to be taken in the event of a failure of the inert gas system.
- The accompanying officer was not familiar with the company procedures for the operation of the vessel’s inert gas system.
- The accompanying officer was not familiar with the actions to be taken in the event of a failure of the inert gas system.
- The inert gas system was not in use at the time of the inspection, although its use was required by industry guidance, SOLAS and IBC regulations and/or company procedures.
- Inerted cargo tanks were not being maintained at positive pressure.
- Inert gas was being delivered to the cargo tanks with an oxygen content in the IG main of more than 5% by volume.
- The oxygen content of a randomly chosen inerted cargo tank was more than 8% by volume.
- Periodic checks had not been performed on the oxygen content of cargo tanks.
- Sampling of cargo, tank cleaning and gas freeing records showed that:
  - The inert gas system had not been used in accordance with industry guidance, SOLAS and IBC regulations and/or company procedures.
  - When inerting a loaded tank before commencement of unloading, inert gas had not been introduced into the tank through the distribution system while venting vapours in the tank to atmosphere.
  - When inerting a loaded tank before commencement of unloading, the inerting operation had not continued until the oxygen content in the ullage space was at or below 8% by volume.
- Records of the operation of the inert gas system and/or inerting of cargo tanks were missing or incomplete.

8.2.2. Were the Master and officers familiar with the company procedures that addressed the carriage of inhibited cargoes, and had these procedures been followed?

Short Question Text
Carriage of inhibited chemical cargoes.

Vessel Types
Chemical

ROVIQ Sequence
Cargo Control Room

Publications
IMO: ISM Code
OCIMF/ICS: International Safety Guide for Oil Tankers and Terminals. Sixth Edition.
IMO: IBC Code

Objective

To ensure that inhibited cargoes are carried safely and in compliance with company procedures and the IBC Code.

Industry Guidance

ICS: Tanker Safety Guide (Chemicals) - Fifth Edition

1.6.2 Unstable chemicals

Reaction characteristics

Unstable chemicals can self-react without the need for another substance to trigger a reaction. Decomposition or polymerisation are the most typical reactions that can occur within unstable chemicals carried on board chemical tankers.

Chemicals that polymerise, such as styrene monomer and vinyl acetate monomer, have a unique property that allows individual molecules to combine with each other to form long chain polymers. Most polymerisation reactions are exothermic and are characterised by an accelerating reaction rate until all the monomer molecules are consumed.

Polymerisation is often initiated by high temperatures or by reaction with small amounts of impurities that act as a catalyst. The most common impurities that create polymerisation are acid, alkalis and metals.

Polymerisation of a monomer cargo presents the following dangers:

- The generation of heat that accelerates the speed of the chemical reaction;
- The rapid expansion of the product that causes over pressurisation of the cargo tank with a consequent danger of rupture;
- The rupture of the tank may lead to chemical reactions with other cargoes in adjacent tanks;
- While a monomer cargo may often be a light and volatile liquid in its stable form, the polymerisation process produces heavier and more viscous liquids, or even solids, which may block the tank vents so that the pressure inside the tank increases even further.

Inhibited cargoes

Under the IBC Code a certificate of protection must be provided for cargoes that are required to be inhibited during the voyage. It is also a requirement of the Code that for such cargoes, unless a certificate of protection is supplied, the cargo must be rejected and not loaded. An example of an appropriate certificate of protection is included in Appendix D.

Cargoes that have the potential to polymerise or otherwise be self-reactive will be provided with an inhibitor that stops the reaction. These inhibitors are designed to be effective for a set duration at a specified temperature. It is therefore essential that the quantity of the inhibitor is sufficient for the expected temperature and duration of the planned voyage and that there is an appropriate safety margin. If additional inhibitor is left on board for use during the voyage the shipper or charterer should provide instructions on:

- The quantity to add;
- How to add it to the cargo, and
- How it should be mixed with the cargo.

An elevated temperature can reduce the effectiveness of the inhibitor or reduce its effective life. It is therefore essential that heat sources are kept away, and that the temperature of the cargo is closely monitored on at least a daily basis, or more frequently if recommended by the cargo manufacturer or shipper.

An increase in cargo temperature that is not related to ambient weather conditions or adjacent cargo temperatures may be an early indication that polymerisation has started. In such instances appropriate counter measures as recommended by the shipper or manufacturer are essential. Such measures may include the application of more inhibitor to the cargo or the cooling of adjacent structures. Should the increase in temperature be rapid then jettison of the cargo may be the only option to avoid a serious incident.

Effect of inert gas on inhibited chemicals

Inhibitors may require the presence of oxygen to be effective. This is usually obtained from oxygen dissolved within the product itself. If the inhibitor is oxygen dependent, the minimum level of oxygen in the tank atmosphere must be stated on the certificate of protection.

If nitrogen is bubbled through an inhibited cargo (such as when compressed nitrogen is used to clear the cargo hose after loading) the nitrogen introduced will deplete the oxygen dissolved in the liquid. Bubbling nitrogen through inhibited chemicals should therefore be avoided (see section 6.7.8). Should there be any doubt, additional advice should be sought from the shipper.

IBC Code requirements

The IBC Code requires the shipper to provide the ship with a number of critical safety instructions concerning inhibited cargoes*. (See IBC Code extract below)*

6.7.8 Tank atmosphere control

Oxygen levels must be maintained at or above the minimum level required by oxygen-dependent inhibitors used with certain self-reactive chemical cargoes (e.g. styrene and acrylonitrile). In such cases, the application of inert gas should not start before loading or during the voyage but should be applied before the start of discharging in compliance with the IBC Code. Using nitrogen during discharging and tank cleaning operations should also be strictly controlled to ensure the oxygen level is maintained within the appropriate limits. Similarly, bubbling nitrogen through these products should be avoided, as this could drive oxygen out of the product; and

Monitoring of the ullage space should be carried out at regular intervals during the voyage to ensure that the correct atmosphere is being maintained.

6.8.4 Inhibited cargoes

Some cargoes are liable to self-react under certain conditions (see section 1.6 and Appendix D). The temperature of cargoes that may self-react should be monitored daily and recorded. Unexpected changes of temperature are an early indicator of a possible self-reaction.

The following should be observed for these cargoes:

- Daily temperature monitoring;
- If the inhibitor is oxygen dependent, monitoring the vapour space for the correct level of oxygen; and
- Monitoring of adjacent temperatures.

Should the temperature rise be higher than expected, taking into account the ambient conditions and the temperature of adjacent cargoes, this should be treated as an emergency with appropriate action being taken (see Chapter 10).

A polymerising cargo will generate a lot of heat with a rapid rise in temperature and increase in pressure so the vessel should always have a contingency plan ready to jettison the cargo.

With inhibited cargoes, the precautions and limitations described in the certificate of protection should be carefully observed. If control of the tank atmosphere is required, ullage spaces should be monitored regularly to ensure that the correct atmosphere is being maintained.

Most inhibitors are not volatile, so they do not vaporise with the cargo and are unlikely to be present in cargo vapours. Polymerisation may therefore occur where cargo vapours condense. Places where this can occur, such as inside vent valves and flame arresters, should be regularly inspected and any blockage by solid polymers promptly cleared.

A cargo that contains an oxygen-dependent inhibitor should not be inerted below the minimum oxygen level required. The certificate of protection should be consulted regarding the minimum content of oxygen.

OCIMF/ICS: International Safety Guide for Oil Tankers and Terminals. Sixth Edition.

Chapter 25 The Ship/Shore Safety Checklist

Part 5b. Tanker and terminal: bulk liquid chemicals. Checks pre-transfer

Item 61 Inhibition certificate received (if required) from manufacturer? Yes/No

TMSA KPI 6.1.1 requires that procedures for cargo, ballast, tank cleaning and bunkering operations are in place for all vessel types within the fleet.

IMO: ISM Code

7 The Company should establish procedures, plans and instructions, including checklists as appropriate, for key shipboard operations concerning the safety of the personnel, ship and protection of the environment. The various tasks involved should be defined and assigned to qualified personnel.

IMO: IBC Code

15.13 Cargoes protected by additives

15.13.1 Certain cargoes with a reference in column "o" in the table of chapter 17 by the nature of their chemical make-up, tend, under certain conditions of temperature, exposure to air or contact with a catalyst, to undergo polymerization, decomposition, oxidation or other chemical changes. Mitigation of this tendency is carried out by introducing small amounts of chemical additives into the liquid cargo or by controlling the cargo tank environment.

15.13.2 Ships carrying these cargoes should be so designed as to eliminate from the cargo tanks and cargo handling system any material of construction or contaminants which could act as a catalyst or destroy the inhibitor.

15.13.3 Care should be taken to ensure that these cargoes are sufficiently protected to prevent deleterious chemical change at all times during the voyage. Ships carrying such cargoes should be provided with a certificate of protection from the manufacturer and kept during the voyage specifying:

1. the name and amount of additive present;
2. whether the additive is oxygen dependent and if so, the minimum level of oxygen required in the vapour space of the tank for the inhibitor to be effective must be specified;
3. date additive was put in the product and duration of effectiveness;
4. any temperature limitations qualifying the additives effective lifetime; and
5. the action to be taken should the length of voyage exceed the effective lifetime of the additives.

15.13.4 Ships using the exclusion of air as the method of preventing oxidation of the cargo should comply with 9.1.3.

15.13.5 When a product containing an oxygen-dependent inhibitor is carried:

1. In a ship for which inerting is required under SOLAS regulation II-2/4.5.5, as amended, the application of inert gas shall not take place before loading or during the voyage but shall be applied before commencement of unloading.
2. In a ship to which SOLAS regulation II-2/4.5.5, as amended, does not apply, the product may be carried without inertion (in tanks of a size not greater than 3000 m3). If inertion is to be applied on such a ship, then the application of inert gas shall not take place before loading or during the voyage, but shall be applied before commencement of unloading

15.13.6 Venting systems should be of a design that eliminates blockage from polymer build-up. Venting equipment should be of a type that can be checked periodically for adequacy of operation.

15.13.7 Crystallization or solidification of cargoes normally carried in the molten state can lead to depletion of inhibitor in parts of the tank contents. Subsequent remelting can thus yield pockets of uninhibited liquid with the accompanying risk of dangerous polymerization. To prevent this, care should be taken to ensure that at no time are such cargoes allowed to crystallize or solidify, either wholly or partially, in any part of the tank. Any required heating arrangements should be such as to ensure that in no part of the tank does cargo become overheated to such an extent that any dangerous polymerization can be initiated. If the temperature from steam coils would induce overheating, an indirect low-temperature heating system should be used.

Inspection Guidance

The operator should have developed procedures that address the carriage of inhibited cargoes and include guidance on:

- Inhibited cargo certificates of protection.
- Temperature monitoring of inhibited cargoes and adjacent spaces.
- Inerting of inhibited cargoes and monitoring of the oxygen level in the vapour space.
- Preventing a build-up of solid polymers in the venting system.
- The use of compressed nitrogen to clear arms/hoses after loading.
- The addition of extra inhibitor when provided on board.
- Contingency planning for uncontrolled polymerisation.

Suggested Inspector Actions

- Sight, and where necessary review, company procedures that address the carriage of inhibited cargoes.
- Review cargo operation log books and records, inhibited cargo certificates of protection and contingency plans in the event of uncontrolled polymerisation.
- During the course of the inspection, note if any parts of the venting system are blocked by solid polymers.

- Interview the responsible officer to verify their familiarity with company procedures that address the carriage of inhibited cargoes

Where the vessel had not carried any inhibited cargoes during the previous six months, make a **comment** in the Process response tool noting the last occasion an inhibited cargo was carried. Focus on the balance of the human and procedural aspects of the guidance.

Expected Evidence

- Company procedures that address the carriage of inhibited cargoes.
- Inhibited cargo certificates of protection.
- Inert gas logs relevant to the carriage of inhibited cargoes.
- Bridge and Cargo Log Books.
- Cargo tank temperature records relevant to the carriage of inhibited cargoes.
- Cargo load and discharge plans relevant to the carriage of inhibited cargoes.
- Contingency plans in the event of uncontrolled polymerisation of an inhibited cargo.

Potential Grounds for a Negative Observation

- There were no company procedures that addressed the carriage of inhibited cargoes and included guidance on:
    - Inhibited cargo certificates of protection.
    - Temperature monitoring of inhibited cargoes and adjacent spaces.
    - Inerting of inhibited cargoes and monitoring of the oxygen level in the vapour space.
    - Preventing a build-up of solid polymers in the venting system.
    - The use of compressed nitrogen to clear arms/hoses after loading.
    - The addition of extra inhibitor when provided on board.
    - Contingency planning for uncontrolled polymerisation.
- The responsible officer was not familiar with the company procedures that addressed the carriage of inhibited cargoes.
- There was no certificate of protection on board for an inhibited cargo, in accordance with IBC 15.13.3.
- The stated duration of effectiveness of the inhibitor had expired prior to discharge.
- Temperatures of an inhibited cargo had not been monitored during the voyage on at least a daily basis or as recommended by the cargo manufacturer.
- Temperatures of spaces adjacent to inhibited cargoes had not been monitored on at least a daily basis.
- The oxygen level in the vapour space of a cargo protected by an oxygen dependent inhibitor had not been monitored.
- A cargo protected by an oxygen dependent inhibitor had been inerted before loading or during carriage.
- There was no evidence that venting systems had been regularly inspected for the build-up of solid polymers, e.g. log book entries or standing orders.
- Parts of the venting system were blocked by solid polymers.
- Compressed nitrogen had been used to clear the arms/hoses after loading a cargo with an oxygen dependent inhibitor.
- There was no contingency plan in the event of uncontrolled polymerisation and a rapid rise in temperature of an inhibited cargo.

8.2.3. Were the Master and officers familiar with the information contained in the Procedures and Arrangements Manual, Certificate of Fitness for the Carriage of Noxious Liquid Substances in Bulk, the IBC Code and the latest MEPC.2/Circular, and was this information readily available to the officers engaged in cargo planning and operations?

Short Question Text
Procedures and Arrangements Manual.

Vessel Types
Chemical, LPG

ROVIQ Sequence
Cargo Control Room

Publications
IMO: ISM Code
IMO: IBC Code
ICS: Tanker Safety Guide (Chemicals) - Fifth Edition
IMO: MEPC.2/Circ.25 Provisional categorization of liquid substances in accordance with MARPOL Annex II and the IBC Code

Objective

To ensure the Master and officers have the necessary information readily available to them to plan and perform safe cargo operations.

Industry Guidance

ICS: Tanker Safety Guide (Chemicals) - Fifth Edition

4.3.2 MARPOL Annex II – Prevention of pollution by noxious liquid substances

Discharging cargoes and the disposal of residues after cleaning should be carried out in accordance with the ship's Procedures and Arrangements (P&A) Manual. The P&A Manual describes how the ship's pumping and stripping system is to be operated in order to ensure that tanks are effectively stripped in order to comply with MARPOL Annex II regulations.

Permitted cargoes

The ship may only load cargoes that are included on the COF or an addendum to the COF. The shipper of the product is required to provide the ship with a full description of the cargo including its IBC Code shipping name. The ship should refuse to accept a cargo if the full shipping name and description of the product are not provided.

IMO: IBC Code

16.2 Cargo information

16.2.1 A copy of this Code or national regulations incorporating the provisions of the Code, shall be on board every ship covered by this Code.

16.2.2 Any cargo offered for bulk shipment shall be indicated in the shipping documents by the product name under which it is listed in chapter 17 or 18 of the Code or the latest edition of MEPC.2/Circ. or under which it has been provisionally assessed. Where a cargo is a mixture, an analysis indicating the dangerous components contributing significantly to the total hazard of the product shall be provided, or a complete analysis if this is available. Such an analysis shall be certified by the manufacturer or by an independent expert acceptable to the Administration.

IMO: MEPC.2/Circ.25 Provisional categorization of liquid substances in accordance with MARPOL Annex II and the IBC Code

(*for example only, this Circular is reissued and renumbered on 1st December each year*)

3.2 The present circular incorporates the following amendments to the information set out in the previous circular (i.e. MEPC.2/Circ.24):

1. any new products, trade-named mixtures, and cleaning additives that have been assessed by the ESPH Working Group during the year;
2. amendments to existing product entries included in the product lists; and
3. new product entries covered by any new tripartite agreements communicated to the Organization since MEPC.2/Circ.24.

TMSA KPI 6.1.1 requires that procedures for cargo, ballast, tank cleaning and bunkering operations are in place for all vessel types within the fleet.

IMO: ISM Code

7 The Company should establish procedures, plans and instructions, including checklists as appropriate, for key shipboard operations concerning the safety of the personnel, ship and protection of the environment. The various tasks involved should be defined and assigned to qualified personnel.

IMO: MARPOL

Annex II

Regulation 14 Procedures and Arrangements Manual

1. Every ship certified to carry substances of category X, Y or Z shall have on board a Manual approved by the Administration. The Manual shall have a standard format in compliance with appendix IV to this Annex. In the case of a ship engaged in international voyages on which the language used is not English, French or Spanish, the text shall include a translation into one of these languages.
2. The main purpose of the Manual is to identify for the ship's officers the physical arrangements and all the operational procedures with respect to cargo handling, tank cleaning, slops handling and cargo tank ballasting and deballasting which must be followed in order to comply with the requirements of this Annex.

Appendix III

Form of International Pollution Prevention certificate for the Carriage of Noxious Liquid Substances in Bulk.

This is to certify:

4. That the ship complies with the requirements of Annex II to MARPOL for the carriage in bulk of the following noxious liquid substances, provided that all relevant provisions of Annex II are observed.

Noxious liquid substances/Conditions of carriage (tank numbers etc.)/Pollution category

List follows

Appendix V

Assessment of residue quantities in cargo tanks, pumps and associated piping

1.2.1 The ability of the pumping system of a tank to comply with regulation 12.1, 12.2 or 12.3 is determined by performing a test in accordance with the procedure set out in section 3 of this appendix. The quantity measured is termed the “stripping quantity”. The stripping quantity of each tank shall be recorded in the ship’s (P&A) Manual.

Inspection Guidance

The information contained in the documents listed should be readily available to the officers engaged in cargo planning and operations. The Master and officers should be familiar with the information they need to safely perform their duties, including:

P&A Manual

- The physical arrangements and all the operational procedures with respect to cargo handling, tank cleaning, slops handling and cargo tank ballasting and deballasting which must be followed in order to comply with the requirements of MARPOL Annex II.

Certificate of Fitness

- List of permitted cargoes attached to the Certificate of Fitness. (It is not a requirement for the list of cargoes to be attached to the P & A Manual.)

IBC Code

- Chapter 17, Summary of minimum requirements.
- Chapter 18, List of products to which the Code does not apply

MEPC.2/Circular

- Any new products, trade-named mixtures, and cleaning additives. (The Circular is issued on 1st December each year)

This question will be allocated to LPG carriers which have been issued with a Noxious Liquid Substances (NLS) certificate

Suggested Inspector Actions

- Sight, in either hard copy or digital format, the P&A Manual, the list of permitted cargoes, the IBC Code and the latest edition available of the MEPC.2/Circular.

- Interview the officer responsible for cargo planning and operations to verify their familiarity with the information contained in the Procedures and Arrangements Manual, Certificate of Fitness for the Carriage of Noxious Liquid Substances in Bulk, the IBC Code and the latest MEPC.2/Circular.
- Interview the accompanying officer to verify their familiarity with the information contained in the P&A Manual that relates to their duties.

Expected Evidence

- Procedures and Arrangements Manual.
- List of permitted cargoes.
- IBC Code.
- Latest edition available of the MEPC.2/Circular.

Potential Grounds for a Negative Observation

- The officer responsible for cargo planning and operations was not familiar with the information contained in the P&A Manual, Certificate of Fitness for the Carriage of Noxious Liquid Substances in Bulk, the IBC Code and/or the latest MEPC.2/Circular.
- The officer responsible for cargo planning and operations was not familiar with the “stripping quantities” for each cargo tank.
- The accompanying officer was not familiar with the information contained in the P&A Manual, as it related to their duties.
- The P&A Manual was not readily available.
- On a ship engaged in international voyages, the P&A Manual was not available in either English, French or Spanish.
- The information contained in the IBC Code was not readily available.
- A copy of the list of permitted cargoes was not readily available.
- A copy of the MEPC.2/Circular was not readily available.
- The MEPC.2/Circular available was not the latest edition.

8.2.4. Were the Master and deck officers familiar with the company procedures for planning and documenting cargo tank cleaning operations after the carriage of volatile and/or toxic products, and had these procedures been followed?

Short Question Text
Chemical tank cleaning procedures.

Vessel Types
Chemical

ROVIQ Sequence
Cargo Control Room, Main Deck

Publications
IMO: ISM Code
OCIMF/ICS: International Safety Guide for Oil Tankers and Terminals. Sixth Edition.
ICS: Tanker Safety Guide (Chemicals) - Fifth Edition

Objective

To ensure that tank cleaning and gas freeing operations after the carriage of volatile and/or toxic products are always carefully planned, conducted and documented.

Industry Guidance

OCIMF/ICS: International Safety Guide for Oil Tankers and Terminals

12.3.2 Tank washing risk management

All tank washing operations should be carefully planned and documented. The potential hazards of planned tank washing operations should be systematically identified, and risk assessed. Appropriate preventative measures should be put in place to reduce the risk to ALARP.

ICS: Tanker Safety Guide (Chemicals) - Fifth Edition

4.3.2 MARPOL Annex II – Prevention of pollution by noxious liquid substances

IMO MEPC.2/Circular

IMO publishes a list of current tripartite agreements on an annual basis in a document titled MEPC.2/Circular. The circular also lists the tank cleaning agents that have been approved for use on board chemical tankers.

The latest version of this document should be kept on board the ship.

8 Tank cleaning and gas freeing

8.1 Introduction

The Master should ensure that the operation is supervised by a responsible officer and that all personnel involved follow the correct procedures.

The tank cleaning process should ensure, whenever possible, that cargo, vapours or inert gas are not released onto the deck area. It is critically important that every possible care is exercised during all operations connected with tank cleaning and gas freeing, and that the operations are carried out using the approved procedures and arrangements for the ship.

8.2 Procedures and Arrangements Manual

All ships certified to carry NLS in bulk must be provided with a P&A Manual, approved by the flag State. The P&A Manual addresses the marine environmental aspects of removal and disposal of residues from cargo tanks and describes how to perform these operations.

The P&A Manual should be adhered to in all respects, including the performance of mandatory prewash requirements in accordance with MARPOL Annex II.

8.3 Supervision and preparation

8.3.1 Responsibility

The Master should ensure that all tank cleaning and gas freeing operations are appropriately planned, supervised and communicated to all involved.

8.3.2 Tank cleaning plan

A written tank cleaning plan should be prepared and made available to all personnel participating in the operation. Any significant deviation from the plan should be approved in writing by the Master or the responsible officer.

The written plan must be followed at all times and should cover:

- The type of cargo to be cleaned from each tank, and its characteristics. The SDS should be available so that personnel involved are familiar with the hazards.
- If applicable, the type of cleaning additives and their hazards.
- The major risks during cleaning including toxicity, flammability, corrosiveness, reactivity, and temperature as well as the safety precautions to be taken.
- The safety equipment and PPE to be available and ready for use throughout the operation and during connecting and disconnecting of hoses at the cargo manifold.
- The tanks to be cleaned, cleaning method, cleaning sequence and gas freeing arrangements.
- Monitoring the pumping of tank washings to ensure correct discharge/transfer.
- MARPOL requirements for the disposal of cargo residues and cleaning water (slops).
- Segregation of slops to avoid mixing different categories of product.
- Necessary actions required to keep the cargo deck area free from cargo vapours during tank washing and gas freeing operations, and
- The management of hazards with the use of nitrogen.

8.3.3 Pre-cleaning meeting

Before starting tank cleaning operations, the responsible officer should lead a review of the tank cleaning plan with all crew members involved, especially those who will supervise operations. Crew members should be actively encouraged to contribute to the review of the plan, especially with regard to their role and any safety concerns they may have.

8.4 Cargo tank washing and cleaning

8.4.3 Prevention of toxic exposure during tank cleaning

Crew members should be protected from exposure to toxic vapours by ensuring that:

- Where possible, tank cleaning is carried out under fully closed conditions.
- Gas freeing operations comply with the IBC Code.
- Access to cargo areas is restricted.

- The ship's ventilation is correctly set, and precautions are taken to monitor and prevent exposure in machinery spaces, and
- Appropriate PPE is provided and worn.

8.4.5 Tank washing in an inert atmosphere

Washing with portable machines

When using portable machines, it is not possible to ensure that an overpressure of inert gas is maintained in the tank. Air may be drawn into the tank increasing the oxygen content. The tank atmosphere should be considered to be non-inert.

8.5 Special cleaning methods

8.5.3 Manual cleaning

It may be necessary for personnel to enter a tank to clean residues from a tank by manual cleaning. For particularly difficult residues a chemical solvent or other cleaning agent may be required. This process may create additional risks, such as increasing the toxicity or flammability of the tank atmosphere. The amount of chemical solvent or other agent used should therefore be the minimum required.

The operation should only proceed once all control measures are in place to ensure the safety and health of the crew involved.

8.5.4 Use of tank cleaning additives

Tank cleaning additives used on a chemical tanker may be toxic and/or corrosive and/or flammable and/or static accumulating. When heated they may emit dangerous fumes. The precautions listed in 8.4.4 should be followed.

Personnel handling cleaning additives should wear PPE as recommended by the manufacturers.

When a washing medium other than water is used to wash a tank, such as mineral oil or chlorinated solvent, its discharge is controlled under the same provisions of MARPOL Annex I or Annex II applicable to the medium had it been carried as cargo. Tank washing procedures involving the use of such a medium must be set out in the P&A Manual and be approved by the flag State.

Tank cleaning additives used on board have to be approved by IMO and an SDS must be provided. Annex 10 of the latest MEPC.2/Circ contains a list of approved cleaning additives.

Cleaning additives that are not cargo should be carried and stored according to the requirements of the IMDG Code.

8.5.5 Steaming

Steam should never be introduced into a tank with an atmosphere which may be flammable.

The standard method for removing chlorides used deionised water. If steaming is required, the tank must be gas free.

8.11 Gas freeing

8.11.1 Safe procedures for gas freeing after tank cleaning and cleaning by ventilation

Gas freeing operations need to be carefully planned, taking into account expected vapours that may be flammable, or toxic or corrosive.

TMSA KPI 6.1.1 requires that procedures for cargo, ballast, tank cleaning and bunkering operations are in place for all vessel types within the fleet. The procedures include:

- Tank cleaning

IMO: ISM Code

7 The Company should establish procedures, plans and instructions, including checklists as appropriate, for key shipboard operations concerning the safety of the personnel, ship and protection of the environment. The various tasks involved should be defined and assigned to qualified personnel.

Inspection Guidance

The vessel operator should have developed procedures for planning and documenting cargo tank cleaning operations after the carriage of volatile and/or toxic products that addressed:

- Tank cleaning guidelines for all expected cargoes.
- Written tank washing and gas freeing plans.
- Record keeping.
- Risk assessment.
- Tank washing procedures and arrangements.
- The required atmosphere for tank washing.
- Manufacturer’s coating guidelines.
- Special tank cleaning procedures including, where applicable:
    - The use of washing media other than water.
    - Recirculation washing.
    - Using chemical additives in wash water.
    - Using chemical solvents or other agents for local cleaning.
- Gas freeing.

The vessel’s P&A Manual will form part of these procedures. Tank cleaning guidelines may be the operators own guidelines or a recognised professionally produced industry publication. Manufacturers' tank coating guidelines should be available and consulted to ensure any temperature and other coating restrictions are not exceeded.

For all tank cleaning operations, the precautions set out in the ICS Tanker Safety Guide (Chemicals), Chapter 8, Tank Cleaning and Gas Freeing, must be strictly observed.

Suggested Inspector Actions

- Sight, and where necessary review, the company procedures for planning and documenting cargo tank cleaning operations after the carriage of volatile and/or toxic products.
- Review available tank cleaning plans, risk assessments, log books and records to verify compliance with company procedures.
- Observe any tank cleaning operations taking place during the course of the inspection, including the performance of mandatory prewash requirements in accordance with MARPOL Annex II.

- Interview the officer responsible for tank cleaning operations to verify their familiarity with company procedures for planning and documenting cargo tank cleaning after the carriage of volatile and/or toxic products.

Expected Evidence

- Company procedures for planning and documenting cargo tank cleaning operations after the carriage of volatile and/or toxic products.
- P&A Manual
- Completed written tank cleaning plans, risk assessments, log books and records for previous tank cleaning operations.
- Tank cleaning guidelines for all expected cargoes.
- Manufacturers tank coating guidelines.
- Cargo Record Book.

Potential Grounds for a Negative Observation

- There were no company procedures for planning and documenting cargo tank cleaning operations after the carriage of volatile and/or toxic products that addressed:
    - Tank cleaning guidelines for all expected cargoes.
    - Written tank washing and gas freeing plans.
    - Risk assessment.
    - Tank washing procedures and arrangements.
    - The required atmosphere for tank washing.
    - Manufacturer’s coating guidelines.
    - Special tank cleaning procedures including, where applicable:
        - The use of washing media other than water.
        - Recirculation washing.
        - Using chemical additives in wash water.
        - Using chemical solvents or other agents for local cleaning.
    - Gas freeing.
- The officer responsible for tank cleaning operations was not familiar with the company procedures for planning and documenting cargo tank cleaning operations after the carriage of volatile and/or toxic products including:
    - The relevant sections of the P&A Manual.
    - Tank cleaning guidelines for all expected cargoes.
    - Manufacturers' tank coating guidelines.
- Tank cleaning guidelines for all expected cargoes were not available on board.
- Manufacturers' tank coating guidelines were not available on board.
- The latest version of MEPC.2/Circular listing approved tank cleaning agents was not available on board.
- Records of written tank washing and gas freeing plans were not available for recent tank cleaning operations.
- Written tank cleaning plans did not include:
    - The type of cargo to be cleaned from each tank, and its characteristics. SDS should be available so that personnel involved are familiar with the hazards.
    - The major risks during cleaning including toxicity, flammability, corrosiveness, reactivity, and temperature as well as the safety precautions to be taken.
    - The safety equipment and PPE to be available and ready for use throughout the operation and during connecting and disconnecting of hoses at the cargo manifold.
    - The tanks to be cleaned, cleaning method, cleaning sequence and gas freeing arrangements.
    - Monitoring the pumping of tank washings to ensure correct discharge/transfer.
    - MARPOL requirements for the disposal of cargo residues and cleaning water (slops).
    - Segregation of slops to avoid mixing different categories of product, and
    - Necessary actions required to keep the cargo deck area free from cargo vapours during tank washing and gas freeing operations.
- Records and interviews indicated that:
    - Tank cleaning plans had not been developed in accordance with the procedures and/or the P & A Manual.
    - Tank cleaning operations had not been documented in accordance with company procedures.
    - Tank cleaning operations had not been conducted in accordance with the tank cleaning plan.
    - Tank cleaning operations had not been supervised by a responsible officer.
    - Officers and ratings involved in tank washing operations had not been briefed by the responsible officer on their roles and responsibilities.
    - When washing with portable machines, the tank atmosphere had not been treated as non-inert.
    - Steam had been introduced into a tank that may have had a flammable atmosphere.

    - Tank cleaning plans did not address the risks from tank cleaning additives used.
- Cleaning additives that were not cargo were not stored according to the requirements of the IMDG Code.
- Tank cleaning operations were taking place that were not in accordance with the written tank cleaning plan.
- Tank cleaning operations were taking place that were not in accordance with company procedures and/or the P&A Manual.
- A washing medium other than water had been used to wash a tank, such as mineral oil or chlorinated solvent, but tank washing procedures involving the use of such a medium were not available in the P&A Manual.

8.2.5. Were the Master and deck officers familiar with the company procedures for identifying and segregating incompatible cargoes during cargo stowage planning, and had these procedures been followed?

Short Question Text
Chemical cargo compatibility charts.

Vessel Types
Chemical

ROVIQ Sequence
Cargo Control Room, Main Deck

Publications
IMO: ISM Code
IMO: IBC Code
ICS: Tanker Safety Guide (Chemicals) - Fifth Edition
USCG: Code of Federal Regulations. Title 46.

Objective

To ensure cargo stowage is carefully planned to avoid the possibility of co-mingling of incompatible cargoes or their vapours.

Industry Guidance

ICS: Tanker Safety Guide (Chemicals) - Fifth Edition

1.6.6 Incompatible Chemicals

Reaction characteristics

Certain groups of chemicals react with those of other groups if they come in contact with each other. Such reactions can be hazardous and result in the generation of toxic gases, heat, fire and explosion. A violent reaction can lead to an overflow and the possible rupture of a cargo tank.

IBC Code requirements *(see below)*

The USCG Compatibility Chart

Several authoritative bodies have divided chemical cargoes into groups, defining criteria for incompatibility between them, and have published lists of incompatible cargoes. The most familiar is published by the United States Coast Guard (USCG) (CFR 46 part 150, Compatibility of Cargoes). The USCG considers a mixture of two chemicals to be hazardous (and the chemicals in question declared incompatible) when, under specified test conditions, the temperature rise in the mixture exceeds 25°C or a gas is produced as a result of the reaction.

Whether cargoes within a pair of groups are incompatible is indicated in a table known as the USCG compatibility chart.

The USCG compatibility chart assigns each bulk chemical cargo to one of 22 reactive groups and 14 cargo groups. Reactive groups contain those chemicals which are most reactive, so that dangerous reactions can be identified between members of different reactive groups and between members of reactive groups and cargo groups. Chemicals assigned to cargo groups are much less reactive and do not react dangerously together.

Two incompatible cargoes are not allowed to be stowed adjacent to each other. Caution must be exercised regarding overlapping tanks.

While the USCG table gives general indications, the footnotes and data sheets for any two particular cargoes should always be consulted because there are exceptions to the compatibility chart.

TMSA KPI 6.1.1 requires that procedures for cargo, ballast, tank cleaning and bunkering operations are in place for all vessel types within the fleet. The procedures include:

- Cargo and ballast handling.

IMO: ISM Code

7 The Company should establish procedures, plans and instructions, including checklists as appropriate, for key shipboard operations concerning the safety of the personnel, ship and protection of the environment. The various tasks involved should be defined and assigned to qualified personnel.

IMO: IBC Code

3.1 Cargo segregation

3.1.3 Cargoes, residues of cargoes or mixtures containing cargoes, which react in a hazardous manner with other cargoes, residues or mixtures, shall:

1. be segregated from such other cargoes by means of a cofferdam, void space, cargo pump-room, pump-room, empty tank, or tank containing a mutually compatible cargo;
2. have separate pumping and piping systems which shall not pass through other cargo tanks containing such cargoes, unless encased in a tunnel; and
3. have separate tank venting systems.

3.1.4 If cargo piping systems or cargo ventilation systems are to be separated, this separation may be achieved by the use of design or operational methods. Operational methods shall not be used within a cargo tank and shall consist of one of the following types:

1. removing spool-pieces or valves and blanking the pipe ends;
2. arrangement of two spectacle flanges in series, with provisions for detecting leakage into the pipe between the two spectacle flanges.

USCG: 46 CFR Part 150 – Compatibility of Cargoes

- Figure 1 to Part 150 – Compatibility chart
- Appendix I to Part 150 – Exceptions to the chart

Inspection Guidance

The vessel operator should have developed procedures for cargo stowage planning that included:

- Identification of incompatible cargoes using recognised compatibility charts.
- Means of segregation of incompatible cargoes.

These procedures may refer to:

- Compatibility charts and appendices.
- P&A Manual.
- Relevant ship's drawings showing acceptable segregation arrangements.

The cargo stowage plan should identify when care should be taken to avoid the co-mingling of non-compatible cargoes, which cargoes are involved, and the means of segregation. All areas where comingling is possible should be considered, i.e. cargo tanks, slop tanks, common pipelines, drip trays, tank venting systems etc.

If the USCG compatibility chart is used, then reference to Appendix 1 (b) 'dangerously reactive exceptions to the compatibility chart' must be made during preparation of the stowage plan and the latest updated information must be on board.

If compatibility charts and supporting exception lists from commercial industry publications are used, care must be taken to ensure that they provide the latest information.

Suggested Inspector Actions

- Sight, and where necessary review, the company procedures for identifying and segregating incompatible cargoes during cargo stowage planning.
- Sight, and where necessary review, the compatibility chart in use and verify it contains the latest information.
- Review current and previous cargo stowage plans to verify compliance with company procedures.
- During the course of the inspection, sight any operational means of segregation identified in the cargo stowage plan such as spool pieces or spectacle flanges.
- Interview the officer responsible for cargo stowage planning to verify their familiarity with company procedures for identifying and segregating incompatible cargoes, and the contents and use of the compatibility charts provided on board.

Expected Evidence

- Company procedures for identifying and segregating incompatible cargoes during cargo stowage planning.
- Current and previous cargo stowage plans.
- Compatibility charts and appendices.
- P&A Manual.
- Relevant ship's drawings showing acceptable segregation arrangements.

Potential Grounds for a Negative Observation

- There were no company procedures for cargo stowage planning that included:
  - Identification of incompatible cargoes using recognised compatibility charts.
  - Means of segregation of incompatible cargoes, including ship specific arrangements.
- The officer responsible for cargo stowage planning was not familiar with company procedures for identifying and segregating incompatible cargoes.
- The officer responsible for cargo stowage planning was not familiar with the contents and use of the compatibility charts provided on board.
- There were no compatibility charts issued by a recognised authority available on board.
- The compatibility charts provided on board did not contain the latest information available.
- The chart table footnotes and the data sheets for two particular cargoes had not been consulted during stowage planning.
- Two incompatible cargoes had been stowed adjacent to each other or in a configuration that did not provide double barrier separation.
- Incompatible cargoes had been stowed in tanks that shared a common venting system.
- Tank cleaning had been carried out after carriage of two incompatible cargoes without identifying mitigations in the tank cleaning plan.
- Operational means of segregation were observed to be not as indicated in the cargo stowage plan.
- The cargo stowage plan did not identify when care should be taken to avoid the co-mingling of non-compatible cargoes, which cargoes were involved, and the means of segregation.

8.2.6. Were there sufficient escape sets as required by the IBC Code for everyone on board, and did the sets provide suitable respiratory and eye protection?

Short Question Text
Escape sets required by IBC Code.

Vessel Types
Chemical

ROVIQ Sequence
Engine Room, Internal Accommodation, Interview - Rating

Publications
IMO: ISM Code
OCIMF/ICS: International Safety Guide for Oil Tankers and Terminals. Sixth Edition.
IMO: IBC Code
ICS: Tanker Safety Guide (Chemicals) - Fifth Edition

Objective

To ensure that everyone on board is provided with a suitable emergency escape set to exit a hazardous atmosphere in case of an emergency.

Industry Guidance

ICS: Tanker Safety Guide (Chemicals) - Fifth Edition

3.11.14 Emergency Escape Respiratory Protection

Ships certified for the carriage of certain cargoes listed in the IBC Code are required to be provided with respiratory and eye protection sufficient for every person on board for emergency escape.

Escape sets, known as emergency escape breathing devices (EEBDs), provide a supply of air for at least 15 minutes. This equipment is for emergency escape only and should not be used for any other purpose.

3.11.17 Training

Practical demonstrations and training in the use of all types of breathing apparatus on board should be carried out regularly to ensure that all personnel gain experience in their use. Familiarity gained through regular practice will lead to confidence in the use of the equipment. Only trained personnel who are confident and capable in the use of breathing apparatus should use the equipment.

OCIMF/ICS: International Safety Guide for Oil Tankers and Terminals. Sixth Edition

10.13.3 Emergency Escape Breathing Device

EEBDs are for emergency escape and should not be used as the primary means for entering spaces or compartments with unsafe atmospheres.

The device can be of two types:

Compressed Air Emergency Escape Breathing Device

This consists of an air cylinder, reducing valve, air hose, face mask or hood and a flame-retardant high visibility bag or jacket. It is normally a constant flow device, providing compressed air at a rate of approximately 40 litres per minute, giving a 10-15 minute duration, depending on the capacity of the cylinder. Compressed air EEBDs can normally be recharged on board with a conventional SCBA compressor. The pressure gauge, supply valve and hood should be checked before use.

Re-breathing Emergency Escape Breathing Device

This normally consists of a robust watertight carrying case, compressed oxygen cylinder, breathing bag, mouthpiece and a flame-retardant hood. It is designed for single use. When the hood is placed over the user's head and the set activated, exhaled air is mixed with compressed oxygen inside the breathing bag to allow the wearer to breath normally when escaping from a hazardous atmosphere.

TMSA KPI 6.1.4 requires that the company has procedures that address cargo specific hazards for all vessel types within the fleet. Cargoes with specific hazards may include:

- Aromatic hydrocarbons.
- Toxic cargoes.
- Incompatible cargoes.
- High vapour pressure cargoes.
- Cargoes containing mercaptans and/or H2S.

IMO: ISM Code

7 The Company should establish procedures, plans and instructions, including checklists as appropriate, for key shipboard operations concerning the safety of the personnel, ship and protection of the environment. The various tasks involved should be defined and assigned to qualified personnel.

IMO: IBC Code

14.3 Emergency equipment

14.3.1 Ships carrying cargoes for which 'Yes' is indicated in column 'n' of chapter 17, shall be provided with suitable respiratory and eye protection sufficient for every person on board for emergency escape purposes, subject to the following:

1. filter-type respiratory protection is unacceptable.
2. self-contained breathing apparatus shall have at least a duration of service of 15 min.
3. emergency escape respiratory protection shall not be used for fire-fighting or cargo-handling purposes and shall be marked to that effect.

Inspection Guidance

Escape Set in this context can be considered synonymous with Emergency Escape Breathing Device (EEBD).

The vessel operator should have provided the emergency escape sets required by the IBC Code that:

- Provide suitable respiratory and eye protection.
- Have a duration of at least 15 minutes.
- Do not use filter-type respiratory protection.

And are:

- Available for every person on board.
- In addition to the EEBDs required by SOLAS to be located in the accommodation and machinery spaces.
- Suitably marked as not to be used for fire-fighting or cargo-handling purposes.
- Included in the company procedures for the use and maintenance of EEBDs and the onboard maintenance plan.

Suggested Inspector Actions

- Review the inspection and maintenance records for the EEBDs contained within the onboard maintenance plan.
- Inspect two escape sets at random.

- Interview a rating to verify their familiarity with the locations, purpose and operation of the escape sets provided.

Expected Evidence

- The inspection and maintenance records for the EEBDs contained within the onboard maintenance plan

Potential Grounds for a Negative Observation

- The escape sets provided:
  - Did not have a design duration of at least 15 minutes.
  - Were not included in the company procedures for the use and maintenance of EEBDs and the onboard maintenance plan.
  - Used filter-type respiratory protection.
  - Did not provide suitable eye protection.
  - Were not suitably marked as not to be used for fire-fighting or cargo-handling purposes.
  - Were not in addition to the EEBDs required by SOLAS to be located in the accommodation and machinery spaces.
- An escape set:
  - Was not fully charged.
  - Had not been inspected and maintained in accordance with the onboard maintenance plan.
  - Had been used for fire-fighting or cargo-handling purposes.
  - Had been used as the primary means for entering spaces or compartments with unsafe atmospheres.
- There were insufficient escape sets for everyone on board at the time of the inspection, including any contractors, supernumeraries, visitors etc.
- An interviewed rating was not familiar with the locations, purpose and operation of the escape sets provided.

8.2.7. Were the Master and officers familiar with the company procedures relating to the safety equipment required by the IBC Code, including SCBAs, and was the equipment in satisfactory condition ready for immediate use?

Short Question Text
Safety equipment required by the IBC Code.

Vessel Types
Chemical

ROVIQ Sequence
Forecastle, Cargo Control Room, Main Deck

Publications
IMO: ISM Code
IMO: IBC Code
ICS: Tanker Safety Guide (Chemicals) - Fifth Edition

Objective

To ensure the safety equipment required by the IBC Code is always ready for immediate use in the event of an emergency.

Industry Guidance

ICS: Tanker Safety Guide (Chemicals) - Fifth Edition

3.11.12 Self-contained breathing apparatus *(SCBA)*

SCBA should be stowed outside hazardous areas in places that are easily accessible and should be maintained ready for immediate use. Air cylinders, including spares, should be kept fully charged and the adjusting straps kept slack so as to enable the SCBA to be quickly donned in an emergency.

The IBC Code specifies the number of SCBA sets that have to be provided on board each ship. Guidance may be available from the administration on the use of SCBA including routine maximum personal daily use and required rest periods.

TMSA KPI 6.1.4 requires that the company has procedures that address cargo specific hazards for all vessel types within the fleet. Cargoes with specific hazards may include:

- Aromatic hydrocarbons.
- Toxic cargoes.
- Incompatible cargoes.
- High vapour pressure cargoes.
- Cargoes containing mercaptans and/or H2S.

IMO: ISM Code

7 The Company should establish procedures, plans and instructions, including checklists as appropriate, for key shipboard operations concerning the safety of the personnel, ship and protection of the environment. The various tasks involved should be defined and assigned to qualified personnel.

IMO: IBC Code

14.2 Safety equipment

14.2.1 Ships carrying cargoes for which 15.12, 15.12.1 or 15.12.3 is listed in column ‘o’ in the table of chapter 17 shall have on board sufficient but not less than three complete sets of safety equipment, each permitting personnel to enter a gas-filled compartment and perform work there for at least 20 min. Such equipment shall be in addition to that required by SOLAS regulation II-2/10.10.

14.2.2 One complete set of safety equipment shall consist of:

1. one self-contained air-breathing apparatus (not using stored oxygen);
2. protective clothing, boots, gloves and tight-fitting goggles;
3. fireproof lifeline with belt resistant to the cargoes carried; and
4. explosion-proof lamp.

14.2.3 For the safety equipment required in 14.2.1, all ships shall carry either:

1. one set of fully charged spare air bottles for each breathing apparatus;
2. a special air compressor suitable for the supply of high-pressure air of the required purity;
3. a charging manifold capable of dealing with sufficient spare air bottles for the breathing apparatus; or
4. fully charged spare air bottles with a total free air capacity of at least 6,000 l for each breathing apparatus on board in excess of the requirements of SOLAS regulation II-2/10.10.

14.2.4 A cargo pump-room on ships carrying cargoes which are subject to the requirements of 15.18 or cargoes for which in column ‘k’ in the table of chapter 17 toxic-vapour-detection equipment is required but is not available shall have either:

1. a low-pressure line system with hose connections suitable for use with the breathing apparatus required by 14.2.1. This system shall provide sufficient high-pressure air capacity to supply, through pressure-reduction devices, enough low-pressure air to enable two men to work in a gas-dangerous space for at least 1 h without using the air bottles of the breathing apparatus. Means shall be provided for recharging the fixed air bottles and the breathing apparatus air bottles from a special air compressor suitable for the supply of high-pressure air of the required purity; or
2. an equivalent quantity of spare bottled air in lieu of the low-pressure airline.

14.2.5 At least one set of safety equipment as required by 14.2.2 shall be kept in a suitable clearly marked locker in a readily accessible place near the cargo pump-room. The other sets of safety equipment shall also be kept in suitable, clearly marked, easily accessible places.

14.2.6 The breathing apparatus shall be inspected at least once a month by a responsible officer, and the inspection recorded in the ship’s log-book. The equipment shall be inspected and tested by an expert at least once a year.

Inspection Guidance

An 'expert' in the context of this question may be a member of the crew provided that:

- The crew member who conducted the annual maintenance had attended a manufacturer's training course for the specific type of SCBA carried on board within the five years prior to the last service.
- The specialist testing equipment required to complete the annual service in accordance with the manufacturer's instructions was available on board at the time of the annual service.
- A copy of the manufacturer's training course certificate for the member of the crew who conducted the annual service was retained with the maintenance records.

The vessel operator should have developed procedures relating to the safety equipment, including SCBAs, required by the IBC Code, giving guidance on:

- Stowage and maintaining readiness of the equipment.
- Inspection and testing of the SCBAs.
- Non-emergency use of the SCBAs, including routine maximum personal daily use and required rest periods.

For vessels carrying toxic cargoes, the safety equipment referred to above should provide full protection. The protective suits themselves shall be capable of providing adequate protection against the product as indicated in the appropriate resistance table that is provided by the manufacturer, and fitted with integral gloves and boots. The responsible officer should be aware of these limitations as they relate to the cargoes being carried. Such protective suits are not required if the vessel does not carry toxic cargoes.

If required to be carried, the protective suits must be suitable for:

- All chemicals listed on the certificate of fitness identified under column ‘o’ in the table of chapter 17 of the IBC code.
- Use in a flammable atmosphere.

Some of these procedures may form part of the onboard maintenance plan.

This question will only be allocated where HVPQ question 9.33.3 has been answered as yes.

Suggested Inspector Actions

- Sight, and where necessary review, company procedures for the use of the safety equipment, including SCBAs, required by the IBC Code.
- Review the records of inspection and testing of the SCBAs forming part of the safety equipment required by the IBC.
- Where the annual testing of the SCBA’s had been completed by an ‘expert’ member of the crew, review:
    - The records of the last annual service and verify that a copy of the manufacturer's training course certificate for the specific type of SCBA carried on board was retained for the crewmember who performed the service.
    - The specialist equipment required by the manufacturer to conduct the annual servicing.
- Inspect at least one set of safety equipment required by the IBC Code.
- Interview the accompanying officer to verify their familiarity with company procedures for the use of the safety equipment, including SCBAs, required by the IBC Code.

Expected Evidence

- Company procedures for the use of the safety equipment, including SCBAs, required by the IBC Code.
- Records of inspection and testing of the SCBAs forming part of the safety equipment required by the IBC.
- Evidence that the protective suits were suitable for:
    - All chemicals listed on the certificate of fitness identified under column ‘o’ in the table of chapter 17 of the IBC code.
    - Use in a flammable atmosphere.
- Where annual testing of the SCBAs had been conducted by an 'expert' member of the crew, a copy of the manufacturer's training course certificate for the specific type of SCBA carried on board for the crewmember who performed the service.

Potential Grounds for a Negative Observation

- There were no company procedures relating to the safety equipment, including SCBAs, required by the IBC Code, giving guidance on:
    - Stowage and maintaining readiness of the equipment.
    - Inspection and testing of the SCBAs.
    - Non-emergency use of the SCBAs, including maximum individual daily use and required rest periods.
- The accompanying officer was not familiar with the company procedures relating to the safety equipment, including SCBAs, required by the IBC Code.

- There were less than three complete sets of safety equipment on board, in addition to those required by SOLAS regulation II-2/10.10 for fire-fighting purposes.
- A set of safety equipment did not contain:
    - one self-contained air-breathing apparatus (not using stored oxygen).
    - protective clothing, boots, gloves and tight-fitting goggles.
    - fireproof lifeline with belt resistant to the cargoes carried.
    - explosion-proof lamp.
- The protective suits where not suitable for:
    - All chemicals listed on the certificate of fitness identified under column ‘o’ in the table of chapter 17 of the IBC code.
    - Use in a flammable atmosphere.
- For the safety equipment required by the IBC, the vessel was not equipped with either:
    - One set of fully charged spare air bottles for each breathing apparatus,
    - A special air compressor suitable for the supply of high-pressure air of the required purity,
    - A charging manifold capable of dealing with sufficient spare air bottles for the breathing apparatus; or
    - fully charged spare air bottles with a total free air capacity of at least 6,000 l for each breathing apparatus on board in excess of the requirements of SOLAS regulation II-2/10.10.
- The sets of safety equipment were not stowed:
    - Outside hazardous areas.
    - In a suitable, clearly marked, easily accessible place.
- The sets of safety equipment were not ready for immediate use because:
    - Air cylinders, including spares, were not fully charged.
    - Adjusting straps were not kept slack so as to enable the SCBAs to be donned quickly.
    - Protective clothing, boots and gloves were not ready to be donned quickly.
- The SCBA required by the IBC had not been:
    - Inspected at least once a month by a responsible officer, and the inspection recorded in the ship’s logbook.
    - Inspected and tested by an expert within the last 12 months.
- Where the SCBA required by the IBC code had been tested onboard by an ‘expert’ member of the crew:
    - A copy of the manufacturer's training course certificate for the specific type of SCBA carried on board for the crewmember who performed the service was not available with the maintenance records.
    - The specialist equipment required by the manufacturer to conduct the annual servicing was not available onboard

8.2.8. Were the Master and officers familiar with the company procedures addressing the protective equipment required by the IBC Code, and was this equipment in satisfactory condition and suitable for the products being handled?

Short Question Text
Protective equipment required by the IBC Code.

Vessel Types
Chemical

ROVIQ Sequence
Main Deck, Internal Accommodation

Publications
IMO: ISM Code
IMO: IBC Code
ICS: Tanker Safety Guide (Chemicals) - Fifth Edition

Objective

To ensure crew members are protected from exposure to hazardous conditions when engaged in cargo operations.

Industry Guidance

ICS: Tanker Safety Guide (Chemicals) - Fifth Edition

3.11 Personal Protective Equipment (PPE)

3.11.1 General

PPE protects the wearer from exposure to hazardous working conditions by providing a barrier between the wearer and a hazardous environment. The effectiveness of that barrier will be lost if the PPE is incorrectly used or is the wrong type. It is therefore essential that the selection of PPE is based on a thorough assessment of the risks involved. To ensure consistency across their fleets and that crew members are adequately protected, companies should identify and harmonise cargo-specific PPE for all products on board their ships.

3.11.4 Toxic or corrosive substance protection

The crew should always wear adequate protective clothing when opening equipment that may contain toxic or corrosive substances, e.g. when ullaging and sampling, connecting and disconnecting hoses, opening sighting ports, working within the manifold area, entering pumprooms and tanks, investigating leaks and dealing with spillages on deck.

3.11.5 Chemical resistant clothing (protective suits)

A protective suit should always be used when working in environments where there is a risk of accidental exposure to products or their vapours. There is a risk of exposure during operations at the ship's manifold when connecting and disconnecting hoses, during tank and line sampling, and tank cleaning.

If a protective suit has been contaminated with a hazardous product, it should first be washed or hosed down thoroughly before removal from the wearer. The protective suit should then be properly cleaned in accordance with the manufacturer's guidelines and dried prior to being stored in a ventilated space designed for the purpose.

3.11.6 Types of chemical resistant clothing

SDS and the company's PPE matrix (see Appendix F) should provide advice on the correct type of protective suits and other associated PPE to use when exposure to a product is possible. Ideally, the protective suit should combine the maximum level of protection with the greatest degree of comfort.

Various materials are used to manufacture chemical protective suits. Each material has different chemical resistant properties. The manufacturer of a protective suit must provide a chemical resistance list to indicate for which chemicals a suit may be used for and which restrictions might apply. This list should be referred to prior to use.

Protective clothing is referenced under European/ISO and US standards respectively. Up to date standards should be consulted.

Protection will only be as good as the weakest link and it is therefore important that gloves, boots and head gear, including face protection, offer the same degree of chemical resistance as the remainder of the clothing. Proper sizing of the clothing is essential since an incorrectly fitting suit can mean the expected level of protection will not be met and may be uncomfortable.

Personnel using the protective suits should be properly trained for the type of suit they are using. Before moving into the working area with type 1/level A and type 3/level B suits it is essential that a second properly trained person inspects the suit and confirms it is being properly worn.

Use of a higher level of protection will generally also involve a higher level of exertion, especially in adverse climatic conditions. An assessment of the user's fitness to wear a particular suit type should therefore be conducted. It is recommended that companies issue guidelines for the maximum time a person is allowed to work in a type 1/level A and type 3/level B protective suit.

At all times protective suits should be maintained as per the manufacturer's instructions. Any defects must be repaired, or the suits removed from service.

When selecting appropriate chemical resistant clothing, the manufacturer's instructions should be consulted to ensure that the clothing provides the degree of protection specified as required in the product's SDS.

3.11.7 Eye protection

- Chemical splash goggles give complete chemical and mechanical eye protection and can generally be worn comfortably over most spectacles.
- Chemical spray hoods, usually combined with a safety helmet, provide eye and face protection from splashes of liquid and mechanical hazards, but not against vapour hazards. They should be worn when disconnecting hoses at the manifold or during any other operation where there is a risk of being splashed or sprayed with product under pressure. Face shields are not suitable for this task as they do not offer full coverage from liquid or vapour releases from below the level of the bottom of the shield; and
- Safety spectacles, with or without lateral protection (side shields), are available with different lens materials. Safety spectacles are not designed to be worn over normal spectacles. These are designed to protect the eyes from dust and debris while chipping or carrying out similar tasks. These are not suitable eye protection in chemical environments.

3.11.8 Hand protection

The cargo's SDS should be consulted. The choice of glove will be dependent on the resistance of the glove's material to the chemicals handled and whether the working conditions are continuous or intermittent. Gloves with long cuffs that can extend over the sleeves of normal clothing are preferable.

3.11.9 Foot protection

Rubber or PVC boots need to be worn when there is a risk of coming into contact with corrosive or toxic chemicals. Boots should have reinforced toe caps in order to provide protection against physical injuries.

3.11.10 Cargo-specific PPE

Companies should ensure that product handling hazards are identified and managed. As such, companies should identify cargo-specific PPE for all products or groups of products that are loaded on board its ships. The use of SDS and other available information must be part of the process. The selection of cargo-specific PPE should be based on a risk assessment.

PPE terminology should be standardised across all company documents.

If the cargo specific PPE matrix refers to general categorisation of products, such as corrosive, toxic, very toxic, etc. the company should identify which products belong to each category.

TMSA KPI 6.1.4 requires that the company has procedures that address cargo specific hazards for all vessel types within the fleet. Cargoes with specific hazards may include:

- Aromatic hydrocarbons.
- Toxic cargoes.
- Incompatible cargoes.
- High vapour pressure cargoes.
- Cargoes containing mercaptans and/or H2S.

IMO: ISM Code

7 The Company should establish procedures, plans and instructions, including checklists as appropriate, for key shipboard operations concerning the safety of the personnel, ship and protection of the environment. The various tasks involved should be defined and assigned to qualified personnel.

IMO: IBC Code

14.1 Protective equipment

14.1.1 For the protection of crew members who are engaged in loading and discharging operations, the ship should have on board suitable protective equipment consisting of large aprons, special gloves with long sleeves, suitable footwear, coveralls of chemical-resistant material, and tight-fitting goggles or face shields or both. The protective clothing and equipment should cover all skin so that no part of the body is unprotected.

14.1.2 Work clothes and protective equipment should be kept in easily accessible places and in special lockers. Such equipment should not be kept within accommodation spaces, with the exception of new, unused equipment and equipment which has not been used since undergoing a thorough cleaning process. The Administration may, however, approve storage rooms for such equipment within accommodation spaces if adequately segregated from living spaces such as cabins, passageways, dining rooms, bathrooms, etc.

14.1.3 Protective equipment should be used in any operation which may entail danger to personnel.

Inspection Guidance

The operator should have developed procedures addressing the protective equipment required by the IBC that included:

- A list of protective equipment to be available on board based upon risk assessment and considering the products to be carried.
- What protective equipment is required to be worn for the different types of operations on board, and products handled, preferably in the form of a cargo-specific PPE matrix.
- Crew training in the correct use of the protective equipment.
- Checks to be made that protective equipment is being correctly worn prior to entering a working area.
- Assessment of a user's fitness to wear particular protective equipment in given climatic conditions.

- Guidelines for the maximum time a person is allowed to work in a Type 1/level A and Type 3/level B suit protective suit, if applicable.
- How protective equipment should be cleaned and stored.
- Actions to be taken if defects are identified in protective equipment.
- Frequency of inspection of the protective equipment and records to be kept.

Suggested Inspector Actions

- Sight, and where necessary review, company procedures, including the cargo-specific PPE matrix where provided, addressing the protective equipment required by the IBC Code.
- Review the records of inspections of the protective equipment.
- Inspect a representative sample of the protective equipment in the storage location(s).
- Observe, where possible, protective equipment in use on deck.

- Interview the officer in charge of cargo operations to verify their familiarity with company procedures, including the cargo-specific PPE matrix where provided, addressing the protective equipment required by the IBC Code.
- Request a deck officer or rating to demonstrate or describe the selection and donning of a full set of protective equipment including a protective suit.

Expected Evidence

- Company procedures, including the cargo-specific PPE matrix where provided, addressing the protective equipment required by the IBC Code.
- Records of inspections of the protective equipment.
- An inventory or the protective equipment available onboard required by the IBC Code
- SDS for the products being handled.
- Chemical resistance list available for the protective suits provided on board.
- Evidence that protective suits were suitable for use in a flammable atmosphere.

Potential Grounds for a Negative Observation

- There were no company procedures addressing the protective equipment required by the IBC that included:
    - A list of protective equipment to be available on board based upon risk assessment and considering the products to be carried.
    - What protective equipment was required to be worn for the different types of operations on board, and products handled, preferably in the form of a cargo-specific PPE matrix.
    - Crew training in the correct use of the protective equipment.
    - Checks to be made that protective equipment is being correctly worn prior to entering a working area.
    - Assessment of a user’s fitness to wear particular protective equipment in given climatic conditions.
    - Guidelines for the maximum time a person is allowed to work in a Type 1/level A and Type 3/level B suit protective suit, if applicable.
    - How protective equipment should be cleaned and stored.
    - Actions to be taken if defects are identified in protective equipment.
    - Frequency of inspection of the protective equipment and records to be kept.
- The officer in charge of cargo operations was not familiar with the company procedures addressing the protective equipment required by the IBC Code.
- The PPE matrix, where provided, was not cargo-specific.
- PPE terminology was not standardised across all company documents.
- A crew member was observed not wearing adequate protective clothing where there was a risk of accidental exposure to toxic or corrosive products or their vapours.
- A crew member was observed wearing protective clothing incorrectly where there was a risk of accidental exposure to toxic or corrosive products or their vapours.

- Protective equipment in use did not provide the degree of protection specified as being required in the SDS of a cargo being handled.
- Face shields were being worn when disconnecting hoses at the manifold or during any other operation where there was a risk of being splashed or sprayed with product under pressure.
- Safety spectacles were being used as eye protection in a chemical environment.
- Protective equipment was not stored in an easily accessible, ventilated space, designed for the purpose.
- Protective equipment in use was stored within the accommodation in an unauthorised space or spaces.
- Items of the protective equipment required by company procedures were not available on board.
- There was no chemical resistance list available for the protective suits provided on board.
- There was no evidence that chemical suits were suitable for use in a flammable atmosphere.
- An item of protective equipment in use was in poor condition.
- Gloves, boots and/or head gear were of inferior chemical resistance than the protective suits provided.
- Protective equipment was not available in a suitable quantity and range of sizes to fit the crew on board.
- A deck officer or rating was unfamiliar with the selection and donning of a full set of protective equipment including a protective suit.

8.3. Oil and Chemical

8.3.1. Were the Master and officers familiar with the purpose, operation and testing of the inert gas generator, and had the system been operated and maintained in accordance with the manufacturer's instructions and company procedures?

Short Question Text
Inert gas generator

Vessel Types
Oil, Chemical

ROVIQ Sequence
Engine Room, Engine Control Room

Publications
IMO: ISM Code
IMO SOLAS
OCIMF/ICS: International Safety Guide for Oil Tankers and Terminals. Sixth Edition.
IMO: Inert Gas Systems

Objective

To ensure the inert gas generator always delivers inert gas in accordance with its design criteria.

Industry Guidance

OCIMF/ICS: International Safety Guide for Oil Tankers and Terminals. Sixth Edition

11.1.5.2 Inert Gas system maintenance

The deck and engine departments should cooperate closely to ensure the IG system is maintained and operated properly.

To demonstrate that the IG plant is fully operational and in good working order, a record of inspection of the plant, including defects and their rectification, should be maintained on board.

IMO: Inert Gas Systems

1.3.3 'Inert gas plant' means all equipment specially fitted to supply, cool, clean, pressurize, monitor and control delivery of inert gas to cargo tank systems.

IMO: FSS Code

Chapter 15

2.3.1 System requirements

2.3.1.1 Inert gas generators

2.3.1.1.1 Two fuel oil pumps shall be fitted to the inert gas generator. Suitable fuel in sufficient quantity shall be provided for the inert gas generators.

2.3.1.1.2 The inert gas generators shall be located outside the cargo tank area. Spaces containing inert gas generators shall have no direct access to accommodation service or control station spaces but may be located in machinery spaces. If they are not located in machinery spaces, such a compartment shall be separated by a gastight steel bulkhead and/or deck from accommodation, service and control station spaces. Adequate positive-pressure-type mechanical ventilation shall be provided for such a compartment.

2.3.1.2 Gas regulating valves

2.3.1.2.1 A gas regulating valve shall be fitted in the inert gas main. This valve shall be automatically controlled to close, as required in paragraph 2.2.2.2. It shall also be capable of automatically regulating the flow of inert gas to the cargo tanks unless means are provided to automatically control the inert gas flow rate.

2.3.1.2.2 The gas regulating valve shall be located at the forward bulkhead of the forward most gas-safe space through which the inert gas main passes.

2.3.1.3 Cooling and scrubbing arrangement

2.3.1.3.1 Means shall be fitted which will effectively cool the volume of gas specified in paragraph 2.2.1.2 and remove solids and sulphur combustion products. The cooling water arrangements shall be such that an adequate supply of water will always be available without interfering with any essential services on the ship. Provision shall also be made for an alternative supply of cooling water.

2.3.1.3.2 Filters or equivalent devices shall be fitted to minimize the amount of water carried over to the inert gas blowers.

2.3.1.4 Blowers

2.3.1.4.1 At least two inert gas blowers shall be fitted and be capable of delivering to the cargo tanks at least the volume of gas required by paragraph 2.2.1.2. For systems fitted with inert gas generators the Administration may permit only one blower if that system is capable of delivering the total volume of gas required by paragraph 2.2.1.2 to the cargo tanks, provided that sufficient spares for the blower and its prime mover are carried on board to enable any failure of the blower and its prime mover to be rectified by the ship's crew.

2.3.1.4.2 Where inert gas generators are served by positive displacement blowers, a pressure relief device shall be provided to prevent excess pressure being developed on the discharge side of the blower.

2.3.1.4.3 When two blowers are provided, the total required capacity of the inert gas system shall be divided evenly between the two and in no case is one blower to have a capacity less than 1/3 of the total required.

TMSA 6.1.1 requires that procedures for cargo, ballast, tank cleaning and bunkering operations are in place for all vessel types within the fleet. The procedures include:

- Maintaining safe tank atmospheres.
- Record keeping.

IMO: ISM Code

10.1 The Company should establish procedures to ensure that the ship is maintained in conformity with the provisions of the relevant rules and regulations and with any additional requirements which may be established by the Company.

IMO: SOLAS

Chapter II-2 Regulation 4

5.5.1.1 For tankers of 20,000 tonnes deadweight and upwards constructed on or after 1 July 2002 but before 1 January 2016, the protection of the cargo tanks shall be achieved by a fixed inert gas system in accordance with the requirements of the Fire Safety Systems Code, as adopted by resolution MSC.98(73), except that the Administration may accept other equivalent systems or arrangements, as described in paragraph 5.5.4.

5.5.1.2 For tankers of 8,000 tonnes deadweight and upwards constructed on or after 1 January 2016 when carrying cargoes described in regulation 1.6.1 or 1.6.2, the protection of the cargo tanks shall be achieved by a fixed inert gas system in accordance with the requirements of the Fire Safety Systems Code, except that the Administration may accept other equivalent systems or arrangements, as described in paragraph 5.5.4.

5.5.1.3 Tankers operating with a cargo tank cleaning procedure using crude oil washing shall be fitted with an inert gas system complying with the Fire Safety Systems Code and with fixed tank washing machines. However, inert gas systems fitted on tankers constructed on or after 1 July 2002 but before 1 January 2016 shall comply with the Fire Safety Systems Code, as adopted by resolution MSC.98(73).

Inspection Guidance

The vessel operator should have developed procedures for the operation, inspection, testing and maintenance of the vessel's inert gas system which included the:

- Inert gas generator.
- Gas regulating valve.

A record of inspection and maintenance of the inert gas plant, including defects and their rectification, should be maintained on board.

These procedures and records may form part of the vessel's planned maintenance system.

This question will only be allocated to a vessel fitted with an inert gas generator as its main inert gas system.

Suggested Inspector Actions

- Sight, and where necessary review, the company procedures for the operation, inspection, testing and maintenance of the vessel's inert gas system which included the:
    - Inert gas generator
    - Gas regulating valve.
- Inspect the inert gas plant and verify that:
    - Where the inert gas systems and generator was contained in an enclosed room or space, safe entry procedures were posted at each entrance to the room.
    - Each component of the inert gas system and generator was in good order and free of gas or liquid leaks.
    - The inert gas pipelines and scrubber seawater lines were free of pinholes or temporary repairs.
    - Blowers were free of excessive vibration.
    - If only one blower was provided, there were sufficient spare parts available for the blower and prime mover.
    - The actuators for the gas regulating valve and remote operated isolation valves were operating automatically/remotely.
    - Local or remote temperature or pressure sensing devices were connected and indicating reasonable values.
    - If the inert gas system and generator was not located in the machinery spaces, the compartment was provided with adequate positive-pressure-type mechanical ventilation.
- Where necessary, review the records of inspection, testing and maintenance of the inert gas generator and system and verify that scheduled inspections and maintenance on the equipment had taken place.

- Interview the accompanying officer to verify their familiarity with the purpose, operation, inspection, testing and maintenance of the inert gas system including the:
    - Inert gas generator
    - Gas regulating valve

Expected Evidence

- The company procedures for the operation, inspection, maintenance and testing of the inert gas system and inert gas generator.
- The manufacturer's instruction and maintenance manual for the inert gas generator and inert gas system.
- The records of inspection, testing and maintenance of the inert gas generator and inert gas system.

Potential Grounds for a Negative Observation

- There were no company procedures for the operation, inspection, testing and maintenance of the vessel’s inert gas system which included the:
    - Inert gas generator
    - Gas regulating valve
- The accompanying officer was not familiar with the procedures for the operation, inspection, maintenance and testing of the vessel’s inert gas system.
- Where the inert gas plant was contained in an enclosed room or space, there were no safe entry procedures posted at each entrance to the room.
- The records of inspection and maintenance of the inert gas plant were missing or incomplete.
- The gas regulating valve or remote controlled isolation valves were being operated on local control.
- Local or remote temperature or pressure sensing devices were disconnected or defective.
- There were significant gas or liquid leaks from the inert gas plant.
- Blower(s) were suffering excessive vibration.
- Where only one blower was provided, there were insufficient spare parts available for the blower and prime mover.
- Where the inert gas generator was not located in the machinery spaces the compartment was not provided with adequate positive-pressure-type mechanical ventilation.
- The inert gas plant was defective in any respect.

Where the entry procedures posted at the entrance(s) to the space or spaces containing the inert gas system were not in alignment with the enclosed space entry procedure in the SMS or, entry into a space containing the inert gas system was authorised during the inspection without full compliance with the enclosed space entry procedure, make an observation under question 5.5.1.

8.3.2. Were the Master and officers familiar with the purpose, operation and testing of the nitrogen generator inert gas system, and had the system been operated and maintained in accordance with the manufacturer's instructions and company procedures?

Short Question Text
Nitrogen generator inert gas system

Vessel Types
Oil, Chemical

ROVIQ Sequence
Engine Room, Engine Control Room

Publications
IMO: ISM Code
IMO SOLAS
European Industrial Gases Association: Safe Installation And Operation Of PSA and Membrane Oxygen And Nitrogen Generators
OCIMF/ICS: International Safety Guide for Oil Tankers and Terminals. Sixth Edition.
IMO: FSS Code

Objective

To ensure the nitrogen generator inert gas system always delivers inert gas in accordance with its design criteria.

Industry Guidance

OCIMF/ICS: International Safety Guide for Oil Tankers and Terminals. Sixth Edition

11.1.5.2 Inert Gas system maintenance

The deck and engine departments should cooperate closely to ensure the IG system is maintained and operated properly.

To demonstrate that the IG plant is fully operational and in good working order, a record of inspection of the plant, including defects and their rectification, should be maintained on board.

European Industrial Gases Association: Safe Installation and Operation of PSA and Membrane Oxygen and Nitrogen Generators

4.4 Oxygen hazards

Oxygen concentrations greater than 23.5% create greater fire hazards than normal air. Although it is not flammable, oxygen vigorously accelerates combustion of flammable materials. Materials that do not burn in air, including fire-resistant materials, can burn vigorously in an oxygen-enriched atmosphere. Although a source of ignition energy is always necessary in combination with flammable materials and oxygen, control or elimination of flammables is a precautionary step. Lubricating oils and other hydrocarbon materials can react violently with higher concentrations of oxygen, and the combination shall be avoided.

It is important to note that the waste gas from nitrogen generators contains significantly greater than 23.5% oxygen and without appropriate venting can create an oxygen-enriched atmosphere.

IMO: FSS Code

Chapter 15

2.4 Requirements for nitrogen generator systems

In addition to the provisions in paragraph 2.2, for inert gas systems using nitrogen generators, the provisions of this section shall apply.

2.4.1 System requirements

2.4.1.1 The system shall be provided with one or more compressors to generate enough positive pressure to be capable of delivering the total volume of gas required by paragraph 2.2.1.2.

2.4.1.2 A feed air treatment system shall be fitted to remove free water, particles and traces of oil from the compressed air.

2.4.1.3 The air compressor and nitrogen generator may be installed in the engine-room or in a separate compartment. A separate compartment and any installed equipment shall be treated as an "Other machinery space" with respect to fire protection. Where a separate compartment is provided for the nitrogen generator, the compartment shall be fitted with an independent mechanical extraction ventilation system providing six air changes per hour. The compartment is to have no direct access to accommodation spaces, service spaces and control stations.

2.4.1.4 Where a nitrogen receiver or a buffer tank is installed, it may be installed in a dedicated compartment, in a separate compartment containing the air compressor and the generator, in the engine room, or in the cargo area. Where the nitrogen receiver or a buffer tank is installed in an enclosed space, the access shall be arranged only from the open deck and the access door shall open outwards. Adequate, independent mechanical ventilation, of the extraction type, shall be provided for such a compartment.

2.4.2 Indicators and alarms

2.4.2.1 In addition to the requirements in paragraph 2.2.4.2, instrumentation is to be provided for continuously indicating the temperature and pressure of air at the suction side of the nitrogen generator.

2.4.2.2 In addition to the requirements in paragraph 2.2.4.5, audible and visual alarms shall be provided to include:

1. failure of the electric heater, if fitted.
2. low feed-air pressure or flow from the compressor.
3. high-air temperature; and
4. high condensate level at automatic drain of water separator.

TMSA 6.1.1 requires that procedures for cargo, ballast, tank cleaning and bunkering operations are in place for all vessel types within the fleet. The procedures include:

- Maintaining safe tank atmospheres.
- Record keeping.

IMO: ISM Code

10.1 The Company should establish procedures to ensure that the ship is maintained in conformity with the provisions of the relevant rules and regulations and with any additional requirements which may be established by the Company.

IMO: SOLAS

Chapter II-2 Regulation 4

5.5.1.1 For tankers of 20,000 tonnes deadweight and upwards constructed on or after 1 July 2002 but before 1 January 2016, the protection of the cargo tanks shall be achieved by a fixed inert gas system in accordance with the requirements of the Fire Safety Systems Code, as adopted by resolution MSC.98(73), except that the Administration may accept other equivalent systems or arrangements, as described in paragraph 5.5.4.

5.5.1.2 For tankers of 8,000 tonnes deadweight and upwards constructed on or after 1 January 2016 when carrying cargoes described in regulation 1.6.1 or 1.6.2, the protection of the cargo tanks shall be achieved by a fixed inert gas system in accordance with the requirements of the Fire Safety Systems Code, except that the Administration may accept other equivalent systems or arrangements, as described in paragraph 5.5.4.

5.5.1.3 Tankers operating with a cargo tank cleaning procedure using crude oil washing shall be fitted with an inert gas system complying with the Fire Safety Systems Code and with fixed tank washing machines. However, inert gas systems fitted on tankers constructed on or after 1 July 2002 but before 1 January 2016 shall comply with the Fire Safety Systems Code, as adopted by resolution MSC.98(73).

Inspection Guidance

The vessel operator should have developed procedures for the operation, inspection, testing and maintenance of the vessel's inert gas system which included the nitrogen generator and its associated equipment.

A record of inspection and maintenance of the inert gas plant, including defects and their rectification, should be maintained on board.

These procedures and records may form part of the vessel's planned maintenance system.

It is recommended a warning sign is posted at an appropriate place to warn of the dangers of the oxygen-enriched waste gases from the nitrogen generator.

It is recommended that a warning sign is posted at each entrance to the space(s) containing the air compressor, nitrogen generator, nitrogen receiver or buffer tank warning of the dangers of asphyxiation in a nitrogen enriched atmosphere.

Suggested Inspector Actions

- Sight, and where necessary review, the company procedures for the operation, inspection, testing and maintenance of the vessel's inert gas system which included the nitrogen generator and its associated equipment.
- Inspect the nitrogen generator and its associated equipment including, where fitted:
    - Air and nitrogen compressor.
    - Feed air treatment system.
    - PSA or membrane nitrogen. generating units.
    - Nitrogen receiver or buffer tank.
- Verify the following visual and audible alarms are in good order:
    - Failure of the electric heater, if fitted.
    - Low feed-air pressure or flow from the compressor.
    - High-air temperature.
    - High condensate level at the automatic drain of the water separator.
- Where the air compressor and nitrogen generator, nitrogen receiver or buffer tank are installed in a dedicated compartment, verify:
    - That the independent mechanical extraction ventilation system is operating correctly.
    - Safe entry procedures are posted at each entrance to the compartment.
    - Warning signs are posted at each entrance to the space warning of the dangers of asphyxiation in a nitrogen enriched atmosphere.
- Where necessary, review the records of inspection, testing and maintenance of the inert gas system and verify that scheduled inspections and maintenance on the equipment had taken place.

- Interview the accompanying officer to verify their familiarity with the purpose, operation, inspection, testing and maintenance of the inert gas system including the nitrogen generator and its associated equipment and the dangers of:
  - An oxygen deficient atmosphere as a result of nitrogen leakage.
  - An oxygen-enriched exhaust from the nitrogen generator.

Expected Evidence

- The company procedures for the operation, inspection, maintenance and testing of the inert gas system.
- The manufacturer's instruction and maintenance manual for the nitrogen generator inert gas system.
- The records of inspection, testing and maintenance of the inert gas system.

Potential Grounds for a Negative Observation

- There were no company procedures for the operation, inspection, testing and maintenance of the vessel's inert gas system which included the nitrogen generator and its associated equipment.
- The accompanying officer was not familiar with the procedures for the operation, inspection, maintenance and testing of the vessel's inert gas system including the nitrogen generator.
- The accompanying officer was not familiar with the dangers from:
  - An oxygen deficient atmosphere as a result of nitrogen leakage.
  - The oxygen-enriched exhaust from the nitrogen generator.
- The record of inspection and maintenance of the inert gas plant, including defects and their rectification, was missing or incomplete.
- Any of the following visual and audible alarms was inoperative:
  - Failure of the electric heater, if fitted.
  - Low feed-air pressure or flow from the compressor.
  - High-air temperature.
  - High condensate level at the automatic drain of the water separator.
- The independent mechanical extraction ventilation system serving a dedicated space containing the air compressor and nitrogen generator or the nitrogen receiver or buffer tank was not operating correctly.
- Where the air compressor and nitrogen generator, nitrogen receiver or buffer tank were installed in a dedicated compartment, there were no safe entry procedures posted at each entrance to the compartment.
- The nitrogen generator and its associated equipment was defective in any respect.

Where:

- The entry procedures posted at the entrance of the space, or spaces, containing the air compressor, nitrogen generator and nitrogen receiver or buffer tank, were not in alignment with the enclosed space entry procedure in the SMS or,
- Entry into a space or spaces containing the air compressor, nitrogen generator and nitrogen receiver or buffer tank was authorised during the inspection without full compliance with the enclosed space entry procedure.

Make an appropriate observation under question 5.5.1.

8.3.3. Were the Master and officers familiar with the purpose, operation and testing of the flue gas inert gas system, and had the system been operated and maintained in accordance with the manufacturer's instructions and company procedures?

Short Question Text
Flue gas inert gas system

Vessel Types
Oil, Chemical

ROVIQ Sequence
Engine Room, Engine Control Room

Publications
IMO: ISM Code
IMO SOLAS
OCIMF/ICS: International Safety Guide for Oil Tankers and Terminals. Sixth Edition.
IMO: FSS Code
IMO: Inert Gas Systems

Objective

To ensure the flue gas inert gas system always delivers inert gas in accordance with its design criteria.

Industry Guidance

OCIMF/ICS: International Safety Guide for Oil Tankers and Terminals. Sixth Edition

11.1.5.2 Inert Gas system maintenance

The deck and engine departments should cooperate closely to ensure the IG system is maintained and operated properly.

To demonstrate that the IG plant is fully operational and in good working order, a record of inspection of the plant, including defects and their rectification, should be maintained on board.

IMO: Inert Gas Systems

1.3.3 'Inert gas plant' means all equipment specially fitted to supply, cool, clean, pressurize, monitor and control delivery of inert gas to cargo tank systems.

IMO: FSS Code

Chapter 15

2.3.1 System requirements

2.3.1.2 Gas regulating valves

2.3.1.2.1 A gas regulating valve shall be fitted in the inert gas main. This valve shall be automatically controlled to close, as required in paragraph 2.2.2.2. It shall also be capable of automatically regulating the flow of inert gas to the cargo tanks unless means are provided to automatically control the inert gas flow rate.

2.3.1.2.2 The gas regulating valve shall be located at the forward bulkhead of the forward most gas-safe space through which the inert gas main passes.

2.3.1.3 Cooling and scrubbing arrangement

2.3.1.3.1 Means shall be fitted which will effectively cool the volume of gas specified in paragraph 2.2.1.2 and remove solids and sulphur combustion products. The cooling water arrangements shall be such that an adequate supply of water will always be available without interfering with any essential services on the ship. Provision shall also be made for an alternative supply of cooling water.

2.3.1.3.2 Filters or equivalent devices shall be fitted to minimize the amount of water carried over to the inert gas blowers.

2.3.1.4 Blowers

2.3.1.4.1 At least two inert gas blowers shall be fitted and be capable of delivering to the cargo tanks at least the volume of gas required by paragraph 2.2.1.2.

2.3.1.4.3 When two blowers are provided, the total required capacity of the inert gas system shall be divided evenly between the two and in no case is one blower to have a capacity less than 1/3 of the total required.

2.3.1.5 Inert gas isolating valves

For systems using flue gas, flue gas isolating valves shall be fitted in the inert gas mains between the boiler uptakes and the flue gas scrubber. These valves shall be provided with indicators to show whether they are open or shut, and precautions shall be taken to maintain them gastight and keep the seatings clear of soot. Arrangements shall be made to ensure that boiler soot blowers cannot be operated when the corresponding flue gas valve is open.

2.3.1.6 Prevention of flue gas leakage

2.3.1.6.1 Special consideration shall be given to the design and location of scrubber and blowers with relevant piping and fittings in order to prevent flue gas leakages into enclosed spaces.

2.3.1.6.2 To permit safe maintenance, an additional water seal or other effective means of preventing flue gas leakage shall be fitted between the flue gas isolating valves and scrubber or incorporated in the gas entry to the scrubber.

TMSA 6.1.1 requires that procedures for cargo, ballast, tank cleaning and bunkering operations are in place for all vessel types within the fleet. The procedures include:

- Maintaining safe tank atmospheres.
- Record keeping.

IMO: ISM Code

10.1 The Company should establish procedures to ensure that the ship is maintained in conformity with the provisions of the relevant rules and regulations and with any additional requirements which may be established by the Company.

IMO: SOLAS

Chapter II-2 Regulation 4

5.5.1.1 For tankers of 20,000 tonnes deadweight and upwards constructed on or after 1 July 2002 but before 1 January 2016, the protection of the cargo tanks shall be achieved by a fixed inert gas system in accordance with the requirements of the Fire Safety Systems Code, as adopted by resolution MSC.98(73), except that the Administration may accept other equivalent systems or arrangements, as described in paragraph 5.5.4.

5.5.1.2 For tankers of 8,000 tonnes deadweight and upwards constructed on or after 1 January 2016 when carrying cargoes described in regulation 1.6.1 or 1.6.2, the protection of the cargo tanks shall be achieved by a fixed inert gas system in accordance with the requirements of the Fire Safety Systems Code, except that the Administration may accept other equivalent systems or arrangements, as described in paragraph 5.5.4.

5.5.1.3 Tankers operating with a cargo tank cleaning procedure using crude oil washing shall be fitted with an inert gas system complying with the Fire Safety Systems Code and with fixed tank washing machines. However, inert gas systems fitted on tankers constructed on or after 1 July 2002 but before 1 January 2016 shall comply with the Fire Safety Systems Code, as adopted by resolution MSC.98(73).

Inspection Guidance

The vessel operator should have developed procedures for the operation, inspection, testing and maintenance of the vessel's inert gas system which included the:

- Boiler uptake valves.
- Scrubber.
- Demister.
- Blowers.
- Gas regulating valve.

A record of inspection and maintenance of the inert gas plant, including defects and their rectification, should be maintained on board.

These procedures and records may form part of the vessel's planned maintenance system.

This question will only be allocated to a vessel with a flue gas system.

Suggested Inspector Actions

- Sight, and where necessary review, the company procedures for the operation, inspection, testing and maintenance of the vessel's inert gas system which included the:
    - Boiler uptake valves.
    - Scrubber.
    - Demister.
    - Blowers.
    - Gas regulating valve.
- Inspect the inert gas plant located in the machinery spaces and verify that:
    - Where the inert gas plant was contained in an enclosed room or space, safe entry procedures were posted at each entrance to the room.
    - Each component of the inert gas system was in good order and free of inert gas or liquid leaks.
    - The inert gas pipelines and scrubber seawater lines were free of pinholes or temporary repairs.
    - Blowers were free of excessive vibration.
    - The actuators for the gas regulating valve and remote operated isolation valves were operating automatically/remotely.
    - Local or remote temperature or pressure sensing devices were connected and indicating reasonable values
- Where necessary, review the records of inspection, testing and maintenance of the inert gas system and verify that scheduled inspections and maintenance on the equipment had taken place.

- Interview the accompanying officer to verify their familiarity with the purpose, operation, inspection, testing and maintenance of the inert gas system including the:
    - Boiler uptake valves.
    - Scrubber.
    - Demister.

    - Blowers.
    - Gas regulating valve.

Expected Evidence

- The company procedures for the operation, inspection, maintenance and testing of the inert gas system.
- The manufacturer's instruction and maintenance manual for the flue gas inert gas system.
- The records of inspection, testing and maintenance of the inert gas system.

Potential Grounds for a Negative Observation

- There were no company procedures for the operation, inspection, testing and maintenance of the vessel's inert gas system which included the:
    - Boiler uptake valves.
    - Scrubber.
    - Demister.
    - Blowers.
    - Gas regulating valve.
- The accompanying officer was not familiar with the procedures for the operation, inspection, maintenance and testing of the vessel's inert gas system.
- Where the inert gas plant was contained in an enclosed room or space, there were no safe entry procedures posted at each entrance to the room.
- The records of inspection and maintenance of the inert gas plant was missing or incomplete.
- The gas regulating valve or remote controlled isolation valves were being operated on local control.
- Local or remote temperature or pressure sensing devices were disconnected or defective.
- There were significant gas or liquid leaks from the inert gas plant.
- Blower(s) were suffering excessive vibration.
- The inert gas plant was defective in any respect.

Where the entry procedures posted at the entrance(s) to the space or spaces containing the inert gas system were not in alignment with the enclosed space entry procedure in the SMS or, entry into a space containing the inert gas system was authorised during the inspection without full compliance with the enclosed space entry procedure, make an observation under question 5.5.1.

8.3.4. Were the Master and officers familiar with the company procedures for the maintenance, testing and setting of the cargo tank high-level and high-high-level alarms, and were these alarm systems fully operational and properly set?

Short Question Text
Cargo tank high level and overfill alarms.

Vessel Types
Oil, Chemical

ROVIQ Sequence
Cargo Control Room, Main Deck

Publications
USCG: Code of Federal Regulations. Title 46.
ICS: Tanker Safety Guide (Chemicals) - Fifth Edition
IMO: ISM Code
IMO SOLAS
IMO: IBC Code

Objective

To ensure that cargo tank high-level and high-high-level alarms are always fully operational, properly set and used during all cargo loading, discharging and transfer operations.

Industry Guidance

USCG: Code of Federal Regulations. Title 46.

46 CFR § 39.2007 - Tankship liquid overfill protection - T/ALL.

(a) Each cargo tank of a tankship must be equipped with an intrinsically safe high-level alarm and a tank overfill alarm.

(b) If installed after July 23, 1990, the high-level alarm and tank overfill alarm required by paragraph (a) of this section must -

- Be independent of each other.
- Activate an alarm in the event of loss of power to the alarm system.
- Activate an alarm during the failure of electrical circuitry to the tank level sensor; and
- Be able to be verified at the tank for proper operation prior to each transfer. This procedure may be achieved with the use of an electronic self-testing feature that monitors the condition of the alarm circuitry and sensor.

(c) The high-level alarm required by paragraph (a) of this section must -

- Activate an alarm once the cargo level reaches 95 percent of the tank capacity or higher, but before the tank overfill alarm.
- Be identified with the legend “High-level Alarm” in black letters at least 50.8 millimetres (2 inches) high on a white background; and
- Activate a visible and audible alarm so that it can be seen and heard on the vessel where cargo transfer is controlled.

(d) The tank overfill alarm required by paragraph (a) of this section must -

- Be independent of the cargo gauging system.

- Be identified with the legend “TANK OVERFILL ALARM” in black letters at least 50.8 millimetres (2 inches) high on a white background.
- Activate a visible and audible alarm so that it can be seen and heard on the vessel where cargo transfer is controlled and in the cargo deck area; and
- Activate an alarm early enough to allow the person in charge of transfer operations to stop the cargo transfer before the tank overflows.

ICS: Tanker Safety Guide (Chemicals) - Fifth Edition

5.3.5 Overfill detection systems

High level alarms

Carriage requirements for certain cargoes require tanks to be fitted with high level alarms that are independent of any alarms fitted to the closed gauging system. The alarm may be activated by either a float-operated switch, a capacitive pressure transmitter, or an ultrasonic device. The activation point should be set to when the cargo is approaching the normal full condition. Typically this limit will be set at 95%.

Tank overflow control systems (overflow alarms)

Tank overflow control systems should be set to alarm when the level in the tank reaches 98% of capacity.

Testing Alarms

All high level and overflow alarms should be tested in accordance with the manufacturer’s instructions to ensure correct operation prior to cargo operations. This will confirm that the alarms are working correctly and can be relied upon.

TMSA KPI 6.1.2 requires that procedures for pre-operational tests and checks of cargo and bunkering equipment are in place for all vessel types within the fleet. Tests and checks of equipment may include:

- Alarms and trips.
- Tank gauging equipment.

IMO: ISM Code

7 The Company should establish procedures, plans and instructions, including checklists as appropriate, for key shipboard operations concerning the safety of the personnel, ship and protection of the environment. The various tasks involved should be defined and assigned to qualified personnel.

IMO: IBC Code

15.19 Overflow control

15.19.1 The provisions of this section are applicable where specific reference is made in column “o” in the table of chapter 17 and are in addition to the requirements for gauging devices.

15.19.2 In the event of a power failure on any system essential for safe loading, an alarm shall be given to the operators concerned.

15.19.3 Loading operations shall be terminated at once in the event of any system essential for safe loading becoming inoperative.

15.19.4 Level alarms shall be capable of being tested prior to loading.

15.19.5 The high-level alarm system required under 15.19.6 shall be independent of the overflow-control system required by 15.19.7 and shall be independent of the equipment required by 13.1 (gauging devices).

15.19.6 Cargo tanks shall be fitted with a visual and audible high-level alarm which complies with 15.19.1 to 15.19.5 and which indicates when the liquid level in the cargo tank approaches the normal full condition.

15.19.7 A tank overflow-control system required by this section shall:

- come into operation when the normal tank loading procedures fail to stop the tank liquid level exceeding the normal full condition.
- give a visual and audible tank-overflow alarm to the ship's operator; and
- provide an agreed signal for sequential shutdown of onshore pumps or valves or both and of the ship's valves. The signal, as well as the pump and valve shutdown, may be dependent on operator's intervention. The use of shipboard automatic closing valves shall be permitted only when specific approval has been obtained from the Administration and the Port State authority concerned.

IMO: SOLAS

Chapter II-2 Regulation 11

6.3.1 Preventive measures against liquid rising in the venting system

Provisions shall be made to guard against liquid rising in the venting system to a height which would exceed the design head of cargo tanks. This shall be accomplished by high-level alarms or overflow control systems or other equivalent means, together with independent gauging devices and cargo tank filling procedures. For the purposes of this regulation, spill valves are not considered equivalent to an overflow system.

Inspection Guidance

For the purposes of this question, the term "high-high-level alarms" includes:

- Overfill alarms
- Overflow alarms
- Overflow control systems

In oil ships, high-level alarms may be integral to the fixed gauging system, but not high-high alarms.

In chemical ships, both high-level and high-high-level alarms must be independent of the fixed gauging system, and each other.

The vessel operator should have developed procedures for the maintenance, setting and testing of the cargo tank high-level and high-high-level alarm systems, including:

- The mandatory use of the alarms during all cargo tank loading, discharging and transfer operations.
- Set points for all alarms.
- Testing procedures and frequency.
- Records of testing and maintenance to be kept.
- Guidance on the use of shipboard automatic closing valves, if fitted.
- Procedure, based on risk assessment, to enable continued cargo loading, discharge or transfer operations in the event of a failure of the cargo tank high-level or high-high-level alarm system or a single alarm for an individual cargo tank.

The instruction within the planned maintenance system may form part of the procedures.

Suggested Inspector Actions

- Sight, and where necessary review, the company procedures for the maintenance, setting and testing of the cargo tank high-level and high-high-level alarm systems.
- Review the records of testing and maintenance of the cargo tank high-level and high-high-level alarm systems.
- Inspect the alarm indicator panels in the cargo control room or position and verify:
    - The panel was switched on with all cargo tanks being monitored.
    - The audible and visible alarms were operational.
- Inspect the alarm equipment on deck including the audible and visible alarm fittings.
- If safe to do so, request that the accompanying officer demonstrates the operation of the audible and visible alarms on the deck area by the test activation of a high-high-level alarm on a randomly selected cargo tank.

- Interview the accompanying officer to verify their familiarity with:
    - The company procedures for the maintenance, setting and testing of the cargo tank high-level and high-high-level alarm systems.
    - The circumstances under which the cargo tank high-level and high-high-level alarm systems or individual tanks alarms may be isolated and the safeguards to ensure they were always in operation during cargo transfer operations.

Expected Evidence

- The company procedures for the maintenance, setting and testing of the cargo tank high-level and high-high-level alarm systems.
- Records of the maintenance, testing and setting of the cargo tank high-level and high-high-level alarm systems.

Potential Grounds for a Negative Observation

- There were no company procedures for the maintenance, testing and setting of the cargo tank high-level and high-high-level alarm systems.
- The accompanying officer was not familiar with:
    - The company procedures for the maintenance, testing and setting of the cargo tank high-level and high-high-level alarm systems.
    - The circumstances under which the cargo tank high-level and high-high-level alarm systems or individual cargo tank alarms may be isolated and the safeguards to ensure they were always in operation during cargo transfer operations.
- The company procedures for the maintenance, testing and setting of the cargo tank high-level and high-high-level alarm systems did not include:
    - The mandatory use of the alarms during all loading, discharging and transfer operations.
    - Set points for all alarms.
    - Testing procedures and frequency.
    - Records of testing and maintenance to be kept.
    - Guidance on the use of shipboard automatic closing valves, if fitted.
    - Procedure, based on risk assessment, to enable continued cargo loading, discharge or transfer operations in the event of a failure of the cargo tank high-level or high-high-level alarm system or a single alarm for an individual cargo tank.
- High-level and/or high-high-level alarms were not in operation at the time of inspection, during loading, discharging or transfer operations.
- High-level alarms were not fitted.
- High-high-level alarms were not fitted.
- High-level and high-high-level alarms were not independent of each other.
- High-high-level alarms were not independent of the fixed tank gauging system.
- High-level alarms were set at or above the high-high-level alarm activation point.
- High-level and high-high-level alarm indicator panels etc. were not clearly identified as such.
- High-level and/or high-high-level alarm audible and/or visible alarms were not operational in the cargo control room or on deck.

- High-high-level alarms were not set at a level to allow the person in charge of transfer operations to stop the cargo transfer before the tank overflows (typically 98% of the tank capacity).
- High-level and/or high-high-level alarms had not been regularly tested in accordance with the manufacturer's instructions.
- In a chemical ship, the:
    - High-level alarms were not independent of the fixed gauging system.
    - High-high-level alarms did not provide an agreed signal for sequential shutdown of onshore pumps and/or valves and ship's valves. (the signal may be dependent on operator intervention)
    - Shipboard automatic closing valves were in use without the specific approval of the flag sate and or port state authority.
- The high-level and/or high-high-level alarms were permanently silenced or inhibited
- The high-level and/or high-high-level alarms were defective in any respect.

8.3.5. Were the Master, deck officers and deck ratings familiar with the company procedures for dipping, ullaging and sampling flammable static accumulator cargoes in non-inerted tanks, and were these procedures being followed?

Short Question Text
Gauging and sampling static accumulator cargo in non-inerted tanks.

Vessel Types
Oil, Chemical

ROVIQ Sequence
Cargo Control Room, Main Deck, Interview - Deck Rating

Publications
IMO: ISM Code
OCIMF/ICS: International Safety Guide for Oil Tankers and Terminals. Sixth Edition.

Objective

To ensure that the required additional precautions are taken when dipping, ullaging and sampling flammable static accumulator cargoes in non-inerted tanks.

Industry Guidance

OCIMF/ICS: International Safety Guide for Oil Tankers and Terminals

3.2 General precautions against electrostatic hazards

3.2.1 Overview

The safest way to protect from electrostatic risks is to conduct operations with tanks protected by IG.

However, if a flammable atmosphere might be present, the following measures should be taken to prevent electrostatic hazards:

- Bond metal objects to the metal structure of the tanker to eliminate risk of spark discharges between metal objects that might be electrically insulated. This includes the metallic components of any equipment used for dipping, ullaging and sampling.
- Remove any loose conductive objects that cannot be bonded.

…

The following additional precautions should be taken against static electricity during ullaging, dipping, gauging, or sampling of static accumulator oils:

- Prohibit the use of conductive (metal) ullaging, dipping, gauging or sampling equipment during product transfers into a tank and for 30 minutes after completion of operations to allow the settling of gas bubbles, water or particulate matter in the liquid and the relaxation of any electrical charge. After the 30 minutes settling time, metal ullaging, dipping, gauging or sampling equipment may be used but it must be effectively bonded and securely earthed to the structure of the ship before it is introduced into the tank and must remain earthed until after removal.
- Prohibit the use of all non-conductive (non-metal) containers of more than one litre capacity for dipping, ullaging and sampling during loading and for 30 minutes after completion of product transfer into a tank.

Non-conductive (non-metal containers) of less than one litre capacity may be used for sampling in tanks at any time if they have no conducting components and if they are not rubbed prior to sampling. Cleaning, with a high conductivity proprietary cleaner or soapy water, is recommended to reduce charge generation. To prevent charging, the container should not be rubbed dry after washing.

Operations can be carried out at any time through a correctly designed and installed full depth sounding pipe. A significant charge cannot accumulate on the surface of the liquid within the sounding pipe and so waiting time is not required. Precautions to prevent the introduction of charged objects into a tank still apply and if metal equipment is used it should be bonded before being inserted into the sounding pipe.

Detailed guidance on precautions to be taken during ullaging, dipping and sampling of static accumulator oils is given in section 12.8.2. These precautions should be closely followed to avoid the hazards associated with the accumulation of an electrical charge on the cargo.

12.8.2 Measuring and sampling non-inerted tanks

12.8.2.2 Introducing equipment to a tank

Measures to avoid charged objects.

Non-conducting and intermediate conducting materials may be acceptable in some circumstances, e.g. plastic sample bottle holders can be lowered safely with natural fibre (intermediate conductivity) rope. Natural fibre rope should be used because synthetic rope generates significant static charge when sliding rapidly through an operator's gloved hand. This type of apparatus needs no special bonding or earthing.

12.8.2.3 Sounding pipes

A sounding pipe is a conducting pipe that extends the full depth of the tank and is effectively bonded and earthed to the tank structure.

A sounding pipe can be used at any time because, as long as it is designed and installed properly, it is not possible for any significant charge to accumulate on the surface of the liquid within it. The pipe should be slotted to prevent any pressure differential between the pipe and the tank and to ensure that true levels are indicated.

TMSA KPI 6.1.1 requires that procedures for cargo, ballast, tank cleaning and bunkering operations are in place for all vessel types within the fleet. The procedures include:

- Cargo and ballast handling.

IMO: ISM Code

7 The Company should establish procedures, plans and instructions, including checklists as appropriate, for key shipboard operations concerning the safety of the personnel, ship and protection of the environment. The various tasks involved should be defined and assigned to qualified personnel.

Inspection Guidance

The vessel operator should have developed procedures for dipping, ullaging and sampling flammable static accumulator cargoes in non-inerted tanks that described the additional precautions to be taken against static electricity including:

- A description of the dipping, ullaging and sampling equipment to be used.
- Bonding/earthing/cleaning procedures for this equipment.
- Settling time after completion of operations.
- Additional precautions if the vessel is not fitted with properly designed and installed full length sounding pipes.
- Actions to be taken in the event of a failure of the fixed tank gauging system, if fitted.

Information on the type of sounding pipes fitted should be clearly displayed at the cargo control position.

Ropes or tapes made of synthetic materials should not be used for lowering equipment into cargo tanks at any time.

This question will be allocated as follows:

- Oil tankers: not fitted with an inert gas system. Determined by HVPQ 9.15.1 answered in the negative.
- Oil / Chemical tankers: All.
- Chemical tankers: All.

Suggested Inspector Actions

- Sight, and where necessary review, the company procedures for dipping, ullaging and sampling flammable static accumulator cargoes in non-inerted tanks.
- If the vessel is fitted with a fixed tank level gauging system but is not fitted with IG and not fitted with full depth sounding pipes, the operator's procedure to be followed in the event of failure of the fixed gauging system must be reviewed.
- Observe dipping, ullaging and sampling taking place, if possible.
- Review cargo log books and records to verify compliance with company procedures.

- Interview the officer in charge of cargo operations to verify their familiarity with company procedures for dipping, ullaging and sampling flammable static accumulator cargoes in non-inerted tanks.
- Interview a deck rating to verify their familiarity with company procedures for dipping, ullaging and sampling flammable static accumulator cargoes in non-inerted tanks.

Expected Evidence

- Company procedures for dipping, ullaging and sampling flammable static accumulator cargoes in non-inerted tanks.
- Cargo log books and records.
- Drawings/plans relating to cargo tank sounding pipes.

Potential Grounds for a Negative Observation

- There were no company procedures for dipping, ullaging and sampling flammable static accumulator cargoes in non-inerted tanks that described the additional precautions to be taken against static electricity including:
  - A description of the dipping, ullaging and sampling equipment to be used.
  - Bonding/earthing/cleaning procedures for this equipment.
  - Settling time after completion of operations.
  - Additional precautions if the vessel is not fitted with properly designed and installed full length sounding pipes.
  - Actions to be taken in the event of a failure of the fixed tank gauging system, if fitted.
- The officer in charge of cargo operations was not familiar with the company procedures for dipping, ullaging and sampling flammable static accumulator cargoes in non-inerted tanks.
- A deck rating was not familiar with the company procedures for dipping, ullaging and sampling flammable static accumulator cargoes in non-inerted tanks as they related to their duties.
- There was no information available on the type of sounding pipes fitted in the cargo tanks.
- In a vessel fitted with a fixed tank level gauging system but not fitted with IG and not fitted with full depth sounding pipes, the operator's procedure to be followed in the event of failure of the fixed gauging system did not adequately address the additional precautions required for dipping, ullaging and sampling flammable static accumulator cargoes in non-inerted tanks.

- Metallic components of any equipment used for dipping, ullaging and sampling were not bonded to the metal structure of the vessel.
- Metal ullaging, dipping, gauging or sampling equipment was introduced into a cargo tank during product transfer or within 30 minutes of completion without the use of a full-length sounding pipe.
- A non- metal sampling container of more than one litre capacity was introduced into a cargo tank during product transfer or within 30 minutes of completion without the use of a full-length sounding pipe.
- Ropes or tapes made of synthetic materials had been used for lowering ullaging and/or sampling equipment into cargo tanks.
- A non-metal sampling container was rubbed dry prior to being introduced to a cargo tank.
- Sounding pipes used for dipping, ullaging and sampling cargo tanks were not metallic and/or did not extend the full depth of the tank and/or were not effectively bonded and earthed to the tank structure.

8.3.6. Were the Master and deck officers familiar with the company procedures for loading flammable static accumulator cargoes into non-inerted tanks, and were these procedures being followed?

Short Question Text
Loading static accumulator cargo into non-inerted tanks.

Vessel Types
Oil, Chemical

ROVIQ Sequence
Cargo Control Room, Main Deck

Publications
IMO: ISM Code
OCIMF/ICS: International Safety Guide for Oil Tankers and Terminals. Sixth Edition.

Objective

To ensure suitable precautions are always taken when flammable static accumulator cargoes are loaded into non-inerted tanks.

Industry Guidance

OCIMF/ICS: International Safety Guide for Oil Tankers and Terminals. Sixth Edition.

3.1.4.3 Conductivity

Liquid non-conductors have conductivities of less than 50 pS/m (picoSiemens/metre). Such liquids are often referred to as static accumulators.

Petroleum products, e.g. clean oils (distillates) including some low sulphur bunker fuels, frequently fall into this category with typical conductivities being below 10 pS/m (relaxation time > 2s). Chemical solvents and highly refined fuels can have conductivities less than 1 pS/m (relaxation time > 20s)

3.2 General precautions against electrostatic hazards

3.2.1 Overview

The safest way to protect from electrostatic risks is to conduct operations with tanks protected by IG.

However, if a flammable atmosphere might be present, the following measures should be taken to prevent electrostatic hazards:

- Restrict the product flow to a maximum of 1 m/sec at the individual tank inlets, irrespective of design, during the initial stages of product transfer into a tank, until:
    - The filling pipe and any other structure on the base of the tank has been submerged to twice the filling pipe diameter and all splashing and surface turbulence has ceased, and
    - Any water collected in the pipeline has been cleared.
- It is necessary to load at this restricted rate for a period of 30 minutes or until two pipeline volumes (i.e. from delivery tank to ship's tank) have been loaded into the receiving tank, whichever is the lesser.
- Continue to restrict the product flow to a maximum of 1 m/sec at the tank inlet for the whole of the operation unless the product is clean. A clean product, in this context, contains less than 0.5% by volume of free water or other immiscible liquid and less than 10 mg/l of suspended solids.
- Avoid splash filling by employing bottom entry using a fill pipe terminating close to the bottom of the tank.
- Not blowing lines using compressed air

See also

- 3.2.4 Filters
- 3.2.6 Free fall into tanks

12.1.7 Loading static accumulator oils

12.1.71 General

Petroleum distillates often have electrical conductivities of less than 50 picoSiemens per metre (pS/m) and so fall into the category of static accumulators.

Since the conductivities of distillates are not normally known and may not be included in an SDS or other common documents, they should all be treated as static accumulators unless they contain an anti-static additive that raises the conductivity above 50 pS/m (for cautions on the effectiveness of anti-static additives, see section 12.1.7.9). A static accumulator may carry enough charge to be an incendive ignition hazard during loading and for up to 30 minutes after loading.

See also

- 12.1.7.3 During the initial filling of a tank
- 12.1.7.4 Minimising hazards from water
- 12.1.7.7 Spread loading
- 12.1.7.8 Limitation of product velocity (loading rates) after the initial filling period (bulk loading)
- 12.1.7.9 Anti-static additives
- 12.1.7.10 Loading different grades of a product into unclean tanks (switch loading)
- 12.1.14.7 Gas release in the bottom of tanks

TMSA KPI 6.1.1 requires that procedures for cargo, ballast, tank cleaning and bunkering operations are in place for all vessel types within the fleet. The procedures include:

- Cargo and ballast handling.

IMO: ISM Code

7 The Company should establish procedures, plans and instructions, including checklists as appropriate, for key shipboard operations concerning the safety of the personnel, ship and protection of the environment. The various tasks involved should be defined and assigned to qualified personnel.

Inspection Guidance

The vessel operator should have developed procedures for loading flammable static accumulator cargoes into non-inerted tanks that described the:

- Identification of flammable static accumulator cargoes.
- Precautions to be taken against hazards from static electricity when loading these cargoes including:
    - Minimising hazards from water.
    - Initial loading rates.
    - Bulk loading rates.
    - Spread loading.
    - Switch loading.
    - Use of anti-static additives.
    - Effect of filters in the pipeline.
    - Avoiding:
        - Free fall into tanks.

- Splash loading.
- Blowing lines with compressed air.

ISGOTT6 table 3.1 identifies the following examples:

Static accumulators:

- Benzene
- Xylene
- Gasoline (straight-run)
- Diesel (ultra-low sulphur)
- Lube oil (base)
- Commercial jet fuel
- Toluene
- Kerosene
- Diesel
- Cyclohexane
- Motor gasoline

Non accumulators

- Fuel with anti-static additive
- Heavy black fuel oils
- Semi-conductive crude oil
- Bitumen
- Conductive crude oil
- Alcohols
- Ketones

Provided that:

- The tank is maintained in an inert condition, or
- The cargo is not a static accumulator, or
- It can be guaranteed that the tank atmosphere is non-flammable,

Then no anti-static precautions are necessary. However, in case of doubt it should be assumed that a product is a static accumulator, and the appropriate precautions should be taken.

This question will be assigned as follows:

- Oil tankers that are not fitted with an inert gas system. (HVPQ 9.15.1)
- Chemical tankers which are not fitted with a nitrogen generator. (HVPQ 9.31.1)

Suggested Inspector Actions

- Sight, and where necessary review the company procedures for loading flammable static accumulator cargoes into non-inerted tanks.
- Observe loading taking place, if possible.
- Review cargo log books and records to verify compliance with company procedures.

- Interview the officer in charge of cargo operations to verify their familiarity with company procedures for loading flammable static accumulator cargoes into non-inerted tanks.

Expected Evidence

- Company procedures for loading flammable static accumulator cargoes into non-inerted tanks.
- Cargo log books and records.

Potential Grounds for a Negative Observation

- There were no company procedures for loading flammable static accumulator cargoes into non-inerted tanks which described:
    - The identification of flammable static accumulator cargoes.
    - The precautions to be taken against hazards from static electricity when loading these cargoes.
- The officer in charge of cargo operations was not familiar with the company procedures for loading flammable static accumulator cargoes into non-inerted tanks.
- A flammable static accumulator cargo was loaded into a non-inert tank with:
    - An initial rate of more than 1 m/sec at the individual tank inlets.
    - An initial rate of less than 1 m/sec at the individual tank inlets, but for shorter than the required period:
        - 30minutes or the time taken to load twice the content of the shore pipeline content whichever is the lesser.
        - But which must include the time to fill the tank to a depth equal to twice the diameter of the filling pipe.
    - A bulk rate of more than 1 m/sec when the cargo was not “clean”.
- A flammable static accumulator cargo was loaded into a non-inert tank:
    - Over the top.
    - In such a way to produce splash filling.
- Upon completion of loading a flammable static accumulator, cargo lines were blown using compressed air.
- A low volatility static accumulator cargo was loaded into an uncleaned non-inerted tank that had previously contained a high volatility cargo, without following the precautions to be taken against hazards from static electricity.

8.3.7. Were the Master and officers familiar with the purpose, operation and calibration of the inert gas system fixed oxygen analyser, and had the equipment been operated, maintained and calibrated in accordance with the manufacturer's instructions and company procedures?

Short Question Text
IGS oxygen analyser

Vessel Types
Oil, Chemical

ROVIQ Sequence
Engine Control Room, Cargo Control Room, Engine Room

Publications
IMO: ISM Code
IMO SOLAS
OCIMF/ICS: International Safety Guide for Oil Tankers and Terminals. Sixth Edition.
IMO: FSS Code
IMO: Inert Gas Systems

Objective

To ensure the inert gas system always delivers inert gas with an oxygen content of not more than 5% by volume to the cargo tanks at any rate of flow.

Industry Guidance

OCIMF/ICS: International Safety Guide for Oil Tankers and Terminals. Sixth Edition

11.1.6 Use during cargo tank operations

Before the IG system is operated the tests required by the operations manual or the manufacturer's instructions should be carried out. The fixed oxygen analyser and recorder should be tested and proved to be in good order. Portable oxygen and hydrocarbon meters should also be prepared and tested.

ISGOTT Checks pre-arrival Ship/Shore Safety Checklist

Part 1B. Tanker: checks pre-arrival if using an inert gas system

IMO: FSS Code

Chapter 15

2.2.1.2 The system shall be capable of:

.5 delivering inert gas with an oxygen content of not more than 5% by volume to the cargo tanks at any required rate of flow.

2.2.4.2 Instrumentation shall be fitted for continuously indicating and permanently recording, when inert gas is being supplied:

.2 the oxygen content of the inert gas.

IMO: Inert Gas Systems

3.14.2 Clear instructions should be provided for operating, calibrating and testing all instruments and alarms. Suitable calibration facilities should be provided.

3.14.7 The arrangement for oxygen analyser, recorder and indicating equipment should be as follows:

.9 Dependent on the principle of measurement, fixed zero and/or span calibration arrangements should be provided in the vicinity of the oxygen analyser fitted with suitable connections for portable analysers.

TMSA 6.1.1 requires that procedures for cargo, ballast, tank cleaning and bunkering operations are in place for all vessel types within the fleet. The procedures include:

- Maintaining safe tank atmospheres.
- Record keeping.

IMO: ISM Code

10.1 The Company should establish procedures to ensure that the ship is maintained in conformity with the provisions of the relevant rules and regulations and with any additional requirements which may be established by the Company.

IMO: SOLAS

Chapter II-2 Regulation 4

5.5.1.1 For tankers of 20,000 tonnes deadweight and upwards constructed on or after 1 July 2002 but before 1 January 2016, the protection of the cargo tanks shall be achieved by a fixed inert gas system in accordance with the requirements of the Fire Safety Systems Code, as adopted by resolution MSC.98(73), except that the Administration may accept other equivalent systems or arrangements, as described in paragraph 5.5.4.

5.5.1.2 For tankers of 8,000 tonnes deadweight and upwards constructed on or after 1 January 2016 when carrying cargoes described in regulation 1.6.1 or 1.6.2, the protection of the cargo tanks shall be achieved by a fixed inert gas system in accordance with the requirements of the Fire Safety Systems Code, except that the Administration may accept other equivalent systems or arrangements, as described in paragraph 5.5.4.

5.5.1.3 Tankers operating with a cargo tank cleaning procedure using crude oil washing shall be fitted with an inert gas system complying with the Fire Safety Systems Code and with fixed tank washing machines. However, inert gas systems fitted on tankers constructed on or after 1 July 2002 but before 1 January 2016 shall comply with the Fire Safety Systems Code, as adopted by resolution MSC.98(73).

Inspection Guidance

The vessel operator should have developed procedures for the operation, inspection, testing and maintenance of the vessel’s inert gas system which included the fixed oxygen analyser and gave guidance on:

- The method and frequency of calibration.
- Actions to be taken in the event of a failure of the fixed analyser.

These procedures and records may form part of the vessel’s planned maintenance system and may refer to the manufacturer’s instruction and maintenance manual for the fixed oxygen analyser.

A record of inspection and maintenance of the inert gas plant, including defects and their rectification, should be maintained on board.

The fixed oxygen analyser must have been calibrated not more than 24 hours prior to starting of the inert gas system.

Clear instructions should be provided for operating, calibrating and testing the fixed oxygen analyser in the vicinity of the equipment.

Suggested Inspector Actions

- Sight, and where necessary review, the company procedures for the operation, inspection, testing and maintenance of the vessel's inert gas system which included the fixed oxygen analyser.
- Inspect the fixed oxygen analyser including the fixed zero and/or span calibration arrangements.
- Verify that the local reading at the fixed oxygen analyser agrees with the remote indications of the oxygen content in the cargo control room or station and the machinery space control room.
- Review the calibration records of the fixed oxygen analyser and verify that it had been calibrated not more than 24 hours before being used for each cargo, purging or inerting operation.
- Where necessary review the records of inspection, testing and maintenance of the inert gas system and verify that scheduled inspections and maintenance on the equipment had taken place.

- Interview the accompanying officer to verify their familiarity with the purpose, operation and testing of the fixed oxygen analyser including the:
    - Method and frequency of calibration.
    - Actions to be taken in the event of a failure of the fixed oxygen analyser.

Expected Evidence

- The company procedures for the operation, inspection, maintenance and testing of the inert gas system.
- The records of inspection, testing and maintenance of the inert gas system.
- The manufacturer's instruction and maintenance manual for the fixed oxygen analyser
- The calibration records for the fixed oxygen analyser.

Potential Grounds for a Negative Observation

- There were no company procedures for the operation, inspection, testing and maintenance of the vessel's inert gas system which included the fixed oxygen analyser.
- The accompanying officer was not familiar with the purpose, operation, inspection, testing and maintenance of the fixed oxygen analyser including the:
    - Method and frequency of calibration.
    - Actions to be taken in the event of a failure of the fixed analyser.
- The records of inspection and maintenance of the inert gas plant were missing or incomplete.
- The fixed oxygen analyser had not been:
    - Operated, maintained and calibrated in accordance with the manufacturer's instructions and company procedures.
    - Calibrated within 24 hours prior to starting the inert gas system for each cargo, purging or inerting operation.
- The zero and/or span gas used to calibrate the fixed oxygen analyser was unsuitable, out of date or not available.
- There were no clear instructions provided for operating, calibrating and testing the fixed oxygen analyser in the vicinity of the equipment.
- The fixed oxygen analyser was defective in any respect.

If the local reading at the fixed oxygen analyser did not agree with the remote indications of the oxygen content in the cargo control room or station and the machinery space control room, an observation should be made under question 8.3.19. Indicators and alarms for the inert gas system.

8.3.8. Were the Master, officers and ratings familiar with the cargo system Emergency Shutdown (ESD) system, where fitted, and/or the cargo pump emergency stop controls, and was there evidence that the systems and equipment had been tested in accordance with company procedures?

Short Question Text
Oil and Chemical Tanker ESD and/or cargo pump emergency stop controls.

Vessel Types
Oil, Chemical

ROVIQ Sequence
Interview - Deck Rating, Cargo Control Room, Pumproom, Main Deck

Publications
IMO: ISM Code
OCIMF/ICS: International Safety Guide for Oil Tankers and Terminals. Sixth Edition.
USCG: Code of Federal Regulations. Title 33.

Objective

To ensure that the cargo handling system or individual cargo pumps will be brought to a safe, static condition, either automatically or manually, in abnormal circumstances.

Industry Guidance

OCIMF/ICS: International Safety Guide for Oil Tankers and Terminals. Sixth Edition.

12.1.6.3 Emergency Shutdown Plan

The ship and the terminal should have agreed an Emergency Shutdown (ESD) procedure and alarm and recorded it on an appropriate form. This agreement sets out those circumstances when operations should stop immediately. It also accounts for the possible dangers of a pressure surge caused by an ESD procedure.

12.1.6.4 Supervision

The following safeguards should be maintained throughout loading:

- All personnel concerned should fully understand the agreed standby notice period for the normally stopping of cargo pumps on completion of loading and the emergency stop system for both the ship and terminal.

18.5 Emergency Shutdown systems

ESD systems for cargo transfers are used to stop the flow of cargo liquid and vapour in an emergency and bring the cargo handling system to a safe, static condition.

It is recommended that tankers and terminals are provided with the necessary equipment to enable interconnections of ESD systems.

As a minimum, ESD systems should:

- Stop all cargo transfer pumps when an ESD is activated on the tanker or terminal.
- Stop the tanker’s cargo transfer pumps when a terminal high level alarm is activated.

ISGOTT Checks pre-transfer Ship/Shore Safety Checklist:

Part 5A. Tanker and terminal: pre-transfer conference (item 51)

TMSA KPI 6.1.2 requires that procedures for pre-operational tests and checks of cargo and bunkering equipment are in place for all vessel types within the fleet.

Tests and checks of equipment may include:

- Emergency Shutdown (ESD) System operation.
- Alarms and trips.
- Cargo and ballast pump tests.

Records of the tests and checks are maintained.

IMO: ISM Code

7 The Company should establish procedures, plans and instructions, including checklists as appropriate, for key shipboard operations concerning the safety of the personnel, ship and protection of the environment. The various tasks involved should be defined and assigned to qualified personnel.

USCG: Code of Federal Regulations. Title 33 Section 155.780

Emergency shutdown.

(a) A tank vessel with a capacity of 250 or more barrels that is carrying oil or hazardous material as cargo must have on board an emergency means to enable the person in charge of a transfer operation to a facility, to another vessel, or within the vessel to stop the flow of oil or hazardous material.

(b) The means to stop the flow may be a pump control, a quick-acting, power actuated valve, or an operating procedure. If an emergency pump control is used, it must stop the flow of oil or hazardous material if the oil or hazardous material could siphon through the stopped pump.

(c) The means to stop the flow must be operable from the cargo deck, cargo control room, or the usual operating station of the person in charge of the transfer operation.

Inspection Guidance

The vessel operator should have developed cargo operation procedures for all vessel types within the fleet which included:

- The testing of Emergency Shutdown (ESD) systems, if fitted to the vessel.
- The periodic testing of automatic cargo pump shut down systems and associated sensors, if fitted to the vessel.
- The periodic testing of manual cargo pump shut down controls from all locations.
- The testing of each cargo pump shut down system prior to each cargo operation.
- The familiarisation of the vessel crew with the cargo system shut down controls and the circumstances in which they should be activated.

<u>Suggested Inspector Actions</u>

- Sight, and where necessary review, the procedures which described the operation and testing of ESD systems and/or cargo pump emergency stop controls.
- Review the most recent records for the testing of:
  - The ESD system, where fitted.
  - The automated cargo pump shut down systems and associated sensors, where fitted.
  - The individual cargo pump emergency stop controls from each location provided.

    - The cargo pump shutdown system for each pump prior to use.

Interview a deck rating to verify their familiarity with:

- The circumstances in which the cargo pump emergency stop control should be activated.
- The locations of the cargo pump emergency stop controls.
- The actions that should be taken once the cargo pump emergency stop control had been activated.
- The danger of shutting a manifold valve against the flow while loading/discharging.

Expected Evidence

- The company procedures which described the operation and testing of the ESD, where fitted, the cargo pump automated shutdown, the cargo pump emergency stop controls and the cargo pump emergency stop system.
- The testing records for the ESD, where fitted, the cargo pump automated shutdown, the cargo pump emergency stop controls and the cargo pump emergency stop system.

Potential Grounds for a Negative Observation

- There was no company procedure which described the testing and operation of cargo system:
    - Emergency shutdown systems.
    - Automated cargo pump shutdown systems and associated sensors.
    - Cargo pump emergency stop controls.
- The testing of the ESD, automated shutdown or cargo pump emergency stop controls and systems had not been tested in accordance with the company procedure.
- The ESD system, automated cargo pump shutdown or cargo pump emergency stop controls or systems were defective in any respect.
- The manual ESD system control or the cargo pump emergency stop controls were not clearly marked and ready for immediate use.
- Access to a manual ESD system control or cargo pump emergency stop control was obstructed.
- The accompanying officer was unfamiliar with the ESD system, where fitted.
- The accompanying officer was unfamiliar with what abnormal or alarm conditions could cause a cargo pump to shut down automatically.
- The accompanying officer was unfamiliar with the company procedure for the testing of the ESD, automated cargo pump shutdown and/or the testing of the cargo pump emergency stop controls.
- An interviewed deck rating was unfamiliar with the location and operation of the cargo pump emergency stop controls, the circumstances in which they should be activated or the actions to take after the emergency stop control had been activated.

8.3.9. Were the Master and officers familiar with the company procedures for the inspection and testing of cargo, vapour and inert gas pipelines, and were records available for these activities?

Short Question Text
Pressure testing and inspection of cargo, inert gas and vapour pipelines.

Vessel Types
Oil, Chemical

ROVIQ Sequence
Pumproom, Cargo Control Room, Main Deck

Publications
OCIMF/ICS: International Safety Guide for Oil Tankers and Terminals. Sixth Edition.
USCG: Code of Federal Regulations. Title 33.
USCG: Code of Federal Regulations. Title 46.
USCG: Marine Safety Manual
Vol. II: Materiel Inspection

Objective

To ensure cargo, vapour and inert gas pipelines are regularly examined, and pressure tested when required, to verify their condition.

Industry Guidance

OCIMF/ICS: International Safety Guide for Oil Tankers and Terminals. Sixth Edition

11.3.2 Cargo and ballast system integrity

Any latent defect in the cargo system will usually reveal itself when the system is pressurised during the discharge operation. It is good practice to pressure test cargo lines on a periodic basis, depending on the trade of the ship. Although these pressure tests may provide an indication of the system's condition at the time of the test, they should not be considered a substitute for regular external inspection of the pipeline system and periodic internal inspections, particularly at known failure points such as pump discharge bends and stub pipe connections.

12.1.15.3 Routine maintenance and housekeeping issues

Pipelines should be visually examined and routinely pressure tested to verify their condition. Other non-destructive testing or examination, such as ultrasonic wall thickness measurement, may be appropriate but should always be supplemented by a visual examination.

TMSA KPI 6.1.2 requires that procedures for pre-operational tests and checks of cargo and bunkering equipment are in place for all vessel types within the fleet. Tests and checks of equipment may include:

- Cargo/bunker line pressure testing

IMO: ISM Code

10.1 The Company should establish procedures to ensure that the ship is maintained in conformity with the provisions of the relevant rules and regulations and with any additional requirements which may be established by the Company.

USCG: Code of Federal Regulations. Title 46.

35.35-70 Maintenance of cargo handling equipment - TB/ALL.

(d) The cargo discharge piping of all tank vessels shall be tested at least once each year for tightness, at the maximum working pressure.

USCG: Code of Federal Regulations. Title 33.

156.170 - Equipment tests and inspections

(c)(4) Each loading arm and each transfer pipe system, including each metallic hose, must not leak under static liquid pressure at least 1 1/2 times the maximum allowable working pressure; and

(f) The frequency of the tests and inspections required by this section must be:

(3) For vessels, annually or as part of the biennial and mid-period inspections.

USCG: Marine Safety Manual, Vol. II: Materiel Inspection

B6-29 Acceptance of Alternative Cargo Piping Test Pressures for Vessels.

Achieving test pressures of 150% MAWP for annual cargo piping tests on tank vessels is often impractical while vessels are in service, where transfers are conducted by vacuum or suction method, or outside the shipyard where special equipment is not available. Therefore, as provided by 33 CFR 156.107, alternative test pressures of not less than 100% MAWP may be used for in-service annual cargo piping tests, provided that a 150% MAWP test of the cargo piping is conducted at least twice in any five-year period. It is envisioned that the 150% MAWP tests will be conducted during drydock periods at the discretion of the vessel owners or operators. Those vessels with longer drydock intervals must make arrangements to conduct the 150% MAWP tests at least twice in any five-year period. All alternatives must provide an equivalent level of safety and protection from pollution. Accurate records of the required tests must be maintained aboard the vessel.

Inspection Guidance

The vessel operator should have developed procedures for the inspection and testing of cargo transfer system, vapour and inert gas pipelines which should include the:

- Frequency of visual external examinations of each type of pipeline.
- Determination of the MAWP of the cargo transfer system.
- Frequency of periodic hydrostatic pressure testing of cargo system pipelines.
- Requirement for hydrostatic pressure testing of cargo system pipelines after repairs, sectional replacements or modifications.
- Marking of cargo system pipelines with the date and pressure of the last hydrostatic pressure test.
- Details of the records required to be maintained of inspections and tests.
- And may include:
    - Periodic internal visual examinations of sections of each type of pipeline.
    - Non-destructive testing, such as ultrasonic wall thickness measurement of sections of each type of pipeline.

The instructions in the planned maintenance system may form part of the procedures.

External visual examination of pipelines should cover all components including:

- Flanges and their bolts.
- Expansion couplings.
- Local and/or remote pressure gauge and thermometer inserts or connections
- The condition and adjustment of U bolts and any rubbing inserts.

The cargo transfer system should be hydrostatically pressure tested to the 100% maximum allowable working pressure (MAWP) at least annually.

The cargo transfer system, which includes the crude oil washing line, should be hydrostatically pressure tested to at least 150% MAWP at least twice within any five-year period.

The cargo transfer system includes the discharge pump and piping between the pump and the vessel's manifold, excluding any non-metallic, i.e. flexible, hoses.

In this context, the maximum allowable working pressure (MAWP) can be assumed to be either the pressure at which the cargo transfer system relief valve is set or, where no relief valve is fitted, the maximum discharge pressure that can be developed by the vessel's pump. For centrifugal pumps this is the pressure developed by the pump at zero flow conditions.

Cargo transfer system pressure testing should be a hydrostatic test. Pressure testing using compressed air or inert gas is not acceptable.

Suggested Inspector Actions

- Sight, and where necessary review, the company procedures for the inspection and testing of cargo, vapour and inert gas pipelines.
- Review the records of the inspection and testing of cargo, vapour and inert gas pipelines and verify that:
  - The MAWP of the cargo transfer system had been determined and documented.
  - Each pipeline had been visually inspected in accordance with the company procedure.
  - Each cargo system pipeline had been hydrostatically pressure tested to 100% of MAWP annually.
  - Each cargo system pipeline had been hydrostatically pressure tested to 150% of MAWP at least twice in the previous five years.
- During the inspection, observe the visual condition of the cargo, vapour and inert gas pipelines.
- Where necessary, compare the observed condition of the pipelines with the records of the inspection and testing of cargo, vapour and inert gas pipelines.

- Interview the accompanying officer to verify their familiarity with:
  - The items to pay attention to when conducting a visual inspection of the cargo, vapour or inert gas pipelines.
  - How and when the previous hydrostatic pressure test of the cargo system pipelines had been conducted.

Expected Evidence

- The company procedures for the inspection and testing of cargo, vapour and inert gas pipelines.
- The determination of the MAWP of the cargo pipeline system.
- Records of the inspection and testing of cargo, vapour and inert gas pipelines.

Potential Grounds for a Negative Observation

- There were no company procedures for the inspection and testing of cargo, vapour and inert gas pipelines that included:
  - The frequency of visual external examinations
  - The frequency of hydrostatic pressure testing of cargo transfer systems.
  - The requirement to hydrostatically pressure test a cargo transfer system after repairs, modifications or sectional replacement.
  - Records to be maintained of inspections and tests.
- The accompanying officer was not familiar with the company procedures for the inspection and testing of cargo, vapour and inert gas pipelines.

- The MAWP of the cargo transfer system had not been determined and documented.
- The determination of the MAWP of the cargo transfer system was inconsistent with the ship's drawings or cargo pump performance curves.
- The cargo transfer system had not been hydrostatically pressure tested to 100% MAWP within the last 12 months.
- There was evidence that cargo system piping had undergone repairs, modifications or sectional replacement that would potentially affect its integrity since the last hydrostatic test without being retested upon completion of the work.
- The cargo transfer system had not been hydrostatically pressure tested to at least 150% MAWP at least twice within any five-year period.
- The cargo transfer system pressure testing was performed using compressed air or inert gas.
- Cargo system pipelines were not marked with the date and pressure of the last test.
- Cargo, vapour or inert gas pipelines had not been inspected and/or tested as required by company procedures.
- There were no records of the inspection and testing of cargo, vapour and/or inert gas lines as required by company procedures.
- Inspection of the cargo, vapour and/or inert gas pipelines indicated that the required inspections and tests had either not been performed or were ineffective.
- The visual inspection of the cargo system, vapour or inert gas pipelines determined that the pipelines or any of their components were in an unsatisfactory condition.

8.3.10. Were the Master and officers familiar with the company procedures for the inspection, testing and operation of the vapour collection system, and was this equipment in satisfactory condition?

Short Question Text
Vapour collection system.

Vessel Types
Oil, Chemical

ROVIQ Sequence
Cargo Control Room, Main Deck

Publications
IMO: ISM Code
OCIMF/ICS: International Safety Guide for Oil Tankers and Terminals. Sixth Edition.
IMO: MARPOL
ICS: Tanker Safety Guide (Chemicals) - Fifth Edition
IMO: MSC/Circ.585 Standards for vapour emission control systems

Objective

To ensure that the vapour collection system is in satisfactory condition and operated correctly when required.

Industry Guidance

OCIMF/ICS: International Safety Guide for Oil Tankers and Terminals. Sixth Edition.

11.5 Vapour recovery systems

Vapour recovery systems fall into two categories:

- Those systems conforming to IMO guidelines that provide a system for returning cargo vapours to the shore for reclaiming or incinerating. These are known as VECS (see section 23.7.7)
- Proprietary systems for recovering petroleum liquid or vapour that would otherwise be vented during the loading operation or during the loaded passage. These are known as vapour recovery systems.

Personnel who operate VECS and vapour recovery systems should be fully trained to use them.

23.7.7 Loading at terminals with Vapour Emission Control Systems

23.7.7.1 General

…The IMO has developed international standards for the design, construction and operation of vapour collection systems on tankers and VECs at terminals…

Note that VECs can serve tankers fitted with IG systems as well as non-inerted tankers.

ISGOTT Checks pre-transfer Ship/Shore Safety Checklist

Part 5A. Tanker and terminal: pre-transfer conference

Item 56 Vapour return line operational parameters are agreed. (11.5, 18.3, 23.7.7)

ICS: Tanker Safety Guide (Chemicals) - Fifth Edition

5.9 Vapour Return Systems

The purpose of vapour return systems is to ensure that cargo vapours are not released to the atmosphere. Vapour return lines on chemical tankers are either connected to the ship's P/V line or, if the ship is fitted with an inert gas system, to an extension of that system.

The IBC Code requires the ship to be able to return vapours of most toxic chemicals to shore.

IMO: MSC/Circ.585 Standards for vapour emission control systems

1.1 These standards have been developed for the design, construction and operation of vapour collection systems on tankers and vapour emission control systems at terminals.

1.2.10 "Vapour collection system" means an arrangement of piping and hoses used to collect vapour emitted from a tanker's cargo tanks and transport the vapour to a vapour processing unit.

2.2.1 Each chemical, product or crude carrier should have vapour collection piping which is permanently installed with a tanker vapour connection located as a close as practical to the loading manifold. In lieu of permanent piping, Administrations may permit chemical tankers to have a permanent vapour connection at each cargo tank for connection to a vapour hose which should be kept as short as practicable.

2.6.4 Each tanker equipped with a vapour collection system that is common to two or more tanks should be fitted with a pressure sensing device that senses the pressure in the main vapour collection line for those tanks, and which:

1. has a high-pressure alarm that alarms at a pressure of not more than the lowest pressure relief valve setting in the cargo tank venting system; and
2. has a low-pressure alarm that alarms at a pressure of not less than atmospheric pressure for an inerted tanker, or the lowest vacuum relief valve setting (i.e. that setting nearest to atmospheric pressure) in the cargo tank venting system for a non-inerted tank vessel.

2.8.1 Each person in charge of a transfer operation utilizing a vapour emission control system should have completed a training programme covering the particular system installed on the tanker. The training should encompass the purpose and principles of operation of the vapour emission control system and provide an understanding of the equipment involved and associated hazards. In addition, the training should provide an understanding of operating procedures including testing and inspection of equipment, pre-transfer procedures, piping connection sequence, start-up procedures, normal operations and emergency procedures. Training should also include an understanding of the shoreside terminal equipment and operating procedures.

2.9.1 Tanker transfer procedures should contain information on the tanker's vapour collection system including:

1. A line diagram of the tanker's vapour collection piping indicating the locations and purpose of all control and safety devices.
2. The maximum allowable transfer rate as limited by the venting capacity of the pressure or vacuum relief valves, or any other factor which would limit the transfer rate.
3. The maximum pressure drop in the vessel's vapour collection system for various transfer rates.
4. The relief settings of each pressure and vacuum valve.
5. Pre-transfer procedures, and
6. Procedures to be followed in the event of a fault during vapour collection operations.

TMSA KPI 10.1.3 requires that procedures minimise marine and atmospheric emissions and ensure that they are always within permitted levels. Procedures may include:

- Methods of minimising emissions.

- VOC management.

IMO: ISM Code

7 The Company should establish procedures, plans and instructions, including checklists as appropriate, for key shipboard operations concerning the safety of the personnel, ship and protection of the environment. The various tasks involved should be defined and assigned to qualified personnel.

IMO: MARPOL

Annex VI

Chapter 3 Regulation 15

1 If the emissions of VOCs from a tanker are to be regulated in a port or ports or a terminal or terminals under the jurisdiction of a Party, they shall be regulated in accordance with the provisions of this regulation.

5 A tanker to which paragraph 1 of this regulation applies shall be provided with a vapour emission collection system approved by the Administration taking into account the safety standards for such systems developed by the Organization* and shall use the system during the loading of relevant cargoes.

*Refer to Standards for vapour emission control systems (MSC/Circ.585)

Inspection Guidance

The vapour collection systems on board oil and chemical tankers are also variously described as:

- Vapour Control Systems (VCS)
- Vapour Emission Control Systems (VECS)
- Vapour Return Systems

The vessel operator should have developed procedures for the inspection, testing and operation of the vapour collection system which included:

- A line diagram of the vessel's vapour collection piping indicating the locations and purpose of all control and safety devices.
- The initial transfer rate.
- The maximum allowable transfer rate as limited by the venting capacity of the pressure or vacuum relief valves, or any other factor which would limit the transfer rate.
- The maximum pressure drop in the vessel's vapour collection system for various transfer rates.
- The relief settings of each pressure and vacuum valve.
- Pre-transfer procedures, including tests of P/V valves, tank level gauges and alarms, and high- and low-pressure alarms.
- Procedures to be followed in the event of a fault during vapour collection operations.
- Training and familiarisation requirements.

These procedures may be in the form of a dedicated system manual approved by the Flag State or recognised organisation (such as a class society).

The pressure sensing device in the system should have an indicator and visible and audible high- and low-pressure alarms at the cargo control room or position.

This question will only be allocated to:

- Oil vessels when HVPQ 9.9.1 “Is a vapour return system fitted?” is answered in the affirmative.
- Chemical vessels when the vessel operator had declared through the Pre-inspection questionnaire that the vessel is fitted with a vapour collection system.

Suggested Inspector Actions

- Sight, and where necessary review, the company procedures for the inspection, testing and operation of the vapour collection system.
- Review, if available, the records of cargo operations, including tank pressures, where the vapour control system had been used.
- Review, where necessary, vapour collection system training/familiarisation records.
- During the deck inspection:
    - Observe the operation, condition and configuration of the vapour collection system.
    - Where provided on chemical tankers, inspect any vapour hoses used for direct connection at the cargo tank.
- Verify the satisfactory operation of the visible and audible high- and low-pressure alarms at the cargo control room or position.

- Interview the accompanying officer to verify their familiarity with the company procedures for the inspection, testing and operation of the vapour collection system.

Expected Evidence

- The company procedures for the inspection, testing and operation of the vapour collection system.
- The vapour collection system manual.
- Cargo operations records and checklists relating to the last occasion the vapour collection system was used.
- The maintenance and testing records for any vapour hoses provided on chemical tankers in accordance with IMO MSC/Circ.585 2.2.1.

Potential Grounds for a Negative Observation

- There were no company procedures for the inspection, testing and operation of the vapour collection system which included:
    - A line diagram of the tanker’s vapour collection piping indicating the locations and purpose of all control and safety devices.
    - The initial transfer rate
    - The maximum allowable transfer rate as limited by the venting capacity of the pressure or vacuum relief valves, or any other factor which would limit the transfer rate.
    - The maximum pressure drop in the vessel’s vapour collection system for various transfer rates.
    - The relief settings of each pressure and vacuum valve.
    - Pre-transfer procedures, including tests of P/V valves, tank level gauges and alarms, and high- and low-pressure alarms.
    - Procedures to be followed in the event of a fault during vapour collection operations.
    - Training and familiarisation requirements.
- The accompanying officer was not familiar with the company procedures for the inspection, testing and operation of the vapour collection system.
- The pressure sensing device in the main vapour collection line was inoperative.
- The visible and audible high- and low-pressure alarms at the cargo control room or position were defective in any respect.
- The high- and low-pressure alarms were not set as required by company procedures.
- There was no evidence that the person(s) in charge of transfer operations had received suitable training/familiarisation covering the particular system installed on the tanker.

- The vapour collection system was not approved by the Flag State or recognised organisation (such as a class society).
- Where vapour hoses were provided onboard chemical tankers in accordance with IMO MSC/Circ.585 2.2.1, there was no evidence of proper maintenance and testing
- The vapour collection system was defective in any respect.

8.3.11. Were the Master, deck officers and deck ratings familiar with the company procedures for cargo tank washing after the carriage of volatile products in a non-inert atmosphere, and had these procedures been followed?

Short Question Text
Oil and chemical tank cleaning in non-inert tanks.

Vessel Types
Oil, Chemical

ROVIQ Sequence
Interview - Deck Rating, Cargo Control Room, Main Deck

Publications
IMO: ISM Code
OCIMF/ICS: International Safety Guide for Oil Tankers and Terminals. Sixth Edition.

Objective

To ensure that tank washing operations after the carriage of volatile products in a non-inert atmosphere are always conducted safely, and in accordance with the recommendations of ISGOTT6.

Industry Guidance

OCIMF/ICS: International Safety Guide for Oil Tankers and Terminals. Sixth Edition.

Reference should always be made to the full text of ISGOTT6 Section 12.3 Tank Cleaning. Edited extracts below are for reference only and are not exhaustive.

12.3.5.2 Washing in a non-inert atmosphere

Non-inert cargo tank washing should only be done when both the source of ignition and the flammability of the tank atmosphere are controlled. To do this, the following precautions should be taken.

To control the fuel in the tank atmosphere

Before washing

- Flush the tank bottom with water, so that all parts are covered, then strip.
- Flush the piping system with water (including cargo pumps, crossovers and discharge lines).
- Ventilate the tank to reduce the gas concentration of the atmosphere to 10% or less of the LFL

During washing

- Monitor the change in LFL percentage by testing the atmosphere frequently and at various levels in the tank.
- Maintain the tank atmosphere at not more than 35% LFL. If the gas level reaches 35% at any measured location within a tank, immediately stop the washing in that tank.
- Only resume washing when continued ventilation has reduced the gas concentration to 10% or less of the LFL and is able to maintain it.

To control the sources of ignition in the tank

- Restrict the throughput of individual tank washing machines to no greater than 60 m3/hr.
- Keep the total water throughput per cargo tank as low as practicable. Do not let it exceed 180 m3/hr.

- Different washing methods create different risks, so follow these precautions when tank washing in non-inert conditions:
    - Never use recirculated wash water
    - Never inject steam into a tank that may contain hydrocarbon vapours and that is in a non-inert condition.
- Make up and test the electrical continuity of all hose connections before introducing any portable washing machines to the tank.
- Introduce sounding rods and other equipment into the tank using a full depth sounding pipe. If a full depth sounding pipe is not fitted, ensure that any metallic components of the sounding rod or other equipment are bonded and securely earthed to the ship before introducing them to the tank and that they remain earthed until removed.
- Observe this precaution during washing and for five hours afterwards to allow enough time for any mist carrying a static charge to dissipate. If the tank is continuously mechanically ventilated after washing, this can be reduced to one hour. During this time:
    - A metal interface detector can be used if earthed to the ship by a clamp or bolted metal connection.
    - A metal rod on the end of a metal tape can be used if earthed to the ship by a clamp or a bolted metal connection.
    - Do not use a metal sounding rod suspended on a fibre rope, even if the end at deck level is fastened to the ship. The rope cannot be relied on to provide an earthing path.
    - Entirely non-metallic equipment may be used, e.g. a wooden sounding rod suspended on a natural fibre rope, without earthing.
    - Do not use ropes made of synthetic polymers to lower equipment into cargo tanks.

12.3.6.2 Portable hoses for fixed and portable tank washing machines

Bonding wires should be incorporated within all portable tank washing hoses to ensure electrical continuity. Couplings should be connected to the hose in a way that ensures effective bonding.

Hoses should be indelibly marked for identification. A record should be kept showing the date and the result of electrical continuity testing.

12.3.6.3 Testing tank cleaning hoses

All hoses supplied for tank washing machines should be tested for electrical continuity in a dry condition before use. In no case should the resistance exceed six ohms per metre length.

12.3.6.5 Free fall

It is essential to avoid the free fall of water or slops into a tank. The liquid level should always cover the discharge inlets in the slop tank to a depth of at least one metre to avoid splashing. This is not necessary when the slop and cargo tanks are fully inerted.

12.3.6.8 Special tank cleaning procedures

Steaming

Steaming may only be carried out in tanks that have been either inerted or water washed, and gas freed. Before steaming, the concentration of flammable gas should not exceed 10% of the LFL.

TMSA KPI 6.1.1 requires that procedures for cargo, ballast, tank cleaning and bunkering operations are in place for all vessel types within the fleet. The procedures include:

- Tank cleaning

IMO: ISM Code

7 The Company should establish procedures, plans and instructions, including checklists as appropriate, for key shipboard operations concerning the safety of the personnel, ship and protection of the environment. The various tasks involved should be defined and assigned to qualified personnel.

Inspection Guidance

The vessel operator should have developed procedures for cargo tank washing after the carriage of volatile products in a non-inert atmosphere that included:

- Precautions to:
    - Control the fuel in the tank atmosphere.
    - Control the sources of ignition in the tank.
- Bonding of portable tank washing machines and hoses.
- Testing tank cleaning hoses.
- Avoiding the free-fall or spraying of water into a tank.
- Prohibition of steaming.

Suggested Inspector Actions

- Sight, and where necessary review, the company procedures for cargo tank washing after the carriage of volatile products in a non-inert atmosphere.
- Review available tank cleaning plans, risk assessments, log books and records to verify compliance with company procedures.
- Review records of electrical continuity testing of portable tank cleaning hoses and portable hydrant/hose/machine connections, where applicable.
- During the course of the inspection, inspect fixed and portable tank cleaning equipment to verify its condition and marking for identification.

- Interview the officer responsible for tank washing operations to verify their familiarity with company procedures for cargo tank washing after the carriage of volatile products in a non-inert atmosphere.
- Interview a deck rating to verify their familiarity with company procedures relating to introducing sounding rods and other equipment into a tank during tank washing after the carriage of volatile products in a non-inert atmosphere.

Expected Evidence

- Company procedures for cargo tank washing after the carriage of volatile products in a non-inert atmosphere.
- Completed plans, risk assessments, log books and records for previous tank cleaning operations.
- Records of electrical continuity testing of portable tank cleaning hoses and portable hydrant/hose/machine connections, where applicable.

Potential Grounds for a Negative Observation

- There were no company procedures for cargo tank washing after the carriage of volatile products in a non-inert atmosphere that included,
    - Precautions to:
        - Control the fuel in the tank atmosphere.
        - Control the sources of ignition in the tank.
    - Bonding of portable tank washing machines and hoses.
    - Testing tank cleaning hoses.
    - Avoiding the free-fall or spraying of water into a tank.
    - Prohibition of steaming.

- The officer responsible for tank washing operations was not familiar with the company procedures for cargo tank washing after the carriage of volatile products in a non-inert atmosphere.
- An interviewed rating was not familiar with the company procedures relating to introducing sounding rods and other equipment into a tank during tank washing after the carriage of volatile products in a non-inert atmosphere.
- Records and interviews indicated that before tank washing in a non-inert atmosphere:
    - The tank bottom and/or the pipeline system had not been flushed and stripped.
    - The tank atmosphere had not been ventilated to less than 10% LFL.
    - The electrical continuity of portable hoses had not been tested or tested resistance exceeded 6 ohms per metre length.
    - The portable tank washing hoses were not indelibly marked for identification purposes.
    - The electrical continuity of portable hydrant/hose/machine connections had not been tested.
- Records and interviews indicated that during tank washing in a non-inert atmosphere:
    - The tank atmospheres had not been tested frequently
    - The tank atmosphere had exceeded 35% LFL, but washing had continued.
    - The tank washing had recommenced with a tank atmosphere above 10% LFL.
    - Wash water throughput was above the recommended levels.
    - Recirculated water was used for washing.
    - Steam had been injected into a tank that was not verified as being gas free.
    - Steam had continued to be injected while the atmosphere exceeded 10% LFL.
    - The recommended methods/equipment had not been used for dipping tanks.
    - The liquid level in the slop tank was not maintained at least one metre above the discharge inlets.
- Tank cleaning equipment was defective or deficient in any respect.

8.3.12. Were the Master and officers familiar with the company procedures for the use of portable cargo ullage/temperature/interface (UTI) measurement and sampling equipment, and was the equipment in satisfactory condition and used in accordance with the company procedures?

Short Question Text
Portable ullage/temperature/interface (UTI) measurement and sampling equipment.

Vessel Types
Oil, Chemical

ROVIQ Sequence
Cargo Control Room, Main Deck, Interview - Deck Rating

Publications
OCIMF/ICS: International Safety Guide for Oil Tankers and Terminals. Sixth Edition.

Objective

To ensure that portable UTI and sampling equipment is always used in accordance with international regulations and industry best practice.

Industry Guidance

OCIMF/ICS: International Safety Guide for Oil Tankers and Terminals.

Chapter 3 Static Electricity

The main precaution for ships against electrostatic risks is to conduct operations with the tanks protected by IG. For tanks that are not protected by IG, section 3.2 describes, in general terms, precautions against electrostatic hazards during operations...

3.2.2 Bonding

The most important countermeasure to prevent and electrical hazard is to bond all metallic objects together to eliminate the risk of discharges between two objects that might be charged to different voltages if they were electrically insulated…

Some examples of objects that might be electrically insulated in hazardous situations and which should be bonded are:

- Manual ullaging and sampling equipment with conducting components.

Any earthing or bonding links used as a safeguard against the hazards of static electricity associated with portable equipment should be connected whenever the equipment is set up and not disconnected until after the equipment is no longer in use.

12.8 Cargo measurement, ullaging, dipping and sampling

12.8.1 General

Cargo measurement and sampling is undertaken using a variety of methods that should conform to the requirements for safe handling of the intended cargoes. Which system is used will be determined by the type of tanker, the toxicity and/or volatility of the particular cargo and associated regulatory requirements.

In general, there are three main methods of gauging – closed, open and restricted:

- Closed: a gauging device that penetrates the cargo tank, but which is part of a closed system maintaining the complete integrity of cargo containment. This device is designed and installed so as not to release cargo liquid or vapour in any amount to the atmosphere, e.g. automatic float, continuous tape (magnetic coupled), sight glass (protected), electronic probe, magnetic, differential pressure cell.
- Open: a gauging method that uses an opening in the cargo tank, such as a gauge hatch or ullage port. This method may expose the user to the cargo and its vapours.
- Restricted: a gauging device that penetrates the cargo tank and which, during operation, can allow the release of small quantities of cargo vapour or liquid. The amount of release is controlled by a small diameter tank penetration opening and by a locally operated valve (sometimes known as a vapour lock) or similar closure device in that opening. When not in use, this type of gauging device is closed to maintain the complete integrity of cargo containment, e.g. rotary tube, fixed tube, slip tube and sounding tube.

As a closed gauging system offers complete integrity and flexibility for varying cargo types and trades, its use is preferred at all times. Open gauging and restricted gauging should only be allowed where:

- Open venting is allowed by the relevant regulations, e.g. the IMO's International Code for the Construction and Equipment of Ships Carrying Dangerous Chemicals in Bulk (IBC Code).
- Means are provided for relieving tank pressure before the gauge is operated.

Cargo compartments may be pressurised, so only authorised personnel should open vapour lock valves, ullage ports or covers to control the release of pressure.

Avoid escaping vapour and wear proper PPE if risk of gas exposure exists (see sections 23.3.1 and/or 23.3.2 and 24.2.1). Stand at right angles to the direction of the wind. Standing immediately upwind of the ullage port might create a back eddy of vapour towards the operator. Depending on the cargo, consider using appropriate RPE (see sections 10.8 and 12.8.4)

When open gauging, the tank opening should be uncovered only as long as it takes to complete the operation.

TMSA 6.1.2 requires that procedures for pre-operational tests and checks of cargo and bunkering equipment are in place for all vessel types within the fleet. Tests and checks of equipment may include:

- Tank gauging equipment

IMO: ISM Code

7 The Company should establish procedures, plans and instructions, including checklists as appropriate, for key shipboard operations concerning the safety of the personnel, ship and protection of the environment. The various tasks involved should be defined and assigned to qualified personnel.

Inspection Guidance

The vessel operator should have developed procedures describing the use, operation, testing, calibration and servicing of the portable cargo ullage/temperature/interface (UTI) measurement and sampling equipment which included:

- The definitions of closed, restricted and open cargo measurement and sampling.
- The circumstances in which:
    - Closed cargo measurement and sampling equipment must be used.
    - Restricted cargo measurement and sampling equipment may be used.
    - Open cargo measurement and sampling may take place.
- The bonding requirement for using the portable measurement equipment in both inerted and non-inerted tank atmospheres.
- The restrictions on introducing portable measurement and sampling equipment into non-inerted cargo tanks when handling static accumulator cargo.
- The required service and calibration interval for the portable UTI equipment.

- The required pre-operational checks for the portable UTI measurement and sampling equipment.
- The procedures for safe use of the portable measurement and sampling equipment including personal protective equipment (PPE) and respiratory protective equipment (RPE) requirements.
- The total number of portable UTI measurement units required to be carried onboard.
- The total number of cargo sampling units required to be carried onboard.

These procedures may refer to the equipment manufacturer's manuals and instructions.

Portable UTI equipment may be rated for open, restricted or closed service and will be certificated accordingly. The appropriately rated equipment should always be used as required for volatile and/or toxic cargoes e.g. equipment certificated for restricted service must not be used when handling a cargo specified for closed gauging in IBC chapter 17, column 'j'.

Portable UTI equipment should be serviced and calibrated in accordance with manufacturer's recommendations and valid certificates of calibration should be provided for each instrument.

The following information provided by the vessel operator through the HVPQ will be inserted in the inspection editor and reproduced in the final report:

- 9.8.12.3 (Portable gauging equipment) How many units are supplied?

Suggested Inspector Actions

- Sight, and where necessary review the company procedures describing the use, operation, testing, calibration and servicing of the of portable cargo ullage/temperature/interface (UTI) measurement and sampling equipment
- Review the service and calibration records for each portable cargo UTI measurement unit carried.
- Where necessary review the:
    - Manufacturer's manuals and instructions for the portable cargo UTI measurement and sampling equipment.
    - Records of pre-operational checks of the portable cargo UTI measurement and sampling equipment.
- Inspect two portable cargo UTI measurement units and verify that:
    - The units were appropriately rated as closed, restricted or open for the operations being undertaken.
    - The grounding wire and clip was properly fixed to the device and in use where required.
    - When the sensors were placed in a bucket of water:
        - The ullage/interface function sounded.
        - The temperature reading was accurate compared to a manual thermometer.

- Interview a deck rating to verify their familiarity with the company procedures for safe use of the portable UTI measurement and sampling equipment including grounding requirements and PPE and RPE requirements.

Expected Evidence

- The company procedures describing the use, operation, testing, calibration and servicing of the of portable cargo ullage/temperature/interface (UTI) measurement and sampling equipment.
- The manufacturer's manuals and instructions for the portable cargo UTI measurement and sampling equipment provided.
- The records of pre-operational checks of the portable cargo UTI measurement and sampling equipment.
- The service and calibration records for the portable cargo UTI measurement units.

Potential Grounds for a Negative Observation

- There were no company procedures describing the use, operation, testing, calibration and servicing of the of portable cargo ullage/temperature/interface (UTI) measurement and sampling equipment.
- The accompanying officer was not familiar with the company procedures describing the use, operation, testing and maintenance of the UTI measurement and sampling equipment.
- The accompanying officer was not familiar with:
  - The service rating of the portable UTI measurement and sampling equipment provided onboard.
  - The service and calibration requirements.
  - The pre-operational checks of portable UTI measurement and sampling equipment.
  - The procedures for safe use of the equipment including PPE and RPE requirements.
  - The bonding requirements for using the UTI measurement and sampling equipment.
- An interviewed deck rating was not familiar with the company procedures for safe use of the portable UTI measurement and sampling equipment including PPE and RPE requirements.
- The portable UTI measurement and sampling equipment in use was not of the correct rating for the cargo being handled, e.g. equipment rated as 'restricted' was being used in tanks where the cargo being handled required a 'closed' device.
- Portable UTI measurement and sampling equipment was not being used in accordance with the company procedures for safe use including PPE and RPE requirements.
- There was no control of the opening of vapour locks and/or ullage ports by unauthorised personnel e.g. cargo inspectors.
- Where open cargo measurement and sampling was permitted, cargo tank openings had been left open after gauging had been completed.
- Portable UTI measurement or sampling equipment was being used without being bonded in a non-inert atmosphere or where the company procedure required bonding to be in use.
- One or more vapour locks were noted to be leaking during use or when closed with the cap on.
- One or more vapour lock was observed to be damaged or missing.
- Inappropriate measurement or sampling equipment was observed being used through the vapour locks (e.g. sounding rods which did not fit on the vapour locks provided).
- Portable UTI measurement and sampling equipment had not been serviced or calibrated according to manufacturer's instructions or did not have the associated certificates.
- No fixed ullage system was fitted but there were insufficient portable UTI units provided to simultaneously gauge each tank being worked, plus two spares.
- More than two portable UTI measurement units were out of service on a vessel with no fixed cargo level measurement system.
- There were less than two operational UTI measurement units on a vessel fitted with an operational fixed cargo level measurement system.

Where a vessel was fitted with a fixed cargo level measurement system which was out of service, make a **comment** in the Hardware response tool to record the number of functioning UTI measurement units that were available.

Address the defective fixed cargo level measurement system through question 8.99.5

Address any issues relating to measurement or sampling of static accumulator cargoes in non-inert tanks through question 8.3.5

8.3.13. Were the Master and officers familiar with the company procedures for the operation of the primary and secondary cargo tank venting systems in accordance with SOLAS, and were these systems correctly set?

Short Question Text
Secondary venting systems.

Vessel Types
Oil, Chemical

ROVIQ Sequence
Cargo Control Room, Main Deck

Publications
IMO: ISM Code
IMO SOLAS
OCIMF/ICS: International Safety Guide for Oil Tankers and Terminals. Sixth Edition.
IMO: IBC Code
ICS: Tanker Safety Guide (Chemicals) - Fifth Edition

Objective

To ensure cargo tanks are always protected from over or under pressurisation in the event of inappropriate use of the ventilation system or a failure of a primary protection device.

Industry Guidance

OCIMF/ICS: International Safety Guide for Oil Tankers and Terminals. Sixth Edition

11.1.8.3 Full flow Pressure/Vacuum venting arrangements

Protection from over or under pressurisation of the cargo tanks may be provided by installing, on each tank, full flow P/V valves rated at 125% of the maximum loading/discharge rate. Where the mast riser is the primary vent, the P/V valve may act as the secondary protection.

11.1.8.4 Individual tank pressure monitoring and alarm systems

A tank pressure monitoring and alarm system may be used as an alternative to P/V valves for the secondary P/V relief. These systems use individual tank pressure sensors connected to an alarm system that is monitored in the cargo control room or a location where cargo operations are normally carried out.

12.8.6 Cargo tank monitoring systems

Tank monitoring systems often have multiple functions, such as radar or other types of remote gauging, temperature measurement, tank pressure sensors and level alarms. It may be integrated with other cargo monitoring or control equipment or with loading computers or control systems. Manufacturers may refer to these multi-function systems as cargo tank monitoring systems.

Whether provided as a complete system or as separate elements, planned maintenance procedures should be established to ensure maintenance, test and calibration of this equipment per the manufacturer’s instructions.

ICS: Tanker Safety Guide (Chemicals) - Fifth Edition

5.8 Venting Systems and P/V Valves

Chemical carriers are provided with an independent P/V valve for each tank. These valves are designed to handle vapour flow based on the maximum loading or discharge rate of the tank.

IMO regulations require a secondary means of protecting cargo tanks against over or under-pressure in case the primary means of venting fails. This can be complied with by fitting an extra P/V valve on a separate vent line or by fitting a pressure sensor in the tank.

TMSA 6.1.1 requires that procedures for cargo, ballast, tank cleaning and bunkering operations are in place for all vessel types within the fleet. The procedures include:

- Cargo and ballast handling.

IMO: ISM Code

7 The Company should establish procedures, plans and instructions, including checklists as appropriate, for key shipboard operations concerning the safety of the personnel, ship and protection of the environment. The various tasks involved should be defined and assigned to qualified personnel.

IMO: SOLAS

Chapter II-2 Regulation 4

5.3.2 Venting arrangements

5.3.2.1 The venting arrangements in each cargo tank may be independent or combined with other cargo tanks and may be incorporated into the inert gas piping.

5.3.2.2 Where the arrangements are combined with other cargo tanks, either stop valves or other acceptable means shall be provided to isolate each cargo tank. Where stop valves are fitted, they shall be provided with locking arrangements which shall be under the control of the responsible ship's officer. There shall be a clear visual indication of the operational status of the valves or other acceptable means. Where tanks have been isolated, it shall be ensured that relevant isolating valves are opened before cargo loading or ballasting or discharging of those tanks is commenced. For tankers constructed on or after 1 January 2017, any isolation shall also continue to permit the passage of large volumes of vapour, air or inert gas mixtures during cargo loading and ballasting, or during discharging in accordance with regulation 11.6.1.2

Chapter II-2 Regulation 11

6.1 General

The venting arrangements shall be so designed and operated as to ensure that neither pressure nor vacuum in cargo tanks shall exceed design parameters and be such as to provide for:

1. the flow of the small volumes of vapour, air or inert gas mixtures caused by thermal variations in a cargo tank in all cases through pressure/vacuum valves; and
2. the passage of large volumes of vapour, air or inert gas mixtures during cargo loading and ballasting, or during discharging.

6.3.2 Secondary means for pressure/vacuum relief

A secondary means of allowing full flow relief of vapour, air or inert gas mixtures shall be provided to prevent over-pressure or under-pressure in the event of failure of the arrangements in paragraph 6.1.2. In addition, for tankers constructed on or after 1 January 2017, the secondary means shall be capable of preventing over-pressure or under-pressure in the event of damage to, or inadvertent closing of, the means of isolation required in regulation 4.5.3.2.2. Alternatively, pressure sensors may be fitted in each tank protected by the arrangement required in paragraph 6.1.2, with a monitoring system in the ship's cargo control room or the position from which cargo operations are normally carried out. Such monitoring equipment shall also provide an alarm facility which is activated by detection of overpressure or under-pressure conditions within a tank.

IMO: IBC Code

8.3.3 Controlled tank venting systems shall consist of a primary and a secondary means of allowing full flow relief of vapour to prevent over-pressure or under-pressure in the event of failure of one means. Alternatively, the secondary means may consist of pressure sensors fitted in each tank with a monitoring system in the ship's cargo control room or position from which cargo operations are normally carried out. Such monitoring equipment shall also provide an alarm facility which is activated by detection of over-pressure or under-pressure conditions within a tank.

Inspection Guidance

The vessel operator should have developed procedures for the operation of the primary and secondary cargo tank venting systems in accordance with SOLAS which described:

- The primary and secondary system for each anticipated cargo tank/group configuration.
- The associated settings of the pressure/vacuum sensor alarms, where fitted.
- Maintenance, test and calibration procedures for the cargo tank pressure/vacuum monitoring system per the manufacturer's instructions.

These procedures may be contained in the vessel's cargo handling manual(s) and/or the planned maintenance system.

In the case of inerted vessels, if pressure sensors are provided as the means of secondary protection, the alarm settings for the pressure sensors must be set to actuate when the tank pressure reaches 10% greater than the normal actuation settings of the pressure valves themselves. In the case of the low-pressure settings, the pressure in a tank should never be permitted to fall below zero and the pressure sensors should be set to alarm above zero.

In the case of non-inerted vessels if pressure sensors are provided, the over-pressure setting should be set to alarm at either 10% greater than the normal actuation settings of the pressure valves or slightly higher than the pressure at which the pressure valve meets the maximum load rate for the tank as measured from the pressure flow diagram. The vacuum setting should be either 10% greater than the normal actuation settings of the vacuum valves or slightly higher than the vacuum at which the vacuum valve meets the maximum discharge rate for the tank as measured from the vacuum flow diagram.

At no time should the alarm settings for the pressure sensors exceed the safe design pressures of the cargo tank.

Class societies may accept a system that may not comply with the SOLAS requirements for 'secondary means of allowing full flow relief'. In such cases an observation should still be made.

If the vessel is described in the IOPPC Form B 1.11.4 as a Crude oil/Product carrier and carries crude and products simultaneously, the cargo tank vapour isolating valve will be intentionally closed to prevent vapour carryover. In such cases, both primary and secondary protection must be provided on the cargo tank side of the cargo tank vapour isolating valve.

The vessel operator will have described the secondary venting arrangements fitted to the vessel though the pre-inspection questionnaire. The description provided will be inserted in the inspection editor and the final report.

The response to HVPQ questions 9.10.6 and 9.10.7 (where applicable) will be inserted in the inspection editor for the information of the inspector.

Suggested Inspector Actions

- Sight, and where necessary review, the company procedures for the operation of the primary and secondary cargo tank venting systems.

- Review the primary and secondary venting arrangements and verify they comply with SOLAS (and the HVPQ).
- Where an electronic pressure/vacuum monitoring system is provided:
    - Verify the satisfactory operation of the system.
    - Verify that the alarms are set to operate at the correct value.
    - Review records of tests and calibration of the pressure sensors.

- Interview the accompanying officer to verify their familiarity with:
    - The company procedures for the operation of the primary and secondary cargo tank venting systems.
    - The required settings for pressure alarms, where fitted.

Expected Evidence

- Company procedures for the operation of the primary and secondary cargo tank venting systems.
- Ship's drawings of the cargo tank venting arrangements.
- Cargo handling manual(s).
- Records of tests and calibration of the pressure sensors, where fitted.

Potential Grounds for a Negative Observation

- There were no company procedures for the operation of the primary and secondary cargo tank venting systems in accordance with SOLAS which described:
    - The primary and secondary system for each anticipated cargo tank/group configuration.
    - The associated settings of the pressure/vacuum sensor alarms, where fitted.
    - Maintenance, test and calibration procedures for the cargo tank pressure/vacuum monitoring system per the manufacturer's instructions.
- The accompanying officer was not familiar with the company procedures for the operation of the primary and secondary cargo tank venting systems in accordance with SOLAS.
- The primary and secondary venting arrangements were not as described in the HVPQ and/or PIQ.
- The means of providing 'secondary means of allowing full flow relief' did not comply with the SOLAS requirements.
- Cargo tanks were fitted with vapour isolating valves which might be damaged or inadvertently closed but were not fitted with either full-flow P/V valves or a pressure/vacuum monitoring system.
- Cargo tanks were fitted with vapour isolating valves which would be intentionally closed for vapour segregation purposes but were not fitted with either two full flow P/V valves or a P/V valve and a pressure/vacuum monitoring system on the cargo tank side of the cargo tank vapour isolating valve.
- On a chemical carrier, cargo tanks were fitted with an independent P/V valve but there was no secondary protection in the form of a second full flow P/V valve or a pressure/vacuum monitoring system.
- The cargo tank pressure/vacuum monitoring system alarms were not set to operate at the correct value.
- One or more cargo tank pressure sensors were not operational.
- One or more cargo tank pressure sensors appeared to be inaccurate.
- The cargo tank pressure/vacuum monitoring system was defective in any respect.
- There were no records of tests and/or calibration of the cargo tank pressure/vacuum monitoring system per the manufacturer's instructions.

In the circumstances that the 'secondary means of allowing full flow relief' did not comply with the requirements of SOLAS, the supporting comment should describe why the requirements were not met.

8.3.14. Were the Master and officers familiar with the company procedures for the operation, inspection, testing and maintenance of the cargo tank venting systems, and were the systems in satisfactory condition?

Short Question Text
Cargo tank venting systems.

Vessel Types
Oil, Chemical

ROVIQ Sequence
Cargo Control Room, Main Deck

Publications
IMO: ISM Code
IMO SOLAS
OCIMF/ICS: International Safety Guide for Oil Tankers and Terminals. Sixth Edition.
IMO: Inert Gas Systems

Objective

To ensure that cargo tank venting systems are maintained in satisfactory condition and operated correctly.

Industry Guidance

OCIMF/ICS: International Safety Guide for Oil Tankers and Terminals. Sixth Edition

11.1.8 Cargo tank protection against over/under pressure.

Serious accidents have occurred on oil tankers as a result of cargo tanks being severely over or under pressure. Although SOLAS regulations have been modified to require tanks to be fitted with pressure monitors and safety devices, it is still essential that venting systems are thoroughly checked to ensure that they are correctly set for the intended operation.

11.2.2.3 Tank over pressurisation – precautions and corrective actions

Regular maintenance, pre-operational testing and operator awareness of isolating valves, P/V valves or high velocity vents can guard against failure during operation.

Ship Shore Safety Check List – Part 1A. Tanker checks pre-arrival

item 6. Pressure/vacuum valves and or high velocity vents are operational (11.1.8)

IMO: Inert Gas Systems

3.9.12 All pressure and vacuum relief openings should be fitted with flame screens with easy access for cleaning and renewal. The flame screens should be at the inlets and outlets of any relief device and be of robust construction sufficient to withstand the pressure of gas generated at maximum loading and during ballasting operations while presenting minimum resistance.

TMSA KPI 6.1.2 requires that procedures for pre-operational tests and checks of cargo and bunkering equipment are in place for all vessel types within the fleet. Tests and checks of equipment may include:

- IGS and venting system

IMO: ISM Code

10.1 The Company should establish procedures to ensure that the ship is maintained in conformity with the provisions of the relevant rules and regulations and with any additional requirements which may be established by the Company.

IMO: SOLAS

Chapter II-2 Regulation 4

5.3.2.1 The venting arrangements in each cargo tank may be independent or combined with other cargo tanks and may be incorporated into the inert gas piping.

Chapter II-2 Regulation 11

6.1 General

The venting arrangements shall be so designed and operated as to ensure that neither pressure nor vacuum in cargo tanks shall exceed design parameters and be such as to provide for:

1. the flow of the small volumes of vapour, air or inert gas mixtures caused by thermal variations in a cargo tank in all cases through pressure/vacuum valves; and
2. the passage of large volumes of vapour, air or inert gas mixtures during cargo loading and ballasting, or during discharging.

6.4 Size of vent outlets

Vent outlets for cargo loading, discharging and ballasting required by paragraph 6.1.2 shall be designed on the basis of the maximum designed loading rate multiplied by a factor of at least 1.25 to take account of gas evolution, in order to prevent the pressure in any cargo tank from exceeding the design pressure. The master shall be provided with information regarding the maximum permissible loading rate for each cargo tank and in the case of combined venting systems, for each group of cargo tanks.

Inspection Guidance

The vessel operator should have developed procedures for the operation, inspection, testing and maintenance of the cargo tank venting systems including, where fitted:

- P/V valves.
- High velocity vents
- Mast risers
- Vent stacks.
- Vacuum valves.
- Flame screens.
- Vapour lines.

P/V valves and/or high velocity vents should be checked for free movement prior to the commencement of each cargo operation as required by the Ship Shore Safety Check List – Part 1A. Tanker checks pre-arrival, item 6.

High velocity vents should not be jacked open, particularly when loading. Their correct operation relies on a pressure build-up within the compartment, which opens the valve at a predetermined level, and which then results in a gas exit velocity of a minimum of 30 metres/sec. The high velocity flow means no flame screen is needed at the vapour outlet on this type of valve.

Suggested Inspector Actions

- Sight, and where necessary review, the company procedures for the operation, inspection, testing and maintenance of the cargo tank venting systems.
- Review the records of inspection, maintenance and pre-operational tests of P/V valves and/or high velocity vents.
- Review the information provided regarding the maximum permissible loading rate for each cargo tank and in the case of combined venting systems, for each group of cargo tanks.
- Assess the condition of, where fitted:
  - P/V valves.
  - High velocity vents
  - Mast risers.
  - Vent stacks.
  - Vacuum valves.
  - Flame screens.
  - Vapour lines.
- Verify that high velocity vents were being operated correctly.

- Interview the accompanying officer to verify their familiarity with the company procedures for the operation, inspection, testing and maintenance of the cargo tank venting systems.

Expected Evidence

- Company procedures for the operation, inspection, testing and maintenance of the cargo tank venting systems.
- Records of inspection and maintenance of P/V valves and/or high velocity vents, which may be contained in the planned maintenance system.
- Ship Shore Safety Check Lists
- Information regarding the maximum permissible loading rate for each cargo tank and in the case of combined venting systems, for each group of cargo tanks.

Potential Grounds for a Negative Observation

- The accompanying officer was not familiar with the company procedures for the operation, inspection, testing and maintenance of the cargo tank venting systems.
- There were no records of inspection, testing and maintenance of the cargo tank venting systems.
- P/V valves and/or high velocity vents had not been checked for free movement prior to the commencement of each cargo operation as required by the Ship Shore Safety Check List – Part 1A. Tanker checks pre-arrival, item 6.
- No information was available regarding the maximum permissible loading rate for each cargo tank and in the case of combined venting systems, for each group of cargo tanks.
- The flame screen for a P/V valve or mast riser was damaged, clogged or missing.
- A P/V valve and/or high velocity vent was passing vapour or drawing air inside its design pressure or vacuum setting.
- High velocity vents had been jacked open during cargo operations.
- A vapour line was in unsatisfactory condition, for example, heavily corroded or with soft patches.
- A P/V valve or high velocity vent was defective in any respect.

8.3.15. Were the Master and officers familiar with the company procedures for monitoring leakage into the cofferdams of deepwell pumps, and had regular purging of the cofferdams taken place to identify any excessive leakage?

Short Question Text
Deepwell pump cofferdam purging.

Vessel Types
Oil, Chemical

ROVIQ Sequence
Cargo Control Room, Main Deck, Interview - Deck Rating

Publications
IMO: ISM Code
ICS: Tanker Safety Guide (Chemicals) - Fifth Edition

Objective

To ensure the vessel's deep well pumps are always in full operational condition.

Industry Guidance

ICS: Tanker Safety Guide (Chemicals) Fifth Edition

5.5.2 Deepwell pumps

…The pump's cofferdam should be purged regularly to allow checking for any signs of leakage past the shaft seals that protect the cofferdam.

TMSA KPI 4.1.1 requires that each vessel in the fleet is covered by a planned maintenance system and spare parts inventory which reflects the company's maintenance strategy. The company identifies all equipment and machinery required to be included in the planned maintenance system, for example:

- Cargo handling machinery/equipment.

IMO: ISM Code

10.1 The Company should establish procedures to ensure that the ship is maintained in conformity with the provisions of the relevant rules and regulations and with any additional requirements which may be established by the Company.

Inspection Guidance

The vessel operator should have developed procedures for monitoring leakage into the cofferdams of deepwell pumps which included:

- Purging procedures.
- Safety precautions to be followed when purging cofferdams.
- Precautions with regards to purging medium and purging medium pressure.
- Frequency of purging.
- Records to be maintained.
- Guidance on acceptable levels of leakage from both the cargo and hydraulic oil sides.
- Actions to be taken when unacceptable levels of leakage are encountered.
- Precautions to be taken when handling specialist cargo types.

- Actions, if any, to be taken to prevent cofferdam blockage when carrying heated or solidifying cargo.
- Actions to be taken when a cofferdam is blocked by solidified cargo.

These procedures may refer to the manufacturer's instruction manual and form part of the vessel's planned maintenance system.

In line with manufacturer's instructions, the cofferdams of deepwell pumps should be purged regularly, with air or an inert gas, to monitor the condition of the seals and detect any leakage of cargo, hydraulic or lubricating oil into the cofferdams.

When purging deepwell pump cofferdams, the exhaust gas and any entrained liquid are likely to be hazardous and suitable safety precautions should be taken, including wearing suitable PPE.

Detailed records of purging routines should be maintained, the results analysed, and suitable action taken when abnormal leakage is detected.

In some cases, small leakage rates during pump operation are normal, rates may vary with the properties of different cargoes. The manufacturer's instruction manuals should provide guidance on acceptable limits.

When handling heated or solidifying cargoes, the cofferdams may be filled with, for example, diesel oil or a light lubricating oil to keep any leakage into the cofferdam in liquid form.

Suggested Inspector Actions

- Sight, and where necessary review, the company procedures for monitoring leakage into the cofferdams of deepwell pumps.
- Review the records of purging of the deepwell pump cofferdams.

- While inspecting a deepwell pump, interview the accompanying officer to verify their familiarity with:
  - The company procedures for monitoring leakage into the cofferdams of deepwell pumps.
  - The connections, controls and indicators used during the purging process.
  - The maximum pressure permitted for the purging medium.
  - The purging medium required for the types of cargo recently carried.
  - The manufacturer's and company guidance on the use of liquid to fill the cofferdams for speciality products, where this practice was utilised.

- Interview a selected rating, for example the pumpman, to verify their familiarity with the safety precautions to be taken when purging deepwell pump cofferdams.

Expected Evidence

- The company procedures for monitoring leakage into the cofferdams of deepwell pumps.
- Manufacturer's instruction manual(s) for the deepwell pumps.
- Records of purging of the deepwell pump cofferdams.

Potential Grounds for a Negative Observation

- There were no company procedures for monitoring leakage into the cofferdams of deepwell pumps.
- The accompanying officer was not familiar with:
  - The company procedure for monitoring leakage into the cofferdams of deepwell pumps.
  - The connections, controls and indicators used during the purging process.

    - The maximum pressure permitted for the purging medium.
    - The purging medium required for the types of cargo recently carried.
    - The manufacturer's and company guidance on the use of liquid to fill the cofferdams for specialty products, where this practice was utilised.
- Purging had not been carried out as required by the company procedure for monitoring leakage into the cofferdams of deepwell pumps.
- There were no detailed records of purging as required by the company procedure for monitoring leakage into the cofferdams of deepwell pumps.
- Records of purging indicated leakage levels above the manufacturer's set limits for cargo, hydraulic oil or lubricating oil for one or more pump, but no defect report(s) had been created to resolve the situation at the next suitable opportunity.
- Records of purging indicated that the cofferdam of one or more pump was apparently blocked, but no defect report(s) had been created to resolve the situation at the next suitable opportunity.
- An interviewed rating was not familiar with the safety precautions to be taken when purging the deepwell pump cofferdams.

Where purging records indicated that one or more pumps had leakage levels above the manufacturer's set limits or that the cofferdams were blocked, but a defect report had been created to correct the situation at the next suitable opportunity, enter a **comment** in Hardware response tool and provide brief details of the defects recorded.

8.3.16. Were the Master and officers familiar with the purpose, operation, testing and maintenance of the non-return devices installed in the inert gas system, and were these devices in satisfactory condition?

Short Question Text
Inert gas system non-return devices

Vessel Types
Oil, Chemical

ROVIQ Sequence
Cargo Control Room, Main Deck

Publications
IMO: ISM Code
IMO SOLAS
OCIMF/ICS: International Safety Guide for Oil Tankers and Terminals. Sixth Edition.
IMO: FSS Code
IMO: Inert Gas Systems

Objective

To ensure the devices installed in the inert gas system to prevent the return of vapour and liquid to the inert gas plant, or to any gas-safe spaces, function correctly.

Industry Guidance

OCIMF/ICS: International Safety Guide for Oil Tankers and Terminals. Sixth Edition

11.1.5.2 Inert gas system maintenance

The deck and engine departments should cooperate closely to ensure the IG system is maintained and operated properly. It is important to make sure that non-return barriers function correctly, especially the deck water seal or block and bleed valves, so that there is no possibility of petroleum gas or liquid petroleum passing back to the machinery spaces.

To demonstrate that the IG plant is fully operational and in good working order, a record of inspection of the plant, including defects and their rectification, should be maintained on board.

IMO: FSS Code

Chapter 15

2.2.2.6 Where a double block and bleed valve is installed, the system shall ensure upon of loss of power, the block valves are automatically closed, and the bleed valve is automatically open.

2.2.3.1 Non-return devices

2.2.3.1.1 At least two non-return devices shall be fitted in order to prevent the return of vapour and liquid to the inert gas plant, or to any gas-safe spaces.

2.2.3.1.2 The first non-return device shall be a deck seal of the wet, semi-wet, or dry type or a double block and bleed arrangement. Two shut-off valves in series with a venting valve in between, may be accepted provided:

1. the operation of the valve is automatically executed. Signal(s) for opening/closing is (are) to be taken from the process directly, e.g. inert gas flow or differential pressure; and

2. alarm for faulty operation of the valves is provided, e.g. the operation status of "blower stop" and "supply valve(s) open" is an alarm condition.

2.2.3.1.3 The second non-return device shall be a non-return valve or equivalent capable of preventing the return of vapours and liquids and fitted between the deck water seal (or equivalent device) and the first connection from the inert gas main to a cargo tank. It shall be provided with positive means of closure. As an alternative to positive means of closure, an additional valve having such means of closure may be provided between the non-return valve and the first connection to the cargo tanks to isolate the deck water seal, or equivalent device, from the inert gas main to the cargo tanks.

2.2.3.1.4 A water seal, if fitted, shall be capable of being supplied by two separate pumps, each of which shall be capable of maintaining an adequate supply at all times. The audible and visual alarm on the low level of water in the water seal shall operate at all times.

2.2.3.1.5 The arrangement of the water seal, or equivalent devices, and its associated fittings shall be such that it will prevent backflow of vapours and liquids and will ensure the proper functioning of the seal under operating conditions.

2.2.3.1.6 Provision shall be made to ensure that the water seal is protected against freezing, in such a way that the integrity of seal is not impaired by overheating.

2.2.3.1.7 A water loop or other approved arrangement shall also be fitted to each associated water supply and drainpipe and each venting or pressure-sensing pipe leading to gas-safe spaces. Means shall be provided to prevent such loops from being emptied by vacuum.

2.2.3.1.8 Any water seal, or equivalent device, and loop arrangements shall be capable of preventing return of vapours and liquids to an inert gas plant at a pressure equal to the test pressure of the cargo tanks.

2.2.3.1.9 The non-return devices shall be located in the cargo area on deck.

IMO: Inert Gas Systems

9.4 Deck water seal

9.4.1 This unit performs an important function and must be maintained in good condition. Corroded inlet pipes and damage to float-controlled valves are not uncommon. The overboard drain line and connection are also possible sources of trouble.

9.5 The non-return valve should be opened for inspection to check for corrosion and also to check the condition of the valve seat.

TMSA 6.1.1 requires that procedures for cargo, ballast, tank cleaning and bunkering operations are in place for all vessel types within the fleet. The procedures include:

- Maintaining safe tank atmospheres.
- Record keeping.

IMO: ISM Code

10.1 The Company should establish procedures to ensure that the ship is maintained in conformity with the provisions of the relevant rules and regulations and with any additional requirements which may be established by the Company.

IMO: SOLAS

Chapter II-2 Regulation 4

5.5.1.1 For tankers of 20,000 tonnes deadweight and upwards constructed on or after 1 July 2002 but before 1 January 2016, the protection of the cargo tanks shall be achieved by a fixed inert gas system in accordance with the requirements of the Fire Safety Systems Code, as adopted by resolution MSC.98(73), except that the Administration may accept other equivalent systems or arrangements, as described in paragraph 5.5.4.

5.5.1.2 For tankers of 8,000 tonnes deadweight and upwards constructed on or after 1 January 2016 when carrying cargoes described in regulation 1.6.1 or 1.6.2, the protection of the cargo tanks shall be achieved by a fixed inert gas system in accordance with the requirements of the Fire Safety Systems Code, except that the Administration may accept other equivalent systems or arrangements, as described in paragraph 5.5.4.

5.5.1.3 Tankers operating with a cargo tank cleaning procedure using crude oil washing shall be fitted with an inert gas system complying with the Fire Safety Systems Code…

Inspection Guidance

The vessel operator should have developed procedures for the operation, inspection, testing and maintenance of the inert gas system which included the:

- Deck seal or double block and bleed arrangement.
- Non-return valve.

A record of inspection and maintenance of the inert gas plant, including defects and their rectification, should be maintained on board. This may form part of the vessel's planned maintenance system.

The type of deck seal fitted to the vessel will be extracted from the HVPQ and inserted in the inspection editor and the final report.

Suggested Inspector Actions

- Sight, and where necessary review, the company procedures for the operation, inspection, testing and maintenance of the inert gas system which included the:
    - deck seal or double block and bleed arrangement
    - non-return valve
- Inspect the IG main non-return valve and verify it had been opened and inspected as required by company procedures.
- Inspect the deck seal, if fitted, and verify that the:
    - Water level gauge is clear and readable.
    - Water level is as required.
    - Overall fabric condition of the deck seal is satisfactory, including pipework.
    - Deck seal had been opened and inspected as required by company procedures, including pipework.
- Inspect the double block and bleed arrangement, if fitted, and verify that:
    - All valves are operating automatically.
    - There was evidence that the valves had been tested/inspected for automatic operation and tightness.
- Where necessary, review the records for the inspection, testing and maintenance of the non-return devices installed in the inert gas system.

- Interview the accompanying officer to verify their familiarity with the purpose, operation, testing and maintenance of the non-return devices installed in the inert gas system

Expected Evidence

- The company procedures for the operation, inspection, testing and maintenance of the vessel's inert gas system.
- The records of inspection, testing and maintenance of the non-return devices installed in the inert gas system.

Potential Grounds for a Negative Observation

- There were no company procedures for the operation, inspection, testing and maintenance of the inert gas system that included the:
    - deck seal or double block and bleed arrangement
    - non-return valve
- The accompanying officer was not familiar with the company procedures for the operation, inspection, testing and maintenance of the inert gas system that included the:
    - deck seal or double block and bleed arrangement
    - non-return valve
- There was no evidence that the IG main non-return valve had been opened and inspected as required by company procedures.
- There was no evidence that the block and bleed valve arrangement, where fitted, had been tested/inspected for automatic operation and tightness.
- The deck seal level gauge was not clear and readable.
- The deck seal water level was not as required.
- The fabric condition of the deck seal, including pipework, was not satisfactory.
- There was no evidence to show the deck seal had been opened and inspected, including pipework, as required by company procedures.
- The valves of the double block and bleed arrangement were not operating automatically as required.
- The non-return devices installed in the inert gas system were defective in any respect.

Where a dry-type deck seal is fitted record as a **comment** in the Hardware response tool.

8.3.17. Were the Master and officers familiar with the company procedures for the use, inspection and testing of manifold reducers, spool pieces and other portable pipework, and were these items in satisfactory condition and properly fitted when in use?

Short Question Text
Manifold reducers and spool pieces.

Vessel Types
Oil, Chemical

ROVIQ Sequence
Cargo Control Room, Main Deck

Publications
OCIMF/ICS: International Safety Guide for Oil Tankers and Terminals. Sixth Edition.
ICS: Tanker Safety Guide (Chemicals) - Fifth Edition
OCIMF/CDI: Recommendations for Oil and Chemical Tanker Manifolds and Associated Equipment
USCG: Code of Federal Regulations. Title 33.
IMO: ISM Code

Objective

To ensure manifold reducers, spool pieces and other items of portable pipework meet the required pressure rating for the cargo transfer system and will not leak at the flange face when used.

Industry Guidance

OCIMF/ICS: International Safety Guide for Oil Tankers and Terminals. Sixth Edition

23.6.3 Reducers and spool pieces

Reducers and spool pieces should be made of steel and be fitted with flanges that conform to the American Society of Mechanical Engineers (ASME) Standard B16.5, Class 150 or equivalent (see OCIMF/CDI's Recommendation for Oil and Chemical Tanker Manifolds and Associated Equipment).

All spool pieces and reducers should have lifting lugs fitted close to the centre of balance so that they can be handled more easily. The handles should not interfere with quick acting coupling devices or the bolting of flanges. When in storage, flange faces should be suitably protected.

OCIMF/CDI: Recommendations for Oil and Chemical Tanker Manifolds and Associated Equipment. First Edition.

4.3 Distance pieces

Distance pieces should be fitted outboard of the manifold valves and immediately inboard of the reducer or spool piece.

4.4 Spool pieces and reducers

To protect the fixed manifold flange, a spool piece or reducer that in turn connects to the loading arm or hose should be used.

No more than one spool piece or reducer should be fitted between the manifold flange and the flange presented for connection.

Lifting lugs

All spool pieces and reducers should be fitted with a lifting lug. This lug should be placed as near to the centre of gravity as possible and at a location that should not interfere with either the operation of quick acting couplers or with the bolting up of flanges.

Presentation flanges, material and design

The number of reducers carried, and the size of presentation flanges, should be in accordance with tables 4.1 and 4.2. Typically, the principal reducers may be kept bolted in place. On the occasions when a smaller presentation flange is required, the principal reducers should be removed and replaced by the required size reducer.

The presentation flanges should be kept vertical and have flat faces. Gasket contact surfaces should be machined and finished with a continuous spiral groove, in accordance with ASME B16.5.

ICS: Tanker Safety Guide (Chemicals) - Fifth Edition

6.7.2 Manifold connections

Reducers and spool pieces should be made of material that is compatible with the cargo and complies with relevant industry standards. Where long reducers or spool pieces are used the resulting lengths should be properly supported to prevent undue stress.

USCG: CFR 33 Part 156.170 Equipment tests and inspections.

(a) Except as provided in paragraph (d) of this section, no person may use any equipment listed in paragraph (c) of this section for transfer operations unless the vessel or facility operator, as appropriate, tests and inspects the equipment in accordance with paragraphs (b), (c) and (f) of this section and the equipment is in the condition specified in paragraph (c) of this section.

(b) During any test or inspection required by this section, the entire external surface of the hose must be accessible.

(c) For the purpose of paragraph (a) of this section:

(4) Each loading arm and each transfer pipe system, including each metallic hose, must not leak under static liquid pressure at least 1 1/2 times the maximum allowable working pressure;

(e) The test fluid used for the testing required by this section is limited to liquids that are compatible with the hose tube as recommended by the hose manufacturer.

(f) The frequency of the tests and inspections required by this section must be:

(3) For vessels, annually or as part of the biennial and mid-period inspections.

TMSA KPI 6.1.2 requires that procedures for pre-operational tests and checks of cargo and bunkering equipment are in place for all vessel types within the fleet. Tests and checks of equipment may include:

- Cargo/bunker line pressure testing

IMO: ISM Code

10 Maintenance of the Ship and Equipment

10.1 The Company should establish procedures to ensure that the ship is maintained in conformity with the provisions of the relevant rules and regulations and with any additional requirements which may be established by the Company.

Inspection Guidance

The vessel operator should have developed procedures for the use, inspection and testing of manifold reducers, spool pieces and other portable pipework that included guidance on:

- The correct use of manifold reducers, spool pieces and other portable pipework.
- Provision of test certification.
- Suitable storage arrangements, including the protection of flange faces.
- Regular inspection.
- Pressure testing at least annually.
- Records to be maintained of inspections and tests.

All manifold reducers, spool pieces and other portable pipework should be provided with pressure test certificates.

A manifold reducer, spool piece or other item of portable pipework should have the same or greater certified rating as the fixed manifold piping to which it is connected.

Manifold reducers, spool pieces and other portable pipework should be marked with the date and pressure of the last test.

Other portable pipework may include cargo Y pieces, spiders or other hard configurations.

This question will apply to all manifold reducers, spool pieces and other items of portable pipework carried onboard for use for cargo or bunker operations unless they are clearly marked as out of service for refurbishment.

Where reducers or spool pieces are provided by the terminal this question will apply in respect of:

- Physical condition and pressure rating.
- The number of reducers fitted between the manifold flange and the flange presented for connection.

Suggested Inspector Actions

- Sight, and where necessary review, the company procedures for the use, inspection and testing of manifold reducers, spool pieces and other portable pipework.
- Review the inventory of manifold reducers, spool pieces and other portable pipework.
- Review the records of inspection and testing of manifold reducers, spool pieces and other portable pipework.
- During the inspection, observe the disposition and visual condition of the manifold reducers, spool pieces and other portable pipework.
- Where necessary, compare the observed condition with the records of inspection and testing of manifold reducers, spool pieces and other portable pipework.

- Request that the blanks or covers are removed from at least one stored reducer or spool piece and verify that the presentation flanges were undamaged and free from pitting or scoring.

Expected Evidence

- The company procedures for the use, inspection and testing of manifold reducers, spool pieces and other portable pipework.
- The inventory of manifold reducers, spool pieces and other portable pipework.
- Records of the inspection and pressure testing of manifold reducers, spool pieces and other portable pipework.

Potential Grounds for a Negative Observation

- There were no company procedures for the use, inspection and testing of manifold reducers, spool pieces and other portable pipework that included guidance on:
    - The correct use of manifold reducers, spool pieces and other portable pipework.
    - Provision of test certification.
    - Suitable storage arrangements, including the protection of flange faces.
    - Regular inspection.
    - Pressure testing at least annually.
    - Records to be maintained of inspections and tests.
- There was no inventory of manifold reducers, spool pieces and other portable pipework.
- The accompanying officer was not familiar with the company procedures for the use, inspection and testing of manifold reducers, spool pieces and other portable pipework.
- Test certification was not available for a manifold reducer, spool piece or other item of portable pipework.
- There were no records available for the inspection and testing of manifold reducers, spool pieces and other portable pipework as required by company procedures.
- Inspection of the manifold reducers, spool pieces and other portable pipework indicated that the required inspections and tests had either not been performed or were ineffective.
- A manifold reducer, spool piece or other item of portable pipework:
    - Had not been pressure tested to 100% MAWP within the last 12 months.
    - Was not marked with the date and pressure of the last test.
    - Did not have the same certified rating (MAWP) as the fixed manifold piping to which it was connected.
- The position of handles or lugs on reducers in use during cargo transfer operations interfered with quick acting coupling devices or the bolting of flanges.
- More than one spool piece or reducer was fitted between the fixed manifold flange and the flange presented for connection.
- The flange face of a manifold reducer, spool piece or other item of portable pipework was visibly damaged, corroded or in an unsatisfactory condition.
- Where a long reducer or spool piece was in use, it was not properly supported to prevent undue stress. (applicable to chemical tankers only)
- A manifold reducer, spool piece or other item of portable pipework in use for cargo transfer at the time of the inspection was defective in any respect.
- A manifold reducer, spool piece or other item of portable pipework in use for cargo transfer at the time of the inspection had been repaired but there was no evidence that it had been pressure tested on completion of the repairs.

8.3.18. Were the Master and officers familiar with the purpose, operation, testing and maintenance of the pressure/vacuum-breaking (P/V) device(s) installed in the inert gas main, and was this device(s) in satisfactory condition?

Short Question Text
Inert gas system pressure/vacuum-breaking (P/V) device(s)

Vessel Types
Oil, Chemical

ROVIQ Sequence
Main Deck, Cargo Control Room

Publications
IMO: ISM Code
IMO SOLAS

Objective

To ensure cargo tanks are not subject to excessive pressure or vacuum should the inert gas system fail or where the venting system is used inappropriately.

Industry Guidance

OCIMF/ICS: International Safety Guide for Oil Tankers and Terminals. Sixth Edition

11.1.8.1 Pressure/Vacuum breakers

P/V breakers are usually liquid filled and it is important that the correct density liquid is used, and the appropriate level maintained. The P/V breakers should be marked with their High Pressure (HP) and vacuum opening pressures, the date of the last inspection, the type of anti-freeze and the lowest operating temperature.

IMO: Inert Gas Systems

3.9.12 All pressure and vacuum relief openings should be fitted with flame screens with easy access for cleaning and renewal. The flame screens should be at the inlets and outlets of any relief device and be of robust construction sufficient to withstand the pressure of gas generated at maximum loading and during ballasting operations while presenting minimum resistance.

TMSA 6.1.1 requires that procedures for cargo, ballast, tank cleaning and bunkering operations are in place for all vessel types within the fleet. The procedures include:

- Maintaining safe tank atmospheres.
- Record keeping.

IMO: ISM Code

10.1 The Company should establish procedures to ensure that the ship is maintained in conformity with the provisions of the relevant rules and regulations and with any additional requirements which may be established by the Company.

IMO: SOLAS

Chapter II-2 Regulation 4

5.5.1.1 For tankers of 20,000 tonnes deadweight and upwards constructed on or after 1 July 2002 but before 1 January 2016, the protection of the cargo tanks shall be achieved by a fixed inert gas system in accordance with the requirements of the Fire Safety Systems Code, as adopted by resolution MSC.98(73), except that the Administration may accept other equivalent systems or arrangements, as described in paragraph 5.5.4.

5.5.1.2 For tankers of 8,000 tonnes deadweight and upwards constructed on or after 1 January 2016 when carrying cargoes described in regulation 1.6.1 or 1.6.2, the protection of the cargo tanks shall be achieved by a fixed inert gas system in accordance with the requirements of the Fire Safety Systems Code, except that the Administration may accept other equivalent systems or arrangements, as described in paragraph 5.5.4.

5.5.1.3 Tankers operating with a cargo tank cleaning procedure using crude oil washing shall be fitted with an inert gas system complying with the Fire Safety Systems Code…

Chapter II-2 regulation 11 Para 6

6.3.4 Pressure/vacuum-breaking devices

One or more pressure/vacuum-breaking devices shall be provided to prevent the cargo tanks from being subject to:

.1 a positive pressure, in excess of the test pressure of the cargo tank, if the cargo were to be loaded at the maximum rated capacity and all other outlets are left shut; and

.2 a negative pressure in excess of 700 mm water gauge if cargo were to be discharged at the maximum rated capacity of the cargo pumps and the inert gas blowers were to fail.

Such devices shall be installed on the inert gas main unless they are installed in the venting system required by regulation 4.5.3.1 or on individual cargo tanks. The location and design of the devices shall be in accordance with regulation 4.5.3 and paragraph 6.

Inspection Guidance

The vessel operator should have developed procedures for the operation, inspection, testing and maintenance of the inert gas system which included the pressure/vacuum-breaking (P/V) devices.

A record of inspection and maintenance of the inert gas plant, including defects and their rectification, should be maintained on board. This may form part of the vessel's planned maintenance system.

The P/V breaker should not be set to operate at a lower pressure than that of the secondary venting system fitted to the individual cargo tanks.

In all cases, the P/V breaker should be set within the safe parameters of the tank structure.

Suggested Inspector Actions

- Sight, and where necessary review, the company procedures for the operation, inspection, testing and maintenance of the inert gas system which included the pressure/vacuum-breaking devices.
- Inspect the P/V breaker(s) and verify that it is marked with the:
    - Design pressure and vacuum opening settings.
    - Date of the last inspection.
    - Type/quantity of anti-freeze and the lowest allowable ambient temperature.
- Assess the fabric condition of the P/V breaker(s), including flame screens.
- Where possible, verify the liquid level in the P/V breaker(s).
- Where necessary, review the records of inspection, testing and maintenance of the pressure/vacuum breaking device(s) installed in the inert gas system.

- Interview the accompanying officer to verify their familiarity with:
  - The purpose of the pressure/vacuum breaking device(s) installed in the inert gas system.
  - The method of verifying the correct liquid level in the P/V breaker, especially where the level could only be verified at atmospheric pressure.

Expected Evidence

- The company procedures for the operation, inspection, testing and maintenance of the vessel's inert gas system.
- The records of inspection, testing and maintenance of the pressure/vacuum breaking device(s) installed in the inert gas system.

Potential Grounds for a Negative Observation

- There were no company procedures for the operation, inspection, testing and maintenance of the inert gas system that included the pressure/vacuum-breaking devices.
- The accompanying officer was not familiar with the company procedures for the operation, inspection, testing and maintenance of the inert gas system that included the pressure/vacuum-breaking devices.
- The fabric condition of a P/V breaker was unsatisfactory.
- P/V breaker flame screens were damaged, missing, fitted with gaps, or had been repaired with mesh which did not conform to the required mesh gauge specification.
- The liquid level in a P/V breaker indicated that the device was not filled to the design settings.
- The P/V breaker liquid level gauge was not clear and readable.
- A P/V breaker was not marked with the:
  - Design pressure and vacuum opening settings.
  - Date of the last inspection.
  - Type/quantity of anti-freeze and the lowest allowable temperature.
- A P/V breaker was
  - Set to operate at a lower pressure than that of the secondary venting system
  - Not set within the safe parameters of the tank structure.
  - Defective in any respect.
- The accompanying officer was not familiar with:
  - The purpose of a liquid P/V breaker.
  - The process to verify the liquid level in a liquid P/V breaker.

8.3.19. Were the Master and officers familiar with the purpose, operation and testing of the indicators and alarms in the inert gas system, and had the equipment been operated, maintained and calibrated in accordance with the manufacturer's instructions and company procedures?

Short Question Text
Indicators and alarms for the inert gas system

Vessel Types
Oil, Chemical

ROVIQ Sequence
Cargo Control Room, Engine Control Room

Publications
IMO: ISM Code
IMO SOLAS
OCIMF/ICS: International Safety Guide for Oil Tankers and Terminals. Sixth Edition.
IMO: FSS Code

Objective

To ensure the inert gas system always delivers inert gas in accordance with its design criteria.

Industry Guidance

OCIMF/ICS: International Safety Guide for Oil Tankers and Terminals. Sixth Edition

ISGOTT Checks pre-arrival Ship/Shore Safety Checklist

Part 1B. Tanker: checks pre-arrival if using an inert gas system

IMO: FSS Code

Chapter 15

2.2.4 Indicators and alarms

2.2.4.1 The operation status of the inert gas system shall be indicated in a control panel.

2.2.4.2 Instrumentation shall be fitted for continuously indicating and permanently recording, when inert gas is being supplied:

1. the pressure of the inert gas mains forward of the non-return devices; and
2. the oxygen content of the inert gas.

2.2.4.3 The indicating and recording devices shall be placed in the cargo control room where provided. But where no cargo control room is provided, they shall be placed in a position easily accessible to the officer in charge of cargo operations.

2.2.4.4 In addition, meters shall be fitted:

1. in the navigating bridge to indicate at all times the pressure referred to in paragraph 2.2.4.2.1 and the pressure in the slop tanks of combination carriers, whenever those tanks are isolated from the inert gas main; and

2. in the machinery control room or in the machinery space to indicate the oxygen content referred to in paragraph 2.2.4.2.2.

2.2.4.5 Audible and visual alarms

2.2.4.5.1 Audible and visual alarms shall be provided, based on the system designed, to indicate:

1. oxygen content in excess of 5% by volume.
2. failure of the power supply to the indicating devices as referred to in paragraph 2.2.4.2.
3. gas pressure less than 100 mm water gauge. The alarm arrangement shall be such as to ensure that the pressure in slop tanks in combination carriers can be monitored at all times.
4. high-gas pressure; and
5. failure of the power supply to the automatic control system.

2.2.4.5.2 The alarms required in paragraphs 2.2.4.5.1.1, 2.2.4.5.1.3 and 2.2.4.5.1.5 shall be fitted in the machinery space and cargo control room, where provided, but in each case in such a position that they are immediately received by responsible members of the crew.

2.2.4.5.3 An audible alarm system independent of that required in paragraph 2.2.4.5.1.3 or automatic shutdown of cargo pumps shall be provided to operate on predetermined limits of low pressure in the inert gas main being reached.

2.2.4.5.4 Two oxygen sensors shall be positioned at appropriate locations in the space or spaces containing the inert gas system. If the oxygen level falls below 19%, these sensors shall trigger alarms, which shall be both visible and audible inside and outside the space or spaces and shall be placed in such a position that they are immediately received by responsible members of the crew.

2.3 Requirements for flue gas and inert gas generator systems

2.3.2 Indicators and alarms

2.3.2.1 In addition to the requirements in paragraph 2.2.4.2, means shall be provided for continuously indicating the temperature of the inert gas at the discharge side of the system, whenever it is operating.

2.3.2.2 In addition to the requirements of paragraph 2.2.4.5, audible and visual alarms shall be provided to indicate:

1. insufficient fuel oil supply to the oil-fired inert gas generator.
2. failure of the power supply to the generator.
3. low water pressure or low water flow rate to the cooling and scrubbing arrangement.
4. high water level in the cooling and scrubbing arrangement.
5. high gas temperature.
6. failure of the inert gas blowers; and
7. low water level in the water seal.

2.4 Requirements for nitrogen generator systems

2.4.2 Indicators and alarms

2.4.2.1 In addition to the requirements in paragraph 2.2.4.2, instrumentation is to be provided for continuously indicating the temperature and pressure of air at the suction side of the nitrogen generator.

2.4.2.2 In addition to the requirements in paragraph 2.2.4.5, audible and visual alarms shall be provided to include:

1. failure of the electric heater, if fitted.
2. low feed-air pressure or flow from the compressor.
3. high-air temperature; and

4. high condensate level at automatic drain of water separator.

IMO Inert Gas Systems

3.14 Instrumentation and alarms

3.14.1 Certain fixed and portable instruments are required for the safe and effective operation of an inert gas system. It is desirable that all instruments should be graduated to a consistent system of units.

3.14.2 Clear instructions should be provided for operating, calibrating and testing all instruments and alarms. Suitable calibration facilities should be provided.

3.14.4 The arrangement of scrubber instrumentation and alarm should be as follows:

.1 The water flow to the scrubber should be monitored either by a flow meter or by pressure gauges. An alarm should be initiated when the water flow drops below the designed flow requirements by a predetermined amount and the inert gas blowers should be stopped automatically in the event of a further reduction in the flow. The precise setting of the alarm and shut-down limits should be related to individual scrubber designs and materials.

.2 The water level in the scrubber shall be monitored by a high-water level alarm. This alarm should be given when pre-determined limits are reached, and the scrubber pump shut down when the level rises above set limits. These limits should be set having regard to the scrubber design and flooding of the scrubber inlet piping from the boiler uptakes.

.3 The inert gas temperature at the discharge side of the gas blowers shall be monitored. An alarm should be given when the temperature reaches 65 ° C and automatic shut-down of the inert gas blowers should be arranged if the temperature reaches 75 ° C.

.4 If a precooler is necessary at the scrubber inlet to protect coating materials in the scrubber, the arrangements for giving an alarm in .3 above should apply to the outlet temperature from the precooler.

.5 To monitor the scrubber efficiency, it is recommended that the cooler water inlet and outlet temperatures, and the scrubber differential pressures are indicated.

.6 All sensing probes, floats and sensors required to be in contact with the water and gas in the scrubber should be made from materials resistant to acidic attack.

3.14.5 For the deck water seal, an alarm should be given when the water level falls by a pre-determined amount but before the seal is rendered ineffective. For certain types of deck water seals, such as the dry type, the water level alarm may require to be suppressed when inert gas is being supplied to the inert gas distribution system.

3.14.6 The pressure of the inert gas in the inert gas main shall be monitored. An alarm should be given when the pressure reaches the set limit. The set limit should be set having regard to the design of cargo tanks, mechanical non-return valve and deck water seal.

3.14.8 A sampling point should be provided between the automatic gas pressure regulating valve and the deck water seal for use with portable instruments.

3.14.9 The inert gas pressure sensor and recorder should obtain the signal from a point in the inert gas main between the deck isolating/non-return valve and the cargo tanks.

3.14.10 When the pressure in the inert gas main forward of the non-return devices falls below 50 millimetres water gauge means shall be provided to give an audible alarm or to shut down the main cargo pumps automatically.

TMSA 6.1.1 requires that procedures for cargo, ballast, tank cleaning and bunkering operations are in place for all vessel types within the fleet. The procedures include:

- Maintaining safe tank atmospheres.
- Record keeping.

IMO: ISM Code

10.1 The Company should establish procedures to ensure that the ship is maintained in conformity with the provisions of the relevant rules and regulations and with any additional requirements which may be established by the Company.

IMO: SOLAS

Chapter II-2 Regulation 4

5.5.1.1 For tankers of 20,000 tonnes deadweight and upwards constructed on or after 1 July 2002 but before 1 January 2016, the protection of the cargo tanks shall be achieved by a fixed inert gas system in accordance with the requirements of the Fire Safety Systems Code, as adopted by resolution MSC.98(73), except that the Administration may accept other equivalent systems or arrangements, as described in paragraph 5.5.4.

5.5.1.2 For tankers of 8,000 tonnes deadweight and upwards constructed on or after 1 January 2016 when carrying cargoes described in regulation 1.6.1 or 1.6.2, the protection of the cargo tanks shall be achieved by a fixed inert gas system in accordance with the requirements of the Fire Safety Systems Code, except that the Administration may accept other equivalent systems or arrangements, as described in paragraph 5.5.4.

5.5.1.3 Tankers operating with a cargo tank cleaning procedure using crude oil washing shall be fitted with an inert gas system complying with the Fire Safety Systems Code and with fixed tank washing machines. However, inert gas systems fitted on tankers constructed on or after 1 July 2002 but before 1 January 2016 shall comply with the Fire Safety Systems Code, as adopted by resolution MSC.98(73).

Inspection Guidance

The vessel operator should have developed procedures for the operation, inspection, testing and maintenance of the vessel’s inert gas system which included the indicators and alarms and gave guidance on the:

- Method and frequency of testing and calibration of the indicators and alarms.
- Actions to be taken in the event of a failure of any of the indicators and alarms.

These procedures and records may form part of the vessel’s planned maintenance system and may refer to the manufacturer’s instruction and maintenance manual for the indicators and alarms.

A record of inspection and maintenance of the inert gas plant, including defects and their rectification, should be maintained on board.

Clear instructions should be provided for operating, calibrating and testing all instruments and alarms. Suitable calibration facilities should be provided.

Suggested Inspector Actions

- Sight, and where necessary review, the company procedures for the operation, inspection, testing and maintenance of the vessel’s inert gas system which included the indicators and alarms.
- Inspect the inert gas system fixed instrumentation, controls, indicators and alarms and verify:
    - The oxygen and pressure recording devices were accurately recording the inert gas oxygen content and main IG line pressure against the date and time.
    - Lamps and indicators were functioning by requesting that the lamp and alarm test feature is operated.
- Verify that the local and remote indicators for oxygen content, inert gas pressure, temperature etc. were consistent.

- Review the test and calibration records for the inert gas system instruments and alarms.
- Where necessary review the records of inspection, testing and maintenance of the inert gas system and verify that scheduled inspections and maintenance on the equipment had taken place.

- Interview the accompanying officer to verify their familiarity with the purpose, operation, and testing of the inert gas system indicators and alarms including the:
    - Method and frequency of testing and calibration of the indicators and alarms.
    - Actions to be taken in the event of a failure of any of the indicators and alarms.
    - Actions to be taken in the event of the activation of any of the alarms.

Expected Evidence

- The company procedures for the operation, inspection, maintenance and testing of the inert gas system.
- The records of inspection, testing and maintenance of the inert gas system.
- The manufacturer's instruction manuals for the operation, calibration and testing of all inert gas system instruments and alarms.
- The test and calibration records for the inert gas system instruments and alarms.

Potential Grounds for a Negative Observation

- There were no company procedures for the operation, inspection, testing and maintenance of the vessel's inert gas system which included the indicators and alarms.
- The accompanying officer was not familiar with the purpose, operation, inspection, testing and maintenance of the inert gas system indicators and alarms including the:
    - Method and frequency of testing and calibration of the indicators and alarms.
    - Actions to be taken in the event of a failure of any of the indicators and alarms.
- The record of inspection and maintenance of the inert gas plant, including defects and their rectification, was missing or incomplete.
- The inert gas control panel pressure indicator and/or recorder was:
    - Defective in any respect.
    - Not consistent with local pressure indicator(s) on deck.
- The inert gas control panel oxygen content indicator and/or recorder was
    - Defective in any respect.
    - Not consistent with the local indicator at the fixed oxygen analyser.
- The inert gas pressure indicator fitted in the navigating bridge was inoperative or not consistent with the inert gas control panel pressure indicator.
- The machinery space control room/machinery space inert gas oxygen content indicator was inoperative or not consistent with the local indicator at the fixed oxygen analyser.
- Any of the required audible and visual alarms in the inert gas control panel or in the engine control room/machinery space were inoperative.
- The independent audible alarm or automatic shutdown of cargo pumps at low-low inert gas pressure in the inert gas main was inoperative.
- There were no clear instructions provided for operating, calibrating and testing all instruments and alarms.
- There were no suitable calibration facilities provided for the inert gas instrumentation.
- There were no records of calibration for the inert gas instrumentation.
- Inert gas instruments were not graduated to a consistent system of units, for example, inert gas pressure indicators.
- Inert gas system indicators and alarms were defective in any respect.

8.3.20. Were the Master and officers familiar with the purpose and operation of the connections and interconnections to the inert gas system for routine and emergency inert gas operations, and were these arrangements in satisfactory condition and clearly identified as to their purpose?

Short Question Text
Connections and interconnections to/with the inert gas system piping

Vessel Types
Oil, Chemical

ROVIQ Sequence
Cargo Control Room, Main Deck

Publications
IMO SOLAS
IMO: FSS Code
IMO: Inert Gas Systems
IACS UI SC 272 Inert gas supply to double-hull spaces (SOLAS II-2/4.5.5.1)

Objective

To ensure the Master and officers are familiar with the location and use of connections to, and interconnections with, the inert gas system, which may include:

- **Connections for the emergency supply of inert gas from an external source.**
- **Connections for portable arrangements to introduce inert gas to the double hull spaces.**
- **Fixed interconnections with the ballast system piping to introduce inert gas to the double hull spaces.**
- **Fixed interconnections with the cargo system piping to introduce inert gas to the cargo tanks.**

Industry Guidance

IMO: FSS Code

Chapter 15

2.2.3.2.6 Arrangements shall be provided to enable the inert gas main to be connected to an external supply of inert gas. The arrangements shall consist of a 250 mm nominal pipe size bolted flange, isolated from the inert gas main by a valve and located forward of the non-return valve referred to in paragraph 2.3.1.4.3. The design of the flange should conform to the appropriate class in the standards adopted for the design of other external connections in the ship's cargo piping system.

2.2.3.2.7 If a connection is fitted between the inert gas supply main and the cargo piping system, arrangements shall be made to ensure an effective isolation having regard to the large pressure difference which may exist between the systems. This shall consist of two shutoff valves with an arrangement to vent the space between the valves in a safe manner or an arrangement consisting of a spool-piece with associated blanks.

2.2.3.2.8 The valve separating the inert gas supply main from the cargo main, and which is on the cargo main side shall be a non-return valve with a positive means of closure

IMO Inert Gas Systems

3.11 Arrangements for inerting, purging and gas-freeing

3.11.4 Arrangement II.

Gas is introduced at the bottom of the tank and vented from the top. Gas replacement is by the dilution method. This arrangement introduces the gas through a connection between the inert gas deck main (just forward of the mechanical non-return valve) and the bottom cargo lines.

8 Emergency procedures

8.1 In the event of total failure of the inert gas system to deliver the required quality and quantity of inert gas and maintain a positive pressure in the cargo tanks and slop tanks, action must be taken immediately to prevent any air being drawn into the tank. All cargo tank operations should be stopped, the deck isolating valve should be closed, and the vent valve between it and the gas pressure regulating valve should be opened and immediate action should be taken to repair the inert gas system.

8.2 In the case of tankers engaged in the carriage of crude oil it is essential that the cargo tanks be maintained in the inerted condition to avoid the hazard of pyrophoric iron sulphide ignition. If it is assessed that the tanks cannot be maintained in an inerted condition before the inert gas system can be repaired, an external supply of inert gas should be connected to the system through the arrangements required by Reg. 62.11.5 as soon as practicable, to avoid air being drawn into the cargo tanks.

IACS UI SC 272 Inert gas supply to double-hull spaces (SOLAS II-2/4.5.5.1)

Double-hull spaces required to be fitted with suitable connections for the supply of inert gas as per SOLAS II-2/4.5.5.1.4.1 are all ballast tanks and void spaces of double-hull and double-bottom spaces adjacent to the cargo tanks, including the forepeak tank and any other tanks and spaces under the bulkhead deck adjacent to cargo tanks, except cargo pump-rooms and ballast pump-rooms.

TMSA 6.1.1 requires that procedures for cargo, ballast, tank cleaning and bunkering operations are in place for all vessel types within the fleet. The procedures include:

- Maintaining safe tank atmospheres.

IMO: ISM Code

7 The Company should establish procedures, plans and instructions, including checklists as appropriate, for key shipboard operations concerning the safety of the personnel, ship and protection of the environment. The various tasks involved should be defined and assigned to qualified personnel.

IMO: SOLAS

Chapter II-2 Regulation 4

5.5.1.4 Tankers required to be fitted with inert gas systems shall comply with the following provisions:

1. double-hull spaces shall be fitted with suitable connections for the supply of inert gas.
2. where hull spaces are connected to a permanently fitted inert gas distribution system, means shall be provided to prevent hydrocarbon gases from the cargo tanks entering the double hull spaces through the system; and
3. where such spaces are not permanently connected to an inert gas distribution system, appropriate means shall be provided to allow connection to the inert gas main.

Inspection Guidance

The vessel operator should have developed procedures for the operation, inspection and maintenance of the vessel's inert gas system which included the arrangements for the:

- Supply of inert gas to the double-hull spaces in an emergency.
- External supply of inert gas in the event of a failure of the vessel's inert gas system.

- Connection of the inert gas supply main to the cargo piping system for inerting, purging and gas-freeing, where such an arrangement was provided.

A record of inspection and maintenance of the inert gas plant, including defects and their rectification, should be maintained on board. This may form part of the vessel's planned maintenance system.

Suggested Inspector Actions

- Sight, and where necessary review, the company procedures for the operation, inspection and maintenance of the vessel's inert gas system. which included the arrangements for the:
    - Supply of inert gas to the double-hull spaces in an emergency.
    - External supply of inert gas in the event of a failure of the vessel's inert gas system.
    - Connection of the inert gas supply main to the cargo piping system for inerting, purging and gas-freeing, if fitted.
- Inspect the
    - Arrangements for the supply of inert gas to the double-hull spaces, including portable hoses if they form part of the arrangements.
    - Where hull spaces were connected to a permanently fitted inert gas distribution system, inspect the means to prevent hydrocarbon gases from the cargo tanks entering the double hull spaces through the system.
    - Connection for an external supply of inert gas.
    - Arrangements for the connection of the inert gas supply main to the cargo piping system for inerting, purging and gas-freeing, if fitted.
- Where necessary review the records of inspection, testing and maintenance of the arrangements for connection to the inert gas system.

- Interview the accompanying officer to verify their familiarity with the arrangements for the:
    - Supply of inert gas to the double-hull spaces in an emergency, including the forepeak where this was adjacent to a cargo space or spaces.
    - External supply of inert gas in the event of a failure of the vessel's inert gas system.
    - Connection of the inert gas supply main to the cargo piping system for inerting, purging and gas-freeing, if fitted.

Expected Evidence

- The company procedures for the operation, inspection and maintenance of the vessel's inert gas system.
- The detailed instruction manuals for the inert gas system.
- Cargo and inert gas operation log books.
- The records of inspection, testing and maintenance of the arrangements for connection to the inert gas system.

Potential Grounds for a Negative Observation

- There were no company procedures for the operation, inspection and maintenance of the vessel's inert gas system which included the arrangements for the:
    - Supply of inert gas to the double-hull spaces in an emergency.
    - External supply of inert gas in the event of a failure of the vessel's inert gas system.
    - Connection of the inert gas supply main to the cargo piping system for inerting, purging and gas-freeing, if fitted.
- The accompanying officer was not familiar with the arrangements for the:
    - Supply of inert gas to the double-hull spaces in an emergency, including the forepeak.
    - External supply of inert gas in the event of a failure of the vessel's inert gas system.
    - Connection of the inert gas supply main to the cargo piping system for inerting, purging and gas-freeing, if fitted.
- The connection for the external supply of inert gas was not clearly marked with its purpose.

- The spool piece to isolate the inert gas supply main from the cargo piping system had been left in place.
- There was no evidence of inspection and maintenance of the non-return valve between the inert gas supply main and the cargo piping system.
- Portable hoses required to connect the inert gas supply main to the double-hull spaces were damaged or missing.
- One or more of the connections to the inert gas supply main were defective in any respect.

8.3.21. Were the Master and officers familiar with the company procedure for cargo heating, and was the cargo heating system in satisfactory condition and tested and used in accordance with the company procedure?

Short Question Text
Cargo heating system

Vessel Types
Oil, Chemical

ROVIQ Sequence
Engine Room, Cargo Control Room, Main Deck

Publications
ICS: Tanker Safety Guide (Chemicals) - Fifth Edition
OCIMF/ICS: International Safety Guide for Oil Tankers and Terminals. Sixth Edition.
IMO: IBC Code

Objective

To ensure cargo heating is always conducted in accordance with international regulations, industry guidance and within the design criteria of the vessel and its fittings.

Industry Guidance

OCIMF/ICS: International Safety Guide for Oil Tankers and Terminals. Sixth Edition.

12.1.11.1 Loading heated products

Unless the ship is specially designed to carry very hot cargoes, such as bitumen, high temperature cargoes can damage a tanker’s structure, the cargo tank coatings and equipment such as valves, pumps and gaskets.

Some Classification Societies have rules on the maximum loading temperature for cargoes. Master should consult the ship operator whenever the temperature of the cargo is more than 60° C.

Precautions that may help to ease the effect of a hot cargo are:

Spreading the cargo throughout the ship as evenly as possible to dissipate the heat and avoid local heat stress.

Ensuring that tanks and pipelines are completely free of water before receiving any cargo with a temperature above the boiling point of water.

ICS: Tanker Safety Guide (Chemicals). Fifth Edition.

5.10 Heating and Cooling Systems

Most chemical tankers are provided with systems to heat or cool the cargo. There are two main methods employed to control the temperature of the cargo: heating coils and heat exchangers.

6.4.5 Preparing the cargo system prior to arrival.

Heating and cooling systems

If the cargo to be loaded requires heating or cooling during the voyage, the integrity of the system should be inspected and tested for tightness before loading starts.

If no heating or cooling is required, it is recommended the heating coils are blown through and blanked.

If the heating or cooling medium is incompatible with the cargo to be loaded the system must be blown through and the coils blanked prior to loading.

TMSA 6.1.1 requires that procedures for cargo, ballast, tank cleaning and bunkering operations are in place for all vessel types within the fleet. The procedures include:

- Roles and responsibilities.
- Cargo and ballast handling.

The procedures clearly identify the designated person(s) in charge of cargo, ballast and/or bunkering operations.

IMO: ISM Code

7 The Company should establish procedures, plans and instructions, including checklists as appropriate, for key shipboard operations concerning the safety of the personnel, ship and protection of the environment. The various tasks involved should be defined and assigned to qualified personnel.

IMO: IBC Code

7.1.1 When provided, any cargo heating or cooling systems shall be constructed, fitted and tested to the satisfaction of the Administration. Materials used in the construction of temperature-control systems shall be suitable for use with the product intended to be carried.

7.1.2 Heating or cooling media shall be of a type approved for use with the specific cargo. Consideration shall be given to the surface temperature of heating coils or ducts to avoid dangerous reactions from localized overheating or overcooling of cargo. (See also 15.13.7)

7.1.3 Heating or cooling systems shall be provided with valves to isolate the system for each tank and to allow manual regulation of flow.

7.1.4 In any heating or cooling system, means shall be provided to ensure that, when in any condition other than empty, a higher pressure can be maintained within the system than the maximum pressure head that could be exerted by the cargo tank contents on the system.

7.1.5 Means shall be provided for measuring the cargo temperature.

1. The means for measuring the cargo temperature shall be of restricted or closed type, respectively, when a restricted or closed gauging device is required for individual substances, as shown in column j in the table of chapter 17.
2. A restricted temperature-measuring device is subject to the definition for a restricted gauging device in 13.1.1.2 (e.g. a portable thermometer lowered inside a gauge tube of the restricted type).
3. A closed temperature-measuring device is subject to the definition for a closed gauging device in 13.1.1.3 (e.g. a remote-reading thermometer of which the sensor is installed in the tank).
4. When overheating or overcooling could result in a dangerous condition, an alarm system which monitors the cargo temperature shall be provided. (See also operational requirements in 16.6.)

7.1.6 When (toxic) products for which 15.12, 15.12.1 or 15.12.3 are listed in column o in the table of chapter 17 are being heated or cooled, the heating or cooling medium shall operate in a circuit:

1. which is independent of other ship's services, except for another cargo heating or cooling system, and which does not enter the machinery space; or
2. which is external to the tank carrying toxic products; or
3. where the medium is sampled to check for the presence of cargo before it is recirculated to other services of the ship or into the machinery space. The sampling equipment shall be located within the cargo area and be capable of detecting the presence of any toxic cargo being heated or cooled. Where this method is used, the

coil return shall be tested not only at the commencement of heating or cooling of a toxic product, but also on the first occasion the coil is used subsequent to having carried an unheated or uncooled toxic cargo.

16.6 Cargoes not to be exposed to excessive heat

16.6.2 Heating coils in tanks carrying this product shall be blanked off or secured by equivalent means.

Inspection Guidance

The vessel operator should have developed procedures describing the operation, testing and maintenance of the cargo heating system. These procedures should be ship and cargo specific and include, as applicable to the ship type:

- Testing of the heating equipment.
- Monitoring the system return for leaks via an observation tank or other means, including special arrangements when heating toxic cargoes.
- Maintaining the required pressure in the heating system.
- Blanking of heating coils when carrying cargoes not to be exposed to excessive heat.
- Blanking of coils when the heating or cooling medium is incompatible with the cargo to be loaded.
- The precautions that may be required when considering the contents of tanks adjacent to heated cargo, such as allowances for expansion, or the dangers of polymerisation.
- The means of checking cargo temperatures, including the use of restricted or closed type devices where required.
- The means of controlling the heating applied to each cargo tank.
- Avoiding localised overheating of sensitive cargoes.
- The use of high temperature alarms.
- Any cargo temperature limits set by the operator, class or the coating manufacturer.
- The records to be maintained of cargo heating and system testing.

These procedures may refer to the vessel's operation manuals, international regulations, industry guidance publications, the heating equipment manufacturer's instructions and/or the coating manufacturer's instructions.

Vessels may be fitted with heating coils in the cargo tanks or deck mounted heat exchangers, using steam, hot water or thermal fluid as a heating medium.

Where steam cargo heating systems are fitted and when a heated cargo is being carried at the time of the inspection, an indication of the condition of the heating coils can be provided by inspection of the hot well or observation tank. A very small amount of oil on the surface of hot wells or observation tanks can be considered normal, but a layer of oil over the surface indicates that there is a problem of some significance.

Suggested Inspector Actions

- Sight, and where necessary review, the company procedures describing the operation, testing and maintenance of the cargo heating system.
- Inspect the cargo heating system including the:
    - Heating coil manifolds and associated pipework, where fitted.
    - Deck mounted heat exchangers and associated pipe work, where fitted.
    - Observation tank or other means for monitoring the system return.
    - Remote temperature indication and alarm system, if fitted.
- Sight, and where necessary review, the cargo heating records.
- Where necessary review the records of the inspection and testing of the cargo heating system.

- Interview the accompanying officer to verify their familiarity with company procedures describing the operation, testing and maintenance of the cargo heating system.

Expected Evidence

- The company procedures describing the operation, testing and maintenance of the cargo heating system.
- The vessel's operation manuals, where provided.
- The records of cargo heating system usage.
- The daily temperature records for heated cargo.
- Records of the inspection and testing of the cargo heating system.

Potential Grounds for a Negative Observation

- There were no company procedures describing the operation, testing and maintenance of the cargo heating system.
- The accompanying officer was not familiar with the company procedures describing the operation, testing and maintenance of the cargo heating system including any cargo temperature limits.
- The cargo heating system had not been operated and/or tested in compliance with company procedures.
- There were no records of the cargo heating system testing.
- There were no records of cargo heating operations.
- The cargo heating system had not been isolated where required in compliance with company procedures.
- There were no records of the regular monitoring of the cargo heating system return to detect leakage.
- Inspection of the observation tank or hot well indicated there was significant leakage in the cargo heating system.
- There were leaks of heating medium from the associated pipework on deck or in the engine room.
- One or more temperature sensors in the remote temperature indicating system were defective.
- Cargo heating records indicated cargo temperature limits had been exceeded.
- There was significant corrosion, pitting, soft patches and/or other temporary repairs on the pipework or components of the heating system.
- The cargo heating system was defective in any respect.

8.3.22. Were the Master and officers familiar with the company procedures for managing on-board doping operations, and had these procedures been complied with?

Short Question Text
Cargo doping and additives.

Vessel Types
Oil, Chemical

ROVIQ Sequence
Cargo Control Room, Main Deck

Publications
ICS: Tanker Safety Guide (Chemicals) - Fifth Edition
IMO: ISM Code
OCIMF/ICS: International Safety Guide for Oil Tankers and Terminals. Sixth Edition.

Objective

To ensure on-board doping operations are properly planned, risk assessed and performed safely.

Industry Guidance

OCIMF/ICS: International Safety Guide for Oil Tankers and Terminals

12.1.6.16 Doping and additives: anti-static, inhibitors, dyes, hydrogen sulphide knockdown

Doping is when cargoes are treated with small quantities of specialised additives and fluids, such as dyes, liquid markers, anti-static agents and lubricants, during loading or before leaving port.

As far as possible, doping should be carried out ashore or in closed-line condition. When the additives are flammable or toxic, a closed doping operation is recommended. However, some terminals do not have a closed in-line additive injection system, so the additives have to be added manually. Any manual doping activity should be risk assessed. Appropriate procedures should be in place to control the associated hazards. Manual doping operations should be carefully planned to minmise the health, safety and environmental impact.

The associated risk assessment should include a review of the Safety Data Sheets (SDS) of the cargo and the additive, supplier's instructions, PPE, physical and operational hazards, supervision, weather, equipment, resources and contingency measures. Any free fall of additives into non-inerted cargo tanks should be avoided.

The supplier/contractor should draw up a doping plan and communicate this to the ship's Master before any doping. On receiving the plan, the Master should carry out their own onboard risk assessment and check that all relevant items have been addressed, and the risks reduced to As Low As Reasonably Practicable (ALARP).

The doping plan should be discussed by all personnel involved on the ship and in the terminal. As a minimum, the plan should include the method of doping, PPE to be used and the contingency measures.

The SDS for any additives should be reviewed as part of the risk assessment process regarding hazard identification and risk mitigation measures. A copy of the SDS should be kept in the vicinity of the doping operation.

If additives are to be stowed on board, they should be well secured; see section 13.5 for further guidance.

13.5.2.2 Additives (anti-static, inhibitors, dyes, hydrogen sulphide knockdown)

These cargo additives are often loaded on tankers in small containers and delivered with the cargo. So that they can be stowed correctly, they should be accompanied by the appropriate SDS.

ICS: Tanker Safety Guide (Chemicals). Fifth Edition.

1.6.2 Unstable chemicals

Inhibited cargoes

If additional inhibitor is left on board for use during the voyage the shipper or charterer should provide instructions on:

- The quantity to add;
- How to add it to the cargo; and
- How it should be mixed with the cargo.

6.3.5 Specific cargo handling requirements

Inhibited cargoes

Adding substances such as powdered inhibitors and other similar material may generate a static charge if introduced to the tank by free-fall or pouring the substance from an opening on the cargo deck. Consequently, at the pre-transfer conference a safe method of adding inhibitors should be agreed.

TMSA KPI 6.3.3 requires that the SMS includes procedures for non-routine or specialised cargo and ballast operations undertaken in the fleet.

These operations may include:

- Cargo dosing (dyes, additives)

IMO: ISM Code

7 The Company should establish procedures, plans and instructions, including checklists as appropriate, for key shipboard operations concerning the safety of the personnel, ship and protection of the environment. The various tasks involved should be defined and assigned to qualified personnel.

Inspection Guidance

The vessel operator should have developed procedures for managing on-board doping operations that included:

- Reviewing the supplier's/contractor's doping plan.
- Performing a risk assessment of the proposed operation.
- Supervising the doping operation.

Preference is for additive injection at a shore location, or via an in-line injection system, e.g. via a spool piece at the ship's manifold. In this case, pressure test records for the injection system should be verified prior to commencing cargo operations. Injection may also be carried out via the cargo tank vapour locks.

Doping via an open tank lid should only take place in exceptional circumstances.

The doping plan and associated risk assessment should identify:

- Any flammability or toxicity hazards associated with the additive.
- The method of doping to be used and any operational restrictions.
- Arrangements for supervision by ship's crew.
- PPE and handling equipment requirements.
- Contingency measures including the method of clean-up of any spillages.

- Storage requirements for any additive to be carried on board.
- Appropriate anti-static precautions if tanks are not inerted.

Suggested Inspector Actions

- Sight, and where necessary review, the company procedures for managing on-board doping operations.
- Review records of current and/or past doping operations.
- If doping operations are taking place during the inspection, observe the operation including the method of doping used, supervision by ship's crew, use of PPE and anti-static precautions.
- Inspect stowage arrangements of any additives stored on board.
- Verify that safety data sheets for any additives stored onboard were available.

- Interview the officer responsible for cargo operations to verify their familiarity with the company procedures for managing on-board doping operations.

Expected Evidence

- Company procedures for managing on-board doping operations.
- Doping plans.
- Associated risk assessments.
- Safety Data Sheets for additives used.
- Cargo operation log books.

Potential Grounds for a Negative Observation

- There were no company procedures for managing on-board doping operations that included:
    - Reviewing the supplier's/contractor's doping plan.
    - Performing a risk assessment of the proposed operation.
    - Supervising the doping operation.
- The officer responsible for cargo operations was not familiar with the company procedures for managing on-board doping operations.
- The vessel had not been provided with the supplier's/contractor's plan for an on-board doping operation.
- A risk assessment had not been performed based upon the supplier's/contractor's plan for an on-board doping operation.
- The doping plan and/or risk assessment did not include:
    - Any flammability or toxicity hazards associated with the additive.
    - The method of doping to be used and any operational restrictions.
    - Arrangements for supervision by ship's crew.
    - PPE and handling equipment requirements.
    - Contingency measures including the method of clean-up of any spillages.
    - Storage arrangements of any additives to be carried on board.
    - Appropriate anti-static precautions if tanks were not inerted.
- There was no evidence that the doping plan and/or risk assessment had been discussed by all personnel involved on the ship and in the terminal, including contractors.
- There was no Safety Data Sheet:
    - Available for the additive(s) used for doping.
    - Kept in the vicinity of the doping operation.
- Doping had taken place via an open tank lid when alternative methods were available.
- The doping method utilised involved free fall of additives into non-inerted cargo tanks.
- Additives were stored on board in a manner that did not reflect the flammability or toxicity hazards indicated in the associated Safety Data Sheet.
- Pressure test records were not available for the injection system used for doping.
- PPE as required by the doping plan and/or risk assessment was not being utilised.

- Contractors were not being supervised by ship’s crew as required by the doping plan and/or risk assessment.

8.3.23. Were the Master and officers familiar with the company procedures for the maintenance, testing and calibration of the cargo temperature monitoring equipment, and was the equipment in satisfactory condition?

Short Question Text
Cargo tank temperature monitoring systems.

Vessel Types
Oil, Chemical

ROVIQ Sequence
Cargo Control Room, Main Deck

Publications
IMO: ISM Code
OCIMF/ICS: International Safety Guide for Oil Tankers and Terminals. Sixth Edition.
IMO: IBC Code
ICS: Tanker Safety Guide (Chemicals) - Fifth Edition

Objective

To ensure the cargo temperature monitoring equipment is maintained in full operational condition.

Industry Guidance

OCIMF/ICS: International Safety Guide for Oil Tankers and Terminals.

12.8.5 Closed gauging for custody transfer

Temperatures can be taken using electronic thermometers inserted through the tank's vapour locks. The thermometers should also be calibrated and have the appropriate approval certificates

12.8.6 Cargo tank monitoring systems

Tank monitoring systems often have multiple functions, such as radar or other types of remote gauging, temperature measurement, tank pressure sensors and level alarms. It may be integrated with other cargo monitoring or control equipment or with loading computers or control systems. Manufacturers may refer to these multi-function systems as cargo tank monitoring systems.

Whether provided as a complete system or as separate elements, planned maintenance procedures should be established to ensure maintenance, test and calibration of this equipment per the manufacturer's instructions.

ICS: Tanker Safety Guide (Chemicals) - Fifth Edition

5.3.7 Temperature monitoring equipment

Sensors are fitted so that the temperature of the cargo can be monitored in order to:

- Ensure that cargo heating requirements are complied with.
- Ensure that any tank structure and tank coating temperature limitations are not exceeded, and
- Calculate the weight of the cargo on board. (The specific gravity of a product varies according to temperature).

Sensors may also be fitted to monitor the temperatures of the structure around the cargo system.

TMSA 6.1.2 requires that procedures for pre-operational tests and checks of cargo and bunkering equipment are in place for all vessel types within the fleet. Tests and checks of equipment may include:

- Tank gauging equipment

IMO: ISM Code

7 The Company should establish procedures, plans and instructions, including checklists as appropriate, for key shipboard operations concerning the safety of the personnel, ship and protection of the environment. The various tasks involved should be defined and assigned to qualified personnel.

IMO: IBC Code

7.1.5 Means shall be provided for measuring the cargo temperature.

1. The means for measuring the cargo temperature shall be of restricted or closed type, respectively, when a restricted or closed gauging device is required for individual substances, as shown in column j in the table of chapter 17.
2. A restricted temperature-measuring device is subject to the definition for a restricted gauging device in 13.1.1.2 (e.g. a portable thermometer lowered inside a gauge tube of the restricted type).
3. A closed temperature-measuring device is subject to the definition for a closed gauging device in 13.1.1.3 (e.g. a remote-reading thermometer of which the sensor is installed in the tank).
4. When overheating or overcooling could result in a dangerous condition, an alarm system which monitors the cargo temperature shall be provided. (See also operational requirements in 16.6.)

Inspection Guidance

The vessel operator should have developed procedures for the maintenance, testing and calibration of the cargo temperature monitoring equipment in accordance with manufacturer’s instructions.

These procedures may refer to the equipment manufacturer’s manuals and instructions and in part be contained in the planned maintenance system.

The cargo temperature monitoring equipment may be portable ullage/temperature/interface (UTI) instruments or a fixed system with sensors fitted in the cargo tanks and remote readouts in the cargo control room, which may be integrated into a cargo tank monitoring system. Visible and audible cargo temperature alarms may be installed in the cargo control room and on the bridge.

Portable UTI equipment should be serviced and calibrated in accordance with manufacturer's recommendations and valid certificates of calibration should be provided for each instrument.

(The safe operation and condition of UTI instruments is addressed by question 8.3.12.)

Fixed cargo temperature monitoring equipment should also be serviced and calibrated in accordance with manufacturer's recommendations. Calibration should be carried out preferably at intervals not exceeding 30 months. Calibration of instrumentation is often difficult whilst the vessel is in service, and it is usually carried out during repair periods

However, comparisons between portable and fixed equipment readings provide a practical cross-reference.

Records should be maintained of all checks, tests and calibrations.

Suggested Inspector Actions

- Sight, and where necessary review the company procedures for the maintenance, testing and calibration of the cargo temperature monitoring equipment.

- Request a demonstration of fixed cargo temperature monitoring equipment, including alarms, if fitted.
- Review where necessary the:
  - Manufacturer’s manuals and instructions for the fixed cargo temperature monitoring equipment.
  - Records of checks, tests and calibration of the cargo temperature monitoring equipment.

- Interview the accompanying officer to verify their familiarity with company procedures for the maintenance, testing and calibration of the cargo temperature monitoring equipment.

Expected Evidence

- Company procedures for the maintenance, testing and calibration of the cargo temperature monitoring equipment.
- Manufacturer’s manuals and instructions for the fixed cargo temperature monitoring equipment.
- Records of checks, tests and calibration of the cargo temperature monitoring equipment.

Potential Grounds for a Negative Observation

- There were no company procedures for the maintenance, testing and calibration of the cargo temperature monitoring equipment in accordance with manufacturer’s instructions.
- The accompanying officer was not familiar with the company procedures for the maintenance, testing and calibration of the cargo temperature monitoring equipment.
- The accompanying officer was unable to demonstrate the operation of the fixed cargo temperature monitoring equipment, including alarms.
- There were no records of checks, tests or calibration of the cargo temperature monitoring equipment.
- The fixed cargo temperature monitoring equipment had not been tested and calibrated in accordance with manufacturer’s instructions.
- The fixed cargo temperature monitoring equipment had not been calibrated within the last 30 months.
- Portable cargo temperature monitoring equipment had not been tested and calibrated in accordance with manufacturer’s instructions.
- One or more temperature sensor in the fixed cargo temperature monitoring system was defective.
- The visible and/or audible alarm in the fixed temperature monitoring system was defective.
- The cargo temperature monitoring equipment was defective in any respect.

8.3.24. Were the Master and officers familiar with the company procedures for managing cargo and vapour connections at the cargo manifolds, and were the manifold arrangements in satisfactory condition?

Short Question Text
Cargo manifold arrangements.

Vessel Types
Oil, Chemical

ROVIQ Sequence
Cargo Manifold

Publications
IMO: ISM Code
OCIMF/ICS: International Safety Guide for Oil Tankers and Terminals. Sixth Edition.
IMO: IBC Code
ICS: Tanker Safety Guide (Chemicals) - Fifth Edition
OCIMF/CDI: Recommendations for Oil and Chemical Tanker Manifolds and Associated Equipment

Objective

To ensure that cargo and vapour manifolds are always properly connected and monitored throughout cargo transfer operations.

Industry Guidance

OCIMF/ICS: International Safety Guide for Oil Tankers and Terminals. Sixth Edition

9.9.1 Manifold platform

Sometimes this platform is higher than two metres and may not have edge protection. Where fitted, edge protection may be temporarily removed to allow hose connection. The risk of falling from height means adequate safety precautions are needed.

18.1.8 Precautions when connecting and disconnecting Marine Loading Arms

Where an elevated manifold platform is fitted, without fixed or movable protections, the area should be properly identified and marked by warning signs to prevent falls.

11.7 Stern loading and discharging arrangements

Using a stern manifold for cargo transfer operations introduces additional hazards and operational concerns. Procedures should address the following:

- The dangerous area extending at least three metres from the manifold valve should be clearly marked. No unauthorised personnel should be allowed in this area during the entire cargo operation.
- Elimination of potential sources of ignition from accommodation openings and electrical fittings. Air inlets and doors to enclosed spaces should be kept closed.

12.1.14.3 Line draining

…Draining any product from the MLAs or hoses into open drip-trays should be avoided. The contents of portable or fixed drip-trays should be transferred to a slop tank or other safe container.

18.1.2 Forces on manifolds

Where supports or jacks are used, they should be fitted in such a way that they stand directly onto the deck or some other substantial support. They should never be placed onto fixtures or fittings that are not capable of, or suitable for, supporting the load.

18.2 Cargo hoses

18.2.10 Handling. Lifting and suspending

Lifting bridles and saddles should be provided. The use of steel wires in direct contact with the hose cover should not be permitted. Certified lifting straps should be used. They should be positioned so that the hose does not fold over on itself (sharp kinks in the hoses should be avoided). Lifting equipment should be appropriately sized to accommodate the weight of the hose when full of product.

Straps should be placed strategically to allow the flange to align horizontally. This will improve hose connection efficiency.

Excessive weight on the ship's manifold should be avoided… Adequate support for the hose, when connected to the manifold should be provided. Where this support is via a single lifting point, such as a hose crane, the hose string should be supported by bridles or webbing straps. Some hoses are specifically designed to be unsupported.

Figure 18.4: Hose handling arrangement

23.6.2 Removing blank flanges

Each tanker and terminal manifold flange should have a removable blank flange made of steel or other approved material, preferably fitted with handles.

Blank flanges should be capable of withstanding the working pressure of the line or system they are connected to. They should also be as thick as the end flange they are fitted to.

23.6.3 Reducers and spool pieces

Manifold pressure gauges should be fitted on the outboard side of the manifold valve to the spool piece or reducer.

23.7 Spills and leaks

23.7.1 General

The cargo transfer system should be checked at the start of cargo transfer and at agreed intervals. This should include tanker outboard manifolds, pipelines, MLAs, cargo hoses, unused connections, blanks, valves and waterside checks.

23.7.5 Spill containment

A permanently fitted spill tank, with suitable means of draining, should be fitted under all tanker/terminal manifold connections. If no permanent spill tank is fitted, portable drip-trays should be placed under each connection to catch any leaks. Avoid plastic and other non-metallic containers unless bonding is possible.

23.7.6 Tanker and terminal cargo and bunker pipelines not in use

Valve tightness should not be relied on to stop the escape or seepage of oil.

All the tanker's cargo and bunker pipelines not in use should be securely blanked at the manifold. Where fitted, cargo pipelines to stern or bow manifolds should be drained of cargo and isolated from the tanker's main pipeline system.

For stern manifolds this will require physical blanking or removal of a spool piece to fully isolate the line forward of the accommodation.

23.7.7.2 Misconnection of liquid and vapour lines

To prevent the possible misconnection of the vapour manifold to a liquid loading line, a mechanical keying arrangement should be provided for vapor manifold presentation flanges as follows:

1. The bolt locations should be arranged so that two bolts straddle the 12 o'clock position at the top of the flange face.
2. One cylindrical stud should be permanently attached to each of the presentation flange faces at the 12 o'clock position on the flange bolt circles.

23.9.4 Tugs and other craft alongside

The midships cargo handling crane should not be used while cargo operations are underway because of a risk of a suspended load falling onto the pressurised manifold pipelines.

ICS: Tanker Safety Guide (Chemicals) - Fifth Edition

6.7.2 Manifold connections

A bolt should be fitted in every hole, then tightened correctly and evenly. Nuts and bolts should be of the correct size and material. Damaged bolts should not be used. Improvised arrangements using G-clamps or similar devices are not permitted under any circumstances.

The IBC Code requires that flanges at the manifold are provided with shields to guard against spray from acid cargoes. It is recommended to use such shields to protect against spray from other cargoes that are toxic or corrosive.

6.7.18 Disconnection of cargo hoses

Care should always be taken to avoid incompatible cargoes being mixed in cargo and stripping lines, slop tanks, drain tanks and manifold drip-trays.

OCIMF/CDI: Recommendations for Oil and Chemical Tanker Manifolds and Associated Equipment

1.5.2 Identification of cargo vapour manifolds

The first inboard metre of each cargo vapour manifold connection should have its exterior surfaces painted, with the exception of the flange faces. The painted area should be divided into three bands, with the outboard and inboard bands being red in colour and 100mm wide and the centre and being yellow in colour. In addition, the word VAPOUR should be painted in black letters, at least 50mm high, on both the forward and aft sides of all reducers, both principal and reserve, in approximately the 2 o'clock and 10 o'clock positions.

IMO: IBC Code

15.11 Acids

15.11.4 Flanges of the loading and discharging manifold connections shall be provided with shields, which may be portable, to guard against the danger of cargo being sprayed: and in addition, drip trays shall also be provided to guard against leakage onto the deck.

TMSA KPI 6.1.2 requires that procedures for pre-operational tests and checks of cargo and bunkering equipment are in place for all vessel types within the fleet. Tests and checks of equipment may include:

- Line and valve setting

IMO: ISM Code

7 The Company should establish procedures, plans and instructions, including checklists as appropriate, for key shipboard operations concerning the safety of the personnel, ship and protection of the environment. The various tasks involved should be defined and assigned to qualified personnel.

Inspection Guidance

The vessel operator should have developed procedures which provided guidance for managing cargo and vapour connections at the cargo manifolds to prevent and detect leakages. These procedures should include:

- Manifold connection via hose or marine loading arm.
- The fitting and monitoring of pressure gauges at each manifold connection outboard of the manifold valve.
- The fitting of blanks to all unused manifold connections.
- The fitting of blanks or caps to all drains and sample points, except while in use.
- The use of fixed and portable drip-trays and the management of drained or spilled cargo.
- The management of vapour manifolds and connections.
- Safe work on elevated manifold platforms, if fitted.
- The supporting of cargo hoses during cargo transfer.
- Restrictions on the use of the mid-ships hose-handling crane(s) during cargo operations.
- The management of bow and stern manifolds, if fitted.

Manifold drip trays should be clean and free from cargo residues.

Suitable means of draining the drip trays to a cargo tank or drain tank should be provided. On chemical tankers, drip-trays should be drained to appropriate tanks with due regard to toxicity and compatibility requirements.

Manifold drip-tray drains to deck should be fitted with valves and either capped or plugged.

Pressure gauge stems should be fitted with valves and capped whenever gauges are not fitted.

It is generally accepted that steel blanks should be of the same thickness as the flanges to which they are attached, but this will not necessarily result in the pressure capability being the same as that of the associated pipework. It is the pressure rating of the blank which is important, and blanks made of materials such as titanium have a superior strength and may therefore be significantly thinner for the same pressure rating as a mild steel blank. If such blanks are fitted, documentation should be on board to prove that the pressure rating is adequate for the service.

Suggested Inspector Actions

- Sight, and where necessary review, the company procedures which described the management of cargo and vapour connections at the cargo manifolds to prevent and detect leakages.
- Inspect cargo and vapour manifolds, including bow and stern manifolds where fitted, and verify that the arrangements were in alignment with industry best practice and, where applicable, regulation.

Expected Evidence

- The company procedures which described the management of cargo and vapour connections at the cargo manifolds to prevent and detect leakages.
- Documentation supporting the pressure rating of manifold blanks, where appropriate.

Potential Grounds for a Negative Observation

- There were no company procedures which described the management of cargo and vapour connections at the cargo manifolds to prevent and detect leakages.
- The accompanying officer was not familiar with the company procedures which described the management of cargo and vapour connections at the cargo manifolds to prevent and detect leakages.
- A manifold connection was:
    - Secured with damaged bolts or bolts of an inappropriate diameter, length or material.
    - Not fully bolted, i.e. without a bolt in every hole in the flange.
    - Made using improvised arrangements such as a G-clamp or similar device.
- Where a hose or marine loading arm was secured by camlocks, one or more cams had not properly engaged with the manifold flange.
- A marine loading arm was improperly supported by jacks or similar arrangements.
- The jacks for a marine loading arm were supported by items not designed to support the load, such as empty oil drums.
- Cargo hoses were not properly supported during cargo transfer.
- On a chemical tanker, manifold flanges in use were not fitted with spray guards whilst handling acids, or another cargo that was toxic or corrosive.
- A manifold pressure gauge was:
    - Not fitted on the outboard side of the manifold valve.
    - Missing from an unused manifold connection.
    - Indicating an increased pressure and possible manifold valve leakage.
- A manifold pressure gauge stem was not fitted with a valve or cock and/or was not capped when not in use
- A manifold blank flange was not:
    - As thick as the end flange it was bolted to and there was no supporting documentation to show it was of the same working pressure rating as the line or system it was connected to.
    - Made of steel or other approved material.
    - Secured with bolts of an inappropriate diameter, length or material.
    - Fully bolted, i.e. without a bolt in every hole in the flange.
- There was a cargo or bunker leak from an unused manifold.
- An unused manifold was not blanked.
- A manifold sample point or drain was not blanked or capped when not in use.
- A manifold sample point or drain was positioned to drain directly onto the deck.
- The manifold(s) had been drained into the open drip-trays.
- Fixed and/or portable drip-trays had not been drained and cleaned of cargo residues.
- There was no permanent or portable drip-tray underneath a manifold connection.
- Plywood or canvas sheeting had been placed across the manifold drip tray gratings to prevent minor spillages entering the drip tray freely.
- A portable drip-tray was made of plastic or another non-metallic material but was not bonded to the ship's structure.
- Manifold drip-tray drains to deck were not fitted with valves and capped.
- On a chemical tanker, there were no suitable means to ensure incompatible cargoes were not mixed in manifold drip trays and/or drain tanks.
- Vapour manifold presentation flanges were not fitted with the required stud at the 12 o'clock position.
- Vapour manifold connections, including reducers, were not painted/marked as required.
- An elevated manifold working platform did not have effective edge protection and was not properly identified and marked by warning signs to prevent falls.
- The midships hose-handling crane was being used to handle stores etc. whilst cargo operations were taking place.
- An unused stern manifold was not isolated from the main cargo pipeline system by a blank or the removal of a spool piece.
- The dangerous area extending at least three metres from the stern manifold valve in use was not clearly marked to prevent access by unauthorised personnel.

8.3.25. Were the Master and deck officers familiar with the company procedures for receiving nitrogen from shore for operations such as inerting, purging or padding cargo tank, or for clearing cargo lines?

Short Question Text
Receiving nitrogen from shore

Vessel Types
Oil, Chemical

ROVIQ Sequence
Cargo Control Room

Publications
ICS: Tanker Safety Guide (Chemicals) - Fifth Edition
IMO: ISM Code
IMO SOLAS
OCIMF/ICS: International Safety Guide for Oil Tankers and Terminals. Sixth Edition.
CDI: Best Practice Recommendations Regarding the use of Nitrogen. First Edition.

Objective

To ensure cargo tanks are not over pressurised, possibly resulting in serious deformation or catastrophic failure of the tank structure.

Industry Guidance

OCIMF/ICS: International Safety Guide for Oil Tankers and Terminals. Sixth Edition

12.1.14.5 Clearing hoses and marine loading arms to the ship

Do not clear hoses and loading arms to the ship using compressed air because of the risks of:

- Static charge generation.
- Compromising IG quality.
- Over pressurisation of tanks or pipelines.
- Oil mists coming from tank vents.

12.1.14.8 Receiving nitrogen from shore

If shore supplied nitrogen is used, e.g. to purge tanks, for padding cargo or to clear lines, be aware that this may be at high pressure (up to ten bar) and at a high flow rate, making it potentially hazardous because of the risk of over pressurising the cargo tanks. Carry out a risk assessment: the operation should only proceed if appropriate risk mitigations are in place. As a minimum, follow the precautions for over pressurisation in section 11.2.2.

One way to reduce the risk is to ensure the tank has vents with a greater flow capacity than the inlet, so that the tank cannot be over pressurised. If vapour control and emission regulations require closed operation, the incoming flow of nitrogen should be restricted to a rate equal to or less than the maximum flow of vapour possible through the vapour return line (VRL). Measures to ensure this should be agreed. A small hose or reducer before the manifold can be used to restrict the flow rate, but the terminal should control the pressure. A gauge will allow the ship to monitor the pressure.

Attempting to throttle a gas flow with a ship's manifold valve designed to control liquid flow is inappropriate. However, the manifold may be used as a rapid safety stop in an emergency. Note the effect of a pressure surge in a gas is not as violent as in a liquid.

Sensitive cargoes, e.g. highly specialised lubricating oils, may have to be carried under a pad or blanket of nitrogen supplied from the shore. In this case, it is better to purge the entire cargo tank before loading. After purging, loading the cargo in a closed condition will create the pad within the tank. This significantly reduces the risk of over pressurisation when padding with shore supplied nitrogen.

SSSCL Part 5A. Tanker and terminal pre-transfer conference

Item 60 Procedure for receiving nitrogen from terminal to cargo tanks are agreed (12.1.14.8).

ICS: Tanker Safety Guide (Chemicals) Fifth Edition

4.4.3 Vapour space environment control

For cargoes that react with air or moisture in the air, the IBC Code requires the atmosphere in the vapour space to be controlled. This is usually achieved using an inert gas such as nitrogen which is either applied as a pad (applied after loading the tank) or before loading by fully inerting the vapour space. Inerting or padding may also be required for quality control purposes.

7.4.9 Nitrogen Supplied from Shore

General

Should it be necessary to obtain nitrogen from the terminal, it is essential that agreement is reached at the pre-transfer conference concerning the flow rate and the pressure of the nitrogen being supplied.

…it should be noted that a high uncontrolled flow rate of nitrogen can cause cargo tank overpressurisation with very little warning. Although a slight overpressure is required (usually no more than 0.2 bar), it is usual for the shore nitrogen supply pressure to be far in excess of this figure.

It is possible to overpressurise and damage a cargo tank if the flow rate of nitrogen supplied from the shore exceeds the maximum design-rated capacity of the P/V valve.

CDI: Best Practice Recommendations Regarding the use of Nitrogen. First Edition.

4.1 Safety Precautions when Handling Nitrogen

Due to the hazards described in this document, nitrogen should be used with the following safety precautions in place…

4.4 Padding Operations

Vessels may receive nitrogen after loading in order to reduce the oxygen content in the ullage space of the cargo tank or to apply a positive pressure to prevent the ingress of moisture or oxygen during the voyage. Numerous tank over-pressurisation incidents have occurred during padding operations. Often the nitrogen is supplied by shore through the cargo line resulting in a large volume of nitrogen being released into the bottom of an already loaded cargo tank. The pressure in the tank may increase rapidly above the venting capacity of the P/V valve or the liquid level in the tank forced to rise blocking the vent line. This can result in extensive structural damage to the tank as well as a loss of containment. The following precautions should be considered…

TMSA 6.2.2 requires that comprehensive procedures cover all aspects of cargo transfer operations for each type of vessel within the fleet. The transfer procedures are specific to the vessel type and cargo to be carried. These may include:

- Gas and chemical specific operational procedures.
- Tank pressure and atmosphere monitoring.
- Draining/blowing lines and disconnection of hoses.

IMO: ISM Code

7 The Company should establish procedures, plans and instructions, including checklists as appropriate, for key shipboard operations concerning the safety of the personnel, ship and protection of the environment. The various tasks involved should be defined and assigned to qualified personnel.

IMO: SOLAS

Chapter II-2 Regulation 11

6 Protection of cargo tank structure against pressure or vacuum in tankers

6.1 General

The venting arrangements shall be so designed and operated as to ensure that neither pressure nor vacuum in cargo tanks shall exceed design parameters and be such as to provide for:

.2 the passage of large volumes of vapour, air or inert gas mixtures during cargo loading and ballasting, or during discharging.

Inspection Guidance

The vessel operator should have developed procedures that described the actions to be taken to avoid over pressurisation of cargo tanks when nitrogen is received from shore. These procedures should include the:

- Requirement to carry out a risk assessment prior to operations.
- Choice of connection and piping system for receiving the nitrogen.
- Methods of controlling the incoming flow of nitrogen.

If possible, padding operations should be conducted through the vessel’s vapour system rather than through the cargo system and the liquid in the cargo line and tank.

Shore line clearing to the ship involving flammable cargoes should only be conducted using nitrogen and not compressed air.

Suggested Inspector Actions

- Sight, and where necessary review, the company procedures which described the procedure for receiving nitrogen from the shore for operations such as inerting or purging tanks, for padding cargo tanks or to clear lines.
- Review the records and completed risk assessments for at least one operation where nitrogen had been received from shore within the last six months.

- Interview the accompanying officer to verify their familiarity with the procedures for receiving nitrogen from shore.

Expected Evidence

- The company procedure which described the procedure for receiving nitrogen from the shore for operations such as inerting or purging tanks, for padding cargo tanks or to clear lines.
- Records and completed risk assessments for operations where nitrogen had been received from shore within the last six months.

Potential Grounds for a Negative Observation

- There was no company procedure which described the processes for receiving nitrogen from the shore for operations such as for operations such as, inerting, purging or padding cargo tanks or for clearing cargo lines.
- Company procedures did not describe the actions to be taken to avoid over pressurisation of cargo tanks when nitrogen is received from shore, including the:
    - Requirement to carry out a risk assessment prior to operations.
    - Choice of connection and piping system for receiving the nitrogen.
    - Methods of controlling the incoming flow of nitrogen.
- The accompanying officer was not familiar with the company procedures which described the procedure for receiving nitrogen from the shore for operations such as inerting or purging tanks, for padding cargo tanks or to clear lines.
- Risk assessments were not available for operations where the vessel received nitrogen from ashore.
- Ship shore safety checklists for cargo operations that included receiving nitrogen from shore had not been completed to document the agreed procedures to receive nitrogen, the maximum pressure and the flow rate.
- Records showed that hoses or loading arms containing flammable cargo had been cleared to the ship using compressed air.

8.4. LPG

8.4.1. Were the Master and officers familiar with the company procedures that addressed the carriage of inhibited cargoes, and had these procedures been followed?

Short Question Text
Carriage of inhibited cargoes.

Vessel Types
LPG

ROVIQ Sequence
Cargo Control Room

Publications
SIGTTO: Liquified Gas Handling Principles on Ships and in Terminals. Fourth Edition.
IMO: ISM Code
OCIMF/ICS: International Safety Guide for Oil Tankers and Terminals. Sixth Edition.
IMO: IGC Code
ICS: Tanker Safety Guide (Gas) - Third Edition

Objective

To ensure that inhibited cargoes are carried safely and in compliance with company procedures and the IGC Code.

Industry Guidance

ICS: Tanker Safety Guide (Gas) - Third Edition

1.4.1 Self-reaction

Some liquefied gas cargoes may react with themselves and may form solids. The most common form of self-reaction is polymerisation which may be initiated by the presence of small quantities of other cargoes or by certain metals. Polymerisation normally produces heat which may then accelerate self-reaction and contamination of the cargo. Polymerisation may also result in the formation of explosive peroxides.

The IGC Code requires cargoes which may self-react either to be carried under an inert gas blanket, or to be inhibited before shipment.

1.4.1.1 Use of Inhibitors

Normally there should be no need to add any inhibitor to the cargo during the voyage. If it should become necessary, for example if the effective lifetime is exceeded, any additions should be made in accordance with the shipper's instructions.

The inhibitor may not boil-off with the cargo and it is possible for reliquefaction systems to contain uninhibited cargo. The reliquefaction system should therefore be drained or purged with inhibited cargo when shut down to prevent self-reaction within the system.

Many inhibitors are much more soluble in water than in the cargo. In order to avoid a reduction in inhibitor concentration, care should be taken to exclude water from the cargo system. Similarly, the inhibitor may be very soluble in anti-freeze additives. The cargo shipper's instructions on the use of anti-freeze should be observed.

If the ship is in still conditions the cargo should be circulated daily to ensure a uniform concentration of inhibitor.

Particular provisions concerning the avoidance of uninhibited stagnant liquid pockets can be found in Section 17.4.2 of the IGC Code.

SIGTTO: Liquified Gas Handling Principles on Ships and in Terminals. Fourth Edition.

2.4.2 Formation of polymers or dimers

The difference between the vapour pressures (see Section 2.8.4) of the cargo and its inhibitor has an important implication on the behaviour of the inhibitor. Inhibitors usually have a vapour pressure much lower than the cargo in which they are dissolved, which means that the inhibitor will remain in the liquid and provide the greatest protection. The gases in the vapour space are, therefore, relatively unprotected, as is any condensate from the reliquefaction plant

Inhibitors can be toxic. The inhibitors used most commonly are tertrahydroquinone (THQ) for VCM and tertiarybutyl catechol (TBC) for butadiene. Particular care should be taken when handling inhibitors and cargoes with inhibitor added. The SDS for the particular inhibitor should be provided in addition to the inhibitor information form.

OCIMF/ICS: International Safety Guide for Oil Tankers and Terminals

Chapter 25   The Ship/Shore Safety Checklist

Part 5c. Tanker and terminal: liquefied gas. Checks pre-transfer

Item 71   Inhibition certificate received (if required) from manufacturer? Yes/No

TMSA KPI 6.1.1 requires that procedures for cargo, ballast, tank cleaning and bunkering operations are in place for all vessel types within the fleet.

IMO: ISM Code

7. The Company should establish procedures, plans and instructions, including checklists as appropriate, for key shipboard operations concerning the safety of the personnel, ship and protection of the environment. The various tasks involved should be defined and assigned to qualified personnel.

IMO: IGC Code

17.8 Inhibition

Care shall be taken to ensure that the cargo is sufficiently inhibited to prevent self-reaction (e.g. polymerization or dimerization) at all times during the voyage. Ships shall be provided with a certificate from the manufacturer stating:

1. name and amount of inhibitor added;
2. date inhibitor was added and the normally expected duration of its effectiveness;
3. any temperature limitations affecting the inhibitor; and
4. the action to be taken should the length of the voyage exceed the effective lifetime of the inhibitors.

17.19 Vinyl chloride

In cases where polymerization of vinyl chloride is prevented by addition of an inhibitor, 17.8 is applicable. In cases where no inhibitor has been added, or the inhibitor concentration is insufficient, any inert gas used for the purposes of 17.6 (Exclusion of air from vapour spaces) shall contain no more oxygen than 0.1% by volume. Before loading is started, inert gas samples from the tanks and piping shall be analysed. When vinyl chloride is carried, a positive pressure shall always be maintained in the tanks and during ballast voyages between successive carriages.

17.20 Mixed C4 cargoes

17.20.2 If the mixed C4 cargo shipped under the terms of this section contains more than 50% (mole) of butadiene, the inhibitor precautions in 17.8 shall apply.

18.4 Suitability for carriage

18.4.3 Where products are required to be inhibited, the certificate required by 17.8 shall be supplied before departure, otherwise the cargo shall not be transported.

Inspection Guidance

The vessel operator should have developed procedures that addressed the carriage of inhibited cargoes and included guidance on:

- Inhibited cargo certificates.
- Temperature monitoring of inhibited cargoes.
- Inerting of inhibited cargoes.
- Draining/purging of the reliquefaction system after shut-down.
- The use of anti-freeze with inhibited cargoes.
- The exclusion of water from the cargo system.
- Recirculation of cargo to ensure a uniform concentration of inhibitor.
- Adding inhibitor to a cargo in transit.
- The possible toxicity of inhibitors.
- Contingency planning for uncontrolled polymerisation.

The products which are required to be inhibited are identified in column 'l' of Chapter 19 of the IGC. They are butadiene, isoprene, vinyl ethyl ether and vinylidene chloride. Products required to be inhibited should be refused if an inhibitor certificate is not available or did not contain the minimum information required.

Suggested Inspector Actions

- Sight, and where necessary review, the company procedures that addressed the carriage of inhibited cargoes.
- Review cargo operation logbooks and records, inhibited cargo certificates and contingency plans in the event of uncontrolled polymerisation.

- Interview the officer responsible for cargo planning to verify their familiarity with company procedures that addressed the carriage of inhibited cargoes.

Where the vessel had not carried any inhibited cargoes during the previous six months, make a **comment** in the Process response tool noting the last occasion an inhibited cargo was carried. Focus on the balance of the human and procedural aspects of the guidance.

Expected Evidence

- Company procedures that address the carriage of inhibited cargoes.
- Inhibited cargo certificates.
- Inert gas logs.
- Bridge and cargo log books.
- Cargo tank temperature records relating to inhibited cargoes.
- Cargo load and discharge plans relating to inhibited cargoes.

- Contingency plans in the event of uncontrolled polymerisation of an inhibited cargo.

Potential Grounds for a Negative Observation

- There were no company procedures that addressed the carriage of inhibited cargoes and included guidance on:
    - Inhibited cargo certificates.
    - Temperature monitoring of inhibited cargoes.
    - Inerting of inhibited cargoes.
    - Draining/purging of the reliquefaction system after shut-down.
    - The use of anti-freeze with inhibited cargoes.
    - The exclusion of water from the cargo system.
    - Recirculation of cargo to ensure a uniform concentration of inhibitor.
    - Adding inhibitor to a cargo in transit.
    - The possible toxicity of inhibitors
    - Contingency planning for uncontrolled polymerisation.
- The officer responsible for cargo planning was not familiar with the company procedures that addressed the carriage of inhibited cargoes.
- There was no certificate on board for an inhibited cargo or the certificate did not contain the minimum information required.
- The stated duration of effectiveness of the inhibitor had expired prior to discharge.
- Temperatures of an inhibited cargo had not been monitored during the voyage on at least a daily basis, or as recommended by the cargo manufacturer.
- There was no contingency plan in the event of uncontrolled polymerisation and a rapid rise in temperature of an inhibited cargo.
- There were no records available to confirm that the oxygen in the inert gas supply into the tanks was less than 0.1% by volume where polymerization of vinyl chloride had been prevented by inert gas when no inhibitor has been added or inhibitor concentration was insufficient.

8.4.2. Were the Master and officers familiar with the company procedures for carrying out cargo sampling operations?

Short Question Text
Cargo sampling

Vessel Types
LPG

ROVIQ Sequence
Cargo Control Room, Main Deck

Publications
IMO: MSC.1/Circ.1625 Unified Interpretation of the IGC Code.
IMO: ISM Code
IMO: IGC Code
ICS: Tanker Safety Guide (Gas) - Third Edition
SIGTTO: Liquefied Petroleum Gas Sampling Procedures First Edition 2010

Objective

To ensure LPG cargo sampling operations are performed safely.

Industry Guidance

ICS: Tanker Safety Guide (Liquefied Gas) 3rd Edition

6.19.2 Liquid Samples

The following precaution should be taken when sampling cargo liquid or vapour. Reference should also be made to the guidance contained in SIGTTO: Liquefied Petroleum Gas Sampling Procedures First Edition 2010.

The responsible officer should be present when any cargo sampling is carried out. The officer should be familiar with all aspects of the ship's sampling system, including the operational characteristics of all valves. It should be understood that whoever is performing the actual sampling, the responsibility rests entirely with the responsible officer for ensuring that sampling is conducted in a safe and efficient manner. This includes preventing any escape of cargo liquid or vapours to the atmosphere beyond that required by the sampling process. During sampling it is important that:

- The responsible officer should be satisfied that the sampling equipment is compatible with the ship's sampling points before starting any sampling operation. If the two are incompatible for any reason it should be ensured that any action taken to rectify the situation does not impair the gastight integrity of any part of the ship's system or endanger life or property;
- Sample containers should be completely clean and compatible with the cargo to be sampled. They should be of a recognised standard and able to withstand the extremes of temperature and pressure anticipated;
- Sample containers should be purged with nitrogen before use;
- It is imperative that sufficient ullage or vapour space is left in the sample container to allow the liquid to expand when the temperature increases to ambient. To this end a container should be used which is suitably designed for the product being sampled, with a built-in ullage tube and bursting disc. The safe ullage space is created by holding the sample container vertically, with the ullage tube end at the top. The container is then filled from the bottom connection and thus cannot be overfilled above the level set by the ullage tube;
- Unless the sample container is free from cargo vapour, it should not be stored in an unventilated space;
- Gloves, goggles and necessary protective clothing should be worn when sampling cold cargoes;
- If the cargo is toxic, self-contained breathing apparatus (SCBA) should be worn. If sampling takes place in an enclosed space, a respirator is insufficient because lack of oxygen may lead to asphyxiation; and
- Any electrical equipment used when taking samples should be of the certified safe type.

6.19.3 Vapour Samples

The precautions in Section 6.19.2 should be observed when sampling cargo vapour or inert gas. When plastic sample bags are used for collecting vapour samples they should be handled carefully and purged after use. Plastic sample bags should never be used for liquid samples.

SIGTTO: Liquefied Petroleum Gas Sampling Procedures First Edition 2010

2. Sampling Systems – ‘Open Loop’ or ‘Closed Loop’ Systems

Ships’ cargo tanks are normally fitted with several sample connections so that samples may be taken at several different levels. ‘Top’, ‘middle’ and ‘bottom’ samples are common, and these are of great assistance when checking vapour displacement operations, such as inerting or ‘gassing up’ for example.

The lower connections can also be used to take liquid samples if there is a suitable pressure in the cargo tanks. This is not possible with fully refrigerated cargoes, where it is necessary to take samples using the cargo pump, usually recirculating product back to the same tank.

Liquid sampling connections should be fitted with two valves to ensure isolation should one be blocked by ice or hydrates, etc., and terminate in a standard connection.

During sampling, venting to atmosphere should always be minimised, although it is recognised that a small, controlled amount of cargo vapour may be released during purging of sample points and when creating an ullage in sample containers. Any such purging, venting or ullaging of sample containers must be carried out in a safe location, taking into account the properties of the product, wind and weather conditions, and proximity of sources of ignition and ventilation intakes, etc.

If the sample system has only an inlet connection to the sample container, it will always be necessary to vent small quantities of cargo to atmosphere. This is known as an ‘open loop’ system.

If a second connection is provided so that product can be returned to the cargo tanks, this arrangement is known as a ‘closed loop’ system and, if used with the sample container with inlet and outlet connections, minimises the amount of product vented to atmosphere.

If the main hazard from the product to be sampled is its flammability, open sampling may be used provided that due care is taken to reduce the amount of product release to an absolute minimum. However, if the cargo has toxic risks, e.g. VCM or butadiene, then SIGTTO recommends the use of ‘closed loop’ sampling to avoid release of the material to atmosphere.

The return path of this closed loop should also be fitted with double shut-off valves. These return valves should be operated full open or closed and should not be used for throttling/flow control during the sampling process.

4. Standard for Sampling Connection Fittings

In fully refrigerated ships, where it is necessary to use a cargo pump to obtain a sample, a standard connection point should be fitted on the pump discharge line.

The sampling connection should be isolated either by two needle valves or by one needle valve and one ball valve. The two valves should be fitted at least 500 mm apart. The double shut-off is to isolate the sampling system in the event of uncontrolled leakage, such as may be caused by hydrate formation in the valve body. Therefore, access to the primary shut off valve should not require personnel to reach over or round the second valve.

If a ‘closed loop’ return connection is fitted, this should have the same valve requirements as detailed in this section.

When not in use, the stub piece should be fitted with a screwed plug incorporating a soft washer to protect the sealing face.

5. The Procedures Involved in Taking Samples

Whenever sampling is undertaken, the safety guidance given in the ICS: Tanker Safety Guide (Liquefied Gas) 3rdEdition and ISO 4257 *(ISO 4257:2001/COR 1:2007)* should be observed, particularly regarding the use of protective clothing, gloves, goggles, breathing apparatus and 'certified safe' electrical equipment. Sampling of toxic cargoes may require additional specialised equipment. Written procedures for sampling all cargoes included on the vessel's Certificate of Fitness should be part of the vessel's cargo operations manual.

It is imperative that everyone involved in sampling operations is properly informed of the nature of the cargo being handled and the precautions to be observed. This information should include a full description of the physical and chemical properties of the cargo, counter measures against accidental personal contact, firefighting and other emergency procedures. The Data Sheets from the 'ICS Tanker Safety Guide (Liquefied Gas)' should be consulted for this information, and any other sources, such as 'HAZCHEM' or 'TREM' cards (Transport Emergency Cards) from terminal and the IGC Code.

A responsible officer should be present at all times when any sample is drawn from a ship's tanks by a terminal representative or third-party inspector. The officer should be fully conversant with all aspects of the ships sampling system, including the operational characteristics of all valves. They should clearly recognise that their duty is to ensure sampling is authorised and carried out in a safe manner, regardless of who is actually performing the sampling operation.

TMSA KPI 6.2.2 requires that comprehensive procedures cover all aspects of cargo transfer operations for each type of vessel within the fleet. The transfer procedures are specific to the vessel type and cargo to be carried. These may include:

- Cargo survey and sampling.

IMO: ISM Code

7. The Company should establish procedures, plans and instructions, including checklists as appropriate, for key shipboard operations concerning the safety of the personnel, ship and protection of the environment. The various tasks involved should be defined and assigned to qualified personnel.

IMO: IGC Code

1.2.15 Closed loop sampling is a cargo sampling system that minimizes the escape of cargo vapour to the atmosphere by returning product to the cargo tank during sampling

5.6.5 Cargo sampling connections

5.6.5.1 Connections to cargo piping systems for taking cargo liquid samples shall be clearly marked and shall be designed to minimize the release of cargo vapours. For vessels permitted to carry toxic products, the sampling system shall be of a closed loop design to ensure that cargo liquid and vapour are not vented to atmosphere.

5.6.5.2 Liquid sampling systems shall be provided with two valves on the sample inlet. One of these valves shall be of the multi-turn type to avoid accidental opening and shall be spaced far enough apart to ensure that they can isolate the line if there is blockage, by ice or hydrates for example.

5.6.5.3 On closed loop systems, the valves on the return pipe shall also comply with 5.6.5.2.

5.6.5.4 The connection to the sample container shall comply with recognized standards and be supported so as to be able to support the weight of a sample container. Threaded connections shall be tack-welded, or otherwise locked, to prevent them being unscrewed during the normal connection and disconnection of sample containers. The sample connection shall be fitted with a closure plug or flange to prevent any leakage when the connection is not in use.

5.6.5.5 Sample connections used only for vapour samples may be fitted with a single valve in accordance with 5.5, 5.8 and 5.13, and shall also be fitted with a closure plug or flange.

5.6.5.6 Sampling operations shall be undertaken as prescribed in 18.9.

18.9 Cargo sampling

18.9.1 Any cargo sampling shall be conducted under the supervision of an officer who shall ensure that protective clothing appropriate to the hazards of the cargo is used by everyone involved in the operation.

18.9.2 When taking liquid cargo samples, the officer shall ensure that the sampling equipment is suitable for the temperatures and pressures involved, including cargo pump discharge pressure, if relevant.

18.9.3 The officer shall ensure that any cargo sample equipment used is connected properly to avoid any cargo leakage.

18.9.4 If the cargo to be sampled is a toxic product, the officer shall ensure that a "closed loop" sampling system as defined in 1.2.15 is used to minimize any cargo release to atmosphere.

18.9.5 After sampling operations are completed, the officer shall ensure that any sample valves used are closed properly and the connections used are correctly blanked.

IMO: MSC.1/Circ.1625 Unified Interpretation of the IGC Code.

4 Cargo sampling (paragraphs 5.6.5 and 18.9)

4.1 These requirements should only be applicable if such a sampling system is fitted on board. Connections used for control of atmosphere in cargo tanks during inerting or gassing up should not be considered as cargo sampling connections.

Inspection Guidance

The vessel operator should have developed procedures for performing cargo sampling operations for all cargoes included on the vessel's Certificate of Fitness which required that:

- Sampling must be authorised and directly supervised by a responsible officer and carried out in a safe manner, regardless of who is actually performing the sampling operation.
- Only fully compatible sampling equipment, connected properly, is used for the task.
- Venting to atmosphere is minimised during sampling.
- Purging, venting or ullaging of sample containers must be carried out in a safe location.
- Only 'closed loop' equipment is used when toxic products are being sampled.
- The correct PPE is available and used.
- Everyone involved in sampling operations is properly informed of the nature of the cargo being handled and the precautions to be observed.
- Sampling connections are clearly marked.
- Sampling connections are capped or blanked when not in use.

These procedures may be contained in the vessel's Cargo System Operation Manual.

<u>Suggested Inspector Actions</u>

- Sight, and where necessary review, the company procedures for performing cargo sampling operations.
- Observe any sampling operations taking place during the course of the inspection.
- Inspect sampling equipment provided onboard and sampling connections to verify compatibility.

- Interview the accompanying officer to verify their familiarity with:
    - The company procedures for performing cargo sampling operations.
    - The PPE and safety precautions for taking liquid and/or gas samples.
    - The sampling equipment carried onboard the vessel.
    - The sampling connections and locations for taking liquid and/or gas samples.

Expected Evidence

- Company procedures for performing cargo sampling operations.

Potential Grounds for a Negative Observation

- There were no company procedures for performing cargo sampling operations for all cargoes included on the vessel's Certificate of Fitness which required that:
    - Sampling must be authorised and directly supervised by a responsible officer and carried out in a safe manner, regardless of who is actually performing the sampling operation.
    - Only fully compatible sampling equipment, connected properly, is used for the task.
    - Venting to atmosphere is minimised during sampling.
    - Purging, venting or ullaging of sample containers must be carried out in a safe location.
    - Only 'closed loop' equipment is used when toxic products are being sampled.
    - The correct PPE is available and used.
    - Everyone involved in sampling operations is properly informed of the nature of the cargo being handled and the precautions to be observed.
    - Sampling connections are clearly marked.
    - Sampling connections are capped or blanked when not in use.
- The accompanying officer was not familiar with the company procedures for performing cargo sampling operations.
- Sampling was taking place without the presence of a responsible officer.
- Connections to cargo piping systems for taking cargo liquid samples were not clearly marked.
- There was evidence that connections used for control of atmosphere in cargo tanks during inerting or gassing up were being used as cargo sampling connections.
- A liquid sampling arrangement was not provided with a double valve arrangement.
- Neither of the valves on a liquid sampling arrangement were of the 'multi turn' type.
- Sampling equipment in use was not fully compatible with the sampling connections.
- Sampling equipment was not properly connected, allowing release of cargo vapour.
- An 'open loop' sampling system was being used to sample a toxic cargo.
- Purging, venting or ullaging of sample containers was being carried out in an unsafe location.
- Personnel involved in sampling operations were not wearing the required PPE.
- Personnel sampling a toxic cargo were not wearing SCBA.
- Electrical equipment used when taking samples was not of the certified safe type.
- Plastic vapour sample bags were being used for liquid samples.
- Personnel involved in sampling operations had not been properly informed of the nature of the cargo being handled and the precautions to be observed.
- Sample connection valves used during sampling operations were inadequately secured on completion.
- A sample connection was not capped or blanked to prevent any leakage when the connection was not in use.
- Sample containers that were not free of cargo vapour were stored in an unventilated space.
- A sampling arrangement was defective in any respect.
- Sampling equipment and sampling connections were incompatible.

8.4.3. Were the Master and officers familiar with the company procedures for identifying and segregating incompatible cargoes and refrigerants during cargo stowage planning, and had these procedures been followed?

Short Question Text
Segregating incompatible cargoes and refrigerants

Vessel Types
LPG

ROVIQ Sequence
Cargo Control Room, Compressor Room, Main Deck

Publications
USCG: Code of Federal Regulations. Title 46.
ICS: Tanker Safety Guide (Gas) - Third Edition
IMO: ISM Code
IMO: IGC Code
SIGTTO: Liquified Gas Handling Principles on Ships and in Terminals. Fourth Edition.

Objective

To ensure cargo stowage is carefully planned to avoid the co-mingling of incompatible cargoes and refrigerants.

Industry Guidance

ICS: Tanker Safety Guide (Liquefied Gas) 3rd Edition

6.13 Separation of Cargoes

When common pipeline systems are provided for various cargo-related operations, risk of contamination exists when different grades of cargo are carried simultaneously. If separation is needed to avoid cargo contamination, shipper's instructions and regulatory requirements should be observed. If a common piping system has to be used for different cargoes, care should be taken to ensure complete drainage and drying of the piping system before purging with new cargo.

Differing levels of cargo separation are used. These include two-valve separation, segregation and isolation.

Where two cargoes are compatible and an apparent negligible mix is permitted, the adjacent systems carrying the different cargoes should be isolated by at least two valves at each connection, or by one positive visible blank.

Where shipper's instructions or regulatory requirements require segregation, the position of the valves, blanks, portable bends, spectacle blanks and spool pieces associated with such segregation should be carefully arranged and identified. These arrangements for segregation should be followed as part of the approved system.

If the cargoes to be carried are not compatible, the responsible officer should ensure that the pipeline systems for each cargo are completely isolated from each other. This entails checking that all necessary blanks are fitted or that pipe spool pieces have been removed. A cargo log book entry should be made of the action taken.

Wherever possible, separate reliquefaction systems should be used for each cargo. However, if there is a danger of chemical reaction, it is necessary to use completely segregated systems. This is known as positive segregation and is characterised by using removable spool pieces or pipe sections at all times. This restriction should apply equally to liquid, vapour and vent lines as appropriate. Whilst positive segregation may be acceptable for most cargoes, some substances may require totally independent piping systems. Special treatment of certain cargoes is specified in the IGC Code.

If there is any doubt about the reactivity or compatibility of two cargoes, the data sheets for each cargo and a cargo compatibility chart should be checked and advice sought from shippers or other authority. If this advice seems inconclusive, the cargoes should be treated as incompatible and positive segregation provided.

The following precautions should be observed:

- Before opening any cargo line, for example, to remove a blank flange or swing a spectacle blank, attention should be given to ensuring that the line is properly inerted and fully de-pressurised. Flanges should not be fully unbolted until the condition of the line is verified;
- Common pipelines and associated equipment should be drained, inerted and checked before being used for another cargo; and
- All temporary pipework should be gas-freed, disconnected and properly stored when not in use.

SIGTTO: Liquified Gas Handling Principles on Ships and in Terminals. Fourth Edition.

2.3.2 Reactivity with other cargoes

Table 2.4 summaries the chemical reactivity between the main cargoes. Confirmation should always be sought from shippers when changing from one grade to another.

(See Table 2.4 Chemical incompatibilities of liquefied gases)

USCG: Code of Federal Regulations. Title 46.

Part 150 Compatibility of cargoes

Fig.1 Compatibility Chart

TMSA KPI 6.1.1 requires that procedures for cargo, ballast, tank cleaning and bunkering operations are in place for all vessel types within the fleet. The procedures include:

- Planning
- Cargo and ballast handling.

IMO: ISM Code

7. The Company should establish procedures, plans and instructions, including checklists as appropriate, for key shipboard operations concerning the safety of the personnel, ship and protection of the environment. The various tasks involved should be defined and assigned to qualified personnel.

IMO: IGC Code

7.3.2 Compatibility

Refrigerants used for reliquefaction shall be compatible with the cargo they may come into contact with. In addition, when several refrigerants are used and may come into contact, they shall be compatible with each other.

Inspection Guidance

The vessel operator should have developed procedures for cargo stowage planning that included the:

- Identification of incompatible cargoes and refrigerants using all available data.
- Means of identifying and documenting locations and processes where segregation is necessary.
- Means of segregation of incompatible cargoes and refrigerants.

These procedures may refer to:

- Charterer's instructions.
- Recognised compatibility charts, safety data sheets and information provided by shippers.
- Cargo System Operation Manual.
- Relevant ship's drawings showing acceptable segregation arrangements.

Where such cargoes are carried, charterers instructions for cargo compatibility issues should be followed. Special attention must be given to the ship's reliquefaction system. There may also be a need, when changing cargoes, to replace the lubricating oil in compressors for certain cargoes.

The cargo stowage plan should identify when care should be taken to avoid the co-mingling of non-compatible cargoes, which cargoes are involved, and the means of segregation. All areas where co-mingling is possible should be considered.

Suggested Inspector Actions

- Sight and where necessary, review the company procedures for identifying and segregating incompatible cargoes and refrigerants during cargo stowage planning.
- Sight and where necessary, review the compatibility chart in use and any other available data.
- Review current and previous cargo stowage plans and supporting documents to verify compliance with company procedures.
- During the course of the inspection, sight any operational means of segregation identified in the cargo stowage plan such as spool pieces or spectacle flanges.

- Interview the officer responsible for cargo stowage planning to verify their familiarity with:
    - The company procedures for identifying and segregating incompatible cargoes and refrigerants.
    - The use of the compatibility chart and any other data provided on board.

Expected Evidence

- Company procedures for identifying and segregating incompatible cargoes and refrigerants during cargo stowage planning.
- Current and previous cargo stowage plans.
- Cargo log book.
- Risk assessments or checklists that identify systems and processes that require segregation.
- Compatibility charts.
- Cargo System Operation Manual.
- Relevant ship's drawings showing acceptable segregation arrangements.

Potential Grounds for a Negative Observation

- There were no company procedures for cargo stowage planning that included the:
    - Identification of incompatible cargoes and refrigerants using all available data.
    - Means of identifying and documenting locations and processes where segregation is necessary.
    - Means of segregation of incompatible cargoes and refrigerants.
- The officer responsible for cargo stowage planning was not familiar with company procedures for identifying and segregating incompatible cargoes and refrigerants.
- The officer responsible for cargo stowage planning was not familiar with the use of the compatibility chart provided on board.
- There was no compatibility chart issued by a recognised body available on board.
- Two incompatible cargoes had been stowed adjacent to each other or in a configuration that did not provide positive segregation.

- Operational means of segregation were observed to be not as indicated in the cargo stowage plan.
- The cargo stowage plan did not identify when care should be taken to avoid the co-mingling of non-compatible cargoes, which cargoes are involved, and the means of segregation.
- A cargo log book entry was not made of the action taken to isolate the pipeline systems prior to the loading of incompatible cargoes.

8.4.4. Were the Master and officers familiar with the company procedures for the safe carriage of propylene oxide (PO), ethylene oxide (EO) and PO-EO mixtures?

Short Question Text
Carriage of propylene oxide (PO) and/or ethylene oxide (EO)

Vessel Types
LPG

ROVIQ Sequence
Cargo Control Room, Compressor Room, Main Deck

Publications
IMO: ISM Code
IMO: IGC Code
SIGTTO: Liquified Gas Handling Principles on Ships and in Terminals. Fourth Edition.
ICS: Tanker Safety Guide (Gas) - Third Edition

Objective

To ensure the safe carriage of propylene oxide (PO), ethylene oxide (EO) and PO-EO mixtures.

Industry Guidance

SIGTTO: Liquified Gas Handling Principles on Ships and in Terminals. Fourth Edition.

2.2 The Chemical Gases

Some non-hydrocarbon cargoes are carried on gas carriers, usually referred to as chemical gases, and their properties vary considerably. As these cargoes can be toxic, appropriate personal protective equipment (PPE) will be used when handling them and information on what PPE is required will commonly be found on the safety data sheet (SDS) for that specific cargo.

Ethylene oxide (EO) $C2H4O$ and propylene oxide (PO) $C3H6O$

These are highly reactive, colourless liquids with an ether-like odour that are used to make common industrial chemicals such as glycols. EO is more sensitive than PO and is rarely carried in bulk as this cargo requires a Type 1G ship. Cargoes of PO and cargo mixtures of EO and PO containing less than 30% EO are more common; these cargoes can generally be carried on Type 2C chemical tankers or Type 2G gas carriers.

EO and PO cargoes are self-reactive, particularly in the presence of air or materials that can catalyse the reaction. For this reason, the IGC code specifies that cargoes of PO and EO/PO mixtures are required to be acetylene-free for shipment.

Both cargoes are flammable and toxic. The flammability hazard is increased because these products contain oxygen that can assist the combustion process. Furthermore, if the products decompose at ambient conditions, that process creates two gases, and the sudden volume expansion may be explosive.

The detailed requirements for carrying these cargoes are set out in the IGC Code.

8.2.2 Sampling systems – ‘open loop or ‘closed loop’ systems

Certain cargoes, such as propylene oxide, are required by the IGC Code to be carried under a nitrogen blanket. Product samples are, therefore, only drawn from the liquid phase. The vapour space is sampled to ensure adequate nitrogen content. Further advice is available from the IGC Code, and the safety data sheets (SDS) for the cargo concerned.

9.4.14 Chemical burns

As shown in table 9.4, chemical burns can be caused by ammonia, chlorine, ethylene oxide and propylene oxide. Deck showers and eye baths are provided for water rinsing on gas carriers certified to carry these products. Their locations will usually be clearly indicated so that treatment can be administered as quickly as possible in the event of an accident.

9.24.2 Protective clothing

In addition to breathing apparatus, full protective clothing will be worn when entering an area where contact with a liquefied gas cargo is a possibility. Types of protective clothing vary from those providing protection against liquid splashes to a full positive pressure gas tight suit that will normally incorporate a helmet, gloves and boots. Such clothing will usually also be resistant to low temperatures and solvents. It is particularly important to wear full protective clothing when entering an enclosed space that has contained toxic gas such as ammonia, chlorine, ethylene oxide, propylene oxide, vinyl chloride monomer or butadiene.

For certain cargoes the IGC Code requires the use of suitable eye protection and clothing that is gas tight.

ICS: Tanker Safety Guide (Gas) - Third Edition

1.4.1.2 Use of Inert Gas

Certain cargoes which can self-react, including ethylene oxide and propylene oxide, cannot be inhibited. Such cargoes have to be carried under inert gas. Care should be taken to ensure that a positive pressure is maintained in the inerted atmosphere at all times and that the oxygen concentration does not exceed 0.2% by volume.

1.8 Pressure

Particularly hazardous cargoes, including ethylene oxide and propylene oxide, may be carried below their boiling points to reduce boil-off and enhance safety. In such cases the cargo tank pressure should be maintained above atmospheric pressure with nitrogen padding.

4.6 Carriage of Noxious Liquid Substances

A number of gas tankers are certified to carry particular chemical products which have a vapour pressure not exceeding 2.8 bar at a temperature of 37.8^{o}C. These products are called noxious liquid substances (NLS). The ten NLS that may be carried on a gas tanker identified by an asterisk in Chapter 19 of the IGC code. NLS commonly carried on gas tankers include:

- Isoprene;
- Pentanes and pentene; and
- Propylene oxide.

A gas tanker should have a Certificate of Fitness which should identify all the liquefied gas cargoes and NLS cargoes that the ship is certified to carry. In addition, gas tankers carrying NLS in bulk are required to have the following documentation on board:

- The International Pollution Prevention Certificate (IPPC) identifying the particular product with their pollution categories that the ship is certified to carry;
- The Procedures and Arrangements Manual describing the operational procedures to be followed in order to comply with MARPOL Annex II;
- The Cargo Record Book required by MARPOL Annex II; and
- The Shipboard Marine Pollution Emergency Plan (SMPEP) describing the on-board response to the spill or release of noxious liquid substances.

The requirement for a P&A Manual applies only when a gas tanker is carrying NLS cargoes. When NLS cargoes are not carried, a P&A Manual is not required on board.

5.4 Atmosphere Control

5.4.2 Cargo Tanks and Piping systems

Some liquefied gas cargoes react easily with oxygen and require the oxygen content in the vapour space to be kept extremely low (in some cases less than 0.1%) to prevent a chemical reaction occurring. As examples, ethylene oxide/propylene oxide mixtures can decompose spontaneously unless special precautions are taken to control the atmosphere, and butadiene can react with oxygen to form unstable peroxide compounds.

Prior to loading such reactive cargoes, the oxygen content in the cargo tank should be reduced to the level appropriate for the cargo to be loaded. While such cargoes remain on board, oxygen should be excluded in accordance with shippers' requirements by keeping the vapour space full of inert gas or cargo vapour at a positive pressure. In the particular case of butadiene, the cargo vapour should be kept above atmospheric pressure.

6.9.2 Reliquefaction and Boil-Off Control

The vapour of certain cargoes, including ethylene oxide and propylene oxide, cannot be compressed. Such cargoes can only be refrigerated by indirect cooling and cargo compressors usually have to be isolated or blanked off.

TMSA KPI 6.1.1 requires that procedures for cargo, ballast, tank cleaning and bunkering operations are in place for all vessel types within the fleet.

IMO: ISM Code

7. The Company should establish procedures, plans and instructions, including checklists as appropriate, for key shipboard operations concerning the safety of the personnel, ship and protection of the environment. The various tasks involved should be defined and assigned to qualified personnel.

IMO: IGC Code

17.14 Ethylene oxide

17.14.1 For the carriage of ethylene oxide, the requirements of 17.18 shall apply, with the additions and modifications as given in this section.

17.14.2 Deck tanks shall not be used for the carriage of ethylene oxide.

17.4.3 Stainless steels types 416 and 442, as well as cast iron, shall not be used in ethylene oxide cargo containment and piping systems.

17.14.4 Before loading, tank shall be thoroughly and effectively cleaned to remove all traces of previous cargoes from tanks and associated pipe work, except where the immediate prior cargo has been ethylene oxide, propylene oxide, or mixtures of these products. Particular care shall be taken in the case of ammonia in tanks made of steel other than stainless steel.

17.14.5 Ethylene oxide shall be discharged only by deep well pumps or inert gas displacement. The arrangement of pumps shall comply with 17.18.15.

17.14.6 Ethylene oxide shall be carried refrigerated only and maintained at temperatures of less than 30^{o}C.

17.14.7 PRVs shall be set at a pressure of not less than 0.55 MPa gauge. The maximum set pressure shall be specially approved by the administration.

17.14.8 The protective padding of nitrogen gas, as required by 17.18.27, should be such that the nitrogen concentration in the vapour space of the cargo tank will, at no time, be less than 45% by volume.

17.14.9 Before loading, and at all times when the cargo tank contains ethylene oxide liquid or vapour, the cargo tank shall be inerted with nitrogen.

17.14.10 The water-spray system required by 17.18.29 and that required by 11.3 shall operate automatically in a fire involving the cargo containment system.

17.14.11 A jettisoning arrangement shall be provided to allow the emergency discharge of ethylene oxide in the event of uncontrollable self-reaction.

17.18 Propylene oxide and mixtures of ethylene oxide-propylene oxide with ethylene oxide content of not more than 30% by weight

17.18.1 Products transported under the provisions of this section shall be acetylene-free.

17.18.2 Unless cargo tanks are properly cleaned, these products should not be carried in tanks that have contained as one of the three previous cargos any product known to catalyse polymerization, such as:

1. anhydrous ammonia and ammonia solutions;
2. amines and amine solutions; and
3. oxidizing substance (e.g., chlorine)

17.18.3 Before loading, tank shall be thoroughly and effectively cleaned to remove all traces of previous cargoes from tanks and associated pipe work, except where the immediate prior cargo has been propylene oxide or ethylene oxide propylene oxide mixtures. Particular care shall be taken in the case of ammonia in tanks made of steel other than stainless steel.

17.18.4 In all cases, the effectiveness of cleaning procedures for tanks and associated pipe work shall be checked, by suitably testing or inspection, to ascertain that no traces of acidic or alkaline materials remain that might create a hazardous situation in the presence of these products.

17.18.5 Tanks shall be entered and inspected prior to each initial loading of these products to ensure freedom from contamination, heavy rust deposits and any visible structural defects. When cargo tanks are in continuous service for these products, such inspections shall be performed at intervals of not more than two years.

17.18.6 Tanks for the carriage of these projects shall be of steel or stainless-steel construction.

17.18.7 Tanks that have contained these products may be used for other cargoes after thorough cleaning of tanks and associated pipework systems by washing or purging.

17.18.8 All valves, flanges, fittings and accessory equipment shall be of a type suitable for use with these products and shall be constructed of steel or stainless steel in accordance with recognised standards. Disc or disc faces, seats and other wearing parts of the valves shall be made of stainless steel containing not less than 11% chromium.

17.18.9 Gaskets shall be constructed of materials which do not react with, dissolve in, or lower the auto ignition temperature of, these products and which are fire resistant and possess adequate mechanical behaviour. The surface presented to the cargo shall be polytetrafluoroethylene (PTFE) materials giving a similar degree of safety by their inertness. Spirally wound stainless steel with a filler of PTFE or similar fluorinated polymer may be accepted, if approved by the Administration or recognised organisation acting on its behalf.

17.18.10 Insulation and packing, if used, shall be of a material which does not react with, dissolve in, or lower the auto ignition temperature of, these products.

17.18.11 The following materials are generally found unsatisfactory for use in gaskets, packing and similar uses in containment systems for these products and would require testing before being approved:

1. Neoprene or natural rubber if it comes into contact with the products;
2. Asbestos or binders used with asbestos; and
3. Materials containing oxides of magnesium, such as mineral wools.

17.18.12 Filling and discharge piping shall extend to within 100 mm of the bottom of the tank or any sump.

17.18.13 The product shall be loaded and discharged in such a manner that venting of the tanks to atmosphere does not occur. If vapour returned to shore is used during tank loading, the vapour return system connected to a containment system for the product shall be independent of all other containment systems.

17.18.14 During discharging operations, the pressure in the cargo tank shall be maintained above 0.007 MPa gauge.

17.18.15 The cargo shall be discharged only by deep well pumps, hydraulically operated submerged pumps or inert gas displacement. Each cargo pump shall be arranged to ensure that the product does not heat significantly if the discharge line from the pump is shut off or otherwise blocked.

17.18.16 Tanks carrying these products shall be vented independently of tanks carrying other products. Facilities shall be provided for sampling the tank contents without opening the tank to atmosphere.

17.18.17 Cargo hoses used for transfer of these products shall be marked “FOR ALKYLENE OXIDE TRANSFER ONLY”.

17.18.18 Hold spaces shall be monitored for these products. Hold spaces surrounding type A and type B independent tanks shall also be inerted and monitored for oxygen. The oxygen content of these spaces shall be maintained below 2% by volume. Portable sampling equipment is satisfactory.

17.18.19 Prior to disconnecting shorelines, the pressure in liquid and vapour lines shall be relieved through suitable valves installed at the loading header. Liquid and vapour from these lines shall not be discharged to atmosphere.

17.18.20 Tanks shall be designed for the maximum pressure expected to be encountered during loading, carriage or unloading of cargo.

17.18.21 Tanks for the carriage of propylene oxide with a design vapour pressure of less than 0.06 MPa, and tanks for the carriage of ethylene oxide-propylene oxide mixtures with a design vapour pressure of less than 0.12 MPa, shall have a cooling system to maintain the cargo below the reference temperature. The reference temperatures are referred to in 15.1.3.

17.18.22 Pressure relief valve settings shall not be less than 0.02 MPa gauge; and for type C independent tanks not greater than 0.7 MPa gauge for the carriage of propylene oxide and not greater than 0.53 MPa gauge for the carriage of ethylene oxide-propylene oxide mixtures.

17.18.23 The piping system for tanks to be loaded with these products shall be completely separate from the piping systems for all other tanks, including empty tanks, and from all cargo compressors. If the piping system for the tanks to be loaded with these products is not independent, as defined in 1.2.28, the required piping separation shall be accomplished by the removal of spool pieces, valves, or other pipe sections and the installation of blank flanges at these locations. The required separation applies to all liquid and vapour piping, liquid and vapour vent lines and any other possible connection such as common inert gas supply lines.

17.18.24 The product shall be transported only in accordance with cargo handling plans approved by the Administration. Each intended loading arrangement shall be shown on a separate cargo handling plan. Cargo handling plans shall show the entire cargo piping system and the locations for installation of the blank flanges needed to meet the above piping separation requirements. A copy of each approved cargo handling plan shall be kept on board the ship. The International Certificate of Fitness for the Carriage of Liquefied Gases in Bulk shall be endorsed to include references to the approved cargo handling plans.

17.18.25 Before each initial loading of these products, and before every subsequent return to such service, certification verifying that the required piping separation has been achieved shall be obtained from a responsible person acceptable to the port Administration and carried on board the ship. Each connection between a blank flange and pipeline flange shall be fitted with a wire and seal by the responsible person to ensure that inadvertent removal of the blank flange is impossible.

17.18.26 The maximum allowable loading limits for each tank shall be indicated for each loading temperature that may be applied, in accordance with 15.5.

17.18.27 The cargo shall be carried under a suitable protective padding of nitrogen gas. An automatic nitrogen makeup system shall be installed to prevent the tank pressure falling below 0.007 MPa gauge in the event of product temperature fall due to ambient conditions or malfunctioning of refrigeration system. Sufficient nitrogen shall be available on board to satisfy the demand of the automatic pressure control. Nitrogen of commercially pure quality (99.9% by volume) shall be used for padding. A battery of nitrogen bottles, connected to the cargo tanks through a pressure reduction valve, satisfies the intention of the expression “automatic” in this context.

17.18.28 The cargo tank vapour space shall be tested prior to and after loading to ensure that the oxygen content is 2% by volume or less.

17.18.29 A water-spray system of sufficient capacity shall be provided to blanket effectively the area surrounding the loading manifold, the exposed deck piping associated with product handling and the tank domes. The arrangement of piping and nozzles shall be such as to give a uniform distribution rate of 10 L/m2/min. The arrangement shall ensure that any spilled cargo is washed away.

17.18.30 The water-spray system shall be capable of local and remote manual operation in case of a fire involving the cargo containment system. Remote manual operation shall be arranged such that the remote starting of pumps supplying the water-spray system and remote operation of any normally closed valves in the system can be carried out from a suitable location outside the cargo area, adjacent to the accommodation spaces and readily accessible and operable in the event of fire in the areas protected.

17.18.31 When ambient temperatures permit, a pressurised water hose ready for immediate use shall be available during loading and unloading operations, in addition to the above water spray requirements.

Inspection Guidance

The vessel operator should have developed procedures for the safe carriage of propylene oxide (PO), ethylene oxide (EO) and PO-EO mixtures which gave guidance on:

- Tank preparation and inspection, including compatibility with previous cargoes.
- Separation of pipeline systems and compressors, including sealing and certification.
- Pressure relief valve (PRV) settings.
- Nitrogen purging and padding requirements.
- Cargo discharge methods.
- Vapour return requirements.
- Cargo temperature control.
- Monitoring/inerting of hold spaces.
- Sampling arrangements.
- Emergency procedures, including jettisoning ethylene oxide.

These procedures may refer to or form part of the Procedures and Arrangements (P&A) Manual, the Cargo System Operation Manual and/or the approved cargo handling plans.

Suggested Inspector Actions

- Sight, and where necessary review, the company procedures for the safe carriage of propylene oxide (PO), ethylene oxide (EO) and PO-EO mixtures.

- Review the approved cargo handling plans and the P&A Manual.
- If the vessel has loaded propylene oxide (PO), ethylene oxide (EO) or PO-EO mixtures within the last 12 months, review:
    - Segregation certification issued by the appropriate shore authority prior to loading.
    - Records of the last 3 cargoes carried prior to the PO/EO.
    - Cargo tank inspection records for tanks used for PO/EO.
    - Records of tank cleaning prior to loading PO/EO.
    - Records of monitoring cargo tank pressure and oxygen content.
    - Records of monitoring hold spaces for PO/EO leakage and oxygen during the voyage.
- If the vessel is carrying propylene oxide (PO), ethylene oxide (EO) or PO-EO mixtures at the time of the inspection:
    - Inspect the seals on the blanks in the pipeline system.
    - Verify the water-spray system is fully operational and ready for immediate use.

- Interview the officer responsible for cargo operations to verify their familiarity with the company procedures for the safe carriage of propylene oxide (PO), ethylene oxide (EO) and PO-EO mixtures.

Expected Evidence

- The company procedures for the safe carriage of propylene oxide (PO), ethylene oxide (EO) and PO-EO mixtures.
- Approved cargo handling plans.
- P&A Manual.
- The Cargo System Operation Manual, where provided.
- Segregation certification issued by the appropriate shore authority prior to loading.
- Records of the last 3 cargoes carried prior to the PO/EO.
- Cargo tank inspection records for tanks used for PO/EO.
- Records of tank cleaning prior to loading PO/EO.
- Records of monitoring cargo tank pressure and oxygen content.
- Records of monitoring hold spaces for PO/EO leakage and oxygen during the voyage.

Potential Grounds for a Negative Observation

- There were no company procedures for the safe carriage of propylene oxide (PO), ethylene oxide (EO) and PO-EO mixtures.
- The officer in charge of cargo operations was not familiar with the company procedures for the safe carriage of propylene oxide (PO), ethylene oxide (EO) and PO-EO mixtures including:
    - Tank preparation and inspection, including compatibility with previous cargoes.
    - Separation of pipeline systems and compressors, including sealing and certification.
    - Pressure relief valve (PRV) settings.
    - Nitrogen purging and padding requirements.
    - Cargo discharge methods.
    - Vapour return requirements.
    - Cargo temperature control.
    - Monitoring/inerting of hold spaces.
    - Sampling arrangements.
    - Emergency procedures, including jettisoning ethylene oxide.
- The vessel was handling PO/EO cargoes but:
    - These cargoes were not included on the Certificate of Fitness or NLS certificate, and/or
    - There was no approved cargo handling plan available.
    - There was no P&A Manual on board.
- There was no segregation certification on board issued by the appropriate shore authority prior to loading propylene oxide (PO), ethylene oxide (EO) or PO-EO mixtures.
- Ethylene oxide was being carried in deck tanks.
- While the vessel was handling PO/EO cargo, blanks were not sealed as required.

- During discharge of PO/EO the tank pressure was not maintained above 0.007 MPa gauge.
- The vessel’s cargo hoses used for PO/EO transfer were not correctly marked with “FOR ALKYLENE OXIDE TRANSFER ONLY”.
- There were no records to show that the hold spaces were being monitored for PO/EO leakage and/or oxygen content.
- Where hold spaces were required to be inerted, oxygen content was more than 2%.
- Where required to be fitted, the cargo tanks were not fitted with a cooling system to maintain the cargo temperature below the reference temperature.
- The cargo loading plan did not document the maximum allowable loading limits for each tank corresponding to the loading temperature.
- The water spray system was not operational or defective in any respect.
- There was no evidence that the gaskets in use were constructed of materials which were resistant to the cargo.
- There was no jettison equipment available on board.

If propylene oxide (PO), ethylene oxide (EO) or PO-EO mixtures are not included on the vessel’s Certificate of Fitness, select “*Not Answerable*” in each of the response tools then select "*Not Applicable - as instructed by question guidance*".

8.4.5. Were there sufficient escape sets as required by the IGC Code for everyone on board, and did the sets provide suitable respiratory and eye protection?

Short Question Text
Escape sets as required by the IGC Code

Vessel Types
LPG

ROVIQ Sequence
Engine Room, Interview - Rating, Internal Accommodation

Publications
IMO: ISM Code
OCIMF/ICS: International Safety Guide for Oil Tankers and Terminals. Sixth Edition.
IMO: IGC Code
ICS: Tanker Safety Guide (Gas) - Third Edition

Objective

To ensure that everyone on board is provided with a suitable emergency escape set to exit a hazardous atmosphere in case of an emergency.

Industry Guidance

ICS: Tanker Safety Guide (Gas) - Third Edition

3.11.5 Breathing Apparatus

Ships carrying toxic cargoes are provided with sets of small breathing apparatus supplying air for approximately 15 minutes. This equipment is for emergency escape only and should not be used for other purposes.

OCIMF/ICS: International Safety Guide for Oil Tankers and Terminals. Sixth Edition

10.13.3 Emergency Escape Breathing Device

EEBDs are for emergency escape and should not be used as the primary means for entering spaces or compartments with unsafe atmospheres.

The device can be of two types:

Compressed Air Emergency Escape Breathing Device

This consists of an air cylinder, reducing valve, air hose, face mask or hood and a flame-retardant high visibility bag or jacket. It is normally a constant flow device, providing compressed air at a rate of approximately 40 litres per minute, giving a 10–15-minute duration, depending on the capacity of the cylinder. Compressed air EEBDs can normally be recharged on board with a conventional SCBA compressor. The pressure gauge, supply valve and hood should be checked before use.

Re-breathing Emergency Escape Breathing Device

This normally consists of a robust watertight carrying case, compressed oxygen cylinder, breathing bag, mouthpiece and a flame-retardant hood. It is designed for single use. When the hood is placed over the user’s head and the set activated, exhaled air is mixed with compressed oxygen inside the breathing bag to allow the wearer to breath normally when escaping from a hazardous atmosphere.

TMSA KPI 6.1.4 requires that the company has procedures that address cargo specific hazards for all vessel types within the fleet. Cargoes with specific hazards may include:

- Toxic cargoes.

IMO: ISM Code

7. The Company should establish procedures, plans and instructions, including checklists as appropriate, for key shipboard operations concerning the safety of the personnel, ship and protection of the environment. The various tasks involved should be defined and assigned to qualified personnel.

IMO: IGC Code

14.4 Personal protection requirements for individual products

14.4.1 Requirements of this section shall apply to ships carrying products for which those paragraphs are listed in column "i" in the table of chapter 19.

14.4.2 Suitable respiratory and eye protection for emergency escape purposes shall be provided for every person on board, subject to the following:

1. filter-type respiratory protection is unacceptable;
2. self-contained breathing apparatus shall have at least a duration of service of 15 min; and
3. emergency escape respiratory protection shall not be used for firefighting or cargo-handling purposes and shall be marked to that effect.

Inspection Guidance

Escape Set in this context can be considered synonymous with Emergency Escape Breathing Device (EEBD).

The vessel operator should have provided the vessel with the emergency escape sets required by the IGC Code that:

- Provide suitable respiratory and eye protection.
- Have a duration of at least 15 minutes.
- Do not use filter-type respiratory protection.
- And are:
    - Available for every person on board while the vessel is underway.
    - In addition to the EEBDs required by SOLAS to be located in the accommodation and machinery spaces.
    - Suitably marked as not to be used for fire-fighting or cargo-handling purposes.
    - Included in the company procedures for the use and maintenance of EEBDs and the onboard maintenance plan.

<u>Suggested Inspector Actions</u>

- Review the inspection and maintenance records for the EEBDs contained within the onboard maintenance plan.
- Inspect two escape sets at random.

- Interview a rating at random to verify their familiarity with the locations, purpose and operation of the escape sets provided.

<u>Expected Evidence</u>

- The inspection and maintenance records for the EEBDs contained within the onboard maintenance plan.

Potential Grounds for a Negative Observation

- The escape sets provided:
    - Did not have a design duration of at least 15 minutes.
    - Were not included in the company procedures for the use and maintenance of EEBDs and the onboard maintenance plan.
    - Used filter-type respiratory protection.
    - Did not provide suitable eye protection.
    - Were not suitably marked as not to be used for fire-fighting or cargo-handling purposes.
    - Were not in addition to the EEBDs required by SOLAS to be located in the accommodation and machinery spaces.
- An escape set:
    - Was not fully charged.
    - Had not been inspected and maintained in accordance with the onboard maintenance plan.
    - Had been used for fire-fighting or cargo-handling purposes.
    - Had been used as the primary means for entering spaces or compartments with unsafe atmospheres.
- There were insufficient escape sets for everyone on board, including any contractors, supernumeraries, visitors etc. while underway.
- An interviewed rating was not familiar with the locations, purpose and operation of the escape sets provided.

8.4.6. Were the Master and officers familiar with the company procedures for the inspection and maintenance of the cargo tank insulation, and was the insulation reported to be in good condition?

Short Question Text
Cargo tank insulation

Vessel Types
LPG

ROVIQ Sequence
Cargo Control Room

Publications
IMO: ISM Code
IMO: IGC Code
SIGTTO: Liquified Gas Handling Principles on Ships and in Terminals. Fourth Edition.
IACS: Requirements Concerning Gas Tankers
SIGTTO: Liquefied Gas Fire Hazard Management. First Edition 2004.

Objective

To ensure the cargo tank insulation is properly inspected and maintained.

Industry Guidance

IACS: Requirements Concerning Gas Tankers

G1.8 Insulation

G1.8.1 When liquified gas is carried at a temperature below –10°C, suitable insulation is to be provided to ensure that the minimum temperature of the hull structure does not fall below the minimum allowable service temperature given for the concerned grade of steel in W1 when the cargo tanks are at their design temperature and the ambient temperatures are 5°C for air and 0°C for sea water.

SIGTTO: Liquified Gas Handling Principles on Ships and in Terminals. Fourth Edition.

3.7.2 Tank insulation

Thermal insulation is fitted to refrigerated cargo tanks for the following reasons:

- To minimise heat flow into cargo tanks and reduce boil off.
- To protect the ship structure around the cargo tanks from the effects of low temperature.

Insulation materials for use on gas carriers will usually possess the following main characteristics:

- Low thermal conductivity.
- Ability to bear loads.
- Ability to with stand mechanical damage.
- Light weight.
- Unaffected by cargo liquid or vapour.

The vapour sealing property of the insulation system is important to prevent the ingress of water or water vapour. Ingress of moisture can cause a loss of insulation efficiency and progressive condensation and freezing can cause extensive mechanical damage to the insulation. Humidity conditions will, therefore, be kept as low as possible in hold spaces. One method used to protect the insulation is to provide a foil skin that acts as a vapour barrier to surround the system.

Thermal insulation may be applied to various surfaces, depending on the design of the containment system. For Type B and Type C containment systems, insulation is applied directly to the cargo tank's outer surfaces. For Type A cargo tanks, insulation can be applied either directly to the cargo tank or to the inner hull (if fitted) although, for maximum effectiveness, it is more common for the insulation to be applied directly to the cargo tank surface.

SIGTTO: Liquefied Gas Fire Hazard Management. First Edition 2004.

5.4 Prevention of Fires in Liquefied Gas Carrier Cargo Containment Systems.

The precautions that should be considered when undertaking repair and construction work on ship and terminal storage tanks can be itemised as follows:

- When hot work is to be carried out near the tank insulation, a suitable area is to be checked for gas in the insulation. If working on the tank surface, a sufficient area of insulation is to be removed to ensure that ignition of possible entrapped gas pockets or the insulation material cannot occur.
- All exposed insulation in the vicinity of hot work should be covered with a non-flammable material. Care should also be taken that any tape or sealing materials are also non- flammable.

TMSA KPI 4.2.2 requires that cargo, void and ballast spaces are inspected to ensure their integrity is maintained.

The frequency of inspections is determined by the applicable regulations of class, flag state and national authorities. In addition, industry recommendations are taken into account. Guidance for inspection of compartments is provided, which may include industry/class publications. Records are compartment specific and made to a standard format that may include photographs as evidence of the compartment's condition.

IMO: ISM Code

10. Maintenance of the Ship and Equipment

10.1 The Company should establish procedures to ensure that the ship is maintained in conformity with the provisions of the relevant rules and regulations and with any additional requirements which may be established by the Company.

10.2 In meeting these requirements the Company should ensure that:

- inspections are held at appropriate intervals;
- any non-conformity is reported, with its possible cause, if known;
- appropriate corrective action is taken; and
- records of these activities are maintained.

IMO: IGC Code

4.10 Thermal insulation

4.10.1 Thermal insulation shall be provided, as required, to protect the hull from temperatures below those allowable (see 4.19.1) and limit the heat flux into the tank to the levels that can be maintained by the pressure and temperature control systems applied in Chapter 7.

4.10.2 In determining the insulation performance, due regard shall be given to the amount of the acceptable boil-off in association with the reliquefaction plant on board, main propulsion machinery or other temperature control system.

Inspection Guidance

The vessel operator should have developed procedures for the inspection and maintenance of the cargo tank insulation which included guidance on:

- Scope and frequency of inspections.
- Maintenance procedures.
- Records to be kept of inspections and maintenance.
- Fire safety precautions to be taken when undertaking maintenance or repair work in the vicinity of cargo tank insulation.

These procedures and records may form part of the ship's maintenance plan. Inspection of cargo tank insulation may form part of general inspection of hold spaces.

Typical Insulation materials are:

- Balsa wood.
- Mineral wool.
- Extruded polystyrene.
- Expanded polystyrene.
- Polyurethane foam.

Insulation materials may be combustible.

If loose-fill perlite insulation is used, levels should be regularly checked and topped up as required.

Suggested Inspector Actions

- Sight, and where necessary review the company procedures for the inspection and maintenance of the cargo tank insulation.
- Review the:
    - Records of inspection of the cargo tank insulation.
    - Records of maintenance and repair of the cargo tank insulation.
- Where defects to the cargo tank insulation had been noted within an inspection report, verify that a defect report had been generated to follow up with the required corrective actions.

- Interview the accompanying officer to verify their familiarity with the company procedures for the inspection and maintenance of the cargo tank insulation.

Expected Evidence

- Company procedures for the inspection and maintenance of the cargo tank insulation.
- Records of inspection of the cargo tank insulation.
- Records of maintenance and repair of the cargo tank insulation.
- Open defect reports for any defects to the cargo tank insulation.
- The enclosed space entry records and permits for recent cargo tank insulation inspections.

Potential Grounds for a Negative Observation

- There were no company procedures for the inspection and maintenance of the cargo tank insulation which included guidance on:
    - Scope and frequency of inspections.
    - Maintenance procedures.
    - Records to be kept of inspections and maintenance.

    - Fire safety precautions to be taken when undertaking maintenance or repair work in the vicinity of cargo tank insulation.
- The accompanying officer was not familiar with the company procedures for the inspection and maintenance of the cargo tank insulation.
- There were no records of the inspection, maintenance, or repair of the cargo tank insulation.
- Inspections of cargo tank insulation had not taken place as required by company procedures.
- Where a defect to the cargo tank insulation had been noted within an inspection report, no defect report had been generated to follow up with the required corrective actions (give details of defect).

8.4.7. Were the vent outlets from the cargo containment system fitted with the correct protection screen or flame screen required for the cargo being carried, and were the screens in satisfactory condition?

Short Question Text
Vent outlet protection screens or flame screens

Vessel Types
LPG

ROVIQ Sequence
Main Deck

Publications
IMO: ISM Code
IMO: IGC Code
SIGTTO: Liquified Gas Handling Principles on Ships and in Terminals. Fourth Edition.
ICS: Tanker Safety Guide (Gas) - Third Edition

Objective

To ensure that the correct protection or flame screens are fitted to vent outlets in accordance with the cargo being carried, and that these screens are in satisfactory condition.

Industry Guidance

ICS: Tanker Safety Guide (Gas) - Third Edition

5.9.2 Vent Mast Protection Screens and Flame Screens

The IGC Code requires specific vent mast protection screens and flame screens to be used when carrying particular cargoes:

When carrying cargoes other than MARPOL Annex II Noxious Liquid Substances (NLS), cargo vent mast outlets are required to be fitted with a coarse protection screen (up to 13mm square mesh) to prevent the ingress of foreign objects without adversely affecting the vent flow: and

When carrying a low vapour pressure MARPOL Annex II NLS, cargo vent mast outlets are required to be fitted with flame screens (typically 2mm square mesh) for fire protection. Flame screens are required to be removed and replaced by the coarse protection screens when gas tankers are not carrying MARPOL Annex II NLS cargoes.

5.9.2.1 Flame Screens

The main purpose of a flame screen is to remove heat from a vent mast fire, and to prevent flame passing down the vent riser into the cargo tank.

Flame arresters and flame screens should be maintained in good condition and replaced if they become defective. Flame screens should never be painted. Particular devices should only be fitted to the vent mast when the ship is carrying cargoes that require them to be fitted.

The passage of cold vapour through a damp screen can cause freezing and blockage. If a flame screen becomes blocked, the passage of gas or vapour may be restricted dangerously. This may increase the pressure in the vent mast.

In some ship designs, the protection screen is permanently fixed in place at the vent mast outlet and the flame screen is bolted on top of it when carrying MARPOL Annex II NLS cargoes. When removed from the vent mast, flame screens should be stored properly in order to prevent damage and marked clearly so that they can be located readily when required.

SIGTTO: Liquified Gas Handling Principles on Ships and in Terminals. Fourth Edition.

2.6.2 Flammability/flammable range

Flammability within vapour clouds

Chemical cargoes have very low vapour pressures so, if a relief valve lifted, there is a potential risk of flammable mixtures existing in the vent mast for some time. Therefore, there is a serious risk of a flame entering the cargo tank in the event of a mast being struck by lightning, if flame screens are not fitted for certain chemical cargoes listed in the IGC Code.

TMSA KPI 6.1.2 requires that procedures for pre-operational tests and checks of cargo and bunkering equipment are in place for all vessel types within the fleet. Tests and checks of equipment may include:

- IGS and venting system

IMO: ISM Code

10.1 The Company should establish procedures to ensure that the ship is maintained in conformity with the provisions of the relevant rules and regulations and with any additional requirements which may be established by the Company.

IMO: IGC Code

8.2.15 Suitable protection screens of not more than 13 mm square mesh shall be fitted on vent outlets to prevent the ingress of extraneous objects without adversely affecting the flow. Other requirements for protection screens apply when carrying specific cargoes (see 17.9 and 17.21).

17.1 General

The requirements of this chapter are applicable where reference thereto is made in column "i" in the table of chapter 19. These requirements are additional to the general requirements of the Code.

17.9 Flame screens on vent outlets

When carrying a cargo referenced to this section, cargo tank vent outlets shall be provided with readily renewable and effective flame screens or safety heads of an approved type. Due attention shall be paid in the design of flame screens and vent heads, to the possibility of the blockage of these devices by the freezing of cargo vapour or by icing up in adverse weather conditions. Flame screens shall be removed and replaced by protection screens, in accordance with 8.2.15, when carrying cargoes not referenced to this section.

17.21 Carbon dioxide: high purity

17.21.2 There is a potential for the cargo to solidify in the event that a cargo tank relief valve, fitted in accordance with 8.2, fails in the open position. To avoid this, a means of isolating the cargo tank safety valves shall be provided and the requirements of 8.2.9.2 do not apply when carrying this carbon dioxide. Discharge piping from safety relief valves shall be designed so they remain free from obstructions that could cause clogging. Protective screens shall not be fitted to the outlets of relief valve discharge piping, so the requirements of 8.2.15 do not apply.

Inspection Guidance

When carrying MARPOL Annex II NLS cargoes, vent outlets connected to the cargo containment system should be fitted with readily renewable and effective flame screens or safety heads of an approved type. These cargoes include:

- Chlorine
- Diethyl ether
- Ethylene oxide/propylene oxide mixtures
- Isoprene
- Isopropylamine
- Monoethylamine
- Pentane
- Pentene
- Propylene oxide
- Vinyl ethyl ether
- Vinylidene chloride

When carrying carbon dioxide cargoes, vent outlets connected to the cargo containment system should **NOT** be fitted with either flame screens or protection screens.

For all other gas cargoes, vent outlets connected to the cargo containment system should be fitted with suitable protection screens of not more than 13 mm square mesh to prevent the ingress of extraneous objects without adversely affecting the flow.

Suggested Inspector Actions

- Verify from cargo records and/or maintenance plans that vent outlets from the cargo containment system are fitted with the correct flame screen or protection screen for the cargo being carried, and that these are in satisfactory condition.
- If flame screens or protection screens are available on board but not currently fitted, inspect the storage location to verify that they are stored properly in order to prevent damage and marked clearly so that they can be located readily when required.

Expected Evidence

- Cargo plans and/or maintenance records that demonstrated vent outlets from the cargo containment system were fitted with the correct flame screen or protection screen for the cargo being carried.
- Maintenance plans that demonstrated flame screens or protection screens had been inspected and maintained in a satisfactory condition.

Potential Grounds for a Negative Observation

- A vent outlet connected to the cargo containment system was not fitted with the required flame screen (or safety head) or protection screen for the cargo being carried.
- A flame screen or protection screen fitted to a vent outlet connected to the cargo containment system was not in satisfactory condition e.g., blocked or clogged, painted over or damaged.
- Flame screens not currently in use were not stored properly in order to prevent damage and/or marked clearly so that they could be located readily when required.
- A vessel issued with an International Pollution Prevention Certificate for the Carriage of Noxious Liquid Substances in Bulk (NLS) did not have the required flame screens (or safety heads) available on board to fit to the vent outlets connected to the cargo containment system.
- On a vessel carrying a carbon dioxide cargo, flame screens or protection screens were fitted to the vent outlets connected to the cargo containment system.

8.5. LNG

8.5.1. Were the Master and officers familiar with the company procedures for the operation, testing and calibration of the custody transfer measurement system (CTMS), and was the system in satisfactory condition?

Short Question Text
Custody transfer measurement system (CTMS)

Vessel Types
LNG

ROVIQ Sequence
Cargo Control Room

Publications
ICS: Tanker Safety Guide (Gas) - Third Edition
GIIGNL: LNG Custody transfer handbook 6th edition

Objective

To ensure the vessel is able to measure the quantity of energy loaded from production facilities, unloaded to a receiving terminal, or transferred to another LNG carrier during ship-to-ship operations.

Industry Guidance

ICS: Tanker Safety Guide (Gas) - Third Edition

6.20 Custody Transfer Measurement Systems

Cargo measurement is generally handled by the custody transfer measurement system (CTMS). The CTMS takes readings from the cargo level gauging system, together with measurements of cargo temperature, pressure and vessel trim and list, and calculates the volume of cargo on board, together with average cargo liquid and vapour temperatures at the time of the measurement. These data are taken as the official record of cargo quantity at the start or completion of loading or discharging operations and are used to calculate the amount of cargo transferred.

The accuracy of the CTMS is certified at the time of delivery of the ship and periodically once in service. It has become common practice to fully calibrate the system at each drydocking. At such time, the cargo tanks are entered and the level gauging system and associated pressure, temperature, trim and list measuring instruments are checked for proper operation and are fully calibrated.

With gas tanker drydocking cycles of up to 5 years, it is usual to undertake an in-service verification of the system's accuracy at the midpoint of a drydocking cycle. This verification can be undertaken without gas-freeing the ship or entering the cargo tanks.

SIGTTO: Liquified Gas Handling Principles on Ships and in Terminals. Fourth Edition.

4.11.6 LNG custody transfer measurement systems (CTMS)

For LNG carriers to meet the requirements for custody transfer, the cargo tanks are commonly calibrated by an independent measurer, and high accuracy level, temperature and vapour pressure measuring equipment is installed. This is often supported by data logging and cargo calculation facilities referred to as custody transfer measurement systems (CTMS) (see Section 8.8). Such systems are usually approved by local customs authorities.

The need for this equipment has developed from the LNG trade practice of relying on shipboard measurement of cargo to determine the quantity of product transferred between seller and buyer.

Accuracy is important in these circumstances since the quantities determined are also used as the basis for import duties and fiscal accounting. The GIIGNL publication, ‘LNG Custody Transfer Handbook’ (Reference 2.22), contains further details on LNG custody transfer.

Such a system normally includes:

- Level gauges
- temperature sensors
- trim and list indicator
- pressure gauges or sensors.

Some LNG ships are fitted with a means of determining cargo density. However, its value is more usually derived from the analysis of samples carried out in the terminal.

GIIGNL: LNG Custody transfer handbook Fifth edition – version 5.0

2.2. General scheme of the measurement operations

The objective is to measure the quantity of energy loaded from production facilities into an LNG carrier or unloaded from an LNG carrier to a receiving terminal. For ship-to-ship operations, the objective is to measure the quantity of energy transferred from one LNG carrier to another LNG carrier.

2.3.5. Periodic instruments recalibration

It is recommended that, unless it is specified by the fiscal authorities or by the Classification Society, Buyer and Seller agree on the periodicity of recalibration intervals, e.g. at each dry-docking.

TMSA KPI 6.2.2 requires that comprehensive procedures cover all aspects of cargo transfer operations for each type of vessel within the fleet. The transfer procedures are specific to the vessel type and cargo to be carried. These may include:

- Pre-arrival checks.
- Cargo survey and sampling.
- Gas and chemical specific operational procedures.

IMO: ISM Code

7. The Company should establish procedures, plans and instructions, including checklists as appropriate, for key shipboard operations concerning the safety of the personnel, ship and protection of the environment. The various tasks should be defined and assigned to qualified personnel.

Inspection Guidance

The vessel operator should have developed procedures for the operation, testing and calibration of the custody transfer measurement system (CTMS), including requirements for:

- Pre-arrival checks
- Servicing and periodic calibration

<u>Suggested Inspector Actions</u>

- Sight, and where necessary review the company procedures for the operation, testing and calibration of the custody transfer measurement system (CTMS).
- Review where necessary the:

    - Manufacturer’s manuals and instructions for the CTMS.
    - Records of pre-operational tests of the CTMS.
    - Service and calibration records for the CTMS.

- Interview the accompanying officer to verify their familiarity with the company procedures for the operation, testing and calibration of the CTMS.

Expected Evidence

- Company procedures for the operation, testing and calibration of the CTMS.
- Manufacturer’s manuals and instructions for the CTMS.
- Records of pre-operational tests of the CTMS.
- Service and calibration records for the CTMS

Potential Grounds for a Negative Observation

- There were no company procedures for the operation, testing and calibration of the custody transfer measurement system (CTMS).
- The accompanying officer was not familiar with the company procedures for the operation, testing and calibration of the custody transfer measurement system (CTMS).
- The CTMS had not been calibrated as required by company procedures.
- There was no current certificate of calibration for the CTMS available on board.
- There were no records of pre-operational tests of the CTMS.
- The CTMS had not been tested prior to the current loading/discharging operations.
- The CTMS was defective in any respect.

8.5.2. Were the Master and officers familiar with the company procedures for the operation, inspection, maintenance and testing of the Gas Combustion Unit (GCU)?

Short Question Text
Gas Combustion Unit (GCU)

Vessel Types
LNG

ROVIQ Sequence
Engine Room, Engine Control Room

Publications
IMO: ISM Code
IMO: IGC Code
ICS: Tanker Safety Guide (Gas) - Third Edition
SIGTTO: Liquified Gas Handling Principles on Ships and in Terminals. Fourth Edition.

Objective

To ensure the Gas Combustion Unit is properly operated, inspected, maintained, and tested.

Industry Guidance

SIGTTO: Liquified Gas Handling Principles on Ships and in Terminals. Fourth Edition.

4.8.3 Gas combustion units (GCU)

GCUs have been specifically developed for the controlled and safe oxidation of BOG from LNG carriers. The GCU system is required to safely oxidise excess BOG from the cargo tanks while maintaining exhaust gas temperatures at the stack outlet below 535 °C. Although this is 50°C below the auto-ignition temperature of methane in air, an industry standard of 450°C has been adopted.

A combination inert gas generator (IGG)/GCU is fitted on some newer LNG carriers, where the exhaust gas from the GCU is used to generate inert gas.

ICS: Tanker Safety Guide (Gas) - Third Edition

Definitions.

GCU Gas Combustion Unit: Equipment used to dispose of excess cargo vapour by thermal oxidation.

1.8 Pressure

Cargo tank pressure on LNG carriers is commonly controlled by:

- Burning the boil-off in the ship's propulsion machinery;
- Burning the boil-off in the gas combustion unit (GCU); or
- Reliquefaction of boil-off.

Appendix 3

Cargo Handling Plant and Equipment

A3.6 Gas Combustion Units

Methane, while an efficient and environmentally friendly fuel, is recognised as being a greenhouse gas if released unburned into the atmosphere. For this and various safety reasons, venting of methane boil off gas (BOG) is not allowed in ports and should be restricted at sea to emergency situations only, or for the very limited cases of cargo system gas-freeing operations.

A gas combustion unit (GCU) is typically fitted on board LNG carriers that have diesel propulsion. It provides a means for the safe and controlled combustion of BOG. On steam propelled LNG carriers, the main boilers provide this function.

The GCU is sized to handle 100% of the daily BOG volume of the fully laden LNG vessel. This is so that the GCU can handle all the BOG in case where it is not:

- Burned as fuel, for example when the vessel is idle; or
- Reliquefied because the vessel does not have a reliquefaction plant or because it is undergoing maintenance.

The GCU is typically located in the ship's funnel and is basically a large vertical tube inside which the BOG is burned. It utilises large fans to both cool the walls of the GCU combustion chamber and to provide air for proper combustion. It is designed so that the temperature of the exhaust gas leaving the top of the combustion chamber is 535° C or less. At this temperature it will not initiate combustion should cargo vapour be released and drift past the GCU exhaust.

The GCU has been designed to operate over a wide range of gas flow, including low gas flow during gas freeing operations. In such cases the gas flow is a combination of methane and inert gas. Methods of maintaining the flame to burn the methane in such a mixed flow are available from the original equipment manufacturer and include the use of igniters or maintaining a pilot flame using diesel oil.

TMSA KPI 6.1.1 requires that procedures for cargo, ballast, tank cleaning and bunkering operations are in place for all vessel types within the fleet.

IMO: ISM Code

7. The Company should establish procedures, plans and instructions, including checklists as appropriate, for key shipboard operations concerning the safety of the personnel, ship and protection of the environment. The various tasks involved should be defined and assigned to qualified personnel.

IMO: IGC Code

1.2.52 Thermal oxidation method means a system where the boil-off vapours are utilized as fuel for shipboard use or as a waste heat system subject to the provisions of chapter 16 or a system not using the gas as fuel complying with this Code.

Chapter 7 – Cargo Pressure/Temperature Control

7.4 Thermal oxidation of vapours

7.4.1 General

Maintaining the cargo tank pressure and temperature by means of thermal oxidation of cargo vapours, as defined by 1.2.52 and 16.2 shall be permitted only for LNG cargoes. In general:

1. thermal oxidation systems shall exhibit no externally visible flame and shall maintain the uptake exhaust temperature below 535ºC;
2. arrangement of spaces where oxidation systems are located shall comply with 16.3 and supply systems shall comply with 16.4; and
3. if waste gases coming from any other system are to be burnt, the oxidation system shall be designed to accommodate all anticipated feed gas compositions.

7.4.4 Safety

7.4.4.1 Suitable devices shall be installed and arranged to ensure that gas flow to the burner is cut off unless satisfactory ignition has been established and maintained.

7.4.4.2 Each oxidation system shall have provision to manually isolate its gas fuel supply from a safely accessible position.

7.4.4.3 Provision shall be made for automatic purging the gas supply piping to the burners by means of an inert gas, after the extinguishing of these burners.

7.4.4.4 In the case of flame failure of all operating burners for gas and oil or for a combination thereof, the combustion chambers of the oxidation system shall be automatically purged before relighting.

7.4.4.5 Arrangements shall be made to enable the combustion chamber to be manually purged.

Chapter 16 – Use of cargo as fuel.

16.1 General

Except as provided for in 16.9, methane (LNG) is the only cargo whose vapour or boil-off gas may be utilized in machinery spaces of category A, and, in these spaces, it may be utilized only in systems such as boilers, inert gas generators, internal combustion engines, gas combustion unit and gas turbines.

16.2 Use of cargo vapour as fuel

This section addresses the use of cargo vapour as fuel in systems such as boilers, inert gas generators, internal combustion engines, gas combustion unit and gas turbines.

16.2.1 For vaporized LNG, the fuel supply system shall comply with the requirements of 16.4.1, 16.4.2 and 16.4.3.

16.2.2 For vaporized LNG, gas consumers shall exhibit no visible flame and shall maintain the uptake exhaust temperature below 535^{o}C.

16.3 Arrangement of spaces containing gas consumers.

16.3.1 Spaces in which gas consumers are located shall be fitted with a mechanical ventilation system that is arranged to avoid areas where gas may accumulate, taking into account the density of the vapour and potential ignition sources. The ventilation system shall be separated from those serving other spaces.

16.3.2 Gas detectors shall be fitted in these spaces, particularly where air circulation is reduced. The gas detection system shall comply with the requirements of chapter 13.

16.3.3 Electrical equipment located in the double wall pipe or duct specified in 16.4.3 shall comply with the requirements of chapter 10.

16.3.4 All vents and bleed lines that may contain or be contaminated by gas fuel shall be routed to a safe location external to the machinery space and be fitted with a flame screen.

Inspection Guidance

The Gas Combustion Unit (GCU) should be operated in automatic mode to allow for failure of the reliquefaction unit or the loss of gas combustion in the machinery.

The vessel operator should have developed procedures for the operation, inspection, testing and maintenance of the GCU, including guidance on:

- Who is responsible for supervising the operation of the GCU.
- Identification of hazards presented by the operation of the GCU.
- Mitigation measures for hazards presented by the operation of the GCU.
- The actions to be taken in the event of the failure of the GCU in automatic mode, and procedures for manual operation if required.
- An inspection, maintenance and testing programme, which may form part of the vessel's maintenance plan, including the testing of alarms which may include:
    - Flame failure.
    - Loss of combustion air supply.
    - Loss of cooling air/dilution air supply.
    - BOG inlet temperature.
    - Combustion gas exit temperature (HH at 535ºC).
    - Methane gas concentration in gas pipe duct.
    - Loss of ventilation in gas pipe duct, alternatively loss of N2 pressure.

Some or all of these procedures may be contained in the Cargo System Operation Manual.

(Gas Combustion Units may also be called Thermal Oxidation Vapour Systems.)

This question will only be assigned where HVPQ 9.111 indicates that a GCU is provided.

Suggested Inspector Actions

- Sight, and where necessary review, the company procedures for the operation, inspection, maintenance and testing of the GCU.
- Review the records of inspection, maintenance and testing of the GCU and associated alarms.
- During the physical inspection of the vessel inspect the GCU and its associated equipment.
- Where necessary, compare the observed condition with the records of inspection, maintenance, testing of the Gas Combustion Unit.

- Interview the accompanying officer to verify their familiarity with the company procedures for the operation, inspection, testing and maintenance of the GCU.

Expected Evidence

- The company procedures for the operation, inspection, testing and maintenance of the GCU.
- Records of inspection, maintenance and testing of the GCU.

Potential Grounds for a Negative Observation

- There were no company procedures for the operation, inspection, maintenance and testing of the GCU.
- The accompanying officer was not familiar with:
    - Actions to be taken in the event of the failure of the GCU in automatic mode and procedures for manual operation if required.
    - Provision to manually isolate the gas fuel supply to the GCU from a safely accessible position.
    - Company procedures for testing GCU alarms which may include:
        - Flame failure.
        - Loss of combustion air supply.
        - Loss of cooling air/dilution air supply.
        - BOG inlet temperature.

    - Combustion gas exit temperature (HH at 535ºC).
    - Methane gas concentration in gas pipe duct.
    - Loss of ventilation in gas pipe duct, alternatively loss of N2 pressure.
- Inspections, tests and maintenance of the GCU had not been carried out in accordance with the company requirements.
- The GCU was defective in any respect.
- The GCU space mechanical ventilation system was defective in any respect.
- Gas detection fitted in the GCU space was defective in any respect.
- Fire detection fitted in the GCU space was defective in any respect.
- Vents or bleed lines that may contain or be contaminated by gas fuel from the GCU were not fitted with flame screens.

8.5.3. Were the Master and officers familiar with the company procedures for the inspection, maintenance and testing of the safety arrangements for the LNG gas fuel supply system, and were these arrangements in satisfactory condition?

Short Question Text
LNG gas fuel supply system

Vessel Types
LNG

ROVIQ Sequence
Engine Room, Engine Control Room

Publications
IMO: ISM Code
IMO: IGC Code
SIGTTO: Liquified Gas Handling Principles on Ships and in Terminals. Fourth Edition.

Objective

To ensure the safe supply of boil-off gas (BOG) to consumers in the engine-room such as boilers, inert gas generators, internal combustion engines, gas combustion unit and gas turbines.

Industry Guidance

SIGTTO: Liquified Gas Handling Principles on Ships and in Terminals. Fourth Edition.

4.8.1 LNG boil-off and vapour handling systems

Boil-off vapours are produced during cool-down, loading and during the loaded and ballast voyages. Typically, the low duty (LD) compressor handles the boil-off while on passage and the high-duty (HD) compressor handles cargo vapours produced during cool-down and loading, returning these vapours to shore.

When a ship is at sea the LD compressor collects the BOG from a header connected to each cargo tank, passing it through a heat exchanger and into the engine room. The pipeline is jacketed from the point at which it enters the engine-room or accommodation, up to either the boiler front or dual fuel engine, depending upon the propulsion system. The annular space (between the gas pipeline and its jacket) may be either pressurised with nitrogen or exhaust ventilated with air, giving at least 30 changes per hour. The gas pipeline will, ordinarily, be purged with nitrogen before and after gas burning operations.

There are a number of automatic protective devices built into the system to ensure safe operation and these will need to be regularly inspected and maintained. Protective systems include continuous monitoring for leakage and automatic shutdown in the event of system malfunction or leak detection. These systems are described in some detail in the IGC Code, and the provisions of the IGC Code should always be complied with in deference to anything in this publication.

TMSA KPI 4.1.1 requires that each vessel in the fleet is covered by a planned maintenance system and spare parts inventory which reflects the company’s maintenance strategy. The company identifies all equipment and machinery required to be included in the planned maintenance system, for example:

- Engine machinery
- Cargo handling machinery/equipment

IMO: ISM Code

10.1 The Company should establish procedures to ensure that the ship is maintained in conformity with the provisions of the relevant rules and regulations and with any additional requirements which may be established by the Company.

IMO: IGC Code

Chapter 16 Use of cargo as fuel.

16.2 Use of cargo vapour as fuel

This section addresses the use of cargo vapour as fuel in systems such as boilers, inert gas generators, internal combustion engines, gas combustion unit and gas turbines.

16.2.1 For vapourised LNG, the fuel supply system shall comply with the requirements of 16.4.1, 16.4.2 and 16.4.3.

16.2.2 For vapourised LNG, gas consumers shall exhibit no visible flame and shall maintain the uptake exhaust temperature below 535ºC.

16.3 Arrangement of spaces containing gas consumers.

16.3.1 Spaces in which gas consumers are located shall be fitted with a mechanical ventilation system that is arranged to avoid areas where gas may accumulate, taking into account the density of the vapour and potential ignition sources. The ventilation system shall be separated from those serving other spaces.

16.3.2 Gas detectors shall be fitted in these spaces, particularly where air circulation is reduced. The gas detection system shall comply with the requirements of chapter 13.

16.3.3 Electrical equipment located in the double wall pipe or duct specified in 16.4.3 shall comply with the requirements of chapter 10.

16.3.4 All vents and bleed lines that may contain or be contaminated by gas fuel shall be routed to a safe location external to the machinery space and be fitted with a flame screen.

16.4 Gas fuel supply

16.4.1 General

16.4.1.1 The requirements of this section shall apply to gas fuel supply piping outside the cargo area. Fuel piping shall not pass-through accommodation spaces, service spaces, electrical equipment rooms or control stations. The routeing of the pipeline shall take into account potential hazards, due to mechanical damage, in areas such as stores or machinery handling areas.

16.4.1.2 Provisions shall be made for inerting and gas freeing that portion of the gas fuel piping systems located in the machinery space.

16.4.2 Leak detection

Continuous monitoring and alarms shall be provided to indicate a leak in the piping system in enclosed spaces and shut down the relevant gas fuel supply.

16.4.3 Routeing of fuel supply pipes

Fuel piping may pass through or extend into enclosed spaces other than those mentioned in 16. 4.1, provided it fulfils one of the following conditions:

1. it is of a double wall design with the space between the concentric pipes pressurised with inert gas at a pressure greater than the gas fuel pressure. The master gas fuel valve, as required by 16 .4 .6, closes automatically upon loss of inert gas pressure; or
2. it is installed in a pipe or duct equipped with mechanical exhaust ventilation having a capacity of at least 30 air changes per hour and is arranged to maintain a pressure less than the atmospheric pressure. The mechanical ventilation is in accordance with chapter 12, as applicable. The ventilation is always in operation when there is fuel in the piping and the master gas fuel valve, as required by 16 .4 .6, closes automatically if the required air flow is not established and maintained by the exhaust ventilation system. The inlet or the duct may be from a non-hazardous machinery space, and the ventilation outlet is in a safe location.

16.4.4 Requirements for gas fuel with pressure greater than 1 MPa

16.4.4.1 Fuel delivery lines between the high-pressure fuel pumps/compressors and consumers shall be protected with a double walled piping system capable of containing a high-pressure line failure, taking into account the effects of both pressure and low temperature. A single-walled pipe in the cargo area up to the isolating valve(s) required by 16.4 .6 is acceptable.

16.4.4.2 The arrangement in 16 .4 .3 .2 may also be acceptable providing the pipe or trunk is capable of containing a high pressure line failure, according to the requirements of 16.4.7 and taking into account the effects of both pressure and possible low temperature and providing both inlet and exhaust of the outer pipe or trunk are in the cargo area.

16.4.5 Gas consumer isolation

The supply piping of each gas consumer unit shall be provided with gas fuel isolation by automatic double block and bleed, vented to a safe location, under both normal and emergency operation. The automatic valves shall be arranged to fail to the closed position on loss of actuating power. In a space containing multiple consumers, the shutdown of one shall not affect the gas supply to the others.

16.4.6 Spaces containing gas consumers.

16.4.6.1 It shall be possible to isolate the gas fuel supply to each individual space containing a gas consumer(s) or through which fuel gas supply piping is run, with an individual master valve, which is located within the cargo area. The isolation of gas fuel supply to a space shall not affect the gas supply to other spaces containing gas consumers if they are located in two or more spaces, and it shall not cause loss of propulsion or electrical power.

16.4.6.2 If the double barrier around the gas supply system is not continuous due to air inlets or other openings, or if there is any point where single failure will cause leakage into the space, the individual master valve for the space shall operate under the following circumstances:

1. automatically by:

    1. gas detection within the space;
    2. leak detection in the annular space of a double-walled pipe;
    3. leak detection in other compartments inside the space, containing single-walled gas piping;
    4. loss of ventilation in the annular space of a double-walled pipe; and
    5. loss of ventilation in other compartments inside the space, containing single-walled gas piping; and

2. manually from within the space, and at least one remote location.

16.4.6.3 If the double barrier around the gas supply system is continuous, an individual master valve located in the cargo area may be provided for each gas consumer inside the space. The individual master valve shall operate under the following circumstances:

1. automatically by:

    1. leak detection in the annular space of a double wall pipe served by that individual master valve;

2. leak detection in other compartments containing singled walled gas piping that is part of the supply system served by the individual master valve; and
3. loss of ventilation or loss of pressure in the annular space of a double walled pipe; and

2. manually from within the space, and at least one remote location.

16.4.8 Gas detection

Gas detection systems provided in accordance with the requirements of this chapter shall activate the alarm at 30% LFL and shut down the master gas fuel valve required by 16.4.6 at not more than 60% LFL (see 13.6.17)

Inspection Guidance

The vessel operator should have developed procedures for the inspection, testing and maintenance of the safety arrangements for the LNG gas fuel supply system to consumers in the engine-room such as boilers, inert gas generators, internal combustion engines, gas combustion unit and gas turbines. including:

- The inerting or ventilation systems for the annular space of double-wall fuel pipes.
- Leak detection systems.
- Ventilation systems in spaces containing BOG consumers.
- Gas detection systems in spaces containing BOG consumers.
- Automatic and manual operation of master valves to isolate gas fuel supply systems.
- Arrangements for inerting and gas freeing that portion of the gas fuel piping systems located in the machinery space.

Some or all of these procedures may be contained in the vessel's maintenance plan and/or Cargo System Operation Manual.

Suggested Inspector Actions

- Sight, and where necessary review, the company procedures for the inspection, testing and maintenance of the safety arrangements for the LNG gas fuel supply system to consumers in the engine-room such as boilers, inert gas generators, internal combustion engines, gas combustion unit and gas turbines.
- Review the records of inspection, maintenance and testing of the safety arrangements for the LNG gas fuel supply system.
- During the physical inspection of the vessel, inspect the LNG gas fuel supply system and the associated safety arrangements.
- Where necessary, compare the observed condition with the records of inspection, maintenance, testing of the safety arrangements for the LNG gas fuel supply system.

- Interview the accompanying officer to verify their familiarity with the company procedures for the inspection, testing and maintenance of the safety arrangements for the LNG gas fuel supply system to consumers in the engine-room such as boilers, inert gas generators, internal combustion engines, gas combustion unit and gas turbines.

Expected Evidence

- The company procedures for the inspection, testing and maintenance of the safety arrangements for the LNG gas fuel supply system to consumers in the engine-room such as boilers, inert gas generators, internal combustion engines, gas combustion unit and gas turbines.
- Records of inspection, maintenance and testing of the safety arrangements for the LNG gas fuel supply system.

Potential Grounds for a Negative Observation

- There were no company procedures for the inspection, maintenance and testing of the safety arrangements for the LNG gas fuel supply system to consumers in the engine-room such as boilers, inert gas generators, internal combustion engines, gas combustion unit and gas turbines.
- The accompanying officer was not familiar with the company procedures for the inspection, testing and maintenance of the safety arrangements for the LNG gas fuel supply system including:
    - The inerting or ventilation systems for the annular space of double-wall fuel pipes.
    - Leak detection systems.
    - Ventilation systems in spaces containing BOG consumers.
    - Gas detection systems in spaces containing BOG consumers.
    - Automatic and manual operation of master gas fuel valves.
    - Arrangements for inerting and gas freeing that portion of the gas fuel piping systems located in the machinery space.
- Inspections, tests and maintenance of the safety arrangements for the LNG gas fuel supply system had not been carried out in accordance with the company requirements.
- A gas detection system associated with the LNG gas fuel supply system was not set to activate the alarm at 30% LFL and shut down the master gas fuel valve at not more than 60% LFL.
- One or more of the safety arrangements for the LNG fuel supply system to consumers in the engine-room such as boilers, inert gas generators, internal combustion engines, gas combustion unit and gas turbines was inoperative or defective in any respect – give details.

8.5.4. Were the Master and officers familiar with the company procedures for protecting the hull structure from low temperature exposure, and was temperature monitoring and cofferdam heating equipment, where fitted, in satisfactory condition?

Short Question Text
Cold spots and cofferdam temperature monitoring and heating equipment.

Vessel Types
LNG

ROVIQ Sequence
Engine Room, Cargo Control Room, Main Deck

Publications
IMO: ISM Code
IMO: IGC Code
SIGTTO: Liquified Gas Handling Principles on Ships and in Terminals. Fourth Edition.
ICS: Tanker Safety Guide (Gas) - Third Edition
IACS: Interpretations of the IMO Gas Code GC23 (July 2018) (Corr.1 Dec 2019)

Objective

To ensure the hull is protected against the risk of brittle fracture in the event of a failure of the cargo containment or insulation.

Industry Guidance

ICS: Tanker Safety Guide (Gas) - Third Edition

Appendix 4 Cargo System Instrumentation

A4.5 Temperature Monitoring Equipment

Temperature sensors are fitted so that the temperatures of both the cargo and the structure around the cargo system can be monitored and also meet the requirements of the IGC Code and operational needs.

For all LNG carriers and for other ships intended for the carriage of cargoes at temperatures below -55°C the temperature of the steel around the cargo tanks has to be monitored to detect any lowering of hull steel temperature resulting from insulation failure.

SIGTTO: Liquified Gas Handling Principles on Ships and in Terminals. Fourth Edition.

4.11.4 Pressure and temperature monitoring

Where cargo is carried in tanks requiring a secondary barrier at a temperature of below minus 55°C (-55°C), the IGC Code requires temperature indicating devices within the insulation or on the hull structure adjacent to the containment system. The thermocouples will usually be set to provide adequate warning before the lowest temperature for the hull steel is approached.

9.5.2 Ship Emergency procedures

Incident plans

In developing plans for dealing with incidents, the following scenarios will commonly be considered:

- Loss of cofferdam space heating system

IACS: Interpretations of the IMO Gas Code GC23 (July 2018) (Corr.1 Dec 2019)

Cargo tank structure heating arrangement power supply

Interpretation

1. Heating system referred to in 4.19.1.6.1 (see below) is to be such that, in case of a single failure of a mechanical or electrical component in any part of the system, heating can be maintained at not less than 100% of the theoretical heat requirement.
2. Where the above requirements are met by duplication of the system components, i.e., heaters, glycol circulation pumps, electrical control panel, auxiliary boilers etc., all electrical components of at least one of the systems are to be supplied from the emergency source of electrical power.
3. Where duplication of the primary source of heat, e.g., oil-fired boiler is not feasible, alternative proposals can be accepted such as an electric heater capable of providing 100% of the theoretical heat requirement provided and supplied by an individual circuit arranged separately on the emergency switchboard. Other solutions may be considered towards satisfying the requirements of 4.19.1.6.1, provided a suitable risk assessment is conducted to the satisfaction of the Administration. The requirement in paragraph 2 of this interpretation continues to apply to all other electrical components in the system.

TMSA KPI 4.2.2 requires that cargo, void and ballast spaces are inspected to ensure their integrity is maintained.

The frequency of inspections is determined by the applicable regulations of class, flag state and national authorities. In addition, industry recommendations are taken into account. Guidance for inspection of compartments is provided, which may include industry/class publications. Records are compartment specific and made to a standard format that may include photographs as evidence of the compartment's condition.

IMO: ISM Code

10. Maintenance of the Ship and Equipment

10.1 The Company should establish procedures to ensure that the ship is maintained in conformity with the provisions of the relevant rules and regulations and with any additional requirements which may be established by the Company.

10.2 In meeting these requirements the Company should ensure that:

- inspections are held at appropriate intervals;
- any non-conformity is reported, with its possible cause, if known;
- appropriate corrective action is taken; and
- records of these activities are maintained.

IMO: IGC Code

Chapter 4 Cargo Containment

Goal

To ensure the safe containment of cargo under all design and operating conditions having regard to the nature of the cargo carried. This will include measures to:

.3 design for or protect the hull structure from low temperature exposure;

4.1 Definitions

4.1.1 A cold spot is a part of the hull or thermal insulation surface where a localized temperature decrease occurs with respect to the allowable minimum temperature of the hull or of its adjacent hull structure, or to design capabilities of cargo pressure/temperature control systems required in chapter 7.

4.19.1.6 The means of heating referred to in 4.19.1.5 shall comply with the following requirements:

1. the heating system shall be arranged so that, in the event of failure in any part of the system, standby heating can be maintained equal to not less than 100% of the theoretical heat requirement;
2. the heating system shall be considered as an essential auxiliary. All electrical components of at least one of the systems provided in accordance with 4.19.1.5.1 shall be supplied from the emergency source of electrical power; and
3. the design and construction of the heating system shall be included in the approval of the containment system by the Administration or recognized organization acting on its behalf.

13.7.2 Temperature indication devices

13.7.2.1 The number and position of temperature-indicating devices shall be appropriate to the design of the containment system and cargo operation requirements.

13.7.2.2 When cargo is carried in a cargo containment system with a secondary barrier, at a temperature lower than -55°C, temperature-indicating devices shall be provided within the insulation or on the hull structure adjacent to cargo containment systems. The devices shall give readings at regular intervals and, where applicable, alarm of temperatures approaching the lowest for which the hull steel is suitable.

Inspection Guidance

The vessel operator should have developed ship-specific procedures for monitoring the integrity of the containment system and protecting the hull structure from low temperature exposure that included:

- Roles and responsibilities.
- Guidance on the detection of cold spots by the inner hull temperature measurement system, and/or by visual inspection.
- Operation, alarm settings and maintenance of the inner hull temperature monitoring equipment.
- Operation and maintenance of the cofferdam heating equipment, where fitted.
- Actions to be taken if:
    - A cold spot is detected.
    - Cofferdam temperatures fall below 5°C or other stated temperature.
    - There is a failure of the cofferdam heating system.
- Records to be maintained of:
    - Inner hull temperature readings
    - Visual inspections of the inner hull structure for cold spots.
    - Cold spots identified and actions taken.

These procedures may form part of the Cargo System Operation Manual.

<u>Suggested Inspector Actions</u>

- Sight, and where necessary review, the company procedures for monitoring the integrity of the containment system and protecting the hull structure from low temperature exposure.
- Review the records of:
    - Inner hull temperature readings.
    - Visual inspections of the inner hull structure for cold spots.
    - Cold spots identified and actions taken.
- Verify that the inner hull temperature monitoring system is in satisfactory condition and alarms are correctly set.
- Where fitted, verify that the cofferdam heating system is in satisfactory condition.

- Interview the accompanying officer to verify their familiarity with the:
  - Operation, alarm settings and maintenance of the inner hull temperature monitoring equipment.
  - Operation and maintenance of the cofferdam heating equipment, where fitted.
  - Actions to be taken if:
    - A cold spot is detected.
    - Cofferdam temperatures fall below 5°C or other stated temperature.
    - There is a failure of the cofferdam heating system.

Expected Evidence

- Company procedures for monitoring the integrity of the containment system and protecting the hull structure from low temperature exposure.
- Records of:
  - Inner hull temperature readings
  - Visual inspections of the inner hull structure for cold spots.
  - Cold spots identified and actions taken.

Potential Grounds for a Negative Observation

- There were no company procedures for monitoring the integrity of the containment system and protecting the hull structure from low temperature exposure that included:
  - Roles and responsibilities.
  - Guidance on the detection of cold spots by the inner hull temperature measurement system, and/or by visual inspection.
  - Operation, alarm settings and maintenance of the inner hull temperature monitoring equipment.
  - Operation and maintenance of the cofferdam heating equipment, where fitted.
  - Actions to be taken if:
    - A cold spot is detected.
    - Cofferdam temperatures falls below 5°C or other stated temperature.
    - There is a failure of the cofferdam heating system.
  - Records to be maintained of:
    - Inner hull temperature readings
    - Visual inspections of the inner hull structure for cold spots.
    - Cold spots identified and actions taken.
- The accompanying officer was not familiar with the:
  - Operation, alarm settings and maintenance of the inner hull temperature monitoring equipment.
  - Operation and maintenance of the cofferdam heating equipment, where fitted.
  - Actions to be taken if:
    - A cold spot is detected.
    - Cofferdam temperatures fall below 5°C or other stated temperature.
    - There is a failure of the cofferdam heating system.
- There were no records of:
  - Inner hull temperature readings
  - Visual inspections of the inner hull structure for cold spots.
  - Cold spots identified and actions taken.
- The inner hull temperature measurement system was defective in any respect.
- The alarms on the inner hull temperature measurement system were not set as required by company procedures or inhibited.
- The cofferdam heating system was defective in any respect.
- The temperature in the cofferdam(s) had not been maintained as required by company procedures.

8.6. Gas (common to all vessels under IGC Code)

8.6.1. Were the Master and officers familiar with the company procedures for the maintenance, testing and setting of the independent cargo tank high-level and overfill alarms, and were these alarm systems fully operational and properly set?

Short Question Text
Cargo tank overfill alarms

Vessel Types
LPG, LNG

ROVIQ Sequence
Cargo Control Room, Main Deck

Publications
SIGTTO: ESD Systems 2nd Edition 2021
SIGTTO: Liquified Gas Handling Principles on Ships and in Terminals. Fourth Edition.
ICS: Tanker Safety Guide (Gas) - Third Edition

Objective

To ensure that independent cargo tank high-level and overfill alarms are always fully operational, properly set and used during all cargo loading, discharging and transfer operations.

Industry Guidance

ICS: Tanker Safety Guide (Gas) - Third Edition

Appendix 4 Cargo System Instrumentation

A4.3 Level Alarms, Automatic Shutdown and Emergency Shutdown.

To prevent over-filling of cargo tanks, high level alarms and automatic shutdown systems may be required depending on the cargo system. These systems may be activated by floats operating a switch device, capacitance probes, ultrasonic, radar or other approved devices.

Whatever system is used, the setpoint may be affected by the properties of the cargo, including density or dielectric constant, and adjustments should be made in accordance with the instructions provided by original equipment manufacturers.

Automatic shutdown systems require particular care. They are normally designed to shut the main cargo tank filling valve if the liquid level rises above the maximum level permitted by the IGC code.

A4.3.1 High Level Alarms

The IGC Code requires tanks to be fitted with high level alarms which are independent of any alarms fitted to the closed gauging system. The alarm should provide an audible and visual warning. The activation point should be set to alarm when the cargo is approaching the normal full condition of the tank.

A4.3.3 Automatic Shutdown Systems

An additional sensor operating independently of the high liquid level alarm should automatically actuate a shut-off valve to the tank in a manner that will both avoid excessive liquid pressure in the loading line and prevent the tank becoming liquid full.

Care should be taken to ensure that the activation point is set accurately, and that the operation of the device is checked by simulation whenever the system is decommissioned.

SIGTTO: Liquified Gas Handling Principles on Ships and in Terminals. Fourth Edition.

7.7.5 Commencement of loading

The use of automatic shutdown during topping off.

When topping off tanks, it is not considered prudent for ship staff to rely on the use of the high-high level alarm system to close the tank valve. The high-high level alarm may activate the closing of the filling valve prior to the planned innage being reached, due to movement of the surface of the cargo as a result of sloshing or through agitation of the cargo due to boiling off at the surface.

It is also considered prudent, during topping off and all critical valve and machinery operations, to have an observer present to view/confirm the closing of the filling valve, rather than having to rely on the remote indication of the cargo control/automation system.

SIGTTO: ESD Systems 2nd Edition 2021

4. Overflow Control and Vacuum Protection

Overflow control and vacuum protection are safety systems that perform a critical function on a ship. This section provides a brief overview of IGC Code requirements and gives recommendations for overflow control systems, including testing.

4.3 Testing of Overflow Control

The IGC Code has specific requirements for testing overflow control systems. A function test (IGC Code 13.3.6) should be carried out prior to cargo operations. This may be carried out as per the manufacturer’s instructions for a function test during the pre-arrival test.

A proof test is a periodic test that is carried out to detect dangerous hidden faults in a safety system. The overflow control system should be proof tested (IGC Code 13.3.5) by raising the cargo liquid level at specified intervals. The cargo operational manual (IGC Code 18.2) should include a description of the procedure to test the high-level alarm (IGC Code 13.3.5) in a safe and controlled manner.

Overflow control systems are typically based on a float, ultrasonic or radar design. For overflow control that is activated by a float-type sensor, failures caused by a damaged or punctured float can be identified by a proof test (IGC Code 13.3.5). This type of test is the actual scenario that the overflow control system is designed to protect against, so it also works for radar systems.

Any alternate means of testing should clearly demonstrate how it is equivalent to a proof test. It should document how it addresses the possible failure modes that are specific to the system design. This alternate means of testing should be documented and would, typically, require Flag State approval.

TMSA KPI 6.1.2 requires that procedures for pre-operational tests and checks of cargo and bunkering equipment are in place for all vessel types within the fleet. Tests and checks of equipment may include:

- Alarms and trips.
- Tank gauging equipment.

IMO: ISM Code

7. The Company should establish procedures, plans and instructions, including checklists as appropriate, for key shipboard operations concerning the safety of the personnel, ship and protection of the environment. The various tasks involved should be defined and assigned to qualified personnel.

IMO: IGC Code

13.3 Overflow control

13.3.1 Except as provided in 13.3.4, each cargo tank shall be fitted with a high liquid level alarm operating independently of other liquid level indicators and giving an audible and visual warning when activated.

13.3.2 An additional sensor operating independently of the high liquid level alarm shall automatically actuate a shut off valve in a manner that will both avoid excessive liquid pressure in the loading line and prevent the tank from becoming liquid full.

13.3 .3 The emergency shutdown valve referred to in 5.5 and 18.10 (i.e. *cargo emergency shut-down or ESD)* may be used for this purpose. If another valve is used for this purpose, the same information as referred to in 18.10.2.1.3 shall be available on board. During loading, whenever the use of these valves may possibly create a potential excess pressure surge in the loading system, alternative arrangements such as limiting the loading rate shall be used.

13.3.4 The high liquid level alarm and automatic shut off of cargo tank filling need not be required, when the cargo tank:

- .1 is a pressure tank with the volume not more than 200 m3; or
- .2 is designed to withstand the maximum possible pressure during the loading operation, and such pressure is below that of the set pressure of the cargo tank relief valve.

13.3.5 The position of the sensors in the tank shall be capable of being verified before commissioning. At the first occasion of full loading after delivery and after each dry-docking, testing of high-level alarms shall be conducted by raising the cargo liquid level in the cargo tank to the alarm point.

13.3.6 All elements of the level alarms, including the electrical circuit on the sensor(s), of the high, and overfill alarms, shall be capable of being functionally tested. System shall be tested prior to cargo operation in accordance with 18.6.2.

13.3 .7 When arrangements are provided for overriding the overflow control system, they shall be such that inadvertent operation is prevented. When this override is operated, continuous visual indication shall be given at the relevant control station(s) and the navigation bridge.

15.1.2 Loading limit (LL) means the maximum allowable liquid volume relative to the tank volume to which the tank may be loaded.

15.6.1 A document shall be provided to the ship, specifying the maximum allowable loading limits for each cargo tank and product, at each applicable loading temperature and maximum reference temperature. The information in this document shall be approved by the Administration or recognised organization acting on its behalf.

15.6.2 Pressures at which the PRVs have been set shall also be stated in the document.

15.6.3 A copy of the above document shall be permanently kept on board by the master.

18.6.2 Essential cargo handling controls and alarms shall be checked and tested prior to cargo transfer operations.

IMO: SOLAS

Chapter II-2 Regulation 11

6.3.1 Preventive measures against liquid rising in the venting system

Provisions shall be made to guard against liquid rising in the venting system to a height which would exceed the design head of cargo tanks. This shall be accomplished by high-level alarms or overflow control systems or other equivalent means, together with independent gauging devices and cargo tank filling procedures. For the purposes of this regulation, spill valves are not considered equivalent to an overflow system.

Inspection Guidance

This question relates only to those alarm systems that are independent of the tank gauging system, and for the purposes of this question, “overfill alarms” means those alarm systems variously described as:

- Overflow alarms.
- Overflow control systems.
- Automatic shut off systems.
- Automatic shutdown systems.
- High-high level alarms
- Extra-high-level alarms.

The vessel operator should have developed procedures for the maintenance, setting and testing of the cargo tank high-level and overfill alarm systems, including:

- The mandatory use of the alarms during all cargo tank loading, discharging and transfer operations.
- Set points for all tank level alarms.
- Testing procedures and frequency.
- Records of testing and maintenance to be kept.
- Guidance on the operation of shipboard automatic closing valves.
- Controls on overriding of overfill alarms/automatic shutdown systems.
- Procedures, based on risk assessment, to enable continued cargo loading, discharge or transfer operations in the event of a failure of the cargo tank high-level or overfill alarm system, or a single alarm for an individual cargo tank.

The instructions within the manufacturer’s manuals and the vessel’s maintenance plan may form part of the procedures.

The overfill alarm system should only be overridden in exceptional circumstances, such as if the tank has been overfilled and it is necessary to bypass the overflow control system to discharge the tank. Such systems are occasionally overridden at sea during reliquefication and in bad weather conditions.

(See IGC 13.3.4 above for those pressurised vessels where these alarm systems are not required. In older GC vessels, the overfill alarm sensor does not need to be independent of the high-level sensor)

Suggested Inspector Actions

- Sight, and where necessary review the company procedures for the maintenance, setting and testing of the cargo tank high-level and overfill alarm systems.
- Sight and where necessary review the document specifying the maximum allowable loading limits for each cargo tank and product at each applicable loading temperature and maximum reference temperature.
- Review the records of testing and maintenance of the cargo tank high-level and overfill alarm systems.
- Inspect the alarm indicator panels in the cargo control room or position and verify:
    - The panel was switched on with all cargo tanks being monitored.
    - The audible and visible alarms were operational.
- Inspect the alarm equipment on deck including the audible and visible alarm fittings, where fitted.

- Interview the accompanying officer to verify their familiarity with:
    - The company procedures for the maintenance, setting and testing of the cargo tank high-level and overfill alarm systems.
    - The circumstances under which the cargo tank high-level and overfill alarm systems or individual tanks alarms may be isolated and the safeguards to ensure they were always in operation during cargo transfer operations.

Expected Evidence

- The company procedures for the maintenance, setting and testing of the cargo tank high-level and overfill alarm systems.
- Records of the maintenance, testing and setting of the cargo tank high-level and overfill alarm systems.
- The document specifying the maximum allowable loading limits for each cargo tank and product, at each applicable loading temperature and maximum reference temperature.

Potential Grounds for a Negative Observation

- There were no company procedures for the maintenance, testing and setting of the cargo tank high-level and overfill alarm systems.
- The company procedures for the maintenance, testing and setting of the cargo tank high-level and overfill alarm systems did not include:
    - The mandatory use of the alarms during all loading, discharging and transfer operations.
    - Set points for all alarms.
    - Testing procedures and frequency.
    - Records of testing and maintenance to be kept.
    - Guidance on the operation of shipboard automatic closing valves.
    - Controls on overriding of overfill alarms/automatic shutdown systems.
    - Procedure, based on risk assessment, to enable continued cargo loading, discharge or transfer operations in the event of a failure of the cargo tank high-level or overfill alarm system or a single alarm for an individual cargo tank.
- The accompanying officer was not familiar with:
    - The company procedures for the maintenance, testing and setting of the cargo tank high-level and overfill alarm systems.
    - The circumstances under which the cargo tank high-level and overfill alarm systems or individual cargo tank alarms may be overridden and the safeguards to ensure they were always in operation during cargo transfer operations.
- There were no records of testing and maintenance of the cargo tank high-level and overfill alarm systems, including tests:
    - Prior to cargo operations.
    - After dry-docking or decommissioning.
- High-level and/or overfill alarms had not been regularly tested in accordance with the manufacturer's instructions.
- The document specifying the maximum allowable loading limits for each cargo tank and product, at each applicable loading temperature and maximum reference temperature was not available on board.
- Overfill alarms were set above the applicable maximum allowable loading limit for a cargo tank.
- High-level and/or overfill alarms were not set at the level required by company procedures.
- High-level and/or overfill alarms were not in operation at the time of inspection, during loading, discharging or transfer operations.
- The high-level or overfill alarm system had been overridden during cargo transfer operations.
- The high-level or overfill alarm system was defective in any respect.

8.6.2. Were the Master, officers, and ratings involved with cargo operations, familiar with the functions of the vessel's cargo transfer Emergency Shut Down (ESD) systems, and was the equipment in good working order, regularly inspected, tested and maintained?

Short Question Text
Cargo transfer Emergency Shut Down (ESD)

Vessel Types
LPG, LNG

ROVIQ Sequence
Bridge, Cargo Control Room, Main Deck, Cargo Manifold, Interview - Deck Rating

Publications
IMO: IGC Code
SIGTTO: ESD Systems 2nd Edition 2021

Objective

To ensure that crewmembers can respond effectively to an emergency situation during cargo transfer operations in accordance with the shipboard emergency plan.

Industry Guidance

SIGTTO: ESD Systems 2nd Edition 2021

2.3 System Availability

ESD is an important safety system, and it should always be active when there is any cargo on the ship. The ESD system should only be switched off for short periods of time for necessary maintenance. It may be inhibited temporarily for testing, but this should be for the minimum duration possible.

If the design of a safety system or ESD system leads the operator to switch it off unintentionally or inappropriately then the reason for this should be thoroughly investigated. This should include whether the design of the system can be adjusted to reduce the risk of this occurring again.

The ESD system should be designed to clearly indicate when it is inhibited or switched off and it should not permit cargo transfer operations in these conditions.

Cargo control systems should be designed to not permit cargo transfer operations unless the ESD system and ship shore link (SSL) are connected and active. The status of the ESD and SSL systems should be clearly visible in the cargo control room (CCR). Ship and terminal operators should ensure that all relevant safety systems, including ESD and SSL systems, are fully operational and active during cargo transfer operations

2.4 Alarm Management Lifecycle

The requirements of the IGC Code are prescriptive in nature and the scope of the safety functions it covers may be sufficient for most gas carriers. However, for some designs of gas carriers, additional safety functions may be advisable. It is important to review the need for additional safety functions in a structured manner and follow industry standard best practice.

Human factors should also be considered and potential dangers such as alarm flooding should be avoided. Any change to the alarm system on the ship should be carried out using the principles of the alarm management lifecycle in IEC 626829 . Any changes to the alarm system should only be made by undergoing a documented process that involves a full hazard and operability (HAZOP) study and a management of change process.

2.5 Maintenance and Testing

Chapter 13 of the IGC Code requires automation systems to be designed, installed and tested in accordance with recognised standards, with particular reference to IEC 60092-504. This provides guidance on the requirements for documentation, maintenance and testing.

Safety systems should be designed to ensure that it is practical to test all parts of the system. Operation and maintenance documentation should provide clear guidance on how to test the safety system and the required intervals for this to ensure that the safety system is maintained in operational condition.

The IGC Code (18.6.2 and 18.10.5) requires cargo ESD and alarm systems to be tested before cargo transfer. This is typically carried out as part of pre-arrival tests, in the 24 hours before berthing. The SSL is tested after connection as part of pre-transfer tests.

TMSA KPI 6.1.2 requires that procedures for pre-operational tests and checks of cargo and bunkering equipment are in place for all vessel types within the fleet. Tests and checks of equipment may include:

- ESD system operation.

IMO: ISM Code

7. The Company should establish procedures, plans and instructions, including checklists as appropriate, for key shipboard operations concerning the safety of the personnel, ship and protection of the environment. The various tasks involved should be defined and assigned to qualified personnel.

IMO: IGC Code

18.10 Cargo emergency shutdown (ESD) system

18.10.1.1 A cargo emergency shutdown system shall be fitted to stop cargo flow in the event of an emergency, either internally within the ship, or during cargo transfer to ship or shore. The design of the ESD system shall avoid the potential generation of surge pressures within cargo transfer pipe work (see 18.10.2.1.4).

18.10.1.5 A functional flow chart of the ESD system and related systems shall be provided in the cargo control station and on the navigation bridge.

18.10.2 ESD valve requirements

18.10.2.1.3 ESD valves in liquid piping systems shall close fully and smoothly within 30 s of actuation. Information about the closure time of the valves and their operating characteristics shall be available on board, and the closing time shall be verifiable and repeatable.

18.10.3 ESD system controls

18.10.3.1 As a minimum, the ESD system shall be capable of manual operation by a single control on the bridge and either in the control position required by 13.1.2 or the cargo control room, if installed, and no less than two locations in the cargo area.

18.10.3.2 The ESD system shall be automatically activated on detection of a fire on the weather decks of the cargo area and/or cargo machinery spaces. As a minimum, the method of detection used on the weather decks shall cover the liquid and vapour domes of the cargo tanks, the cargo manifolds and areas where liquid piping is dismantled regularly. Detection may be by means of fusible elements designed to melt at temperatures between 98°C and 104°C, or by area fire detection methods.

18.10.3.3 Cargo machinery that is running shall be stopped by activation of the ESD system in accordance with the cause and effect matrix in table 18.1.

18.10.3.4 The ESD control system shall be configured so as to enable the high-level testing required in 13.3.5 to be carried out in a safe and controlled manner. For the purpose of the testing, cargo pumps may be operated while the overflow control system is overridden. Procedures for level alarm testing and re-setting of the ESD system after completion of the high-level alarm testing shall be included in the operation manual required by 18.2.1.

18.10.5 Pre-operations testing

Cargo emergency shutdown and alarm systems involved in cargo transfer shall be checked and tested before cargo handling operations begin

18.2 Cargo operations manuals

18.2.1 The ship shall be provided with copies of suitably detailed cargo system operation manuals approved by the Administration such that trained personnel can safely operate the ship with due regard to the hazards and properties of the cargoes that are permitted to be carried.

18.2.2 The content of the manuals shall include, but not be limited to:

.9 emergency shutdown systems.

Inspection Guidance

The vessel operator should have developed procedures for the operation, inspection, maintenance and testing of the vessel's cargo transfer emergency shutdown (ESD) systems which defined:

- The functions and operation of the ESD systems.
- The actions to take in the event of an ESD system failure.
- The requirement for functional flowcharts (cause-effect) for the ESD system to be available in the cargo control station and on the navigation bridge.
- The contingency plans in the event of non-availability of the ESD ship/shore link system, if fitted.
- The frequency and method of inspection, maintenance and testing of the ESD systems, including pre-operational checks.
- The circumstances in which any part of the ESD system may be inhibited, such as for the purpose of system testing.
- The person responsible for authorising the inhibiting any part of the ESD system and the controls required to ensure that all parts of the ESD system are reinstated as soon as the need to inhibit is over.

The Cargo System Operation Manual may form part of these procedures.

The Master and officers should be familiar with the ESD systems installed on their vessel, and its initiators, which may include:

- Emergency push-buttons.
- Fire detection on deck or in a compressor house.
- High levels in cargo tanks.
- A signal from a ship/shore link.
- Loss of motive power to ESD valves.
- Main electric power failure (blackout).
- Tank level alarm override.

And its shutdown actions, which may include:

- Cargo pumps/cargo booster pumps.
- Spray/stripping pumps.
- Vapour return compressors.

- Fuel gas compressors.
- Reliquefication plant including condensate return pumps if fitted.
- Gas combustion unit.
- ESD valves.
- Signal to ship/shore link.

Fusible plugs may be used for the required fire detection on deck. Fusible elements should not be painted over as this might affect the temperature at which they will operate.

Ratings should be familiar with the location of the manual ESD system controls and the circumstances in which they should be activated.

Suggested Inspector Actions

- Sight, and where necessary review, the company procedures that defined the operation, inspection, maintenance and testing of the vessel's cargo transfer emergency shutdown (ESD) systems.
- Sight and review the checklists used to test the ESD system before the most recent cargo operation.
- Sight and review the checklists used to verify the timing and sequencing of ESD system functions.
- If necessary, review the records of inspections, maintenance and tests carried out contained within the planned maintenance system.
- Review the functional flowcharts (cause-effect) for the ESD system.
- Inspect the means of fire detection on the weather deck i.e. fusible plugs or area fire detection.
- Inspect the emergency push buttons on the bridge, in the cargo control room and on deck.
- Inspect an ESD manifold valve and verify that the connection between the ESD valve position indicator and the ESD valve actuator is intact

- Interview the accompanying officer to verify their familiarity with:
  - The purpose, operation, and testing of the ESD systems.
  - The functional flowcharts (cause-effect) for the ESD system.
  - The ESD valve closing timings.
  - The circumstances in which any part of the ESD may be inhibited, the person who may authorise the inhibiting and the controls in place to ensure that the ESD system is reinstated immediately after the need to inhibit is over.
- Interview a rating involved in cargo operations and verify their familiarity with the location of the manual ESD controls and circumstances in which the ESD system should be manually activated.

Expected Evidence

- The company procedures for the operation, inspection, maintenance and testing of the vessel's ESD systems.
- The checklist used to conduct the pre-arrival tests on the ESD system prior to the previous cargo transfer operation.
- The checklist used to verify the timing and sequencing of the ESD system functions.
- Records of the inspection, maintenance and testing of the vessel's ESD systems.
- Functional flowcharts (cause-effect) for the cargo ESD system.
- The Cargo System Operation Manual(s), describing the ESD systems.

Potential Grounds for a Negative Observation

- There were no company procedures for the operation, inspection, maintenance and testing of the vessel's cargo ESD systems.
- The Master, officers and ratings involved in cargo operations were not familiar with the vessel's ESD systems at a depth relevant to their seniority.

- A functional flowchart (cause-effect) of the ESD systems was not posted in the cargo control room and on the bridge.
- The status of the ESD and ship/shore link (SSL) systems was not clearly visible in the cargo control room (CCR).
- Area fire detection on the weather deck, if fitted, was not fully functional.
- Fusible elements were painted over.
- Access to the emergency push buttons was obstructed, or they were not ready for immediate use.
- The Cargo System Operation Manual did not describe the ESD system.
- The Cargo System Operation Manual did not contain procedures for re-setting of the ESD system after completion of high-level alarm testing.
- There were no records of checks and tests of the ESD systems before cargo handling operations began.
- There were no records of checks to verify the timing and sequencing of the ESD system functions.
- Information about the closure time of the ESD valves and their operating characteristics was not available on board,
- Records of inspections, maintenance and tests carried out were incomplete.
- The accompanying officer was not familiar with:
    - The purpose, operation and testing of the ESD systems.
    - The functional flowcharts (cause-effect) for the ESD system.
    - The ESD valve closing timings.
    - The circumstances in which any part of the ESD may be inhibited, the person who may authorise the inhibiting and the controls in place to ensure that the ESD system is reinstated immediately after the need to inhibit is over.
- An interviewed rating, involved as part of the cargo watch, was unfamiliar with the location of the ESD system manual controls and/or the circumstances in which manual activation of the ESD should take place.
- Inspection of the ESD systems indicated that actions recorded in the planned maintenance system had not in fact taken place.
- The ESD systems were defective in any respect.
- Company procedures did not include a contingency plan for the circumstances where the ESD link system, if fitted, was not available.

8.6.3. Were the Master and officers familiar with the company procedures for the inspection, maintenance, testing and setting of the cargo tank relief valves?

Short Question Text
Cargo tank relief valves

Vessel Types
LPG, LNG

ROVIQ Sequence
Cargo Control Room, Main Deck

Publications
IMO: ISM Code
IMO: IGC Code
SIGTTO: Liquified Gas Handling Principles on Ships and in Terminals. Fourth Edition.
ICS: Tanker Safety Guide (Gas) - Third Edition
SIGTTO: Recommendations for Relief Valves on Gas Carriers 3rd Ed 2020

Objective

To ensure cargo tank relief valves are properly inspected, maintained, tested, and set.

Industry Guidance

SIGTTO: Liquified Gas Handling Principles on Ships and in Terminals. Fourth Edition.

4.1.8 Relief valves for cargo tanks and pipelines

The IGC Code requires at least two pressure relief valves of equal capacity to be fitted to any cargo or deck tank.

On some liquefied gas carriers, adjustable settings for pilot operated relief valves may be used to provide a higher than normal set pressure (i.e. the sea setting) (but not exceeding the MARVS). On LPG carriers this is known as the ‘harbour setting’ and allows a higher pressure within the tank during loading only. On Type C tanks, pilot operated relief valves can be adjusted, if necessary, to reduce the MARVS to comply with the United States Coast Guard (USCG) regulations.

Type C tanks on recent liquefied gas carriers, which fall under the American Society of Mechanical Engineers (ASME) Pressure Vessel Code Div. II (Ref 2.18), may only require one MARVS setting as these more recent ASME requirements align with the IGC Code requirements. The original ASME regulations impose more stringent safety factors for pressure vessels design than the IGC Code requirements.

Whenever such valves are used for more than one pressure setting, it is common for a proper record to be kept of changes to the pilot valve springs. The pilot assembly cap will always be resealed after such changes, which helps to ensure that no unauthorised adjustments can be made. When relief valve settings are changed, the high-pressure alarm will usually be adjusted. Generally, the valve will be tagged to show the set pressure on the fitted valve, both in the cargo control room and on the valve itself. Commonly, auxiliary setting devices used for changing the pressure settings will be connected to the same valve, as they are calibrated to be so. Proper records to this effect should be maintained on board.

Cargo tank relief valves exhaust to atmosphere via a vent line to a vent mast riser. Vent riser drains should usually be provided and be checked regularly to ensure no accumulation of rainwater in the riser. Any accumulation of water has the effect of altering the relief valve operation due to increased back pressure and may cause blockage if frozen.

SIGTTO: Recommendations for Relief Valves on Gas Carriers 3rd Ed 2020

1.1 Introduction

Relief valves perform a safety critical function. Proper design and robust maintenance procedures are essential to ensure that this equipment will function as required.

3.3 Installation Design

Depending on the grades of stainless steel used in construction, painting for corrosion prevention may or may not be required. If it is necessary to paint the relief valves, the coatings should be applied carefully, as numerous malfunctions of relief valves have been caused by the blockage of small orifices by paint.

3.4 Materials

While atmospheric corrosion is a concern, there are also risks of galvanic corrosion, particularly for tanks made of aluminium. This is because the aluminium piping flange connected to the inlet of the stainless-steel relief valve will cause corrosion of the aluminium, as both materials have widely different electrode potentials.

4.2 Operational

Ship staff responsible for the maintenance and operation of relief valves are recommended to attend a manufacturers training course.

Ship staff should be familiar with the operation of the relief valves fitted on their ship. In particular they should be aware of what to do if a relief valve malfunctions.

4.3.1 Maintenance frequency

Cargo tank relief valve – pilot operated or spring type.

During each loading

- Visual inspection for leaks from external fittings and connections.

Continuously monitored.

- Seat leakage detection to be carried out by way of gas detection in vent line if fitted, and visual check for icing of outlet or by observing *shimmering* at vent outlet.

Every six months

- Verify integrity of security seals.
- Visual inspection of external services for presence of corrosion or stress cracks.
- Ensure all external bolting, fasteners and mounting brackets are torqued to manufacturer’s instructions.

Annually

- Verify free operation using field test kit.

Special survey (every five years)

- Verify calibration of all spring settings, pilots and auxiliary setter devices.
- Verify proper operation and seat tightness of all valves in a clean environment with proper testing arrangements.
- Inspect internals of valves for wear, corrosion and the presence of soft seal lubricants. Any adverse signs shall require inspection of all valves and maintenance as necessary.
- Verify valve maintenance history is logged and updated as necessary.

- Advise manufacturer of actions taken so as to allow them to update their records.

4.5 Routine Testing

Cargo tank relief valves are critical safety equipment and should be tested as per manufacturer’s instructions. Manufacturers should provide clear instructions on the interval and procedure for testing. The testing should include, but not necessarily be limited to, the pilot and the main valve.

The testing routine should be included in the ships planned maintenance routines. Testing of cargo tank relief valves should only be carried out under a permit to work. Testing may require the use of a field test kit.

ICS: Tanker Safety Guide (Gas) - Third Edition

Appendix 3 Cargo Handling Plant and Equipment

A3.12 Vent and Purge Masts

Discharges from relief valves and purging systems are carried to the atmosphere through vent masts, the outlets of which are designed to promote vapour dispersal and reduce the risk of flammable mixtures being produced.

Vents are likely to collect water and should be drained frequently to guard against freezing due to the discharge of cold vapour. Drain should never be left open, otherwise vapour could be discharged at low level. Some vent masts have provision to extinguish flames resulting from a lightning strike and a connection for the injection of carbon dioxide or inert gas.

TMSA KPI 6.1.2 requires that procedures for pre-operational tests and checks of cargo and bunkering equipment are in place for all vessel types within the fleet. Tests and checks of equipment may include:

- IGS and venting system

IMO: ISM Code

10 Maintenance of the Ship and Equipment

10.1 The Company should establish procedures to ensure that the ship is maintained in conformity with the provisions of the relevant rules and regulations and with any additional requirements which may be established by the Company.

IMO: IGC Code

5.6.4 Cargo tank vent piping systems

The pressure relief system shall be connected to a vent piping system designed to minimize the possibility of cargo vapour accumulating on the decks, or entering accommodation spaces, service spaces, control stations and machinery spaces, or other spaces where it may create a dangerous condition.

8.1 General

All cargo tanks shall be provided with a pressure relief system appropriate to the design of the cargo containment system and the cargo being carried.

8.2 Pressure relief systems

8.2.1 Cargo tanks, including deck tanks, shall be fitted with a minimum of two pressure relief valves (PRVs), each being of equal size within manufacturer's tolerances and suitably designed and constructed for the prescribed service.

8.2.3 The setting of the PRVs shall not be higher than the vapour pressure that has been used in the design of the tank. Where two or more PRVs are fitted, valves comprising not more than 50% of the total relieving capacity may be set at a pressure up to 5% above MARVS to allow sequential lifting, minimalizing unnecessary release of vapour.

8.2.6 PRVs shall be set and sealed by the Administration or recognised organization acting on its behalf, and a record of this action, including the valves' set pressure, shall be retained on board the ship.

8.2.7 Cargo tanks may be permitted to have more than one relief valve set pressure in the following cases:

1. Installing two or more properly set and sealed PRVs and providing means, as necessary, for isolating the valves not in use from the cargo tank; or
2. installing relief valves whose settings may be changed by the use of a previously approved device not requiring pressure testing to verify the new set pressure. All other valve adjustments shall be sealed.

8.2.8 Changing the set pressure under the provisions of 8.2 .7 and the corresponding resetting of the alarms referred to in 13.4 .2 shall be carried out under the supervision of the master in accordance with approved procedures and as specified in the ship's operating manual. Changes in set pressure shall be recorded in the ship's log and a sign shall be posted in the cargo control room, if provided, and at each relief valve, stating the set pressure.

8.2.9 In the event of a failure of a cargo tank installed PRV, a safe means of emergency isolation shall be available:

1. Procedures shall be provided and included in the cargo operations manual (see 18.2)
2. The procedures shall allow only one of the cargo tank installed PRVs to be isolated.
3. Isolation of the PRV shall be carried out under the supervision of the master. This action shall be recorded in the ships log and a sign posted in the cargo control room, if provided, and at the PRV.
4. The tank shall not be loaded until the full relieving capacity is restored.

8.2.10 Each PRV installed on a cargo tank shall be connected to a venting system, which shall be:

1. So constructed that the discharge will be unimpeded and directed vertically upwards at the exit;
2. Arranged to minimise the possibility of water or snow entering the vent system;

8.2.14 In the vent piping system, means for draining liquid from places where it may accumulate shall be provided. The PRVs and piping shall be arranged so that liquid can, under no circumstances, accumulate in or near the PRVs.

Inspection Guidance

The vessel operator should have developed procedures for the inspection, maintenance, testing and setting of the cargo tank relief valves, including:

- Changing the set pressure of the cargo tank relief valves and the corresponding resetting of alarms, including record keeping.
- The actions to take in the event of a cargo tank relief valve malfunction including emergency isolation.
- Training requirements for the officer responsible for the maintenance and operation of the cargo relief valves.
- An inspection, maintenance and testing programme, which may form part of the vessel's maintenance plan, including:
    - Checks prior each cargo operation.
    - Six-monthly visual inspections.
    - Annual verification of free operation using a field test kit, where applicable according to the vessel operational manual and/or instructions.
    - Five-yearly overhaul.

Where the operation of the cargo tank venting system is automated, procedures should give guidance on the correct setting for each part of the voyage, loading, discharging, loaded passage etc.

Some or all of these procedures may be contained in the Cargo System Operation Manual.

Suggested Inspector Actions

- Sight, and where necessary review, the company procedures for the inspection, maintenance, testing and setting of cargo tank relief valves.
- Review the records of inspection, maintenance and testing of the cargo tank relief valves.
- Review the records for any change of settings of cargo tank relief valves.
- During the inspection, observe the disposition and visual condition of the cargo tank relief valves and the venting arrangements.
- Where necessary, compare the observed condition with the records of inspection, maintenance and testing of cargo tank relief valves.

- Interview the accompanying officer to verify their familiarity with the company procedures for:
    - Changing the set pressure of the cargo tank relief valves and the corresponding resetting of alarms, including record keeping.
    - Inspection, maintenance and testing of the cargo tank relief valves.
    - Actions to take in the event of a cargo tank relief valve malfunction including emergency isolation.
    - Where fitted, the operation of the automated cargo tank venting system.

Expected Evidence

- The company procedures for the inspection, maintenance, testing and setting of the cargo tank relief valves.
- Records of inspection, maintenance, testing and setting of the cargo tank relief valves.
- Records for any change of settings of cargo tank relief valves.
- Evidence of training for the officer responsible for the maintenance and operation of the cargo tank relief valves.

Potential Grounds for a Negative Observation

- There were no company procedures for the inspection, maintenance, testing and setting of the cargo tank relief valves.
- The accompanying officer was not familiar with the company procedures for:
    - Changing the set pressure of the cargo tank relief valves and the corresponding resetting of alarms, including record keeping.
    - Inspection, maintenance and testing of the cargo tank relief valves.
    - Actions to take in the event of a cargo rank relief valve malfunction including emergency isolation.
- The accompanying officer was not familiar with the company procedures for the operation of the automated cargo tank venting system.
- There were no records available of inspections, tests and maintenance carried out on the cargo tank relief valves including:
    - Checks prior each cargo operation.
    - Six-monthly visual inspections.
    - Annual verification of free operation using a field test kit, where applicable according to the vessel operational manual and/or instructions.
    - Five-yearly overhaul.
- Inspections, tests and maintenance of the cargo tank relief valves had not been carried out in accordance with the company requirements.
- The officer responsible for the maintenance and operation of the cargo tank relief valves had not received training in accordance with the company procedure.
- Cargo tank relief valves were not sealed, or the seals were broken.

- Where more than one pressure setting was permitted, there were no records available of the changes made to the cargo tank relief valve settings.
- Where more than one pressure setting was permitted, there was no sign displayed in the cargo control room or at the cargo tank relief valve indicating the setting in force.
- Where a defective cargo tank relief valve had been isolated, no records had been kept.
- Where a defective cargo tank relief valve had been isolated, there was no sign displayed in the cargo control room or at the cargo tank relief valve indicating the status of the valve.
- A cargo tank had been loaded despite having a defective and previously isolated cargo tank relief valve.
- A cargo tank relief valve had been painted in a manner which might cause the valve to malfunction.
- Galvanic corrosion was evident on a cargo tank relief valve.
- A cargo tank relief valve was defective in any respect.
- Vent masts contained accumulated rainwater.
- Vent mast drains were found to be open during the inspection.

8.6.4. Was a ship specific Cargo System Operation Manual provided on board, and were the Master and officers familiar with its content?

Short Question Text
Cargo System Operation Manual

Vessel Types
LPG, LNG

ROVIQ Sequence
Cargo Control Room

Publications
IMO: ISM Code
IMO: IGC Code
ICS: Tanker Safety Guide (Gas) - Third Edition

Objective

To ensure that all ship staff involved in cargo operations have sufficient information about cargo properties and operating the cargo system so that they can conduct cargo operations safely. *(IMO: IGC Code Ch.18 Goal)*

Industry Guidance

ICS: Tanker Safety Guide (Liquefied Gas) 3rd Edition

6.1 Introduction

This chapter outlines the range of cargo operations normally encountered on liquefied gas tankers and the general safety precautions to be observed in connection with these operations. The procedures outlined should be considered as general guidance only. There is a considerable variation in the design of cargo containment and cargo handling systems, and specific instructions should be prepared for inclusion in the cargo operations manual for individual gas tankers.

In order to achieve the required level of safety during cargo operations, all personnel involved should:

- Be trained appropriately in cargo operations;
- Be familiar with their role and responsibilities during cargo operations and understand the procedures in the cargo operations manual; and
- Be able to respond effectively to emergency situations.

Although the cargo containment and handling systems have been carefully designed and have been constructed under strict supervision, the required levels of safety in cargo operations can only be achieved if all parts of the systems and equipment are maintained in good working order.

6.4 General Cycle of Operations

Every liquefied gas tanker should be provided with copies of a suitably detailed Cargo System Operating Manual (CSOM) to facilitate the safe operation of the ship, taking into account the hazards and properties of the liquefied gas cargoes that are permitted to be carried.

In addition, where the gas tanker is approved to carry noxious liquid substances (NLS) identified in MARPOL Annex II, a Procedures and Arrangements (P&A) Manual is required to be available on board.

TMSA KPI 6.1.1 requires that procedures for cargo, ballast, tank cleaning and bunkering operations are in place for all vessel types within the fleet.

IMO: ISM Code

7. The Company should establish procedures, plans and instructions, including checklists as appropriate, for key shipboard operations concerning the safety of the personnel, ship and protection of the environment. The various tasks involved should be defined and assigned to qualified personnel.

IMO: IGC Code

18.2 Cargo operations manuals

18.2.1 The ship should be provided with copies of suitably detailed cargo system operation manuals approved by the Administration such that trained personnel can safely operate the ship with due regard to the hazards and properties of the cargoes that are permitted to be carried.

18.2.2 The content of the manuals shall include, but not be limited to:

1. overall operation of the ship from dry-dock to dry-dock, including procedures for cargo tank cooldown and warm-up, transfer (including ship-to-ship transfer), cargo sampling, gas-freeing, ballasting, tank cleaning and changing cargoes;
2. cargo temperature and pressure control systems;
3. cargo system limitations, including minimum temperatures (cargo system and inner hull), maximum pressures, transfer rates, filling limits and sloshing limitations;
4. nitrogen and inert gas systems;
5. firefighting procedures: operation and maintenance of firefighting systems and use of extinguishing agents;
6. special equipment needed for safe handling of the particular cargo;
7. fixed and portable gas detection;
8. control, alarm and safety systems;
9. emergency shutdown systems;
10. procedures to change cargo tank pressure relief valve set pressures in accordance with 8.2.8 and 4.13.2.3; and
11. emergency procedures, including cargo tank relief valve isolation, single tank gas-freeing and entry and emergency ship-to-ship transfer operations.

Inspection Guidance

The vessel operator should have provided on board a suitably detailed, ship specific, Cargo System Operation Manual that documented the overall operation of the ship from dry-dock to dry-dock and described the cargo equipment and systems fitted.

The Cargo System Operation Manual may be made up of more than one manual or document.

Suggested Inspector Actions

Sight the Cargo System Operation Manual and verify the contents include:

- Overall operation of the ship from dry-dock to dry-dock, including procedures for cargo tank cooldown and warm-up, transfer (including ship-to-ship transfer), cargo sampling, gas-freeing, ballasting, tank cleaning and changing cargoes.
- Cargo temperature and pressure control systems.
- Cargo system limitations, including minimum temperatures (cargo system and inner hull), maximum pressures, transfer rates, filling limits and sloshing limitations.
- Nitrogen and inert gas systems.
- Firefighting procedures: operation and maintenance of firefighting systems and use of extinguishing agents.
- Special equipment needed for safe handling of the particular cargo.
- Fixed and portable gas detection.
- Control, alarm and safety systems.

- Emergency shutdown systems.
- Procedures to change cargo tank pressure relief valve set pressures.
- Emergency procedures, including cargo tank relief valve isolation, single tank gas-freeing and entry and emergency ship-to-ship transfer operations.

Verify that the accompanying officer is familiar with the contents of the manual(s).

Expected Evidence

Cargo System Operation Manual(s)

Potential Grounds for a Negative Observation

- There was no Cargo System Operation Manual available on board.
- The Cargo System Operation Manual available on board was not ship specific.
- The Cargo System Operation Manual available on board did not address the hazards and properties of all the liquified gas cargoes that the vessel was permitted to carry.
- The Cargo System Operation Manual available on board did not document the overall operation cycle of the ship from dry-dock to dry-dock and/or describe the cargo equipment and systems fitted.
- The Cargo System Operation Manual available on board did not include information on maximum loading rates.
- The Cargo System Operation Manual was not approved by the flag administration or a recognised organisation.
- The accompanying officer was not familiar with the contents of the Cargo System Operation Manual available on board.
- The Cargo System Operation Manual available on board was not provided in a language understandable by the officers responsible for cargo operations.

8.6.5. Were the Master and officers familiar with the company procedures for monitoring the integrity of the containment system and maintaining the atmosphere in the interbarrier spaces and/or hold spaces in a safe condition, and had records been maintained?

Short Question Text
Maintaining the atmosphere in the interbarrier spaces and/or hold spaces

Vessel Types
LPG, LNG

ROVIQ Sequence
Main Deck, Cargo Control Room

Publications
IMO: IGC Code
ICS: Tanker Safety Guide (Gas) - Third Edition
IMO: ISM Code
SIGTTO: Liquified Gas Handling Principles on Ships and in Terminals. Fourth Edition.

Objective

To ensure that the integrity of the containment system is monitored and that the atmosphere within the system and hold spaces are always maintained in a safe condition.

Industry Guidance

ICS: Tanker Safety Guide (Gas) - Third Edition

1.8.6 Cargo Tank Pressures

Pressure in cargo tanks and hold or interbarrier spaces should be closely monitored, especially during cargo operations. Any necessary pressure adjustments should be made using the equipment provided. Particular care is necessary with membrane or semi-membrane cargo containment systems which are vulnerable to damage from vacuum or incorrect differential pressures because of the thin barrier material.

5.4.3 Hold and Interbarrier Spaces

Hold and interbarrier spaces may have to be filled with inert gas if the gas cargo is flammable. The appropriate atmosphere (gas and pressure) and procedures for hold and interbarrier spaces depend on the cargo containment system.

When carrying non-flammable cargoes, including ammonia, the hold or interbarrier space atmosphere may be maintained under dry air.

5.4.4 Inert Gas Quality

When inert gas is used in the cargo system, including tanks, hold or interbarrier spaces, the atmosphere in each space should be checked regularly to confirm that the oxygen concentration does not exceed the specified level and the pressure remains above atmospheric.

9.3.4 Tank Leakage

Cargo tank leakage to the hold space or interbarrier spaces is detected by the gas detection equipment, and constant monitoring will give continuous information on the change of a vapour concentration. The stability or rate of change of equipment readings will indicate the magnitude of the leak and, together with constant monitoring of the hold or interbarrier space pressure and temperature, will enable the operator to establish the leak rate. All leakages from cargo tanks should be regarded as serious and reported immediately.

SIGTTO: Liquified Gas Handling Principles on Ships and in Terminals. Fourth Edition.

7.2.3 Drying – hold spaces and interbarrier spaces.

Hold spaces, interbarrier spaces on membrane tanks and annular spaces on spherical tanks will also be dried. These spaces will be exposed to low temperatures and, in the case of interbarrier and annular spaces on gas carriers carrying refrigerated cargoes, the temperatures will be very low. If the interbarrier and annular spaces have any moisture in them when the tanks are cooled down, the water vapour will condense into the insulation and then expand on freezing, which may damage the insulation and reduce its performance. Hold spaces are dried to protect the outer part of the insulation and to prevent the condensation that can lead to corrosion problems on the steel work.

These spaces are much smaller in volume than the cargo tanks and are normally dried by the process of inerting. The IGC Code requires that the interbarrier and hold spaces associated with cargo containment systems for flammable gases requiring full secondary barriers be inerted. This is achieved using either inert gas or nitrogen. The IGC Code allows the interbarrier and hold spaces for cargo containment systems for certain flammable gases requiring only a partial secondary barrier, such as Moss type LNG carriers, to be maintained in a dry condition and pressurised with dry air, provided the capability exists to quickly detect a leak and inert the hold space before a dangerous condition can develop. For non-flammable gases, the IGC Code allows that interbarrier and hold spaces may be maintained simply with dry air.

7.8.1 Cargo temperature and pressure control.

Condition inspections

Gas concentrations in the interbarrier spaces of membrane containment systems may vary between loaded and ballast passages and may also be affected by the motion of the vessel in a seaway. Gas concentrations in primary barrier spaces will normally remain broadly the same for each voyage. It may be prudent to establish a formalised and efficient recording system and trend the condition of the cargo containment system. Any leaks can be identified, and appropriate intervention planned and implemented, well before any large problems occur. Main parameters such as nitrogen consumption, oxygen content, and gas content in each installation space (primary and secondary spaces), local temperatures in the insulation spaces, loaded condition and weather conditions will commonly be monitored and recorded.

TMSA KPI 6.1.1 requires that procedures for cargo, ballast, tank cleaning and bunkering operations are in place for all vessel types within the fleet. The procedures include:

- Roles and responsibilities.
- Cargo and ballast handling.
- Maintaining safe tank atmospheres.
- Record keeping.

The procedures clearly identify the designated person(s) in charge of cargo, ballast and/or bunkering operations.

IMO: ISM Code

7. The Company should establish procedures, plans and instructions, including checklists as appropriate, for key shipboard operations concerning the safety of the personnel, ship and protection of the environment. The various tasks involved should be defined and assigned to qualified personnel.

IMO: IGC Code

9.2 Atmosphere control within the hold spaces (cargo containment systems other than type C independent tanks)

9.2.1 Interbarrier and hold spaces associated with cargo containment systems for flammable gases requiring full or partial secondary barriers shall be inerted with a suitable dry inert gas and kept inerted with make-up gas provided by a shipboard inert gas generation system, or by shipboard storage, which shall be sufficient for normal consumption for at least 30 days.

9.2.2 Alternatively, subject to the restrictions specified in chapter 17, the spaces referred to in 9.2.1 requiring only a partial secondary barrier may be filled with dry air provided that the ship maintains a stored charge of inert gas or is fitted with an inert gas generation system sufficient to inert the largest of these spaces, and provided that the configuration of the spaces and the relevant vapour detection systems, together with the capability of the inerting arrangements, ensures that any leakage from the cargo tanks will be rapidly detected and inerting effected before a dangerous condition can develop. Equipment for the provision of sufficient dry air of suitable quality to satisfy the expected demand shall be provided.

9.2.3 For non-flammable gases, the spaces referred to in 9.2.1 and 9.2.2 may be maintained with a suitable dry air or inert atmosphere.

9.3 Environmental control of spaces surrounding type C independent tanks.

Spaces surrounding cargo tanks that do not have secondary barriers shall be filled with suitable dry inert gas or dry air and be maintained in this condition with make-up inert gas provided by a shipboard inert gas generation system, shipboard storage of inert gas, or with dry air provided by suitable air drying equipment. If the cargo is carried at ambient temperature, the requirement for dry air or inert gas is not applicable.

13.4 Pressure Monitoring

13.4.6 Hold spaces and interbarrier spaces without open connection to the atmosphere shall be provided with pressure indication.

13.6 Gas detection

13.6.1 Gas detection equipment shall be installed to monitor the integrity of the cargo containment, cargo handling and ancillary systems, in accordance with this section.

13.6.2 A permanently installed system of gas detection and audible and visual alarms shall be fitted in:

.2 other enclosed or semi-enclosed spaces where cargo vapours may accumulate, including interbarrier spaces and hold spaces for independent tanks other than type C tanks;

13.7 Additional requirements for containment systems requiring a secondary barrier

13.7.1 Integrity of barriers

Where a secondary barrier is required, permanently installed instrumentation shall be provided to detect when the primary barrier fails to be liquid-tight at any location or when liquid cargo is in contact with the secondary barrier at any location. This instrumentation shall consist of appropriate gas detecting devices according to 13.6. However, the instrumentation need not be capable of locating the area where liquid cargo leaks through the primary barrier or where liquid cargo is in contact with the secondary barrier.

13.7.2 Temperature indication devices

13.7.2.1 The number and position of temperature-indicating devices shall be appropriate to the design of the containment system and cargo operation requirements.

Inspection Guidance

The vessel operator should have developed ship-specific procedures for monitoring the integrity of the containment system and maintaining the atmosphere in the interbarrier spaces and/or hold spaces in a safe condition that included:

- Roles and responsibilities.
- Guidance on parameters to be monitored, which may include, depending upon the cargo containment system:
    - Pressure.
    - Nitrogen consumption.
    - Temperature.
    - Flammable gas levels.
    - Oxygen content.
    - Dew point.
- Acceptable ranges for applicable parameters.
- Actions to be taken if a parameter is out of the acceptable range.
- Set points for any automatic pressure control systems and alarms.
- Records to be maintained for each applicable parameter, and actions taken to maintain the atmosphere in the required condition.

These procedures may form part of the Cargo System Operation Manual.

Where applicable, frequent sweeping or purging with nitrogen, with resultant use of nitrogen, may be used to reduce the flammable gas levels in the interbarrier spaces. Sweeping valves should always be in the closed position when not in use for purging. If found in the open position, this may indicate gas leakage into the primary space.

Suggested Inspector Actions

- Sight, and where necessary review, the company procedures for monitoring the integrity of the containment system and maintaining the atmosphere in the interbarrier spaces and/or hold spaces in a safe condition.
- Review the records of the parameters monitored and actions taken to maintain the atmosphere in the required condition.
- Where applicable:
    - Verify that arrangements for purging the interbarrier spaces with nitrogen are in a satisfactory condition.
    - Review records of nitrogen consumption and, where fitted, the running hours of the nitrogen generator.
    - Verify whether nitrogen sweeping valves have been left open or closed.

- Interview the accompanying officer to verify their familiarity with the company procedures for monitoring the integrity of the containment system and maintaining the atmosphere in the interbarrier spaces and/or hold spaces in a safe condition.

Expected Evidence

- The company procedures for monitoring the integrity of the containment system and maintaining the atmosphere in the interbarrier spaces and/or hold spaces in a safe condition.
- Records of the parameters monitored.
- Records of actions taken to maintain the atmosphere in the required condition.
- Records of nitrogen consumption and, where fitted, running hours of the nitrogen generator.

Potential Grounds for a Negative Observation

- There were no company procedures for monitoring the integrity of the containment system and maintaining the atmosphere in the interbarrier spaces and/or hold spaces in a safe condition that included:

    - Roles and responsibilities.
    - Guidance on parameters to be monitored, which may include, depending upon the cargo containment system:
        - Pressure.
        - Nitrogen consumption.
        - Temperature.
        - Flammable gas levels.
        - Oxygen content.
        - Dew point.
    - Acceptable ranges for applicable parameters.
    - Actions to be taken if a parameter is out of the acceptable range.
    - Set points for any automatic pressure control systems and alarms.
    - Records to be maintained for each applicable parameter, and actions taken to maintain the atmosphere in the required condition.
- The accompanying officer was not familiar with the company procedures for monitoring the integrity of the containment system and maintaining the atmosphere in the interbarrier spaces and/or hold spaces in a safe condition.
- The atmosphere in the interbarrier spaces and/or hold spaces had not been maintained as required by company requirements for:
    - Pressure.
    - Temperature.
    - Flammable gas levels.
    - Oxygen content.
    - Dew point.
- Records had not been maintained of nitrogen consumption and nitrogen generator running hours.
- The pressure in the interbarrier spaces had not been maintained at a sufficient level to prevent ingress from the atmosphere.
- Equipment to monitor the atmosphere in interbarrier and/or hold spaces was defective in any respect.
- Alarms fitted to equipment to monitor the atmosphere in interbarrier and/or hold spaces had been inhibited.
- Alarms fitted to equipment to monitor the atmosphere in interbarrier and/or hold spaces had not been set as required by company procedures.
- Hold spaces, without open connection to the atmosphere, were not provided with suitable pressure gauges.
- Secondary barrier temperature sensors had recorded a low reading indicating that liquid cargo may be in contact with the barrier.
- Sweeping valves were not closed after purging operations were completed.

8.6.6. Were the Master and officers familiar with the company procedures for the management and operation of the cargo alarm systems, and had these procedures been followed?

Short Question Text
Cargo system alarm management

Vessel Types
LPG, LNG

ROVIQ Sequence
Cargo Control Room

Publications
IMO: ISM Code
IMO: IGC Code
ICS: Tanker Safety Guide (Gas) - Third Edition
SIGTTO: Recommendations for Management of Cargo Alarm Systems
1st edition
2019

Objective

To ensure that there is an effective alarm management system in place.

Industry Guidance

SIGTTO: Recommendations for Management of Cargo Alarm Systems, 1st edition, 2019

Part 1 Introduction

2. Scope

This document provides guidance for all types of gas carriers, from large LNG carriers to the smallest LPG carriers. All gas carriers will need to have alarm management processes, but less complex alarm systems will be easier to set up.

The purpose of these recommendations is to encourage owners to create an alarm management system that will address the design, management and operation of alarm systems.

3.2 Alarm Management

Alarm management also requires proper procedures to be in place to manage the many alarms that may be present in the system. An early stage is the collection of all relevant information relating to cargo alarms, which is then stored on a master alarm database. Procedures are created for managing change and specifying training requirements for operators and maintenance staff. Completing the process are audit requirements where the system is checked against ship specific alarm performance metrics.

Part 2 Recommendations

6. Philosophy (A)

The recommended first step towards creating an alarm management system is to create a philosophy document. This document should contain the objectives of the system, i.e., how the ship-owner will address all aspects of alarm management. This document should contain information on the system design, operation and maintenance. It should also contain the philosophy that was used to classify and prioritise the alarms, colour code of alarms and performance standards. The roles and responsibilities should also be defined in the philosophy document.

Roles and responsibilities for alarm management should be defined in the philosophy document, including the identities of the personnel responsible for managing changes to the system, keeping proper records and carrying out maintenance. The philosophy document should be a ‘controlled document’ as defined by the ISM Code.

11. Operation (F)

The operation stage comes after implementation and after a maintenance event.

This stage deals with alarm response procedure recommendations, alarm shelving, record keeping and refresher training for operators.

Documentation on specific alarm response procedures should be readily available to the operator. This information should include the alarm tag name and number, type, setpoint, potential causes, operator action etc.

It is recommended that operator access to shelve or modify alarms should be controlled and only allowed as specified in the philosophy document. Proper authorisation and reauthorisation procedures should be in place and all documentation should be maintained. Watch handover should include a list of shelved alarms, if any.

Depending on the requirements of the class of alarms in the system, refresher training may be required for operators. This should have been identified and documented in the alarm philosophy stage.

12. Maintenance (G)

The section on maintenance in alarm management covers the condition when an alarm is removed from service for testing and repair and subsequently returned to service. If any alarms are temporarily not in service, then suitable interim procedures should be in place until the fault is rectified.

14. Management of Change (I)

Management of change is an important part of the lifecycle. This philosophy is in line with the ISM Code requirements for ships.

To preserve the integrity and effectiveness of the system, it is important that changes are properly authorised and are in accordance with the alarm philosophy document. There should be procedures in place to cover the addition, removal or modification of alarms and to ensure that changes have the desired effect.

For example, a change in the setpoint of an alarm should be monitored to verify that it has the desired effect. It is important to ensure that there is a proper technical basis for any change and that it is in line with the alarm philosophy document. If the change is temporary, then the time limit for the change should be clearly stated. Proper records should be kept of any permanent changes to the alarm system, and these should be retained for the life of the system. The records should include the reason, date, type and person authorising the change. Any training requirements identified should be fed back to the operator training standard.

Management of change records should be stored on the ship, and ashore with the company, for the life of the alarm system. These records may be stored electronically but should be in a format appropriate for archiving and searching. Editable records are not appropriate for archiving.

ICS: Tanker Safety Guide Liquefied Gas 3rd Edition

7.2.5 Control and Alarm Systems

Gas tanker cargo systems include many remote control and automatic alarm and trip systems. It is important that these control systems are kept in good working order and maintained in accordance with the recommendations of original equipment manufacturers.

If there is a need to bypass or override any alarm system, or if any alarm is disabled, a risk assessment should be undertaken, and appropriate controls should be put in place to ensure continued safe operation.

TMSA KPI 6.1.2 requires that procedures for pre-operational tests and checks of cargo and bunkering equipment are in place for all vessel types within the fleet. Tests and checks of equipment may include:

- Alarms and trips

IMO: ISM Code

10.1 The Company should establish procedures to ensure that the ship is maintained in conformity with the provisions of the relevant rules and regulations and with any additional requirements which may be established by the Company.

IMO: IGC Code

18.6.2 Essential cargo handling controls and alarms shall be checked and tested prior to cargo transfer operations.

Inspection Guidance

The vessel operator should have developed procedures for the management and operation of the cargo alarm systems that included, as applicable:

- Roles and responsibilities including the identities of the personnel responsible for managing changes to the system, keeping proper records and carrying out maintenance.
- Authorisation required before changing a set point or overriding an alarm.
- Requirements for risk assessment before changing a set point or overriding an alarm.
- Actions to be taken when an alarm is temporarily out in service.
- Records to be kept, including any changes made to alarm systems and/or settings, and when alarms have been overridden.

<u>Suggested Inspector Actions</u>

- Sight, and where necessary review, the company procedures for the management and operation of the cargo alarm systems.
- Review the records of any changes made to alarm systems and/or settings, and when alarms have been overridden. Verify that they had been risk assessed and authorised as required and time limits set as appropriate.

- Interview the accompanying officer to verify their familiarity with the company procedures for the management and operation of the cargo alarm systems.

<u>Expected Evidence</u>

- The company procedures for the management and operation of the cargo alarm systems.
- Records of any changes made to alarm systems and/or settings, and when alarms have been overridden.

<u>Potential Grounds for a Negative Observation</u>

- There were no company procedures for the management and operation of the cargo alarm systems that included, as applicable:
    - Roles and responsibilities, including the identities of the personnel responsible for managing changes to the system, keeping proper records, and carrying out maintenance.
    - Authorisation required before changing a set point or overriding an alarm.
    - Requirements for risk assessment before changing a set point or overriding an alarm.
    - Actions to be taken when an alarm is temporarily out in service.
    - Records to be kept, including any changes made to alarm systems and/or settings, and when alarms have been overridden.
- The company procedures were not aligned with the systems that were fitted onboard with regards to the controls to prevent unauthorised adjustment of an alarm set point or the overriding of an alarm.
- The password and/or key control to operate the adjustment of alarm set points or the override of an alarm were freely available and not under the control of those identified by the company procedure for managing changes to the cargo system.
- The accompanying officer was not familiar with the company procedures for the management and operation of the cargo alarm systems.
- There were no records of changes made to alarm systems and/or settings, and when alarms had been overridden, or records were incomplete e.g., no risk assessments where required.
- An alarm was observed to have been overridden or disabled but there was no record of the required risk assessment, authorisation and/or authorisation.

8.6.7. Were the Master and officers familiar with the company procedures for the operation, inspection, testing and maintenance of the vessel's inert gas system and its associated equipment, and was the equipment in satisfactory condition?

Short Question Text
Inert gas system

Vessel Types
LPG, LNG

ROVIQ Sequence
Cargo Control Room, Engine Room, Engine Control Room

Publications
IMO: ISM Code
IMO: IGC Code
SIGTTO: Liquified Gas Handling Principles on Ships and in Terminals. Fourth Edition.
ICS: Tanker Safety Guide (Gas) - Third Edition

Objective

To ensure the inert gas system always delivers inert gas in accordance with the requirements for the cargo carried.

Industry Guidance

SIGTTO: Liquified Gas Handling Principles on Ships and in Terminals. Fourth Edition.

2.7.2 The use of inert gas

On board gas carriers, inert gas may be used to prevent the formation of a flammable mixture in cargo tanks during cargo grade change, preparation to load the first cargo after dry dock or when gas freeing prior to dry dock, inspection or repairs. Inert gas may also be used in the hold or interbarrier spaces.

4.9 Inert Gas and Nitrogen Systems

Gas carriers use a number of types of inert gas:

- Inert gas from combustion type generators
- nitrogen from shipboard production systems
- liquid nitrogen taken from the shore (either by road tanker or barge).

ICS: Tanker Safety Guide (Gas) - Third Edition

5.4.4 Inert Gas Quality

Inert gas used for atmosphere control should be suitable for the intended purpose, regardless of its source. In particular, inert gas should:

- Be chemically compatible with the liquefied gas cargo and the materials of construction of the cargo system throughout the full range of operating temperatures and pressures. In some cases, for purity reasons, this may require the use of nitrogen rather than combustion produced inert gas;
- Have a sufficiently low dew point to prevent condensation, freezing, corrosion and damage to insulation at the minimum operating temperature;
- Have an oxygen concentration not exceeding 5%. For cargoes which can react to form peroxides, the oxygen concentration should not exceed 0.1%;

- Have a low concentration of carbon dioxide to prevent freezing at the anticipated service temperature; and
- Have minimal capacity for accumulating a static electrical charge.

When inert gas is used in the cargo system, including tanks, holds or interbarrier spaces, the atmosphere in each space should be checked regularly to confirm that the oxygen concentration does not exceed the specified level and that the pressure is above atmospheric. All instruments and equipment used in the system should be maintained in good condition and calibrated in accordance with the recommendations of original equipment manufacturers.

Personnel should be aware that an inert gas/cargo vapor mixture may become s flammable mixture if it should escape or be vented to the atmosphere.

5.4.5 Inert Gas Hazards and Precautions

It is recommended that a means is provided to monitor the oxygen content in enclosed or semi-enclosed spaces containing equipment, including nitrogen generators, inert gas (IG) generators or nitrogen cycle refrigerant systems, that may cause an oxygen-deficient environment.

Care should be taken to ensure that cargo vapour is prevented from flowing back along inert gas supply lines into the IG generator. Non-return valves should be tested for effectiveness at regular intervals. Any temporary connection between the inert gas plant and the cargo system should be disconnected and tightly blanked after use.

7.2.13 Inert Gas Systems

Ships may have the means to produce nitrogen gas on board by physical separation from the atmosphere, using the pressure swing absorption method or the membrane method.

Ship's personnel should be aware that the exhaust from the nitrogen generator plant is oxygen-rich and be fully alert to the personal safety and flammability hazard which this presents at vent piping flanges/fittings and within the area of the vent exhaust.

TMSA KPI 6.1.1 requires that procedures for cargo, ballast, tank cleaning and bunkering operations are in place for all vessel types within the fleet. The procedures include:

- Roles and responsibilities.
- Cargo and ballast handling.
- Maintaining safe tank atmospheres.
- Tank cleaning.
- Record keeping.

The procedures clearly identify the designated person(s) in charge of cargo, ballast and/or bunkering operations.

IMO: ISM Code

7. The Company should establish procedures, plans and instructions, including checklists as appropriate, for key shipboard operations concerning the safety of the personnel, ship and protection of the environment. The various tasks involved should be defined and assigned to qualified personnel.

IMO: IGC Code

9.4 Inerting

9.4.1 Inerting refers to the process of providing a non-combustible environment. Inert gases shall be compatible chemically and operationally at all temperatures likely to occur within the spaces and the cargo. The dew points of the gases shall be taken into consideration.

9.4.2 Where inert gas is also stored for firefighting purposes, it shall be carried in separate containers and shall not be used for cargo services.

9.4.3 Where inert gas is stored at temperatures below 0ºC, either as a liquid or as a vapour, the storage and supply system shall be designed so that the temperature of the ship's structure is not reduced below the limiting values imposed on it.

9.4.4 Arrangements to prevent the backflow of cargo vapour into the inert gas system that are suitable for the cargo carried, shall be provided. If such plants are located in machinery spaces or other spaces outside the cargo area, two non-return valves or equivalent devices and, in addition, a removable spool piece shall be fitted in the inert gas main in the cargo area. When not in use, the inert gas system shall be made separate from the cargo system in the cargo area except for connections to the hold spaces or Interbarrier spaces.

9.4.5 The arrangement shall be such that each space being inerted can be isolated and the necessary controls and relief valves, etc., shall be provided for controlling pressure in these spaces.

9.4.6 Where insulation spaces are continually supplied with an inert gas as part of a leak detection system, means shall be provided to monitor the quantity of gas being supplied to individual spaces.

9.5 Inert gas production on board

9.5.1 The equipment shall be capable of producing inert gas with an oxygen content at no time greater than 5% by volume, subject to the special requirements of chapter 17. A continuous-reading oxygen content meter shall be fitted to the inert gas supply from the equipment and shall be fitted with an alarm set at a maximum of 5% oxygen content by volume, subject to the requirements of chapter 17.

9.5.2 An inert gas system shall have pressure controls and monitoring arrangements appropriate to the cargo containment system.

9.5.3 Spaces containing inert gas generation plants shall have no direct access to accommodation spaces, service spaces or control stations, but may be located in machinery spaces. Inert gas piping shall not pass through accommodation spaces, service spaces or control stations.

9.5.4 Combustion equipment for generating inert gas shall not be located within the cargo area. Special consideration may be given to the location of inert gas generating equipment using a catalytic combustion process.

17.1 General

The requirements of this chapter are applicable where reference thereto is made in column “I” in the table of Chapter 19.

17.6 Exclusion of air from vapour spaces

Air shall be removed from cargo tanks and associated piping before loading and then, subsequently excluded by:

1. introducing inert gas to maintain a positive pressure. Storage or production capacity of the inert gas shall be sufficient to meet normal operating requirements and relief valve leakage. The oxygen content of inert gas shall, at no time, be greater than 0.2% by volume; or
2. control of cargo temperatures such that a positive pressure is maintained at all times.

Inspection Guidance

The vessel operator should have developed procedures for the operation, inspection, testing and maintenance of the vessel’s inert gas system and its associated equipment which included:

- Roles and responsibilities for operation, testing and maintenance.

- Description of the inert gas system fitted on board.
- Procedures to ensure that instruments and equipment used in the system are maintained in good condition and calibrated in accordance with the recommendations of original equipment manufacturers.
- Arrangements to prevent the backflow of cargo vapour into the inert gas system.
- Guidance on the maximum percentage of carbon dioxide that is acceptable to avoid ‘dry ice’ formation.
- Guidance on dew point limitations to prevent condensation, freezing, corrosion and damage to insulation at the minimum operating temperature.
- Arrangements for checking regularly to confirm that the oxygen concentration does not exceed the specified level and that the pressure is above atmospheric when inert gas is used in the cargo system, including tanks, holds or interbarrier spaces.
- Arrangements for monitoring the oxygen content in enclosed or semi-enclosed spaces containing equipment, including nitrogen generators, inert gas (IG) generators or nitrogen cycle refrigerant systems, that may cause an oxygen deficient environment.

A record of inspection and maintenance of the inert gas plant, including defects and their rectification, should be maintained on board.

These procedures and records may form part of the vessel’s Cargo System Operation Manual and planned maintenance system.

Where a nitrogen generator is fitted:

- It is recommended a warning sign be posted at an appropriate place to warn of the dangers of the oxygen-enriched waste gases from the nitrogen generator.
- It is recommended that a warning sign is posted at each entrance to the space(s) containing the air compressor, nitrogen generator, nitrogen receiver or buffer tank warning of the dangers of asphyxiation in a nitrogen enriched atmosphere.

<u>Suggested Inspector Actions</u>

- Sight, and where necessary review, the company procedures for the operation, inspection, testing and maintenance of the inert gas system.
- Review the records of inspection, testing and maintenance of the inert gas system.
- Review the records of checks of the inert gas system, before, during and after operation.
- Review the records of checks to confirm that the oxygen concentration did not exceed the specified level and that the pressure was above atmospheric when inert gas was used in the cargo system, including tanks, holds or interbarrier spaces.
- Where necessary, compare the observed condition with the records of inspection, testing and maintenance of the inert gas system.
- During the physical inspection of the vessel inspect the inert gas system.

- Interview the accompanying officer to verify their familiarity with the company procedures for the operation, testing and maintenance of the inert gas system.

<u>Expected Evidence</u>

- The company procedures for the operation, inspection, testing and maintenance of the inert gas system.
- Records of inspection, testing and maintenance of the inert gas system.
- Records of checks of the inert gas system, before, during and after operation.
- Records of checks to confirm that the oxygen concentration did not exceed the specified level and that the pressure was above atmospheric when inert gas was used in the cargo system, including tanks, holds or interbarrier spaces.

Potential Grounds for a Negative Observation

- There were no company procedures for the operation, inspection, testing and maintenance of the inert gas system that included, as applicable:
  - Roles and responsibilities for operation, testing and maintenance.
  - Description of the inert gas system fitted on board.
  - Procedures to ensure that instruments and equipment used in the system are maintained in good condition and calibrated in accordance with the recommendations of original equipment manufacturers.
  - Arrangements to prevent the backflow of cargo vapour into the inert gas system.
  - Guidance on the maximum percentage of carbon dioxide that is acceptable to avoid 'dry ice' formation.
  - Guidance on dew point limitations to prevent condensation, freezing, corrosion and damage to insulation at the minimum operating temperature.
  - Arrangements for checking regularly to confirm that the oxygen concentration does not exceed the specified level and that the pressure is above atmospheric when inert gas is used in the cargo system, including tanks, holds or interbarrier spaces.
  - Arrangements for monitoring the oxygen content in enclosed or semi-enclosed spaces containing equipment, including nitrogen generators, inert gas (IG) generators or nitrogen cycle refrigerant systems, that may cause an oxygen deficient environment.
- The accompanying officer was not familiar with the company procedures for the operation, inspection, testing and maintenance of the inert gas system.
- Where a nitrogen generator was fitted, the accompanying officer was not familiar with the dangers from:
  - An oxygen deficient atmosphere as a result of nitrogen leakage.
  - The oxygen-enriched exhaust from the nitrogen generator.
- Inspection, testing and maintenance of the inert gas system had not been carried out in accordance with the company procedures.
- The continuous-reading oxygen content meter had not been calibrated in accordance with the recommendations of original equipment manufacturers.
- Non-return valves to prevent the backflow of cargo vapour into the inert gas system had not been tested for effectiveness at regular intervals.
- There were no records of inspection, testing and maintenance of the inert gas system.
- There were no records of checks to confirm that the oxygen concentration did not exceed the specified level and that the pressure was above atmospheric when inert gas was used in the cargo system, including tanks, holds or interbarrier spaces.
- There were no records of checks of the inert gas system, before, during and after operation.
- There was no evidence that the oxygen content in enclosed or semi-enclosed spaces containing equipment, including nitrogen generators, inert gas (IG) generators or nitrogen cycle refrigerant systems, that may cause an oxygen deficient environment had been monitored.
- Where the inert gas plant was contained in an enclosed room or space, there were no safe entry procedures posted at each entrance to the room.
- The inert gas delivered was not suitable for the intended purpose, because:
  - It was not chemically compatible with the liquefied gas cargo and the materials of construction of the cargo system throughout the full range of operating temperatures and pressures.
  - The dew point was not sufficiently low enough to prevent condensation, freezing, corrosion and damage to insulation at the minimum operating temperature.
  - The oxygen concentration exceeded 5%, (or 0.2% or less, as required, for cargoes which can react to form peroxides).
  - It did not have a low concentration of carbon dioxide to prevent freezing at the anticipated service temperature.
- The continuous-reading oxygen content meter and alarm system was defective in any respect.
- Temporary connections (e.g., spool-pieces) had not been removed from between the inert gas system and the cargo system following inerting operations.
- The inert gas system was defective in any respect.

Where the entry procedures posted at the entrance(s) to the space or spaces containing the inert gas system were not in alignment with the enclosed space entry procedure in the SMS, or entry into a space containing the inert gas system was authorised during the inspection without full compliance with the enclosed space entry procedure, make an observation under question 5.5.1.

8.6.8. Were the Master and officers familiar with the company procedures for managing cargo and vapour connections at the cargo manifolds, and were the manifold arrangements in satisfactory condition?

Short Question Text
Gas vessel cargo manifolds

Vessel Types
LPG, LNG

ROVIQ Sequence
Interview - Deck Rating, Cargo Manifold

Publications
SIGTTO: LNG Marine Loading Arms and Manifold Draining
Purging and Disconnection Procedure
IMO: ISM Code
SIGTTO/OCIMF: Recommendations for Liquefied Gas Carrier Manifolds 2nd Ed 2018
IMO: IGC Code

Objective

To ensure that cargo and vapour manifolds are always safely connected, disconnected, and monitored throughout cargo transfer operations.

Industry Guidance

SIGTTO/OCIMF: Recommendations for Liquefied Gas Carrier Manifolds 2nd Ed 2018

3. Protection from Cargo Spill

3.4 Gratings

Manifold drip tray gratings should be of a material that is not adversely affected by spilled cargo. All manifold gratings should be secured to the drip tray structure to provide a firm, non-skid, working surface that is free from any protrusions that personnel may trip on, and would not interfere with operations.

The grating support structure and the drip tray structure should be designed with sufficient additional load bearing capacity to take the loading from the loading arm jacks. In the absence of any other requirements, it is recommended that gratings should be designed to withstand a load of 1 tonne per sq. metre. For LNG carriers, consideration should also be given to the load (including dynamic loading) from STS equipment.

3.5 Drainage – LPG

For LPG carriers, it is recommended that the protected area and drip tray should be provided with means to drain off any water that may accumulate.

3.6 Drainage – LNG

For LNG carriers, it is recommended that the protected area should be provided with a drain line capable of leading a spill overboard. The drain line should be fitted with a valve that would be closed during normal operation and which can be opened from a remote location. The discharge from the line should point vertically downwards or otherwise so as not to deluge the jetty or its associated equipment with drained liquid. The discharge from the line should be in the manifold area so that the LNG carrier's hull is protected by the water curtain specified in Section 3.7.

3.7 Water Curtains for LNG Carriers

The hull of LNG carriers should be protected by a water curtain at the ship's side that extends over at least the full length of the potential spillage area. For ship to ship (STS) transfer using hoses, consideration should also be given to the provision of an effective water curtain or suitable screen. This is to protect the deck under the manifold platform.

4. Manifold Design

Ensuring the integrity of the manifold design is typically addressed by specifying the:

1. Pipe schedule
2. Allowable loads for the manifold support
3. Minimum mechanical properties of material used
4. Pressure rating of flanges, reducers and spool pieces.

Information on the pipe schedule, materials used, allowable loads used in the design of the support and pressure rating should be available on board and certified by a Classification Society. This information will assist in the ship personnel's awareness of the limitations of the manifold design. This information will also allow engineering calculations to be carried out at a future date, if required under special circumstances.

5.3 Marking of Manifolds

It is recommended that the cargo manifold should be permanently and clearly marked, at a suitable location, with its designed safe working loads. The manifold arrangement should be marked on the ship side shell.

6.5 Access and Exits from the Manifold Area

Safe access is to be provided for the connecting and disconnecting of arms/hoses. It is recommended that there should be two independent means of exit for personnel from the manifold area to enable evacuation in the event of an emergency.

Annex 1 – Manifold Strainers

The use of filters in the cargo manifold helps prevent debris from getting into the cargo tanks or shore tanks.

Filters may be conical or basket type.

When using filters in the manifold, the pressure differential across the filter should be monitored to check for filter blockage. The ship and terminal should agree on a suitable method to monitor the pressure before commencing cargo operations.

SIGTTO: LNG Marine Loading Arms and Manifold Draining, Purging and Disconnection Procedure

The principal objective is to disconnect the MLAs in a manner that eliminates any risk of liquid release and reduces the release of cargo vapour to the atmosphere to an absolute minimum. For this operation to be conducted safely and in a timely manner, it is essential that there is a carefully thought out procedure in place and that there is good communication between the ship's staff and the shore operational staff, both of whom bear responsibility for safe conduct of the operation.

The process has a number of logical steps:

1. Lining up to drain the system from the MLA, and/or manifold, to shore or ship tank.
2. Isolation of liquid and vapour valves on either side of the manifold connection.
3. Removal of liquid from the MLA, and/or manifolds, to shore or ship tank.
4. Purging of flammable vapours from the connection.
5. Verification that the target conditions (flammable gas concentration) have been achieved.
6. Disconnection of the manifold.

5. Verification

This is a key aspect of ensuring the safety of the disconnection procedure. The vent in way of the manifold is opened and the vapour is tested using a meter calibrated for measuring methane in nitrogen. A typical target level is 2% by volume in nitrogen to ensure a margin of safety when disconnection occurs and the vapour and nitrogen mixture is achieved. As a final check, briefly crack open the drain to the drip tray to ensure that no liquid is lying in the bottom of the line.

TMSA KPI 6.1.2 requires that procedures for pre-operational tests and checks of cargo and bunkering equipment are in place for all vessel types within the fleet.

IMO: ISM Code

7. The Company should establish procedures, plans and instructions, including checklists as appropriate, for key shipboard operations concerning the safety of the personnel, ship and protection of the environment. The various tasks involved should be defined and assigned to qualified personnel.

IMO: IGC Code

1.2.53 Toxic products are those defined by a “T” in column “f” in the table of Chapter 19.

3.8.2 Bow or stern loading and unloading lines that are led past accommodation spaces, service spaces or control stations shall not be used for the transfer of products requiring a type 1G ship. Bow or stern loading and unloading lines shall not be used for the transfer of toxic products as specified in 1.2.53, where the design pressure is above 2.5 MPa.

5.7.3 Water curtain

For cargo temperatures below -110°C, a water distribution system shall be fitted in way of the hull under the shore connections to provide a low-pressure water curtain for additional protection of the hull steel and the ship's side structure. This system is in addition to the requirements of 11.3.1.4 and shall be operated when cargo transfer is in progress.

Inspection Guidance

The vessel operator should have developed procedures for managing cargo and vapour connections at the cargo manifolds. These procedures should include:

- Manifold connection via hose or marine loading arm.
- In LNG vessels, procedures for disconnection, including:
    - Lining up to drain the system from the MLA, and/or manifold, to shore or ship tank.
    - Isolation of liquid and vapour valves on either side of the manifold connection.
    - Removal of liquid from the MLA, and/or manifolds, to shore or ship tank.
    - Purging of flammable vapours from the connection.
    - Verification that the target conditions (flammable gas concentration) have been achieved, using a meter calibrated for measuring methane in nitrogen.
    - Disconnection of the manifold.
- The fitting and monitoring of pressure gauges at each manifold connection outboard of the manifold valve.
- The fitting of blanks to all unused manifold connections.
- The fitting of blanks or caps to all vents, drains and sample points, except while in use.
- The use of fixed and portable drip-trays and the management of drained or spilled cargo.
- The management of vapour manifolds and connections.
- Safe work on elevated manifold platforms, if fitted.
- The supporting of cargo hoses during cargo transfer.

- Restrictions on the use of the mid-ships hose-handling crane(s) during cargo operations.
- The management of bow and stern manifolds, if fitted.
- The hazards associated with low temperature cargoes.
- The use of manifold strainers

The offshore manifolds on LNG carriers are often pressurised with nitrogen and it is normal that the space between the manifold valve and the flange is under pressure. This does not indicate valve leakage. Valve leakage would be indicated by frosting.

Gratings on LNG tanker manifold drip trays are sometimes made of two different materials; gratings near to the connections may be of stainless steel, and the gratings on the periphery made of composite material. The stainless-steel gratings are designed to bear the point load of the cargo arm supports in the event of a PERC's release. If, however, the loading arm supports are located on the composite section, the vessel should confirm that they are constructed of sufficient strength to take the point load.

Manifold drip trays for LNG transfers should be kept as dry as reasonably practical. Water should not be introduced deliberately, or rain-water allowed to accumulate. This will prevent rapid phase transition in the event of a spill.

Manifold drip-tray drains to deck should be fitted with valves and either capped or plugged.

Pressure gauge stems should be fitted with valves and capped whenever gauges are not fitted.

It is generally accepted that steel blanks should be of the same thickness as the flanges to which they are attached, but this will not necessarily result in the pressure capability being the same as that of the associated pipework. It is the pressure rating of the blank which is important, and blanks made of materials such as titanium have a superior strength and may therefore be significantly thinner for the same pressure rating as a mild steel blank. If such blanks are fitted, documentation should be on board to prove that the pressure rating is adequate for the service.

Manifold strainers may be fitted at the option of the terminal or the vessel. The provision of the strainers may be by the terminal or by the vessel. Where fitted they must be in good order and frequently checked and cleaned as required. Many strainers are designed for one-way flow only. They should not be by-passed.

Manifold valves and lines should be clearly marked as to whether they are liquid or vapour.

Non-essential personnel should be kept clear of the manifold area during cargo operations and access should be visibly restricted.

Suggested Inspector Actions

- Sight, and where necessary review, the company procedures for managing cargo and vapour connections at the cargo manifolds.
- Inspect cargo and vapour manifolds, including bow and stern manifolds where fitted, and verify that the arrangements were in alignment with industry best practice and, where applicable, regulation.

- Interview a deck rating on manifold watch to verify their familiarity with:
    - The hazards associated with low temperature cargoes.
    - The identification of potential manifold leakage.

Expected Evidence

- Company procedures for managing cargo and vapour connections at the cargo manifolds.
- Information on the allowable loads for the manifold supports and pressure rating of flanges, reducers, and spool pieces, certified by the vessel's Class Society.

Potential Grounds for a Negative Observation

- There were no company procedures which described the management of cargo and vapour connections at the cargo manifolds to prevent and detect leakages.
- On an LNG carrier, there were no detailed disconnection procedures.
- On an LNG carrier, the meter used to verify that target conditions (flammable gas concentration) for disconnection had been achieved was not calibrated for measuring methane in nitrogen.
- The accompanying officer was not familiar with the company procedures which described the management of cargo and vapour connections at the cargo manifolds.
- On an LNG carrier, the accompanying officer was not familiar with the:
    - Detailed disconnection procedures.
    - Function of the manifold drain line and the means of remotely opening it in the event of a cargo spill into the drip tray.
- The accompanying officer was not familiar with the procedures for monitoring the pressure differential across the filter to check for possible blockage.
- A rating on manifold watch was not sufficiently familiar with:
    - The hazards associated with low temperature cargoes.
    - The identification of potential manifold leakage.
- A manifold strainer had been by-passed.
- A manifold connection was:
    - Secured with damaged bolts or bolts of an inappropriate diameter, length or material.
    - Not fully bolted, i.e. without a bolt in every hole in the flange.
    - Made using improvised arrangements such as a G-clamp or similar device.
- Where a hose or marine loading arm was secured by camlocks, one or more cams had not properly engaged with the manifold flange.
- A marine loading arm was improperly supported by jacks or similar arrangements.
- The jack for a marine loading arm was supported by items not designed to support the load, such as empty oil drums.
- The jack for a marine loading arm was supported on gratings that were not designed to support such a load.
- Cargo hoses were not properly supported during cargo transfer.
- A manifold pressure gauge was:
    - Not fitted on the outboard side of the manifold valve.
    - Missing from an unused manifold connection.
- A manifold pressure gauge stem was not fitted with a valve or cock and/or was not capped when not in use.
- A manifold blank flange was not:
    - As thick as the end flange it was bolted to and there was no supporting documentation to show it was of the same working pressure rating as the line or system it was connected to.
    - Made of steel or other approved material.
    - Secured with bolts of an inappropriate diameter, length or material.
    - Fully bolted, i.e. without a bolt in every hole in the flange.
- There was a cargo or bunker leak from an unused manifold.
- An unused manifold was not blanked.
- There was no permanent or portable drip-tray underneath a manifold connection.
- Manifold drip-tray drains to deck were not fitted with valves and capped.
- The midships hose-handling crane was being used to handle stores etc. whilst cargo operations were taking place.
- There were not two independent means of exit for personnel from the manifold area to enable evacuation in the event of an emergency.
- Access to the manifold area for non-essential personnel was not visibly restricted.
- Manifold gratings were not secured to the drip tray structure to provide a firm, non-skid, working surface.
- Manifold drip tray gratings were constructed of a material that would be adversely affected by spilled cargo.
- The manifold drip tray on an LNG carrier contained water.
- The hull water curtain was not in operation during an LNG cargo transfer operation.
- There was no information available on board on the allowable loads for the manifold supports and pressure rating of flanges, reducers and spool pieces, certified by the vessel's Class Society.
- The cargo manifold was not permanently and clearly marked, at a suitable location, with its designed safe working loads.

- Manifold valves and lines were not clearly marked as to whether they were liquid or vapour.
- Bow or stern loading and unloading lines that led past accommodation spaces, service spaces or control stations were being used for the transfer of products requiring a type 1G ship.
- Bow or stern loading and unloading lines were being used for the transfer of toxic products as specified in IGC 1.2.53, where the design pressure was above 2.5 MPa.

8.6.9. Were the Master and officers familiar with the company procedures for the use, inspection and testing of manifold reducers, spool pieces and other portable pipework, and were these items in satisfactory condition and properly fitted when in use?

Short Question Text
Manifold reducers, spool pieces and other portable pipework

Vessel Types
LPG, LNG

ROVIQ Sequence
Cargo Control Room, Cargo Manifold

Publications
IMO: ISM Code
USCG: Code of Federal Regulations. Title 46.
ICS: Tanker Safety Guide (Gas) - Third Edition
SIGTTO/OCIMF: Recommendations for Liquefied Gas Carrier Manifolds 2nd Ed 2018

Objective

To ensure manifold reducers, spool pieces and other items of portable pipework meet the required pressure rating for the cargo transfer system and will not leak at the flange face when used.

Industry Guidance

SIGTTO/OCIMF: Recommendations for Liquefied Gas Carrier Manifolds 2nd Ed 2018

4. Manifold Design

The recommendations in this section are provided for two types of material, i.e. carbon steel and stainless steel. The choice of material is usually dictated by the temperature of the product carried.

Carbon steel may be used to construct fuel oil bunker manifolds. This may also be used to construct some types of LPG carrier manifolds. Stainless steel is typically used to construct LNG carrier, LPG carrier and LNG bunker manifolds.

Ensuring the integrity of the manifold design is typically addressed by specifying the:

1. Pipe schedule
2. Allowable loads for the manifold support
3. Minimum mechanical properties of material used
4. Pressure rating of flanges, reducers and spool pieces.

Information on the pipe schedule, materials used, allowable loads used in the design of the support and pressure rating should be available on board and certified by a Classification Society. This information will assist in the ship personnel's awareness of the limitations of the manifold design. This information will also allow engineering calculations to be carried out at a future date, if required under special circumstances.

5. Manifold Specification and Fittings

5.5 Reducers and Spool Pieces

If necessary, reducers and spool pieces should be fitted with a lifting lug. This lifting lug should be placed as near as possible to the centre of gravity and at a location that will not interfere with either the operation of the quick connect/disconnect coupler (QC/DC) or with the bolting of flanges.

If the reducer or spool piece flange connection is a solid flange without bolt holes, it is recommended that it should be provided with a blank flange that uses QC/DC fittings for securing the blank on completion of cargo transfer.

The required reducer or spool piece should be bolted directly to the outboard end of the distance piece. It is recommended that no more than one reducer or spool piece should be bolted to the distance piece. This is because if more than one reducer is fitted, the design criteria defined in Section 4 could be exceeded.

Reducers and spool pieces for LNG carriers should be carried in accordance with the requirements of the trade.

It is recommended that use of cranked or offset reducers, Y-pieces, or additional spool pieces should be avoided unless sufficient engineering studies have been carried out that support safe use. If such equipment is used, certificates that indicate suitability should be available.

ICS: Tanker Safety Guide (Gas) - Third Edition

6.5 Preparation for cargo transfer

6.5.1 General

Cargo hoses, loading arms and gaskets should be suitable for the cargo and in good condition. The responsible cargo officer should check the condition of the ship shore flange connection. Flexible hoses should be suspended from suitable equipment and should not be subjected to excessive bending or dynamic forces and should not put excessive strain on the cargo manifold. This is particularly relevant when the cargo manifold is extended by unsupported reducing pieces. Care should be taken not to damage mechanical loading arms during cargo operations.

USCG: Code of Federal Regulations. Title 46.

Chapter I Part 38

38.10-1 Valves, fittings and accessories.

(a) All valves, flanges, fittings, and accessory equipment shall be of a type suitable for use with liquefied flammable gases, and shall be made of steel or grade A malleable iron, acceptable for the service temperature and pressure according to the requirements of part 56 of subchapter F (Marine Engineering) of this chapter. Other materials may be specially considered and approved by the Commandant.

(b) All valves, flanges, fittings, and accessory equipment shall have a pressure rating at operating temperatures not less than the maximum allowable pressure to which they may be subjected. Piping which is not protected by a relief valve or which can be isolated from its relief valve by other valves shall be designed for the greatest of the cargo vapor pressure at 115 °F., or the maximum allowable pressure of the cargo tank, or the requirements of §38.10–10(a). Cargo liquid piping which may be subject to liquid full conditions shall be fitted with relief valves. The escape from piping systems relief valves shall be piped to a venting system or to a suitable vapor recovery system. Provision shall be made for the proper venting of all valves, fittings, etc., in which pressure build up may occur, especially in refrigerated systems, because of an increase in product temperature.

38.10–10 Cargo piping.

(a) The piping shall be designed for a working pressure of not less than the maximum pressure to which it may be subjected but in no case less than the design pressure of the cargo tanks. In the case of piping on the discharge side of the liquid pumps or vapor compressors, the design pressure shall not be less than the pump or compressor discharge relief valve setting; or, provided the piping is not protected by relief valves, the design pressure shall not be less than the total discharge head of the pump or compressor.

(b) Piping subject to tank pressure shall be seamless drawn steel or electric resistance welded steel. Pipe used in refrigerated tank systems shall be of a material which is suitable for the minimum service temperature to which it may be subjected, according to the requirements of part 56 of sub- chapter F (Marine Engineering) of this chapter.

(c) Piping shall be provided with adequate support to take the weight of the piping off valves and fittings and to prevent excessive vibration and stresses on tank connections.

TMSA KPI 6.1.2 requires that procedures for pre-operational tests and checks of cargo and bunkering equipment are in place for all vessel types within the fleet. Tests and checks of equipment may include:

- Cargo/bunker line pressure testing

IMO: ISM Code

10 Maintenance of the Ship and Equipment

10.1 The Company should establish procedures to ensure that the ship is maintained in conformity with the provisions of the relevant rules and regulations and with any additional requirements which may be established by the Company.

Inspection Guidance

The vessel operator should have developed procedures for the use and inspection of manifold reducers, spool pieces and other portable pipework that included guidance on:

- The correct use of manifold reducers, spool pieces and other portable pipework.
- Provision of test certification.
- Suitable storage arrangements, including the protection of flange faces.
- Regular inspection.
- Records to be maintained of inspections.

A manifold reducer, spool piece or other item of portable pipework should have the same or greater certified rating as the fixed manifold piping to which it is connected.

Reducers and spool pieces should be made of suitable material compatible with the cargo and comply with relevant industry standards. Where long reducers or spool pieces are used the resulting lengths should be properly supported to prevent undue stress.

Other portable pipework may include cargo Y pieces, spiders or other hard configurations.

This question will apply to all manifold reducers, spool pieces and other items of portable pipework carried onboard for use in cargo or bunker operations unless they are clearly marked as out of service for refurbishment.

<u>Suggested Inspector Actions</u>

- Sight, and where necessary review, the company procedures for the use and inspection of manifold reducers, spool pieces and other portable pipework.
- Review the inventory of manifold reducers, spool pieces and other portable pipework.
- Review the records of inspection of manifold reducers, spool pieces and other portable pipework.
- During the inspection, observe the disposition and visual condition of the manifold reducers, spool pieces and other portable pipework.
- Where necessary, compare the observed condition with the records of inspection of manifold reducers, spool pieces and other portable pipework.

- Request that the blanks or covers are removed from at least one stored reducer or spool piece and verify that the presentation flanges are undamaged and free from pitting or scoring.

Expected Evidence

- The company procedures for the use and inspection of manifold reducers, spool pieces and other portable pipework.
- The inventory of manifold reducers, spool pieces and other portable pipework.
- Records of the inspection of manifold reducers, spool pieces and other portable pipework.

Potential Grounds for a Negative Observation

- There were no company procedures for the use, inspection and testing of manifold reducers, spool pieces and other portable pipework that included guidance on:
    - The correct use of manifold reducers, spool pieces and other portable pipework.
    - Provision of test certification.
    - Suitable storage arrangements, including the protection of flange faces.
    - Regular inspection.
    - Records to be maintained of inspections.
- There was no inventory of manifold reducers, spool pieces and other portable pipework.
- The accompanying officer was not familiar with the company procedures for the use and inspection of manifold reducers, spool pieces and other portable pipework.
- Test certification was not available for a manifold reducer, spool piece or other item of portable pipework.
- There were no records available for the inspection of manifold reducers, spool pieces and other portable pipework as required by company procedures.
- Inspection of the manifold reducers, spool pieces and other portable pipework indicated that the required inspections had either not been performed or were ineffective.
- A manifold reducer, spool piece or other item of portable pipework did not have the same certified rating (MAWP) as the fixed manifold piping to which it was connected.
- The position of handles or lugs on reducers in use during cargo transfer operations interfered with quick acting coupling devices or the bolting of flanges.
- More than one spool piece or reducer was fitted between the fixed manifold flange and the flange presented for connection.
- The flange face of a manifold reducer, spool piece or other item of portable pipework was visibly damaged, corroded or in an unsatisfactory condition.
- Where a long reducer or spool piece was in use, it was not properly supported to prevent undue stress.
- A manifold reducer, spool piece or other item of portable pipework in use for cargo transfer at the time of the inspection was defective in any respect.
- A manifold reducer, spool piece or other item of portable pipework in use for cargo transfer at the time of the inspection had been repaired but there was no evidence that it had been pressure tested on completion of the repairs.
- A manifold reducer, spool piece or other item of portable pipework was not made of a suitable material compatible with the minimum cargo temperature recorded in the Certificate of Fitness.

8.6.10. Were the Master and officers familiar with the company procedures for carrying out emergency discharge operations, and was any required additional equipment in satisfactory condition?

Short Question Text
Emergency discharge operations

Vessel Types
LPG, LNG

ROVIQ Sequence
Cargo Control Room, Main Deck

Publications
IMO: ISM Code
IMO: IGC Code
SIGTTO: Liquified Gas Handling Principles on Ships and in Terminals. Fourth Edition.

Objective

To ensure the vessel will be able to discharge the cargo safely in the event of equipment failure.

Industry Guidance

SIGTTO: Liquified Gas Handling Principles on Ships and in Terminals. Fourth Edition

4.2.6 Emergency cargo pumps

Emergency cargo pumps are usually found on vessels that are fitted with submerged cargo pumps where other means of removing cargo from a tank, in the event of total pump failure, are not available.

An emergency cargo pump is typically only fitted on membrane ships, although some LPG very large gas carriers (VLGCs) of Type A tank design may also be outfitted with an emergency cargo pump.

Each membrane ship carries an emergency cargo pump that can be used in the event of failure of either one or both cargo pumps in a particular tank. The cargo tanks are equipped with an emergency pump well. This pump well has a foot valve that is held closed by highly loaded springs. The emergency pump is lowered down the well after purging the well with nitrogen (N2). The weight of the pump overcomes the compression of the springs to open the foot valve. It is prudent to maintain a small flow of N2 while the pump is being installed.

It is standard practice to reduce and maintain cargo tank pressure to near atmospheric pressure throughout the installation/fitting.

When not in use, the emergency pump is stowed in a special case (coffin) that has connections to introduce N2. This ensures that the pump can be kept in a ‘dry’ atmosphere prior to use.

Some LPG carriers have permanently installed emergency pumps; others employ a well and foot valve system similar to membrane ships.

Full instructions for fitting and operating the emergency pump will be found in the ship’s cargo operations manual.

TMSA KPI 6.1.1 requires that procedures for cargo, ballast, tank cleaning and bunkering operations are in place for all vessel types within the fleet.

IMO: ISM Code

7. The Company should establish procedures, plans and instructions, including checklists as appropriate, for key shipboard operations concerning the safety of the personnel, ship and protection of the environment. The various tasks involved should be defined and assigned to qualified personnel.

IMO: IGC Code

5.6 Cargo transfer arrangements

5.6.1 Where cargo transfer is by means of cargo pumps that are not accessible for repair with the tanks in service, at least two separate means shall be provided to transfer cargo from each cargo tank, and the design shall be such that failure of one cargo pump or means of transfer will not prevent the cargo transfer by another pump or pumps, or other cargo transfer means.

5.6.2 The procedure for transfer of cargo by gas pressurisation shall preclude lifting of the relief valve during such transfer. Gas pressurization may be accepted as a means of transfer of cargo for those tanks where the design factor of safety is not reduced under the conditions prevailing during the cargo transfer operation. If the cargo tank relief valves or set pressure are changed for this purpose, as is permitted in accordance with 8.2.7 and 8.2.8, the new set pressure shall not exceed Ph as is defined in 4.13.2.

Inspection Guidance

The vessel operator should have developed ship-specific procedures for safely carrying out emergency discharge operations in the event of equipment failure.

In general,

- LNG vessels are fitted with two cargo pumps on each tank.
- LNG membrane vessels are equipped with an emergency cargo pump that can be installed in the tank if both cargo pumps were to fail.
- LNG Moss vessels are not provided with an emergency cargo pump; if both cargo pumps were to fail, any remaining cargo would be transferred to another tank by pressurising the vapour space above the liquid. This operation may require the resetting of the cargo tank relief valves to compensate for the increase in pressure from the normal set pressure.
- Fully and semi-pressurised LPG Carriers use the compressors for emergency discharge operations.

Where an emergency cargo pump is provided, procedures should include guidance on:

- Preparing and installing the emergency cargo pump.
- Operating the emergency cargo pump.
- Storing the emergency cargo pump.
- Inspection and testing of the emergency cargo pump.

Where emergency transfer is achieved by pressurisation, procedures should include guidance on:

- Resetting the cargo tank relief valves, where necessary.

Where emergency transfer is achieved through other means such as eductors, procedures should include guidance on:

- The drive medium for the eductors and avoiding contamination between cargo grades.

<u>Suggested Inspector Actions</u>

- Sight, and where necessary review the company procedures for carrying out emergency discharge operations.

- Verify that the accompanying officer is familiar with the company procedures for carrying out emergency discharge operations.
- Where an emergency cargo pump is provided:
    - Inspect the emergency cargo pump where possible.
    - Verify that inspections and tests had been conducted in accordance with company procedures.

Expected Evidence

- Company procedures for carrying out emergency discharge operations.
- Where carried, the inspection and testing records for the emergency cargo pump.

Potential Grounds for a Negative Observation

- There were no ship-specific company procedures for carrying out emergency discharge operations using an emergency cargo pump or via pressurisation as applicable.
- The accompanying officer was not familiar with the company procedures for carrying out emergency discharge operations.
- Where emergency discharge procedures involved an emergency cargo pump, the pump was:
    - Defective in any respect.
    - Not stored in the required 'dry' atmosphere.
- Where carried, there were no records of the inspection and testing of the emergency cargo pump.
- Where emergency discharge procedures involved pressurisation, they did not give guidance on resetting the cargo tank relief valves where necessary.

8.6.11. Were the Master and officers familiar with the company procedures for the regular inspection and maintenance of cargo and vapour pipeline insulation and expansion arrangements, and were these arrangements in satisfactory condition?

Short Question Text
Cargo and vapour pipeline insulation and expansion arrangements

Vessel Types
LPG, LNG

ROVIQ Sequence
Cargo Control Room, Main Deck

Publications
IMO: ISM Code
IMO: IGC Code
ICS: Tanker Safety Guide (Gas) - Third Edition

Objective

To ensure cargo and vapour line insulation and expansion arrangements are regularly inspected and properly maintained.

Industry Guidance

ICS: Tanker Safety Guide (Gas) - Third Edition

Appendix 3 Cargo Handling Plant and Equipment

A3.11 Expansion Bellows

Bellows may be used to accommodate thermal contraction and expansion in a number of applications including:

- In pipe work systems to accommodate lateral and axial movement;

If used properly, bellows pieces are very durable, but they are vulnerable to misuse and for this reason expansion loops and offsets may be used instead. If bellows are intended to be fitted, the design will take careful account of pressure, temperature, diameters, pipe layout and movements. All associated parts, including anchor points and supports, are vital to safe operation within design limits.

The following precautions should be observed:

- Bellows should never be subjected to unnecessary shocks such as pressure surge;
- Every effort should be made to protect bellows from internal and external damage. Personnel should not stand on or mishandle bellows units;
- For low temperature service, a flexible sleeve may be fitted to protect the unit from excessive ice build-up. Such sleeves should not be permanently removed;
- The design efficiency of anchor points, supports, guides or constraints should be maintained. Their operation should never be impaired, for example by incomplete reassembly, change of position, misalignment of pipe work, or any other action which would place stress on the unit for which it was not designed;
- Bellows should be inspected regularly for cracks, corrosion, cleanliness and signs of excessive wear;
- Before replacement units are installed, it should be determined whether pre-compression or extension is necessary;
- When bellows are stored, they should be properly protected against over-extension, compression, misalignment and mechanical damage;

- When pressure tests are carried out, bellows should be prevented from extending beyond design limits in order to avoid damage or possible bellows failure; and
- Temporary tie-bars or constraints should be removed before cargo service and replaced with normal constraints.

A3.13 Pipeline Supports

Pipeline supports may be of a number of designs. They provide secure mountings which support pipework and prevent transverse movement, but will ensure correct alignment and, at the same time, permit expansion and contraction of pipes without imposing stress.

All supports or anchor points should be correctly assembled and securing devices should be locked securely. Some designs require bolts to be fully tightened but in others clearance is provided. The arrangement should be checked before reassembly. If relative movement is to be provided, all moving surfaces should be clean and, if necessary, lubricated.

In some designs, pipework may be supported by load bearing insulating chocks. The correct type of material should be used, and pieces found to be missing should be replaced to prevent transverse movement and damage.

If the system or part of it is being pressure tested, special care is necessary to ensure that adequate support is given, and that any side forces which may be created are controlled. Sudden pressurisation or depressurization of the system should be avoided.

A3.14 Insulation

Insulation materials intended for use with cold cargoes are easily damaged by high temperatures.

All insulation should be protected against deterioration or mechanical damage in order to preserve the integrity of the ship's structure and, at the same time, prevent a level of cargo boil off which could exceed plant capacity.

Insulation boundaries should be adequately vapour/water sealed to prevent corrosion of the adjoining material. The sealing should be inspected periodically. During maintenance, care should be taken to exclude moisture which may be absorbed by the insulation and reduce its effectiveness.

Occasionally repairs to insulation may be required. Insulation materials should be regarded as flammable and be protected from flames or sparks, with proper firefighting precautions taken. The material may also be toxic and personnel working with it may therefore require additional protection. Adequate ventilation during work should be provided.

TMSA KPI 4.1.1 requires that each vessel in the fleet is covered by a planned maintenance system and spare parts inventory which reflects the company's maintenance strategy. The company identifies all equipment and machinery required to be included in the planned maintenance system, for example:

- Cargo handling machinery/equipment.

IMO: ISM Code

10.1 The Company should establish procedures to ensure that the ship is maintained in conformity with the provisions of the relevant rules and regulations and with any additional requirements which may be established by the Company.

IMO: IGC Code

5.7 Installation requirements

5.7.1 Design for expansion and contraction

Provision shall be made to protect the piping, piping system and components and cargo tanks from excessive stresses due to thermal movement and from the movements of the tank and hull structure. The preferred method outside the cargo tanks is by means of offsets, bends or loops, but multi-layered bellows may be used if offsets, bends or loops are not practicable.

5.7.2 Precautions against low temperature

Low temperature piping shall be thermally isolated from the adjacent hull structure, where necessary, to prevent the temperature of the hull from falling below the design temperature of the hull material. Where liquid piping is dismantled regularly, or where liquid leakage may be anticipated, such as at shore connections and at pump seals, protection for the hull beneath shall be provided.

5.8.4 Expansion joints

Where bellows and expansion joints are provided in accordance with 5.7.1, the following requirements apply:

1. if necessary, bellows shall be protected against icing; and
2. slip joints shall not be used except within the cargo tanks.

5.12.3 Cargo piping insulation system

5.12.3.1 Cargo piping systems shall be provided with a thermal insulation system as required to minimise heat leak into the cargo during transfer operations and to protect personnel from direct contact with cold surfaces.

5.12.3.2 Where applicable, due to location or environmental conditions insulation materials shall have suitable properties of resistance to fire and flame spread and shall be adequately protected against penetration of water vapour and mechanical damage.

5.12.4 Where the cargo piping system is of a material susceptible to stress corrosion cracking in the presence of salt-laden atmosphere, adequate measures to avoid this occurring shall be taken by considering material selection, protection of exposure to salty water and/or readiness for inspection.

Inspection Guidance

The vessel operator should have developed procedures for the inspection and maintenance of cargo and vapour pipeline insulation and expansion arrangements. Inspections should cover all cargo and vapour lines and include:

- Pipeline insulation and covers where fitted.
- Expansion bellows, bends and/or loops.
- Pipeline supports, clamps and insulating chocks.

More comprehensive inspections of pipeline insulation involving techniques such as profile radiography, ultrasonic spot readings, and/or insulation removal may be performed during repair periods.

Records should be maintained of inspections and include details of any repairs made to insulation or expansion arrangements.

These procedures and associated records may form part of the vessel’s maintenance plan.

Suggested Inspector Actions

- Sight, and where necessary review, the company procedures for the regular inspection and maintenance of cargo and vapour pipeline insulation and expansion arrangements.
- Review the records of the regular inspection and maintenance of cargo and vapour pipeline insulation and expansion arrangements.

- During the inspection of the main deck inspect the cargo and vapour pipeline insulation, where fitted, and expansion arrangements.
- Where necessary, compare the observed condition with the records of inspection and maintenance of the cargo and vapour pipeline insulation and expansion arrangements.

Expected Evidence

- The company procedures for the regular inspection and maintenance of cargo and vapour pipeline insulation and expansion arrangements.
- Records of the regular inspection and maintenance of cargo and vapour pipeline insulation and expansion arrangements.

Potential Grounds for a Negative Observation

- There were no company procedures for the regular inspection and maintenance of cargo and vapour pipeline insulation and expansion arrangements.
- Inspection and maintenance of cargo and vapour pipeline insulation and expansion arrangements had not been carried out in accordance with the company procedures.
- A section of cargo or vapour pipeline insulation had been removed and not replaced.
- Cargo or vapour pipeline insulation was cracked or otherwise damaged (give details).
- Icing on pipework insulation indicated a local failure of the insulation.
- There was evidence of corrosion on the pipework underneath the insulation.
- Bellows were found to be defective in some respect e.g. mechanical damage, cracks, corrosion, pin-hole leaks, or signs of excessive wear.
- Bellows were fitted with temporary tie-bars or constraints.
- A flexible sleeve was missing from a bellows where previously fitted.
- Pipelines were not free to move within their clamps.
- Pipe workload bearing insulating chocks were:
    - Constructed of the incorrect material.
    - Wholly or partly missing.
- Cargo and/or vapour pipeline insulation arrangements were defective in any respect.
- Cargo and/or vapour pipeline expansion arrangements were defective any respect.

8.6.12. Were the Master and officers familiar with the company procedures relating to the safety, rescue and recovery equipment, including SCBAs, required by the IGC Code, and was the equipment ready for immediate use?

Short Question Text
IGC safety, rescue and recovery equipment

Vessel Types
LPG, LNG

ROVIQ Sequence
Cargo Control Room, Main Deck

Publications
IMO: ISM Code
IMO: IGC Code
ICS: Tanker Safety Guide (Gas) - Third Edition

Objective

To ensure the safety, rescue and recovery equipment required by the IGC Code is always ready for immediate use in the event of an emergency.

Industry Guidance

ICS: Tanker Safety Guide (Gas) - Third Edition

8.7.5 Rescue and Recovery Equipment

8.7.5.2 Stretcher

When selecting a stretcher for enclosed space rescues the following should be considered:

- In enclosed spaces where a vertical lift is required the stretcher should be able to secure the casualty properly and prevent injury;
- The stretcher and casualty should be able to pass through the enclosed space openings and around tight corners; and
- The stretcher should be capable of being handled by rescuers wearing full protective equipment.

8.7.5.3 Breathing Apparatus

The following should be considered:

- The design of the apparatus should be lightweight and enable the wearer to access confined spaces without the need to remove it; and
- Radio communication should be possible when using the breathing apparatus.

8.7.5.4 Resuscitation Equipment

The following should be considered:

- It should be light, portable and preferably capable of being recharged on board;
- It should be provided with a manual and automatic resuscitation system; and
- Due to the potential fire risk, pure oxygen should not be used for resuscitation in an enclosed space.

TMSA KPI 6.1.4 requires that the company has procedures that address cargo specific hazards for all vessel types within the fleet. Cargoes with specific hazards may include:

- Aromatic hydrocarbons.
- Toxic cargoes.
- Incompatible cargoes.
- High vapour pressure cargoes.
- Cargoes containing mercaptans and/or H2S.

IMO: ISM Code

7. The Company should establish procedures, plans and instructions, including checklists as appropriate, for key shipboard operations concerning the safety of the personnel, ship and protection of the environment. The various tasks involved should be defined and assigned to qualified personnel.

IMO: IGC Code

Chapter 11

Fire protection and fire extinction

11.6 Firefighter's outfits

11.6.1 Every ship carrying flammable products shall carry firefighter's outfits complying with the requirements of regulation II-2/10.10 of the SOLAS Convention, as follows:

Total cargo capacity	Number of outfits
5,000 m^3 and below	4
Above 5,000 m^3	5

11.6.2 Additional requirements for safety equipment are given in chapter 14.

11.6.3 Any breathing apparatus required as part of a firefighter's outfit shall be a self-contained compressed air-operated breathing apparatus having a capacity of at least 1,200 â„“ of free air.

Chapter 14 Personnel protection

14.1.2 Personal protective and safety equipment required in this chapter shall be kept in suitable, clearly marked lockers located in readily accessible places.

14.1.3 The compressed air equipment shall be inspected at least once a month by a responsible officer and the inspection logged in the ship's records. This equipment shall also be inspected and tested by a competent person at least once a year.

14.2 First-aid equipment

14.2.1 A stretcher that is suitable for hoisting an injured person from spaces below deck shall be kept in a readily accessible location.

14.2.2 The ship shall have onboard medical first-aid equipment, including oxygen resuscitation equipment, based on the requirements of the Medical First Aid Guide (MFAG) for the cargoes listed on the International Certificate of Fitness for the Carriage of Liquefied Gases in Bulk shown in appendix 2.

14.3 Safety equipment

14.3.1 Sufficient, but not less than three complete sets of safety equipment shall be provided in addition to the firefighter's outfits required by 11.6.1. Each set shall provide adequate personal protection to permit entry and work in a gas-filled space. This equipment shall take into account the nature of the cargoes, listed on the International Certificate of Fitness for the Carriage of Liquified Gases in Bulk shown in appendix 2.

14.3.2 Each complete set of safety equipment shall consist of:

1. one self-contained positive pressure air-breathing apparatus incorporating full face mask, not using stored oxygen and having a capacity of at least 1,200 â„“ of free air. Each set shall be compatible with that required by 11.6.1;
2. protective clothing, boots and gloves to a recognized standard;
3. steel-cored rescue line with belt; and
4. explosion-proof lamp.

14.3.3 An adequate supply of compressed air shall be provided and shall consist of:

1. at least one fully charged spare air bottle for each breathing apparatus required by 14.3.1;
2. an air compressor of adequate capacity capable of continuous operation, suitable for the supply of high-pressure air of breathable quality; and
3. a charging manifold capable of dealing with sufficient spare breathing apparatus air bottles for the breathing apparatus required by 14.3.1.

14.4.4 The protective clothing required under 14.3.2.2 shall be gastight.

Inspection Guidance

Re IGC 14.3.1, for vessels delivered before 01 July 2016, a minimum of two sets of safety equipment are required, for vessels delivered after 01 July 2016, a minimum of three.

A 'competent person' in the context of the question may be a member of the crew provided that:

- The crew member who conducted the annual service had attended a manufacturer's training course for the specific type of SCBA carried on board within the five years prior the last service.
- The specialist testing equipment required to complete the annual service in accordance with the manufacturer's instructions was available on board at the time of the annual service.
- A copy of the manufacturer's training course certificate for the member of the crew who conducted the annual service was retained with the maintenance records.

The operator should have developed procedures relating to the safety equipment, including SCBAs, required by the IGC Code, giving guidance on:

- Stowing and maintaining readiness of the equipment.
- Inspection and testing of the SCBAs.
- Non-emergency use of the SCBAs, including maximum individual daily use and required rest periods.
- Use of the oxygen resuscitation equipment.

The protective suits provided should be gastight, for use in a flammable atmosphere, and suitable for all the cargoes listed on the vessel’s International Certificate of Fitness for the Carriage of Liquified Gases in Bulk, appendix 2.

For vessels carrying toxic cargoes, the safety equipment referred to above should provide full protection. The protective suits themselves should be fitted with integral gloves and boots and capable of providing adequate protection against the product, as indicated in the resistance table provided by the manufacturer. The responsible officer should be aware of any limitations as they relate to the cargoes being carried. Such protective suits are not required if the vessel does not carry toxic cargoes.

Some of these procedures may form part of the onboard maintenance plan.

Suggested Inspector Actions

- Sight, and where necessary review, company procedures for the use of the safety equipment, including SCBAs, required by the IGC Code.
- Review the records of inspection and testing of the SCBAs forming part of the safety equipment required by the IGC.
- Review the documentation supporting the appointment of a crew member as the designated competent person responsible for annual inspection and testing of the SCBAs required by the IGC, where applicable.
- Inspect at least one set of safety equipment required by the IGC Code.
- Inspect the stretcher and oxygen resuscitation equipment.
- If the vessel is over 5000m^3 total cargo capacity, verify that there are five firefighter's outfits on board, in addition to the minimum of two or three safety equipment sets required.

- Interview the accompanying officer to verify their familiarity with company procedures for the use of the safety equipment, including SCBAs and oxygen resuscitation equipment, required by the IGC Code.

Expected Evidence

- Company procedures for the use of the safety equipment, including SCBAs, required by the IGC Code.
- Records of inspection and testing of the SCBAs forming part of the safety equipment required by the IGC.
- Evidence that the protective suits were suitable for:
    - All the cargoes listed on the International Certificate of Fitness for the Carriage of Liquified Gases in Bulk.
    - Use in a flammable atmosphere.
- Where annual testing of the SCBAs had been conducted by a 'competent person' who was a member of the crew, a copy of the manufacturer's training course certificate for the specific type of SCBA carried on board for the crewmember who performed the service.

Potential Grounds for a Negative Observation

- There were no company procedures relating to the safety equipment, including SCBAs, required by the IGC Code, giving guidance on:
    - Stowage and maintaining readiness of the equipment.
    - Inspection and testing of the SCBAs.
    - Non-emergency use of the SCBAs, including maximum individual daily use and required rest periods.
    - Use of the oxygen resuscitation equipment.
- The accompanying officer was not familiar with the company procedures relating to the safety equipment, including SCBAs and/or oxygen resuscitation equipment, required by the IGC Code.
- There were fewer than two/three complete sets of safety equipment on board, in addition to the four or five sets required by the IGC for fire-fighting purposes.
- A set of safety equipment did not contain:
    - one self-contained, positive pressure air-breathing apparatus incorporating full face mask, not using stored oxygen, having a capacity of at least 1,200 â„“ of free air and compatible with those forming part of the firefighter's outfits.
    - protective clothing, boots and gloves to a recognized standard;
    - steel-cored rescue line with belt; and
    - explosion-proof lamp.
- For the safety equipment required by the IGC, the vessel was not equipped with:
    - at least one fully charged spare air bottle for each breathing apparatus.
    - an air compressor of adequate capacity capable of continuous operation, suitable for the supply of high-pressure air of breathable quality; and

    - a charging manifold capable of dealing with sufficient spare breathing apparatus air bottles for the breathing apparatus.
- The protective suits forming part of the safety equipment were not suitable for:
    - All the cargoes listed on the International Certificate of Fitness for the Carriage of Liquified Gases in Bulk
    - Use in a flammable atmosphere.
    - Gastight
- Where annual testing of the SCBAs had been conducted by a 'competent person' who was a member of the crew, there was no evidence that the crewmember who performed the service was in possession of a valid manufacturer's training course certificate for the specific type of SCBA carried on board.
- The oxygen resuscitation was not in satisfactory condition and/or the oxygen bottle was not fully charged.
- Records of monthly inspection or annual inspection and testing of the SCBA were either missing or incomplete.

8.6.13. Were the Master and officers familiar with the company procedures addressing the protective equipment required by the IGC Code, and was this equipment in satisfactory condition and suitable for the products being handled?

Short Question Text
Protective equipment required by the IGC Code

Vessel Types
LPG, LNG

ROVIQ Sequence
Cargo Control Room, Main Deck

Publications
IMO: ISM Code
IMO: IGC Code
ICS: Tanker Safety Guide (Gas) - Third Edition

Objective

To ensure crew members are protected from exposure to hazardous conditions when engaged in cargo operations.

Industry Guidance

ICS: Tanker Safety Guide (Gas) - Third Edition

3.11.2 Personal protective equipment

Personal protective equipment (PPE) including appropriate protective clothing should be worn as necessary to protect those involved in cargo operations from the hazards associated with the cargo. The suits, gloves, boots, goggles, face-shields and other items used should be suitable for the cargo. Many plastics become brittle and crack when subjected to low temperatures, or can be dissolved by the cargo, although clothing of PVC or similar material is less susceptible to absorption and should be worn when exposure to vapour or liquid emissions is involved.

In particular, gloves should be worn when handling cold equipment, valves or sampling devices. Face protection should be worn to protect against liquid contact, including when dismantling cargo equipment or conducting sampling. Respiratory protection should be worn during cargo operations involving toxic or asphyxiating gases.

Appendix 10 of this Guide provides an example of a matrix that may be used to describe the PPE required to be worn by personnel when undertaking a number of shipboard tasks. The matrix should be adapted to suit the requirements of individual operators and ships and should be included in the SMS.

When considering the PPE required for handling a particular cargo, reference should be made to the recommendations contained in the relevant cargo safety data sheets provided in Appendix 1 of this Guide.

Cargo vapour may be absorbed into working clothing in sufficient quantities to create a hazard when taken into the accommodation and associated areas.

When dealing with cryogenic liquids certain additional precautions should be taken, including:

- Eye protection. Even for minor risks of liquid splashes, suitable eye and face protection should be worn combining goggles and a face shield;
- Hand protection. Loose fitting insulated gloves should be worn whenever a risk of splashes is present and when handling material that could have been in contact with cryogenic liquid. It should be possible to quickly discard the gloves should liquid be spilt on them;

- Body protection. For minor risks of small quantities of liquid splashed, non-absorbent PPE can be used (e.g., a leather apron or a splash suit). Care should be taken that no liquid can get trapped in pockets or cuffs; and
- Foot protection. Splashed liquid can enter safety shoes. It is therefore recommended that boots are worn. Care should be taken that spilled liquid cannot enter boots by wearing trousers over them.

TMSA KPI 6.1.4 requires that the company has procedures that address cargo specific hazards for all vessel types within the fleet.

IMO: ISM Code

7. The Company should establish procedures, plans and instructions, including checklists as appropriate, for key shipboard operations concerning the safety of the personnel, ship and protection of the environment. The various tasks involved should be defined and assigned to qualified personnel.

IMO: IGC Code

Chapter 14 Personnel protection

14.1 Protective equipment

14.1.1 Suitable protective equipment, including eye protection to a recognized national or international standard, shall be provided for protection of crew members engaged in normal cargo operations, taking into account the characteristics of the products being carried.

14.1.2 Personal protective and safety equipment required in this chapter shall be kept in suitable, clearly marked lockers located in readily accessible places.

Inspection Guidance

The vessel operator should have developed procedures addressing the protective equipment required by the IGC that included:

- A list of protective equipment to be available on board based upon risk assessment and considering the products to be carried.
- What protective equipment is required to be worn for the different types of operations on board, and products handled, preferably in the form of a PPE matrix.
- Crew training in the correct use of the protective equipment.
- Checks to be made that protective equipment is being correctly worn prior to entering a working area.
- Assessment of a user's fitness to wear particular protective equipment in given climatic conditions.
- Guidelines for the maximum time a person is allowed to work in a chemical suit, if applicable.
- How protective equipment should be cleaned and stored.
- Actions to be taken if defects are identified in protective equipment.
- Frequency of inspection of the protective equipment and records to be kept.

Suggested Inspector Actions

- Sight, and where necessary review, company procedures, including the PPE matrix where provided, addressing the protective equipment required by the IGC Code.
- Review the records of inspections of the protective equipment.
- Inspect a representative sample of the protective equipment in the storage location(s).
- Observe, where possible, protective equipment in use on deck.

- Interview the officer in charge of cargo operations to verify their familiarity with company procedures, including the PPE matrix where provided, addressing the protective equipment required by the IGC Code.
- Request a deck officer or rating to demonstrate or describe the selection and donning of a full set of protective equipment including a protective suit.

Expected Evidence

- Company procedures, including PPE matrix where provided, addressing the protective equipment required by the IGC Code.
- Records of inspections of the protective equipment.
- An inventory of the protective equipment available onboard required by the IGC Code.
- SDS for the products being handled.
- Chemical resistance list available for the protective suits provided on board.
- Evidence that protective suits were suitable for use in a flammable atmosphere.

Potential Grounds for a Negative Observation

- There were no company procedures addressing the protective equipment required by the IGC that included:
    - A list of protective equipment to be available on board based upon risk assessment and considering the products to be carried.
    - What protective equipment was required to be worn for the different types of operations on board, and products handled, preferably in the form of a PPE matrix.
    - Crew training in the correct use of the protective equipment.
    - Checks to be made that protective equipment is being correctly worn prior to entering a working area.
    - Assessment of a user's fitness to wear particular protective equipment in given climatic conditions.
    - Guidelines for the maximum time a person is allowed to work in a chemical suit, if applicable.
    - How protective equipment should be cleaned and stored.
    - Actions to be taken if defects are identified in protective equipment.
    - Frequency of inspection of the protective equipment and records to be kept.
- The officer in charge of cargo operations was not familiar with the company procedures addressing the protective equipment required by the IGC Code.
- A crew member was observed not wearing adequate protective clothing where there was a risk of accidental exposure to toxic or corrosive products or their vapours.
- A crew member was observed wearing protective clothing incorrectly where there was a risk of accidental exposure to toxic or corrosive products or their vapours.
- Protective equipment in use did not provide the degree of protection specified as being required in the SDS of a cargo being handled.
- Safety spectacles were being used as eye protection against splashes.
- Protective equipment was not stored in an easily accessible, ventilated space, designed for the purpose.
- Protective equipment in use was stored within the accommodation in an unauthorised space or spaces.
- Items of the protective equipment required by company procedures were not available on board.
- There was no chemical resistance list available for the protective suits provided on board.
- There was no evidence that chemical suits were suitable for use in a flammable atmosphere.
- An item of protective equipment in use was in poor condition.
- Gloves, boots and/or head gear were of inferior chemical resistance to that of the protective suits provided.
- Suitable protective equipment was not available in the quantity and range of sizes required to fit the crew on board.
- A deck officer or rating was unfamiliar with the selection and donning of a full set of protective equipment including a protective suit.

8.6.14. Were the Master and officers familiar with the company procedures for the safe operation and maintenance of the reliquefaction plant, and was the equipment in satisfactory condition?

Short Question Text
Reliquefaction plant

Vessel Types
LPG, LNG

ROVIQ Sequence
Cargo Control Room, Compressor Room

Publications
IMO: ISM Code
IMO: IGC Code
SIGTTO: Liquified Gas Handling Principles on Ships and in Terminals. Fourth Edition.
ICS: Tanker Safety Guide (Gas) - Third Edition

Objective

To ensure the safe operation of the reliquefaction plant.

Industry Guidance

SIGTTO: Liquified Gas Handling Principles on Ships and in Terminals. Fourth Edition.

7.8.2 Operation of the reliquefaction plant on refrigerated LPG carriers

On a loaded voyage, and depending on cargo temperature, ambient temperature and the design of tank insulation, the plant may be operated continuously or intermittently. If it is necessary to reduce the temperature of the cargo before reaching the discharge port, to comply with the receiving terminals requirements or charterparty stipulations for example, the plant will potentially operate continuously for long periods of time.

Before starting the reliquefaction plant it is necessary to ensure that, for example, oil levels in the compressors are correct and that the glycol/water cooling system is ready for operation. This will require a check to make sure the header tank is full and that the cooling fluid is circulating.

The lubricating oil in the compressors will need to be compatible with the cargo being handled and may need to be changed, depending on the change of grades of cargo carried on a specific voyage.

Before starting a cargo compressor, the condenser cooling system will normally be operating with sea water circulating or the refrigerant system in cascade systems running. Compressors should always be started and stopped in accordance with the manufacturer’s instructions. Compressor outlet valves will normally be opened fully, and inlet valves opened slowly to minimise the risk of damage from liquid carry-over. The jacket cooling water outlet temperature should be adjusted in accordance with the manufacturer’s instructions. The following conditions, amongst others, will usually be checked regularly during operation:

- Suction, interstage and discharge pressures.
- Lubricating oil pressures.
- Gas temperature on the suction and delivery side of the compressor (note: high discharge temperature switches may only initiate an alarm and not a protective trip of the compressor). Compressor parameters should be plotted against the appropriate Mollier diagram for the cargo to show if the operation is as efficient as the design condition.
- Current drawn by the electric motor.
- Oil leakage from the shaft seal.
- Condenser cooling water temperature (inlet and outlet).

Compressor discharge temperature limits should generally be set in accordance with the compressor manufacturer and cargo operation manual requirements. For example, butadiene, mixed C4 and VCM vapours have reduced temperature limits to prevent polymerisation reaction in the vapour phase.

Stopping the compressor will normally be followed by closure of the inlet and outlet valves. The glycol/water system will usually be left running to provide crankcase heating or, alternatively, the lubricating oil heater will be switched on.

7.8.3 Operation of the reliquefaction plant on LNG carriers

Where fitted, the primary means of tank pressure control is through the reliquefaction plant. The gas combustion unit (GCU) is the secondary means of tank pressure control that is used, either through excess BOG mode or if there is a fault with the reliquefaction plant.

For the reliquefaction plant operation there are two modes of tank pressure control available: laden and ballast.

On loaded passage, depending on the temperature of cargo loaded, ambient temperature and the design of the tank insulation spaces, the load and operation of the reliquefaction plant can be operated at maximum efficiency. Cargo conditioning is carried out keeping in mind the requirements of the discharge terminal with respect to the cargo temperature and vapour pressure. The vapour pressure required to be maintained is entered as the set point value in the reliquefaction controller. This governs the load and flow through the reliquefaction plant to maintain the actual pressures in accordance with the setpoint. Excess BOG is normally disposed of via the GCU.

If a ship has previously completed a warm ballast passage it normally takes about 2 days for the insulation spaces to cool down fully after the loading. During these first days the generation of cargo vapour is usually higher.

The following will usually need to be checked regularly:

- Cargo tank liquid levels so the condensate return can be lined up.
- cargo tank pressures so that the BOG compressor flow and the reliquefaction load can be adjusted to optimise the operation and fuel consumption.
- BOG, condensate and refrigeration system parameters, such as:
    - suction and discharge pressures of each stage
    - LNG condensate return temperature and pressures
    - dew point
    - flow rates
    - seal gas pressures and temperatures
    - machinery lube oil levels, temperature, pressure, shaft bearing temperatures and vibration levels.

ICS: Tanker Safety Guide (Gas) - Third Edition

6.9.2 Reliquefaction and Boil-Off Control

In addition to the specific operating instructions for the reliquefaction system installed on board, the following should be noted:

- If two or more cargoes are carried simultaneously, they should be segregated throughout all cargo operations, including during reliquefaction. Particular care is required with incompatible cargoes;
- Gas detection equipment in spaces containing reliquefaction plant, instrumentation and controls should always be activated. Upper and lower sample points, if fitted, should be selected according to the relative vapour density of the cargo;
- Ventilation equipment for the reliquefaction plant space should be started well in advance of activating the plant;
- Filters on the suction side of compressors should be checked and carefully cleaned if necessary. If they are blocked, the efficiency of the plant may be significantly reduced;
- The lubricants used for all machinery should be compatible with the cargoes carried and suitable for the temperatures and pressures experienced both in operation and when stopped. Oil levels should be checked, and crankcase heaters started, if necessary, before plant or machinery started;

- All plant, machinery, instrumentation, control and shutdown equipment should be tested on a regular basis;
- The precautions against ice and hydrate formation, reactivity, and cargo contamination should be observed;
- All pipelines and valves should be checked and verified to ensure that they are correctly set before starting the plant or machinery;
- To prevent overheating, the cooling water supply to condensers should be established and the refrigerant system, if fitted, started before cargo compressors are run;
- Cargo compressor should never be operated with discharge valves shut;
- Sub-atmospheric pressures should normally be avoided in any part of the system to prevent the ingress of air;
- Refrigerant or cargo vapour compressors should be started with suction valve slightly open to control the load on the compressor. The plant should be started on the minimum setting and the capacity increased gradually as necessary;
- Care should be taken to prevent liquid cargo from entering compressors and potentially causing severe mechanical damage if liquid separation equipment is not fitted. This could be a significant problem which may require shutdown of compressors, particularly during heavy weather and during the spray cooling of cargo tanks.
- Operation of the reliquefaction plant may be affected by any incondensable gases in the vapour drawn from the cargo tanks. These incondensable gases may originate from the cargo itself or maybe residual inert gas from previous purging. Incondensable gases will cause abnormally high condenser pressures and will reduce condensation of the cargo vapour. To establish full condensation, the incondensable gases should be vented regularly. Problems with incondensable gases mainly arise during the early stages of reliquefaction;
- Reliquefaction plant liquid level should be checked regularly during operation to prevent overfilling of receivers or condensers, which may be caused by sticking control valves or expansion valves. Comprehensive records should be maintained so that any unexpected changes can be quickly identified, and remedial action taken;
- If condensate is returned to more than one tank simultaneously, or if vapour is taken from several tanks and is returned to a single tank, the liquid level should be checked regularly, and remedial action taken to avoid possible overfilling; and
- It is recognised that high level alarms may not be engaged to avoid excessive spurious alarms due to cargo movement in a seaway. Operating procedures should address the need to carefully monitor tank levels, particularly if reliquefaction returns are to a single tank.

Flammable vapour/air mixtures should never be passed through cargo compressors.

TMSA KPI 6.1.1 requires that procedures for cargo, ballast, tank cleaning and bunkering operations are in place for all vessel types within the fleet. The procedures include:

- Cargo and ballast handling.
- Maintaining safe tank atmospheres.
- Record keeping.

IMO: ISM Code

7. The Company should establish procedures, plans and instructions, including checklists as appropriate, for key shipboard operations concerning the safety of the personnel, ship and protection of the environment. The various tasks involved should be defined and assigned to qualified personnel.

IMO: IGC Code

7.1.3 Venting of the cargo to maintain cargo tank pressure and temperature shall not be acceptable except in emergency situations. The Administration may permit certain cargoes to be controlled by venting cargo vapours to the atmosphere at sea. This may also be permitted in port with the authorization of the port Administration.

7.3 Reliquefaction of cargo vapours

7.3.1 General

The reliquefaction system may be arranged in one of the following ways:

1. a direct system, where evaporated cargo is compressed, condensed and returned to the cargo tanks;
2. an indirect system, where cargo or evaporated cargo is cooled or condensed by refrigerant without being compressed;
3. a combined system, where evaporated cargo is compressed and condensed in a cargo/ refrigerant heat exchanger and returned to the cargo tanks; and
4. if the reliquefaction system produces a waste stream containing methane during pressure control operations within the design conditions, these waste gases, as far as reasonably practicable, are disposed of without venting to atmosphere.

Note: The requirements of chapter 17 and 19 may preclude the use of one or more of these systems or may specify the use of a particular system.

7.3.2 Compatibility

Refrigerants used for reliquefaction shall be compatible with the cargo they may come into contact with. In addition, when several refrigerants are used and may come into contact, they shall be compatible with each other.

17.1 General

The requirements of this chapter are applicable where referenced thereto is made in column ‘i’ in the table of chapter 19. These requirements are additional to the general requirements of the Code.

17.4 Refrigeration systems

17.4.1 Only the indirect system described in 7.3.1.2 shall be used.

17.4.2 For a ship engaged in the carriage of products that readily form dangerous peroxides, recondensed cargo shall not be allowed to form stagnant pockets of uninhibited liquid. This may be achieved either by:

1. using the indirect system described in 7.3.1.2, with the condenser inside the cargo tank; or
2. using the direct system or combined system described in 7.3.1.1 and.3 respectively, or the indirect system described in 7.3.1.2 with the condenser outside the cargo tank and designing the condensate system to avoid any places in which liquid could collect and be retained. Where this is impossible, inhibited liquid shall be added upstream of such a place.

17.4.3 If the ship is to consecutively carry products as specified in 17.4.2 with a ballast passage between, all uninhibited liquid shall be removed prior to the ballast voyage. If a second cargo is to be carried between such consecutive cargoes, the reliquefaction system shall be thoroughly drained and purged before loading the second cargo. Purging shall be carried out using either inert gas or vapour from the second cargo, if compatible. Practical steps shall be taken to ensure that polymers or peroxides do not accumulate in the cargo system.

18.10 Cargo emergency shutdown (ESD) system

18.10.1.2 Auxiliary systems for conditioning the cargo that use toxic or flammable liquids or vapours shall be treated as cargo systems for the purpose of ESD. Indirect refrigeration systems using an inert medium, such as nitrogen need not be included in the ESD function.

Inspection Guidance

The vessel operator should have developed procedures for the operation, testing and maintenance of the reliquefaction plant, machinery, instrumentation, control and shutdown equipment, including, as applicable:

- Roles and responsibilities for operation, testing and maintenance.
- Description of the reliquefaction system, its components and its functions.

- Procedures for start-up and shut-down of the system.
- Regular checks including:
    - compressor lubrication oil levels,
    - suction filters
    - reliquefaction plant liquid level during operation to prevent overfilling of receivers or condensers.
- Periodic inspections, tests and maintenance of the equipment including pressure tests of the condensers and calibration of the instrumentation.
- Compatibility of compressor lubrication oil with the cargoes carried.
- Compatibility of refrigerants with the cargoes carried and other refrigerants in use.
- Segregating reliquefaction systems for incompatible cargoes.
- Reliquefaction of inhibited cargoes.
- Dealing with incondensable gases.
- Prevention of overfilling of cargo tanks via reliquefication including setting high-level alarms.
- Integration of the reliquefaction system into the cargo ESD system or any independent shutdown system for the reliquefaction plant.
- The secondary tank pressure management system to be used at sea in the event of a shutdown of the reliquefaction system.

All or part of the above may be contained in the Cargo System Operation Manual and the vessel's maintenance plan.

Suggested Inspector Actions

- Sight, and where necessary review, the company procedures for the operation, testing and maintenance of the reliquefaction plant, machinery, instrumentation, control and shutdown equipment.
- Review the records of inspection, maintenance and testing of the reliquefaction equipment.
- Where necessary, compare the observed condition with the records of inspection, maintenance, testing of the reliquefaction equipment.

- Interview the accompanying officer to verify their familiarity with the company procedures for the operation, testing and maintenance of the reliquefaction plant, machinery, instrumentation, control and shutdown equipment.
- During the physical inspection of the vessel inspect the reliquefaction plant and its associated equipment.

Expected Evidence

- The company procedures for the operation, testing and maintenance of the reliquefaction plant, machinery, instrumentation, control and shutdown equipment.
- Record of inspection, maintenance and testing of the reliquefaction system.
- Test records for safety relief valves fitted to reliquefaction system.
- Records of regular checks of reliquefaction plant liquid level during operation.

Potential Grounds for a Negative Observation

- There were no company procedures for the operation, testing and maintenance of the reliquefaction plant, machinery, instrumentation, control and shutdown equipment that included, as applicable:
    - Roles and responsibilities for operation, testing and maintenance.
    - Description of the reliquefaction system, its components and its functions.
    - Procedures for start-up and shut-down of the system.
    - Regular checks including:
        - compressor lubrication oil levels,
        - suction filters
        - reliquefaction plant liquid level during operation to prevent overfilling of receivers or condensers.

    - Periodic inspections, tests and maintenance of the equipment including pressure tests of the condensers and calibration of the instrumentation.
    - Compatibility of compressor lubrication oil with the cargoes carried.
    - Compatibility of refrigerants with the cargoes carried and other refrigerants in use.
    - Segregating reliquefaction systems for incompatible cargoes.
    - Reliquefaction of inhibited cargoes.
    - Dealing with incondensable gases.
    - Prevention of overfilling of cargo tanks via reliquefication including setting high-level alarms.
    - Integration of the reliquefaction system into the cargo ESD system or any independent shutdown system for the reliquefaction plant.
    - The secondary tank pressure management system to be used at sea in the event of a shutdown of the reliquefaction system.
- The accompanying officer was not familiar with the company procedures for the operation, testing and maintenance of the reliquefaction plant, machinery, instrumentation, control and shutdown equipment.
- Inspection, testing and maintenance of the reliquefaction plant had not been carried out in accordance with the company procedures.
- Refrigerant in use was not compatible with the cargo.
- Compressor lubricating oil level was found to be low.
- Compressor lubricating oil was not compatible with the cargo.
- There were no records of regular checks of reliquefaction plant liquid levels during operation to prevent overfilling of receivers or condensers.
- Compressor discharge temperature limits were not set in accordance with the compressor manufacturer and cargo operation manual requirements.
- The reliquefaction plant was defective in any respect.
- There were no records of inspection, testing and maintenance of the reliquefaction plant including safety relief valves, where fitted.
- Cargo was being or had been vented to atmosphere to control tank pressure without flag and/or port state authorisation.

8.6.15. Were the Master and officers familiar with the company procedures for the safe operation and maintenance of the cargo heaters, vaporisers and condensers, and was the equipment in satisfactory condition?

Short Question Text
Cargo heaters, vaporisers and condensers

Vessel Types
LPG, LNG

ROVIQ Sequence
Cargo Control Room, Compressor Room

Publications
SIGTTO: Liquified Gas Handling Principles on Ships and in Terminals. Fourth Edition.
ICS: Tanker Safety Guide (Gas) - Third Edition
IMO: ISM Code
IMO: IGC Code

Objective

To ensure the safe operation of the cargo heaters, vaporisers and condensers.

Industry Guidance

SIGTTO: Liquified Gas Handling Principles on Ships and in Terminals. Fourth Edition.

4.4 Cargo heaters

Ordinarily, refrigerated cargo will need to be heated before it can be transferred into pressurised storage systems, to avoid low temperature embrittlement of the cargo tanks and pipelines. Heating can take place while loading a cold cargo into a pressurised ship or when discharging a refrigerated cargo into pressurised tanks ashore.

4.4.1 Direct cargo heaters

A cargo heater is usually a conventional horizontal shell and tube type exchanger and is normally mounted in the open air on the ships deck. The cargo passes through one side of the tubes while the sea water flows on the other side before going overboard. They are known as direct heaters.

There is a requirement for temperature controls and alarms to avoid freezing as this is a risk that always has to be guarded against.

For safety reasons, the cargo flow into direct heaters will usually need to be controlled so that the sea water outlet temperature never falls below 5ºC, to help protect the heater against freezing in the event of a sudden loss of water flow.

Consideration should also be given when the heater is used in river berths, where the water is ‘fresh’ (which freezes at about 0ºC) rather than ‘salt’ (which freezes at about minus 2ºC (-2ºC)).

Before start-up, it is prudent to test both cargo and water sides for leakage and test water flow shutdowns as well.

Specific instructions will, ordinarily, be available on board to cover the testing, operation and maintenance of the particular heater installed. They will, amongst other things:

- Identify the various alarms fitted to protect the unit.
- Indicate how to test these alarms before use.

- Provide correct start-up sequence and procedures.
- Explain how to regulate cargo flow during operations.
- State how to shut down the heater correctly after use.

It is common practice to start the heating water flow some time before cold cargo is admitted to allow conditions to stabilise and, after the transfer is completed, to keep the water flow running until well after any liquid cargo has been drained off from the unit (typically one hour before and one hour after operations).

After use, some heaters require fresh water washing and isolation from the sea water system to prevent corrosion when not in use. In some cases, the cargo heater may have to be isolated and filled with an anti-corrosive.

Some designs include a fixed gas detection sensor to monitor the overboard water from the cargo heater and provide an early warning of leakage in service. If a fixed system is not installed, it is usually possible to fit a hose from the overboard water vent so that it can be checked regularly with a portable gas detector.

Other variants on direct type heaters have been fitted, such as a system where the sea water flow is heated by steam or thermal oil from a boiler before passing into the heater. This type of system would overcome the limitation of direct systems in cases where the sea water is too cold. However, large quantities of sea water are required to heat the cargo at a reasonable rate and, therefore, a high capacity energy source is needed.

4.4.2 Indirect cargo heaters

Indirect cargo heaters use an intermediate circuit between the cargo and the heat source. Examples include steam heated glycol system, where glycol tank is heated by steam and the warm glycol is passed through the cargo heater and returned to the glycol tank to be reheated and recirculated.

Another type of alternative ‘indirect heater’ is shown in Figure 4.36. In this case, an intermediate fluid in the lower heat exchanger is evaporated by the sea water and condenses against the cold tubes in the upper exchanger, which have cold liquid cargo passing inside them. The intermediate fluid may be a refrigerant gas with a suitable evaporation point or the cargo itself.

4.5 Cargo Vaporisers

A means of producing cargo vapour from liquid is often required on gas carriers. For example, vapour may be needed to gas-up cargo tanks after they have been gas-freed or to maintain cargo tank pressure during discharge if no vapour return line is provided from the shore. On LNG carriers there is also a requirement to occasionally produce vapour to supplement BOG to provide sufficient for use in the propulsion system.

LPG carriers usually only have a single vaporiser, while on LNG carriers it is common practice for two vaporisers to be installed, one high duty (large capacity) for use when gassing up the LNG carrier and another low duty (low capacity) unit for use in maintaining the vapour supply to the engine room.

Cargo vaporisers may be vertical or horizontal shell and tube heat exchangers. They are used with either steam or sea water as the heating source and so are similar in construction to the cargo heaters described in Section 4.4. The main difference in the design is that a heater simply warms the liquid cargo, while a vaporiser is intended to change the phase of the cargo from a liquid to a vapour.

If sea water is the heating medium in the vaporiser, care may need to be taken to prevent freezing and subsequent bursting of the tubes if, for example, the cargo vapour pressure inside the vaporiser becomes too low.

As a general principle, the heating medium is started first and the cold liquid introduced very carefully until the pressure in the unit has reached the required value and the liquid level is correct. At this stage the outlet valve can be opened to supply vapour to the system and adjusted to ensure that pressure is maintained such that the liquid level in the vaporiser is adequate.

ICS: Tanker Safety Guide (Gas) - Third Edition

1.8.9 Cargo Heaters

Cargo heating systems should be leak tested prior to use. When initially operated, the heater system should be subjected to enhanced monitoring until steady state conditions are achieved.

The routine inspection and pressure testing recommendations of the original equipment manufacturer should be followed.

7.2.3 Heat Exchangers

Heat exchangers may be used for a number of purposes, including:

- Condensing and reliquefying cargo vapour;
- Vaporising cargo liquid;
- Puddle heating;
- Inter-cooling; and
- Drying.

For ships with multiple heat exchangers, it should be confirmed that the heat exchangers in use are compatible with the particular cargo. The specific instructions for the operation concerned should be observed, especially with regard to the sequence for introducing the ‘hot’ and ‘cold’ phases, and the relative pressures of each. The equipment should be kept free from fouling.

Cargo heaters using water should be operated with care, particularly if the cargo is at low temperature. In order to avoid blocking the equipment with ice or causing damage, the water supply should be established first and the cargo liquid supply carefully regulated to prevent the water freezing. Furthermore, when the temperature of water supplied to cargo heaters is close to freezing, such equipment should not be used. At all times original equipment manufacturers’ recommendations on the use of equipment should be followed.

Appendix 3 Cargo Handling Plant and Equipment

A3.4 Heat Exchangers

Heat exchangers may be fitted for any of the following purposes and may use sea water, fresh water, steam or other liquids (e.g., glycol) as a heating or cooling medium:

- As vaporisers (for cargo or nitrogen liquid);
- As heaters (for liquid or vapour);
- As heaters for cofferdam heating systems on LNG carriers;
- As condensers (for cargo vapour or refrigerant gas);
- As driers (for inert gas, cargo vapour or compressed air);
- As intercoolers (in refrigeration plants); and
- As coolers (for water or lubricating oil).

Reference should be made to instruction manuals provided by original equipment manufacturers of the equipment fitted. Particular attention should be paid to the following points:

- Hot or cold phase flow should be established in the correct sequence. Many heat exchangers have special internal coatings or bi-metal tubing which is easily damaged by temperatures only slightly different from normal operating temperatures. Care should be taken with heat exchangers using water in order to prevent freezing of the water;
- Heat exchangers should be pressure tested or otherwise checked for leaks at regular intervals;
- Instrumentation and associated equipment such as pressure and temperature switches, float controllers or relief valves should be functioning correctly; and

- For those heat exchangers using water, any fouling will lead to loss of efficiency, leading to sub-cooling and freezing when used as a cargo heater, or overheating when used as a cooler.

Appendix 6 Basic Thermodynamic Theory

A6.7.7 Condensers, Heat Exchangers and Evaporators

These items of plant are designed to affect a heat exchange from one substance to another across a barrier. They may be described as 'evaporators' when used to convert liquid to vapour, as 'condensers' when used to convert vapour to liquid, and as 'heat exchangers' when the main purpose is to effect a heat exchange without evaporation or condensation necessarily occurring. In cargo systems the same heat exchangers may act as condensers for one operation, and as evaporators in another. Shell and tube condensers are used extensively and are either water cooled, or refrigerant cooled as in cascade systems.

Condenser efficiency is directly proportional to the total surface area of the tubes, their conductivity, and the rate of flow and temperature differential between the substances passing through.

Refrigerant efficiency will be lost in the condenser when:

- The temperature of the cooling medium is comparatively high;
- The rate of flow of the cooling medium is low;
- The conductivity of the tubes is insulated by scale or deposit formation;
- When there is a decrease in the tube surface area due to leaking tubes which have been plugged; or
- When a 'backup' of condensate covers the cooling tubes or shell and restricts the heat exchange area.

TMSA KPI 6.1.1 requires that procedures for cargo, ballast, tank cleaning and bunkering operations are in place for all vessel types within the fleet. The procedures include:

- Roles and responsibilities.
- Cargo and ballast handling.
- Maintaining safe tank atmospheres.
- Record keeping.

The procedures clearly identify the designated person(s) in charge of cargo, ballast and/or bunkering operations.

IMO: ISM Code

7. The Company should establish procedures, plans and instructions, including checklists as appropriate, for key shipboard operations concerning the safety of the personnel, ship and protection of the environment. The various tasks involved should be defined and assigned to qualified personnel.

IMO: IGC Code

Chapter 7 Cargo pressure/temperature control.

7.8 Availability

The availability of the system and its supporting auxiliary services shall be such that:

1. In case of a single failure of a mechanical non-static component or a component of the control systems, the cargo tanks pressure and temperature can be maintained within their design range without affecting other essential services;
2. Redundant piping systems are not required;
3. Heat exchangers that are solely necessary for maintaining the pressure and temperature of the cargo tanks within their design ranges shall have a standby heat exchanger, unless they have a capacity in excess of

25% of the largest required capacity for pressure control and they can be repaired on board without external sources. When an additional and separate method of cargo tank pressure and temperature control is fitted that is not reliant on the sole heat exchanger, then a standby heat exchanger is not required; and

4. For any cargo heating or cooling medium, provision shall be made to detect the leakage of toxic or flammable vapours into an otherwise non-hazardous area or overboard in accordance with 13.6. Any vent outlet from this leak detection arrangement shall be to a safe location and be fitted with a flame screen.

Inspection Guidance

The vessel operator should have developed procedures for the operation, testing and maintenance of the cargo heaters, vaporisers and condensers that include, as applicable:

- Roles and responsibilities for operation, testing and maintenance.
- Descriptions of the cargo heaters, vaporisers, condensers, their components and functions.
- Pressure testing.
- Procedures for start-up and shut-down of the system, including tests of both cargo and water sides for leakage and test water flow shutdowns.
- Ensuring the equipment in use is compatible with the cargo being handled.
- Identification of the alarms required to be tested to ensure the unit is protected.
- The correct sequence for hot or cold phase flow.
- Avoiding freezing of alarms and temperature controls.
- Gas detection monitoring during use.
- Regulating cargo flow.
- The control of the cargo flow rate into direct heaters.
- Precautions when using sea water as the heating medium to prevent freezing and subsequent tube damage if the cargo vapour pressure inside the vaporiser becomes too low.
- The precautions when using fresh water as opposed to salt water at river berths.
- Flushing requirements after use.

All or part of the above may be contained in the Cargo System Operation Manual and the vessel's maintenance plan.

<u>Suggested Inspector Actions</u>

- Sight, and where necessary review, the company procedures for the operation, testing and maintenance of the cargo heaters, vaporisers and condensers.
- Review the records of inspection, testing and maintenance of the cargo heaters, vaporisers, condensers.
- Where necessary, compare the observed condition with the records of inspection, testing and maintenance of the cargo heaters, vaporisers and condensers.
- During the physical inspection of the vessel inspect the cargo heaters, vaporisers and condensers.

- Interview the accompanying officer to verify their familiarity with the company procedures for the operation, testing and maintenance of the cargo heaters, vaporisers, condensers.

<u>Expected Evidence</u>

- The company procedures for the operation, testing and maintenance of the cargo heaters, vaporisers and condensers.
- Records of inspection, testing and maintenance of the cargo heaters, vaporisers, condensers.
- Test records for safety relief valves fitted to cargo heaters, vaporisers, condensers.
- Records of checks of the cargo heaters, vaporisers, condensers prior, during and after operation.

<u>Potential Grounds for a Negative Observation</u>

- There were no company procedures for the operation, testing and maintenance of the cargo heaters, vaporisers and condensers that included, as applicable:
    - Roles and responsibilities for operation, testing and maintenance.
    - Descriptions of the cargo heaters, vaporisers, condensers, their components and functions.
    - Pressure testing.
    - Procedures for start-up and shut-down of the system, including tests of both cargo and water sides for leakage and test water flow shutdowns.
    - Ensuring the equipment in use is compatible with the cargo being handled.
    - Identification of the alarms required to be tested to ensure the unit is protected.
    - The correct sequence for hot or cold phase flow.
    - Avoiding freezing of the alarms and temperature controls.
    - Gas detection monitoring during use.
    - Regulating cargo flow.
    - The control of the cargo flow rate into direct heaters.
    - Precautions when using sea water as the heating medium to prevent freezing and subsequent tube damage if the cargo vapour pressure inside the vaporiser becomes too low.
    - The precautions when using fresh water as opposed to salt water at river berths.
    - Flushing requirements after use.
- The accompanying officer was not familiar with the company procedures for the operation, testing and maintenance of the cargo heaters, vaporisers and condensers.
- Inspection, testing and maintenance of the cargo heaters, vaporisers and condensers, including pressure testing, had not been carried out in accordance with the company procedures.
- There were no records of inspection, testing and maintenance of the cargo heaters, vaporisers, condensers including safety relief valves, where fitted.
- There were no records of checks of the cargo heaters, vaporisers, condensers prior, during and after operation.
- A cargo heater, vaporiser or condenser was defective in any respect.

8.6.16. Were the Master and officers familiar with the filling limits (FL) and loading limits (LL) for the cargo tanks, and was this information readily available in the cargo control room or position?

Short Question Text
Filling Limits (FL) and Loading Limits (LL)

Vessel Types
LPG, LNG

ROVIQ Sequence
Cargo Control Room

Publications
IMO: ISM Code
IMO: IGC Code
SIGTTO: Liquified Gas Handling Principles on Ships and in Terminals. Fourth Edition.
ICS: Tanker Safety Guide (Gas) - Third Edition

Objective

To ensure cargo tanks are never over-filled.

Industry Guidance

ICS: Tanker Safety Guide (Gas) - Third Edition

2.2 Cargo information

The IGC Code requires the following information to be available to every ship and for each gas cargo carried:

Details of the maximum filling limits allowed for each cargo that may be carried at each loading temperature, the maximum reference temperature and the set pressure for each relief valve.

6.8 Cargo Loading

Filling limit regulations should be observed. The maximum liquid level in each cargo tank should be calculated and, where appropriate, information exchanged with shore/terminal representatives.

SIGTTO: Liquified Gas Handling Principles on Ships and in Terminals. Fourth Edition.

7.7.8 Cargo tank loading limits

Chapter 15 of the IGC Code recognises the large thermal coefficient of expansion of liquefied gas and gives requirements for maximum allowable loading limits for cargo tanks. This is to avoid tanks becoming liquid-full under conditions of surrounding fire.

As provided for in the IGC Code, the maximum value to which any tank may be filled is governed by the flowing formula:

LL = FL x (rR/rL)

Where:

LL = loading limit expressed in % which means the maximum liquid volume relative to the tank volume to which the tank may be loaded.

FL = filling limit, which is 98% unless certain exceptions apply

rR = relative density of cargo at the reference temperature

rL = relative density of cargo at the loading temperature

The default value of the filling limit (FL) of cargo tanks is 98% at the reference temperature. An FL value greater than 98% may be permitted provided that the conditions specified in the IGC Code are satisfied.

Where cargo vapour pressure/temperature control is provided, R is the temperature of the cargo on termination of loading, during transport or at unloading, whichever is greater.

TMSA KPI 6.2.1 requires that a comprehensive procedure for planning cargo, ballast and bunkering operations is in place for all types of vessel within the fleet. The planning procedure is specific to the vessel type and cargo to be carried. This may include:

- Cargo stowage, cargo segregation, pipeline and valve management, heating requirements and final ullages.

IMO: ISM Code

7. The Company should establish procedures, plans and instructions, including checklists as appropriate, for key shipboard operations concerning the safety of the personnel, ship and protection of the environment. The various tasks involved should be defined and assigned to qualified personnel.

IMO: IGC Code

15.1 Definitions

15.1.1 Filling limit (FL) means the maximum liquid volume in a cargo tank relative to the total tank volume when the liquid cargo has reached the reference temperature.

15.1.2 Loading limit (LL) means the maximum allowable liquid volume relative to the tank volume to which the tank may be loaded.

15.1.3 Reference temperature means (for the purpose of this chapter only):

.1 when no cargo vapour pressure/temperature control, as referred to in chapter 7, is provided, the temperature corresponding to the vapour pressure of the cargo at the set pressure of the PRVs *(pressure relief valves)*; and

.2 when a cargo vapour pressure/temperature control, as referred to in chapter 7, is provided, the temperature of the cargo upon termination of loading, during transport or at unloading, whichever is the greatest.

15.3 Default filling limit

The default value for the filling limit (FL) of cargo tanks is 98% at the reference temperature. Exceptions to this value shall meet the requirements of 15.4

15.4.2 In no case shall a filling limit exceeding 99.5% at reference temperature be permitted.

15.6 Information to be provided to the master

15.6.1 A document shall be provided to the ship, specifying the maximum allowable loading limits for each cargo tank and product, at each applicable loading temperature and maximum reference temperature. The information in this document shall be approved by the Administration or recognised organization acting on its behalf.

15.6.2 Pressures at which the PRVs have been set shall also be stated in the document.

15.6.3 A copy of the above document shall be permanently kept on board by the master.

Inspection Guidance

In order to safely plan cargo loading operations, the vessel must be provided with a document specifying the maximum allowable loading limits for each cargo tank and product, at each applicable loading temperature and maximum reference temperature. This document must be approved by the flag administration or the vessel's class society on its behalf. It may form part of a flag/class approved Cargo System Operation Manual.

This information should be readily available in the cargo control room or location and the officer responsible for cargo planning should be familiar with the contents. Cargo tanks should not be loaded above these loading limits (LL).

Suggested Inspector Actions

- Sight and where necessary review the approved document specifying the maximum allowable loading limits for each cargo tank.
- Review the loading plans for the current and previous cargo and verify that:
    - The maximum liquid level in each cargo tank had been pre-calculated.
    - Cargo tanks had not been loaded above the loading limits (LL).

- Interview the officer responsible for cargo planning to verify their familiarity with filling limits (FL), loading limits (LL) and reference temperatures, and their application when planning cargo stowage.

Expected Evidence

- The approved document specifying the maximum allowable loading limits for each cargo tank and product, at each applicable loading temperature and maximum reference temperature.
- Loading plans for the current and previous cargo.

Potential Grounds for a Negative Observation

- There was no document available specifying the maximum allowable loading limits for each cargo tank and product, at each applicable loading temperature and maximum reference temperature.
- The document specifying the maximum allowable loading limits for each cargo tank and product, at each applicable loading temperature and maximum reference temperature had not been approved by the flag administration or the vessel's class society on its behalf.
- The officer responsible for cargo planning was not familiar with filling limits (FL), loading limits (LL) and/or reference temperatures, and their application when planning cargo stowage.
- A cargo tank(s) had been loaded above the specified loading limit (LL).
- The maximum liquid level in each cargo tank had not been pre-calculated for the current and/or previous loading operation.

8.6.17. Were the Master and officers familiar with the company procedures for the operation, inspection, testing and maintenance of the vent mast fire suppression system, and was the system in satisfactory condition?

Short Question Text
Vent mast fire suppression system

Vessel Types
LPG, LNG

ROVIQ Sequence
Cargo Control Room, Main Deck

Publications
IMO: ISM Code
IMO: IGC Code
ICS: Tanker Safety Guide (Gas) - Third Edition

Objective

To ensure that crewmembers can respond effectively to a fire situation in accordance with the shipboard emergency plan.

Industry Guidance

ICS: Tanker Safety Guide (Gas) - Third Edition

2.8.2 Electrical Storms

To provide a safe means of extinguishing a vent mast fire, consideration should be given to fitting a nitrogen injection system to the vent masts, together with remote valves to control the flow.

10.4 Vent Mast Fires

Ignition can be caused at the vent mast by a lightning strike or other source of ignition when venting a flammable vapour. Any venting operation should therefore be suspended in the vicinity of an electrical storm.

In the event of a fire at the vent mast, the following action should be considered:

- Stop venting;
- Inject inert gas into the vent, if possible, using the fixed nitrogen fire suppression inlet, if fitted; and
- Spray the mast head with water.

Venting may be resumed when the mast head and its surroundings are cool, and the electrical storm is over.

TMSA KPI 3.1.4 requires that formal familiarisation procedures are in place for vessel personnel, including contractors. The documented procedures may include familiarisation with:

- Vessel specific operations and equipment.

IMO: ISM Code

6.3 The Company should establish procedures to ensure that new personnel and personnel transferred to new assignments related to safety and protection of the environment are given proper familiarisation with their duties. Instructions which are essential to be provided prior to sailing should be identified, documented and given.

IMO: IGC Code

18.2 Cargo operations manuals

18.2.1 The ship shall be provided with copies of suitably detailed cargo system operation manuals approved by the Administration such that trained personnel can safely operate the ship with due regard to the hazards and properties of the cargoes that are permitted to be carried.

18.2.2 The content of the manuals shall include, but not be limited to:

.4 nitrogen and inert gas systems;

.5 firefighting procedures: operation and maintenance of firefighting systems and use of extinguishing agents;

Inspection Guidance

The vessel operator should have developed procedures for the operation, inspection, testing and maintenance of the vent mast fire suppression system, that include:

- Roles and responsibilities for inspection, testing and maintenance.
- Description of the vent mast fire suppression system, its components and its functions.
- Requirements for regular inspection, testing and maintenance of the equipment including checking the level in any portable gas cylinders.
- Actions to be taken in the event of a fire at the vent mast, including instructions for the release of the system.

All or part of the above may be contained in the Cargo System Operation Manual and the vessel's maintenance plan.

Suggested Inspector Actions

- Sight, and where necessary review, the company procedures for the operation, inspection, testing and maintenance of the vent mast fire suppression system.
- Review the records of inspection, testing and maintenance of the vent mast fire suppression system.
- Where necessary, compare the observed condition with the records of inspection, testing and maintenance of the vent mast fire suppression system.
- During the physical inspection of the vessel, inspect the vent mast fire suppression system and its associated equipment.

- Interview the accompanying officer to verify their familiarity with the company procedures for the operation, inspection, testing and maintenance of the vent mast fire suppression system.

Expected Evidence

- The company procedures for the operation, inspection, testing and maintenance of the vent mast fire suppression system.
- Record of inspection, testing and maintenance of the vent mast fire suppression system.
- The Cargo System Operation Manual and/or FFA manual.

Potential Grounds for a Negative Observation

- There were no company procedures for the operation, inspection, testing and maintenance of the vent mast fire suppression system that included:
    - Roles and responsibilities for inspection, testing and maintenance.

    - Description of the vent mast fire suppression system, its components and its functions.
    - Requirements for regular inspection, testing and maintenance of the equipment including checking the level in any portable gas cylinders.
    - Actions to be taken in the event of a fire at the vent mast, including instructions for the release of the system.
- The accompanying officer was not familiar with the company procedures for the operation, inspection, testing and maintenance of the vent mast fire suppression system.
- Inspection, testing and maintenance of the vent mast fire suppression system had not been carried out in accordance with the company procedures.
- The vent mast fire suppression system was defective in any respect.
- The Cargo System Operation Manual and/or FFA manual did not include instructions for the use of the vent mast fire suppression system.

8.6.18. Were the Master and officers familiar with the company procedures for detecting water leakage into hold or insulation spaces and for dealing with any water or liquid cargo that may have accumulated in these spaces?

Short Question Text
Water or liquid cargo leakage into a hold or insulation space

Vessel Types
LPG, LNG

ROVIQ Sequence
Cargo Control Room

Publications
IMO: ISM Code
IMO: IGC Code
SIGTTO: Liquified Gas Handling Principles on Ships and in Terminals. Fourth Edition.
ICS: Tanker Safety Guide (Gas) - Third Edition

Objective

To ensure any water or cargo liquid leakage into hold or insulation spaces is safely removed.

Industry Guidance

ICS: Tanker Safety Guide (Gas) - Third Edition

9.3.1 Water Leakage into Hold or Interbarrier Space

If water leaks into a hold or interbarrier space, it may damage the insulation and in the case of a membrane tank system, result in insulation and membrane damage as well as potential membrane corrosion. These spaces are normally equipped with a water detection alarm system which will indicate if leakages occur. Pumping arrangements are provided to remove any leakage.

SIGTTO: Liquified Gas Handling Principles on Ships and in Terminals. Fourth Edition.

9.5.2 Ship emergency procedures

Incident plans

In developing plans for dealing with incidents, the following scenarios will commonly be considered:

- Water leakage into a hold or interbarrier space.

TMSA KPI 6.1.1 requires that procedures for cargo, ballast, tank cleaning and bunkering operations are in place for all vessel types within the fleet.

IMO: ISM Code

10.1 The Company should establish procedures to ensure that the ship is maintained in conformity with the provisions of the relevant rules and regulations and with any additional requirements which may be established by the Company.

IMO: IGC Code

3.7 Bilge, ballast and oil fuel arrangements

3.7.1 Where cargo is carried in a cargo containment system not requiring a secondary barrier, suitable drainage arrangements for the hold spaces that are not connected with the machinery space shall be provided. Means of detecting any leakage shall be provided.

3.7.2 Where there is a secondary barrier, suitable drainage arrangements for dealing with any leakage into the hold or insulation spaces through the adjacent ship structure shall be provided. The suction shall not lead to pumps inside the machinery space. Means of detecting such leakage shall be provided.

3.7.3 The hold or interbarrier spaces of type A independent tank ships shall be provided with a drainage system suitable for handling liquid cargo in the event of cargo tank leakage or rupture. Such arrangements shall provide for the return of any cargo leakage to the liquid cargo piping.

3.7.4 Arrangements referred to in 3.7.3 shall be provided with a removable spool piece.

Inspection Guidance

The vessel operator should have developed ship-specific procedures for detecting water leakage into a hold or insulation space and for dealing with any water or liquid cargo that may have accumulated in these spaces that included guidance on the:

- Means of detecting any water leakage into hold or insulation spaces.
- Pumping arrangements for removing any water leakage into these spaces.
- Where required, arrangements for removing any liquid cargo leakage into these spaces.
- Testing requirements for the water detection and pumping arrangements.
- Inventory and maintenance of any portable equipment required for the pumping arrangements.

These procedures may form part of the ship emergency procedures, Cargo System Operation Manual and/or the vessel's maintenance plan.

Suggested Inspector Actions

- Sight, and where necessary review, the company procedures for detecting water leakage into a hold or insulation space and for dealing with any water or liquid cargo that may have accumulated in these spaces.
- Review the records of tests of the water detection and pumping arrangements.
- During the physical inspection of the vessel, inspect:
    - The water detection alarm system, if fitted.
    - If practical, the pumping arrangements.
    - Where required, portable equipment required for the pumping arrangements.

- Interview the accompanying officer to verify their familiarity with the company procedures for:
    - Detecting water leakage into a hold or insulation space and for dealing with any water or liquid cargo that may have accumulated in these spaces.
    - Testing the water detection alarm system and pumping arrangements.

Expected Evidence

- Company procedures for detecting water leakage into a hold or insulation space and for dealing with any water or liquid cargo that may have accumulated in these spaces.
- Records of tests of the water detection and pumping arrangements.
- Where required, the inventory of portable equipment required for the pumping arrangements.

Potential Grounds for a Negative Observation

- There were no ship-specific company procedures for detecting water leakage into a hold or insulation space and for dealing with any water or liquid cargo that may have accumulated in these spaces that included guidance on the:
  - Means of detecting any water leakage into hold or insulation spaces.
  - Pumping arrangements for removing any water leakage into these spaces.
  - Where required, arrangements for removing any liquid cargo leakage into these spaces.
  - Testing requirements for the water detection and pumping arrangements.
- The accompanying officer was not familiar with the ship-specific company procedures for detecting water leakage into a hold or insulation space and for dealing with any water or liquid cargo that may have accumulated in these spaces.
- There were no records of tests of the water detection and pumping arrangements.
- Tests of the water detection and pumping arrangements had not been carried out as required by company procedures.
- The means of detecting any water leakage into hold or insulation spaces were defective in any respect.
- The water detection alarm system was inhibited.
- The pumping arrangements for removing any water leakage into these spaces were defective in any respect.
- The arrangements for removing any liquid cargo leakage into these spaces were defective in any respect.
- A removable spool piece that formed part of the arrangements for removing liquid cargo leakage had been left in place.
- Any item of portable equipment required for the pumping arrangements was not available onboard.

8.6.19. Were the Master and officers familiar with the company procedures for the operation of the submerged motor electric cargo pumps and the testing of their associated safety devices and alarms, and had these procedures been followed?

Short Question Text
Submerged motor electric cargo pumps

Vessel Types
LPG, LNG

ROVIQ Sequence
Cargo Control Room, Main Deck

Publications
IMO: ISM Code
IMO: IGC Code
SIGTTO: Liquified Gas Handling Principles on Ships and in Terminals. Fourth Edition.

Objective

To ensure the submerged motor electric cargo pumps are always operated safely.

Industry Guidance

SIGTTO: Liquified Gas Handling Principles on Ships and in Terminals. Fourth Edition.

4.2.3 Submerged motor pumps

Submerged motor pumps are installed at the bottom of cargo tanks and enable very low pump-down levels to be achieved.

The pump and electrical motor are integrally mounted on the same shaft, which eliminates the need for a mechanical seal or coupling. Power is supplied to the motor through specially sheathed cables. Electrical cabling is passed through a hazardous area junction box in the tank dome and then, by flexible stainless steel armoured insulated power cables, to the motor terminals.

The pumps are cooled and lubricated by cargo flow and are prone to damage due to loss of flow. Therefore, the pump is protected from dry running by safety devices such as an under-current relay, a low discharge pressure switch or a low tank level switch.

The electric drive motors of submerged pumps are not 'certified safe' – so it is prudent to ensure there is always some cargo liquid level and a positive pressure in the tank during operation to avoid any risk of flammable atmospheres developing. For the same reason, it is prudent to isolate submerged cargo pump motors from the electrical supply. This isolation capability is a requirement of the IGC Code.

TMSA KPI 3.1.4 requires that formal familiarisation procedures are in place for vessel personnel, including contractors. The documented procedures may include familiarisation with:

- Vessel specific operations and equipment.

IMO: ISM Code

10.1 The company should establish procedures to ensure that the ship is maintained in conformity with the provisions of the relevant rules and regulations and with any additional requirements which may be established by the company.

IMO: IGC Code

10.2.9 Submerged cargo pump motors and their supply cables may be fitted in cargo containment systems. Arrangements shall be made to automatically shut down the motors in the event of low-liquid level. This may be accomplished by sensing low pump discharge pressure, low motor current or low liquid level. This shutdown shall be alarmed at the cargo control station. Cargo pump motors shall be capable of being isolated from their electrical supply during gas-freeing operations.

Inspection Guidance

The vessel operator should have developed ship-specific procedures for the operation of the submerged motor electric cargo pumps and the testing of their associated safety devices and alarms that included guidance on:

- Arrangements for isolating the pumps from the electrical supply and the occasions when this must be done e.g., during gas-freeing operations.
- Settings and periodic tests of the associated safety devices such as:
    - Low pump discharge pressure alarm.
    - Low motor current alarm.
    - Low liquid level alarm.

The junction boxes of submerged motor electric cargo pumps should be visually inspected prior to each discharge.

Suggested Inspector Actions

- Sight, and where necessary review, the company procedures for the operation of the submerged motor electric cargo pumps and the testing of their associated safety devices and alarms.
- Inspect the submerged motor electric cargo pump monitoring system panel and verify that the monitoring system is fully operational.
- Review the test records for the submerged motor electric cargo pump monitoring system and verify that the required safety device and alarm tests have been completed at the frequency defined by the company.
- Review the records of visual inspection of the junction boxes of the submerged motor electric cargo pumps prior to each discharge.

- Interview the accompanying officer to verify their familiarity with the actions to be taken in the event of:
    - A low liquid level alarm and cargo pump shutdown.
    - Gas-freeing operations.

Expected Evidence

- Company procedures for the operation of the submerged motor electric cargo pumps and the testing of their associated safety devices and alarms.
- Records of tests of the safety devices and alarms.
- Records of visual inspection of the junction boxes of the submerged motor electric cargo pumps prior to each discharge.

Potential Grounds for a Negative Observation

- There were no company procedures for the operation of the submerged motor electric cargo pumps and the testing of their associated safety devices and alarms that included guidance on:
    - Arrangements for isolating the pumps from the electrical supply and the occasions when this must be done e.g., during gas-freeing operations.
    - Settings and periodic tests of the associated safety devices such as:
        - Low pump discharge pressure alarm.
        - Low motor current alarm.

        - Low liquid level alarm.
- The submerged motor electric cargo pump monitoring system was defective in any respect.
- The required safety device and alarm tests had not been completed at the frequency defined by the company.
- The submerged motor electric cargo pumps were not fitted with arrangements to automatically shut down the motors in the event of low-liquid level.
- The submerged motor electric cargo pumps were not capable of being isolated from their electrical supply.
- The accompanying officer was not familiar with the actions to be taken in the event of:
    - A low liquid level alarm and cargo pump shutdown.
    - Gas-freeing operations.

8.6.20. Were the Master and officers familiar with the company procedures for the inspection, maintenance, testing and setting of the liquid line, hold, insulation and inter-barrier space relief valves?

Short Question Text
Liquid line, hold, insulation and inter-barrier space relief valves

Vessel Types
LPG, LNG

ROVIQ Sequence
Cargo Control Room, Main Deck

Publications
IMO: ISM Code
IMO: IGC Code
SIGTTO: Recommendations for Relief Valves on Gas Carriers 3rd Ed 2020

Objective

To ensure liquid line, hold, and insulation and inter-barrier space relief valves are properly inspected, maintained, tested, and set.

Industry Guidance

SIGTTO: Recommendations for Relief Valves on Gas Carriers 3rd Ed 2020

1.1 Introduction

Relief valves perform a safety critical function. Proper design and robust maintenance procedures are essential to ensure that this equipment will function as required.

3.3 Installation Design

Depending on the grades of stainless steel used in construction, painting for corrosion prevention may or may not be required. If it is necessary to paint the relief valves, the coatings should be applied carefully, as numerous malfunctions of relief valves have been caused by the blockage of small orifices by paint.

3.4 Materials

While atmospheric corrosion is a concern, there are also risks of galvanic corrosion, particularly for tanks made of aluminium. This is because the aluminium piping flange connected to the inlet of the stainless-steel relief valve will cause corrosion of the aluminium, as both materials have widely different electrode potentials.

4.2 Operational

Ship staff responsible for the maintenance and operations of relief valves are recommended to attend a manufacturers training course.

Ship staff should be familiar with the operation of the relief valves fitted on their ship. In particular they should be aware of what to do if a relief valve malfunctions.

4.3.1 Maintenance frequency

Liquid line piping relief valve – pilot operated or spring type.

Each loading

- Visual inspection for leaks on all external fittings and connections. Verify lifting lever is free.
- Seat leakage detection to be carried out by way of visual checking for outlet flange frosting.

Every six months

- Verify integrity of security seals.
- Visual inspection of external services for presence of corrosion or stress cracks.
- Ensure all external bolting, fasteners on mounting brackets are torqued to manufacturer’s instructions.

Annually

- Verify free operation using field test kit.

Special survey (every five years)

- Verify proper operation and seat tightness of all valves.
- Inspect internals of valves. Inspect for wear, corrosion and damage to soft seals. Any adverse signs shall require an inspection of all relief valves and repair as necessary.
- Verify presence of valve maintenance history log an update as necessary.
- Advise manufacturer of actions taken so as to allow them to update their records.

Pilot operated hold/insulation/inter-barrier space relief valve.

Every 6 months

- Visual observance of leaks. All external fittings and connections to be checked.
- Internal visual inspection for the purpose of leakage detection.
- Verify integrity of security seal for spring adjusting screw chamber.
- Visual inspection of external services for presence of corrosion or stress cracks.
- Ensure all external bolting, fasteners and mounting brackets are torqued to manufacturer’s instructions.

Annually

- Verify free operation using field test kit.

Special survey (every five years)

- Verify calibration of all spring settings.
- Verify proper operation and seat tightness.
- Inspect internals of valves for wear, corrosion on the presence of soft seal lubricant. Any adverse signs shall require inspection of all relief valves and repair as necessary.
- Verify presence of valve maintenance history log an update as necessary.
- Advise manufacturer of actions taken so as to allow them to update their records.

TMSA KPI 6.1.2 requires that procedures for pre-operational tests and checks of cargo and bunkering equipment are in place for all vessel types within the fleet. Tests and checks of equipment may include:

- IGS and venting system

IMO: ISM Code

10 Maintenance of the Ship and Equipment

10.1 The Company should establish procedures to ensure that the ship is maintained in conformity with the provisions of the relevant rules and regulations and with any additional requirements which may be established by the Company.

IMO: IGC Code

5.2.2.4 Relief valves discharging liquid cargo from the piping system shall discharge into the cargo tanks. Alternatively, they may discharge to the cargo vent mast, if means are provided to detect and dispose of any liquid cargo that may flow into the vent system. Where required to prevent overpressure in downstream piping, relief valves on cargo pumps shall discharge to the pump suction.

5.5.6 All pipelines or components which may be isolated in a liquid full condition shall be protected with relief valves for thermal expansion and evaporation.

8.1 General

Hold spaces and inter-barrier spaces, which may be subject to pressures beyond their design capabilities, shall also be provided with a suitable pressure relief system.

8.2.2 Inter-barrier spaces shall be provided with pressure relief devices. For membrane systems, the designer shall demonstrate adequate sizing of inter-barrier space PRVs.

8.2.6 PRVs shall be set and sealed by the Administration or recognised organisation acting on its behalf, and a record of this action, including the valves' set pressure, shall be retained on board the ship.

8.2.12 Means shall be provided to prevent liquid overflow from vent mast outlets, due to hydrostatic pressure from spaces to which they are connected.

8.2.13 If cargoes that react in a dangerous manner with each other are carried simultaneously, a separate pressure relief system shall be fitted for each one.

8.2.14 In the vent piping system, means for draining liquid from places where it may accumulate shall be provided. The PRVs and piping shall be arranged so that liquid can, under no circumstances, accumulate in or near the PRVs.

13.4.6 Hold spaces and interbarrier spaces without an open connection to the atmosphere shall be provided with pressure indication.

Inspection Guidance

The vessel operator should have developed procedures for the inspection, maintenance, testing and setting of the liquid line, hold, insulation and inter-barrier space relief valves, including:

- The actions to take in the event of a relief valve malfunction.
- Training requirements for the officer responsible for the maintenance and operation of the relief valves.
- An inspection, maintenance and testing programme, which may form part of the vessel's maintenance plan, including:
    - Checks prior each loading.
    - Six-monthly visual inspections
    - Annual verification of free operation using a field test kit
    - Five-yearly overhaul.

Suggested Inspector Actions

- Sight, and where necessary review, the company procedures for the inspection, maintenance, testing and setting of the liquid line, hold, insulation and inter-barrier space relief valves.
- Review the records of inspection, maintenance, testing and setting of the liquid line, hold, insulation and inter-barrier space relief valves.
- During the inspection, observe the disposition and visual condition of the liquid line, hold, insulation and inter-barrier space relief valves.
- Where necessary, compare the observed condition with the records of inspection, maintenance, testing and setting of the liquid line, hold, insulation and inter-barrier space relief valves.

Expected Evidence

- The company procedures for the inspection, maintenance, testing and setting of the liquid line, hold, insulation and inter-barrier space relief valves
- Records of inspection, maintenance, testing and setting of the liquid line, hold, insulation and inter-barrier space relief valves
- Evidence of training for the officer responsible for the maintenance and operation of the relief valves.

Potential Grounds for a Negative Observation

- There were no company procedures for the inspection, maintenance, testing and setting of the liquid line, hold, insulation and inter-barrier space relief valves.
- The accompanying officer was not familiar with:
  - The company procedures for the inspection, maintenance, testing and setting of the liquid line, hold, insulation and inter-barrier space relief valves.
  - The actions to take in the event of a relief valve malfunction.
- There were no records available of inspections, tests and maintenance carried out on the relief valves including:
  - Checks prior each loading.
  - Six-monthly visual inspections.
  - Annual verification of free operation using a field test kit.
  - Five-yearly overhaul.
- Inspections, tests and maintenance of the relief valves had not been carried out in accordance with the company requirements.
- The officer responsible for the maintenance and operation of the relief valves had not received training in accordance with the company procedure.
- A relief valve had been painted in a manner which might cause the valve to malfunction.
- Galvanic corrosion was evident on a relief valve.
- A liquid line, hold, insulation or inter-barrier space relief valve was defective in any respect.

8.6.21. Were the Master and officers familiar with the company procedures that gave guidance on cargo tank environmental control during inerting, gas freeing and gassing up operations, thermal load hazards during tank cool-down, and the minimum cargo temperature?

Short Question Text
Inerting, gas freeing and gassing up operations

Vessel Types
LPG, LNG

ROVIQ Sequence
Cargo Control Room

Publications
IMO: ISM Code
IMO: IGC Code
SIGTTO: Liquified Gas Handling Principles on Ships and in Terminals. Fourth Edition.
ICS: Tanker Safety Guide (Gas) - Third Edition

Objective

To ensure inerting, gas freeing, gassing up and tank cool-down operations are carried out in a safe manner.

Industry Guidance

SIGTTO: Liquified Gas Handling Principles on Ships and in Terminals. Fourth Edition.

7.3.1 Principles of atmosphere changing.

Tank atmosphere changing is required for several cargo operations, such as inerting, gassing up, purging and aeration of the tank. On LPG carriers grade changes between, for example, LPG and ammonia will require an atmosphere change. The two methods of changing atmosphere are displacement and dilution.

7.5 Gassing-up

On an LPG carrier with a reliquefaction plant, neither nitrogen nor carbon dioxide, which are the main constituents of inert gas, can be condensed by the plant. This is because, at cargo temperatures, both gases will be above their critical temperatures and, therefore, incondensable. Removal of inert gas from the cargo tank is therefore necessary.

7.6 Cool-down

The primary purpose of cool-down is to avoid thermal stress on the tanks. A secondary benefit is the avoidance of the excessive tank pressures that could occur if cold liquid is introduced into a warm tank. The rate at which a tank can be cooled down can usually be confirmed from the ships operating manual. In some cases, a maximum temperature difference between the top and bottom of the tank may also be specified. The lower the temperature of the cargo to be loaded, the more important the cool-down process becomes.

LNG carriers have an additional requirement during cool-down of managing the nitrogen pressure in the Interbarrier spaces on membrane type LNG carriers and in the annular space on Moss and SPB type LNG carriers.

7.6.1 Refrigerated LPG cargoes

As the cargo containment system cools down, thermal contraction of the tank, combined with a drop in temperature around it, tends to cause a pressure drop in the adjoining hold space. Pressure control systems supplying air or inert gas will usually maintain these spaces at suitable pressures, but a watch will usually be kept on appropriate instruments as the cool-down proceeds.

Difficulties that may occur during cool-down can be the result of inadequate gassing up (too much inert gas remaining) or from inadequate drying. In this latter case, ice or hydrates may form and ice-up valves and pump shafts. In such cases, and subject to the approval of the charterer, antifreeze can be added, provided, for example, that it is compatible with the cargo or that the addition will not damage the electrical insulation of a submerged cargo pump. Throughout the cool-down, deep well pump shafts should be turned frequently by hand to prevent the pumps from freezing up.

7.6.2 LNG

On Moss type ships the rate of cool-down is critical for the management of stress in the equatorial ring, where the skirt attaches to the tank, and so the readings from the temperature sensors fitted to the skirt will be compared with the cool-down table in the LNG carrier’s operating manual. Nitrogen pressure in the annular space will be monitored as it cools with the tank and the flow of nitrogen to the annular space will be increased to compensate for the falling pressure. The cargo manual will specify the temperature to which the equator must be cooled before loading can begin which is typically in the range of -110° C to -124° C.

For membrane type LNG carriers, the rate of cool-down of the membrane is not normally as critical. However, the pressure in the tank and the pressure of the nitrogen in the interbarrier spaces will still be closely monitored as they typically limit the rate of cool-down. As with the annular space in the Moss type ship, the nitrogen pressure will fall as the membrane cools. The flow of nitrogen will usually be increased to maintain the required pressure. This puts a high demand on the LNG carrier’s nitrogen generators, both of which will normally be in use for this operation. The cargo manual will specify the temperature the tank must be cooled down to before the tank can be considered ready for loading but, typically, cool-down is considered complete when the temperature sensors in each tank indicate an average temperature over the whole tank of -130° C.

The ship designers and builders will include the information in the ships operating manuals, but for general reference, the representative cool-downtime is normally 24 to 36 hours for a Moss type LNG carrier and normally 10 to 12 hours for a membrane type LNG carrier.

ICS: Tanker Safety Guide (Gas) 3rd Edition

6.6 Inerting and Gassing-Up

6.6.1 General

The term ‘inerting’ generally refers to the replacement of air or cargo vapour by inert gas before loading or gas-freeing respectively, to prevent the formation of flammable mixtures.

The term ‘gassing-up’ generally refers to the introduction of a suitable cargo vapour to displace an existing cargo tank atmosphere. The extent of ‘gassing-up’ and the vapours used will normally be laid down by the IGC Code or shippers requirements. Shippers should always be consulted about the atmosphere required on arrival at the loading port or terminal.

Inerting or gassing up operations may take place at sea if the ship is suitably equipped, or in harbour. In either case, due consideration should be given to ensuring safe venting of cargo vapour to the atmosphere and any local regulation should be observed. Venting is not normally permitted in port. If venting is unavoidable, venting operation should be carefully controlled to prevent dangerous vapour concentrations in the vicinity of the ship. Facilities may however be available for venting cargo vapours safely using a shore flare system.

During inerting or gassing up the relevant gas concentration should be monitored regularly at different tank levels to ensure safe concentrations. This is particularly important in tanks with internal structures.

6.7.2 Cool-down of Tanks and Pipelines

Cool-down of cargo tanks and pipelines is undertaken to control thermal stresses and loading rates should be restricted during cool-down. If cargo tanks are fitted with spray equipment it should be used, and the liquid should be distributed around the inside of the tank as evenly as possible to minimise thermal stresses. Spray cooling is essential for very cold cargoes, including ethylene and LNG. Certain restrictions on the rate of cool-down may also apply to LPG carriers.

Cargo pipework and equipment should be cooled down by circulating cargo liquid at a controlled rate. The system should reach liquid cargo temperature sufficiently slowly to prevent undue thermal stresses in the materials or expansion/contraction of fittings. The cargo liquid used can come from the shore, shipboard storage vessels or cargo tanks. The temperature sensors will indicate when cargo liquid is present on the tank bottom, but the liquid should be introduced slowly until the bottom is completely covered.

The cool-down of tanks may cause a pressure reduction in sealed hold or interbarrier spaces and dry air, inert gas or dry nitrogen should be introduced in order to maintain a positive pressure. This is usually done by automatic equipment. However, pressure gauges should be observed regularly during cool-down to ensure that acceptable pressures are maintained.

6.7.4 Minimum Cargo Tank Temperature

Fully pressurised, and some semi-pressurised, gas tankers have a minimum allowed cargo tank temperature, which is higher than the atmospheric boiling point for one or more of the product which the ship is certified to carry.

In order to avoid cooling fully pressurised (and some semi-pressurised) cargo tanks to below their minimum permitted temperature and risking brittle fracture, these cargo tanks should be pressurised until the corresponding cargo liquid temperature is above the minimum permitted cargo tank temperature.

At the end of discharge any remaining liquid should be thoroughly stripped before the tank vapours are evacuated, in order to prevent the temperature of any remaining liquid from dropping below the minimum permissible tank temperature.

TMSA KPI 6.1.1 requires that procedures for cargo, ballast, tank cleaning and bunkering operations are in place for all vessel types within the fleet. The procedures include:

- Roles and responsibilities.
- Planning.
- Cargo and ballast handling.
- Maintaining safe tank atmospheres.
- Tank cleaning.
- Record keeping.

The procedures clearly identify the designated person(s) in charge of cargo, ballast and/or bunkering operations.

IMO: ISM Code

7. The Company should establish procedures, plans and instructions, including checklists as appropriate, for key shipboard operations concerning the safety of the personnel, ship and protection of the environment. The various tasks involved should be defined and assigned to qualified personnel.

IMO: IGC Code

4.1.3 Design temperature for selection of materials is the minimum temperature at which cargo may be loaded or transported in the cargo tanks.

Chapter 9 Cargo containment system atmosphere control

Goal

To enable monitoring of the integrity of the containment system and to ensure that the atmosphere within the system and hold spaces is maintained in a safe condition at all times that the ship is in service.

9.1 Atmosphere control within the cargo containment system

9.1.1 A piping system shall be arranged to enable each cargo tank to be safely gas-freed, and to be safely filled with cargo vapour from a gas-free condition. The system shall be arranged to minimise the possibility of pockets of gas or air remaining after changing the atmosphere.

9.1.2 For flammable cargoes, the system shall be designed to eliminate the possibility of a flammable mixture existing in the cargo tank during any part of the atmosphere change operation by utilising an inerting medium as an intermediate step.

9.1.4 A sufficient number of gas sampling points shall be provided for each cargo tank and cargo piping system to adequately monitor the progress of atmosphere change. Gas sampling connections should be fitted with a single valve above the main deck, sealed with a suitable cap or blank.

Inspection Guidance

The vessel operator should have developed procedures that give guidance on cargo tank environmental control during inerting, gas freeing and gassing up operations, thermal load hazards during tank cool-down, and the minimum cargo temperature, and include as applicable:

- Guidance on parameters to be monitored, which may include:
    - Pressure in interbarrier spaces during cool-down.
    - Nitrogen consumption/flow.
    - Temperature.
    - Rate of cool-down.
    - Flammable gas levels.
    - Oxygen content.
    - Humidity.
    - Removal of inert gas from the cargo tank.
- Acceptable ranges for applicable parameters.
- Actions to be taken if a parameter is out of the acceptable range.
- Set points for any automatic pressure control systems and alarms.
- Records to be maintained for each applicable parameter, and actions taken to maintain the atmosphere in the required condition.
- Maximum allowable temperature differential between the top and bottom of the cargo tank.
- Control of ice or hydrates and use of anti-freeze.
- Pressurising cargo tanks to maintain the liquid temperature above the minimum permitted cargo tank temperature.

These procedures may form part of the Cargo System Operation Manual.

<u>Suggested Inspector Actions</u>

- Sight, and where necessary review, the company procedures that give guidance on cargo tank environmental control during inerting, gas freeing and gassing up operations, thermal load hazards during tank cool-down, and the minimum cargo temperature.
- Review records of inerting, gassing up and cooling down operations including:
    - Parameters monitored.
    - Evidence that gas concentration monitoring was carried out at different tank levels during inerting or gassing up operations.
    - Actions taken to maintain the interbarrier / hold space pressure.
    - Nitrogen consumption and, where fitted, running hours of the nitrogen generator.
- Review the Certificate of Fitness and note the minimum allowable cargo temperature.

- Interview the accompanying officer to verify their familiarity with:
    - The company procedures that give guidance on cargo tank environmental control during inerting, gas freeing and gassing up operations.
    - Thermal load hazards during tank cool-down
    - The minimum cargo temperature.

Expected Evidence

- The company procedures that give guidance on cargo tank environmental control during inerting, gas freeing and gassing up operations, thermal load hazards during tank cool-down, and the minimum cargo temperature.
- Records of inerting, gassing up and cooling down operations including:
    - Parameters monitored.
    - Evidence that gas concentration monitoring was carried out at different tank levels during inerting or gassing up operations.
    - Actions taken to maintain the interbarrier / hold space pressure.
    - Nitrogen consumption and, where fitted, running hours of the nitrogen generator.
- Certificate of Fitness for the Carriage of Liquefied Gases in Bulk.

Potential Grounds for a Negative Observation

- There were no company procedures that gave guidance on cargo tank environmental control during inerting, gas freeing and gassing up operations, thermal load hazards during tank cool-down, and the minimum cargo temperature, and included as applicable:
    - Guidance on parameters to be monitored, which may include:
        - Pressure in interbarrier spaces during cool-down.
        - Nitrogen consumption/flow.
        - Temperature.
        - Rate of cool-down.
        - Flammable gas levels at different levels in the tank.
        - Oxygen content.
        - Humidity.
        - Removal of inert gas from the cargo tank.
    - Acceptable ranges for applicable parameters.
    - Actions to be taken if a parameter is out of the acceptable range.
    - Set points for any automatic pressure control systems and alarms.
    - Records to be maintained for each applicable parameter, and actions taken to maintain the atmosphere in the required condition.
    - Maximum allowable temperature differential between the top and bottom of the cargo tank.
    - Control of ice or hydrates and use of anti-freeze.
    - Pressurising cargo tanks to maintain the liquid temperature above the minimum permitted cargo tank temperature.
- The accompanying officer was not familiar with the company procedures that gave guidance on cargo tank environmental control during inerting, gas freeing and gassing up operations, thermal load hazards during tank cool-down, and the minimum cargo temperature.
- The accompanying officer was not familiar with the minimum cargo temperature at which the vessel was certified to load.
- There were no detailed records available for previous inerting, gassing up and cooling down operations.
- Records indicated that the parameters required to be monitored had not been met and/or maintained during any stage of an inerting, gassing up and cooling down operation.
- There was no evidence that gas concentration monitoring was carried out at different tank levels during inerting or gassing up operations.

8.7. Shuttle Tanker Cargo Operations

8.7.1. Were the Master and officers familiar with the purpose and operation of the vessel's Emergency Shut Down (ESD) systems, and was the equipment in good working order, regularly inspected, tested and maintained?

Short Question Text
BLS Emergency Shut Down (ESD) systems

Vessel Types
Oil

ROVIQ Sequence
Bridge, Cargo Control Room, Bow Loading Area

Publications
IMO: ISM Code
Norwegian Oil and Gas recommended guidelines for offshore loading shuttle tankers Guideline No. 140
OCIMF Guidelines for Offshore Tanker Operations

Objective

To ensure the vessel is able to execute a controlled ESD 1 or ESD 2 operation.

Industry Guidance

OCIMF: Guidelines for Offshore Tanker Operations

1.2.8 Inspection and test regimes

The SMS should detail procedures for, and records of, tests and inspections. Tests and inspections relevant to offshore operations are:

Alarms and Emergency Shutdown (ESD) tests.

5.4.4 Cargo transfer radio telemetry and ESD systems

Manual ESD1/ASD1 activation points (push buttons) should be located at strategic positions around the bow loading tanker…

5.4.6 Cargo system Failure Mode Effects and (and Criticality) Analysis

A maintenance and test programme should be developed based on the FME(C)A. The maintenance part should be included in the Class-approved planned maintenance system for the tanker. The test programme should include all interlock and safety barriers that are required to be tested at intervals in compliance with field-specific operational procedures.

Norwegian Oil and Gas: Recommended guidelines for offshore loading shuttle tankers. Guideline No.140.

9.1 Bow Loading System

- The *(Offshore Loading Shuttle Tanker)* OLST should under all circumstances be able to execute a controlled ESD 1 and ESD 2 operation

13.2 Emergency shut down and "green line" testing operations

Each *(Offshore Loading Shuttle Tanker)* OLST should utilise and keep updated checklists for regular testing/preparation of the following equipment (but not limited to):

- ESD1
- ESD2

Appendix A Bow Loading System

A.9.2.1 Emergency Shut Down Class1 (ESD 1)

- Total time for the ESD 1 should be 28-35 seconds.

A.9.2.2 Emergency Shut Down Class 2 (ESD 2)

- For ESD 2, the total time, excluding opening of chain stopper, should be 38 (+/-2) seconds.

TMSA KPI 3.1.4 requires that formal familiarisation procedures are in place for vessel personnel, including contractors. The documented procedures may include familiarisation with:

- Vessel specific operations and equipment.

IMO: ISM Code

7. The Company should establish procedures, plans and instructions, including checklists as appropriate, for key shipboard operations concerning the safety of the personnel, ship and protection of the environment. The various tasks involved should be defined and assigned to qualified personnel.

Inspection Guidance

The vessel operator should have developed procedures for the operation, inspection, maintenance and testing of the vessel's ESD systems which defined:

- The circumstances under which the ESD systems would be activated.
- The actions to take in the event of an ESD system failure.
- The frequency and method of inspection, maintenance and testing of the ESD systems
- The requirement to complete and retain checklists developed for the regular testing/preparation of the ESD system.

Suggested Inspector Actions

- Sight, and where necessary review, the company procedures that defined the operation, inspection, maintenance and testing of the ESD systems.
- Sight and review the checklists used to prepare/test the ESD systems.
- If necessary, review the records of inspections, maintenance and tests carried out contained within the planned maintenance system.

- Interview the accompanying officer to verify their familiarity with the purpose, operation, and testing of the ESD systems with particular emphasis on the sequence and timing of the ESD system actions.

Expected Evidence

- The company procedures for operation, inspection, maintenance and testing of the ESD systems.
- Completed checklists for the preparation/testing of the ESD systems.
- The inspection, maintenance and test records for the ESD systems.

Potential Grounds for a Negative Observation

- There were no company procedures that defined the operation, inspection, maintenance and testing of the ESD systems.
- There were no checklists available for preparation/testing of the ESD systems.
- The ESD systems had not been tested as required by company procedures.
- The vessel's planned maintenance system did not include the ESD systems or the required inspections, maintenance and tests.
- Records of inspections, maintenance and tests carried out were incomplete.
- The accompanying officer was not familiar with the purpose, operation and testing of the ESD systems.
- The responsible officer was unfamiliar with the maintenance plan for the ESD system.
- Inspection of the ESD systems indicated that actions recorded in the maintenance plan had not in fact taken place.
- Either or both of the ESD systems were defective in any respect.

8.7.2. Were the Master and officers familiar with the company procedures, including appropriate arrival checklists, detailing the necessary checks and actions to be carried out when approaching an offshore terminal prior to DP and/or bow loading operations, and had these procedures been complied with?

Short Question Text
Checks when approaching an offshore terminal.

Vessel Types
Oil

ROVIQ Sequence
Bridge, Cargo Control Room, Engine Control Room, Bow Loading Area

Publications
IMO: ISM Code
OCIMF Guidelines for Offshore Tanker Operations
IMO: MSC.1/Circ.1580 Guidelines for vessels and units with dynamic positioning (DP) systems

Objective

To ensure DP and bow loading shuttle tankers carry out all necessary checks and actions when approaching offshore terminals.

Industry Guidance

OCIMF: Guidelines for Offshore Tanker Operations

9.6 Approach to terminals

Further guidance can be found in the checklist in appendix F1.

9.6.1 Pre-arrival preparations

Prior to arriving at the station-keeping position the DP bow loading tanker should ensure that all equipment is tested and fully operational, as laid down in the FSOG (*Field Specific Operating Guidelines*). All appropriate checklists should be completed, and the terminal advised.

The DP bow loading tanker and terminal should liaise to confirm that all PRS (Position Referencing Systems) and radio telemetry systems are working properly, and all functional checks have been completed.

The field DP software should be selected and used to approach the terminal following the instructions in the FSOG. All systems should be confirmed fully operational, and the DP bow loading tanker should be in auto DP mode before requesting permission to enter the terminal's 500m zone.

Appendix F3: Example DP bow loading tanker checklists

This appendix includes examples of checklists for use by the offtake tanker and includes the following:

- Checklist 1 - Field Arrival Checklist - Checklist to commence withing 12 hours of arrival at the 10nmz.
- Checklist 2 - Bow Loading Checklist- Checklist to be completed within 24 hours of arrival at the 10nmz.
- Checklist 3 - Engine Room Field Arrival Checklist - Checklist to be completed before arrival at the 3nmz.
- Checklist 4 - DP Arrival Checklist - Commence checklist before arrival at the 3nmz and complete checks before cargo transfer commences.
- Checklist 5 - Radio Telemetry Checklist - Commence checklist upon arrival at the 3nmz and finish checks upon completion of cargo transfer.

- Checklist 6 - Emergency Towing Trial Checklist - Checklist to be completed on completion of any trial at the offshore terminal.

Notes:

Checklists provide guidance on important steps associated with the operation. Detailed descriptions of systems and equipment should be obtained from operating procedures and manufacturers' manuals. All steps of the cargo transfer operation should be risk assessed as appropriate.

It is recommended that completed checklists are retained in accordance with the company's document retention procedures within the SMS. Any malfunctions should be reported to relevant stakeholders.

TMSA KPI 5.1.2 requires that comprehensive procedures to ensure safe navigation are in place.

These procedures may include:

- Berth to berth passage planning.
- Supporting checklists.

IMO: ISM Code

7. The Company should establish procedures, plans and instructions, including checklists as appropriate, for key shipboard operations concerning the safety of the personnel, ship and protection of the environment. The various tasks involved should be defined and assigned to qualified personnel.

IMO: MSC.1/Circ.1580 Guidelines for vessels and units with dynamic positioning (DP) systems

4 Operational requirements

4.1 Before every DP operation, the DP system should be checked according to applicable vessel specific location checklist(s) and other decision support tools such as ASOG (*Activity Specific Operational Guidelines*) in order to make sure that the DP system is functioning correctly, and that the system has been set up for the appropriate mode of operation.

4.6 The following checklists, test procedures, trials and instructions should be incorporated into the vessel-specific DP operations manuals:

.1 location checklist (see paragraph 4.1);

Inspection Guidance

The vessel operator should have developed procedures, including appropriate arrival checklists, detailing the necessary checks and actions to be carried out when approaching an offshore terminal prior to DP and /or bow loading operations.

These checklists may include:

- Location Checklist.
- Field Arrival Checklist.
- Bow Loading Checklist.
- Engine Room Field Arrival Checklist.
- DP Arrival Checklist.
- Radio Telemetry Checklist.
- Emergency Towing Trial.

Completed checklists should be retained on board.

Any identified defects or malfunctions should be reported to the offshore terminal, and to the vessel operator as appropriate.

Not all bow loading shuttle tankers are outfitted with DP systems and in this case, this question should be addressed based on the necessary actions to be carried out when approaching an offshore terminal to conduct bow loading operations at the terminals serviced.

Suggested Inspector Actions

- Sight, and where necessary review, the company procedures, including appropriate arrival checklists, detailing the necessary checks and actions to be carried out when approaching an offshore terminal prior to DP and /or bow loading operations.
- Review completed arrival checklists for the previous two offshore loading operations.

- Interview the accompanying officer to verify their familiarity with the company procedures and arrival checklists.
- Select two items from any of the arrival checklists in use and verify that the accompanying officer was familiar with the tests or checks required to be completed.

Expected Evidence

- Company procedures, including appropriate arrival checklists, detailing the necessary checks and actions to be carried out when approaching an offshore terminal prior to DP and /or bow loading operations.
- Completed arrival checklists.

Potential Grounds for a Negative Observation

- There were no company procedures detailing the necessary checks and actions to be carried out when approaching an offshore terminal prior to DP and /or bow loading operations.
- The company procedures detailing the necessary checks and actions to be carried out when approaching an offshore terminal prior to DP and /or bow loading operations did not include appropriate arrival checklists.
- The accompanying officer was not familiar with the company procedures detailing the necessary checks and actions to be carried out when approaching an offshore terminal prior to DP and /or bow loading operations.
- The accompanying officer was unfamiliar with the company checklists used when approaching an offshore terminal.
- The accompanying officer was unfamiliar with any actions they were responsible for completing or verifying within the checklists used when approaching an offshore terminal.
- Records indicated that arrival checklists:
    - Had not been utilised.
    - Had not been fully completed.
- Checklists in use were insufficiently detailed or insufficiently ship-specific.
- There was no evidence that a defect or malfunction identified when completing an arrival checklist had been reported to the offshore terminal and to the vessel operator as appropriate.
- Review of completed checklists indicated that although a defect or malfunction had been identified, the vessel had proceeded in contravention of FSOG or ASOG.

8.7.3. Were the Master and officers familiar with the equipment for control and monitoring of the Bow Loading System (BLS), and was the equipment in good working order, regularly inspected, tested and maintained?

Short Question Text
Control and monitoring of the Bow Loading System (BLS)

Vessel Types
Oil

ROVIQ Sequence
Bridge, Cargo Control Room, Bow Loading Area

Publications
IMO: ISM Code
Norwegian Oil and Gas recommended guidelines for offshore loading shuttle tankers Guideline No. 140

Objective

To ensure that the vessel's telemetry and green line systems will safely start, control and stop cargo transfer operations.

Industry Guidance

Norwegian Oil and Gas recommended guidelines for offshore loading shuttle tankers Guideline No. 140

9.3 Green line control system

The BLS and cargo loading system should be provided with a "green line" control system according to Appendix A.9. Specifications are to be approved by field operator(s).

When the "green line" is completed, a "loading permit" signal should be transmitted to the adjacent offloading installation via the telemetry system. Any interruption in the "green line" should automatically initiate an ESD1 on the shuttle tanker and shut down of the crude export from the installation.

9.4 Telemetry system

A telemetry system should be a fail to safe design and capable of securing a safe start, control and stopping of the cargo transfer from the OLT (*offshore loading terminal)* to the OLST (*offshore loading shuttle tanker)*. System reliability should be achieved by the use of duplicated fail-safe telemetry systems operating in parallel and duplicated UHF radio transceivers with automatic changeover.

9.5 Online flow-monitoring

OLSTs designed for BLS loading operations where the export line/offloading hose (i.e., system from OLT cargo pumps to OLST manifold) is submerged should be equipped with an online flowrate monitoring system.

9.7 Cargo loading system FMEA

A Failure Mode Effect Analysis (FMEA) for the BLS and cargo loading system should be carried out for each OLST prior to first offshore loading. This should be made available for field operator(s) review.

The BLS and cargo loading system should as a minimum be designed and verified according to these requirements:

- A single failure, in the cargo loading and storage system, should not lead to a pressure rise exceeding the design pressure of the cargo loading and storage system.

- No single failure is to cause a single-configured valve to close or open uncontrolled.
- The vessel should under all circumstances be able to execute a controlled ESD 1 and ESD 2 operation.
- Each active component should be designed with a fail-safe specification.

13.2 Emergency shut down and “green line” testing operations

Each OLST should utilise and keep updated checklists for regular testing/preparation of the following equipment (but not limited to):

- Telemetry system.
- Interlock, ‘green line’ systems.
- GLF (*green line failure*), e.g., chain stopper tension, hose in position, cargo system ready, DP/vessel positioning, crude oil pressure high, hydraulic system pressure/accumulated pressure, hose tension.

Appendix A Bow Loading System

A.3 Bridge Equipment

The bridge should include all necessary equipment for control and monitoring of the BLS and its operation. This should be reflected in the layout of the bridge where the BLS controls should be installed next to the DP manoeuvring stations.

A.3.3 BLS data logger

There should be installed a BLS data logger system that should continuously record:

- Hose tension.
- Hawser tension.
- Status/operation of all equipment in the “green line” system.
- All operator commands/warnings/alarms generated by the BLS control system.

The time for the above activities should be recorded and the timing for the logged data should be based on GMT. The data logger should have the capacity for storing data for minimum 1 year and the data should be readily available for export.

A.3.4 Tension monitoring

Tension meters for monitoring of hawser and hose tension should be installed. These meters should be readable both from the BLS operator panel and the DP console(s). The meters should be illuminated and have a dimmer unit located in the operator panel.

Equipment for calibration of corresponding load cells should be on-board.

A.13 BLS FMEA

In addition, a cargo handling system FMEA should be performed for the BLS by a recognised 3rd party. Similar format to the IMCA guidelines for FMEA should be followed and should be approved by field operator(s).

TMSA KPI 6.2.2 requires that comprehensive procedures cover all aspects of cargo transfer operations for each type of vessel within the fleet. The transfer procedures are specific to the vessel type and cargo to be carried.

IMO: ISM Code

7. The Company should establish procedures, plans and instructions, including checklists as appropriate, for key shipboard operations concerning the safety of the personnel, ship and protection of the environment. The various tasks involved should be defined and assigned to qualified personnel.

Inspection Guidance

The vessel operator should have developed procedures for the operation, inspection, maintenance and testing of the equipment for control and monitoring of the BLS which set out:

- Guidance on the use of the green line, interlocks and telemetry systems to ensure safe start, control and stopping of cargo transfer offshore.
- The actions to take in the event of a green line failure (GLF).
- The frequency and method of inspection, maintenance and testing of the telemetry and green line systems, including sensors e.g., tension monitoring load cells, and where fitted, cargo flow meters.

An FMEA report for the cargo loading system and BLS should be available on board and the Master and officers should be familiar with the contents.

Suggested Inspector Actions

- Sight, and where necessary review, the company procedures for the operation, inspection, maintenance and testing of the equipment for control and monitoring of the BLS.
- Sight, and where necessary review, the FMEA report for the cargo loading system and BLS.
- If necessary, review the records of inspections, maintenance and tests carried out contained within the planned maintenance system.
- Review completed checklists for the regular testing/preparation of the BLS including the telemetry system and green line system.
- Review test/calibration records of the tension monitoring load cells, and where fitted, cargo flow meter.
- Review the BLS data logger records if readily available.
- Inspect the:
    - BLS operator panel.
    - BLS data logger.

- Interview the accompanying officer to verify their familiarity with the purpose, operation and testing of the equipment for control and monitoring of the BLS with particular emphasis on the:
    - Green line and telemetry systems.
    - Green line input sensors.
    - BLS and cargo system interlocks.
    - FMEA report for the cargo loading system and BLS.

Expected Evidence

- The company procedures for operation, inspection, maintenance and testing of the equipment for control and monitoring of the BLS.
- FMEA report for the cargo loading system and BLS.
- The inspection, maintenance and test records for the equipment for control and monitoring of the BLS.
- Completed checklists for the regular testing/preparation of the BLS including the telemetry system and green line system.
- Test/calibration records of the tension monitoring load cells, and where fitted, the cargo flow meter.
- BLS data logger records.

Potential Grounds for a Negative Observation

- There were no company procedures for the operation, inspection, maintenance and testing of the equipment for control and monitoring of the BLS which set out:
    - Guidance on the use of the telemetry and green line systems to ensure safe start, control and stopping of cargo transfer offshore.
    - The actions to take in the event of a green line failure (GLF).
    - The frequency and method of inspection, maintenance and testing of the telemetry and green line systems, including sensors e.g., tension monitoring load cells, and where fitted, the cargo flow meter.
- The accompanying officer was unfamiliar with the:
    - Functions of the green line and telemetry systems.
    - Actions to take in the event of a green line failure.
    - Input sensors to the green line system.
    - FMEA report for the cargo loading system and BLS.
- There was no FMEA report available for the cargo loading system and BLS.
- The tension monitoring information was not readable from the BLS operator panel and the DP console(s).
- The tension monitoring load cells had not been calibrated as required by company procedures.
- There was no on board equipment for the calibration of the tension load cells.
- Where fitted, the cargo flow control meter had not been tested/calibrated as required by company procedures.
- The BLS operator panel was not installed next to the DP manoeuvring stations.
- The company procedures did not include checklists for the regular testing/preparation of the following equipment:
    - Telemetry systems.
    - Green line systems.
    - GLF (Green Line Failure) input sensors, e.g., chain stopper tension, hose in position, cargo system ready, DP/vessel positioning, crude oil pressure high, hydraulic system pressure/accumulated pressure, hose tension.
- The equipment for control and monitoring of the BLS was defective in any respect.
- The green line system was defective in some respect, but observation/records showed it had been overridden to allow cargo operations to be carried out.
- The equipment for control and monitoring of the BLS was not included in the onboard planned maintenance system.
- There was no BLS data logger fitted.
- There were no BLS data logger records available.
- The BLS data logger was defective in any respect.
- The BLS data logger did not record the following:
    - Hose tension.
    - Hawser tension.
    - Status/operation of all equipment in the “green line” system.
    - All operator commands/warnings/alarms generated by the BLS control system.

8.7.4. Were the Master and officers familiar with the company procedures for the operation, inspection, testing and maintenance of the Bow Loading System (BLS), including alarms and indicators, and was the BLS area well maintained and free from oil.

Short Question Text
Bow Loading System (BLS) operation, inspection, testing and maintenance.

Vessel Types
Oil

ROVIQ Sequence
Bow Loading Area

Publications
IMO: ISM Code
Norwegian Oil and Gas recommended guidelines for offshore loading shuttle tankers Guideline No. 140
ABS : Shuttle Tanker Advisory
September 2019

Objective

To ensure the BLS is operated safely and regularly inspected, tested, and maintained.

Industry Guidance

Norwegian Oil and Gas recommended guidelines for Offshore Loading Shuttle Tankers Guideline No. 140

(NB/CC = New building/Conversion candidate)

14.2 BLS competence requirements

For competence and training related to BLS equipment, BLS maker guidelines for operation and maintenance should as a minimum be followed. Adequate competence and training related to BLS equipment will be required.

Appendix A Bow Loading System

A.5 Forecastle platform deck

A.5.9 Manifold room

On the forecastle deck, a manifold room should be installed with bulkheads, doors and coamings.

There should be gutter bars/open drains leading to main cargo deck (scuppers should be used during offshore loading operations).

A.5.10 Loading Manifold

Safeguards should be in place to prevent a slam-shut situation of the coupler valve.

The closing-time for the coupler valve during tubing/hydraulic hose rupture should not be less than 20 seconds during said accidental scenario and not exceed normal closing time of 25-28 seconds.

A.5.11 BLS operator console forward

One operator console for the BLS should be installed. The following functions should be operated from this console:

- Position of the loading manifold.
- Operation of coupler claws.
- Operation of chain stopper movement or operation of the adjustable roller fairlead.
- Operation of traction winch.
- Operation of hose handling winch.
- Operation of bypass valves for relevant cylinders.
- Operation of the bow door.
- Operation of the retractable bow roller (if installed).

A.5.13 Pressure relief arrangement (NB/CC)

A pressure relief arrangement should be provided to cater for possible surge pressures in the event of a blocked outlet/quick closing of valve(s) downstream the loading manifold. Pressure setting for the relief arrangement should be 7.0 barg. Necessary valves for maintenance should be provided. The arrangement should have some means of monitoring, verifying its status.

A.5.14 Inboard valve

Safeguards should be in place to prevent a slam-shut situation of the inboard valve. The closing-time for the inboard valve during tubing/hydraulic hose rupture should be minimum 28 seconds during said accidental scenario (i.e., min. 3 seconds after the coupler valve has closed).

A.5.16 Access to Bow Loading Area and forecastle

All doors should be self-closing. An airlock should be installed for access/escape via the staircase. All steps should be of a non-slip type. Loss of pressure in the airlocks should be alarmed (i.e., when 2 doors are open simultaneously). This alarm should be of visual and an audible type. When one door is open a visual alarm should be triggered (i.e., a red lamp flashing), if both doors are open an audible alarm in connection with a visual alarm should be triggered.

A.5.17 Watchman cabin

The following equipment should be installed in the cabin:

- General alarm.
- Fire alarm.
- Fire extinguisher.
- Sound powered telephone.
- HVAC (ambient temperature -20/+50ºC) (NB/CC).
- A suitable desk with chair.
- 1 off CCTV monitor (NB/CC).
- Minimum 2 escape sets (EEBD).

A.5.19 Hydrant/flushing line

A 2½" or 3" hydrant should be installed and connected to the fire water system. The hydrant should be used for connection of a hose for flushing of the manifold after the loading is completed.

A.5.20 Crude oil line

An isolating valve should be installed aft of the collision bulkhead for easy inerting/gas freeing of the bow cargo piping (ref. SOLAS and class requirements).

A.5.21 Bow door

A bow door should be installed for the protection of the BLS equipment when the OLST is in transit, and for being used as a working platform during maintenance and service of the loading equipment.

- Appropriate railing and securing wires should be provided for use when the door is used as a working platform.
- When the bow door is open a detachable rail should be installed across the opening.

A.6 Hydraulic room

Inside the forecastle and in a safe area at main deck level, a separate hydraulic room with a door to the forecastle area should be installed.

A.7 Electrical equipment room (NB/CC)

To avoid possible spray/mist due to liquid leakage, the electrical equipment related to the BLS should be installed in a separate electric room with A-60 insulation.

No piping/tubing containing liquid (incl. hydraulic tubing) should be installed or pass through the electrical equipment room.

ABS: Shuttle Tanker Advisory, September 2019

Section 3 - Design and Operational Issues

Pressure Test

Connection Tightness Test

The tightness of the NSV (North Sea Valve) connection with the BLS (Bow Loading System) coupler should be tested before each loading. The test must take place with open Coupler Valve and closed Crude Valve or Inboard Valve, so that the test is limited to the bow piping (BLS area). The test should be carried out by the F(P)SO with a pressure of five bar for ten minutes. The shuttle tanker will monitor the pressure until the test has ended. The results of the test will be logged. After the conclusion, the system must be depressurized by the F(P)SO

TMSA KPI 6.1.2 requires that procedures for pre-operational tests and checks of cargo and bunkering equipment are in place for all vessel types within the fleet. Records of the tests and checks are maintained.

IMO: ISM Code

10.1 The Company should establish procedures to ensure that the ship is maintained in conformity with the provisions of the relevant rules and regulations and with any additional requirements which may be established by the Company.

Inspection Guidance

The vessel operator should have developed procedures for the operation, inspection, testing and maintenance of the Bow Loading System (BLS), including:

- BLS coupler valve tightness tests.
- Coupler and inboard valve closing-time checks.
- BLS operator console alarm and indicators tests.
- Other test requirements.
- Arrangements for flushing and gas-freeing the bow cargo piping.

These procedures may incorporate the BLS manufacturer's instruction manuals and may form part of the vessel's maintenance plan.

Suggested Inspector Actions

- Sight, and where necessary review, the company procedures for the operation, inspection, testing and maintenance of the Bow Loading System (BLS).
- Review the records of inspection, testing and maintenance of the BLS including:
    - BLS coupler valve tightness tests.
    - Coupler and inboard valve closing-time checks.
    - BLS operator console alarm and indicators tests.
    - Other test requirements.
- During the physical inspection of the vessel inspect the BLS including:
    - Manifold room.
    - Loading manifold.
    - Forward BLS operator console.
    - Pressure relief arrangements, where fitted.
    - Inboard valve.
    - Access to the bow loading area and forecastle.
    - Watchman's cabin.
    - Manifold flushing arrangements.
    - Crude oil line.
    - Bow door(s).
    - Hydraulic room.
    - Electrical equipment room, where fitted.
- Where necessary, compare the observed condition with the records of inspection, testing and maintenance of the BLS.

- Interview the accompanying officer to verify their familiarity with the company procedures for the operation, inspection, testing and maintenance of the BLS.

Expected Evidence

- The company procedures for the operation, inspection, testing and maintenance of the Bow Loading System (BLS).
- Records of inspection, testing and maintenance of the BLS including:
    - BLS coupler valve tightness tests.
    - Coupler and inboard valve closing-time checks.
    - BLS operator console alarm and indicators tests.
    - Other test requirements.

Potential Grounds for a Negative Observation

- There were no company procedures for the operation, inspection, testing and maintenance of the Bow Loading System (BLS), including:
    - BLS coupler valve tightness tests.
    - Coupler and inboard valve closing-time checks.
    - BLS operator console alarm and indicators tests.
    - Other test requirements.
    - Arrangements for flushing and gas-freeing the bow cargo piping.
- The accompanying officer was not familiar with the company procedures for the operation, inspection, testing and maintenance of the BLS.
- There were no records, or records were incomplete, of inspection, testing and maintenance of the BLS including:
    - BLS coupler valve tightness tests before each loading operation.
    - Coupler and inboard valve closing-time checks.

    - BLS operator console alarm and indicators tests.
    - Other test requirements.
- The BLS area was not free of oil.
- Arrangements for draining the manifold room were inadequate.
- The controls, alarms and/or indicators of the forward BLS operator console were defective in any respect.
- Where fitted, there was no means of monitoring and verifying the status of the pressure relief arrangements.
- Access doors to the bow loading area were not self-closing or were lashed open.
- The audible and/or visible alarms for the air lock doors to the bow loading area were defective in any respect.
- An item(s) of the required equipment in the watchman's cabin was missing or defective e.g., fire extinguisher, EEBDs.
- The bow door(s) were not provided with:
    - Appropriate railing and securing wires for use when the door is used as a working platform.
    - A detachable rail installed across the opening when the door is open.
- The condition of the hydraulic room was unsatisfactory in any respect, e.g., hydraulic leaks.
- Where fitted, the condition of the electrical equipment room was unsatisfactory in any respect, e.g., hydraulic piping passed through the room.
- The BLS was defective in any respect.

8.7.5. Were the Master and officers familiar with the location, purpose and operation of the deluge system in the bow loading system (BLS) area, and was the equipment in good working order, regularly inspected, tested and maintained?

Short Question Text
Deluge system in the bow loading system (BLS) area

Vessel Types
Oil

ROVIQ Sequence
Bridge, Bow Loading Area, Cargo Control Room

Publications
IMO: ISM Code
Norwegian Oil and Gas recommended guidelines for offshore loading shuttle tankers Guideline No. 140
IMO: MSC.1/Circ.1432 Revised guidelines for the maintenance and inspection of fire protection systems and appliances.

Objective

To ensure that those measures specifically designed to prevent or extinguish fires in the BLS area of shuttle tankers are effective.

Industry Guidance

Norwegian Oil and Gas recommended guidelines for offshore loading shuttle tankers Guideline No. 140

11 Fire Fighting for Offshore Loading

A fire water system should be installed in the BLS area. The system should serve two purposes:

- Supply of deluge (water only) to the BLS equipment and bow slot to prevent that any possible sparks created during emergency disconnection (ESD 2) may cause a fire.
- Supply of water for the foam fire-fighting system. The foam system should be operated from the fire-fighting panel on the bridge.

Appendix F BLS Fire Fighting System

F.1 BLS water deluge logic

- The deluge logic should include start of a fire pump and opening of required valve(s) within the set time criteria for deluge at ESD2.
- Fire pumps connected with the BLS deluge system should be redundant according to DP Class 2 philosophy; if one pump fails to start or stops while deluge is active a second fire pump should automatically start. All fire pumps interconnected to the BLS deluge system should have an auto-priming function ensuring water supply when started.
- Activation of ESD 2 should automatically provide deluge water before the coupler claws start opening, regardless of sequence of ESD commands initiated.
- The fire-fighting system should have fully pressurized deluge in all water nozzles before the coupler claws starts to open.
- It should be possible to activate the BLS deluge system from dedicated operator panels close to the BLS Operator Panel on the bridge and in the watchman’s cabin.
- The deluge system should be fully operative in a black-out situation. A prerequisite for this design is that there is power at the emergency switch board to run the emergency fire pump and power the deluge valve HPU.

- Valve(s) required for BLS deluge should be possible to open manually in case of valve control failure.

F.2 BLS water deluge system

The BLS water deluge system should as minimum meet the following requirements:

- Minimum two nozzles should be installed on the inside (port and starboard side) and minimum two on the outside (port and starboard side) of the manifold.
- The nozzles should spray the wire rollers and the manifold.
- One main deluge valve to be located as close as possible to the deluge distribution piping.
- The main deluge valve should be automatically opened when ESD 2 is activated, or the deluge function is activated from the bridge (applicable for all operational modes).
- Only the deluge should be activated (no foam), and the fire-fighting system should have fully pressurized deluge in all water nozzles before the coupler claws starts to open.
- The deluge valve controls should have dual supply of power, i.e. main and emergency power securing power if any or all main switchboards fail. Alternatively, the deluge valve should fail safe to open position in case of loss of power.

IMO: MSC.1/Circ.1432 Revised guidelines for the maintenance and inspection of fire protection systems and appliances

2 Operational readiness

All fire protection systems and appliances should at all times be in good order and readily available for immediate use while the ship is in service. If a fire protection system is undergoing maintenance, testing or repair, then suitable arrangements should be made to ensure safety is not diminished through the provision of alternate fixed or portable fire protection equipment or other measures. The onboard maintenance plan should include provisions for this purpose.

3 Maintenance and testing

3.1 Onboard maintenance and inspections should be carried out in accordance with the ship's maintenance plan, which should include the minimum elements listed in sections 4 to 10 of these Guidelines.

3.2 Certain maintenance procedures and inspections may be performed by competent crew members who have completed an advanced fire-fighting training course, while others should be performed by persons specially trained in the maintenance of such systems. The onboard maintenance plan should indicate which parts of the recommended inspections and maintenance are to be completed by trained personnel.

3.3 Inspections should be carried out by the crew to ensure that the indicated weekly, monthly, quarterly, annual, two-year, five-year and ten-year actions are taken for the specified equipment, if provided. Records of the inspections should be carried on board the ship or may be computer-based. In cases where the inspections and maintenance are carried out by trained service technicians other than the ship's crew, inspection reports should be provided at the completion of the testing.

3.4 In addition to the onboard maintenance and inspections stated in these Guidelines, manufacturer's maintenance and inspection guidelines should be followed.

3.5 Where particular arrangements create practical difficulties, alternative testing and maintenance procedures should be to the satisfaction of the Administration.

(These guidelines set out requirements applicable to fixed water spray or water mist systems for:

- *Weekly tests and inspections*
- *Monthly tests and inspections*
- *Annual tests and inspections*

- *Five-year servicing)*

TMSA KPI 3.1.4 requires that formal familiarisation procedures are in place for vessel personnel, including contractors. The documented procedures may include familiarisation with:

- Vessel specific operations and equipment.

IMO: ISM Code

6.3 The Company should establish procedures to ensure that new personnel and personnel transferred to new assignments related to safety and protection of the environment are given proper familiarisation with their duties. Instructions which are essential to be provided prior to sailing should be identified, documented and given.

Inspection Guidance

The vessel operator should have developed procedures for the operation, inspection and maintenance of the deluge system fitted in the BLS area which defined the:

- Operation of the BLS deluge system in the event of an emergency disconnection.
- Actions to take in the event of a BLS deluge system valve control failure.
- Frequency of inspection and testing of the BLS deluge system.

Suggested Inspector Actions

- Sight, and where necessary review, the company procedures that defined the operation and maintenance of the BLS deluge system.
- Inspect the dedicated operator panels for the BLS deluge system on the bridge and in the watchman's cabin.
- Inspect the piping and control valves for the BLS deluge system and, if safe to do so, verify that control valves can be manually operated freely.
- If necessary, review the records of inspections, tests, and maintenance carried out on the BLS deluge system contained within the maintenance plan.

- Interview the accompanying officer to verify their familiarity with the purpose, operation, and testing of the BLS deluge system.

Expected Evidence

- The company procedures for the testing, maintenance and operation of the BLS deluge system.
- The manufacturer's instruction manuals for the BLS deluge system.
- The maintenance and test records for the BLS deluge system.

Potential Grounds for a Negative Observation

- There was no company procedure for the testing, maintenance and operations of the BLS deluge system.
- Operating instructions for the BLS deluge system were not posted close to the operator panels.
- There was no maintenance plan for the vessel's fire protection systems and fire-fighting systems and appliances available.
- The maintenance plan for the vessel's fire protection systems and fire-fighting systems and appliances did not include the BLS deluge system or the required inspections, tests and maintenance.
- Records of inspections, tests and maintenance carried out on the BLS deluge system were incomplete.
- The accompanying officer was not familiar with the purpose and operation of the BLS deluge system.

- The accompanying officer was unfamiliar with the maintenance plan for the BLS deluge system.
- Inspection of the BLS deluge system indicated that actions recorded in the maintenance plan had not in fact taken place.
- The BLS deluge system was defective in any respect.

8.7.6. Were the Master and officers familiar with the location, purpose and operation of the fixed foam fire extinguishing system in the bow loading system (BLS) area, and was the equipment in good working order and regularly inspected, tested and maintained?

Short Question Text
Fixed foam fire extinguishing system in the bow loading system (BLS) area

Vessel Types
Oil

ROVIQ Sequence
Bridge, Cargo Control Room, Bow Loading Area

Publications
IMO: ISM Code
IMO: MSC.1/Circ.1432 Revised guidelines for the maintenance and inspection of fire protection systems and appliances.
Norwegian Oil and Gas recommended guidelines for offshore loading shuttle tankers Guideline No. 140
OCIMF Guidelines for Offshore Tanker Operations

Objective

To ensure that those measures specifically designed to prevent or extinguish fires in the BLS area of shuttle tankers are effective.

Industry Guidance

Norwegian Oil and Gas recommended guidelines for Offshore Loading Shuttle Tankers Guideline No. 140

11 Fire Fighting for Offshore loading

A fire water system should be installed in the BLS area. The system should serve two purposes:

- Supply of deluge (water only) to the BLS equipment and bow slot to prevent that any possible sparks created during emergency disconnection (ESD 2) may cause a fire
- Supply of water for the foam fire-fighting system. The foam system should be operated from the fire-fighting panel on the bridge

Appendix F BLS Fire Fighting System

The BLS fire-fighting system should as a minimum meet the following requirements:

- A fire water monitor should be installed in the fore mast or on the forecastle and be remotely operated from the bridge
  - The monitor should have pan and tilt functions that allow coverage of the whole area of the forecastle and platform deck
- Piping/nozzles should not be located in the restricted area as shown in Appendix A 5.9 Fig 4.
- All external piping, with risk of containing water, should have electric heat tracing
  - Alternative means of avoiding freezing may be considered (e.g. high pressure blowing, drains at low points etc.)
- The system should be of the ‘self-draining-type’ in order to avoid ice-build-up in the piping during cold weather conditions
- The BLS foam system should as a minimum cover the bow manifold and bow manifold room

OCIMF: Guidelines for Offshore Tanker Operations

5.4.6 Cargo System Failure Mode Effects (and Criticality) Analysis

An FME(C)A is a desktop study that identifies failure modes and is used to examine and assess all types of failures in a bow loading tanker cargo system. …. *including*:

- The fire-fighting system, which covers the bow area, cargo pump room and VOC area including foam system.

A maintenance and test programme should be developed based on the FME(C)A. The maintenance part should be included in the Class-approved planned maintenance system for the tanker. The test programme should include all interlock and safety barriers that are required to be tested at intervals in compliance with field-specific operational procedures.

A typical test programme will include the following:

- Foam fire monitors in forward area

IMO: MSC.1/Circ.1432 Revised guidelines for the maintenance and inspection of fire protection systems and appliances

2 Operational readiness

All fire protection systems and appliances should at all times be in good order and readily available for immediate use while the ship is in service. If a fire protection system is undergoing maintenance, testing or repair, then suitable arrangements should be made to ensure safety is not diminished through the provision of alternate fixed or portable fire protection equipment or other measures. The onboard maintenance plan should include provisions for this purpose.

3 Maintenance and testing

3.1 Onboard maintenance and inspections should be carried out in accordance with the ship's maintenance plan, which should include the minimum elements listed in sections 4 to 10 of these Guidelines.

3.2 Certain maintenance procedures and inspections may be performed by competent crew members who have completed an advanced fire-fighting training course, while others should be performed by persons specially trained in the maintenance of such systems. The onboard maintenance plan should indicate which parts of the recommended inspections and maintenance are to be completed by trained personnel.

3.3 Inspections should be carried out by the crew to ensure that the indicated weekly, monthly, quarterly, annual, two-year, five-year and ten-year actions are taken for the specified equipment, if provided. Records of the inspections should be carried on board the ship or may be computer-based. In cases where the inspections and maintenance are carried out by trained service technicians other than the ship's crew, inspection reports should be provided at the completion of the testing.

3.4 In addition to the onboard maintenance and inspections stated in these Guidelines, manufacturer's maintenance and inspection guidelines should be followed.

3.5 Where particular arrangements create practical difficulties, alternative testing and maintenance procedures should be to the satisfaction of the Administration.

(These guidelines set out requirements applicable to foam fire-extinguishing systems for:

- *Monthly tests and inspections.*
- *Quarterly tests and inspections.*
- *Annual tests and inspections.*
- *Five yearly tests and inspections)*

TMSA KPI 3.1.4 requires that formal familiarisation procedures are in place for vessel personnel, including contractors. The documented procedures may include familiarisation with:

- Vessel specific operations and equipment.

IMO: ISM Code.

6.3 The Company should establish procedures to ensure that new personnel and personnel transferred to new assignments related to safety and protection of the environment are given proper familiarisation with their duties. Instructions which are essential to be provided prior to sailing should be identified, documented and given

Inspection Guidance

The vessel operator should have developed procedures for the operation, inspection and maintenance of the BLS fixed foam fire extinguishing system which described the:

- Operation of the BLS fixed foam fire extinguishing system in the event of a fire in the BLS space and/or emergency disconnection of the loading hose.
- Actions to take in the event of a BLS fixed foam fire extinguishing system failure.
- Frequency of inspection, testing and maintenance of the BLS fixed foam fire extinguishing system.
- The frequency of shore-based analysis of the BLS fixed foam fire extinguishing system foam concentrate.

The first test of foam concentrates should be performed not more than 3 years after being supplied to the ship, and after that, every year.

<u>Suggested Inspector Actions</u>

- Sight, and where necessary review, the company procedures for the operation, inspection and maintenance of the BLS fixed foam fire extinguishing system.
- Inspect the space(s) containing the BLS fixed foam fire extinguishing system foam concentrate tanks(s) and pump(s) and verify that:
    - The system operating instructions were posted near the control panel and in the space(s) containing the BLS foam system foam concentrate tanks(s) and pump(s).
    - The system valves were clearly identified, and the system instructions indicated their required status in the standby and operational conditions.
    - A copy of the foam concentrate annual test certificate indicated that it was fit for continued use.
    - The foam tank was filled to the required level.
- Inspect the BLS fixed foam fire extinguishing system control panel on the bridge and verify that:
    - The system operating instructions were posted near the system control panel.
    - The remote control of the forward monitor was functioning correctly.
- Inspect the BLS fixed foam fire extinguishing system piping, monitor(s), applicator(s) and isolating valves.
- Where safe to do so, operate an isolating valve and monitor to verify that they are free to move through their full range.
- Review inspection and servicing data available in the space.
- If necessary, review the records of inspections, tests and maintenance carried out contained in the maintenance plan, including annual foam concentrate test results.

- Interview the accompanying officer to verify their familiarity with the purpose and operation of the BLS fixed foam fire extinguishing system with reference to:
    - Extinguishing spill fires.
    - Precluding ignition of spilt oil, not yet ignited.

<u>Expected Evidence</u>

- The company procedures for the operation, inspection and maintenance of the BLS fixed foam fire extinguishing system.
- The vessel’s maintenance plan for the vessel’s fire protection systems and fire-fighting systems and appliances.
- The records of inspections, tests and maintenance carried out on the BLS fixed foam fire extinguishing system, including annual foam concentrate test results.
- The system manual showing the quantity of foam concentrate required to be in the storage tank to meet the system design criteria.

Potential Grounds for a Negative Observation

- There was no company procedure for the operation, inspection and maintenance of the BLS fixed foam fire extinguishing system.
- The BLS fixed foam fire extinguishing system operating instructions were not posted near the control panel and in the space(s) containing the BLS foam system foam concentrate tanks(s) and pump(s).
- The valves and/or system controls were not clearly identified to their purpose and required status during system operation.
- The foam storage tank was not filled to the required level.
- The foam concentrate test had not been carried out within the required time frame.
- The foam concentrate test certificate indicated that the foam was not fit for continued use.
- The accompanying officer was not familiar with the purpose and operation of the vessel’s BLS fixed foam fire extinguishing system.
- There was no maintenance plan for the vessel’s fire protection systems and fire-fighting systems and appliances available.
- The maintenance plan for the vessel’s fire protection systems and fire-fighting systems and appliances did not include the vessel’s BLS fixed foam fire extinguishing system or all the required inspections, tests and maintenance.
- Records of inspections, tests and maintenance carried out were incomplete, including the required foam concentrate tests.
- The accompanying officer was unfamiliar with the maintenance plan for the vessel’s fire protection systems and fire-fighting systems and appliances.
- Inspection of the vessel’s BLS fixed foam fire extinguishing system indicated that actions recorded in the plan had not in fact taken place.
- The BLS fixed foam fire extinguishing system isolation valves or monitors were not free to move through their full range of motion.
- The BLS fixed foam fire extinguishing system was defective in any respect.

8.7.7. Are all items of DP equipment in satisfactory condition and are they included in the Planned Maintenance System (PMS)?

Short Question Text
DP equipment condition and maintenance

Vessel Types
Oil

ROVIQ Sequence
Bridge, Cargo Control Room, Engine Control Room, Chief Engineer's Office

Publications
IMO: ISM Code

Objective

To ensure all DP systems and sub-systems are maintained in good working order.

Industry Guidance

TMSA KPI 4.1.1 requires that each vessel in the fleet is covered by a planned maintenance system and spare parts inventory which reflects the company strategy.

The company identifies all equipment and machinery required to be included in the planned maintenance system, for example:

- Navigation equipment.
- Engine machinery.
- Deck machinery.
- Cargo handling machinery/equipment.
- Hull structure.
- Electronic equipment.

The spare parts inventory may be standalone or integrated into the planned maintenance system.

The planned maintenance system, which may be computer-based, covers all identified onboard equipment and machinery and includes a schedule of planned maintenance tasks and a record of completed planned and unplanned maintenance.

IMO: ISM Code

10.1 the company should establish procedures to ensure that the ship is maintained in conformity with the provisions of the relevant rules and regulation and with any additional requirements which may be established by the company.

Inspection Guidance

All items of DP equipment should be included in the vessel's planned maintenance system, i.e.

- Power Systems.
- Control System Computers (including reboot requirements).
- Thruster Systems (including calibration requirements).
- Position Reference Systems.
- Environmental and Motion Sensors.
- Operator Control Stations.

- Uninterruptible Power Supplies (UPS) and Batteries (with expiry dates).

Any items of defective equipment should be entered in the vessel’s Defect List.

Suggested Inspector Actions

- Refer to the FME(C)A to identify the systems and sub-systems that make up the DP system.
- Select three sample items of equipment from the FME(C)A and verify that they are included in the PMS.
- Review the latest shore maintenance reports for the DP system and note any recommendations or deficiencies recorded.
- Review the DP data log and alarm history and note any malfunctions recorded.
- Review the DP log book and note any malfunctions recorded.
- Interview the accompanying officer and confirm the status of any malfunctioning equipment identified.
- Verify that any defective equipment identified has been entered in the vessel’s Defect List.

Expected Evidence

- Planned Maintenance System.
- FME(C)A.
- DP log book.
- DP data log.
- Shore maintenance reports.

Potential Grounds for a Negative Observation

- An item of DP equipment was defective in any respect.
- An item of DP equipment (give details) was not included in the Planned Maintenance System.
- A necessary task (give details) was not included in the Planned Maintenance System, e.g., calibration of thrusters, routine rebooting of computer systems.
- Necessary data (give details) was not included in the Planned Maintenance System, e.g., battery expiry dates.
- Maintenance tasks associated with DP equipment were overdue or deferred without shore authorisation.

8.7.8. Were the Master and officers familiar with the vessel's DP FMEA, was the latest version available on board, and were any modifications to the DP system included?

Short Question Text
DP FMEA

Vessel Types
Oil

ROVIQ Sequence
Documentation, Bridge, Engine Control Room, Chief Engineer's Office

Publications
IMO: ISM Code
IMO: MSC.1/Circ.1580 Guidelines for vessels and units with dynamic positioning (DP) systems
IMCA: M 166 Rev. 2 October 2019 – Guidance on Failure Modes and Effects Analysis (FMEA)
IMCA: M 190 Guidance for Developing and Conducting Annual DP Trials Programmes for DP Vessels. Rev 2.1

Objective

To ensure that the FMEA is properly managed and that the appropriate vessel personnel are familiar with its contents.

Industry Guidance

IMO:MSC.1/Circ.1580 Guidelines for vessels and units with dynamic positioning (DP) systems

1.2.13 Failure Modes and Effects Analysis (FMEA) means a systematic analysis of systems and sub-systems to a level of detail that identifies all potential failure modes down to the appropriate sub-system level and their consequences.

1.2.14 FMEA proving trials means the test program for verifying the FMEA.

IMCA: M 166 Rev. 2 October 2019 – Guidance on Failure Modes and Effects Analysis (FMEA)

1.2 The Failure Modes and Effects Analysis (FMEA)

The findings of the FMEA should be used to rectify and improve the design or incorporated into the operations, emergency and maintenance manuals and procedures. These findings can then be fed into the risk assessment for each vessel task and 'standing orders'. It is necessary, for example, that:

- The DP operators (DPOs) and engineering staff need to know what corrective actions are required should the vessel's DP system be subjected to a specific failure;
- The DP operators (DPOs), engineering staff and key onshore personnel need to know what the impact on redundancy is if an item of equipment fails or is taken out of service. Therefore, it would be beneficial to cross-reference the FMEA with the planned maintenance system (PMS).

1.7 The Uses of an FMEA

Crew Training:

The crew should have access to and become familiar with the FMEA to increase their knowledge of the operation of their vessel over and above that contained within the DP operations manual.

2.4 The FMEA Report

The FMEA report should be a self-contained document containing a full description of the system under analysis, broken down into its component parts with their functions. The standards and guidelines followed during the analysis together with the class rules applicable to the vessel should be stated. The worst case failure design intent (WCFDI) should also be specified. The failure modes and their causes and effects should be able to be understood without any need to refer to other plans and documents not in the report. The analysis assumptions and system block diagrams should be included where appropriate.

Two levels of reporting are recommended; a comprehensive executive summary (or management, overview) and a main report (with building blocks or subsections relating to each discipline). Operational assumptions should be included in the top level executive summary, together with a summary of the conclusions which should state the worst case failure determined from the analysis.

The FMEA report should be kept up to date to reflect any changes made to the system, hardware or software, during the life cycle of the vessel and in the light of any information gathered at a later date that was not available at the time of the FMEA. The FMEA should have a revision history section and be fully auditable with changes properly recorded during the process.

One secondary purpose of the FMEA document is to assist in the training of crew; therefore, it is vital that all changes and modifications to the systems are analysed by the FMEA practitioner to determine any changes to post failure DP capability and updated in the document as and when they occur.

2.5.1 FMEA Management and Ongoing QA

During the life of a vessel, inevitably modifications will be made to either improve the system operation or alter it to provide additional or different functions. The FMEA should be kept on board for reference and review by the vessel's staff on a regular basis so that any modifications to the vessel's system will prompt the need for a possible update of the FMEA. Such modifications may include hardware and/or software changes.

In order for DP related modifications to be managed, an FMEA management procedure should be put in place so that any changes are recorded and analysed and the FMEA updated where appropriate.

The vessel's FMEA should be identified as a controlled document which is part of the quality management system of the vessel so any changes to the FMEA contents will be identified through the audit trail.

2.7 Updating of an FMEA

The FMEA will become out of date if it is not maintained regularly and systematically, due to changes in operating procedures, modifications to DP hardware and software, to confirm compliance with the latest industry guidance, etc., over the life cycle of the vessel. If this happens, it is likely that another FMEA revision will be incurred later. A systematic FMEA review through the vessel's life cycle should be an ongoing process which should be formally completed at least once every five years.

3.3 DP FMEA Proving Trials

The DP FMEA proving trials are a series of controlled failure mode tests which are intended to prove the findings of the desktop FMEA and, where there are any doubts about any failure modes from the desktop analysis, eliminate these doubts by carrying out onboard testing in a safe and practical manner.

3.4 DP Annual Trials and Five-Yearly Periodical Trials

DP FMEA proving trials: As described in this document, the DP FMEA proving trials are a component part of the FMEA. For a new build vessel, commissioning tests should be carried out prior to the DP FMEA proving trials being undertaken. The system should be fully commissioned prior to the DP FMEA proving trials as all parts of the system need to be functioning as designed, otherwise the system's response to a failure during FMEA testing cannot be determined with certainty.

Five-yearly periodical trials: IMO requires that a complete test of the DP system at intervals should be carried out periodically, but not exceeding a period of five-years. Some classification societies recommend that the DP FMEA proving trials should be repeated every five-years. Others require that the five-year tests validate the redundancy concept that is established during the initial proving trials but allow for a shortened test schedule when compared with the initial proving trials. It should be noted that often tests completed during the initial proving trials were designed to answer a particular question the FMEA practitioner may have raised. Therefore, re-testing the complete proving trials every five[1]years may not be necessary, unless it is required by class. It is recommended that the five-yearly periodical trials programme is carefully planned, the intent clearly specified and then verified through testing.

Appendix 1

Specifying an FMEA

Objective of FMEA

The main objective of the DP FMEA is to identify the single point failures in any part of the vessel's DP system and/or its sub-systems which, if they were to occur, would cause loss of the position keeping capability of the vessel. The causes and consequences of any such failures should be noted and obvious corrective actions which can be taken to avoid such failures should be described in the final FMEA report. The FMEA should also prove that the requirements with respect to redundancy, independency and separation are achieved in the design.

Final Documentation Required

The final FMEA report after the DP FMEA proving trials should be supplied with its companion documents. The companion documents should include the completed registers and documentation to demonstrate and verify that all recorded technical queries both historically and currently have been effectively closed out and the method of close out recorded, together with the preliminary annual trials document as required.

1.20 DP Operations with Closed Main Bus Tie breakers

When generators in different redundancy groups are running in parallel, this will introduce the possibility that a single failure may propagate between systems. In such cases, it is required that protective measures are implemented in the system in order to ensure the required integrity between the redundancy groups. In the past, because such protective measures could not be shown to be effective, the safest mode of operation identified through the FMEA process in many cases stated that the bus tiebreaker between the main switchboards be opened. Operating with the bus tiebreakers open has the benefit that a failure in one main switchboard will not propagate to the other main switchboard via the bus tie, resulting in a partial blackout rather than a full blackout. Positioning capability would still be available, albeit reduced, at the level dictated by the redundancy concept. However, operating with the bus tie breakers open may also have some downsides, notably an increase in the amount of generators required online, hence an increase in fuel consumption, emissions, the amount of maintenance required and an increase in operating costs. For DP 2 and DP3 vessels it is required by all of the classification societies that analysis of the relevant failure modes associated with closed bus tiebreaker operation are addressed in the FMEA.

IMCA: M 190 Guidance for Developing and Conducting Annual DP Trials Programmes for DP Vessels. Rev 2.1

4.6.3 Review of the FMEA

10) The fail-safe condition of thrusters

IMO, IMCA and class rules and guidelines require thrusters to fail safe. Thrusters should not fail to uncontrolled thrust magnitude or direction. The fail-safe condition is generally accepted to be fail 'as set', 'to zero thrust', or 'propeller stop'. Uncontrolled changes in thruster direction are acceptable if at the same time the thrust is set to zero. These tests should include failure of the local pitch/speed and azimuth command and feedback loops. The test should include demonstration of the 'prediction errors' intended to alert the DPO to the fact that the thruster is malfunctioning.

TMSA KPI 5.1.2 requires that comprehensive procedures to ensure safe navigation are in place.

These procedures may include:

- Actions upon equipment failure.

IMO: ISM Code

10. Maintenance of the Ship and Equipment

10.3 The Company should identify equipment and technical systems the sudden operational failure of which may result in hazardous situations. The SMS should provide for specific measures aimed at promoting the reliability of such equipment or systems. These measures should include the regular testing of stand-by arrangements and equipment or technical systems that are not in continuous use.

Inspection Guidance

The vessel operator should have developed procedures to ensure that the:

- The FMEA is reviewed and updated as required due to changes in operating procedures or modifications to DP hardware and/or software.
- The latest copy of the FMEA is available on board.
- The Master, DPOs and engineers are familiar with the content of the FMEA.

<u>Suggested Inspector Actions</u>

- Sight and review the FMEA, including:
    - Results of proving trials.
    - Whether recorded technical queries after proving trials had been effectively closed out, and the method of close out.
    - Record of any modifications to the onboard DP systems.
    - The FMEA revision history.
    - Fail-safe condition of thrusters.
    - Relevant failure modes associated with closed bus tiebreaker operation.
- Interview the accompanying officer to verify their familiarity with the FMEA, including for example:
    - Actions to be taken in the event of a given DP system or sub-system failure.
    - The fail-safe condition of thrusters i.e. ‘fail as set’, ‘fail to zero thrust’ or ‘propeller stop’.
    - Relevant failure modes associated with closed bus tiebreaker operation.

<u>Expected Evidence</u>

- The latest FMEA document, and associated documents.
- The Planned Maintenance System (PMS).

<u>Potential Grounds for a Negative Observation</u>

- There were no company procedures to ensure that the:
    - FMEA is reviewed and updated as required due to changes in operating procedures or modifications to DP hardware and/or software.
    - Latest copy of the FMEA is available on board.
    - Master, DPOs and engineers are familiar with the content of the FMEA.
- The FMEA was not identified as a controlled document within the vessels quality management system or include a revision history.
- The FMEA was not written in the working language of the ship.
- The latest FMEA report and associated documents were not available on board.
- Technical queries recorded in the FMEA after proving trials had not been effectively closed out.
- On a newly delivered vessel, FMEA proving trials had not been carried out.

- The FMEA had not been:
    - carried out by an authorised organisation.
    - reviewed and updated as required due to changes in operating procedures or modifications to DP hardware and/or software.
    - systematically tested, reviewed, and verified over a five year period.
- Where the vessel is permitted to operate with closed bus tie in accordance with a field operators manual or local regulations, the FMEA did not include analysis of the relevant failure modes associated with closed bus tiebreaker operation.
- Thruster failure modes did not meet accepted requirements to ‘fail as set’, ‘fail to zero thrust’ or ‘propeller stop’.
- The accompanying officer was not familiar with the FMEA, including for example:
    - Actions to be taken in the event of a given DP system or sub-system failure.
    - The fail-safe condition of thrusters i.e. ‘fail as set’, ‘fail to zero thrust’ or ‘propeller stop’.
    - Relevant failure modes associated with closed bus tiebreaker operation.

8.7.9. Were the Master and officers familiar with the location, purpose and operation of the gas and fire detection systems in the bow loading system (BLS) area, and was the equipment in good working order, regularly tested, maintained and calibrated?

Short Question Text
Gas and fire detection systems in the bow loading system (BLS) area

Vessel Types
Oil

ROVIQ Sequence
Bow Loading Area, Bridge, Cargo Control Room

Publications
IMO: MSC.1/Circ.1432 Revised guidelines for the maintenance and inspection of fire protection systems and appliances.
Norwegian Oil and Gas recommended guidelines for offshore loading shuttle tankers Guideline No. 140
OCIMF Guidelines for Offshore Tanker Operations
IMO: ISM Code

Objective

To ensure that those measures specifically designed to prevent or extinguish fires in the Bow Loading System (BLS) area of shuttle tankers are effective.

Industry Guidance

Norwegian Oil and Gas recommended guidelines for offshore loading shuttle tankers Guideline No. 140

Appendix F BLS Fire Fighting System

F.3 Fire and gas detection

In the centre area of the BLS manifold room, detectors should be installed underneath the forecastle platform deck.

The following fixed detection sensors should as a minimum be installed and connected to the vessels fire and gas detection systems, giving alarms on the bridge when activated:

- 2 smoke detectors (for enclosed manifold rooms)
- 2 flame detectors
- 2 gas detectors
- Rotating yellow light(s) when having a fire or gas alarm (NB/CC)

OCIMF: Guidelines for Offshore Tanker Operations.

5.4.6 Cargo system Failure Mode Effects (and Criticality) Analysis.

An FME(C)A is a desktop study that identifies failure modes and is used to examine and assess all types of failures in a bow loading tanker cargo system. …. *including*:

- The fire-fighting system, which covers the bow area, cargo pump room and VOC area including foam system.

A maintenance and test programme should be developed based on the FME(C)A. The maintenance part should be included in the Class-approved planned maintenance system for the tanker. The test programme should include all interlock and safety barriers that are required to be tested at intervals in compliance with field-specific operational procedures.

A typical test programme will include the following:

- Smoke and flame detectors in bow area
- Gas detectors in bow area

IMO: MSC.1/Circ.1432 Revised guidelines for the maintenance and inspection of fire protection systems and appliances

2 Operational readiness

All fire protection systems and appliances should at all times be in good order and readily available for immediate use while the ship is in service. If a fire protection system is undergoing maintenance, testing or repair, then suitable arrangements should be made to ensure safety is not diminished through the provision of alternate fixed or portable fire protection equipment or other measures. The onboard maintenance plan should include provisions for this purpose.

3 Maintenance and testing

3.1 Onboard maintenance and inspections should be carried out in accordance with the ship's maintenance plan, which should include the minimum elements listed in sections 4 to 10 of these Guidelines.

3.2 Certain maintenance procedures and inspections may be performed by competent crew members who have completed an advanced fire-fighting training course, while others should be performed by persons specially trained in the maintenance of such systems. The onboard maintenance plan should indicate which parts of the recommended inspections and maintenance are to be completed by trained personnel.

3.3 Inspections should be carried out by the crew to ensure that the indicated weekly, monthly, quarterly, annual, two-year, five-year and ten-year actions are taken for the specified equipment, if provided. Records of the inspections should be carried on board the ship or may be computer-based. In cases where the inspections and maintenance are carried out by trained service technicians other than the ship's crew, inspection reports should be provided at the completion of the testing.

3.4 In addition to the onboard maintenance and inspections stated in these Guidelines, manufacturer's maintenance and inspection guidelines should be followed.

3.5 Where particular arrangements create practical difficulties, alternative testing and maintenance procedures should be to the satisfaction of the Administration.

(These guidelines set out requirements applicable to fixed fire detection and alarm systems for:

- *Weekly tests and inspections.*
- *Monthly tests and inspections*
- *Annual tests and inspections.)*

TMSA KPI 3.1.4 requires that formal familiarisation procedures are in place for vessel personnel, including contractors. The documented procedures may include familiarisation with:

- Vessel specific operations and equipment.

IMO: ISM Code

6.3 The Company should establish procedures to ensure that new personnel and personnel transferred to new assignments related to safety and protection of the environment are given proper familiarisation with their duties. Instructions which are essential to be provided prior to sailing should be identified, documented and given.

Inspection Guidance

The vessel operator should have developed procedures for the operation, inspection and maintenance of the fire and hydrocarbon gas detection and alarm systems fitted in the BLS area which defined:

- Actions to be taken in the event of a fire or gas alarm in the BLS area.
- The frequency of gas sensor calibration.
- The required alarm activation set point for gas detectors in the BLS area
- The frequency of verification of the gas alarm activation point settings.
- The frequency of testing of the BLS smoke and flame detectors.
- The frequency of testing of the associated alarms and indicators.
- The actions to take in the event that the fire or gas detection system fails.

Suggested Inspector Actions

- Sight, and where necessary review, the company procedures for the operation, inspection and maintenance of the fire and hydrocarbon gas detection and alarm systems fitted in the BLS area.
- Inspect the central control station for the BLS gas detection system and verify that:
  - The gas detecting system was fully operational.
  - The system was not indicating any faults.
  - The alarm activation settings were in accordance with company procedures.
- Review the inspection and calibration data for the BLS gas detecting system available in the cargo control room and verify that:
  - Each gas detector sensor had been calibrated at the frequency defined by the company.
  - The associated alarms had been tested at the frequency defined by the company.
- Inspect the fire detection control panel and verify that:
  - The system was fully operational.
  - The system was not indicating any faults.
- Review the test data for the fire detection system and verify that:
  - Flame and smoke detectors had been tested as required by company procedures.
- If necessary, review the records of inspections, tests, calibration and maintenance carried out contained within the maintenance plan.

- Interview the accompanying officer to verify their familiarity with the purpose, operation, calibration and testing of the fire and hydrocarbon gas detection and alarm systems fitted in the BLS area.

Expected Evidence

- The company procedures for the operation, inspection and maintenance of the fire and hydrocarbon gas detection and alarm systems fitted in the BLS area.
- The manufacturer's instruction manuals for the fire and hydrocarbon gas detection and alarm systems fitted in the BLS area.
- The maintenance, calibration and test records for the fire and hydrocarbon gas detection and alarm systems fitted in the BLS area.

Potential Grounds for a Negative Observation

- There were no company procedures for the operation, inspection and maintenance of the fire and hydrocarbon gas detection and alarm systems fitted in the BLS area.

- The accompanying officer was unfamiliar with the operation and maintenance of the fire and hydrocarbon gas detection and alarm systems fitted in the BLS area.
- The alarm activation set point of one or more gas sensors was not in accordance with company procedures.
- The gas detecting sensors had not been calibrated in accordance with manufacturer's instructions at the frequency defined by the company.
- The associated alarms and signals had not been tested at the frequency defined by the company.
- The calibration gas used for calibration of the hydrocarbon sensors was out of date or not appropriate for use with the system.
- Flame and smoke detectors had not been tested as required by company procedures.
- One or more smoke, flame or hydrocarbon gas sensors was out of service.
- The gas detecting system in the BLS area was defective in any respect.
- The fire detection system in the BLS area was defective in any respect.

8.8. OBO / Combination Carriers

8.8.1. Were the Master and officers familiar with the company procedures for the operation, inspection, maintenance and testing of the cargo hold hatch-covers, and were the hatch covers in satisfactory condition?

Short Question Text
Cargo hold hatch covers

Vessel Types
Oil

ROVIQ Sequence
Cargo Control Room, Main Deck

Publications
IMO: ISM Code
OCIMF/ICS: International Safety Guide for Oil Tankers and Terminals. Sixth Edition.

Objective

To ensure the cargo hold hatch-covers of combination carriers are properly maintained and gas tight.

Industry Guidance

OCIMF/ICS: International Safety Guide for Oil Tankers and Terminals. Sixth Edition

14.1.4 Venting of cargo holds

The vent system on combination carriers is similar to that of conventional tankers, with the vent lines from the cargo holds leading to either individual P/V valves on each tank outlet or to a main cargo vent/IG common line that expels the hydrocarbon vapour through a riser at a safe height above the deck or to an IG system pipeline. Typically, the P/V valves are located on the top of the hatch covers. They are disconnected and stored when carrying dry cargo. The cargo tank vent and IG line connection to the cargo holds is arranged to prevent liquid ingress.

During the carriage of dry bulk cargoes, the holds are isolated from the liquid cargo pipeline and gas venting systems

14.1.6 Hatch covers

The hatches of OBOs are much larger than on oil tankers, but as they need to remain gas and liquid tight when carrying oil cargoes, they are normally of the dual seal type.

Closing device maintenance and operation is critical. Their tension should be checked regularly and adjusted evenly, and the screw threads should be cleaned and lubricated.

When closing hatch covers, the closing devices should be evenly and progressively pulled down in the correct sequence and in accordance with the manufacturer's instructions.

The sealing arrangements should be positively tested prior to loading a liquid cargo, by pressurising the holds with IG and applying a soapy solution to the sealing arrangements. Any leakage noted should be fixed by further adjusting the closing devices in the affected area.

The cover joints should also be examined for gas leakage when the compartment is loaded with liquid cargo. Any gas or liquid leaks that cannot be stopped by adjusting the closing devices should be marked or noted, so that the jointing material can be examined at the earliest opportunity and the joint made good. Additional sealing, e.g., by tape or compound, may be needed. A risk assessment should be conducted to identify the measures necessary to mitigate the risk.

TMSA KPI 6.1.2 requires that procedures for pre-operational tests and checks of cargo and bunkering equipment are in place for all vessel types within the fleet.

IMO: ISM Code

10 Maintenance of the Ship and Equipment

10.1 The Company should establish procedures to ensure that the ship is maintained in conformity with the provisions of the relevant rules and regulations and with any additional requirements which may be established by the Company.

10.2 In meeting these requirements the Company should ensure that:

1. inspections are held at appropriate intervals;
2. any non-conformity is reported, with its possible cause, if known;
3. appropriate corrective action is taken; and
4. records of these activities are maintained.

Inspection Guidance

The vessel operator should have developed procedures for the operation, inspection, maintenance, and testing of the cargo hold hatch-covers. These procedures may form part of the vessel's maintenance plan and may also include the manufacturer's instruction manuals.

The sealing arrangements of the hatch-covers should be pressure tested with inert gas prior to loading a liquid cargo, and the results recorded.

The cargo handling procedures should include the optimum pressure range to ensure the effectiveness of the hatch sealing arrangements.

The sealing arrangements should be further examined after loading a liquid cargo. Any gas and/or liquid leaks that cannot be immediately rectified should be subject to risk assessment.

<u>Suggested Inspector Actions</u>

- Sight, and if necessary, review, the company procedures for the operation, inspection, maintenance, and testing of the cargo hold hatch-covers.
- Review the records of inspection, maintenance and testing of the cargo hold hatch-covers.
- Review risk assessments pertaining to any gas or liquid leaks from the hatch-covers.
- Inspect the hatch-covers, paying particular attention to the:
    - Sealing arrangements.
    - P/V valves, where fitted to the hatch-covers.
    - The corners of hatch coamings and adjacent decks.
    - Any damage to the hatch-covers or coamings etc caused by discharging equipment.
    - The hatch-cover hydraulic systems.

- Interview the accompanying officer to verify their familiarity with the company procedures for the operation, inspection, maintenance, and testing of the cargo hold hatch-covers.

<u>Expected Evidence</u>

- Company procedures for the operation, inspection, maintenance, and testing of the cargo hold hatch-covers.
- Records of inspection, maintenance and testing of the cargo hold hatch-covers.

- Risk assessments pertaining to any gas or liquid leaks from the hatch-covers.

Potential Grounds for a Negative Observation

- There were no company procedures for the operation, inspection, maintenance, and testing of the cargo hold hatch-covers.
- The accompanying officer was not familiar with the company procedures for the operation, inspection, maintenance, and testing of the cargo hold hatch-covers.
- The accompanying officer was not aware of the optimum tank atmosphere pressure range to maintain an effective hatch seal.
- The sealing arrangements of the hatch-covers were not of the dual-seal type.
- The hatch-covers were not included in the vessel's maintenance plan.
- The hatch-covers were not subject to regular inspection, with the results recorded.
- There was ongoing gas and/or liquid leakage from the flanges of the P/V valves fitted on top of the hatch-covers.
- The hatch-cover sealing arrangements had not been pressure tested using inert gas prior to loading a liquid cargo.
- There was ongoing gas and/or liquid leakage from the sealing arrangements of the hatch-covers.
- Ongoing gas and/or liquid leakage from the hatch-covers had not been subject to risk assessment.
- There was oil leakage from the hatch-cover hydraulic system.
- There was visible cracking at the corner of a hatch-coaming or in the adjacent deck.
- There was unrepaired grab damage to the hatch-covers or coamings.

Note: Any physical defects observed should also be considered under Questions 2.4.1 and/or 2.4.2 Defect Reporting

8.8.2. Were the Master and officers familiar with the company procedures for changing cargo modes, including ship-specific checklists, and were there records to show that these procedures had been followed?

Short Question Text
Changing between wet and dry cargoes

Vessel Types
Oil

ROVIQ Sequence
Cargo Control Room

Publications
IMO: ISM Code
OCIMF/ICS: International Safety Guide for Oil Tankers and Terminals. Sixth Edition.

Objective

To ensure the changeover from wet to dry and vice versa in combination carriers is carried out safely and that all the necessary actions are completed.

Industry Guidance

OCIMF/ICS: International Safety Guide for Oil Tankers and Terminals. Sixth Edition

14.1.11 Cargo changeover checklists

The following checklists are a generic guide to help each OBO develop its own specific checklists.

14.1.11.1 Oil to dry bulk cargo

When changing the cargo from oil to dry, the following should be done:

- Wash cargo holds and tanks, including access trunks.
- Flush all main suctions into cargo holds and tanks and strip dry.
- Ensure all cargo holds and tanks are gas free.
- Ensure that cargo deck heaters or fixed heating coils are free of oil before blanking ends.
- Complete hand hosing and digging of holds and sumps.
- Drain cargo holds and cargo suction wells.
- Blank off cargo suctions and droplines to holds by fitting watertight bolted covers inside cargo holds.
- Ensure sounding pipes to bilge wells are open and clear of obstructions.
- Fit main and stripping suction recess doors. Also, fit heating coil connecting pipe recess doors.
- Wash cargo pipeline system, including pumps, deck lines and bottom lines.
- Ensure gauging system is stowed or blanked as necessary, in accordance with manufacturer's recommendations.
- Drain, vent and verify all gas lines and risers are gas free.
- Blank off gas lines to holds.
- Set up venting system.
- Check hatch cover sealing arrangements and closing devices.
- Check ballast lines, void spaces and cofferdams for flammable gas. Ventilate and verify as gas free.
- If slops are retained, ensure designated pipeline blanks are fitted, slop tanks are inerted and the venting system is in operation.

14.1.11.2 Dry bulk cargo to oil

When changing the cargo from dry to oil, the following should be done:

- Sweep holds clean, and lift cargo remains out of hold for disposal.
- Wash cargo remnants from bulkheads, stripping slowly to remove water, but let solid residues settle.
- Remove remaining solid residues from the tank top and sumps and verify that the stripping suction is clear.
- Remove suction doors and attach securely to stowage positions.
- Close off sounding pipes to sumps. Lower and secure heating coils in place, connect and ensure tight.
- Remove requisite blanks from gauging system and render fully operational.
- Remove blanks from main cargo suctions and stripping discharges to after hold.
- Wash all stripping lines thoroughly to remove solid residues. Check valve seats are not damaged by solid residues and test stripping valves for tightness.
- Check and clean all cargo system strainers.
- Check and clean all hatch cover sealing arrangements, closing devices, trackways, etc.
- Remove blanks from gas lines.
- Set up venting system.
- Prove all valves and NRVs in cargo system.
- Inert cargo holds prior to loading.
- Verify tightness of hatch covers, tank cleaning covers, access hatches and all openings into cargo spaces.

TMSA KPI 6.1.1 requires that procedures for cargo, ballast, tank cleaning and bunkering operations are in place for all vessel types within the fleet.

IMO: ISM Code

7. The Company should establish procedures, plans and instructions, including checklists as appropriate, for key shipboard operations concerning the safety of the personnel, ship and protection of the environment. The various tasks involved should be defined and assigned to qualified personnel.

Inspection Guidance

The vessel operator should have developed procedures for changing cargo mode from wet to dry and vice versa. These procedures should include ship-specific checklists to facilitate the change.

Records of changeover operations should be maintained, including completed checklists and details of hold inspections and corrective actions taken, if required, after the carriage of dry cargoes with regard to damage caused by discharging equipment.

Suggested Inspector Actions

- Sight, and if necessary, review, the company procedures for changing cargo mode from wet to dry and vice versa.
- Review records of cargo mode changeovers, including completed checklists.
- Review records of hold inspections and corrective actions taken, if required, after the carriage of dry cargoes with regard to damage caused by discharging equipment.

- Interview the accompanying officer to verify their familiarity with the company procedures, including appropriate checklists, for changing cargo mode from wet to dry and vice versa.

Expected Evidence

- Company procedures for changing cargo mode from wet to dry and vice versa.
- Records of cargo mode changeovers, including completed checklists.

- Records of hold inspections prior to changeover.

Potential Grounds for a Negative Observation

- There were no company procedures for changing cargo mode from wet to dry and vice versa.
- The procedures for changing cargo mode from wet to dry and vice versa did not include ship-specific checklists to facilitate the changeover.
- The ship-specific cargo mode changeover checklists had not been completed as required by company procedures.
- There were no records available of previous cargo mode changeovers.
- Records showed that the company procedures had not been followed during a previous cargo mode changeover.
- There were no records of hold inspections and corrective actions taken prior to cargo mode changeover.
- The accompanying officer was not familiar with the company procedures for changing cargo mode from wet to dry and vice versa.

8.99. All types

8.99.1. Were the Master and all officers directly involved in cargo transfer operations familiar with the company procedure for planning cargo and ballast transfers, and were records available to demonstrate that cargo operations had been planned in accordance with the company procedure and conducted in accordance with the agreed plan?

Short Question Text
Cargo and ballast transfer planning and execution.

Vessel Types
Oil, Chemical, LPG, LNG

ROVIQ Sequence
Cargo Control Room

Publications
IMO: ISM Code
OCIMF/ICS: International Safety Guide for Oil Tankers and Terminals. Sixth Edition.
SIGTTO: Liquified Gas Handling Principles on Ships and in Terminals. Fourth Edition.
ICS: Tanker Safety Guide (Gas) - Third Edition

Objective

To ensure cargo and ballast transfer operations are planned and conducted in accordance with company procedures and industry best practice guidance.

Industry Guidance:

OCIMF/ICS: International Safety Guide for Oil Tankers and Terminals. Sixth Edition.

12.1.1 General.

All cargo operations should be carefully planned and documented well in advance. The plans should be discussed with all personnel on the ship and at the terminal. Plans may need to be modified after consultation with the terminal and following changing circumstances, either onboard or ashore. Any changes should be communicated, understood and formally recorded.

21.5 Agreed loading plan.

On the basis of the information exchanged, the Responsible Officer and Terminal Representative should draw up a written operational agreement that covers:

- Tanker's name, berth, date and time
- Names of tanker and terminal representatives.
- Cargo distribution on arrival and departure.
- For each product:
    - Quantity
    - Tanker's tanks to be loaded.
    - Shore tanks to be discharged.
    - Lines to be used tanker/terminal.
    - Cargo transfer rate.
    - Operating pressure.
    - Maximum allowable pressure.
    - Temperature limits.
    - Venting system.
    - Sampling and gauging procedures.

- Any restrictions because of:
  - Electrostatic properties
  - Emergency Shutdown (ESD) valve closing times.

This agreement should include a loading plan that indicates the expected timing and covers:

- The loading sequence for the tanker's tanks, taking into consideration:
  - De-ballasting operations.
  - Tanker and shore tank change over.
  - Avoiding cargo contamination.
  - Pipeline clearing for loading.
  - Other operations that may affect flow rates.
  - Trim and draught of the tanker.
  - Need to ensure that permitted stresses will not be exceeded.
- The initial and maximum loading rates, topping off-rates and normal stopping times, including:
  - Nature of the cargo to be loaded.
  - Arrangement and capacity of the tanker's cargo lines and gas venting system or vapour return, if applicable.
  - Maximum allowable pressure and flow rate in the tanker/terminal hoses or MLAs.
  - Precautions to avoid static electricity.
  - Any other flow control limitations.
- The method of tank venting to avoid or reduce gas emissions at deck level, accounting for:
  - TVP of the cargo to be loaded.
  - Loading rates.
  - Atmospheric conditions, including wind speed (see section 2.1.3.2) and electrical storms.
- Bunker or storing operations.
- Emergency stop procedure.

Once the loading plan has been agreed, it should be signed by the Responsible Officer and Terminal Representative

21.6 Agreed discharge plan.

On the basis of the information exchanged, the responsible Officer and Terminal representative should draw up a written operational agreement that covers:

- Tanker's name, berth, date and time
- Names of tanker and terminal representatives.
- Cargo distribution on arrival and departure.
- For each product:
  - Quantity
  - Shore tanks to be filled.
  - Tanks to be discharged.
  - Lines to be used tanker/terminal.
  - Cargo transfer rate.
  - Maximum allowable pressure.
  - Temperature limits.
  - Venting system.
  - Sampling and gauging procedures.
- Any restrictions because of:
  - Electrostatic properties.
  - ESD valve closing times.

The discharge plan should include the details and expected timings of:

- The discharge sequence for the tanker's tanks, including:
  - Tanker and terminal tank change over.
  - Avoiding cargo contamination.

  - Pipeline clearing for discharge.
  - Any COW or other tank cleaning.
  - Any other movements or operations that may affect flow rates.
  - Trim and freeboard of the tanker.
  - Need to ensure that permitted stresses will not be exceeded.
  - Ballasting operations.
- The initial and maximum discharge rates, accounting for:
  - Specification of the cargo to be discharged.
  - Arrangements and capacity of the tanker's cargo lines, shore pipelines and tanks.
  - Maximum allowable pressure and flow rate in the tanker/terminal hoses or MLAs.
  - Precautions to avoid static electricity.
  - Any other limitations.
- Bunkering or storing operations.
- The ESD procedure.

Once the discharge plan has been agreed it should be signed by the Responsible Officer and the Terminal Representative.

ICS: Tanker Safety Guide (Gas) - Third Edition

6.5 Preparation for Cargo Transfer

6.5.1 General

All personnel directly involved in cargo operations should be formally briefed regarding the cargo handling plan. A copy of the handling plan should be provided to all involved, and watchkeeping officers should sign that they have read and fully understood the plan. The plan should include information exchanged with the responsible terminal representative and should provide details of required communications, routine checks between ship and terminal as well as planned and emergency shutdown (ESD) procedures.

SIGTTO: Liquified Gas Handling Principles on Ships and in Terminals. Fourth Edition

6.6 Discussions Prior to Cargo Transfer

The cargo transfer operation should be planned and confirmed in writing to help to assure full mutual understanding. The items to be addressed will commonly include:

- The cargo transfer arm connection, leak test, purging and cool down procedure
- SSL link tests
- permission, or not, to continue gas burning mode in engine room (for power generation) during cargo transfer
- the order of loading or discharging
- the total quantities of cargo to be transferred
- the sequence of discharging and receiving tanks
- critical stages of the transfer operation
- the intended transfer rates (including topping off rates) and constraints
- the transfer temperature and pressures to be expected
- use of cargo heater or vaporiser
- the vapour handling method, temperature and pressures
- the cargo transfer arm draining, purging and disconnection procedure
- simultaneous cargo and ballast handling, for stress and ship stability purposes, will commonly be noted on the cargo plan
- reconfirm any earlier pre-charter advice, the previous three cargoes carried by the ship and the dates of carriage should be noted to identify and assess any possible cargo contamination problems, particularly after the carriage of ammonia

- the appropriate cargo information and safety data sheets (SDS) should be provided (see Section 9.25) and should be posted in prominent places on board the ship and within the terminal. Similar detail for cargo inhibitors, where applicable, should be provided by the terminal
- a review of port and jetty regulations should be made, including berth operating limits, firefighting capabilities and other emergency procedures. Similarly, ship regulations and emergency procedures should be communicated to terminal personnel. Particular importance will usually be paid to ESD valve closure times and to the agreed emergency shutdown procedures
- equipment and procedures for normal and emergency communications between the ship and the terminal should be defined and understood. Where portable radios are provided, adequate spare battery capacity should be made available. A common language should be established
- any planned drills.
- any further information or procedures relevant to the operation should be discussed.

TMSA KPI 6.2.1 requires that a comprehensive procedure for planning cargo, ballast and bunkering operations is in place for all types of vessel within the fleet which will include, as applicable to vessel and cargo type:

- Roles and responsibilities for the operations.
- Stability, stress, draught and trim calculations for key stages of the operation.
- Free surface effect restrictions.
- Highlighting limitations on number and location of slack tanks.
- Cargo stowage, cargo segregation, pipeline and valve management, heating requirements and final ullages.
- Ballast and bunkering operations where applicable.
- Tank cleaning including Crude Oil Washing (COW).
- Gas and chemical specific operations.
- Initial, bulk and final loading/discharging rates.
- Management of tank atmosphere.
- Static precautions.
- Cold weather precautions.
- Cargo data and hazards of particular cargoes (such as H_2S).
- Ship/shore interface and communications.

IMO: ISM Code

7. The company should establish procedures, plans and instructions, including checklists as appropriate, for key shipboard operations concerning the safety of the personnel, ship and protection of the environment. The various tasks should be defined and assigned to qualified personnel.

Inspection Guidance

The company should have developed procedures for planning cargo and ballast transfers which described:

- The factors that must be considered and documented within a cargo and ballast transfer plan.
- The operations which require a cargo and ballast transfer plan to be developed, such as loading, discharging, ballast exchange, internal transfer etc.
- The requirement to document the cargo tank atmosphere management processes and operational limits that will be utilised during cargo transfer operations.
- The activities that must be included in the cargo and ballast transfer plan, such as tank cleaning, crude oil washing, gas freeing, sampling, blending and the management of doping and additives, where applicable to the operation.
- The review and approval process for cargo transfer plans.
- The process to update a cargo and ballast transfer plan when circumstances change.
- The record keeping requirements for cargo and ballast transfers such that sufficient detail is recorded, within aggregated documents, to accurately reconstruct a cargo operation for investigative purposes should the need arise.

Suggested Inspector Actions

- Sight, and where necessary review the company procedures for planning cargo and ballast transfers.
- Review a recent cargo and ballast transfer plan and verify that it:
    - Contained the information required by the company procedures.
    - Included draught, trim and stress calculations for key stages of the cargo and ballast operation.
    - Was signed by the Chief Officer, deck officers and, where necessary, engineer officers for understanding.
    - Was signed by the Master for approval.
    - Was signed by the Terminal Representative.
- Review the records of the same cargo and ballast operation and verify that:
    - The sequence of cargo and ballast transfer followed the plan as presented.
    - The atmosphere of the cargo tanks was maintained according to the plan.
    - The venting or vapour management system was used in accordance with the plan.
    - Crude oil washing or other specialist cargo operations were completed in accordance with the plan.
    - Requests for increasing and decreasing cargo transfer rates were noted with confirmation that the requested rate was achieved.
    - Sufficient detail was included within the aggregated cargo records to reconstruct the progress of the cargo operation and determine which tanks, pumps and lines were involved at any point during a cargo transfer.

Expected Evidence

- The company procedures for planning cargo and ballast transfers.
- The company procedures for cargo and ballast operation record keeping.
- The plans for recent cargo and ballast transfer operations.
- The records for recent cargo and ballast transfer operations.

Potential Grounds for a Negative Observation

- There was no company procedure:
    - That required cargo and ballast transfer plans to be prepared with defined content applicable to the vessel type and the equipment and systems fitted.
    - Which defined the record-keeping requirements for cargo and ballast transfer operations.
- The accompanying officer was unfamiliar with the:
    - Company procedures for cargo and ballast transfer planning.
    - Company requirements for maintaining records of cargo and ballast operations.
- The reviewed cargo and ballast transfer plan was:
    - Missing key information required by the company procedures.
    - Missing draught, trim and stress calculations at key stages of the cargo and ballast operation.
    - Not signed by all deck officers and, where required, engineer officers and/or was not approved by the Master.
- Where the cargo and/or ballast sequence or operations had to be updated due to changes in circumstances, the cargo and ballast transfer plan had not been updated and then re-approved by the Master and acknowledged by the officers involved in the cargo/ballast operation.
- The reviewed cargo and ballast transfer records:
    - Indicated that the cargo and ballast plan was not followed.
    - Indicated that cargo-related operations were conducted which were not included in the cargo and ballast transfer plan.

    - Did not comply with company record keeping requirements.
    - Did not include sufficient detail, within the aggregated cargo records, to reconstruct the progress of the cargo operation and determine which tanks, pumps and lines were involved at any point during a cargo transfer.
- The cargo space venting or tank atmosphere management was not conducted in accordance with the cargo plan.

8.99.2. Were the Master and all officers with a direct responsibility for cargo, tank cleaning or ballast operations familiar with the requirements of the ISGOTT Ship/Shore Safety Checklist (SSSCL) and, were appropriate sections of the SSSCL in use with all applicable provisions and agreements maintained throughout?

Short Question Text
Ship/Shore Safety Checklist (SSSCL)

Vessel Types
Oil, Chemical, LPG, LNG

ROVIQ Sequence
Cargo Control Room, Pumproom, Compressor Room, Main Deck, Mooring Decks

Publications
IMO: ISM Code
OCIMF/ICS: International Safety Guide for Oil Tankers and Terminals. Sixth Edition.

Objective

To verify that there are good communications between the tanker and terminal, from pre-arrival to post departure, to ensure compliance with agreed safe operational procedures.

OCIMF/ICS: International Safety Guide for Oil Tankers and Terminals. Sixth Edition.

Chapter 25 The Ship/Shore Safety Checklist

The responsibility for the safe conduct of operations while a tanker is at a terminal is shared between the tanker's Master and the Terminal Representative. Before cargo or ballast operations start, the Master (or their representative) and the Terminal Representative should communicate and:

- Agree in writing the transfer procedure and sequence of products, including the maximum loading or unloading rates and initial and topping-off rates (see part 6 of the SSSCL).
- Agree in writing the action to be taken in an emergency while the tanker is at the terminal.
- Complete and sign the SSSCL sections appropriate to the operation.

The Master, tanker personnel, Terminal Representative and shore personnel should all follow ISGOTT guidelines and recommendations throughout the ship's stay at the terminal. Each should cooperate with the other in the mutual interest of safe operations. All parties should agree appropriate actions and record them on the SSSCL.

25.2 Composition of the Ship/Shore Safety Checklist

All relevant statements should be reviewed and the associated responsibility for compliance accepted, either jointly or singly. Each Statement provides a primary reference where additional guidance on the subject may be found in ISGOTT Sixth Edition. This may be shown either as:

1. A complete chapter or technical section with multiple cross references to the topical issue, e.g. gas measurement (2.4).
2. A specific sub-paragraph within a technical section, e.g. fendering (22.4.1).

Some statements in part 5B (bulk liquid chemical) and part 5C (liquified gas) have no linked guidance to ISGOTT Sixth Edition. Guidance on these technical topics should be sought from the relevant Chemical or Liquid Gas Safety Guides produced by ICS or SIGTTO.

- Figure 25.1: Oil tanker flowchart
- Figure 25.2: Chemical tanker flowchart

- Figure 25.3: Gas tanker flowchart.

25.4.5 Summary of repetitive checks during and after transfer

Repetitive checks to be undertaken at intervals agreed in the pre-transfer conference by the tanker and terminal representative are provided to:

- Act as an aide memoire for tanker and terminal personnel to monitor key operational items during the period of operations.
- Provide a basis for status checks at watch or shift handovers.
- Enable decision making in the event that conditions change during the course of the operations.

TMSA KPI 6.2.2 requires that comprehensive procedures cover all aspects of cargo transfer operations for each type of vessel in the fleet.

The transfer procedures are specific to the vessel type and cargo to be carried. These may include:

- Pre-arrival checks.
- Ship shore safety checklist including ship/shore interface and communications.

IMO: ISM Code

7. The Company should establish procedures, plans and instructions, including checklists as appropriate, for key shipboard operations concerning the safety of the personnel, ship and protection of the environment. The various tasks involved should be defined and assigned to qualified personnel.

Inspection Guidance

The vessel operator should have developed procedures that required the relevant sections of a Ship/Shore safety checklist (SSSCL), conforming to the guidance provided in ISGOTT Sixth Edition Chapter 25, are completed by the vessel during every cargo, tank cleaning or ballast operation at a terminal or during defined ship to ship transfer operations.

The relevant sections of the SSSCL may be provided by the terminal or the ship may use one developed or provided by the company. Duplication is not expected but the vessel must confirm that any checklists provided by the terminal meet the guidance provided by ISGOTT Sixth Edition as a minimum.

Suggested Inspector Actions

- Sight, and where necessary review, the company procedures which required the relevant sections of a SSSCL in accordance with ISGOTT Sixth Edition to be completed during every cargo, tank cleaning or ballast operation at a terminal or during defined ship to ship transfer operations.
- Review the sections of the SSSCL that had been completed and were in use to monitor the ongoing operation and for each checklist:
    - Select at least one item and request that an officer having responsibility for cargo operations describes how the check is performed or documented.
    - Select at least one item that required some form of documented evidence and verify that the evidence was available.
    - Compare the SSSCL remarks against the list of open defect reports recorded in the defect reporting system as provided by the vessel during the opening meeting and verify that any defective equipment relevant to the SSSCL had been declared appropriately.
- Review Part 6, pre-transfer agreements, of the SSSCL and:
    - Verify that each agreement had been properly completed if it was applicable to the operation.
    - Select any two items and verify that the agreements had been understood and complied with during the operations to that point.

    - Verify that the cargo and ballast transfer plan had been updated to reflect the agreements documented in the pre-transfer conference.
- Review Part 8, repetitive checks during and after transfer and verify that:
    - Repetitive checks were being completed in accordance with the pre-transfer agreement.
    - A responsible officer had conducted the repetitive checks on deck at least once during each watch period.
- During the balance of the inspection verify that all items included in the relevant sections of the SSSCL and agreed during the pre-transfer conference were maintained in compliance with the guidance provided in ISGOTT Sixth Edition.

Where the inspection was being conducted at anchor or idle, the inspector should review the SSSCL used during a recent cargo operation and compare the responses in the SSSCL with Bridge Log Book and cargo records.

Expected Evidence

- The company procedure which required the relevant sections of a SSSCL in accordance with ISGOTT Sixth Edition to be completed during every cargo, tank cleaning or ballast operation at a terminal or during defined ship to ship transfer operations.
- The SSSCL for the ongoing operations and for at least two previous operations.
- Cargo operational records for the ongoing operation and at least two previous operations.
- The Bridge Log Book.

Potential Grounds for a Negative Observation

- There was no company procedure which required the relevant sections of a SSSCL in accordance with ISGOTT Sixth Edition to be completed during every cargo, tank cleaning or ballast operation at a terminal or during defined ship to ship transfer operations.
- The relevant sections of the SSSCL in use were not in alignment with the guidance provided in ISGOTT Sixth Edition.
- The sections of the SSSCL relevant to the operation being undertaken or reviewed had not been completed or were not in use.
- There were open defect reports for equipment or systems relevant to the SSSCL which had not been brought to the attention of the Terminal Representative through a documented remark in the relevant sections of the SSSCL.
- Inspection of the vessel determined that equipment or systems relevant to the SSSCL were defective and there was neither an open defect report in the defect reporting system nor a documented remark in the relevant sections of the SSSCL.
- Items in the relevant SSSCL checklists had been answered as "yes" when there was evidence that the item reported on was not in accordance with the referenced guidance provided in ISGOTT Sixth Edition.
- The vessel was found to be violating any of the documented agreements identified in SSSCL Part 6, tanker and terminal pre-transfer agreements.
- The cargo and ballast transfer plan had not been updated, where required, to reflect the documented agreements reached during the tanker and terminal pre-transfer meeting.
- Inspection of the vessel determined that any item included in SSSCL Part 8, repetitive checks was not maintained in the required condition.
- The accompanying officer or any officer having a responsibility for cargo operations was unfamiliar with the relevant sections of the SSSCL applicable to the vessel or any check or declaration made therein.
- A responsible officer had not conducted the repetitive checks required by the SSSCL Part 8 on deck at least once during each cargo watch period.

Where the vessel was in breach of the conditions of the SSSCL and an observation is being considered, the inspector should be guided by the ISGOTT6 references provided within the SSSCL. For specific Gas and Chemical cargo related concerns, the inspector should be guided by the relevant Chemical or Liquid Gas Safety Guides produced by the ICS.

8.99.3. Were the Master and officers familiar with the company procedures which provided guidance on the level of supervision and support for cargo / port operations, and were operations supervised and supported by an appropriate team in accordance with the company procedures?

Short Question Text
Cargo operations team composition.

Vessel Types
Oil, Chemical, LPG, LNG

ROVIQ Sequence
Main Deck, Cargo Control Room

Publications
ICS: Tanker Safety Guide (Gas) - Third Edition
IMO: ISM Code
OCIMF/ICS: International Safety Guide for Oil Tankers and Terminals. Sixth Edition.
OCIMF: Mooring Equipment Guidelines. Fourth Edition 2018 (MEG4)
ICS: Tanker Safety Guide (Chemicals) - Fifth Edition

Objective

To ensure that there are always enough properly supervised personnel on duty for the management of cargo operations, means of access, moorings and any other planned operations while in port or at a terminal.

Industry Guidance

OCIMF/ICS: International Safety Guide for Oil Tankers and Terminals. Sixth Edition.

7.9 Manning levels

Not having enough people available on board or at the terminal can lead to accidents and incidents. Marine regulations require:

- Flag States to issue ships with a minimum safe manning document.
- Ships to be appropriately manned to undertake all aspects of safe operations onboard…

…Both ship and terminal should consider how many people are needed for both regular operations and any emergencies that might be encountered.

12.1.6 Loading Procedures

12.1.6.4 Supervision

The following safeguards should be maintained throughout loading:

- A responsible officer should be on watch and enough crewmembers should be on board to deal with the operation and security of the ship.
- A watch of the tank deck should be maintained…

23.11 Manning requirements

The level of manning should ensure that all operations related to the tanker/terminal interface are carried out safely. It should also ensure that emergency situations and security can be managed at all times during the tanker's stay at the terminal.

Ship Shore Safety Checklist

Part 5a. Tanker and terminal: pre-transfer conference.

Item 35 Operation supervision and watchkeeping is adequate (7.9, 23.11)

ICS: Tanker Safety Guide (Chemicals) Fifth Edition

6.6 Monitoring Cargo Operations

Cargo operations should be continually monitored and be under the control of a watchkeeping officer.

While many of the watchkeeping officer's functions require them to be based in the CCR (*cargo control room*), their responsibilities extend to the entire cargo operation, including the supervision of cargo deck watches. It is good practice that at regular intervals the officer is relieved by another responsible person so that an inspection can be made of the cargo deck to ensure that the cargo operation is proceeding safely and according to the cargo handling plan.

A crew member should always be on watch on the cargo deck and be in constant radio contact with the watchkeeping officer. The ship's access and manifold area should never be left unattended. The duties of the deck watch will also include making regular safety rounds of the deck, including a check that the moorings are correctly adjusted and that there is equal tension on all lines. This will require a second person in addition to the access and manifold watch.

During the safety rounds all areas of the cargo deck should be inspected to ensure there are no leaks or other developments that could affect the safety or the cargo operation, and that access to the ship is clear and safe.

ICS: Tanker Safety Guide (Gas) - Third Edition

Appendix 8 Ship/Shore Safety Checklist

A8.4 Ship/Shore Safety Checklist Guidelines

22. Action - There is an effective deck watch in attendance on board and adequate supervision of operations on the ship and in the terminal.

22. Remark- The operation should be under constant control and supervision on the ship and in the terminal. Supervision should be aimed at preventing the development of hazardous situations. However, if such a situation arises, the controlling personnel should have adequate knowledge and the means available to take corrective action.

The controlling personnel on the ship and in the terminal should maintain effective communication with their respective supervisors.

All personnel connected with the operations should be familiar with the dangers of the substances handled and should wear appropriate protective clothing and equipment.

OCIMF: Mooring Equipment Guidelines. Fourth Edition.

1.7.1 Line management principles

The objective of good line tending is to ensure that all lines share the load to the maximum extent possible and the ship's movement is limited in the berth (off or along the berth face).

TMSA KPI 6.2.2 requires that comprehensive procedures cover all aspects of cargo transfer operations for each type of vessel within the fleet.

The transfer procedures are specific to the vessel type and cargo to be carried. These may include:

- Cargo hose/arm connection including supervision of third party personnel.
- Cargo survey and sampling.
- Pre-operational checks including an independent verification of line setting prior to the start of operations.
- Starting cargo operations.
- Bulk cargo transfer.
- Topping off/stripping.
- Draining/blowing lines and disconnection of hoses.

IMO: ISM Code

6.2 The company should ensure that each ship is:

.2 appropriately manned in order to encompass all aspects of maintaining safe operations onboard.

Inspection Guidance

The vessel operator should have developed procedures to provide guidance on the minimum number of personnel that should form the cargo operations team on duty during cargo operations.

The procedures should consider the various stages of a cargo operation and describe the level of supervision and support required in the cargo control room and on deck while:

- Connecting or disconnecting cargo hoses or marine loading arms.
- Commencing loading or discharging operations.
- Bulk loading and/or discharging.
- Topping off cargo tanks.
- Crude oil washing or cargo tank cleaning.
- Stripping cargo tanks.
- Draining lines.

The procedure should additionally consider that:

- Moorings and the means of access must be properly tended throughout all port operations, and that cargo operations such as topping off, sounding tanks during stripping and surveying activities may distract the deck support rating(s) for considerable periods of time.
- Simultaneous operations may require additional personnel to be on duty to supervise and conduct any SIMOPS without impacting the cargo operation and mooring system management.

The cargo / port operations planning documentation should include details of the supervision and manning required for the various stages of operations.

Suggested Inspector Actions

- Sight, and where necessary review, the company procedures that provided guidance on the supervision and support levels required during cargo / port operations.

- Review the cargo / port operations planning documentation for a recent cargo operation and verify that the supervision and support levels identified for the various stages of the operation were in accordance with the guidance provided by the company procedures.
- During the balance of the inspection verify that the supervision and support available for cargo / port operations was maintained in accordance with the cargo / port planning documentation and the company guidance for cargo operations team.

Expected Evidence

- The company procedures that provided guidance on the supervision and support levels required during cargo / port operations.
- The cargo / port planning documentation for the current operations and the previous three months or six cargo / port operations whichever is the lesser.
- The Bridge Log Book.

Potential Grounds for a Negative Observation

- There were no company procedures that provided guidance on the supervision and support levels required during cargo / port operations.
- The accompanying officer was not familiar with the company procedures that provided guidance on the supervision and support levels required during cargo / port operations.
- The cargo / port planning documentation did not include the level of supervision and support required during the various stages of cargo / port operations.
- The cargo / port planning documentation was not developed in alignment with the company procedures that provided guidance on the supervision and support levels required during cargo / port operations.
- The level of supervision and support in the cargo control room and on deck observed during the inspections was not in alignment with the company procedures that provided guidance on the supervision and support levels required during cargo / port operations.
- The cargo operation team supervisors and/or support were observed to be involved with a conflicting operation (SIMOPS) and distracted from their designated duties documented within the cargo / port plans.
- Operations identified by the company procedures as requiring senior officer supervision, such as, crude oil washing, commencing loading/discharging operations or completing loading/discharging operations were not supervised as required.

8.99.4. Were the Master and officers familiar with the company procedures for checking and testing cargo and ballast system valves, and were the valves and the remote control system in satisfactory condition?

Short Question Text
Cargo and ballast valve testing.

Vessel Types
Oil, Chemical, LPG, LNG

ROVIQ Sequence
Cargo Control Room, Main Deck

Publications
IMO: ISM Code
OCIMF/ICS: International Safety Guide for Oil Tankers and Terminals. Sixth Edition.
SIGTTO: Liquified Gas Handling Principles on Ships and in Terminals. Fourth Edition.

Objective

To ensure that cargo and ballast system valves always operate as designed.

Industry Guidance

OCIMF/ICS: International Safety Guide for Oil Tankers and Terminals. Sixth Edition

12.1.3 Valve operation

Valves that control liquid flow should be closed slowly. The time that it takes for power operated valves to move from open to closed, and from closed to open, should be checked regularly at their normal operating temperature.

SIGTTO: Liquified Gas Handling Principles on Ships and in Terminals. Fourth Edition.

4.1.4 Cargo Valves

Isolating valves for cargo tanks must meet the requirements of the IGC Code...

The types of valve normally found on gas carriers are ball, globe, gate or butterfly valves. These valves are usually fitted with pneumatic or hydraulic actuators.

System design will usually be such that valves will default to a safe position in the event of an actuator power failure.

TMSA KPI 4.1.1 requires that each vessel in the fleet is covered by a planned maintenance system and spare parts inventory which reflects the company's maintenance strategy. The company identifies all equipment and machinery required to be included in the planned maintenance system, for example:

- Cargo handling machinery/equipment.

IMO: ISM Code

7. The Company should establish procedures, plans and instructions, including checklists as appropriate, for key shipboard operations concerning the safety of the personnel, ship and protection of the environment. The various tasks involved should be defined and assigned to qualified personnel.

Inspection Guidance

The vessel operator should have developed procedures for the regular checking and testing of cargo and ballast system valves, including manifold valves, which included the:

- Frequency of checks and tests of cargo and ballast system valves.
- Records to be kept of checks and tests of cargo and ballast system valves.
- Procedure for checking of the time taken for power operated valves to move from open to closed, and from closed to open.
- Procedure for verifying the accuracy of local and remote valve indicators.
- Procedure for testing the emergency valve control mode and local hand pumps, as applicable to the vessel.

These procedures may form part of the planned maintenance system and should refer to:

- The valve manufacturer’s instructions.
- The ship’s drawings which identified the designed opening and closing times for each size, type and service of power operated valve fitted in the cargo and ballast systems.

Suggested Inspector Actions

- Sight, and where necessary review, the company procedures for the regular checking and testing of cargo and ballast system valves.
- Review the records for valve testing which included:
    - The actual times recorded for opening and closing.
    - The verification of the accuracy of local and remote valve indicators.
- During the course of the inspection, observe the operation of cargo and ballast system valves to verify their condition and satisfactory operation.

- Interview the accompanying officer to verify their familiarity with:
    - The company procedures for the checking and testing of cargo and ballast system valves.
    - The required times for opening and closing of each size, type and service of power operated valve fitted in the cargo and ballast systems.
    - The actions to take if the opening and closing times for cargo or ballast system valves were not in accordance with the designed valve operating speed.
    - The procedure to operate the emergency valve control mode and local hand pumps, as applicable to the vessel.

Expected Evidence

- The company procedures for the regular checking and testing of cargo and ballast system valves.
- The manufacturer's operation and maintenance manual for the power operated valves fitted in the cargo and ballast systems.
- The ship's drawings which identified the design opening and closing times for each size, type and service of power operated valve fitted in the cargo and ballast systems.
- Records of checks and tests of cargo and ballast system valves.

Potential Grounds for a Negative Observation

- There were no company procedures for the regular checking and testing of cargo and ballast system valves which included the:
    - Frequency of checks and tests of cargo and ballast system valves.
    - Records to be kept of checks and tests of cargo and ballast system valves.
    - Procedure for checking of the time taken for power operated valves to move from open to closed, and from closed to open, and the optimum times.
    - Verification of the accuracy of local and remote valve indicators.

    - Procedure for testing the emergency valve control mode and local hand pumps, as applicable to the vessel.
- The accompanying officer was not familiar with:
    - The company procedures for the regular checking and testing of cargo and ballast system valves.
    - The emergency valve control mode and local hand pumps, as applicable to the vessel.
- There were no records of regular checking and testing of cargo and ballast system valves.
- Checks and tests of cargo and ballast system valves did not include:
    - Checking and recording the time taken for power operated valves to move from open to closed, and from closed to open.
    - Verifying that the local and remote valve indicators were showing the correct position of the valve.
    - Testing the emergency valve control mode and local hand pumps, as applicable to the vessel.
- Records indicated that power operated valves were not operating in the optimum times.
- A cargo or ballast system valve indicator was observed to be indicating the incorrect position of the valve. (e.g. the valve signal was set to full open or full closed, but the valve indicator did not reflect the order by showing an intermediate position or by continuing to flash).
- A hydraulically operated cargo or ballast system valve was isolated from the hydraulic system due to suspected hydraulic leakage.
- A cargo or ballast system valve designed to be remotely operated was disconnected from the remote control system and was being operated manually.
- The valve hydraulic system was not maintained at normal operating pressure during cargo transfer operations due to suspected hydraulic oil leakage in the system.
- The valve hydraulic system or pneumatic system was not set to automatically maintain the normal system operating pressure throughout cargo and ballast transfer operations.
- There was evidence of excessive hydraulic oil loss from the valve hydraulic system.
- A cargo or ballast system valve was observed to be defective in any respect.
- The cargo and ballast system valve remote control system was defective in any respect.
- There was no functional emergency valve control mode local hand pump available.

8.99.5. Were the Master and officers familiar with the company procedures for the operation, maintenance, testing, calibration and comparison of the fixed cargo tank level gauging system, and was the system in satisfactory condition and fully operational?

Short Question Text
Fixed cargo tank level gauging system.

Vessel Types
Oil, Chemical, LPG, LNG

ROVIQ Sequence
Cargo Control Room, Main Deck

Publications
IMO: ISM Code
IMO SOLAS
OCIMF/ICS: International Safety Guide for Oil Tankers and Terminals. Sixth Edition.
IMO: IGC Code
IMO: IBC Code

Objective

To ensure the fixed tank level gauging system is always fully operational, reliable and accurate.

Industry Guidance

OCIMF/ICS: International Safety Guide for Oil Tankers and Terminals. Sixth Edition

12.8.6 Cargo tank monitoring systems

Tank monitoring equipment often has multiple functions, such as radar or other remote gauging, temperature measurement, tank pressure sensors and level alarms. It may be integrated with other cargo monitoring or control equipment or with loading computers or control systems. Manufacturers may refer to the multi-function units as cargo tank monitoring systems.

Whether provided as a complete system or as separate elements, planned maintenance procedures should be established to ensure maintenance, test and calibration of this equipment per the manufacturer's instructions.

A risk assessment should identify procedures to enable work to continue if tank monitoring equipment fails. If temporary exchange with a unit from another tank is considered, check the compatibility. The equipment may need to be recalibrated.

IMO: IBC Code

13.1.1 Cargo tanks shall be fitted with one of the following types of gauging devices:

Open device: which makes use of an opening in the tanks and may expose the gauger to the cargo or its vapour. An example of this is the ullage opening.

Restricted device: which penetrates the tank and which, when in use, permits a small quantity of cargo vapour or liquid to be exposed to the atmosphere. When not in use, the device is completely closed. The design shall ensure that no dangerous escape of tank contents (liquid or spray) can take place in opening the device.

Closed device: which penetrates the tank, but which is part of a closed system and keeps tank contents from being released. Examples are the float-type systems, electronic probe, magnetic probe and protected sight-glass. Alternatively, an indirect device which does not penetrate the tank shell, and which is independent of the tank may be used. Examples are weighing of cargo, pipe flow meter.

13.1.2 Gauging devices shall be independent of the equipment required under 15.19.

13.1.3 Open gauging and restricted gauging shall be allowed only where:

open venting is allowed by the Code; or means are provided for relieving tank pressure before the gauge is operated.

13.1.4 Types of gauging for individual products are shown in column j in the table of chapter 17.

IMO: IGC Code

13.1.1 Each cargo tank shall be provided with a means for indicating level, pressure and temperature of the cargo. Pressure gauges and temperature indicating devices shall be installed in the liquid and vapour piping systems, in cargo refrigeration installations.

13.1.2 If loading and unloading of the ship is performed by means of remotely controlled valves and pumps, all controls and indicators associated with a given cargo tank shall be concentrated in one control position.

13.1.3 Instruments shall be tested to ensure reliability under the working conditions and recalibrated at regular intervals. Test procedures for instruments and the intervals between recalibration shall be in accordance with manufacturer's recommendations.

13.2 Level indicators for cargo tanks

13.2.1 Each cargo tank shall be fitted with liquid level gauging device(s), arranged to ensure that a level reading is always obtainable whenever the cargo tank is operational. The device(s) shall be designed to operate throughout the design pressure range of the cargo tank and at temperatures within the cargo operating temperature range.

13.2.2 Where only one liquid level gauge is fitted, it shall be arranged so that it can be maintained in an operational condition without the need to empty or gas-free the tank.

13.2.3 Cargo tank liquid level gauges may be of the following types, subject to special requirements for particular cargoes shown in column "g" in the table of chapter 19:

1. indirect devices, which determine the amount of cargo by means such as weighing or in-line flow metering.
2. closed devices which do not penetrate the cargo tank, such as devices using radio-isotopes or ultrasonic devices.
3. closed devices which penetrate the cargo tank, but which form part of a closed system and keep the cargo from being released, such as float type systems, electronic probes, magnetic probes and bubble tube indicators. If closed gauging device is not mounted directly onto the tank, it shall be provided with a shutoff valve located as close as possible to the tank; and
4. restricted devices which penetrate the tank and, when in use, permit a small quantity of cargo vapour or liquid to escape to the atmosphere, such as fixed tube and slip tube gauges. When not in use, the devices shall be kept completely closed. The design and installation shall ensure that no dangerous escape of cargo can take place when opening the device. Such gauging devices shall be so designed that the maximum opening does not exceed 1.5 mm diameter or equivalent area unless the device is provided with an excess flow valve.

TMSA KPI 4.1.1 requires that each vessel in the fleet is covered by a planned maintenance system and spare parts inventory which reflects the company's maintenance strategy. The company identifies all equipment and machinery required to be included in the planned maintenance system, for example:

- Cargo handling machinery/equipment.

IMO: ISM Code

10.1 The Company should establish procedures to ensure that the ship is maintained in conformity with the provisions of the relevant rules and regulations and with any additional requirements which may be established by the Company.

IMO: SOLAS

Chapter II-2 Regulation 4

5.5.3.2 Tankers fitted with a fixed inert gas system shall be provided with a closed ullage system.

Inspection Guidance

The vessel operator should have developed procedures for the operation, maintenance, testing, calibration and comparison of the fixed tank level gauging system, based on the manufacturer's instructions, which included the:

- Procedure and frequency for tests and calibrations.
- Procedure and frequency for comparison checks against portable equipment or secondary tank level gauges, where practicable.
- Procedure, based on risk assessment, to enable continued cargo transfer operations in the event of a failure of the fixed tank level gauging system or individual cargo tank fixed gauging device.
- Records to be maintained.

These procedures and records may form part of the vessel's planned maintenance system.

Suggested Inspector Actions

- Sight, and where necessary review, the company procedures for the operation, maintenance, testing, calibration and comparison of the fixed tank level gauging system.
- Review the records of maintenance, testing, calibration, and comparison checks of the fixed tank level gauge system.
- Request the accompanying officer to demonstrate the use of the fixed tank level gauging system to verify operation and familiarity.

- Interview the accompanying officer to verify their familiarity with:
    - The company procedures for the operation, maintenance, testing, calibration and comparison checks of the fixed tank level gauging system.
    - The actions to take if the fixed gauging system or an individual cargo tank fixed gauging device is defective or unreliable.
    - The setting and monitoring of any level alarms built into the fixed tank level gauging system.

Expected Evidence

- The company procedures for the operation, maintenance, testing, calibration and comparison checks of the fixed tank level gauging system.
- The manufacturer's instruction manual for the fixed tank level gauging system.
- Records of maintenance, testing, calibration, and comparison checks of the fixed tank level gauge system.

Potential Grounds for a Negative Observation

- There were no company procedures for the operation, maintenance, testing, calibration and comparison checks of the fixed tank level gauging system based on the manufacturer's instructions.
- The accompanying officer was not familiar with:

    - The company procedures for the operation, maintenance, testing, calibration and comparison checks of the fixed tank level gauging system.
    - The actions to take if the fixed gauging system or an individual cargo tank fixed gauging device is defective or unreliable.
    - The setting and monitoring of any level alarms built into the fixed tank level gauging system.
- Testing and calibration of the fixed tank level gauging system had not been performed in accordance with the company procedures and/or manufacturer's instructions.
- There were no records available of testing and calibration of the fixed tank level gauging system.
- Fixed tank level gauges had not been regularly checked against portable equipment or secondary tank level gauges, where practicable, and records of the comparison maintained.
- There were significant discrepancies in the comparison between the fixed tank level gauges and the portable or secondary gauges.
- There was no procedure, based on risk assessment, to enable continued cargo transfer operations in the event of a failure of the fixed tank level gauging system.
- The fixed tank level gauging system was inoperative, and gauging was being performed using portable equipment.
- The fixed tank level gauging system was unreliable, and gauging was being performed using portable equipment.
- Level alarms built into the fixed ullaging system, if any, were permanently silenced or inhibited
- The fixed tank level gauging system was defective in any respect.

Where the vessel was not fitted with fixed cargo tank level gauging equipment, select "*Not Answerable*" in each of the response tools then select "*Not Applicable - as instructed by question guidance.*"

8.99.6. Were the Master and deck officers familiar with the company procedure and manufacturer’s instructions for the periodic testing of the stability and loading instrument(s), and were records maintained to confirm that tests had been completed in accordance with the procedure?

Short Question Text
Stability and loading instrument(s)

Vessel Types
Oil, Chemical, LPG, LNG

ROVIQ Sequence
Cargo Control Room

Publications
IMO: MARPOL
IACS: Unified Requirement S1 Requirements for the Loading Conditions
Loading Manuals and Loading Instruments
IMO: IGC Code
IMO: IBC Code
IMO: ISM Code
IACS: Unified Requirements L5 Computer Software for Onboard Stability Calculations

Objective

To ensure that the vessel’s stability and loading instrument(s) provides accurate stress and stability calculations.

Industry Guidance

IACS Unified Requirements S1 Requirements for Loading Conditions, Loading Manuals and Loading Instruments

S1.1.2 Definitions

Loading Instrument

A loading instrument is an instrument, which is either analogue or digital, by means of which it can be easily and quickly ascertained that, at specified read-out points, the still water bending moments, shear forces, and the still water torsional moments and lateral loads, where applicable, in any load or ballast condition will not exceed the specified permissible values.

An operational manual is always to be provided for the loading instrument.

Single point loading instruments are not acceptable.

S1.1.3 Annual and Special Survey

At each Annual and Special Survey, it is to be checked that the approved loading guidance information is available on board.

The loading instrument is to be checked for accuracy at regular intervals by the ship's Master by applying test loading conditions.

At each Special Survey this checking is to be done in the presence of the Surveyor.

S1.2 Loading Conditions, Loading Manuals and Loading Instruments

S1.2.1 General

An approved loading manual is to be supplied for all ships except those of Category II with length less than 90m in which the deadweight does not exceed 30% of the displacement at the summer load line draft.

In addition, an approved loading instrument is to be supplied for all ships of Category I of 100m in length and above.

S1.2.3 Condition of Approval of Loading Instruments

The loading instrument is subject to approval, which is to include:

- verification of type approval if any
- verification that the final data of the ship has been used
- acceptance of number and position of read-out points
- acceptance of relevant limits for all read-out points
- checking of proper installation and operation of the instrument on board, in accordance with agreed test conditions, and that a copy of the operation manual is available.

In case of modifications implying changes in the main data of the ship, the loading instrument is to be modified accordingly and approved.

The operation manual and the instrument output must be prepared in a language understood by the users. If this language is not English, a translation into English is to be included.

The operation of the loading instrument is to be verified upon installation. It is to be checked that the agreed test conditions and the operation manual for the instrument is available on board.

IACS Unified Requirements L5 Computer Software for Onboard Stability Calculations

1. General

An operation manual is to be provided for the onboard computer stability software.

- The language in which the stability information is displayed and printed out as well as the operation manual written shall be the same as used in the ship's approved stability information. The society may require a translation into a language considered appropriate.
- In case of modifications implying changes in the main data or internal arrangement of the ship, the specific approval of any original stability calculation software is no longer valid. The software is to be modified accordingly and re- approved.

8. Installation Testing

To ensure correct working of the computer after the final or updated software has been installed, it is the responsibility of the ship's Master to have test calculations carried out according to the following pattern in the presence of a Society surveyor:

From the approved test conditions at least one load case (other than light ship) shall be calculated. Note: Actual loading condition results are not suitable for checking the correct working of the computer.

Normally, the test conditions are permanently stored in the computer. Steps to be performed:

- Retrieve the test load case and start a calculation run; compare the stability results with those in the documentation.

- Change several items of deadweight (tank weights and the cargo weight) sufficiently to change the draught or displacement by at least 10%. The results are to be reviewed to ensure that they differ in a logical way from those of the approved test condition.
- Revise the above modified load condition to restore the initial test condition and compare the results. Confirm that the relevant input and output data of the approved test condition have been replicated.
- Alternatively, one or more test conditions shall be selected, and the test calculation performed by entering all deadweight data for each selected test condition into the program as if it were a proposed loading. The results shall be verified as identical to the results in the approved copy of the test conditions.

9. Periodical Testing

It is the responsibility of the ship's master to check the accuracy of the onboard computer for stability calculations at each Annual Survey by applying at least one approved test condition. If a Society surveyor is not present for the computer check, a copy of the test condition results obtained by the computer check is to be retained on board as documentation of satisfactory testing for the surveyor's verification.

At each Special Survey this checking for all approved test loading conditions is to be done in presence of the surveyor.

The testing procedure shall be carried out in accordance with paragraph 8.

10. Other Requirements

Protection against unintentional or unauthorised modification of programs and data shall be provided.

The program shall monitor operation and activate an alarm when the program is incorrectly or abnormally used.

The program and any data stored in the system shall be protected from corruption by loss of power.

Error messages with regard to limitations such as filling a compartment beyond capacity, or exceeding the assigned load line, etc. shall be included.

TMSA KPI 6.1.2 requires that procedures for pre-operational tests and checks of cargo and bunkering equipment are in place for all vessel types within the fleet. Tests and checks of equipment may include

- Loading computer or alternative calculations.

IMO: ISM Code

7. The Company should establish procedures, plans and instructions, including checklists as appropriate, for key shipboard operations concerning the safety of the personnel, ship and protection of the environment. The various tasks involved should be defined and assigned to qualified personnel.

IMO: MARPOL

Annex I

Chapter 4 Regulation 28

All oil tankers shall be fitted with a stability instrument, capable of verifying compliance with intact and damage stability requirements approved by the Administration having regard to the performance standards recommended by the Organization.

IMO: IBC Code

2.2.6

All ships subject to the Code shall be fitted with a stability instrument, capable of verifying compliance with intact and damage stability requirements approved by the Administration having regard to the performance standards recommended by the Organization.

IMO: IGC Code

2.2.6

All ships subject to the Code shall be fitted with a stability instrument, capable of verifying compliance with intact and damage stability requirements approved by the Administration having regard to the performance standards recommended by the Organization.

Inspection Guidance

By IMO regulation, all oil tankers, chemical tankers and gas carriers must be fitted with a stability instrument, capable of verifying compliance with intact and damage stability requirements.

It is a class requirement that all oil tankers, chemical tankers and gas carriers over 100 metres in length must be fitted with a loading instrument for calculating SF/BMs etc.

In most cases these requirements will be combined in one stability and loading instrument, which may be computer based.

Class approvals for stability and loading instruments are made under a type approvals process. Type-approval certificates are generally valid for periods of not more than five years.

IMO: MSC.1/Circ.1221 states that the validity of the type approval certificate itself has no influence on the operational validity of a product accepted and installed onboard ship and that a product manufactured during the period of validity of the relevant type approval certificate need not be renewed or replaced due to the expiry of such type approval certificate.

The vessel operator should have developed procedures requiring the vessel's stability and loading instrument to be tested regularly, at least at annual and special surveys, using approved test conditions and with test records maintained.

Suggested Inspector Actions

- Sight, and where necessary review, the company procedures for the testing of the stability and loading instrument.
- Review a recent test of the stability and loading instrument and verify that the condition used was an approved test condition and that the test was conducted in accordance with the manufacturer's instructions.
- Verify that the stability and loading instrument had been tested at Special Survey in the presence of a class surveyor.
- Verify that the accompanying officer was able to demonstrate the damage stability function of the instrument.

Expected Evidence

- The company procedures for the management and testing of the stability and loading instrument.
- The stability and loading instrument instruction manual.
- The records for the regular tests of the stability and loading instrument accuracy by vessel staff.
- The records for the annual tests of the stability and loading instrument at the time of annual survey.
- The records for the tests in the presence of a class surveyor at the time of special survey.

- Where a vessel was exempt from carrying a stability and/or loading instrument under IMO regulations or class requirements, a copy of the appropriate certificate indicating that the instrument was not required.

Potential Grounds for a Negative Observation

- There was no company procedure requiring the periodic testing of the vessel's loading instrument.
- The accompanying officer was unfamiliar with the company procedures or the manufacturer's instructions for testing the loading instrument.
- The accompanying officer was unfamiliar with the damage stability functions of the loading instrument.
- The vessel had not completed the periodic verification of the loading instrument accuracy in accordance with the company procedures or the manufacturer's instructions.
- Records were not available for the periodic verification of the loading instrument accuracy.
- Records were not available for the verification of the loading instrument accuracy at Special Survey in the presence of a Class Surveyor.
- The loading instrument in use was defective in any respect.
- The vessel did not have a loading instrument but there was no clear evidence that the vessel was exempt from the requirement to carry such a device.

Where the vessel was exempt from carrying a loading instrument, provide details of why the vessel was exempt as a **comment** within the hardware response tool

8.99.7. Where the vessel was subject to loading restrictions and/or intact stability concerns at any phase of a voyage or cargo operation, had the company developed procedures to manage these restrictions and/or concerns, and were the Master and cargo officers familiar with the company procedures?

Short Question Text
Loading limitations

Vessel Types
Oil, Chemical, LPG, LNG

ROVIQ Sequence
Cargo Control Room

Publications
OCIMF/ICS: International Safety Guide for Oil Tankers and Terminals. Sixth Edition.
IMO: ISM Code
ICS: Tanker Safety Guide (Gas) - Third Edition

Objective

To ensure that the vessel is never loaded in such a manner that any structural limitations are exceeded due to tank filling level, or intact stability is compromised by unmanaged free surface effect.

Industry Guidance:

OCIMF: International Safety Guide for Oil Tankers and Terminals. Sixth Edition.

12.2 Stability, stress, trim and sloshing considerations

Oil tankers usually have a high metacentric height in all conditions, so they remain inherently stable. While tanker personnel have always had to take account of longitudinal bending moments and vertical shear forces during cargo and ballast operations, the actual stability of the ship has seldom been a major concern. Masters and officers should account for free surface and sloshing effects during all stages of cargo and ballast operations. Double hull tankers, particularly those without centreline bulkheads in cargo tanks and/or having U-shaped ballast tanks, may face potential issues from large free surface effects influencing their stability.

ICS: Tanker Safety Guide (Gas) - Third Edition

6.9.3 Sloshing

Within a particular range of cargo tank filling levels, the pitching and rolling of the ship and the liquid free surface can create high impact pressure on cargo tanks. This effect is called ‘sloshing’ and can cause structural damage, particularly to membrane containment systems. Filling levels within this range should therefore be avoided.

Guidance on acceptable filling limits should be sought from the operator, ship designer and/or Classification Society

TMSA KPI 6.2.1 requires that a comprehensive procedure for planning cargo, ballast and bunkering operations is in place for all types of vessel within the fleet which includes:

- Stability, stress, draught and trim calculations for key stages of the operation.
- Free surface restrictions,
- Highlighting limitations on numbers and location of slack tanks.

IMO: ISM Code

7. The company should establish procedures, plans and instructions, including checklists as appropriate, for key shipboard operations concerning the safety of the personnel, ship and protection of the environment. The various tasks should be defined and assigned to qualified personnel.

Inspection Guidance

The vessel operator should have identified whether the vessel was subject to:

- Restrictions in the density of the cargoes that may be loaded onboard or in any individual tanks.
- Restrictions in the filling height for any tanks onboard and the phases of operations for which the restrictions are in place.
- Intact stability concerns due to large width cargo tanks, double bottom tanks without a centreline bulkhead or "U" section ballast tanks.
- Any other loading limitations or stability concerns.

Where the vessel is subject to any of the above restrictions or concerns the vessel operator should have developed procedures to:

- Warn the vessel staff of the limitations imposed.
- Instruct the vessel staff to avoid any limitations or concerns entirely, or where this is not possible,
- Advise the actions to take to mitigate the restrictions and/or concerns.

Where a vessel had undergone any weight variations, such as the installation of a scrubber or ballast water treatment plant or, major structural modifications, the vessel operator should have arranged for the loading instrument and stability booklet to be updated as appropriate.

The vessel operator should have declared any loading limitations or stability concerns through the pre-inspection questionnaire which will be inserted in the final report.

Suggested Inspector Actions

- Review the vessel loading and stability manual, identify whether the vessel was subject to any loading restrictions or stability concerns and verify that the vessel operator's declaration in the pre-inspection questionnaire was correct.
- Where the vessel was subject to loading limitations or stability concerns, review the company procedures that addressed the issues and verify that:
    - Cargo and ballast plans had been developed to address the loading limitations or stability concerns.
    - Warning signs had been posted to inform the cargo officers of the loading limitations and/or stability concerns.
    - Cargo and ballast records confirmed that the company procedures relating to the limitations and concerns had been complied with.
- Where a vessel had undergone any weight variations, such as the installation of a scrubber or ballast water treatment plant or, major structural modifications, verify that the loading instrument and stability booklet had been updated as appropriate.

Expected Evidence

- The vessel's loading and stability manual.
- The company procedures that addressed any loading limitations or stability concerns.
- Recent cargo plans and records to demonstrate that the company procedures to address any loading limitations or stability concerns had been complied with.
- Evidence that the impact of any equipment installations or structural modifications had been assessed and the loading instrument and stability manual updated as appropriate.

Potential Grounds for a Negative Observation

- The vessel operator had not correctly declared any loading limitations or stability concerns applicable to the vessel through the pre-inspection questionnaire.
- The vessel was subject to loading limitations or stability concerns, but the vessel operator had not developed procedures to manage the issues onboard the vessel.
- The vessel was subject to loading limitations or stability concerns, but there were no warning signs posted to notify the officers with cargo related responsibilities of the issues onboard the vessel.
- The accompanying officer was unfamiliar with the loading limitations or stability concerns applicable to the vessel, where they existed.
- The cargo plans had not been developed to address loading limitations or stability concerns where they existed.
- Vessel records determined that the guidance provided by the company procedure to address loading limitations or stability concerns had not been complied with.
- The vessel had undergone weight variations due to the installation of a scrubber or ballast water treatment system, or major structural modifications, but there was no evidence that the loading instrument and/or stability booklet had been updated to take account of the changes where appropriate.

Where the vessel had been confirmed as not being subject to any loading limitations or stability concerns this question should be answered as N/A under the Process response tool.

8.99.8. Were the Master and officers familiar with the company procedures for the selection, inspection, testing and storage of cargo transfer hoses, and were the hoses in satisfactory condition?

Short Question Text
Cargo transfer hoses.

Vessel Types
Oil, Chemical, LPG, LNG

ROVIQ Sequence
Cargo Control Room, Main Deck

Publications
USCG: Code of Federal Regulations. Title 33.
SIGTTO: Floating LNG installations 1st edition 2021
IMO: ISM Code
OCIMF/ICS: International Safety Guide for Oil Tankers and Terminals. Sixth Edition.
IMO: IGC Code
IMO: IBC Code
OCIMF: Ship to Ship Transfer Guide for Petroleum
Chemicals and Liquefied Gases. First Edition.
OCIMF: Guidelines for the Handling
Storage
Use
Maintenance and Testing of STS Hoses. First Edition.
SIGTTO: Liquified Gas Handling Principles on Ships and in Terminals. Fourth Edition.

Objective

To ensure ship supplied cargo transfer hoses are always fit for purpose.

Industry Guidance

OCIMF: Guidelines for the Handling, Storage, Use, Maintenance and Testing of STS Hoses. First Edition.

3 Composite hose assemblies

Composite STS hose assemblies are typically used for liquified gas and chemical transfers. These hoses are resistant to cryogenic cargoes, high-aromatic-content cargoes and various other cargoes that are not compatible with rubber compounds.

Composite STS hoses are very different from rubber hose assemblies, and it is important that users understand these differences as well as their properties. Composite hoses are lightweight and flexible, but it is important that the manufacturers' minimum bend radius (MBR) guidance is strictly followed.

4.6 Bend radius

Care should be taken when handling and supporting hose strings to avoid any kinking or over-stressing that may cause damage or reduce service life. To prevent damage when handling or supporting hoses, the hose's MBR should be taken into account. Helix-free rubber STS hoses should not be bent beyond six times their nominal bore. The MBR for storage and operation should be confirmed with the manufacturer.

5.8 Inspection and testing

Tests and inspections should be conducted every twelve months as a minimum. The testing and inspection frequency should take into account the types of products handled through the hose, the age of the hose, and the severity of service conditions. A decision, dependent on the testing and inspection regime, can then be made about whether to retire a hose or keep it in service.

5.8.9.1 Hose service life

The service life of a hose depends on factors such as age, handling, throughput and storage conditions. There are various approaches to gauging the life of a hose during the time it is in service. Service life expectancy should be based on a combination of testing and visual inspection…

…Test records should be kept for each hose. It is recommended that the temporary and permanent elongations be compared to previous readings to facilitate trending and to give early indication of maximum elongation exceedance.

SIGTTO: Floating LNG installations 1st edition 2021

2.5.3 Gas transfer system

Equipment should be designed, constructed and tested in compliance with BS EN 1474-3 (Reference 12) for hoses….and certified to the required SIL(safety integrity level), determined in the owner's risk analysis.

Annex 3 Reference List

12. BS EN 1474-3 Installation and equipment for liquefied natural gas – Design and testing of marine transfer systems – Offshore transfer systems

OCIMF*: Ship to Ship Transfer Guide for Petroleum, Chemicals and Liquefied Gases. First Edition.

9.2.7 Marking

Each transfer hose should be permanently marked with the information required by the appropriate international standard and other applicable regulations, such as the IGC Code. Information provided will include details such as:

- The manufacturers name or trademark.
- Identification of the standard specification for manufacture.
- Maximum allowable working pressure.
- Month and year of manufacture and manufacturers serial number.
- Indication that the hose is electrically continuous, electrically discontinuous or semi-continuous.
- The type of service for which it is intended e.g. oil, product, petroleum gas.

OCIMF* A joint publication by OCIMF/SIGTTO/ICS/CDI

OCIMF/ICS: International Safety Guide for Oil Tankers and Terminals. Sixth Edition

18.2.6 Inspection, testing and maintenance requirements for cargo hoses

Hoses in service should have a documented inspection at least annually to confirm their suitability for continued use.

Hoses should be retired in accordance with defined criteria (see section 18.2.6.5).

All hoses should be certified, fit for purpose, in good physical condition, and should have been pressure tested. A record of all hose certificates should be maintained and made available for review by appropriate parties on request.

18.2.6.2 Visual examination

A visual examination should be carried out before each use and consist of examining the:

- Hose assembly for signs of damage, slippage or misalignment.
- Internal liner, where applicable.
- Hose cover to determine if any cuts, gouges or abrasions have penetrated to a liquid barrier.
- For crushed or kinked areas, longitudinal ridges or bulges.

Additionally, for composite hoses:

- Pitch angle and spacing between wraps in outer helix wire, excessive corrosion, rust or scaling on wire helices.

A hose assembly exhibiting any of the above defects should be removed from service for a more detailed inspection to determine suitability for continued use. When a hose assembly is withdrawn from service following a visual inspection, the reason for withdrawal and the date should be recorded.

18.2.6.3 Hydrostatic pressure testing

Hose assemblies should be hydrostatically tested to check their integrity. The intervals between tests should be determined in accordance with service experience but, in any case, should not be more than 12 months. Testing intervals should be shortened for hoses handling particularly aggressive products, for products at elevated temperatures or for older hoses.

If the rated pressure of a hose has been exceeded, it should be removed and retested before further use. A record should be kept of the service history of each hose assembly.

18.2.6.4 Electrical continuity and discontinuity test

Since electrical continuity can be affected by any of the physical hose tests, a check on electrical resistance should be carried out before, during and after the pressure tests.

18.2.6.6 Explanation of pressure rating for hoses

Maximum Working pressure (MWP)

The MWP is the maximum hose pressure capability. This pressure rating is expected to account for dynamic surge pressures and is used by BS and EN Standards for designing hoses.

18.2.9 Extended storage

New hoses or hoses removed from service for a period of two months or more, should as far as practicable be kept in a cool, dark, dry storage in which air can circulate freely. They should be drained and washed out with fresh water and laid out horizontally on solid supports, spaced to keep the hose straight. No oil should be allowed to come into contact with the outside of the hose.

If the hose is stored outside, it should be well protected from the ultraviolet rays of the sun.

SIGTTO: Liquified Gas Handling Principles on Ships and in Terminals. Fourth Edition.

For LNG, hoses can be of composite construction or of corrugated stainless steel, but the composite type is generally preferred.

For LPG, hoses may be of similar construction to those used for LNG, but hoses of synthetic rubber manufacture may also be used.

USCG: Code of Federal Regulations. Title 33.

156.170 - Equipment tests and inspections

(a) Except as provided in paragraph (d) of this section, no person may use any equipment listed in paragraph (c) of this section for transfer operations unless the vessel or facility operator, as appropriate, tests and inspects the equipment in accordance with paragraphs (b), (c) and (f) of this section and the equipment is in the condition specified in paragraph (c) of this section.

(b) During any test or inspection required by this section, the entire external surface of the hose must be accessible.

(c) For the purpose of paragraph (a) of this section:

(1) Each non-metallic transfer hose must:

(i) Have no unrepaired loose covers, kinks, bulges, soft spots or any other defect which would permit the discharge of oil or hazardous material through the hose material, and no gouges, cuts or slashes that penetrate the first layer of hose reinforcement as defined in § 156.120(i).

(ii) Have no external deterioration and, to the extent internal inspection is possible with both ends of the hose open, no internal deterioration;

(iii) Not burst, bulge, leak, or abnormally distort under static liquid pressure at least 1.5 times the maximum allowable working pressure;

TMSA KPI 4.1.1 requires that each vessel in the fleet is covered by a planned maintenance system and spare parts inventory which reflects the company's maintenance strategy. The company identifies all equipment and machinery required to be included in the planned maintenance system, for example:

- Cargo handling machinery/equipment.

IMO: ISM Code

10 Maintenance of the Ship and Equipment

10.1 The Company should establish procedures to ensure that the ship is maintained in conformity with the provisions of the relevant rules and regulations and with any additional requirements which may be established by the Company.

IMO: IBC Code

5.7.1 Liquid and vapour hoses used for cargo transfer shall be compatible with the cargo and suitable for the cargo temperature.

5.7.2 Hoses subject to tank pressure or the discharge pressure of pumps shall be designed for a bursting pressure not less than 5 times the maximum pressure the hose will be subjected to during cargo transfer.

5.7.3 …. Thereafter, before being placed in service, each new length of cargo hose produced shall be hydrostatically tested at ambient temperature to a pressure not less than 1.5 times its specified maximum working pressure but not more than two-fifths of its bursting pressure. The hose shall be stencilled or otherwise marked with the date of testing, its specified maximum working pressure and, if used in services other than the ambient temperature services, its maximum and minimum service temperature, as applicable. The specified maximum working pressure shall not be less than 1 MPa gauge.

IMO: IGC Code

5.11.7.1 Liquid and vapour hoses used for cargo transfer shall be compatible with the cargo and suitable for the cargo temperature.

5.11.7.2 Hoses subject to tank pressure, or the discharge pressure of pumps or vapour compressors, shall be designed for a bursting pressure not less than five times the maximum pressure the hose will be subjected to during cargo transfer.

5.11.7.3 …. Thereafter, before being placed in service, each new length of cargo hose produced shall be hydrostatically tested at ambient temperature to a pressure not less than 1.5 times its specified maximum working pressure, but not more than two fifths of its bursting pressure. The hose shall be stencilled, or otherwise marked, with the date of testing, its specified maximum working pressure and, if used in services other than ambient temperature services, its maximum and minimum service temperature, as applicable. The specified maximum working pressure shall not be less than 1 MPa gauge.

Inspection Guidance

The vessel operator should have developed procedures for the selection, inspection, testing, storage and retirement of cargo transfer hoses that included the:

- Selection of compatible hoses for specific cargo service.
- Information to be clearly marked on the hoses including:
    - The manufacturers name or trademark.
    - Identification of the standard specification for manufacture.
    - Maximum working pressure.
    - Month and year of manufacture and manufacturers serial number.
    - Indication that the hose is electrically continuous, electrically discontinuous, or semi-continuous.
    - The type of service for which it is intended e.g. oil, product, petroleum gas.
    - Last hydrostatic test date and test pressure.
    - Any operational restrictions for use of the hose such as minimum bend radius (MBR) or maximum flow rate.
- Details and frequency of:
    - Hydrostatic tests.
    - Tests for electrical continuity.
- Records and documentation to be maintained, including:
    - Inspection and pressure/elongation/electrical continuity test data.
    - Compatibility data.
    - Service history.
- Hose retirement criteria.
- Guidance on hose storage.

Hoses should be tested to 1.5 times their MWP.

Cryogenic hoses can only be safely tested under controlled conditions ashore which may include liquid nitrogen as the test medium. Cargo hoses used on LNG carriers should be pressure tested prior to each use, however, vessels that are conducting transfers using hoses on a regular basis, may have an alternative documented procedure in place to ensure the integrity of the transfer hoses.

Cryogenic hoses should be protected from sunlight and weather and kept covered except when in use. Blank flanges must be fitted to each end each and the hoses charged internally with nitrogen.

Portable cargo pump hoses should be tested and maintained as per manufacturers guidelines.

Suggested Inspector Actions

- Sight, and where necessary review, the company procedures for the selection, inspection, testing and storage of cargo transfer hoses.
- Review the certificates, compatibility data, inspection records, service history and, hydrostatic and electrical continuity test records for the cargo transfer hoses.
- Inspect ship supplied cargo transfer hoses which were either in use and/or stored onboard.

- Interview the accompanying officer to verify their familiarity with:
    - The company procedures for the selection, inspection, testing and storage of cargo transfer hoses.
    - The inspections that must be conducted before a cargo transfer hose is used.
    - Any limitations or special handling considerations for the hoses provided onboard.
    - The records that must be maintained for cargo transfer usage.

Expected Evidence

- The company procedures for the selection, inspection, testing, storage, and retirement of cargo transfer hoses.
- Cargo transfer hose certificates and compatibility data.
- Inspection records.
- Hydrostatic, elongation and electrical continuity test records.
- Cargo transfer hose usage history.

Potential Grounds for a Negative Observation

- There were no company procedures for the selection, inspection, testing, storage, and retirement of cargo transfer hoses.
- The accompanying officer was not familiar with the company procedures for the selection, inspection, testing, storage, and retirement of cargo transfer hoses.
- A ship supplied cargo transfer hose:
    - Was not clearly marked with the required information.
    - Had not been inspected within the last 12 months to confirm suitability for continued use.
    - Had not been pressure tested within the last 12 months to confirm suitability for continued use.
    - Had not been retired in accordance with the company set criteria.
    - Had visual damage as detailed in the guidance but had not been withdrawn from service.
    - Had not been tested for electrical continuity since the last hydrostatic test.
    - Was not compatible with the cargo being handled and/or the cargo temperature.
    - Had a maximum working pressure of less than 1MPa (approximately 145 psi or 10.2 kg/cm2).
    - Was stored or used with a bend radius less than the minimum bend radius (MBR) information provided by the manufacturer.
- It could not be confirmed if a ship supplied cargo transfer hose was compatible with the cargo being handled and/or the cargo temperature.
- There was no:
    - Record of the service history of ship supplied cargo transfer hoses.
    - Valid certificate and/or documentation on board for a ship supplied cargo transfer hose.
    - Documentary evidence for hydrostatic test data marked on a ship supplied cargo transfer hose.
    - Record of the temporary and permanent elongation during pressure testing for each cargo transfer hose.
- Cargo transfer hoses were stored in unsuitable conditions or in an unsuitable manner.
- Cargo transfer hoses on an LNG carrier had not been pressure tested prior to each use or in accordance with an alternative documented procedure to ensure their integrity.
- Portable cargo pump hoses were:
    - Damaged or in poor condition.
    - Had not been tested and maintained in accordance with manufacturers guidelines.
- Flow rate through a cargo transfer hose exceeded the maximum permitted flow rate stated by the hose manufacturer where flow rate was a limiting design factor.
- Ship supplied cargo transfer hoses were defective in any respect.

8.99.9. Were the Master and officers familiar with the company procedures for periodically verifying the accuracy of cargo and ballast system controls and indicators, and were legible and up-to-date pipeline and/or mimic diagrams available at the cargo control location(s) and in the pumproom(s) as applicable?

Short Question Text
Cargo and ballast system controls, indicators, mimics and displays.

Vessel Types
Oil, Chemical, LPG, LNG

ROVIQ Sequence
Engine Control Room, Cargo Control Room, Pumproom

Publications
IMO: ISM Code
OCIMF/ICS: International Safety Guide for Oil Tankers and Terminals. Sixth Edition.

Objective

To ensure accurate information and data is available to the officer in charge of cargo operations.

Industry Guidance

OCIMF/ICS: International Safety Guide for Oil Tankers and Terminals. Sixth Edition

11.3 Cargo and ballast systems

11.3.1 Operation manual

The ship's crew should have access to up-to-date drawings and information on the cargo and ballast systems as well as an operation manual.

TMSA KPI 6.1.2 requires that procedures for pre-operational tests and checks of cargo and bunkering equipment are in place for all vessel types within the fleet.

IMO: ISM Code

10.1 The Company should establish procedures to ensure that the ship is maintained in conformity with the provisions of the relevant rules and regulations and with any additional requirements which may be established by the Company.

Inspection Guidance

Pipeline and/or mimic diagrams should be updated to reflect any modifications made to the cargo and or ballast systems.

Cargo and ballast system controls and indicators should be accurate and fully operational, including, where fitted:

- Draft, trim and list monitoring.
- Control and monitoring of cargo and ballast pumps and associated plant.
- Control of cargo and ballast system valves and indication of status.
- Temperature monitoring in cargo and ballast plant and pipeline systems.
- Pressure and vacuum monitoring in cargo and ballast plant and pipeline systems.
- Cargo and ballast system information mimics/displays

The vessel operator should have developed procedures to ensure that:

- All cargo and ballast system pressure, temperature and level sensors are periodically verified for accuracy.
- Cargo information displays and mimics are checked periodically to verify that information is being transferred and displayed correctly.
- Cargo and ballast system controls incorporated into cargo information displays and mimics are functioning properly.

These procedures may form part of the maintenance plan.

Suggested Inspector Actions

- Sight the pipeline and/or mimic diagrams in the cargo control room or cargo control position as appropriate.
- Inspect cargo and ballast system controls and indicators in the cargo control room / pump control station and verify that:
    - Where fitted, remote pressure indicators are connected and displaying a value which is appropriate to the status and operation of the system or pipeline being monitored.
    - Where fitted, remote temperature indicators are connected and displaying a value which is appropriate to the status and operation of the system or pipeline being monitored.
    - Where fitted, the draught, list and trim indicators are displaying an accurate value.
    - Cargo and ballast pump speed controls are fully functional and that the pumps are being controlled from the cargo control room / pump control station and not from the machinery space or locally.
    - Cargo and ballast system mimic diagrams or displays, where fitted, are showing the correct status of valves, pumps, temperatures, pressures, levels and any other monitoring function designed to be displayed.

Where the vessel is provided with a cargo and/or ballast pumproom:

- Sight the pipeline and/or mimic diagrams
- Inspect the cargo and ballast system and verify that:
    - Where fitted, pressure indicators are connected and displaying a value which is appropriate to the status and operation of the system or pipeline being monitored.
    - Where fitted, temperature indicators are connected and displaying a value which is appropriate to the status and operation of the system or pipeline being monitored.

The degree of automation and monitoring provided on an inspected vessel will determine what will be in scope while addressing this question. The following principle should be adopted:

- If a cargo or ballast system or plant monitoring device or system is provided, it should be functioning and accurate.
- If the information from an individual monitoring device or system is transmitted to a central mimic diagram or information display, then the information displayed should be accurate.
- If a cargo or ballast pump or component of plant is designed to be remotely controlled, then the remote control and status indication should be functioning.
- Where a cargo or ballast system is designed to operate automatically then the system should be maintained to permit automatic operation where required or permitted.
- Where isolated faults develop which cannot be rectified with the staff and resources available onboard, they should be addressed through the defect reporting system.

Expected Evidence

- The company procedures which ensured that:
    - All cargo and ballast system pressure, temperature and level sensors are periodically verified for accuracy.
    - Cargo information displays and mimics are checked periodically to verify that information is being transferred and displayed correctly.

    - Cargo and ballast system controls incorporated into cargo information displays and mimics are functioning properly.
- Cargo and ballast system plant and pipeline diagrams where no suitable mimic diagram or display was available in the space.
- Records of periodic cargo and ballast system pressure sensor accuracy verification.
- Records of periodic cargo and ballast system temperature sensor accuracy verification.
- Records of periodic draught gauge accuracy verification.

Potential Grounds for a Negative Observation

- Legible and up to date pipeline and/or mimic diagrams were not available in the pumproom(s) and/or at the cargo control location(s).
- Pipeline and/or mimic diagrams had not been updated to reflect modifications or additions to the pipeline systems.
- Pipeline systems were not marked/identified consistently with the cargo systems mimic diagram or display.
- There was no company procedure which ensured that:
    - All cargo and ballast system pressure, temperature and level sensors are periodically verified for accuracy.
    - Cargo information displays and mimics are checked periodically to verify that information is being transferred and displayed correctly.
    - Cargo and ballast system controls incorporated into cargo information displays and mimics are functioning properly.
- There were no records for the periodic verification of sensor, information display, or cargo and ballast system control accuracy and/or function checks.
- A cargo or ballast pump was being controlled from the machinery space or the main deck local control station due to a defect in the remote control system.
- A cargo or ballast pump speed/electrical load indicator was inaccurate or out of service.
- The draught gauges were inaccurate.
- The local and/or remote pressure sensor displays for the cargo or ballast system/plant were inaccurate.
- The local and/or remote temperature sensor displays for the cargo or ballast system/plant were inaccurate.
- The cargo systems mimic diagram or display was indicating incorrect information such as:
    - Cargo or ballast pump status.
    - Cargo or ballast plant status.
    - Cargo or ballast pipeline pressure or temperature.
    - Draught, list or trim.
    - Cargo tank level.
    - Cargo tank pressure.
    - Cargo tank temperature.
    - Cargo and ballast valve remote control system hydraulic pressure.
    - Cargo or ballast system valve position. (this includes manual indication)
    - Inert gas system status.
    - Inert gas system valve position. (this includes manual indication)
    - The venting system valve position. (this includes manual indication)
    - The stripping system valve position and status. (this includes manual indication)
    - Cargo and ballast system alarms.
    - Cargo system controls and indicators were defective in any respect.

Where a **single** sensor or remote display input was defective or inaccurate, but the issue was in the process of being addressed through an open defect report, then no observation should be made.

8.99.10. Were the Master and officers a familiar with the company procedures for the inspection and maintenance of the bonding arrangements for independent cargo tanks, process plant and cargo pipelines and, were these arrangements in satisfactory condition?

Short Question Text
Cargo system bonding arrangements.

Vessel Types
Oil, Chemical, LPG, LNG

ROVIQ Sequence
Main Deck

Publications
OCIMF/ICS: International Safety Guide for Oil Tankers and Terminals. Sixth Edition.
IMO: IGC Code
IMO: IBC Code
IACS: Requirements Concerning Electrical And Electronic Installations

Objective

To ensure the earthing and bonding arrangements for the cargo tanks, process plant and piping systems on board are maintained as required by class rules and international regulations.

Industry Guidance

OCIMF/ICS: International Safety Guide for Oil Tankers and Terminals. Sixth Edition

3.2.2 Bonding

The most important counter measure to prevent an electrostatic hazard is to bond all metallic objects together to eliminate the risk of discharges between objects that might be charged to different voltages if they were electrically insulated. To avoid discharges from conductors to earth, it is normal practice to require bonding to earth (earthing or grounding). On ships, bonding to earth is effectively accomplished by connecting metallic objects to the metal structure of the ship, which is naturally earthed through the sea.

The best method of ensuring bonding and earthing will usually be a metallic connection between the conductors. Alternative means of bonding are available and have proved effective in some applications, for example semi-conductive (dissipative) pipes and O-rings rather than embedded metallic layers, for GRP pipes and their metal couplings.

IACS: Requirements Concerning Electrical and Electronic Installations

E9 Earthing and bonding of cargo tanks/ process plant/piping systems for the control of static electricity

E9.1 The hazard of an incendive discharge due to the build-up of static electricity resulting from the flow of liquids/gases/vapours can be avoided if the resistance between the cargo tanks/process plant/piping systems and the hull of the ship is not greater than 106 ohm.

E9.2 This value of resistance will be readily achieved without the use of bonding straps where cargo tanks/process plant/piping systems are directly or via their supports, either welded or bolted to the hull of the ship.

E9.3 Bonding straps are required for cargo tanks/process plant/piping systems which are not permanently connected to the hull of the ship, e.g.

1. independent cargo tanks.
2. cargo tanks/piping systems which are electrically separated from the hull of the ship.
3. pipe connections arranged for the removal of spool pieces.
4. wafer-style valves with non-conductive (e.g. PTFE) gaskets or seals.

E9.4 Where bonding straps are required, they should be:

1. clearly visible so that any shortcomings can be clearly detected.
2. designed and sited so that they are protected against mechanical damage and that they are not affected by high resistivity contamination e.g. corrosive products or paint.
3. easy to install and replace.

TMSA KPI 4.1.1 requires each vessel in the fleet is covered by a planned maintenance system and spare parts inventory which reflects the company's maintenance strategy. The company identifies all equipment and machinery required to be included in the planned maintenance system, for example:

- Cargo handling machinery/equipment.
- Hull structure.

IMO: ISM Code

10.1 The Company should establish procedures to ensure that the ship is maintained in conformity with the provisions of the relevant rules and regulations and with any additional requirements which may be established by the Company.

IMO: IBC Code

Chapter 10 Electrical Installations

10.2 Bonding

Independent cargo tanks shall be electrically bonded to the hull. All gasketed cargo-pipe joints and hose connections shall be electrically bonded.

IMO: IGC Code

Chapter 5 Process pressure vessels and liquid, vapour and pressure piping systems

5.7.4 Bonding

Where tanks or cargo piping and piping equipment are separated from the ship's structure by thermal isolation, provision shall be made for electrically bonding both the piping and the tanks. All gasketed pipe joints and hose connections shall be electrically bonded. Except where bonding straps are used, it shall be demonstrated that the electrical resistance of each joint or connection is less than 1Mâ„¦.

Inspection Guidance

The operator should have developed procedures for the inspection and maintenance of the bonding arrangements for independent cargo tanks, process plant and cargo pipelines. These may form part of the planned maintenance system.

Effective bonding of independent cargo tanks, process plant and cargo pipelines may be achieved in a number of ways, such as direct structural connection to the deck or bonding straps.

All bonding arrangements should be maintained to the original design and size.

Suggested Inspector Actions

- Sight, and where necessary review, the company procedures for the inspection and maintenance of the bonding arrangements for independent cargo tanks, process plant and cargo pipelines.
- During the course of the inspection, examine visible bonding arrangements, such as bonding straps, for cargo tanks/process plant/piping systems which are not permanently connected to the hull of the ship.
- Where the application of bonding straps or other forms of bonding was inconsistent or apparently missing, review the ship's drawings to confirm whether bonding straps or arrangements were required in the area of concern.

- Interview the accompanying officer to verify their understanding of the bonding arrangements fitted to the vessel and their purpose.

Expected Evidence

- The company procedures for the inspection and maintenance of the bonding arrangements for independent cargo tanks, process plant and cargo pipelines.
- The ship's drawings or instruction books showing bonding arrangements as fitted.
- Records of inspections and maintenance of the bonding arrangements.

Potential Grounds for a Negative Observation

- There were no company procedures for the inspection and maintenance of the bonding arrangements for independent cargo tanks, process plant and cargo pipelines.
- The accompanying officer was not familiar with the company procedures for the inspection and maintenance of the bonding arrangements for independent cargo tanks, process plant and cargo pipelines or the particular arrangements on board the vessel.
- Bonding straps or other bonding arrangements, where required by the original vessel design, were:
    - Missing
    - Mechanically damaged
    - Functionally compromised by high resistivity contamination e.g. corrosive products or paint.
    - Coated in paint hampering effective inspection.
- Bonding arrangements were defective in any respect.

8.99.11. Was there a procedure in place to complete an independent check of the entire cargo liquid, vapour and venting pipeline system prior to commencement of cargo operations to ensure that valves, vacuum breakers, sampling connections, drains and unused connections or interconnections were correctly set, and blanked or capped, where appropriate?

Short Question Text
Independent verification of cargo piping systems line up.

Vessel Types
Oil, Chemical, LPG, LNG

ROVIQ Sequence
Cargo Control Room, Main Deck

Publications
ICS: Tanker Safety Guide (Gas) - Third Edition
IMO: ISM Code
ICS: Tanker Safety Guide (Chemicals) - Fifth Edition
OCIMF/ICS: International Safety Guide for Oil Tankers and Terminals. Sixth Edition.

Objective

To ensure that the entire cargo system integrity and line up is independently verified by a second person before every cargo operation.

Industry Guidance

OCIMF/ICS: International Safety Guide for Oil Tankers and Terminals. Sixth Edition.

12.1.2 Setting of lines and valves

Before starting any loading or discharging, the ship's cargo pipelines should be set in line with the loading or discharging plan and checked independently and by other personnel under the control of the Responsible Officer. If a change in the line-up is required during a change of grades, the valves should be checked in the same way. The responsible officer should document the completion of the task and sign it.

ICS: Tanker Safety Guide (Chemicals) - Fifth Edition

6.4 Preparations for Cargo Operations

6.4.5 Preparing the cargo system prior to arrival

Once a cargo operation plan has been made and the lines and valves have been set, the entire system should be checked by a responsible officer to ensure that:

- The valves and lines are correctly lined up and the valves correctly set. The system line-up is therefore verified by two persons independently.
- Drain valves, plugs, and sampling connections are all closed and capped where necessary;
- Unused flanges are securely blanked;
- P/V valves are correctly set;
- If vapour return is to be used, the vapour lines are correctly set;
- Hatches, lids and openings to cargo tanks not required to be open for a specific reason are securely closed, and
- Unless it is to be used, the stern cargo pipeline is isolated from the tanker's main pipeline system at a point forward of the accommodation.

ICS: Tanker Safety Guide (Gas) - Third Edition

6.5 Preparation for Cargo Transfer

6.5.1 General

Pre-arrival checks should be made by the ship to ensure that:

- ...The ship’s pipeline system is set for the relevant operation and all valves have been checked;
- The stern cargo line, if fitted, is isolated if it is not to be used;
- Any removable pipe sections or hoses connecting the cargo system to the ship’s inert gas plant have been removed and blind flanges properly fitted;...

TMSA KPI 6.2.2 requires that comprehensive procedures cover all aspects of cargo transfer operations for each type of vessel within the fleet.

The transfer procedures are specific to the vessel type and cargo to be carried. These may include:

- Pre-arrival checks
- Pre-operational checks including an independent verification of line setting prior to the start of operations.

IMO: ISM Code

7. The Company should establish procedures, plans and instructions, including checklists as appropriate, for key shipboard operations concerning the safety of the personnel, ship and protection of the environment. The various tasks involved should be defined and assigned to qualified personnel.

Inspection Guidance

The vessel operator should have developed procedures to ensure that the entire cargo liquid, vapour and venting pipeline system is independently cross-checked by a second person under the control of the responsible officer prior to commencement of cargo operations. The procedure should describe:

- Who may conduct the independent cross-checks of the cargo pipelines.
- When the cross-checks should be completed.
- Where the verification of the cross-checks should be recorded.

Cargo pipeline system drains, stub pieces, sampling connections and vacuum breakers should be fitted with valves and either capped or blanked.

Suggested Inspector Actions

- Sight, and where necessary review, the company procedures to ensure that that the entire cargo liquid, vapour and venting pipeline system is independently cross-checked by a second person under the control of the responsible officer prior to commencement of cargo operations.
- Review the cargo records for a recent cargo operation and verify that the independent cross-checks on the entire cargo liquid, vapour and venting pipeline system had been completed and documented in accordance with the company procedure.
- During the course of the inspection, verify that all cargo pipeline system drains, stub pieces, sampling connections and vacuum breakers were closed and capped or blanked as necessary.

- Interview the accompanying officer to verify their familiarity with:

- The procedure and process to ensure that that the entire cargo liquid, vapour and venting pipeline system is independently cross-checked by a second person under the control of the responsible officer prior to commencement of cargo operations.
- Who was required to conduct the independent cross-checks in accordance with the company procedure.
- How and where the result of the independent cross-check was recorded.

Expected Evidence

- The company procedures to ensure that that entire cargo liquid, vapour and venting pipeline system is independently cross-checked by a second person under the control of the responsible officer prior to commencement of cargo operations.
- Cargo records which demonstrated that the independent cross-checks of cargo system pipelines had been completed and documented before cargo operations commenced.

Potential Grounds for a Negative Observation

- There were no company procedures to ensure that that the entire cargo liquid, vapour and venting pipeline system is independently cross-checked by a second person under the control of the responsible officer prior to commencement of cargo operations.
- The accompanying officer was not familiar with the company procedures to ensure that that the entire cargo liquid, vapour and venting pipeline system is independently cross-checked by a second person under the control of the responsible officer prior to commencement of cargo operations.
- There was no documentary evidence that the independent cargo system pipeline cross-checks had been completed before commencing cargo operations.
- The valve for a cargo pipeline drain, stub piece, sampling connection or vacuum breaker was not closed during cargo operations.
- A cargo pipeline system drain, stub piece, sampling connection or vacuum breaker was not fitted with a valve.
- A cargo pipeline system drain, stub piece, sampling connection or vacuum breaker was not capped or blanked as necessary during cargo operations.

9. Mooring and Anchoring

9.1. Mooring Equipment Management

9.1.1. Were the Master and deck officers familiar with the company procedures for the testing and correct operation of the mooring winch brakes, and were records available to demonstrate that brakes had been tested periodically, after maintenance or when there was evidence of premature brake slippage?

Short Question Text
Testing and correct operation of the mooring winch brakes

Vessel Types
Oil, Chemical, LPG, LNG

ROVIQ Sequence
Documentation, Cargo Control Room, Mooring Decks

Publications
IMO SOLAS
OCIMF: Mooring Equipment Guidelines. Fourth Edition 2018 (MEG4)
IMO: ISM Code

Objective

To ensure that mooring winches function as designed, shedding excess load at a defined value in accordance with the Ship Design MBL.

Industry Guidance

OCIMF: Mooring Equipment Guidelines. Fourth Edition 2018 (MEG4)

6.3.4.1 Brake holding load

OCIMF recommends that the primary brake should be set to hold 60% of the ship design MBL on the first layer.

Split drum winches should not have more than one layer of mooring line on the tension section of the drum because it can reduce the brake holding capacity of the mooring winch.

6.4.5.1 Effect of layers of mooring line on brake holding load

Undivided drum winch

For undivided winch drums, it is recommended to ask the manufacturer for guidance on maintaining the OCIMF recommended value for brake rendering. This may require ship operational experience to identify the normal layer in use for most mooring operations.

6.4.6 Winch brake testing

6.4.6.4 Supervision of testing

Winch testing should be carried out under the supervision or in the presence of a responsible person familiar with the operation of the winches, the test procedure and the ship's safety management system. This may be a person designated by the Master, Chief Engineer or a repair superintendent.

6.4.6.5 Method of testing

Once the brakes are tested and calibrated, the torque setting should be recorded. For conventional screw brakes, a tag should be attached stating the torque value. For spring applied brakes the spring compression distance should be recorded and the mechanism secured with a seal.

A stopper arrangement, e.g. locking nut on the threaded end, should not be used on the tightening screw. Stopper arrangements can impede the brake setting and reduce the brake holding load.

TMSA KPI 6A.1.2 requires that maintenance, testing and routine inspections of mooring and anchoring equipment is included in the planned maintenance system. The planned maintenance system covers all mooring equipment. This equipment may include:

- Winches and windlasses.

Winch and windlass brake testing is conducted according to industry guidelines or local regulations.

IMO: ISM Code

10.1 The Company should establish procedures to ensure that the ship is maintained in conformity with the provisions of the relevant rules and regulations and with any additional requirements which may be established by the Company.

IMO: SOLAS

Chapter II-1 Regulation 3-8

Towing and Mooring Equipment

1 This regulation applies to ships constructed on or after 1 January 2007 but does not apply to emergency towing arrangements provided in accordance with regulation 3-4.

2 Ships shall be provided with arrangements, equipment and fittings of sufficient safe working load to enable the safe conduct of all towing and mooring operations associated with the normal operation of the ship.

3 Arrangements, equipment and fittings provided in accordance with paragraph 2 shall meet the appropriate requirements of the Administration or an organization recognized by the Administration under regulation I/6*.

4 Each fitting or item of equipment provided under this regulation shall be clearly marked with any restrictions associated with its safe operation, taking into account the strength of its attachment to the ship's structure.

Inspection Guidance

The vessel operator should have developed mooring procedures which are in alignment with MEG4 and the information recommended for inclusion within the Mooring System Management Plan (MSMP). The procedures should provide guidance on:

- The frequency of winch brake testing (MEG4 6.4.6.1).
- The method of winch brake testing (MEG4 6.4.6.2).
- The method of ensuring the correct torque is applied (MEG4 6.4.6.5).
- The primary brake holding load – adjusted to 60% of the Ship Design MBL (MEG4 6.3.4.1).
- The use of split drum winches – not more than one layer of mooring line on the tension side (MEG4 6.3.4.1), and/or
- The use of undivided drum winches (6.4.5.1)

- The reeling of lines onto drums – band brakes are designed to work effectively in only one direction (MEG4 6.3.4.2).

It is recognised that the testing of mooring winch brakes is often completed by engineer officers or shore-based contractors. The intent of the question is to establish that the Master and deck officers are familiar with the requirement for brake testing, the operation of the mooring winch brake systems and, the indicators during operation when maintenance and further testing is required.

The vessel operator should have uploaded one photograph relating to the brake mechanism for a representative mooring winch to the document portal prior to the inspection. This will be linked to this question within the inspection editor.

Suggested Inspector Actions

- Sight, and where necessary review, the company procedure for the testing and operation of the vessel's mooring winch brakes.
- Review the Mooring System Management Plan and verify that it contained the mooring winch brake testing records or, where records were integrated within the ships document control system, that the location of the mooring winch brake testing records was identified.
- Review the mooring winch brake testing records and verify that the brakes had been tested and adjusted to render at 60% of the ship's design MBL at least annually and after completion of any modification or maintenance, or where there had been evidence of premature brake slippage or related malfunctions.
- During the physical inspection of the vessel verify that winches were marked with:
    - The correct reeling direction (MEG4 6.3.4.2).
    - The date of the last brake test ((MEG 6.4.6.1).
    - The primary brake holding load value as set (MEG4 6.3.6).
    - The torque setting value where a brake is set with a torque wrench (MEG4 6.4.6.5).
    - The pressure gauge setting value where a brake is initially applied by a hydraulic assist (MEG4 6.4.6.5).
    - Where applicable, an indicator to show that a brake was set to the correct value.
- During the physical inspection of the vessel verify that:
    - The lines were reeled on the winch drums in the correct direction (MEG4 6.3.4.2).
    - Where winches were provided with split drums, that there was no more than a single layer of line on the tension side of a drum (MEG4 6.3.4.1).
    - Where winches were provided with split drums, that the number of turns of mooring line on the tension side of a drum were at least the minimum number as indicated within the Line Management Plan (MEG4 6.3.3.1).
    - The winch brakes were set in accordance with any instructions or indicators provided.
    - The winch drum brake assemblies including brake lining material and brake drum surface were in apparent good order and well maintained.
    - The brake test equipment was safely stored as per manufacturer's instructions, if kept onboard.

- Where safe to do so and the appropriate personnel are available during the physical inspection, observe the adjustment of a mooring line.

Expected Evidence

- The company mooring procedures which included the use and testing of mooring winches fitted to the vessel.
- The Mooring System Management Plan, where provided.
- The Line Management Plan.
- The mooring winch brake testing records.
- The calibration test certificate for the brake testing equipment pressure gauge where testing equipment carried.
- The winch manufacturer's instructions for the testing of the mooring winch brakes.

- Mooring winch maintenance records since the last annual winch test where repairs or component replacement had been performed on any part of a winch drum brake assembly or mechanism.

Potential Grounds for a Negative Observation

- There was no company procedure which provided instructions for the use and testing of the mooring winches brakes fitted to the vessel.
- The vessel was not provided with a Mooring System Management Plan (MSMP) which was in alignment with MEG4.
- The accompanying deck officer was not familiar with the company procedures for the operation, setting and testing of the mooring winch brakes.
- The accompanying deck officer or observed crew were not familiar with the operation and setting of the mooring winch brakes.
- The brake testing equipment was not maintained in good condition, or the hydraulic jack pressure gauge had not been calibrated before use where brake testing equipment was carried.
- The mooring winch brakes had not been periodically tested in accordance with the company procedure or the Mooring System Management Plan requirements.
- The mooring winch brakes had not been tested on completion of any repairs or maintenance which affected the mooring winch brake mechanism assembly.
- The mooring winch brakes had not been retested where there had been evidence of premature brake slippage or related malfunctions.
- The mooring winch drums were not marked with the date of the previous test, the primary brake load capacity, the reeling direction or the brake setting torque or hydraulic brake assist setting pressure (as applicable to the brake type).
- The brake on any single mooring drum in active mooring service was observed to be incorrectly set.
- A stopper arrangement, e.g. a locking nut on the threaded end, was used on the tightening screw of the brake to set the brake torque.
- A mooring line was reeled onto a mooring drum in the wrong direction for the correct operation of the brake mechanism.
- Where the vessel was provided with split drums there was more than one layer of line on the tension side of a drum.
- Where the vessel was provided with split drums there were insufficient turns of line, as determined by the company procedure or MSMP, on the tension side of the drum.
- The mooring winch drum brake mechanisms, brake drums or brake band linings were apparently defective on any mooring winch. This would include where brake drums had more than a light layer of superficial surface rust.

9.1.2. Was the vessel satisfactorily moored in accordance with both the terminal mooring plan and the mooring configurations permitted by the vessel's Mooring System Management Plan?

Short Question Text
Was the vessel satisfactorily moored

Vessel Types
Oil, Chemical, LPG, LNG

ROVIQ Sequence
Documentation, Cargo Control Room, Mooring Decks

Publications
OCIMF: Mooring Equipment Guidelines. Fourth Edition 2018 (MEG4)
IMO: ISM Code

Objective

To ensure that the vessel is always moored safely in accordance with a terminal's published mooring plan and the acceptable mooring line configurations identified within the vessel's Mooring System Management Plan.

Industry Guidance

OCIMF: Mooring Equipment Guidelines. Fourth Edition 2018 (MEG4)

Section 1.9.2 Mooring System Management Plan Structure.

Part B – Mooring equipment design philosophy

- 5. Assumptions on the standard mooring pattern and considerations for redundancy provisions, including sub-optimal line distribution to cover unpredicted events (e.g. storm surges, shore mooring hooks out of service).
- 8. Alternate mooring patterns to meet the standard environmental criteria assessment and designed-in options when the optimal mooring pattern is unachievable in some real-world scenarios (e.g. hooks, dolphins or mooring winches out of service, breast lines not in an optimal perpendicular lead, etc.).

TMSA KPI 6A.2.1 requires that detailed procedures address each different type of mooring operation likely to be undertaken by fleet vessels.

Procedures have been developed following risk assessments for each type of mooring operation, which may include;

- Conventional berths.
- Conventional buoy moorings.
- Double-banking at berths.

IMO: ISM Code

7. The Company should establish procedures, plans and instructions, including checklists as appropriate, for key shipboard operations concerning the safety of the personnel, ship and protection of the environment. The various tasks should be defined and assigned to qualified personnel.

Inspection Guidance

The vessel operator should have developed the Mooring System Management Plan to include optimal, sub-optimal and alternate mooring patterns permissible to assist vessel staff in evaluating a terminal's published or proposed mooring plan prior to mooring.

The mooring patterns should identify:

- The minimum number of lines that must be deployed in each service (spring, breast, head and stern) to meet the design mooring constraint requirement for the standard environmental criteria at a conventional tanker jetty.
- The minimum number of lines that must be deployed in each service (breast, quarter and stern) to meet the design mooring constraint requirement for the standard environmental criteria at a conventional buoy mooring (multi-buoy mooring).
- Environmental conditions where additional mooring lines are required to be utilised and in what service.
- The permissible alternative mooring configurations where shore hooks or bollards are not in the optimal position or are out of service.
- The horizontal angles of lines to the perpendicular of the ship's fore and aft axis and vertical angles of lines (in true elevation) with the vessel in the least favourable load state that are permitted for mooring lines in each service in the standard or alternative mooring patterns.

The vessel operator should have developed a procedure for evaluating proposed mooring configurations which do not conform to, or modify, the criteria upon which the Mooring System Management Plan was developed. This should include double banking operations at a berth.

Suggested Inspector Actions

- Review the Mooring System Management Plan and identify the permissible mooring configurations that may be used by the vessel to meet optimal, sub-optimal and alternate mooring arrangements.
- Review the published terminal mooring plans for recent terminal visits and verify that there was a process to confirm that the vessel could comply with both the terminal mooring layout and the mooring patterns permitted by the Mooring System Management Plan.
- Where the vessel was moored at the time of the inspection, verify that the mooring pattern employed was in accordance with both the mooring plan published by the terminal and the Mooring System Management Plan. (Where the number of mooring lines required to be utilised between the terminal and vessel mooring plans was different, the plan requiring the higher number of lines should be followed.)
- Where the terminal mooring plan required the use of swamp lines or other shore-lines to supplement the vessel's mooring system, verify that these lines had been utilised.
- Verify that the vessel's mooring lines were deployed within the permitted horizontal angles to the perpendicular of ships fore and aft axis and vertical angles of lines as documented within the Mooring System Management Plan.
- Where the vessel was required to undertake a mooring analysis as part of the terminal acceptance process, verify that the vessel had moored in accordance with the mooring analysis provided to the vessel.
- Where the vessel was involved in a double banking operation* verify that;
    - A mooring analysis was available to confirm that both the inside and outside vessel were provided with adequate restraint,
    - That the inside vessel was not bearing the load of both vessels on its own moorings unless the mooring analysis determined that the moorings deployed were sufficient for the forces of both vessels,
    - That both the inside and outside vessels were moored in accordance with the agreed mooring plan.

The mooring of a bunker barge or small coastal tanker to the outboard side does not constitute a double banking operation*.

Expected Evidence

- The Mooring System Management Plan.
- The terminal mooring plan, showing the positioning of a similar sized vessel in relationship to the terminal mooring fittings, published in either the terminal handbook or an industry standard publication.

- The passage plan, pilot card, cargo plan or risk assessment which showed the specific mooring layout that was used at the terminal or berth.
- Where the vessel was required to be subject to a terminal compatibility assessment prior to berthing, the mooring plan determined during the mooring assessment.
- Where the vessel was engaged in a double-banking alongside a berth, the agreed mooring plan for both the inside and outside vessels.

Potential Grounds for a Negative Observation

- The vessel was not provided with a Mooring System Management Plan (MSMP) which was in alignment with MEG4.
- The Mooring System Management Plan was not developed to include the permissible mooring configurations for optimal, sub-optimal and alternative mooring arrangements for conventional tanker berths and, where used, conventional buoy moorings.
- The Mooring System Management Plan was not developed to show the maximum permitted deviation from the horizontal angles of lines to the perpendicular of the ships fore and aft axis and vertical angles of lines.
- The accompanying deck officer was unfamiliar with the process for comparing the published or proposed terminal mooring plan with the mooring configurations permitted within the Mooring System Management Plan.
- The vessel was moored in a pattern that was not in accordance with the published terminal mooring plan.
- The vessel was moored in a pattern that was not in accordance with the mooring configurations permitted by the Mooring System Management Plan.
- The vertical angle (in true elevation) of any mooring line exceeded the limit identified within the Mooring System Management Plan.
- The vessel had deployed fewer lines than required by either the published terminal mooring plan or the mooring configurations permitted by the Mooring System Management Plan.
- The vessel had not utilised supplementary shore-lines required by the terminal mooring plan.
- Where the vessel had been subject to a mooring analysis for the terminal or berth, the actual mooring configuration was not in accordance with the plan developed through the mooring analysis.
- Where the vessel was double banked there was no analysis available to demonstrate that the mooring plan had been verified as providing sufficient restraint for both the inside and outside vessels.

Where the terminal had not published a mooring plan and the vessel could demonstrate that it had made efforts to obtain the plan through its operator or agent then make a **comment** under the Process response tool.

Where the vessel is not moored at the time of inspection, the inspector should follow the Suggested Inspector Actions as far as possible, reviewing the Mooring System Management Plan and recent/planned mooring layouts against terminal mooring plans.

9.1.3. Were the Master, deck officers, and ratings involved with mooring operations, familiar with the content of the Line Management Plan and was the plan maintained in accordance with company instructions with mooring line, mooring tail and joining shackle certificates available for each item included within the Line Management Plan?

Short Question Text
Line Management Plan (LMP) implementation.

Vessel Types
Oil, Chemical, LPG, LNG

ROVIQ Sequence
Documentation, Cargo Control Room, Mooring Decks

Publications
OCIMF: Effective Mooring. Fourth Edition 2019
OCIMF: Mooring Equipment Guidelines. Fourth Edition 2018 (MEG4)

Objective

To ensure that mooring lines, mooring tails and joining shackles are always in serviceable condition and managed to avoid failure in service.

Industry Guidance:

OCIMF: Mooring Equipment Guidelines. Fourth Edition 2018 (MEG4)

Chapter 5.4.2 Line Management Plans.

OCIMF: Effective Mooring. Fourth Edition 2019

2.6 Taking care of mooring equipment

Line and tail certificates

You need to know what kinds of lines are on board, where they are, and how to find their service records in the line management plan. All lines and tails used for mooring need a certificate.

- Label certificates clearly.
- Regularly check their condition.
- Keep certificates/inspection records in an easily accessible file.

Section 3.4 Synthetic fibre tails

- Keep a record of which tail is fitted to each mooring line, and when, and give this data to your supervisor so that the line management plan can be updated.

3.8 Care of mooring lines

- Guidance on mooring line care, use and replacement can be found in your line management plan.
- Do not move lines or tails from one winch to another without approval. Make sure records in the line management plan are updated with any approved change of position. Tracking a line’s history is critical to know how used it is, as required by the line management plan.

TMSA KPI 6A.2.4 requires that procedures are in place for the inspection, maintenance and replacement of wires, ropes, tails and ancillary equipment. The procedures may include:

- Inspection methods and frequency
- Maintenance requirements.
- Retirement criteria
- Minimum spares
- Stowage requirements
- Record keeping

The records may include:

- Date of bringing rope/wires into service.
- Identification and tagging of all equipment.
- Certification for all ropes/wires/tails/joining shackles.
- Dates of end for ending.

IMO: ISM Code

10.1 The Company should establish procedures to ensure that the ship is maintained in conformity with the provisions of the relevant rules and regulations and with any additional requirements which may be established by the Company.

Inspection Guidance

The vessel operator should have developed a Line Management Plan (LMP) in alignment with MEG4 Table 5.2 which should give guidance on:

- Maintenance; including line installation, storage, repair, line maintenance and wear zone management.
- Inspection; including routine inspection and detailed inspection. (detailed in MEG4 5.4.3)
- Service life and retirement criteria; including determination of expected service life and planned retirement criteria policy. (it may also include residual strength testing, but this is not a required aspect of an LMP)
- General; including hazards and precautions, operator's SMS and ship HSE procedures, training and competence requirements, and roles and responsibilities.

The LMP can be a standalone tool, or it may be integrated into existing safety or maintenance management systems. It can be available as hard or electronic copy, or both. LMP information should be stored in a location that is easy for all users to access, e.g. on a computer system that can be accessed from both the ship and shore or compiled in a single physical location. It should be easy for the system users to access the LMP information from a single physical or virtual location. This is necessary for access by all officers and crew who will be involved in mooring operations.

The vessel should retain manufacturer's product certificates onboard which will be referenced to the location of each mooring line, mooring tail and joining shackle onboard, both in use and available as spares.

Suggested Inspector Actions

- Review the mooring line, mooring tail and joining shackle certificates and verify that the vessel has an effective process in place to identify each individual item and associate it with its location onboard and its manufacturer's product certificate.
- Review the Line Management Plan (LMP) and verify that, as a minimum, the four key categories and their subcategories identified in table 5.2 (MEG4) had been addressed and populated with the relevant information.
- Identify the stated service life criteria for mooring lines and mooring tails and verify that the lines and tails in service were within the company's stated service life criteria. This may be elapsed time or hours in service since being brought into service and will be defined within the LMP.

- Review the inspection history for the mooring lines and mooring tails and verify that inspections had been carried out as required by the inspection intervals defined within the LMP.
- Review the inspection history and where a line had parted in service verify that an incident investigation report was onboard that identified the causes of the line failure.
- Review the maintenance records and verify that mooring lines had been “end for ended” or moved to a different service in accordance with the LMP to meet the wear zone management expectations.
- Identify whether the vessel operator permitted the splicing of mooring lines and if so verify that the persons permitted to conduct the splicing had been identified within the LMP. Where specialist training was required verify that the identified persons had received the training.

- During the physical inspection:
    - Randomly inspect several accessible mooring lines, mooring tails and joining shackles and verify that they were in apparent good order and that they were tagged or marked to permit identification within the LMP and the associated retained product certificate.
    - Where the vessel was provided with mooring tails connected to the mooring lines verify that the connection method was in accordance with the LMP and MEG4 5.8.4, connection devices (MEG4 figure 5.20) or cow hitch (MEG4 Figure 5.21) and that these were correctly fitted.
    - Interview at least one rating involved in mooring operations and verify that they were familiar with the location of the LMP and, who was responsible for the splicing of the mooring lines or any other relevant item that would confirm familiarity with the LMP and its content.

Expected Evidence

- The Line Management Plan.
- The manufacturer’s product certificates for all mooring lines, mooring tails and joining shackles onboard.
- The SMS procedures that were referenced in the general section of the Line Management Plan.
- Incident investigation reports for any in service mooring line, mooring tail or joining shackle failures.

Potential Grounds for a Negative Observation

- The vessel was not provided with a Line Management Plan (LMP).
- The vessel had not retained manufacturer’s product certificates for all mooring lines, mooring tails and joining shackles onboard referenced against each item’s location.
- The LMP was not developed in alignment with the sections and subsections of MEG4 table 5.2, as a minimum.
- The accompanying officer was unfamiliar with the content of the LMP and how the information was to be recorded and managed within it.
- An interviewed rating who was involved with mooring operations was unfamiliar with the existence of the LMP or content relevant to their role onboard.
- The LMP had not been maintained accurately. (Inspection determined that lines, tails or shackles were in the wrong location or items were onboard which were not included in the LMP).
- Mooring line, mooring tail and joining shackle inspections had not been completed and documented in accordance with the LMP.
- Mooring lines, mooring tails or joining shackles in use or provided as spares were in a condition that indicated the inspection processes required under the LMP were ineffective.
- Joining shackles were fitted the wrong way around according to the shackle design.
- Mooring wires were connected to mooring tails using a cow hitch or an inappropriate shackle.
- A mooring line or mooring tail was in service beyond the stated company retirement criteria.
- A mooring line or mooring tail was in service which had suffered damage to such an extent that it should have been taken out of service for repair or retirement.
- Splicing of mooring lines had been undertaken onboard but the resulting splices were not in accordance with the line manufacturer’s instructions.
- Mooring lines had not been “end for ended” or rotated in service in accordance with the line management plan wear zone management process.

- A mooring line, mooring tail or joining shackle had parted in service during the previous six months but there was no incident investigation report onboard to document the causes of the failure.

9.1.4. Did all mooring lines, mooring tails and joining shackles, including those carried as spares, meet industry guidelines?

Short Question Text
Mooring lines, tails and mooring shackles.

Vessel Types
Oil, Chemical, LPG, LNG

ROVIQ Sequence
Documentation

Publications
OCIMF: Mooring Equipment Guidelines. Fourth Edition 2018 (MEG4)

Objective

To ensure that mooring lines, mooring tails and joining shackles are fit for the intended purpose to prevent line failure in service.

Industry Guidance

OCIMF: Mooring Equipment Guidelines. Fourth Edition 2018 (MEG4)

Chapter 5.2 – Mooring system design and line selection

TMSA KPI 6A.2.4 requires that procedures are in place for the inspection, maintenance and replacement of wires, ropes, tails and ancillary equipment.

IMO: ISM Code

10.1 The Company should establish procedures to ensure that the ship is maintained in conformity with the provisions of the relevant rules and regulations and with any additional requirements which may be established by the Company.

Inspection Guidance

The vessel operator should have provided the vessel with a Mooring System Management Plan (MEG4 1.9) which consisted of the following:

- Part A – General ship particulars
- Part B -Mooring equipment design philosophy (MEG4 1.9.2.2).
  - 4. Design loads, safety factors and strength for required mooring lines and fixed equipment.
- Part C – Detailed list of mooring equipment (MEG4 1.9.2.3).
  - 3. Loose equipment (mooring lines, tails, pennants, joining shackles etc.).
- Part D – Inspection, maintenance and retirement strategies/principles.(MEG4 1.9.2.4)
  - 4. A Mooring Line Management Plan covering all mooring ropes and wires in use including joining shackles.
- Part E – Risk and change management, safety of personnel and human factors
- Part F – Records and documentation
- Part G – Mooring System Management Plan Register

Mooring lines shall have a Line Design Break Force (LDBF) of 100-105% of the Ship Design MBL (MEG4 5.2.1).

Synthetic mooring tails shall have a Tail Design Break Force (TDBF) of 125-130% of the Ship Design MBL (MEG4 5.8.2).

The LDBF for nylon (polyamide) mooring lines should be specified as break tested wet, because nylon lines change strength characteristics once exposed to water and generally do not fully dry to their original construction state.

Connection devices (joining shackles) should have a safety factor of three, i.e. the breaking load is three times the safe working load (SWL). The safe working load of the joining shackle should always be equal to, or greater than, the working load limit (WLL) of the lines in the mooring system. (MEG4 5.8.4.1).

Suggested Inspector Actions

- Review the Mooring System Management Plan and identify the values for Ship Design MBL and the working load limit (WLL) of the lines.
- Review the detailed list of mooring equipment and loose equipment and verify that;
    - The mooring lines had a Line Design Break Force (LDBF) in the range of 100-105% of the Ship Design MBL.
    - The mooring tails, where provided, had a Tail Design Break Force (TDBF) in the range 125-130% of the Ship Design MBL.
    - The joining shackles, where provided, had a Safe Working Load (SWL) equal to, or greater than, the working load limit (WLL) of the mooring lines in the system. (it is not expected that the SWL and WLL exactly match).
- Where the vessel had a summary list of all mooring system loose equipment with the values of LDBF and TDBF tabulated, verify that the values for the components were accurate by spot-checking the values against several manufacturer's product certificates.

Expected Evidence

- The Mooring System Management Plan.
- The list of loose equipment (mooring lines, mooring tails and joining shackles)
- The file of manufacturer product certificates for all mooring lines, mooring tails and joining shackles.

Potential Grounds for a Negative Observation

- The vessel was not provided with a Mooring Systems Management Plan (MSMP).
- The vessel did not have a file containing the manufacturer's product certificates for all mooring lines, mooring tails and joining shackles carried onboard.
- One or more mooring lines onboard, in service mounted on a winch, or loose or carried as a spare, had a Line Design Break Force (LDBF) that was lower than 100% of the Ship Design MBL.
- One or more mooring tails carried onboard, either in service or carried as a spare, had a Tail Design Break Force (TDBF) that was lower than 125% of the Ship Design MBL.
- One or more of the mooring joining shackles carried onboard, either in use or carried as a spare, had a Safe Working Load (SWL) that was less than Working Load Limit (WLL) for the mooring lines in use onboard.

- Where one or more mooring lines carried onboard, either in service or carried as a spare, had a LDBF of greater than 105% of the ship design MBL, make a **comment** in the Hardware response tool describing how many lines were affected and what the actual LDBF was as a percentage of the ship design MBL.
- Where one or more mooring tails carried onboard, either in service or carried as a spare, had a TDBF of greater than 130% of the ship design MBL, make a **comment** in the Hardware response tool describing how many tails were affected and what the actual TDBF was as a percentage of the ship design MBL.

9.2. Emergency Towing Arrangement

9.2.1. Were the Master and all officers familiar with the vessel specific emergency towing procedure, and was the emergency towing equipment, where fitted, in satisfactory condition and ready for immediate use?

Short Question Text
Emergency towing procedure and equipment

Vessel Types
Oil, Chemical, LPG, LNG

ROVIQ Sequence
Aft Mooring Deck, Bridge, Forecastle, Cargo Control Room

Publications
IMO SOLAS
IMO: MSC.1/Circ.1255 Guidelines for Owners/Operators on Preparing Emergency Towing Procedures
IMO: ISM Code

Objective

To ensure that the vessel crew are familiar with the emergency towing procedure, and that the emergency towing equipment, where required to be fitted, is ready for immediate use.

Industry Guidance

IMO: MSC.1/Circ.1255 Guidelines for Owners/Operators on Preparing Emergency Towing Procedures.

4.1 The Emergency Towing Booklet (ETB) should be ship specific and be presented in a clear, concise and ready-to-use format (booklet, plan, poster, etc.).

4.6 A minimum of three copies should be kept on board and located in:

1. the bridge;
2. a forecastle space; and
3. the ship's office or cargo control room.

TMSA KPI 11.1.1 requires that detailed vessel emergency response plans include initial notification procedures and cover all credible emergency scenarios.

IMO: ISM Code

8.1 The Company should identify potential emergency shipboard situations and establish procedures to respond to them.

IMO: SOLAS

Chapter II – I Regulation 3-4

1 Emergency towing arrangements on tankers.

1.1 Emergency towing arrangements shall be fitted at both ends on every tanker of not less than 20,000 tonnes deadweight.

2 Emergency towing procedures on ships.

2.2 ships shall be provided with a ship-specific emergency towing procedure. Such a procedure shall be carried onboard the ship for use in emergency situations and shall be based on existing arrangements and equipment available on board the ship.

Inspection Guidance

The vessel operator should have provided the vessel with an emergency towing procedure in the form of an Emergency Towing Booklet (ETB) in accordance with SOLAS regulation and supporting IMO Marine Safety Circulars.

Suggested Inspector Actions

- Review the vessel specific emergency towing procedure (Emergency Towing Booklet - ETB).
- Verify a copy of the ETB was available on the bridge, in the ship's office or cargo control room and in the forecastle space.
- Where fitted, inspect the emergency towing arrangements fitted to the vessel and verify that the emergency towing procedure (ETB) is aligned with the equipment provided.
- Inspect the physical condition of the emergency towing equipment and confirm that all visible and accessible parts are functional with evidence of recent maintenance.
- Verify, by sampling, that the ancillary equipment listed in the emergency towing procedure (ETB) is present in the correct location.
- Interview the accompanying officer to verify they understand how to deploy the emergency towing equipment.

Expected Evidence

- Vessel specific emergency towing procedure (Emergency Towing Booklet - ETB).

Potential Grounds for a Negative Observation

- The emergency towing procedure (ETB) was not based on the existing arrangements and equipment fitted on board.
- The accompanying officer was unfamiliar with the vessel specific emergency towing procedure (ETB).
- The accompanying officer was unfamiliar with the emergency towing equipment fitted to the vessel.
- The accompanying officer was unfamiliar with the process of deploying the emergency towing equipment fitted to the vessel.
- The emergency towing procedure (ETB) was not available on the bridge, in the ship's office or cargo control room and in the forecastle space.
- The emergency towing arrangements were defective in any respect.
- The ancillary equipment listed in the emergency towing procedure (ETB) was missing, in the wrong location or defective in any way.
- The emergency towing equipment was not ready for immediate use in any respect.

9.3. Mooring and Anchoring Procedures

9.3.1. Were the Master and deck officers familiar with the company procedures for anchoring operations, and were records available to confirm that recent anchoring operations had been conducted in compliance with company expectations?

Short Question Text
Anchoring operations

Vessel Types
Oil, Chemical, LPG, LNG

ROVIQ Sequence
Bridge, Forecastle

Publications
OCIMF Anchoring Systems and Procedures 2010 edition
IACS Unified Requirements A: Requirements concerning Mooring
Anchoring and Towing
IACS: UR A3 Anchor Windlass Design and Testing
ICS: Bridge Procedures Guide – Fifth Edition
IMO: ISM Code
INTERTANKO: Anchoring Guidelines: A Risk-Based Approach v.3 June 2020

Objective

To ensure that anchoring operations are conducted within the limitations of the equipment fitted to the vessel

Industry Guidance

Intertanko: Anchoring Guidelines: A Risk-Based Approach v.3 June 2020

Appendix 2

Planning of the anchoring operation

There are procedures for:

- Selection of anchoring position
- Planning including toolbox talk
- Methods of anchoring
- Equipment design limitations and characteristics
- Emergency anchoring
- Roles and responsibilities
- Requirements for risk assessments for anchoring
- Use of main engine (and thrusters if fitted)

Anchoring

There are procedures for:

- Anchoring in extreme depths (beyond 82.5 metres)
- Anchoring in deep waters
- Anchoring methods

- Protection of personnel and safe operation of equipment

At anchor

There are procedures for:

- Anchor watches, including actions to be taken when dragging or action to be taken when bad weather is expected

Heaving up the anchor

There are procedures for:

- Emergency departure from an anchorage
- Heaving up anchor in extreme depth
- Protection of personnel and safe operation of equipment

ICS: Bridge Procedures Guide. Fifth Edition.

2.4.10 Planning an anchorage

Checklist B12 Anchoring and Anchor Watch.

OCIMF: Anchoring Systems and Procedures 2010 edition

3.1.3 Limitations of the Anchoring System.

Typically, a windlass is required to heave in the weight of an anchor and chain from a depth of between 82.5 and 100m, depending upon individual Class requirements. The windlass is not designed to break out the anchor from the seabed and may not be designed to lift chain lengths in excess of Class minimum requirements.

The weakest component in most anchoring systems is the windlass motor. The two main failure modes of motors are associated with heaving when there is too much weight on the cable and walking out the cable with excessive way on the vessel.

When attempting to recover anchors in extreme conditions, the windlass will heave until its pulling force is exceeded by the tension in the chain. At this time, the windlass may start to render and such rendering may lead to damage to the motor’s components. This could lead to catastrophic failure and the associated risk of personal injury.

5.1 Anchoring Procedures

It is recommended that the procedures used for anchoring operations are developed by shore and vessel management using risk assessment methodology and that these are included within the SMS. As a minimum, the procedures should:

- Include the use of checklists to ensure that all bridge and forecastle preparations are correctly made.
- Identify any precautions to be taken with a particular vessel and describe the distinctive features of the equipment fitted.
- Prescribe the use of appropriate PPE by the anchor party.

TMSA KPI 6A.2.2 requires that procedures address all aspects of anchoring operations likely to be undertaken by fleet vessels. Procedures for anchoring operations have been developed, following risk assessments, which address:

- Selection of anchoring position.
- Methods of anchoring.
- Equipment design limitations and characteristics.
- Emergency anchoring.
- Anchor watches, including actions to be taken when dragging or at onset of bad weather.
- Emergency departure from an anchorage.

IMO: ISM Code

7. The Company should establish procedures, plans and instructions, including checklists as appropriate, for key shipboard operations concerning the safety of the personnel, ship and protection of the environment. The various tasks should be defined and assigned to qualified personnel.

IACS Unified Requirements A: Requirements Concerning Mooring

IACS: UR A3 Anchor Windlass Design and Testing

Note

1. This UR is to be uniformly implemented by IACS Societies:

i) when an application for certification of an anchor windlass is dated on or after 1 July 2018; or

ii) installed in new ships for which the date of contract for construction is on or after 1 July 2018.

6. Marking

Windlass shall be permanently marked with the following information:

(a) Nominal size of chain (e.g. 100/3/45 means chain dia./grade/breaking load)

(b) Maximum anchorage depth, in metres.

Inspection Guidance

The vessel operator should have developed anchoring procedures and supporting checklists in alignment with

- TMSA KPI 6A.2.2 and its best practice guidance.
- OCIMF Anchoring Systems and Procedures First Edition 2010:
    - 5.1 Anchoring Procedures.
    - 5.1.1 General.
    - 5.1.2 Preparations for anchoring.
    - 5.1.3 Methods of anchoring.
    - 5.1.4 Commonly used anchoring procedures.
    - 5.2.1 Watchkeeping Responsibilities.
    - 5.2.2 Securing the Cable at Anchor.

The procedures should provide specific guidance on the environmental limits for:

- Safe anchoring operations as determined by company risk assessment processes.
- Remaining at anchor.
- Recovering the anchor and proceeding to sea.

Suggested Inspector Actions

- Review the company procedures for anchoring operations.
- Verify that the anchoring procedures gave guidance relating to:
    - The maximum depth of water for normal anchoring operations.
    - The maximum recommended wind strength and wave height for anchoring.
    - The weather conditions when the company requires the vessel to depart an anchorage.
    - The required level of supervision for the anchoring party.
    - The minimum composition of the anchoring party.
    - The required checks on the windlass, anchors, stoppers and power systems prior to use.
- Review a recent anchoring operation to:
    - Verify that the necessary appraisal and planning checklists were completed prior to the operation.
    - Verify that checks on the windlass, anchor, stopper and power systems had been completed prior to the operation.
    - Verify that the weather conditions during the time at anchor were within the company guidelines for remaining at anchor.
    - Verify that the depth of water at the anchoring location was within the limits provided by the company.

During the physical inspection:

- Inspect the windlass, anchors, chain and stoppers and verify that they were in satisfactory condition.
- Verify that the accompanying officer was familiar with the anchor brake adjustment setting and other checks on equipment required to be completed prior to and after anchoring.
- Verify that the anchors were free to be used in an emergency – anchor chain not hard up against the stopper bar when in port or at sea.
- Verify that, when the vessel was in port, the anchor lashings were removed unless specifically required to be in place in accordance with terminal regulations.

Expected Evidence

- The company procedures for anchoring operations.
- Records and checklists for recent anchoring operations.
- Recent checklist and/or maintenance record to demonstrate that the windlass brake setting had been checked.
- Bridge Log Book and bell book.

Potential Grounds for a Negative Observation

- There were no company procedures with supporting checklists which covered the process of anchoring and included:
    - The selection of an anchorage taking into account the proximity and density of other vessels at anchor, the quality of the seabed and the proximity of navigational dangers.
    - The maximum depth of water permitted for normal anchoring operations.
    - The required level of supervision of the anchoring party.
    - The minimum composition of the anchoring party.
    - The maximum environmental conditions permitted for anchoring.
    - The environmental conditions at which the vessel would be expected to have departed an anchorage.
    - The checks required to be carried out for the anchoring equipment and power system prior to, and upon completion of, anchoring operations.

- The accompanying officer was unfamiliar with the company procedures for anchoring operations.
- The vessel had anchored, or remained at anchor, with environmental conditions in excess of the limits provided by the company.
- The vessel had anchored in a water depth that exceeded the limit set by the company.
- The maximum anchorage depth in metres was not either marked on the windlass or posted on the bridge.
- The checks required to be completed prior to and during anchoring operations had not been completed as required.
- The anchoring systems (windlass, anchor, chain, stoppers, power system) were defective in any respect.
- The accompanying officer was unable to demonstrate how to verify that the windlass brake was correctly adjusted.
- When in coastal waters and port the anchors were not free to use in an emergency – the chain was resting against the stopper bar preventing it being lifted without the use of the windlass.

9.4. Mooring and Anchoring Team Management

9.4.1. Were the Master, deck officers and deck ratings familiar with the company procedure that defined mooring team supervision and composition for the various mooring and anchoring operations likely to be undertaken, and was evidence available that each mooring work space had been supervised and manned in accordance with company expectations?

Short Question Text
Mooring team supervision and composition

Vessel Types
Oil, Chemical, LPG, LNG

ROVIQ Sequence
Documentation, Cargo Control Room, Mooring Decks

Publications
OCIMF: Mooring Equipment Guidelines. Fourth Edition 2018 (MEG4)
IMO: STCW Code
OCIMF: Effective Mooring. Fourth Edition 2019
INTERTANKO: Anchoring Guidelines: A Risk-Based Approach v.3 June 2020
IMO: ISM Code

Objective

To ensure that mooring and anchoring operations are always properly supervised with enough personnel assigned to conduct the operations safely and efficiently at each mooring or anchoring workspace.

Industry Guidance

OCIMF: Mooring Equipment Guidelines. Fourth Edition 2018 (MEG4)

1.9 Mooring System Management Plan

1.9.2.5 Part E – Risk and change management, safety of personnel and human factors

E.3 Manning and Training

- Safe manning levels including minimum required by Class, Flag and/or the ship's SMS.
- Manufacturer's instructions and standard operating procedures.
- Outline competency requirements for undertaking mooring operations and operating mooring machinery operator and/or industry).
- Induction, familiarisation and training requirements necessary before personnel undertake mooring operations, including any ship-specific requirements and periodic refresher training.

E.5 Mooring operations plans and procedures

- Risk-based mooring operations plans and procedures should be detailed and include pre-arrival briefings, ship/shore mooring arrangements, safety and occupational health issues and required crew resources.
- Contingency plans for mooring operations with appropriate control measures and operational procedures.
- Requirements for operations supervision at each mooring work space and overall control of mooring operations (e.g. Master/Pilot) are to be detailed.
- Communications methods both primary and secondary should form a part of the operations plans.

OCIMF: Effective Mooring. Fourth Edition 2019.

Chapter 2.5 Common risks and hazards *(list not complete)*

- Lack of communications and planning.
- No risk assessment before mooring operations.
- Not enough crew.
- Ineffective training on the hazards of the job.
- Inadequate information or unclear instructions.
- Poor supervision.

OCIMF Anchoring Systems and Procedures 2010 edition

5.1.2 Preparation for Anchoring

It is recommended that a certificated/licensed deck officer supervises anchoring operations and that only experienced crew members are assigned to anchor work.

Intertanko: Anchoring Guidelines: A Risk-Based Approach v.3 June 2020

Appendix 3- Worked example on risk-based approach – Hazid technique

Description of Identified Hazards

– Inadequate supervision / communication

Possible Consequences

– Personnel injury, equipment damage

Control Measures to Protect: Personnel – Environment – Company – Asset from Harm

1. Anchoring operations shall be planned, co-ordinated and supervised by the Master.
2. A responsible and qualified Officer should be in charge of the anchor party.
3. Efficient communication between the Bridge and the anchoring team should be tested before the operation and a backup system (i.e. availability of a second UHF, talk-back system) should be ensured. Communications procedures should be familiar to all personnel that will participate in the task (Working channels and reporting methods).

TMSA KPI 6A.3.1 requires that procedures identify requirements for personnel involved in mooring operations. The requirements may include:

- Designated person in charge at each location.
- Minimum numbers of people required at each station.
- Toolbox talk prior to mooring operations.
- Minimum training and experience requirements.
- Supervision of third-party personnel.

IMO: ISM Code

6.2 The Company should ensure that each ship is:

1. manned with qualified, certificated and medically fit seafarers in accordance with national and international requirements; and
2. appropriately manned in order to encompass all aspects of maintaining safe operations on board.

IMO: STCW Code

Table A-II/1 – Specification of minimum standards of competence for officers in charge of a navigational watch on ships of 500 gross tonnage or more.

- Function - Navigation at the operational level
- Competence - Manoeuvre the ship
- Knowledge, understanding and proficiency - Ship manoeuvring and handling - .5 proper procedures for anchoring and mooring.

- Function - Controlling the operation of the ship and care for persons on board at operational level.
- Competence - Application of teamworking and leadership skills
- Knowledge, understanding and proficiency - Knowledge and ability to apply effective resource management.

Table A-II/5 – Specification of minimum standards of competence of ratings as able seafarer deck

- Function - Navigation at the support level
- Competence - Contribute to berthing, anchoring and other mooring operations
- Knowledge, understanding and proficiency - Working knowledge of the mooring system and related procedures…

Inspection Guidance

The vessel operator should have developed procedures aligned with the Mooring System Management Plan (MSMP) which described:

- The onboard roles permitted to supervise mooring and anchoring teams.
- Where the identified supervisor was not a licenced officer, the additional training and competency evaluations that an individual must have undertaken prior to undertaking a supervisory role.
- The minimum number of ratings that must form part of the mooring team(s) for the various types of mooring and anchoring activities expected to be conducted onboard the vessel.
- The roles and responsibilities of the mooring and anchoring team members.
- How the mooring team will be informed of expectations around the mooring or anchoring operation, for example, though the use of toolbox talks or risk assessment review.

Suggested Inspector Actions

- Sight, and where necessary review, the company procedure which defined the supervision and composition of mooring and anchoring teams.
- Review the sections of MSMP relating to Manning and Training, and Mooring Operations Plans and Procedures and verify that they had been developed to include detail of the mooring team composition and workspace supervisor.
- Where the company procedure required the review of a risk assessment prior to a mooring or anchoring operation, review the risk assessment for a recent operation and verify that it reflected the operation undertaken.

- Interview one deck officer and one rating involved in mooring operations to understand who supervised mooring and anchoring operations during recent operations and whether there was a clear understanding of the company expectations around mooring team composition, supervision and toolbox talks prior to each operation.

- While conducting the review of hours of rest records, consider the required mooring and anchoring team composition and verify that vessel records gave an accurate representation of the vessel complement involvement in mooring and anchoring operations.

Expected Evidence

- The company procedure which defined the mooring and anchoring team composition and workspace supervision expectations.
- The hours of rest records for the previous full month.
- The vessel's Mooring System Management Plan sections:
    - Manning and Training – Safe manning levels required by the ship's SMS,
    - Mooring Operations Plans and Procedures - Requirements for operations supervision at each mooring workspace.
- Where an unlicenced crewmember was nominated as an acceptable mooring or anchoring workspace supervisor, the records of the training courses and competency assessment required by the relevant sections of the MSMP.
- Where required to be reviewed prior to an operation by company procedures, the risk assessments for recent mooring and anchoring operations.

Potential Grounds for a Negative Observation

- MSMP sections, relating to Manning and Training and Mooring Operations Plans and Procedures, had not been developed to specify the mooring or anchoring team composition or identified the required level of supervision at each mooring workspace.
- The accompanying deck officer was unable to identify the company procedure defining who should supervise each mooring and anchoring workspace and the minimum workspace composition when requested to do so.
- An interviewed deck officer or rating involved in mooring operations was unfamiliar with the company expectations with regards to mooring or anchoring team composition or workspace supervision.
- Review of hours of rest or other records determined that the company expectations relating to mooring or anchoring team composition or supervision had not been complied with.
- Where an unlicenced crew member was permitted to supervise an anchoring or mooring workstation there was no evidence that they had completed the training courses or the competency assessment as required by the company for fulfilling the role.

- Where the company procedure permitted an unlicenced crewmember to supervise a mooring or anchoring workspace enter a **comment** in the Process response tool and describe the circumstances in which this was permitted.

9.4.2. Were the deck officers and ratings involved with mooring operations familiar with the safe operation of the mooring winches and the dangers of working with and around mooring lines during mooring operations and while under tension?

Short Question Text
Dangers of working with and around mooring lines

Vessel Types
Oil, Chemical, LPG, LNG

ROVIQ Sequence
Cargo Control Room, Mooring Decks

Publications
IMO: ISM Code
OCIMF: Effective Mooring. Fourth Edition 2019

Objective

To ensure that vessel personnel are aware of the dangers of working with mooring equipment and near lines under tension.

Industry Guidance:

OCIMF: Effective Mooring. Fourth Edition 2019.

Section two- General mooring safety practices.

Section three- Mooring lines

3.5 Stoppers for wires not mounted on winch drums

3.6 Stoppers for synthetic fibre mooring lines

3.7 Snap-back.

Section four- Mooring winches

4.7 Winch safety reminders.

TMSA KPI 6A.1.1 requires that procedures for mooring and anchoring operations are in place for all vessel types within the fleet which include:

- Roles and responsibilities.
- Planning including toolbox talk.
- Requirements for risk assessments.
- Mooring arrangement and layout.

IMO: ISM Code

7. The Company should establish procedures, plans and instructions, including checklists as appropriate, for key shipboard operations concerning the safety of the personnel, ship and protection of the environment. The various tasks should be defined and assigned to qualified personnel.

Inspection Guidance

The vessel operator should have developed mooring procedures which include:

- The role of the supervisor and their responsibilities.
- The role of the supporting ratings and their responsibilities.
- The hand signals that should be used during mooring operations.
- The requirement for a toolbox talk or risk assessment review prior to commencing mooring operations.
- The areas that should be considered as hazardous due to potential snap-back from parted mooring lines.
- The safety features of a mooring winch that must be tested prior to use and be consistently used during winch operation.
- Where stoppers are to be used, the correct type and application for the lines in use.

Procedures may reference industry guidance such as OCIMF: Effective Mooring.

Suggested Inspector Actions

- Sight, and where necessary review, the mooring procedure which included operational safety during mooring operations and in areas where mooring lines were under tension.

During the physical inspection verify that:

- The winch drums were out of gear and pins were available to lock the clutch in position while engaged and disengaged.
- The mooring winch control levers were free to move and returned to the neutral position when released.
- The mooring winch control levers were clearly marked with the direction of heave and slack.
- That there was no evidence that the mooring winch controls had been tied or secured to permit unmanned operation.
- The winch controls were mounted to give the operator a clear sight of the operational working area and other mooring team members.
- The working platforms around the winches gave uninterrupted safe access to mooring drums and winch controls.
- The winch controls were sited to make sure that the operator was not at risk from moving parts.
- Stoppers in use were appropriate for the types of mooring line in service and were of sufficient strength.
- Warning signs and barriers were in place to warn personnel of the dangers posed by mooring operations and mooring lines under tension.

- Interview one deck officer and one rating who had been involved in mooring operations to establish how they had been informed of the dangers of snap-back and how to keep safe during mooring operations.

Expected Evidence

- The company mooring procedure which defined operational safety during mooring operations or in areas where mooring lines were under tension.

Potential Grounds for a Negative Observation

- There was no company procedure which included the considerations for operational safety during mooring operations or in areas where mooring lines were under tension.
- A deck officer or rating involved in mooring operations was unfamiliar with the company mooring procedure which defined the considerations for operational safety during mooring operations and in areas where there were mooring lines under tension.
- A deck officer or rating involved in mooring operations was unfamiliar with the danger of snap-back and how this was communicated onboard the vessel prior to and after mooring operations.

- Interviews with deck officers or ratings involved in mooring operations indicated that toolbox talks were not taking place prior to each mooring operation.
- Ship’s personnel or visitors were observed stepping over lines under tension when there was a route which avoided the need to do so.
- There were no warning signs or barriers to prevent personnel from approaching a mooring line under tension.
- The mooring drums were left in gear while the drum was in active mooring service with the brake applied.
- The safety locking pins for the winch drum clutch mechanisms were missing or not used.
- The mooring winch control levers were stiff and did not return to the neutral position when released.
- The mooring winch controls were not clearly marked with the direction of heave and slack.
- There was evidence that mooring winch controls had been fastened in the heave or slack position at some point in the past.
- The winch control and drum access platforms were damaged, uneven or had missing plates.

9.5. STS Operation Management

9.5.1. Were the appropriate industry checklists used during STS operations, and were comprehensive records of these operations maintained?

Short Question Text
STS operations checklists

Vessel Types
Oil, Chemical, LPG, LNG

ROVIQ Sequence
Bridge, Cargo Control Room, Mooring Decks

Publications
OCIMF: Ship to Ship Transfer Guide for Petroleum
Chemicals and Liquefied Gases. First Edition.
IMO: ISM Code

Objective

To ensure that all stages of an STS operation are conducted in accordance with industry best practice guidance.

Industry Guidance

OCIMF: Ship to Ship Transfer Guide for Petroleum, Chemicals and Liquefied Gases. First Edition. *

"At sea" Indicates offshore waters or partially sheltered waters where transfers may be undertaken between vessels underway or at anchor.

"In Port" Used to indicate where STS operations are conducted under the jurisdiction of a port or harbour authority and includes operations that may involve berthing alongside a Discharging ship or Mother ship at anchor or alongside a terminal.

3.4 Use of checklists

Checklists are an important risk management tool aimed at ensuring that operations are conducted in a safe manner. They are essential reminders of the principal safety factors to be considered, but they should be supplemented by continuous vigilance throughout the whole operation.

It should be noted that the checklists have been developed to specifically address factors that are relevant to the STS operation and the questions are supplementary to those contained in standard pre-transfer checklists, such as the International Safety Guide for Oil Tankers and Terminals (ISGOTT) Ship/Shore Safety Checklist.

Appendix E: Operational/safety checklists

- At sea ship to ship operations:
    - Checklist 1 - Pre-fixture information (for each ship)
    - Checklist 2 - Before operations commence
    - Checklist 3 - Before run-in and mooring
    - Checklist 4 - Before cargo transfer
    - Checklist 5 - Before unmooring
- In port STS operations:
    - Checklist 6 – An example of a Pre-transfer checklist
    - Checklist 6A – An example of Checks during transfer

Appendix G: Example checklist for transfers involving vapour balancing

Appendix L: Example liquefied natural gas ship to ship transfer compatibility questionnaire

* a joint publication by OCIMF, CDI, ICS & SIGTTO.

TMSA KPI 6A.2.1 requires that detailed procedures address each different type of mooring operation likely to be undertaken by fleet vessels.

Procedures have been developed following risk assessments for each type of mooring operation which may include:

- STS operations (including reverse STS).

IMO: ISM Code

7. The Company should establish procedures, plans and instructions, including checklists as appropriate, for key shipboard operations concerning the safety of the personnel, ship and protection of the environment. The various tasks should be defined and assigned to qualified personnel.

Inspection Guidance

The vessel operator should have developed procedures to requiring:

- Checklists identified by the OCIMF* STS Transfer Guide for “at sea” or “in port” cargo specific operations are completed before, during and after each relevant STS operation and, as required by an individual checklist.
- Checklists are retained onboard along with other STS related records applicable to the type of STS operation, which may include;
    - The JPO (Joint Plan of Operations) as provided by the service provider.
    - Risk assessment as submitted by the Service Provider.
    - Detailed Mooring Plan of participating vessels.
    - Copies of certificates of fenders and hoses.
    - Notification to coastal authorities.
    - Details of Drills associated with the specific STS Operation.
    - Records of Crew Experience.
    - Post operation feedback/ assessment by the Master.

Suggested Inspector Actions

- Sight, and where necessary review, the company procedures which required the vessel to use the checklists identified by the OCIMF* STS Transfer Guide.
- Where the vessel was involved in an STS operation, review the STS checklists completed during the operation thus far and verify that the correct checklists, including a standard pre-transfer checklist, had been utilised and that they had been completed appropriately.
- Where the vessel had conducted STS operations during the previous twelve months, select the records for an STS operation at random and verify that the following records were available as applicable to the operation:
    - The JPO (Joint Plan of operations) as provided by the service provider,
    - Risk assessment as submitted by the Service Provider,
    - Detailed Mooring Plan of participating vessels.
    - Copies of certificates of fenders and hoses,
    - Notification to coastal authorities,
    - Details of Drills associated with the specific STS Operation,
    - Records of Crew Experience,
    - Post operation feedback/ assessment by the Master.

Expected Evidence

- The company procedure which required the vessel to use the checklists identified by the OCIMF* STS Transfer Guide.
- The company procedure which required the retention of STS checklists and records.
- Where the vessel was undertaking an STS operation at the time of the inspection, the STS checklists, standard pre-transfer checklist and, vapour balancing checklist where this was taking place.
- The records for STS operations completed during the previous twelve months or, where numerous operations had been undertaken, records for the previous six operations.

Potential Grounds for a Negative Observation

- There was no company procedure which required the vessel to use the checklists identified by the OCIMF* STS Transfer Guide.
- There was no company procedure which required that comprehensive STS records were maintained onboard.
- The accompanying deck officer was not familiar with the company procedure for the use of checklists during STS operations.
- The accompanying officer was not familiar with the company procedure for the retention of records relating to STS operations.
- Review of checklists in use at the time of the inspection or from past STS operations indicated that the wrong STS checklists were used i.e. “at sea” checklists were used for “in port” operations or vice-versa.
- Individual STS checklists were either not used or missing.
- Review of individual STS checklists identified that items had been checked off, but the required evidence was missing.
- Standard pre-transfer checklists had not been used to supplement the STS checklists.
- Where vapour balancing had been conducted there was no vapour balancing checklist used.
- Physical inspection of the vessel during an STS operation determined that checks required by the STS checklists had not been accomplished.
- Repetitive checks required by the STS checklists had not been completed.
- Review of records for past STS operations identified that checklists or required records were missing.
- Review of completed “in port” pre -transfer STS checklists indicated that the confirmation of checks and signatures required from the second vessel, and the terminal where applicable, involved in the STS operation had not been completed.

Where the ship had never been involved in an STS operation as described by the OCIMF joint industry publication and there was no future intention to do so, select “*Not Answerable*” in each of the response tools then select "*Not Applicable - as instructed by question guidance*".

9.5.2. Where the vessel was involved in an “at sea” STS operation, was an accurate Joint Plan of Operation available onboard, were the Master and deck officers familiar with its content, and were operations being conducted in accordance with its requirements?

Short Question Text
STS Joint Plan of Operation (JPO)

Vessel Types
Oil, Chemical, LPG, LNG

ROVIQ Sequence
Bridge, Cargo Control Room, Interview - Deck Officer, Interview - Deck Rating, Documentation

Publications
OCIMF: Ship to Ship Transfer Guide for Petroleum
Chemicals and Liquefied Gases. First Edition.
IMO: ISM Code

Objective

To ensure that each “at sea” ship to ship (STS) operations is planned and executed taking into consideration the operational and environmental requirements for the specific transfer location, vessels and cargo transfer operations involved.

Industry Guidance

OCIMF*: Ship to Ship Transfer Guide for Petroleum, Chemicals and Liquefied Gases. First Edition.

"At sea" indicates offshore waters or partially sheltered waters where transfers may be undertaken between vessels underway or at anchor.

"Joint plan of operation (JPO)" An operation-specific plan that includes, as appropriate, reference to ship compatibility, manoeuvring, approach, mooring and transfer and, if applicable, references the ship-specific STS operations plans.

3.10.4 Electrical isolation

It is necessary to ensure that electrical isolation in maintained between the ships involved in STS operations during transfer line connection/disconnection and cargo transfer operations. This is to reduce the risk of high energy sparks being produced due to the electrical potential difference between the hulls.

To eliminate the potential for incendive arcing between the two ships, when presenting the hose string for connection one of the following arrangements should be used:

- A single insulating flange fitted at the manifold of one ship or within each hose string and all hoses in the string electrically continuous; or
- A single length of electrically discontinuous hose fitted in each hose string; or
- Hoses that are specially constructed to prevent static build up and limit electrical conductance to an inherently safe level.

5.2 Joint Plan of Operation

Prior to commencement of any STS operation a Joint Plan of Operation (JPO) should be developed to ensure that all parties involved, including the STS service provider, are in alignment with regard to how the operation is to be conducted.

In all cases the person in overall advisory control (POAC), STS Superintendent or transfer organizer should establish agreement and consensus between all parties.

The JPO should include a compilation of information from various sources.

For a particular location, a generic template may be used. Information may include the following:

- Details regarding rendezvous location and designated lightering area, including relevant risk assessment(s).
- Brief description regarding how the STS operation will be conducted, for example approach and mooring underway or with one vessel at anchor, transfer at anchor or underway, unmooring with one vessel at anchor or while underway.
- Details regarding any local or government regulatory requirements and mandatory notifications.
- Communication protocols.
- Security requirements.
- Procedures associated with any personnel transfers.
- Details regarding any service craft and launches.
- Environmental operating parameters/limits for each stage of the STS operation. These should include environmental and operational limits that would trigger suspension of the transfer operation and disconnection and unmooring of the vessels.
- Fender configuration and rigging arrangements.
- Mooring plans and arrangements and sequence of running lines, including use of any specialist mooring equipment.
- Details of transfer and associated equipment, including the number, type and dimensions of cargo (and where applicable vapour) hoses and method of rigging/support.
- Maximum and minimum draught and freeboard anticipated during operations, including details of the stage of operations they relate to.
- Emergency and spill containment procedures.
- Sequence of actions in case of spillage of cargo.
- Co-ordination of plans for cargo hose connection, draining, purging and disconnection, as appropriate.
- Detailed unmooring sequence.
- For double banking operations, the suitability of the berth and strength of mooring points should be confirmed.

In addition, the JPO should include details of the cargo transfer plan(s) or make reference to their content.

OCIMF* a joint publication by OCIMF, CDI, ICS & SIGTTO.

TMSA KPI 6A.2.1 requires that detailed procedures address each different type of mooring operation likely to be undertaken by fleet vessels.

Procedures have been developed following risk assessments for each type of mooring operation which may include:

- STS operations (including reverse STS).

IMO: ISM Code

7. The Company should establish procedures, plans and instructions, including checklists as appropriate, for key shipboard operations concerning the safety of the personnel, ship and protection of the environment. The various tasks should be defined and assigned to qualified personnel.

Inspection Guidance

The vessel operator should have developed procedures which required that a JPO is developed, available onboard and reviewed by vessel staff prior to an STS operation commencing.

Suggested Inspector Actions

- Review the Joint Plan of Operations for the STS operation and verify that:
  - The plan contained all information required by the OCIMF* guidance.
  - The risk assessment(s) had been developed to address the risks of the specific location and type of STS operation being undertaken.
  - The means for eliminating the potential for incendive sparking between the two ships had been addressed.
  - There was evidence that any mandatory notifications to comply with local or government requirements had been made.
  - That the vessel had been moored in accordance with the agreed mooring plan.
  - That the vessel was complying with any environmental operating parameters.
  - The unmooring sequence was documented.

- Interview one deck officer and one deck rating to gauge their level of understanding of the Joint Plan of Operation for the STS operation being undertaken.

Expected Evidence

- The company procedures which required the development of a Joint Plan of Operation for every STS operation.
- The vessel's STS Operations Plan.
- The Joint Plan of Operation for the STS operation, developed by the STS service provider, the STS organiser, the STS Superintendent or the Person in overall advisory control (POAC) depending on the circumstances of the operation.

Potential Grounds for a Negative Observation

- There was no procedure which required that a Joint Plan of Operation (JPO) was developed for every STS operation.
- The vessel did not have onboard a JPO which reflected the specific STS operation being undertaken.
- The JPO did not include all information required by the OCIMF* STS Guide relevant to the operation being undertaken.
- The accompanying deck officer was unfamiliar with the company procedure which required a JPO to be developed for every STS operation.
- The accompanying deck officer was unfamiliar with the content of the JPO.
- An interviewed deck officer or deck rating had not been briefed regarding the content of the JPO prior to the commencement of the STS operation.
- The risk assessment contained in the JPO did not reflect the location or type of STS operation that was being undertaken.
- The JPO did not address the measures in place to eliminate the potential for incendive arcing between the two vessels.
- The measures to eliminate incendive arcing identified within the JPO had not been implemented.
- There was no evidence that the mandatory notifications to comply with local or government regulations had been made.
- The vessel was not moored in accordance with the JPO.
- The vessel had continued the STS operation or cargo transfer operations despite the environmental operating parameters being exceeded.

9.5.3. Were the Master, officers and deck ratings familiar with the vessel's STS Operations Plan?

Short Question Text
STS Operations Plan

Vessel Types
Oil, Chemical, LPG, LNG

ROVIQ Sequence
Bridge, Cargo Control Room, Main Deck, Engine Control Room

Publications
IMO: MARPOL
OCIMF: Ship to Ship Transfer Guide for Petroleum
Chemicals and Liquefied Gases. First Edition.
IMO: ISM Code

Objective

To ensure that ship to ship (STS) mooring & cargo operations are always planned and conducted in a consistent manner.

Industry Guidance

OCIMF*: Ship to Ship Transfer Guide for Petroleum, Chemicals and Liquefied Gases. First Edition.

1.1 Introduction

The requirements of MARPOL Annex I, chapter 8, The Prevention of Pollution During Transfer of Oil Cargo Between Oil Tankers at Sea, should be adhered to for all applicable operations involving oil cargoes.

The requirement for vessels to be provided with an STS operations plan should be considered for adoption by vessels involved in the STS transfer of other cargoes as recommended best practice.

7.2 Responsibility for cargo operations

Where applicable, a copy of the ship's approved STS operations plan should also be available on the bridge, CCR and ECR.

OCIMF* a joint publication by OCIMF, CDI, ICS & SIGTTO.

TMSA KPI 6A.2.1 requires that detailed procedures address each different type of mooring operation likely to be undertaken by fleet vessels.

Procedures have been developed following risk assessments for each type of mooring operation which may include:

- STS operations (including reverse STS).

IMO: ISM Code

7. The Company should establish procedures, plans and instructions, including checklists as appropriate, for key shipboard operations concerning the safety of the personnel, ship and protection of the environment. The various tasks should be defined and assigned to qualified personnel.

IMO: MARPOL

Annex 1

Chapter 8 – Prevention of pollution during transfer of oil cargo between tankers at sea.

Regulation 40

1. the regulation contained in this chapter apply to oil tankers of 150 gross tonnage and above engaged in the transfer of oil cargo between oil tankers at sea (STS operations).
2. the regulations contained in this chapter shall not apply to oil transfer operations associated with FPSOs used for the offshore production and storage of oil and FSUs used for the offshore storage of produced oil.
3. the regulations in this chapter shall not apply to bunkering operations.

Inspection Guidance

The vessel Operator should have developed an STS Operations Plan as follows:

- For vessels involved in transfer of MARPOL Annex 1 cargo – Administration approved.
- For vessels involved in transfers of all other liquid cargoes – As recommended best practice.

Copies should be available in the following locations:

- Bridge.
- Cargo transfer control station.
- Engine Room.

And should contain the following information:

- A step-by-step description of the entire STS operation.
- A description of the mooring and unmooring procedures and arrangements, including diagrams where necessary, and procedures for tending the oil tankers' moorings during the transfer of cargo.
- A description of the cargo and ballast transfer procedures, including those used while underway or anchored and procedures for connecting and testing the integrity of cargo hoses and hose to manifold interface, topping off cargo tanks and disconnecting cargo hoses.
- The titles, locations and duties of all persons involved in the STS operation.
- Procedures for operating the emergency shutdown and communication systems and for rapid breakaway.
- A description of the drip trays and procedures for emptying them.
- Procedures for reporting spillages of oil into the water.
- An approved contingency plan.
- A cargo and ballast plan.

The Master should ensure that the STS Operations Plan on board is current and should require all personnel on board to follow the procedures in the plan.

<u>Suggested Inspector Actions</u>

- Review the STS Operations Plan and verify that:
  - A copy of the STS Operations Plan is located on the bridge, in the cargo transfer station and in the Engine room.
  - Where the vessel carries MARPOL Annex 1 cargo, the STS Operations plan has been approved by the administration.
  - Where the vessel did not carry MARPOL Annex 1 cargo, the STS Operations Plan was developed in alignment with Annex A of the OCIMF* Ship to Ship Transfer Guide.
  - Where the vessel was involved in an STS operation, that the STS Operations Plan had been updated with:
    - The mooring plan for the current operation.

    - The cargo plan for the current operation.

- Where the vessel was involved in an STS operation during the inspection or had conducted an STS operation within the previous two months, interview one rating and gauge their familiarity with the location and content of the STS Operations Plan.

Expected Evidence

- The vessel's STS Operations Plan.

Potential Grounds for a Negative Observation

- The vessel did not have an STS Operations Plan. (irrespective of whether the vessel had been involved in STS operations.)
- Where the vessel had been involved in the STS transfer of Annex 1 cargo the STS plan had not been approved by the vessel's Administration. (except where specifically exempted by MARPOL Annex 1 Regulation 40)
- Where the vessel was not involved in the carriage of Annex 1 cargo, the content of the STS Operations Plan was not in alignment with Annex A of the OCIMF Ship to Ship Transfer Guide.
- The onboard STS Operations Plan were found to be outdated or incomplete.
- One or more copies of the STS Operations Plan was missing from the following locations; bridge, cargo transfer control station or engine room.
- The accompanying officer was unfamiliar with the location and content of the STS Operations Plan.
- An interviewed deck rating who was onboard during a recent STS operation was unfamiliar with the location and content of the STS Operations Plan.

Where the ship had never been involved in an STS operation as described by the OCIMF joint industry publication and there was no future intention to do so, select *"Not Answerable"* in the Process and Human response tools then select *"Not Applicable - as instructed by question guidance".*

9.6. Single Point Mooring

9.6.1. Were the vapour collection system manifold arrangements suitable for hose handling at buoy moorings?

Short Question Text
Vapour hose securing arrangement for buoy moorings.

Vessel Types
Oil

ROVIQ Sequence
Cargo Manifold

Publications
OCIMF/CDI: Recommendations for Oil and Chemical Tanker Manifolds and Associated Equipment

Objective

To ensure that vapour collection system manifolds are suitably designed and equipped to facilitate hose handling at buoy moorings.

Industry Guidance

OCIMF/CDI: Recommendations for Oil and Chemical Tanker Manifolds and Associated Equipment

Section five

Hose support at ship's side

A means of adequately supporting hoses in way of the ship's side abreast of the manifolds should be provided.

Section nine

Deck fittings to facilitate hose handling at buoy moorings

Vessels likely to conduct operations at buoy moorings (SPM, CBM and tandem berthing) should follow the guidance in this section, which is on the design of deck fittings in way of the manifold for use when hoisting and hanging-off hoses.

Details of all deck fittings in way of the manifold should be included in the vessel's mooring arrangement plan.

TMSA KPI 6A.2.1 requires that detailed procedures address each different type of mooring operation likely to be undertaken by fleet vessels.

Procedures have been developed following risk assessments for each type of mooring operation, which may include:

- Conventional buoy mooring, Single Point Moorings.
- Tandem mooring to F(P)SO.

IMO: ISM Code

10.1 The Company should establish procedures to ensure that the ship is maintained in conformity with the provisions of the relevant rules and regulations and with any additional requirements which may be established by the Company.

Inspection Guidance

For vapour collection system manifolds on vessels likely to conduct operations at buoy moorings (SPM, CBM and tandem berthing):

- The vapour manifolds should be supported to the same strength as the cargo manifolds.
- The hose rails should be of the same strength and construction throughout their length, extend beyond the vapour manifolds to permit use at buoy moorings and be fitted with stopper plates at both the forward and aft ends of the hose rails.
- A closed chock should be fitted at the ship's side in line with the vapour manifolds.
- A cruciform bollard should be fitted in line, or nearly in line with the vapour manifolds to allow securing of the vapour hose hang-off chain.
- Two deck pad-eyes of a size sufficient to secure a 16-inch floating hose should be provided, one to either side of the line from the closed chocks to the vapour manifolds.
- Fittings for securing the vapour hose should be permanently marked with their safe working load (SWL).
- Means to thoroughly drain the vapour manifold should be provided at the lowest point in the vapour collection system line to avoid risk of liquid carry-over into the floating hose.

Suggested Inspector Actions

- Inspect the vapour collection system manifolds and verify that the required fittings are in place.

Expected Evidence

- The vessel’s mooring arrangement plan.

Potential Grounds for a Negative Observation

For a vapour return system manifold (VRSM) which was designed for use at single buoy moorings:

- The vapour manifolds were not supported to the same strength as the cargo manifolds.
- Hose rails did not extend beyond the vapour manifolds.
- Hose rails serving the vapour manifolds were not:
    - Of the same strength and construction throughout their length.
    - Fitted with stopper plates at both the forward and aft ends of the hose rails.
- The vapour manifolds were not fitted with the necessary:
    - Closed chocks.
    - Cruciform bollards.
    - Deck pad-eyes.
- The fittings for securing the vapour hose were not permanently marked with their safe working load (SWL).
- There were no means to drain the vapour manifold to avoid risk of liquid carry-over into the floating hose.

9.6.2. Were the Master and officers familiar with the company procedures for mooring at an SPM or F(P)SO and were the fittings required accurately described in the HVPQ?

Short Question Text
SPM mooring arrangements.

Vessel Types
Oil, Chemical, LPG, LNG

ROVIQ Sequence
Forecastle, Documentation

Publications
OCIMF Guidelines for Offshore Tanker Operations
IMO: ISM Code

Objective

To ensure the vessel is appropriately equipped and will be able to safely moor to an SPM or F(P)SO terminal.

Industry Guidance

OCIMF Guidelines for Offshore Tanker Operations. First Edition 2018.

5.3.2 Bow mooring equipment overview

OCIMF has published recommendations for conventional tanker bow mooring equipment in a range of earlier publications and the current recommendations are repeated in this section…

…Conventional tankers that are likely to trade to F(P)SOs and SPM buoys should be equipped with bow chain stopper s designed to accept 76mm chafe chain in accordance with figure 5.2.

Technical operators of conventional tankers that are expected to trade to F(P)SOs or SPM buoy terminals are recommended to fit bow chain stoppers in accordance with table 5.1

5.3.3 Bow chain stoppers

Bow chain stoppers, foundations and supporting structure should be adequate for the expected loads. The tanker should hold a copy of the manufacturer's type approval certificate for the bow chain stoppers. The certificate should confirm that the bow chain stoppers are constructed in strict compliance with a recognised standard that specifies SWL, yield strength and safety factors. The tanker should also hold a certificate confirming the strength of the bow chain stopper foundations and supporting structure, substantiated by detailed engineering analysis or calculations and an inspection of the structure. An independent authority, such as a Classification Society, should issue both certificates. Bow chain stoppers, foundations and supporting structures should be kept in good order and surveyed at least once every five years. Bow chain stoppers should be permanently marked with the SWL and appropriate serial numbers, so that the certificates can be easily cross-referenced.

Bow chain stopper manufacturers should provide basic operating, maintenance and inspection instructions, which should be followed without modification. For example, wedges should not be used between the pin and tongue of bow chain stoppers. Where appropriate, manufacturers should also provide guidance on maximum component wear limits.

SMIT type towing bracket fittings should not be used as bow chain stoppers.

5.3.4 Bow fairleads

Bow fairleads should be of at least equivalent SWL to the bow chain stoppers.

Bow fairleads, foundations and supporting structure should be adequate for the expected loads. The tanker should hold a copy of the manufacturer's type approval certificate for the bow fairleads confirming the bow fairleads are constructed in strict compliance with a recognised standard that specifies SWL and safety factor. The tanker should also hold a certificate confirming the strength of the bow fairlead foundations and associated supporting structure, substantiated by detailed engineering analysis or calculations and an inspection of the structure. An independent authority, such as a Classification Society, should issue both certificates. Bow fairleads, foundations and supporting structure should be kept in good order and surveyed at least once every five years.

5.3.5 Position of winch stowage drums and possible pedestal rollers

There should be no obstructions or fittings (e.g. a hatch with securing dogs) close to the route of the pick-up line or chain, to ensure that if the line is allowed to run free during letting go, it is unlikely to snag on any such structure.

On all conventional tankers, winch stowage drums used to stow the pick-up line should be capable of lifting at least 15 tonnes and be of sufficient size to accommodate 150m of 80mm diameter rope. Using winch warping drums to handle pick-up lines is considered unsafe and should be avoided. This is because the combined weight of the pick-up line and buoys can lead to the line slipping and jerking on the drum end if not effectively handled.

TMSA KPI 6a.2.1 requires that detailed procedures address each different type of mooring operation likely to be undertaken by fleet vessels.

Procedures have been developed following risk assessments for each type of mooring operation, which may include:

- SPMs
- Tandem mooring to Floating, (Production), Storage and Offloading (F(P)SO).

IMO: ISM Code

7. The Company should establish procedures, plans and instructions, including checklists as appropriate, for key shipboard operations concerning the safety of the personnel, ship and protection of the environment. The various tasks involved should be defined and assigned to qualified personnel.

Inspection Guidance

The vessel operator should have developed procedures for mooring at SPM or F(P)SO terminals that included:

- Preparations for mooring at SPM or F(P)SO terminals.
- Instructions for safe mooring at SPM or F(P)SO terminals.
- Inspection and maintenance of the bow stoppers.

The vessel operator should have confirmed via the HVPQ 10.6 whether the ship meets the latest OCIMF recommendations for equipment employed in the bow mooring of conventional tankers at single point moorings, and supplied the following details:

- Single Point Mooring (SPM) Equipment
    - Details of the bow chain stoppers.
    - Details of the closed bow fairleads.
    - Distance between bow fairleads.
    - Distance between the bow fairlead and the bow stopper.
    - Distance from the bow stopper to the roller lead or winch drum.
    - The lead from the bow stopper to the winch drum.
    - The capacity of the winch drum.
- Bow Mooring Arrangement Diagram.

This question will only be assigned to vessels where HVPQ question 10.6.2 (are bow chain stoppers fitted) is answered affirmatively.

Suggested Inspector Actions

- Sight, and where necessary review, the company procedures for mooring at SPM or F(P)SO terminals.
- Sight, and where necessary review, the certificates for the bow stoppers and closed bow fairleads, particularly if these have been modified or retro-fitted.
- Sight, and where necessary review, the records of inspection and maintenance of the bow stoppers
- Inspect the arrangements at the bow for mooring to an SPM or F(P)SO terminal.
- During the inspection verify, as far as practicable, that the HVPQ accurately describes the arrangements for mooring at an SPM or F(P)SO terminal.

- Interview the accompanying officer to verify their familiarity with the company procedures for mooring at SPM or F(P)SO terminals.

Expected Evidence

- The company procedures for mooring at SPM or F(P)SO terminals.
- Mooring arrangement plan(s).
- Certificates, issued by an independent authority, such as a Classification Society, for the:
    - Bow stopper(s) and/or foundations and supporting structure.
    - Closed bow fairlead(s) and/or foundations and supporting structure.
- Records of inspection and maintenance of the bow stoppers, which may form part of the maintenance plan.

Potential Grounds for a Negative Observation

- There were no company procedures for mooring at SPM or F(P)SO terminals that included:
    - Guidance on preparations for mooring at SPM or F(P)SO terminals.
    - Instructions for safe mooring at SPM or F(P)SO terminals.
    - Inspection and maintenance instructions for the bow stopper(s).
- The accompanying officer was not familiar with the company procedures for mooring at SPM or F(P)SO terminals, as they related to their duties.
- The actual physical arrangements for mooring at an SPM or F(P)SO terminal were not as described in the HVPQ - provide details.
- There was no certificate, issued by an independent authority, such as a Classification Society, available for the:
    - Bow stopper(s) and/or foundations and supporting structure.
    - Closed bow fairlead(s) and/or foundations and supporting structure.
- The bow stopper(s) was not permanently marked with the SWL and appropriate serial number.
- The SWL of the closed bow fairlead(s) was less than the SWL of the bow stopper(s).
- There were no records of inspection and maintenance of the bow stopper(s).
- There was an obstruction or fitting (e.g. a hatch with securing dogs) close to the route of the pick-up line or chain.
- At the SPM or FS(P)O terminal where the inspection took place:
    - The winch stowage drum was not of sufficient size to accommodate the pick-up line.
    - The winch warping drum had been used to handle the pick-up line.
    - Wedges had been used between the pin and tongue of the bow chain stopper(s).
    - A Smit type towing bracket had been used as a bow chain stopper.
- A bow stopper(s), roller lead(s) or closed bow fairlead(s) was defective in any respect.

9.7. Shuttle Tanker Mooring Systems

9.7.1. Were the Master and officers familiar with the company procedures for the operation, inspection, testing and maintenance of the bow mooring system for offshore terminals, and was the equipment in satisfactory condition?

Short Question Text
Shuttle tanker bow mooring system

Vessel Types
Oil

ROVIQ Sequence
Forecastle

Publications
IMO: ISM Code
Norwegian Oil and Gas recommended guidelines for offshore loading shuttle tankers Guideline No. 140
OCIMF Guidelines for Offshore Tanker Operations

Objective

To ensure the bow mooring system is regularly inspected, tested, and maintained, and operated safely.

Industry Guidance

OCIMF Guidelines for Offshore Tanker Operations

5.4.1 Bow mooring equipment overview

A typical mooring system for bow loading tankers consists of the following:

- Hydraulic power-pack.
- Traction winch.
- Stowage drum, fitted with guide rollers, for messenger line and pick-up line (may be a rope bin).
- Chain stopper (for securing the chafe chain), with on-load releasable pawl.
- Chain stopper load cell (for sensing hawser loads).
- Bow fairlead (for the mooring hawser).
- Indicators for hawser load and hydraulic oil pressure at the cargo control station.
- Maintenance crane.

The principal mooring equipment on the bow loading tanker consists of the chain stopper, (which typically has an SWL of between 250 and 500 tonnes depending on yield factor used), and the traction winch. The traction winch may be used not only for retrieving the mooring but also to haul the cargo hose into close proximity to the coupler. For safe mooring operations, the chafe chain (usually 76mm diameter stud link chain) must match the size of the chain stopper on the bow loading tanker and the traction winch must be able to safely accommodate the expected loads.

DP bow loading tankers are normally fitted with a single fairlead with slightly different shape and dimensions to conventional tankers. The single fairlead is mounted on a raised platform at the bow and can sometimes be moved forward and aft on hydraulic rams.

Bow loading tankers with bow mooring systems are fitted with specialised hydraulic bow chain stoppers. The mooring equipment should be linked electronically and mechanically to the ESD system, with appropriate interlocks integral to the BLS and the green line system.

5.4.1.1 Fairlead

The fairlead should be fitted with a roller complete with roller bearings in the bottom of the fairlead.

The roller and all parts in contact with the chafing chain should be covered with stainless steel material (non-sparking). The structural strength of the fairlead and its supporting structure should be based on a safety factor of 1.0 against the yield criterion when applying a load equal to MBL (typical 500 tonnes) of the corresponding chafing chain's weak link. The design force should be established at an angle of 90 degrees off the ship's centreline in the horizontal plane and ± 30 degrees in the vertical plane.

The foundation should be designed to support and guide the lower part of the Offshore Loading System (OLS) messenger line in the transverse direction during the connection of the hose. The internal opening in the fairlead should be minimum 500mm x 500mm. A spark-free cladding should cover the substructure of the fairlead openings (forecastle platform deck, foundations etc.), which may be hit by the chafing chain during an ESD2 release.

To allow consideration for the widest possible range of terminals, operators of these tankers may wish to assess the suitability of these specialised bow chain stoppers for use at conventional terminals and provide engineering interlocks incorporated into the control systems to ensure the chafe chain cannot be accidentally released. Procedures and crew training to prevent accidental release of the chafe chain should also be addressed.

On all bow mooring tankers, winch stowage drums used to stow the pick-up line should be capable of lifting at least 15 tonnes and be of sufficient size to accommodate 150m of 80mm diameter rope, in addition to any small messenger line. Remotely operated winch stowage drums may give some additional snap-back injury protection to the winch operator.

Norwegian Oil and Gas recommended guidelines for offshore loading shuttle tankers Guideline No. 140

A.2 Operation

The mooring and coupling operation should be performed as per the relevant Field Offloading Manual.

A.5.1 Fairlead

A spark-free cladding should cover the substructure of the fairlead-openings (forecastle platform deck, foundations etc.) which may be hit by the chafing chain during an ESD 2 release.

A.5.2 Hardwood protection on deck

The deck area between the chain stopper and the fairlead should be protected by 75 mm thick hardwood. The width of the hardwood layer should be twice the width of the fairlead, i.e., 1m.

The hardwood should be fixed to the deck by recessed stud bolts/nuts, and a hardwood plug should cover the top.

A.5.3 Chain stopper

The chain stopper should be of the self-locking type, remote operated and designed for 84 mm chain (range 76 - 89 mm). The closing/opening time of the chain stopper should not exceed 30 sec.

The structural strength of the chain stopper including the release mechanism and its supporting structure should be based on a safety factor of 1.0 against the yield criterion when applying a load equal to MBL of 500 tonnes.

A tension meter with a minimum range 0-350 tonnes should be installed to measure the tension in the hawser during the loading operation.

Either the fairlead or the chain stopper should have the possibility to adjust the hose handling wire/rope relative to the loading manifold to enable the SPM-auto function.

A.5.4 Guide roller

A guide roller with (*Working Load Limit*) WLL 900 kN and equipped with a 0-100 T tension meter should be installed in front of the traction winch. The load cell should read the mooring forces during winch operations.

A.5.5 Traction winch

The traction winch should be of the twin drum type designed for 25-120 mm synthetic fibre rope.

The winch should be designed for bridge and local control. The winch should be equipped with a failsafe disc brake system suitable for emergency release of the OLS, which requires an automatic release speed adjustable between 1 and 2 m/s. The static weight of the OLS hose should be as per field operator requirements. The “Loading Permitted” signal should not be obtained unless the dog-clutch on the traction winch has been disengaged in OLS-mode, i.e., interlocked (i.e., chain stopper is open).

A manual brake release should be supplied to release the failsafe brake in the event of a power failure. This should be placed in a safe area, which protects the operator for any possible debris during the release of the brake.

Winch capacity requirements:

Pulling force: minimum 700 kN WLL

- Speeds: minimum 2 steps; approx. 0-8 m/min. and 0-50 m/min.
- High speed, minimum: 50 m/min.
- Brake capacity, minimum: 900 kN WLL.
- Brake disc to be of stainless-steel material (NB/CC).
- Rendering function according to field specific requirements or typically, 120% of maximum dynamic hose tension (NB/CC).

The static capacity of the foundations should be in accordance with the capacity of the traction winch. The winch should have a bolted cover to protect the brakes. Motors, cables, valves and pipes should be properly protected from mechanical impact. Any hydraulic piping for the traction winch motor should have a flexible configuration to reduce stress in the pipes during pressure shock. Such pipes should have an “expansion loop” between the deck and the hydraulic motor.

Necessary guide rollers between the traction winch and the rope pulling unit for correct entering of the rope into the rope pulling unit should be installed.

A.5.6 Rope pulling unit

A rope pulling unit should be installed to ensure that the rope enters directly to a stowing arrangement. The rope pulling unit should provide necessary back tension for the traction winch. The back tension should be adjustable from 0 to 4 kN.

For air driven rope pulling units dry and clean air should be provided as well as lubrication pan and water trap.

For rotating stowage arrangements, the control panel should include control of the rotation.

The following operational requirements should be fulfilled:

- The operator should be protected from accidental contact with the rotating reels and the rope.
- The operator should have a free view to the stowing tank, and it should be possible to see the entire bottom of the tank from the operating position.
- It should be easy for the operator to reach all the controls from the operating position.
- The rope pulling may be automatically controlled via the traction winch and with the possibility of manual/local control.

A.5.8 Service crane

A service crane should be installed on the platform deck. The crane should be designed and installed for general lifting operations and maintenance of the BLS equipment located on the platform deck. It should be installed as far forward as possible, but still being able to service the rope pulling unit and all the other equipment installed on the platform deck. The crane should fulfil the following requirements:

- WLL 50 kN at 10m working radius.
- Slewing sector of 360° (continuous).
- Self-contained type (electro/hydraulic).

G.3 Messenger line cutter

The (*Offshore Loading Shuttle Tanker*) OLST should have a messenger line cutter device designed to enable cutting the line if sucked into the thruster(s) / propeller(s).

TMSA KPI 6A.2.1 requires that detailed procedures address each different type of mooring operation likely to be undertaken by fleet vessels. Procedures have been developed following risk assessments for each type of mooring operation, which may include:

- Tandem mooring to F(P)SO.
- DP operations.

IMO: ISM Code

7. The Company should establish procedures, plans and instructions, including checklists as appropriate, for key shipboard operations concerning the safety of the personnel, ship and protection of the environment. The various tasks involved should be defined and assigned to qualified personnel.

Inspection Guidance

The vessel operator should have developed procedures for the operation, inspection, testing and maintenance of the bow mooring system for offshore terminals. These procedures may be incorporated in Field Operations Manuals and the vessel's maintenance plan. In addition to routine operation, inspection, testing and maintenance, they should also give guidance on:

- Measures to prevent accidental release of the chafe chain from the bow stopper.
- Use of the traction winch manual brake release in the event of a power failure.
- Use of the messenger line cutter device designed to enable cutting the line if sucked into the thruster(s)/propeller(s).

<u>Suggested Inspector Actions</u>

- Sight, and where necessary review, the company procedures for the operation, inspection, testing and maintenance of the bow mooring system for offshore terminals.
- Review the records of inspection, testing and maintenance of the bow mooring system for offshore terminals.
- During the physical inspection of the vessel inspect the bow mooring system for offshore terminals including:
    - Bow fairlead.
    - Hardwood deck protection.
    - Chain stopper.
    - Guide roller.
    - Traction winch.
    - Manual brake release.
    - Rope pulling unit.
    - Service crane.

- Hydraulic power-pack.
- Messenger line cutter.

- Where necessary, compare the observed condition with the records of inspection, testing and maintenance of the bow mooring system for offshore terminals.

- Interview the accompanying officer to verify their familiarity with the company procedures for the operation, inspection, testing and maintenance of the bow mooring system for offshore terminals including:
    - Measures to prevent accidental release of the chafe chain from the bow stopper.
    - Use of the traction winch manual brake release in the event of a power failure.
    - Use of the messenger line cutter device designed to enable cutting the line if sucked into the thruster(s) / propeller(s).

Expected Evidence

- The company procedures for the operation, inspection, testing and maintenance of the bow mooring system for offshore terminals.
- Records of inspection, testing and maintenance of the bow mooring system for offshore terminals.

Potential Grounds for a Negative Observation

- There were no company procedures for the operation, inspection, testing and maintenance of the bow mooring system for offshore terminals.
- The accompanying officer was not familiar with the company procedures for the operation, inspection, testing and maintenance of the bow mooring system for offshore terminals including:
    - Measures to prevent accidental release of the chafe chain from the bow stopper.
    - Use of the traction winch manual brake release in the event of a power failure.
    - Use of the messenger line cutter device designed to enable cutting the line if sucked into the thruster(s) / propeller(s).
- There were no records, or records were incomplete, of inspection, testing and maintenance of the bow mooring system for offshore terminals.
- There were no records to show that the time taken for the chain stopper to open and close had been tested, and that operation was within the recommended 30 seconds.
- The chain stopper was not marked with its SWL.
- The bow fairlead was not constructed of stainless steel or was not covered with a spark free cladding.
- The deck area between the chain stopper and the fairlead was not protected by 75mm thick hardwood, or there were sections of hardwood missing or damaged.
- Recess studs bolts/nuts, fixing the hardwood layer to the deck were not covered with hardwood plugs, or some of the plugs were missing.
- There was no tension monitor installed to measure the tension in the hawser during the loading operation.
- The manual brake release for the traction winch for use in the event of a power failure was not located in a safe area that would protect the operator from debris during the release of the brake.
- Traction winch motors, cables, valves and pipes were not properly protected from mechanical impact.
- The traction winch was not fitted with a bolted cover to protect the brakes.
- The rope pulling unit was not fitted with protection devices to prevent the operator from accidentally coming into contact with the rotating reels.
- The operators view of the rope stowing area was obscured in some way.
- The bow mooring system for offshore terminals was defective in any respect.

10. Machinery Spaces

10.1. Engineering Procedures

10.1.1. Had the Chief Engineer prepared Standing Orders, supplemented by Daily Orders, which emphasised and reinforced the company expectations with regards to engine room management and, if so, had all engineer officers signed to acknowledge their understanding of the same?

Short Question Text
Chief Engineer's standing and daily orders

Vessel Types
Oil, Chemical, LPG, LNG

ROVIQ Sequence
Engine Control Room

Publications
OCIMF: Recommendations on Engineering Watch/Duty Period Handover and Inspection Routines
IMO: ISM Code
ICS: Engine Room Procedures Guide. First Edition.

Objective

To ensure that all engineer officers are aware of the key expectations of both the company and the Chief Engineer with respect to the management of the vessel's machinery spaces.

Industry Guidance

ICS: Engine Room Procedures Guide. First Edition.

2.1.2 Standing Orders

The safety management manual and its associated operational procedures, along with standing orders and instructions, form the basis of command and control on board.

The Chief Engineer should issue written standing orders for the engineering team. These should reflect the Chief Engineer's own requirements, and take into account the Master's standing orders, the circumstances of the ship and trade, and the experience of the engineering team on board.

Standing orders and instructions should not conflict with the SMS. However, they provide a good opportunity to give specific guidance about the occasions when the Chief Engineer should be consulted or called to the engine room.

On joining the ship, all relevant engineer officers should read, sign and date the standing orders. A reference copy of the orders should be readily available in the ECR.

2.1.3 Night and Day Orders

The Chief Engineer should issue night orders and day orders in the engineering department order book. These orders provide specific instructions to address circumstances and requirements outside the normal routines. All EOOWs should fully understand and acknowledge these orders when going on or off watch.

OCIMF: Recommendations on Engineering Watch/Duty Period Handover and Inspection Routines.

Shore management, having responsibility for establishing and maintaining technical standards on board, should prepare overall inspection guidelines and procedures based on their established operational and maintenance philosophy.

TMSA KPI: none defined.

IMO: ISM Code

5.1 The Company should clearly define and document the master's responsibility with regard to

.3 issuing appropriate orders and instructions in a clear and simple manner.

(*The Chief Engineer issues orders on behalf of the Master*)

Inspection Guidance

The vessel operator should have developed procedures which require the Chief Engineer to create Standing Orders, supplemented by Daily Orders, which reiterate key machinery space management expectations of the company along with any additional expectations of the Chief Engineer.

The Standing Orders should include:

- UMS procedures and arrangements for periodic inspections of the machinery space.
- Entry into the machinery space during periods of UMS including use of the dead man alarm and/or communicating procedures to be utilised.
- The actions to be taken when a machinery space alarm is activated, particularly when equipment involved was identified as critical.
- The actions to be taken when machinery or equipment is found to be defective.
- Instructions for the supervision and documentation of bilge water, sludge, fuel oil and lube oils transfers and disposal.
- Instructions for the supervision and documentation of incinerator use.
- Instructions and limitations for hot and cold work in the machinery space workshop.
- Calling the Chief Engineer.

The Daily Orders should include:

- The anticipated time(s) of:
    - Changing the engine room status for navigational operations.
    - Conducting machinery tests for navigational operations.
    - Changing the number of generators to accommodate operational needs.
    - Commencing the changing of fuel grades or other measures to comply with environmental restrictions.
    - When the incinerator and/or oily water separator may be used in compliance with regulations and company procedures.

Suggested Inspector Actions

- Sight, and where necessary review, the company procedures which outlined the requirement for the Chief Engineer to develop Standing Orders and Daily Orders along with their expected content.
- Review the Chief Engineer's Standing and Daily Orders and verify that the content of each was aligned with the company expectations, reflected the equipment fitted to the vessel and, in the case of the daily orders, the vessel's operation.
- Review the Engine Room Log Book and other records for a recent operation and verify that the instructions given in the daily orders had been complied with.

Expected Evidence

- The company procedures for developing the Chief Engineer's Standing Orders and for writing Daily Orders.
- The current Chief Engineer's Standing Orders signed by the Chief Engineer and all engineer officers.
- The Daily Order Book with each dated and timed entry signed by the Chief Engineer, and subsequently, each watchkeeping officer before taking over their watch or period of duty.

- The Engine Room Log Book and other records to support the changes of machinery space operating mode and the status of machinery.

Potential Grounds for a Negative Observation

- There was no company procedure defining the requirement for the Chief Engineer to prepare Standing and Daily Orders.
- The accompanying engineer officer was unfamiliar with the content of the Chief Engineer's Standing or Daily orders.
- The Chief Engineer had not prepared their own Standing Orders which were signed and dated at the time of taking over the responsibilities as Chief Engineer.
- The engineer officers onboard at the time of the inspection had not signed the Standing Orders, (unless they had only joined that day).
- The content of the Standing Orders was in contradiction to the company procedures for managing the machinery space or any machinery or equipment.
- The Standing Orders did not define the Chief Engineer's expectations in respect of:
    - Entry into the machinery spaces during periods of UMS.
    - The actions to be taken when a machinery space alarm is activated, particularly when equipment involved was identified as critical.
    - The actions to be taken when machinery or equipment is found to be defective.
    - Supervision and documentation of bilge water, sludge, fuel oil and lube oils transfers and disposal.
    - Instructions for the supervision and documentation of Incinerator use.
    - Instructions and limitations for hot and cold work in the engine room workshop.
- The Chief Engineer had not prepared Daily Orders which were signed, dated and timed, to supplement their Standing Orders (not generally required for days where vessel was operating with periodically unmanned machinery spaces and in open ocean).
- The watchkeeping engineer officers had not signed the Chief Engineer's Daily Orders for understanding.
- Review of Engine Room Log Books and/or other records indicated that instructions contained within the Chief Engineer's Standing or Daily orders had not been followed. (A **negative observation** should not be raised where a change in circumstances, such as a delay in mooring/unmooring had occurred.)

10.1.2. Were the Chief Engineer and engineer officers familiar with the company procedures for testing main propulsion, steering gear, thrusters and power generation plant prior to use and at critical points during a voyage or operation, and were checklists and log book entries completed as required?

Short Question Text
Testing main propulsion, steering gear, thrusters & power generation plant

Vessel Types
Oil, Chemical, LPG, LNG

ROVIQ Sequence
Engine Control Room, Steering Gear

Publications
ICS: Engine Room Procedures Guide. First Edition.
IMO: ISM Code
ICS: Bridge Procedures Guide – Fifth Edition
IMO SOLAS
USCG: Code of Federal Regulations. Title 33.

Objective

To ensure that all machinery required for safe navigation is tested to verify full functionality and availability at key stages of a voyage or operation.

Industry Guidance

ICS: Engine Room Procedures Guide. First Edition.

Annex A Manoeuvring Checklists

A1 preparations for arrival

A2 preparations for departure

A3 Steering gear checks

ICS: Bridge Procedures Guide. Fifth Edition.

Chapter 3.18 Periodic Checks of Navigational Equipment

Operational checks on navigational equipment should be undertaken when preparing for sea and prior to port entry (see Checklists B1, B6 & B7) and at any other time required by the SMS.

Before entering restricted or coastal waters, it is important also to check that full control of engine and steering function is available.

TMSA KPI 5.1.2 requires that comprehensive procedures to ensure safe navigation are in place.

IMO: ISM Code

7 The company should establish procedures, plans and instructions, including checklists as appropriate, for key shipboard operations concerning the safety of the personnel, ship and protection of the environment. The various tasks should be defined and assigned to qualified personnel.

IMO: SOLAS

Chapter V Regulation 26

Steering gear: testing and drills

1. Within 12 hours before departure, the ship's steering gear shall be checked and tested by the ship's crew.

USCG: CFR Title 33

Part & Section 164.25. Test before entering or getting underway.

(a) Except as provided in paragraphs (b) and (c) of this section no person may cause a vessel to enter into or get underway on the navigable waters of the United States unless no more than 12 hours before entering or getting underway, the following equipment has been tested:

- Primary and secondary steering gear.
- All internal vessel control communications and vessel control alarms.
- Standby or emergency generator.
- Storage batteries for emergency lighting and power systems inf vessel control and propulsion machinery spaces.
- Main propulsion machinery, ahead and astern.

Inspection Guidance

The vessel operator should have developed procedures for preparing and testing all machinery necessary to ensure that the vessel can be safely and efficiently manoeuvred at all stages of the voyage.

The procedures and supporting checklists should include all checks and/or tests required by international and local regulations and reflect the equipment fitted to the vessel.

The procedures should define:

- Which items of machinery and equipment are required to be checked and/or tested pre-arrival, pre-departure and/or pre-transit.
- What functions of each item of machinery or equipment is required to be checked and/or tested.
- Who will conduct the checks and/or tests.
- When the checks and tests are required to be carried out.
- The record keeping requirements for the checks and tests that have been completed.
- The actions to take when equipment is found to be defective during the testing process.

Suggested Inspector Actions

- Sight, and where necessary review, the company procedures which defined the machinery tests required to be carried out pre-arrival, pre-departure and at defined stages during a voyage or operation.
- Review a recently completed pre-arrival, pre-departure and/or pre-transit machinery check list or record and verify that the required tests were completed in compliance with the company expectations.
- Randomly select an item from the pre-arrival, pre-departure and/or pre-transit machinery check list and verify that the accompanying engineer officer understood how to complete the test or check.

- Review the Engine Room Log Book and other items such as printers and data loggers as necessary to verify that the required machinery tests had been completed at the appropriate points within a recent voyage or operation.
- Where defects or abnormalities were present during machinery tests which could not be immediately rectified by onboard staff, verify that the defect had been communicated to the bridge and entered into the defect reporting system for later rectification.

- Where safe to do so, request the accompanying engineer officer to demonstrate the local operation of the steering gear.

Expected Evidence

- The company procedures which defined the pre-arrival, pre-departure and/or pre-transit machinery testing requirements.
- Completed pre-arrival, pre-departure and pre-operational machinery checklists or the required wipe-clean checklist along with the supporting logbook entries to verify satisfactory completion of the required tests.
- Evidence that machinery and equipment defects detected during the testing program had been noted and either immediately repaired by onboard staff or that the defect had been communicated to the bridge and entered in the defect reporting system for later repair.

Potential Grounds for a Negative Observation

- There was no documented procedure for testing and checking equipment and machinery at defined points in the voyage.
- The accompanying engineer officer was unfamiliar with the machinery testing process or any test or check that was required to be carried out by the vessel specific checklist.
- The accompanying engineer officer was unfamiliar with the local operation of the steering gear.
- Checklists did not reflect the equipment fitted to the vessel or the tests and/or checks required to be carried out at defined points prior to and within the voyage.
- Machinery and equipment tests and/or checks required by the company procedures had not been completed and documented.
- Defects detected during the equipment and machinery testing process had not been recorded as either being repaired immediately or entered into the defect reporting system for later rectification.

10.1.3. Were the Chief Engineer and engineer officers familiar with company procedures for periodic rounds and monitoring of the machinery space, and were log book entries and checklists available to confirm that the rounds had been completed as required?

Short Question Text
Periodic rounds of machinery space for non-UMS vessels

Vessel Types
Oil, Chemical, LPG, LNG

ROVIQ Sequence
Engine Control Room

Publications
IMO: ISM Code
ICS: Engine Room Procedures Guide. First Edition.
IMO SOLAS
OCIMF: Recommendations on Engineering Watch/Duty Period Handover and Inspection Routines

Objective

To ensure that the machinery spaces had been effectively monitored to manage machinery in operation and on standby.

Industry Guidance

ICS: Engine Room Procedures Guide. First Edition.

8.5 Periodic Checks on Machinery and Related Equipment

The EOOW should use all their senses as appropriate when verifying the correct operation of systems and machinery during frequent engine room rounds. Any abnormalities should be investigated immediately and rectified as appropriate. The Chief Engineer should be informed of any problems encountered and actions taken.

8.9.3 The Complete Engine Room Round

The most important duty of a watchkeeper is to carry out comprehensive and frequent rounds. This is essential to ensure trouble free operation of all engine room machinery.

Annex B Engine Room Checklists and Permits

B1 Preparations for Change of Watch

OCIMF: Recommendations on Engineering Watch/Duty Period Handover and Inspection Routines

Shore management, having responsibility for establishing and maintaining technical standards on board, should prepare overall inspection guidelines and procedures based on their established operational and maintenance philosophy.

TMSA KPI none defined

IMO: ISM Code

7. The company should establish procedures, plans and instructions, including checklists as appropriate, for key shipboard operations concerning the safety of the personnel, ship and protection of the environment. The various tasks should be defined and assigned to qualified personnel.

IMO: SOLAS

Chapter II-1 Regulation 31

Machinery Controls.

.3 Where the main propulsion and associated machinery, including sources of main electrical supply, are provided with various degrees of automatic or remote control and are under continuous manual supervision from a control room the arrangements and controls shall be so designed, equipped and installed that the machinery operation will be as safe as if it were under direct supervision.

Inspection Guidance

The vessel operator should have developed procedures, supplemented by checklists, which described the requirement for monitoring the machinery space(s) and include:

- Requirements for routine machinery space rounds by the engineer officer on watch.
- Vessel and operation specific checklists developed to ensure machinery space rounds are conducted thoroughly with local instrument readings recorded for comparison with remote values.

Checklists should be adapted to reflect the equipment and machinery fitted onboard the vessel being inspected.

The vessel operator should have declared through the pre-inspection questionnaire whether the vessel had a UMS notation.

This question will be assigned to vessels which do not have a UMS notation.

Suggested Inspector Actions

- Sight, and where necessary review, the company procedures which defined the requirement for routine monitoring of machinery and machinery spaces.
- Review checklists and vessel logbooks and verify that the required machinery space rounds had been completed in accordance with the company procedures.
- Verify that the machinery space round checklists in use covered all sections of the machinery space and all principal machinery applicable to the vessel and the various operations undertaken.
- Select an item from one of the checklists presented and verify that the accompanying officer was familiar with the required check, how to perform it and what data needed to be recorded.

Expected Evidence

- The company procedures which defined the requirement for routine monitoring of machinery spaces.
- Checklists for machinery space rounds.
- Engine room operational records for recent voyages.

Potential Grounds for a Negative Observation

- There was no procedure that required periodic machinery space rounds.
- The accompanying engineer officer was unfamiliar with the company procedures for monitoring the machinery spaces.
- The accompanying engineer officer was unfamiliar with any of the checks required to be conducted during the machinery space rounds and included on the checklists.
- There were no vessel specific checklists for periodic rounds of the machinery space.
- The periodic rounds of the machinery spaces had not been carried out in accordance with the company procedure.

10.1.4. Were the Chief Engineer and engineer officers familiar with company procedures for periodic machinery space rounds and monitoring of the machinery space during both manned and unmanned (UMS) periods, and were log book entries and checklists available to confirm that the inspections had been completed as required?

Short Question Text
Periodic machinery space rounds during both manned and unmanned (UMS) periods

Vessel Types
Oil, Chemical, LPG, LNG

ROVIQ Sequence
Engine Control Room

Publications
IMO: ISM Code
ICS: Engine Room Procedures Guide. First Edition.
IMO SOLAS
OCIMF: Recommendations on Engineering Watch/Duty Period Handover and Inspection Routines

Objective

To ensure that the machinery spaces had been monitored to effectively manage machinery in operation and on standby while in both manned and unmanned modes.

Industry Guidance

ICS: Engine Room Procedures Guide. First Edition.

7.6.1 Pre-UMS Rounds and Checklist

Before changing over to unattended operation, the EEOW should complete a round of spaces, following a checklist which lists all the parameters to be tested and verified.

See checklist B2: Preparations for UMS

8.9.3 The Complete Engine Room Round

The most important duty of a watchkeeper is to carry out comprehensive and frequent rounds. This is essential to ensure trouble free operation of all engine room machinery.

Annex B

Engine Room Checklists and Permits

B1 Preparations for Change of Watch

OCIMF: Recommendations on Engineering Watch/Duty Period Handover and Inspection Routines

Shore management, having responsibility for establishing and maintaining technical standards on board, should prepare overall inspection guidelines and procedures based on their established operational and maintenance philosophy.

TMSA KPI none defined

IMO: ISM Code

7 The company should establish procedures, plans and instructions, including checklists as appropriate, for key shipboard operations concerning the safety of the personnel, ship and protection of the environment. The various tasks should be defined and assigned to qualified personnel.

IMO: SOLAS

Chapter II-1 Regulation 31

Machinery Controls

.3 Where the main propulsion and associated machinery, including sources of main electrical supply, are provided with various degrees of automatic or remote control and are under continuous manual supervision from a control room the arrangements and controls shall be so designed, equipped and installed that the machinery operation will be as safe as if it were under direct supervision.

Chapter II-1

Part E - Additional requirements for periodically unattended machinery spaces

- Regulation 46 – General.
- Regulation 47 – Fire precautions.
- Regulation 48 – Protection against flooding.
- Regulation 49 – Control of propulsion machinery from the navigation bridge.
- Regulation 50 – Communication.
- Regulation 51 – Alarm system.
- Regulation 52 – Safety systems.
- Regulation 53 – Special requirements for machinery, boiler and electrical installations.

Inspection Guidance

The vessel operator should have developed procedures, supplemented by checklists, which described the requirement for monitoring the machinery space(s) in both the manned and unmanned mode and include:

- Requirements for routine machinery space rounds by the engineer officer on watch.
- Requirements for machinery space rounds and checks prior to beginning an unmanned period.
- Maximum period which a machinery space may be operated in the unmanned mode according to the governing rules of Class and/or Flag.
- Vessel and operation specific checklists developed to ensure machinery space rounds are conducted thoroughly with local instrument readings recorded for comparison with remote values.
- Circumstances in which unmanned machinery space operations will be permitted which should include the proper functioning of all systems required to be fitted under SOLAS II-1 Part E.

<u>Suggested Inspector Actions</u>

- Sight, and where necessary review, the company procedures which defined the requirement for routine monitoring of machinery during manned operation and prior to and during unmanned machinery space periods.
- Review checklists and vessel logbooks and verify that the machinery space rounds had been completed in accordance with the company procedure during both manned and unmanned periods.
- Verify that the machinery space round checklists in use covered all sections of the machinery space and all principal machinery applicable to the vessel and its operation.
- Verify that the pre-UMS period checklist included checks of the proper functioning off all systems required to be fitted under SOLAS II-1 Part E.

- Select an item from one of the checklists provided and verify that the accompanying engineer officer was familiar with the purpose of the check and how to carry it out.

Expected Evidence

- The company procedures which defined the requirement for routine monitoring of machinery during manned operation and, prior to and during unmanned machinery space periods.
- Checklists for machinery space rounds during manned operation and prior to unmanned machinery space operation.
- Machinery space operational records for recent voyages.
- Machinery space alarm records for recent voyages.

Potential Grounds for a Negative Observation

- There was no procedure that required periodic machinery space rounds during manned periods and prior to unmanned periods.
- The accompanying engineer officer was unfamiliar with the company procedures for monitoring the machinery spaces during manned and unmanned operation.
- There were no vessel specific checklists for periodic inspections of the machinery space during manned periods and prior to unmanned operation.
- The accompanying engineer officer was unfamiliar with any of the checks required to be conducted during the machinery space rounds and included on the checklists.
- The periodic rounds of the machinery spaces had not been carried out in accordance with the company procedures.
- The machinery space had been operated in the unmanned mode for a period exceeding that permitted by company procedures and/or class rules.
- The machinery space had been operated in the unmanned mode in circumstances where company procedures required the machinery space to be operated in the manned mode.
- The vessel had been operated in the manned mode during open sea passages due to reliability concerns where the cause of the concern was not entered into the defect reporting system for rectification.
- The vessel had been operated in the UMS mode with equipment and/or systems required under SOLAS II-1 Part E out of service or defective.

10.1.5. Were the Chief Engineer and engineer officers familiar with the operation, inspection and testing of the means provided to control propulsion machinery and related auxiliary systems locally in the event of failure of a remote-control system?

Short Question Text
Local control of propulsion machinery

Vessel Types
Oil, Chemical, LPG, LNG

ROVIQ Sequence
Engine Room, Engine Control Room

Publications
IMO: ISM Code
IMO SOLAS
ICS: Engine Room Procedures Guide. First Edition.

Objective

To ensure the engineer officers can respond promptly and effectively in the event of a failure of the remote control of propulsion machinery or a related auxiliary system.

Industry Guidance

ICS: Engine Room Procedures Guide. First Edition.

10.2.2 Emergency Operation

All members of the engineering team should be trained and proficient in the local and emergency procedures for starting and manoeuvring the main engine. Periodic drills will help to maintain this proficiency. Clear instructions on this procedure should be posted next to the manual/emergency starting and manoeuvring stations.

TMSA KPI 3.1.4 requires that formal familiarisation procedures are in place for vessel personnel, including contractors. The documented procedures may include familiarisation with:

- Vessel specific operations and equipment.

IMO: ISM Code

6.3 The Company should establish procedures to ensure that new personnel and personnel transferred to new assignments related to safety and protection of the environment are given proper familiarisation with their duties. Instructions which are essential to be provided prior to sailing should be identified, documented and given.

IMO: SOLAS

Chapter II-1 Regulation 31

Machinery controls

2 Where remote control of propulsion machinery from the navigating bridge is provided and the **machinery spaces are intended to be manned**, the following shall apply:

.6 it shall be possible to control the propulsion machinery locally, even in the case of failure in any part of the remote-control system.

Chapter II-1 Regulation 49

Additional requirements for periodically unattended machinery spaces

Control of propulsion machinery from the navigating bridge

4. It shall be possible for all machinery essential for the safe operation of the ship to be controlled from a local position, even in the case of failure in any part of the automatic or remote-control systems.

Inspection Guidance

The vessel operator should have developed procedures for the operation, inspection and testing of the means provided to control propulsion machinery and related auxiliary systems locally, in the event of failure of a remote-control system which defined:

- The actions to take in the event of a failure of a remote-control system
- The frequency of inspection and testing of the local control systems.

Ship-specific operating instructions should be posted at each local control station.

A means of communicating with the navigation bridge should be provided at each local control station.

Local control is normally provided at or near the concerned machinery, but for specific arrangements local control can also be from a separate location or compartment e.g. controlling the pitch of a controllable pitch propeller (CPP).

If fitted, the navigation and engineer officers should be aware of the vessel's specific CPP failure mode (e.g. full ahead, full astern or zero pitch). It is recommended that a notice indicating the failure mode is in place in the machinery space and on the navigation bridge.

Suggested Inspector Actions

- Sight, and where necessary review, the company procedures that defined the operation, inspection and testing of the means provided to control the propulsion machinery and related auxiliary systems locally.
- Inspect the manual controls or HMIs (human machine interfaces) at local control stations and the instructions posted nearby.
- Review inspection and testing records available at local control stations or in the engine control room.
- If necessary, review the records of inspections and tests carried out contained within the planned maintenance system.

- Interview the accompanying engineer officer to verify their familiarity with:
    - The operation, inspection and testing of the local control systems.
    - The means of communication with the navigation bridge from the control station(s)
- If the vessel was fitted with a CPP, interview a navigation officer to verify their familiarity with the failure mode of the CPP.

Expected Evidence

- The company procedures for the operation, inspection and testing of the means provided to control the propulsion machinery and related auxiliary systems locally.
- The inspection and test records for the local control systems.

Potential Grounds for a Negative Observation

- There were no company procedures for the operation, inspection and testing of the means provided to control the propulsion machinery and related auxiliary systems locally.
- The accompanying engineer officer was not familiar with the purpose, operation and testing of the propulsion local control systems.
- Ship specific operating instructions for the local control systems were not posted close to the control locations
- The planned maintenance system did not include the means provided to control the propulsion machinery locally or the required inspections and tests
- Records of inspections and tests carried out were incomplete.
- Inspection of the local control locations indicated that actions recorded in the planned maintenance system had not in fact taken place.
- The means of communication from any local control location was not ready for immediate use or was defective
- There was no notice posted, either on the navigating bridge or the machinery space, indicating the failure mode of the CPP, if fitted.
- An interviewed navigation officer was unaware of the CPP failure mode, if fitted.
- The local control systems were defective in any respect.

10.2. Machinery Status

10.2.1. Were the officers familiar with the starting procedure for the emergency generator and were records available to demonstrate that the emergency generator had been tested according to company procedures?

Short Question Text
Emergency generator

Vessel Types
Oil, Chemical, LPG, LNG

ROVIQ Sequence
Exterior Decks

Publications
IMO: ISM Code
IMO SOLAS
UK MSA: MGN 52. Testing of Emergency Sources of Electrical Power

Objective

To ensure the emergency generator will supply alternative power when needed.

Industry Guidance

U.K. MSA: MGN 52 Testing of emergency sources of electrical power.

6. It is to be ensured that the emergency generator prime mover can be satisfactorily started by all means fitted for this purpose including manual starting where this is provided in compliance with the Regulations and also including any cold starting arrangements.

TMSA KPI 4A.1.4 requires that procedures are in place to record the testing of critical equipment and systems that are not in continuous use. Testing is performed in accordance with mandatory requirements and manufacturers' recommendations.

IMO: ISM Code

10.3 The company should identify equipment and technical systems the sudden operational failure of which may result in hazardous situations. The SMS should provide for specific measures aimed at promoting the reliability of such equipment or systems. These measures should include the regular testing of standby arrangements and equipment or technical systems that are not in continuous use.

IMO: SOLAS

Chapter II-1 Regulation 44

2 Each emergency generating set arranged to be automatically started shall be equipped with starting devices approved by the Administration with a stored energy capability of at least three consecutive starts. A second source of energy shall be provided for an additional three starts within 30 minutes unless manual starting can be demonstrated to be effective.

Chapter II-1 Regulation 43

(2. The generator should be capable of providing full load requirements for at least 18 hours.)

Chapter II-2 Regulation 4

2.2.3.4 Oil fuel pipes, which if damaged would allow oil to escape from a storage, settling or daily service tank having a capacity of 500 litres and above situated above the double bottom, shall be fitted with a cock or valve directly on the tank capable of being closed from a safe position outside the space concerned in the event of a fire occurring in the space in which such the tanks are situated. The controls for remote operation of the valve for the emergency generator fuel tank shall be in a separate location from the controls for remote operation of other valves for tanks located in machinery spaces.

Inspection Guidance

The vessel operator should have developed procedures for the starting and testing of the emergency generator. These procedures should include:

- Primary and secondary starting arrangements.
- Arrangements for supplying the emergency switchboard.
- Description of the fuel system.
- Instructions for testing the emergency generator and switchboard, including on-load tests and testing of consumers for continued satisfactory performance.
- The required frequency of testing and method of recording the results.

Starting instructions for the emergency generator should be prominently and clearly displayed adjacent to the equipment. These instructions are not for the use of the qualified engineering personnel, but for others who might be required to start the generator in an emergency and there should be instruction on how to put power on the emergency switchboard if there is no automatic system. All officers should be fully familiar with these starting instructions.

Where the emergency generator starting source relies on a single starter motor, a spare starter motor should be available. This spare starter motor should be tested periodically.

Periodic testing of the emergency generator should be carried out under load, but to do this may require the vessel to be blacked out. This testing under load is not to be conducted during an inspection.

The requirement to provide full load requirements for at least 18 hours may not necessarily mean a full fuel tank. A minimum quantity to provide enough fuel for this requirement should have been established and marked on the tank level gauge.

If necessary, the emergency generator fuel tank should be charged with fuel designed for use in sub-zero temperatures.

The position and identification of the closing devices for the emergency generator fuel supply must be clearly marked.

Suggested Inspector Actions

- Sight, and where necessary review, the company procedures for the emergency generator.
- Sight and review the starting instructions posted adjacent to the equipment.
- Inspect the general condition of the emergency generator, the emergency switchboard and the emergency generator space.
- Verify that electrical insulation matting was in place in front of and behind the emergency switchboard.
- Verify that the emergency generator was set to start and supply power to the emergency switchboard automatically in the event of power interruption.
- Provided it is safe to do so, witness the starting of the emergency generator by primary and secondary methods.
- Verify that the voltage and frequency displayed on the emergency switchboard when the emergency generator was running were appropriate.
- Sight the level in the emergency generator fuel tank.

- Where the vessel was operating in sub-zero temperatures verify that the fuel in the tank was designed for use in sub-zero temperatures.
- Witness a test of the quick closing valve for the emergency generator where permitted.
- Witness the operation of the emergency generator space fire-flaps.
- Where necessary, check maintenance records for the emergency generator verify that:
    - The emergency generator had been routinely run on load for sufficient time to ensure that normal running temperatures and pressures had been achieved.
    - Emergency consumers had been put on load to verify their connection to the emergency switchboard and continued satisfactory performance.
    - The quick closing fuel valve had been tested in accordance with company procedures
    - The spare starter motor had been tested in accordance with company procedures

- Interview a deck officer, if present, to verify their familiarity with emergency generator starting and operating procedures.

Expected Evidence

- The company procedures for the operation and testing of the emergency generator.
- The ship specific procedure for starting the emergency generator and connecting it to the emergency switchboard.
- Onboard records for the testing of the emergency generator, fuel quick closing valve and spare starter motor, where provided.

Potential Grounds for a Negative Observation

- There was no company procedure for operating, testing and maintaining the emergency generator.
- The emergency generator was not set up to start and supply power to the emergency switchboard automatically in the event of a power interruption.
- Ship specific starting instructions were not posted adjacent to the equipment.
- Posted starting instructions were unclear or inadequate.
- Officers were not familiar with the ship specific starting procedure for the emergency generator and connecting it to the emergency switchboard.
- The emergency generator would not start within three attempts by either the primary or secondary means.
- The voltage or frequency delivered by the emergency generator to the emergency switchboard was outside acceptable limits.
- The emergency generator or emergency switchboard was defective in any respect.
- There was no spare starter motor, where required.
- There was no evidence that the spare starter motor had been tested in accordance with company procedures.
- Engineer officers were not familiar with the operating and testing procedures for the emergency generator or quick closing valve.
- Records for testing the emergency generator or fuel quick closing valve were not available or incomplete.
- The emergency generator had not been run onload in accordance with the company procedure.
- Electrical consumers connected to the emergency switch board had not been put onload to verify their continued satisfactory performance in accordance with company procedures.
- There was not enough fuel in the tank to run for 18 hours or the required level had not been established and marked on the fuel level gauge.
- The vessel was or had been trading in sub-zero temperatures but the fuel in the tank was not designed for use in sub-zero temperatures.
- The fuel quick closing valve did not operate correctly.
- The fuel quick closing valve was closed at the time of inspection.
- The fuel quick closing valve was not readily accessible in an emergency.
- The fire-flaps serving the space did not operate correctly.
- Electrical insulation mats had not been positioned in front and behind the emergency switchboard.
- The emergency generator exhaust piping was wasted or in poor condition.

10.2.2. Were the Chief Engineer and engineer officers familiar with the company procedures for the regular inspection, maintenance and testing of the ship's emergency batteries, and were the batteries fully charged and in satisfactory condition?

Short Question Text
Battery emergency source of power.

Vessel Types
Oil, Chemical, LPG, LNG

ROVIQ Sequence
Engine Room, Engine Control Room

Publications
IMO: ISM Code
IMO SOLAS

Objective

To ensure that the emergency source of electrical power is always ready in all respects.

Industry Guidance

TMSA KPI 4A.1.4 requires that procedures are in place to record the testing of critical equipment and systems that are not in continuous use. Testing is performed in accordance with mandatory requirements and manufacturers' recommendations.

IMO: ISM Code

10.3 The Company should identify equipment and technical systems the sudden operational failure of which may result in hazardous situations. The SMS should provide for specific measures aimed at promoting the reliability of such equipment or systems. These measures should include the regular testing of stand-by arrangements and equipment or technical systems that are not in continuous use.

IMO: SOLAS

Chapter II-1 Regulation 43

Emergency source of electrical power in cargo ships

3 The emergency source of electrical power may be either a generator or an accumulator battery, which shall comply with the following:

3.2 Where the emergency source of electrical power is an accumulator battery it shall be capable of:

1. carrying the emergency electrical load without recharging while maintaining the voltage of the battery throughout the discharge period within 12% above or below its nominal voltage;
2. automatically connecting to the emergency switchboard in the event of failure of the main source of electrical power; and
3. immediately supplying at least those services specified in paragraph 4.

5.3 No accumulator battery fitted in accordance with this regulation shall be installed in the same space as the emergency switchboard. An indicator shall be mounted in a suitable place on the main switchboard or in the machinery control room to indicate when the batteries constituting either the emergency source of electrical power or the transitional source of electrical power referred to in paragraph 3.2 or 4 are being discharged.

7 Provision shall be made for the periodic testing of the complete emergency system and shall include the testing of automatic starting arrangements.

Inspection Guidance

The vessel operator should have developed procedures for the regular inspection, maintenance and testing of the emergency battery source of electrical power, including:

- Inspection of the batteries.
- Assessment of the condition of the batteries.
- Periodic testing of the complete emergency battery system including bringing it onload as part of a blackout simulation test.
- The battery retirement criteria based on the maximum service life and/or functional condition.

These activities should be integrated into the ship's operational maintenance routine.

Emergency batteries must be capable of supplying the designed power load for up to 18 hours (refer to SOLAS Ch II-1 Reg 43) and should be maintained in a fully charged condition.

To assess the condition of a battery, specific gravity and voltage are measured and may be compared with a standard chart provided by the manufacturer.

- The electrolyte level in the batteries should be just above the top of the plate.
- The battery should be clean and dry with no dirt deposits or spilled electrolyte on the casing.
- All the battery terminals should be clean and protected with petroleum jelly.
- The small vents in the cell caps should be clear.

Where the vessel is fitted with sealed, maintenance free, gel or NiFe batteries, the manufacturer's instructions for the required tests and checks should be available in the battery space.

For all types of batteries, the terminals should be provided with plastic/rubber caps or other protective devices to prevent the terminals shorting or arcing to another metal body during maintenance or other work near to the battery location.

The vessel operator should have declared through the pre-inspection questionnaire what source of emergency electrical power was provided onboard.

This question will only be allocated to vessels where the source of emergency electrical power was declared as batteries.

Suggested Inspector Actions

- Sight and if necessary, review the company procedures for the regular inspection, maintenance and testing of the emergency battery source of electrical power.
- Review the records of:
    - Inspection of the batteries.
    - Assessment of the condition of the batteries.
    - Periodic testing of the complete emergency battery system including bringing it onload as part of a blackout simulation test.
- Inspect the emergency battery compartment to verify the batteries are in satisfactory physical condition.
- During the inspection of the machinery space, verify that the emergency batteries are fully charged, and the battery charger is functional.

- Interview the accompanying officer to verify their familiarity with:
    - The company procedures for the regular inspection, maintenance and testing of the emergency battery source of electrical power.
    - The periodic testing of the complete emergency battery system including bringing it onload as part of a blackout simulation test.

Expected Evidence

- Company procedures for the regular inspection, maintenance and testing of the emergency battery source of electrical power.
- Records of:
    - Inspection of the batteries.
    - Assessment of the condition of the batteries.
    - Periodic testing of the complete emergency battery system.
    - The date the batteries were installed.

Potential Grounds for a Negative Observation

- There were no company procedures for the regular inspection, maintenance and testing of the emergency battery source of electrical power, including:
    - Inspection of the batteries.
    - Assessment of the condition of the batteries.
    - Periodic testing of the complete emergency battery system.
    - The battery retirement criteria based on either the maximum service life and/or functional condition.
- The accompanying officer was not familiar with the company procedures for the regular inspection, maintenance and testing of the emergency battery source of electrical power.
- The accompanying officer was not familiar with the periodic testing of the complete emergency battery system including bringing the system online as part of a blackout simulation test.
- There were no records of the regular inspection, maintenance and testing of the emergency battery source of electrical power.
- There were no records of the periodic testing of the complete emergency battery system including bringing the system on load as part of a blackout simulation test.
- Records indicated that regular inspection, maintenance and/or testing of the emergency battery source of electrical power had not taken place in accordance with company procedures.
- Records of testing of voltage and specific gravity indicated that the batteries were not in satisfactory condition.
- The batteries had not been replaced in accordance with the company defined retirement criteria.
- The batteries were not in satisfactory physical condition.
- The metal terminals of the batteries were exposed and not protected by rubber or plastic caps or other protective devices to prevent arcing or shorting.
- The battery locker or compartment was being used for storage or contained inappropriate material.
- The batteries were not fully charged.
- The battery charger was defective in any respect.

10.2.3. Were the Chief Engineer and engineer officers familiar with the company procedures for the operation, calibration and maintenance of the exhaust gas cleaning system (EGCS), and were required safety and regulatory measures being complied with?

Short Question Text
Exhaust gas cleaning system (EGCS)

Vessel Types
Oil, Chemical, LPG, LNG

ROVIQ Sequence
Engine Room, Engine Control Room, Chief Engineer's Office

Publications
IMO: MEPC.1/Circ.883 Guidance on indication of ongoing compliance in the case of the failure of a single monitoring instrument
and recommended actions to take if the Exhaust Gas Cleaning System (ECGS) fails…
ICS: Engine Room Procedures Guide. First Edition.
IMO: ISM Code
IMO: MARPOL
OCIMF Guide for Implementation of Sulphur Oxide Exhaust Gas Cleaning Systems
IMO: Resolution MEPC.259(68) 2015 Guidelines for exhaust gas cleaning systems

Objective

To ensure the EGCS is operated safely in accordance with company procedures and applicable regulations and local/national limitations.

Industry Guidance

OCIMF: Guide for Implementation of Sulphur Oxide Exhaust Gas Cleaning Systems

5.6 Safety and crew training

IMO has identified the following as potential safety hazards associated with EGCS:

- Handling and proximity of exhaust gases.
- Storage and use of pressurised containers of pure and calibrated gases.
- Position of permanent access platforms and sampling locations.
- Hazards associated with the handling of caustic materials.

Crews should be adequately trained to handle hazardous reactants or chemicals used (or chemicals that are created as a result of the process) and be trained to deal with possible medical emergencies. The required Personal Protective Equipment (PPE) is dictated in the associated Safety Data Sheet (SDS) of the hazardous chemicals that will be handled. Health, safety and environmental risk assessments associated with EGCS should be performed to identify hazards and to facilitate the reduction of uncertainties associated with costs, liabilities or losses.

ICS: Engine Room Procedures Guide. First Edition.

The use of Exhaust Gas Cleaning Systems (EGCS), often known as scrubbers, is an equivalent means of compliance with MARPOL Annex VI, regulation 14, while still using high sulphur fuel oil. On ships where these are installed, most EGCS use wet technologies: open loop, closed loop or hybrid types. Some EGCS are dry, and some are non-thermal plasma systems.

- When using EGCS:

- The bridge team should communicate with the engineering team to ensure that the EGCS is in use and that emissions meet exhaust and wash water regulations when entering an ECA; and
- The engineering team should carry out regular spot checks, recording all parameters.

The EGCS Record Book should be kept up to date, usually including occasions whenever the:

- Ship enters or leaves an ECA or area of local emission control;
- EGCS starts and stops (for each individual engine fitted with a scrubber);
- System undergoes any maintenance (including cleaning filters and sensors); and
- System goes out of compliance. This should include the time and position when it started, and when and where the system was brought back into compliance, along with any measures taken to reduce the extent of non-compliance.

TMSA KPI 3.1.4 requires that formal familiarisation procedures are in place for vessel personnel, including contractors.

The documented procedures may include familiarisation with:

- Onboard HSSE requirements.
- Vessel specific operations and equipment.

Records of familiarisation are maintained.

IMO: ISM Code

7 The Company should establish procedures, plans and instructions, including checklists as appropriate, for key shipboard operations concerning the safety of the personnel, ship and protection of the environment. The various tasks involved should be defined and assigned to qualified personnel.

IMO: MARPOL

Annex VI

Regulation 4

1. The Administration of a Party may allow any fitting, material, appliance or apparatus to be fitted in a ship or other procedures, alternative fuel oils, or compliance methods used as an alternative to that required by this Annex if such fitting, material, appliance or apparatus or other procedures, alternative fuel oils, or compliance methods are at least as effective in terms of emissions reductions as that required by this Annex, including any of the standards set forth in regulations 13 and 14.

IMO: Resolution MEPC.259(68) 2015 Guidelines for exhaust gas cleaning systems

2.1.1 the purpose of these guidelines is to specify the requirements for the testing, survey certification and verification of EGC systems under regulation 4 of MARPOL Annex VI to ensure that they provide effective equivalence to the requirements of regulations 14.1 and 14.4 of MARPOL Annex VI.

8 Onboard Monitoring Manual (OMM)

8.1 An OMM should be prepared to cover each EGC unit installed in conjunction with fuel oil combustion equipment, which should be identified, for which compliance is to be demonstrated.

8.2 The OMM should, as a minimum, include:

1. the sensors to be used in evaluating EGC system performance and washwater monitoring, their service, maintenance and calibration requirements;
2. the positions from which exhaust emission measurements and washwater monitoring are to be taken together with details of any necessary ancillary services such as sample transfer lines and sample treatment units and any related service or maintenance requirements;
3. the analysers to be used, their service, maintenance, and calibration requirements;
4. analyser zero and span check procedures; and
5. other information or data relevant to the correct functioning of the monitoring systems or its use in demonstrating compliance.

8.3 The OMM should specify how the monitoring is to be surveyed.

8.4 The OMM should be approved by the Administration

IMO: MEPC.1/Circ.883 Guidance on indication of ongoing compliance in the case of the failure of a single monitoring instrument, and recommended actions to take if the Exhaust Gas Cleaning System (EGCS) fails…

System malfunction

2 As soon as possible after evidence of a malfunction (e.g. alarm is triggered), the ship should take action to identify and remedy the malfunction.

3 The ship operator should follow the process to identify and remedy the malfunction in the Exhaust Gas Cleaning System – Technical Manual that is approved at the time the EGCS is certified or in other documentation provided by the EGCS manufacturer.

5 An EGCS malfunction event should be included in the EGCS Record Book including the date and time the malfunction began and, if relevant, how it was resolved, the actions taken to resolve it and any necessary follow-up actions.

6 A system malfunction that cannot be rectified is regarded as an accidental breakdown. The ship should then change over to compliant fuel oil if the EGCS cannot be put back into a compliant condition within one hour. If the ship does not have compliant fuel oil or sufficient amount of compliant fuel oil on board, a proposed course of action, in order to bunker compliant fuel oil or carry out repair works, should be communicated to relevant authorities including the shipÊ¹s administration, for their agreement.

Notifications to relevant Authorities

12 Any EGCS malfunction that lasts more than one hour or repetitive malfunctions should be reported to the flag and port stateÊ¹s Administration along with an explanation of the steps the ship operator is taking to address the failure. At their discretion, the flag and port state's Administration could take such information and other relevant circumstances into account to determine the appropriate action to take in the case of an EGCS malfunction, including not taking action.

Inspection Guidance

The vessel operator should have developed procedures, based on risk assessment(s), for the operation, calibration and maintenance of the exhaust gas cleaning system (EGCS). These should include:

- The identification of associated hazards such as:
    - Exposure to chemicals used in, or produced by, the EGCS.
    - Exposure to exhaust gases.
    - The location of the equipment and sampling locations.
    - Storage and use of pressurised containers of calibration gases.
    - Storage of chemicals used in, or produced by, the EGCS.
- The proper management and disposal of spent/waste chemicals and/or residual sludge/wastewater.
- Crew training requirements.

- PPE and signage requirements.
- Instructions for routine operations, calibration and maintenance.
- Any restrictions imposed on the use of the type of EGCS fitted by local and/or national regulation.
- Actions to be taken in the case of system failure or deviation from normal operation.
- Records to be kept (may be electronic or hard copy).

The following documents are required to be on board and may form part of these procedures:

- Sox Emissions Compliance Plan.
- EGCS Technical Manual.
- Onboard Monitoring Manual.
- EGCS Record Book or electronic logging system.

The ship's maintenance plan may also contain part of the procedures.

This question will only be allocated to vessels fitted with an EGCS. The vessel operator should have declared whether an EGCS was fitted through the Pre-inspection questionnaire.

Suggested Inspector Actions

- Sight and where necessary, review the:
  - Company procedures for the operation, calibration and maintenance of the EGCS.
  - Required documentation for the EGCS.
  - Risk assessments for the operation, calibration and maintenance of the EGCS.
  - The planned maintenance records for the EGCS.
- As far as it is safe and practicable, inspect the EGCS.

- During the Inspection of the EGCS, request that the accompanying officer describes:
  - The routine operation of the EGCS plant with reference to any checklists provided by the company or manufacturer for this purpose.
  - The action to take in the case of system failure or deviation from normal operation.
  - How to close the EGCS overboard valve (normally open) in an emergency.

Expected Evidence

- Company procedures for the operation, calibration and maintenance of the EGCS.
- Any checklists provided for the routine operation of the EGCS.
- The planned maintenance records for the EGCS.
- Risk assessments for the operation, calibration and maintenance of the EGCS.
- Records of crew training or familiarisation in the operation, calibration and maintenance of the EGCS.
- Sox Emissions Compliance Plan.
- EGCS Technical Manual.
- Onboard Monitoring Manual.
- EGCS Record Book or electronic logging system.

Potential Grounds for a Negative Observation

- There were no company procedures for the operation, calibration and maintenance of the exhaust gas cleaning system (EGCS) that included:
  - The identification of associated hazards.
  - Crew training requirements.
  - PPE and signage requirements.

    - Instructions for routine operations, calibration and maintenance.
    - Actions to be taken in the case of system failure or deviation from normal operation.
    - Records to be kept (may be electronic or hard copy).
- There were no risk assessments available for the operation, calibration and maintenance of the EGCS.
- The accompanying officer was not familiar with the company procedures for the operation, calibration and maintenance of the EGCS.
- There was evidence that the vessel had operated the EGCS in locations where the company procedure or local/national regulations prohibited its use.
- There was evidence that spent/waste chemicals and/or residual sludge/wastewater had not been managed and disposed of in accordance with the company procedures and/or any applicable regulation.
- The chemicals and/or compressed gasses used or produced by the EGCS were not stored in accordance with company procedures.
- The accompanying officer was not familiar with the routine operation of the EGCS.
- The accompanying officer was not familiar with how to close the EGCS overboard valve in an emergency.
- There was no evidence of crew training or familiarisation in the operation, calibration and maintenance of the EGCS.
- The following documents were not available on board:
    - Sox Emissions Compliance Plan.
    - EGCS Technical Manual.
    - Onboard Monitoring Manual.
    - EGCS Record Book or electronic logging system.
- The maintenance and calibration of the EGCS was not included in the planned maintenance system.
- The maintenance and calibration of the EGCS had not been carried out as required by the planned maintenance system.
- The EGCS record book had not been maintained as required by company procedures.
- The EGCS was or had been defective but there was no evidence that notifications had been made to the relevant Authorities as required by IMO: MEPC.1/Circ.883.
- The EGCS was defective in any respect.

10.2.4. Were seawater pipelines, sea chests and seawater pumps in satisfactory condition and free of temporary repairs?

Short Question Text
Seawater pipelines

Vessel Types
Oil, Chemical, LPG, LNG

ROVIQ Sequence
Engine Room

Publications
IMO: ISM Code

Objective

To ensure there are no weak points in seawater systems that might lead to failure and machinery space flooding.

Industry Guidance

TMSA KPI 4.1.1 requires that each vessel in the fleet is covered by a planned maintenance system and spare parts inventory which reflects the company's maintenance strategy. The company identifies all equipment and machinery required to be included in the planned maintenance system, for example:

- Engine machinery.

IMO: ISM Code

10.1 The Company should establish procedures to ensure that the ship is maintained in conformity with the provisions of the relevant rules and regulations and with any additional requirements which may be established by the Company.

Inspection Guidance

The condition of seawater pipelines, sea chests, storm valves, hull penetrations and seawater pumps should be carefully checked to ensure that they are in satisfactory condition. All coatings should be checked for failure, particularly pitting and/or hard rust.

Special attention should be paid at the following locations:

- Outboard of ship-side valves.
- Pipe bends and elbows.
- Clips and supports, where there may be wear and thinning due to vibration.
- Fixed expansion joints (bellows) for deformation.
- Wet areas or locations of localised leakage where there may be accelerated corrosion.
- Hidden areas where there may be unnoticed problems.

Any necessary local repair should be treated as temporary only. Permanent repairs usually involve the removal and replacement of a length of piping. After the repair has been completed, pipe supports, or clips should be refitted. A permanent repair should only be done with classification society approved materials, and subsequently examined and approved by a class surveyor.

The following are not acceptable as a permanent repair.

- Welded doublers.
- Expansion joints.
- Mismatched materials e.g. mild steel and stainless steel.
- Material of different thickness in the same piping run.

Patent couplings are not acceptable as a permanent repair except where they had been fitted as part of the original design. Where such couplings are installed, inspectors should ascertain that they conform with the original plans/design.

Four types in use are:

- Grip type joining couplings with axial restraint.
- Flex type joining couplings without axial restraint (i.e. not pull-out resistant).
- Open flex type repairing couplings.
- Repair clamps for damage control.

Flexible hoses should never be used to replace a failed metal pipe, except as an unavoidable emergency repair.

Suggested Inspector Actions

- During the tour of the machinery spaces, inspect seawater pipelines, sea chests, storm valves, hull penetrations and seawater pumps.
- If necessary, review machinery space pipeline drawings and specifications.

Expected Evidence

- Machinery space pipeline drawings and specifications.

Potential Grounds for a Negative Observation

- A seawater pipeline, sea chest, storm valve, hull penetration or seawater pump was corroded with pitting or hard rust/scale (give details and location).
- A seawater pipeline, sea chest, storm valve, hull penetration or seawater pump was leaking (give details and location).
- Fixed expansion joints (bellows) in a seawater pipeline were deformed.
- A pipeline was worn/thinned in way of a clip or support.
- A series of pipe clips and/or supports in a single pipe length were heavily corroded or missing.
- There was a temporary repair on a seawater pipeline e.g. a clamp or bandage (give details and location).
- There was an unacceptable ‘permanent’ repair on a seawater pipeline e.g. a doubler plate or coupling (give details and location).
- Pipe clips or supports had not been replaced after a pipeline repair.
- There was no evidence of class approval for a completed repair to a seawater pipeline.
- Flexible hose(s) had been rigged as a replacement for a failed metal pipe.

10.2.5. Were the officers familiar with the company procedure for testing the bilge monitoring devices within their area of responsibility, and were records available to demonstrate that the bilge monitoring devices and associated alarms had been tested in accordance with the company procedure?

Short Question Text
Bilge monitoring devices

Vessel Types
Oil, Chemical, LPG, LNG

ROVIQ Sequence
Engine Room, Forecastle, Bridge, Cargo Control Room

Publications
IMO: ISM Code
ICS: Engine Room Procedures Guide. First Edition.
IMO: A.1021(26) Codes on Alerts and Indicators
2009.
IMO SOLAS
OCIMF/ICS: International Safety Guide for Oil Tankers and Terminals. Sixth Edition.

Objective

To ensure that the flooding detection systems fitted on board are always fully operational.

Industry Guidance

OCIMF/ICS: International Safety Guide for Oil Tankers and Terminals. Sixth Edition

Chapter 12.1.15.7 Miscellaneous

A high-level alarm in the pumproom bilge which activates audible and visual alarms in the cargo control room, engine room and the navigating bridge.

ICS: Engine Room Procedures Guide. First Edition.

8.4 Alarms and Actions

High-level alarms for engine room bilges should be tested at least once every watch and as part of pre-UMS checks...

TMSA KPI 4.1.1 requires that each vessel in the fleet is covered by a planned maintenance system and spare parts inventory which reflects the company strategy.

The company identifies all equipment and machinery required to be included in the planned maintenance system, for example:

- Engine machinery
- Cargo handling machinery/equipment
- Hull Structure

IMO: ISM Code

10.1 The Company should establish procedures to ensure that the ship is maintained in conformity with the provisions of the relevant rules and regulations and with any additional requirements which may be established by the Company.

IMO: SOLAS

Chapter II-1 Regulation 48

Protection against flooding. (vessels with UMS notation)

1 bilge wells in periodically unattended machinery spaces shall be located and monitored in such a way that the accumulation of liquids is detected at normal angles of heel and trim and shall be large enough to accommodate easily the normal drainage during the unattended period.

Chapter II-2 Regulation 4

Probability of Ignition. (Tankers)

5.10.1 Protection of cargo pump-rooms in tankers:

.4 All pump-rooms shall be provided with bilge monitoring devices together with appropriately located alarms.

Chapter XII Regulation 12

Hold, ballast and dry space water ingress alarms. (OBO Carriers)

1 Bulk carriers shall be fitted with water level detector…

2 The audible and visual alarms specified in paragraph 1 shall be located on the navigation bridge.

IMO: Resolution A.1021 Codes on Alerts and Indicators, 2009. (excludes tanker pump room bilge alarm)

3.3 the following alerts are classified as alarms:

.4 Bilge alarm. An alarm which indicates an abnormally high level of bilge water.

Inspection Guidance

The vessel operator should have developed a process to identify all bilge level monitoring or flooding detection devices fitted to the vessel, whether required by regulation or not, and a procedure to require that each device and its associated alarm is periodically tested to verify that:

- The level monitoring or flooding device activates its associated alarm at the correct level.
- Any delay programmed into the activation circuit remains in accordance with the design criteria.
- The remote warning alarm is activated in the locations required by regulation or by design of the shipbuilder where a device is fitted in addition to any regulatory requirement.

The job instructions in the planned maintenance system may form part of the procedure.

Suggested Inspector Actions

- Sight, and where necessary review, the company procedure which required that bilge level monitoring devices and their associated alarms and indicators were periodically tested.

- Review vessel records and verify that the vessel had identified all bilge alarms fitted to the vessel and that the periodic checks required by the company procedure had been completed as required.

- During the physical inspection request, that one bilge alarm is tested and verify that:
    - The alarm was activated in the required locations.
    - The delay in alarm activation, if any, was in alignment with the alarm design criteria.

Expected Evidence

- The company procedure that required all bilge level monitoring devices and water level detectors and their associated alarms and indicators were identified and periodically tested.
- The vessel records to demonstrate that each bilge level monitoring device, its activation delay and its associated alarm had been tested in accordance with company procedures.

Potential Grounds for a Negative Observation

- There was no company procedure which required that all bilge level monitoring devices and water level detectors were periodically tested.
- The accompanying deck or engineer officer was not familiar with company procedure for the testing of the bilge level monitoring devices and water level detectors within their area of responsibility.
- There were no records available to demonstrate that the periodic testing of all bilge level monitoring devices and water level detectors and their associated alarms, including any activation delay, had been completed in accordance with company procedures.
- A bilge level monitoring device and / or water level detector and/or its associated alarm was defective in any respect.
- There was evidence that bilge level monitoring devices or water level detectors and/or their associated alarms and indicators had been modified or prevented from activating as designed.
- One or more of the following spaces was not protected by a bilge level monitor or water level detector:
    - Cargo pumproom,
    - Ballast pumproom,
    - Main machinery space,
    - Bow thruster space.
    - For OBO carriers only, in ballast tanks forward of the collision bulkhead.
    - For OBO carriers only, in any dry or void space other than a chain locker forward of the foremost cargo hold.

10.2.6. Were the Chief Engineer and engineer officers familiar with the company procedures for the operation, inspection and testing of the emergency air compressor and emergency air reservoir, and was the equipment in satisfactory condition?

Short Question Text
Emergency compressed air machinery starting system.

Vessel Types
Oil, Chemical, LPG, LNG

ROVIQ Sequence
Engine Room

Publications
ICS: Engine Room Procedures Guide. First Edition.
IMO: ISM Code
IMO SOLAS

Objective

To ensure the emergency compressed air machinery starting system is always ready in all respects.

Industry Guidance

ICS: Engine Room Procedures Guide. First Edition.

8.9.3 The Complete Engine Room Round

- Check the emergency generator and make sure it is ready for starting, synchronising and paralleling in auto. Also check the emergency air compressor, if fitted;

TMSA KPI 4A.1.4 requires that procedures are in place to record the testing of critical equipment and systems that are not in continuous use. Testing is performed in accordance with mandatory requirements and manufacturers' recommendations.

IMO: ISM Code

10.3 The Company should identify equipment and technical systems the sudden operational failure of which may result in hazardous situations. The SMS should provide for specific measures aimed at promoting the reliability of such equipment or systems. These measures should include the regular testing of stand-by arrangements and equipment or technical systems that are not in continuous use.

IMO: SOLAS

Chapter II-1 Regulation 26

3 Means shall be provided whereby normal operation of propulsion machinery can be sustained or restored even though one of the essential auxiliaries becomes inoperative. Special consideration shall be given to the malfunctioning of:

.9 an air compressor and receiver for starting or control purposes;

4 Means shall be provided to ensure that the machinery can be brought into operation from the dead ship condition without external aid.

Inspection Guidance

The vessel operator should have developed procedures for:

- The operation, inspection and testing of the emergency air compressor and emergency air reservoir.
- The use of the emergency air compressor and emergency air reservoir for bringing machinery into operation from the dead ship condition.

The emergency air compressor should be regularly tested to the starting pressure of the diesel generator. It may be powered by a hand-started diesel engine or an electric motor. If driven by an electric motor, this should be supplied by the emergency source of power.

The emergency air reservoir should be permanently maintained at the required pressure.

The vessel operator should have declared the motive power of the emergency compressor through HVPQ question 12.4.3. The information provided will be inserted in the inspection editor and the final report.

Suggested Inspector Actions

- Sight and where necessary, review the company procedures for the operation, inspection and testing of the emergency air compressor and emergency air reservoir.
- Review the records of regular inspection and testing of the emergency air compressor.
- During the inspection of the machinery space:
    - Observe the condition of the emergency air compressor.
    - Verify that the emergency air reservoir is at the required pressure.
- Interview the accompanying officer to verify their familiarity with:
    - The company procedures for the operation, inspection and testing of the emergency air compressor and emergency air reservoir.
    - The actions necessary to use the emergency air compressor and/or emergency air reservoir to start a main generator engine.

Expected Evidence

- Company procedures for:
    - The operation, inspection and testing of the emergency air compressor and emergency air reservoir.
    - The use of the emergency air compressor and emergency air reservoir for bringing machinery into operation from the dead ship condition.
- Records of regular inspection and testing of the emergency air compressor and emergency air reservoir.

Potential Grounds for a Negative Observation

- There were no company procedures for:
    - The operation, inspection and testing of the emergency air compressor and emergency air reservoir.
    - The use of the emergency air compressor and emergency air reservoir for bringing machinery into operation from the dead ship condition.
- The accompanying officer was not familiar with:
    - The company procedures for the operation, inspection and testing of the emergency air compressor and emergency air reservoir.
    - The actions necessary to use the emergency air compressor and/or emergency air reservoir to start a main generator engine.
- There were no records of regular inspection and testing of the emergency air compressor and emergency air reservoir.

- Records indicated that the emergency air compressor and emergency air reservoir had not been regularly inspected and tested in accordance with company procedures.
- The emergency air reservoir was not at the required pressure.
- The emergency air compressor was defective in any respect.

10.3. Safety Management

10.3.1. Was suitable deck insulation provided to the front and rear of electrical switchboards, and was it in good order?

Short Question Text
Switchboard deck insulation.

Vessel Types
Oil, Chemical, LPG, LNG

ROVIQ Sequence
Engine Control Room, Engine Room

Publications
IMO: ISM Code
IMO SOLAS
UK MCA: Code of Safe Working Practices for Merchant Seafarers
USCG: Code of Federal Regulations. Title 46.

Objective

To ensure that people are protected from injury when working on or around switchboards.

Industry Guidance

UK MCA: Code of Safe Working Practices for Merchant Seafarers

20.13 Electrical equipment

20.13.1 The risks of electric shock are much greater on-board ship than they are normally ashore because wetness, high humidity and high temperature (including sweating) reduce the contact resistance of the body. In those conditions, severe and even fatal shocks may be caused at voltages as low as 60V. It should also be borne in mind that cuts and abrasions significantly reduce skin resistance.

20.15 High-voltage systems

20.15.1 Additional precautions are necessary to ensure safety when work is to be undertaken on high-voltage equipment (designed to operate at a nominal system voltage in excess of 1000V).

USCG: Code of Federal Regulations. Title 46.

111.30-11 - Deck coverings.

Non-conducting deck coverings, such as non-conducting mats or gratings, suitable for the specific switchboard voltage must be installed for personnel protection at the front and rear of the switchboard and must extend the entire length of, and be of sufficient width to suit, the operating space.

TMSA KPI 9A.1.1 requires that safety inspections are conducted at scheduled intervals by a designated Safety Officer. Safety inspections of the vessel:

- Identify hazards and potential hazards to health, safety and the environment.

IMO: ISM Code

10.1 The Company should establish procedures to ensure that the ship is maintained in conformity with the provisions of the relevant rules and regulations and with any additional requirements which may be established by the Company.

IMO: SOLAS

Chapter II-1 Regulation 45

Precautions against shock, fire and other hazards of electrical origin

2 Main and emergency switchboards shall be so arranged as to give easy access as may be needed to apparatus and equipment, without danger to personnel. The sides and the rear and, where necessary, the front of switchboards shall be suitably guarded. Exposed live parts having voltages to earth exceeding a voltage to be specified by the Administration shall not be installed on the front of such switchboards. Where necessary, non-conducting mats or gratings shall be provided at the front and rear of the switchboard.

Inspection Guidance

Insulating matting is only required at the front and rear of switchboards.

Individual machinery starter boxes throughout the machinery space are not considered switchboards and do not require insulating matting in front or behind them.

Some decks are made from composite insulating material and will not need extra insulation. Where this is the case and insulation matting is not provided, ship’s drawings should be available to demonstrate the extent and safe working voltage of the composite deck covering installed.

Insulation matting should be suitable for the specific switchboard voltage but should be rated not less than IEC 61111:2009 Class O or equivalent which has a safe working voltage of up to 1000 volts. Switchboards with voltages higher than 1000 volts should be protected with matting of a higher rating as appropriate, for example Class 1 with a safe working voltage up to 7500 volts.

Suggested Inspector Actions

- During the course of the inspection of the machinery spaces, verify that:
    - Switchboards were provided with the required deck insulation of an appropriate safe working voltage.
    - Insulating matting or composite deck material was complete and undamaged.

Expected Evidence

- Certification, marking or other documentary evidence of the safe working voltage rating for the deck insulation in use.

Potential Grounds for a Negative Observation

- Switchboards were not provided with deck insulation to the front and/or rear.
- The deck insulation matting or composite insulating deck covering was incomplete or damaged.
- The deck insulation matting or composite insulating deck covering provided was not suitable for the specific voltage of the switchboard.
- There was no certification, marking or other documentary evidence of the rating of the deck insulation provided.

If the insulation matting presented a trip hazard this should be recorded as an observation under question 5.8.2

10.3.2. Were the engineer officers familiar with the purpose and setting of the insulation monitoring devices provided on the primary and secondary distribution systems, and were the distribution switchboards free of significant earth faults?

Short Question Text
Electrical distribution system switchboard earth monitoring.

Vessel Types
Oil, Chemical, LPG, LNG

ROVIQ Sequence
Engine Control Room

Publications
ICS: Engine Room Procedures Guide. First Edition.
IMO: ISM Code
IMO SOLAS
UK MCA: Code of Safe Working Practices for Merchant Seafarers
USCG: Code of Federal Regulations. Title 46.

Objective

To ensure that any significant earth faults are promptly addressed to prevent injury to personnel from electrical shock.

Industry Guidance

ICS: Engine Room Procedures Guide. First Edition.

10.7.5 Earth Faults

Earth faults may occur within electric equipment, such as broken insulation on conductors. To maintain supply to essential equipment (for example, the steering gear) the electrical circuits for this equipment will usually have an insulated neutral system. This means that a single earth fault does not interrupt the system. But if another earth fault occurs, the two faults combine to cause a short circuit that trips the system. So to maintain the safe operation of the ship it is vital that the initial earth fault is found and fixed before the second one occurs.

UK MCA: Code of Safe Working Practices for Merchant Seafarers

20.13 Electrical equipment

20.13.1 The risks of electric shock are much greater on-board ship than they are normally ashore because wetness, high humidity and high temperature (including sweating) reduce the contact resistance of the body. In those conditions, severe and even fatal shocks may be caused at voltages as low as 60V. It should also be borne in mind that cuts and abrasions significantly reduce skin resistance.

TMSA KPI 9A.1.1 requires that safety inspections are conducted at scheduled intervals by a designated Safety Officer. Safety inspections of the vessel:

- Identify hazards and potential hazards to health, safety and the environment.

IMO: ISM Code

10.1 The Company should establish procedures to ensure that the ship is maintained in conformity with the provisions of the relevant rules and regulations and with any additional requirements which may be established by the Company.

IMO: SOLAS

Chapter II-1 Regulation 45

4.2 When a distribution system, whether primary or secondary, for power, heating or lighting, with no connection to earth is used, a device capable of continuously monitoring the insulation level to earth and of giving an audible or visual indication of abnormally low insulation values shall be provided.

USCG: Code of Federal Regulations. Title 46.

111.05-21 Ground detection.

There must be ground detection for each:

- (a) Electric propulsion system;
- (b) Ship's service power system;
- (c) Lighting system; and
- (d) Power or lighting distribution system that is isolated from the ship's service power and lighting system by transformers, motor generator sets, or other devices.

Inspection Guidance

Significant earth faults - it is good practice that as near to infinity as possible, but not less than 5 megohms, be maintained on the Insulation Monitoring Device (IMD) of a 440-volt system. For a 220-volt system, not less than 2 megohms is acceptable due to the large number of parallel circuits.

The vessel operator should have developed a procedure which:

- Provided guidance for the setting values for the IMDs for 110v, 220v, 440v and any other voltages used for the primary or secondary distribution systems.
- Where a vessel was only provided with earth insulation lamps as the IMD, provided guidance on interpreting the indications for low insulation faults.
- Required that the causes of earth faults are investigated and corrected with the aim to maintain the insulation values as close to infinity as possible.

Suggested Inspector Actions

- If necessary, review the company procedure which provided guidance on the required alarm set point for the IMDs.
- During the inspection of the machinery spaces, examine the IMDs on each primary or secondary distribution system switchboard and note any indications:
    - Below 5 megohms on 440-volt systems, and/or below 2 megohms on 220-volt systems.
    - For systems with any other voltage, below the setting value identified within the company procedure.
- Where safe to do so, request that a responsible officer:
    - Demonstrates that the alarm setting point for an IMD was set in accordance with company procedures to provide the required audible and/or visual alarm if abnormally low insulation values were detected.
    - Operate the test device of the IMD to demonstrate that it was monitoring the insulation level to earth.

- Where a switchboard(s) was only provided with an earth indication lamp(s) as the IMD, the inspector should determine:
    - Whether vessel staff can demonstrate a satisfactory understanding of the lamp display, and can describe the criteria that triggers the need for an investigation to identify low insulation faults, and
    - How the vessel staff quantify the insulation values when identifying and correcting earth faults.

Expected Evidence

- The company procedure which:
    - Provided guidance for the setting values for the IMDs for 110v, 220v, 440v and any other voltages used for the primary or secondary distribution systems.
    - Where a vessel was only provided with earth insulation lamps as the IMD, provided guidance on interpreting the indications for low insulation faults.
    - Required that the causes of earth faults are investigated and corrected with the aim to maintain the insulation values as close to infinity as possible.

Potential Grounds for a Negative Observation

- There was no company procedure which:
    - Provided guidance for the setting values for the IMDs for 110v, 220v, 440v and any other voltages used for the primary or secondary distribution systems.
    - Where a vessel was only provided with earth insulation lamps as the IMD, provided guidance on interpreting the indications for low insulation faults.
    - Required that the causes of earth faults are investigated and corrected with the aim to maintain the insulation values as close to infinity as possible.
- The accompanying officer was not familiar with the company procedure which provided guidance for the setting values for the IMDs for 110v, 220v, 440v and any other voltages used for the primary or secondary distribution systems.
- Where the vessel was only provided with earth insulation lamps as the IMD, the accompanying officer was not familiar with the company procedure which provided guidance on interpreting the indications for low insulation faults.
- The accompanying officer was not able demonstrate the IMD alarm setting point or describe how to interpret the earth low insulation indicator lamps.
- An IMD was inoperative or defective in any respect.
- An IMD alarm set point had been adjusted to inhibit the generation of alarms:
    - When abnormally low insulation values were detected.
    - When detecting insulation values lower than the guidance provided in the company procedure.
- The Insulation Monitoring Device for a 440-volt system showed an insulation resistance of less than 5 megohms (specify indication).
- The Insulation Monitoring Device for a 220-volt system showed an insulation resistance of less than 2 megohms (specify indication).
- The Insulation Monitoring Device for any primary or secondary distribution system showed an insulation resistance value of less than that required by the company procedure (specify required value and indication).

Where specific electrical consumers, such as electric deepwell pumps, were causing a significant earth fault during operation, an observation should be made irrespective of whether this was considered normal by the manufacturer.

10.3.3. Were the Chief Engineer and engineer officers familiar with the company procedures for safe entry into the machinery space(s) during UMS operation, including the operation and testing of the dead man alarm, if fitted?

Short Question Text
Entry into the machinery space during UMS.

Vessel Types
Oil, Chemical, LPG, LNG

ROVIQ Sequence
Interview - Engineer Officer, Bridge, Engine Room, Engine Control Room

Publications
ICS: Engine Room Procedures Guide. First Edition.
IMO: ISM Code
IMO SOLAS
IMO: A.1021(26) Codes on Alerts and Indicators
2009.

Objective

To ensure safe entry into the machinery space(s) during UMS operation.

Industry Guidance

ICS: Engine Room Procedures Guide. First Edition.

4.4.2 Unattended Machinery Space (UMS) Operation

The EOOW should inform the bridge before switching to Unattended Machinery Space (UMS) operation, whenever people enter and exit unattended machinery spaces and when the engine room is switched back to attended operation.

When the EOOW needs to enter the machinery space outside of normal working hours – e.g. for night rounds – they should:

- Inform the bridge on entering and exiting the machinery space;
- Say how long they intend to remain there; and
- Establish a method for confirming their safety (for example, regular agreed calls to the bridge and use of the deadman alarm – see section 7.6.2).

7.6.2 The Deadman Alarm

The EEOW should report to the bridge whenever entering or leaving an unattended machinery space. On entering the space for any reason, they should use the deadman alarm system if fitted. This alarm has to be reset at specified intervals by the person entering the unattended machinery space. If not, a warning is triggered on the bridge and other locations. This helps to ensure the safety of anybody entering an unattended machinery space. On ships without a deadman alarm, the bridge should be contacted at least once every 15 minutes.

IMO: A.1021(26) Codes on Alerts and Indicators, 2009.

3.3 The following alerts are classified as alarms:

.1 Machinery alarm. An alarm which indicates a malfunction or other abnormal condition of the machinery and electrical installations.

.6 Engineers' alarm. An alarm to be operated from the engine control room or at the manoeuvring platform, as appropriate, to alert personnel in the engineers' accommodation that assistance is needed in the engine-room.

.7 Personnel (*dead man*) alarm. An alarm to confirm the safety of the engineer on duty when alone in the machinery spaces.

8 Requirements for particular alarms

8.1 Personnel (*dead man*) alarm

8.1.1 The personnel alarm (*dead man*) should automatically set off an alarm on the navigation bridge or in the officers' quarters, as appropriate, and, if it is not reset from the machinery spaces in a period satisfactory to the Administration, this should be in a period not exceeding 30 min.

8.1.2 A pre-warning signal should be provided in the machinery spaces which operates 3 min before the alarm required by 8.1.1 is given.

8.1.3 The alarm system should be put into operation:

.1 automatically when the engineer on duty has to attend machinery spaces in case of a machinery alarm;

.2 or manually by the engineer on duty when attending machinery spaces on routine checks.

8.1.4 The alarm system should be disconnected by the engineer on duty after leaving the machinery spaces. When the system is brought into operation in accordance with 8.1.3.1, disconnection should not be possible before the engineer has acknowledged the alarm in the machinery spaces.

8.1.5 The personnel (*dead man*) alarm may also operate the engineers' alarm.

8.3 Engineers' alarm

In addition to manual operation from the machinery space, the engineers' alarm on ships with periodically unattended machinery spaces should operate when the machinery alarm is not acknowledged in the machinery spaces or control room in a specified limited period of time, depending on the size of the ship but not exceeding 5 min.

TMSA KPI 3.1.4 requires that formal familiarisation procedures are in place for vessel personnel, including contractors.

The documented procedures may include familiarisation with:

- Vessel specific operations and equipment.

Records of familiarisation are maintained.

IMO: ISM Code

7 The Company should establish procedures, plans and instructions, including checklists as appropriate, for key shipboard operations concerning the safety of the personnel, ship and protection of the environment. The various tasks involved should be defined and assigned to qualified personnel.

IMO: SOLAS

Chapter II-1

Part C – Machinery installations

Regulation 38

Engineer's alarm

An engineer's alarm shall be provided to be operated from the engine control room or at the manoeuvring platform as appropriate and shall be clearly audible in the engineers' accommodation.

Part E - Additional requirements for periodically unattended machinery spaces

Regulation 51

Alarm system

1 An (*machinery*) alarm system shall be provided indicating any fault requiring attention and shall:

1. be capable of sounding an audible alarm in the main machinery control room or at the propulsion machinery control position, and indicate visually each separate alarm function at a suitable position;
2. have a connection to the engineers' public rooms and to each of the engineers' cabins through a selector switch, to ensure connection to at least one of those cabins. Administrations may permit equivalent arrangements;
3. activate an audible and visual alarm on the navigating bridge for any situation which requires action by or attention of the officer on watch;
4. as far as is practicable be designed on the fail-to-safety principle; and
5. activate the engineers' alarm required by Regulation 38 if an alarm function has not received attention locally within a limited time.

Inspection Guidance

The vessel operator should have developed procedures for entry into the machinery space during periods of unmanned operation which included but were not necessarily limited, to the following requirements:

- During unattended periods, no-one enters the machinery spaces alone, for example to carry out final evening checks, without first informing the bridge.
- During unattended periods, contact should be maintained with the bridge at frequent predetermined periods during any entry, unless a dead man alarm is fitted.
- A rating should not be assigned any duty which involved them attending the engine room alone during unattended periods.
- Where a single engineer maintains a watch, contact is maintained with the bridge or cargo control room at frequent predetermined periods, unless a dead man alarm system is fitted.
- The dead man alarm, if fitted, is regularly tested and the results recorded.

Safe entry requirements should be clearly posted at the normally accessible entrance to the machinery space including the requirements to use the dead man alarm (where fitted) during rounds in the machinery space.

A dead man alarm is not a SOLAS requirement.

The question will only be allocated to a vessel which is certified for unmanned machinery space (UMS) operations and identified by HVPQ question 12.1.10 being answered in the affirmative.

<u>Suggested Inspector Actions</u>

- Sight, and where necessary review, the company procedures for safe entry into the machinery space(s) during UMS operation.
- Review the records of testing of the dead man alarm (where fitted).
- Review the Bridge and Engine Room Log Books to ascertain the status of machinery space operation and records of entry during recent unattended periods.

- During the inspection of the machinery space, interview an engineer officer to verify their familiarity with the company procedures for safe entry into the machinery space(s) during UMS operation.
- During the inspection of the bridge, interview a navigation officer to verify their familiarity with the company procedures for safe entry into the machinery space(s) during UMS operation.

- Where possible and safe to do so, request that the accompanying officer manually start the dead man alarm, if fitted, and note the time taken to activate the alarm.

Expected Evidence

- Company procedures for safe entry into the machinery space(s) during UMS operation.
- Records of testing of the dead man alarm (where fitted).
- Engine Room Log Book.
- Bridge Log Book.

Potential Grounds for a Negative Observation

- There were no company procedures for safe entry into the machinery space(s) during UMS operation requiring that:
    - During unattended periods, no-one enters the machinery spaces alone, for example to carry out final evening checks, without first informing the bridge.
    - During unattended periods, contact should be maintained with the bridge at frequent predetermined periods during any entry, unless a dead man alarm is fitted.
    - A rating should not be assigned any duty which involved them attending the engine room alone during unattended periods.
    - Where a single engineer maintains a watch, contact is maintained with the bridge or cargo control room at frequent predetermined periods, unless a dead man alarm system is fitted.
    - The dead man alarm, if fitted, is regularly tested and the results recorded.
- An engineer officer was not familiar with the company procedures for safe entry into the machinery space(s) during UMS operation.
- A navigation officer was not familiar with the company procedures for safe entry into the machinery space(s) during UMS operation.
- Safe entry requirements were not clearly posted at the normally accessible entrance to the machinery space including the requirements to use the dead man alarm (where fitted) during rounds in the machinery space.
- There was no evidence that the dead man alarm, if fitted, had been regularly tested as required by company procedures.
- The dead man alarm activation period was observed to be greater than that specified by the company procedures and/or greater than 30 minutes.
- The dead man alarm, if fitted, was defective in any respect.

10.3.4. Were the Chief Engineer and engineer officers familiar with the operation of the engineers' alarm, and was the alarm in good order, tested regularly and the results recorded?

Short Question Text
Engineers' alarm.

Vessel Types
Oil, Chemical, LPG, LNG

ROVIQ Sequence
Interview - Engineer Officer, Engine Room, Engine Control Room

Publications
ICS: Engine Room Procedures Guide. First Edition.
IMO: ISM Code
IMO SOLAS
IMO: A.1021(26) Codes on Alerts and Indicators
2009.

Objective

To ensure the engineers' alarm is in good order and regularly tested.

Industry Guidance

ICS: Engine Room Procedures Guide. First Edition.

4.6.2 Engineers' Call Alarm

The engineers' call alarm should be used in any engine room emergency. All engine room personnel should be trained and familiarised in their emergency duties and where to assemble upon hearing the engineers' call alarm.

IMO: A.1021(26) Codes on Alerts and Indicators, 2009.

3.3 The following alerts are classified as alarms:

1. Machinery alarm. An alarm which indicates a malfunction or other abnormal condition of the machinery and electrical installations.

6. Engineers' alarm. An alarm to be operated from the engine control room or at the manoeuvring platform, as appropriate, to alert personnel in the engineers' accommodation that assistance is needed in the engine-room.

7. Personnel alarm. An alarm to confirm the safety of the engineer on duty when alone in the machinery spaces.

8. Requirements for particular alarms

8.1 Personnel alarm

8.1.1 The personnel alarm should automatically set off an alarm on the navigation bridge or in the officers' quarters, as appropriate, and, if it is not reset from the machinery spaces in a period satisfactory to the Administration, this should be in a period not exceeding 30 min.

8.1.2 A pre-warning signal should be provided in the machinery spaces which operates 3 min before the alarm required by 8.1.1 is given.

8.1.3 The alarm system should be put into operation:

1. automatically when the engineer on duty has to attend machinery spaces in case of a machinery alarm;
2. or manually by the engineer on duty when attending machinery spaces on routine checks.

8.1.4 The alarm system should be disconnected by the engineer on duty after leaving the machinery spaces. When the system is brought into operation in accordance with 8.1.3.1, disconnection should not be possible before the engineer has acknowledged the alarm in the machinery spaces.

8.1.5 The personnel *(dead man)* alarm may also operate the engineers' alarm.

8.3 Engineers' alarm

In addition to manual operation from the machinery space, the engineers' alarm on ships with periodically unattended machinery spaces should operate when the machinery alarm is not acknowledged in the machinery spaces or control room in a specified limited period of time, depending on the size of the ship but not exceeding 5 min.

TMSA KPI 3.1.4 requires that formal familiarisation procedures are in place for vessel personnel, including contractors.

The documented procedures may include familiarisation with:

- Vessel specific operations and equipment.

Records of familiarisation are maintained.

IMO: ISM Code

7 The Company should establish procedures, plans and instructions, including checklists as appropriate, for key shipboard operations concerning the safety of the personnel, ship and protection of the environment. The various tasks involved should be defined and assigned to qualified personnel.

IMO: SOLAS

Chapter II-1

Part C – Machinery installations

Regulation 38

Engineer's alarm

An engineer's alarm shall be provided to be operated from the engine control room or at the manoeuvring platform as appropriate and shall be clearly audible in the engineers' accommodation.

Part E - Additional requirements for periodically unattended machinery spaces

Regulation 51

Alarm system

1 An (*machinery*) alarm system shall be provided indicating any fault requiring attention and shall:

1. be capable of sounding an audible alarm in the main machinery control room or at the propulsion machinery control position, and indicate visually each separate alarm function at a suitable position;
2. have a connection to the engineers' public rooms and to each of the engineers' cabins through a selector switch, to ensure connection to at least one of those cabins. Administrations may permit equivalent arrangements;
3. activate an audible and visual alarm on the navigating bridge for any situation which requires action by or attention of the officer on watch;
4. as far as is practicable be designed on the fail-to-safety principle; and
5. activate the engineers' alarm required by Regulation 38 if an alarm function has not received attention locally within a limited time.

Inspection Guidance

The operator should have developed procedures for the operation and testing of the engineers' alarm that included:

- A description of its operation.
- Requirements for regularly testing the alarm and recording the results.

The engineers' alarm must be capable of manual operation from the engine control room or at the manoeuvring platform as appropriate to indicate that assistance is needed.

In UMS ships, the engineers' alarm should act as a back-up in the event the machinery alarm is not acknowledged within a specified time, but not exceeding 5 minutes (A.1021(26) 8.3).

In addition, the engineers' alarm may be configured to sound if the (personnel) dead man alarm is not reset within the specified time.

Suggested Inspector Actions

- Sight, and if necessary review, the company procedures for the operation and testing of the engineers' alarm.
- Review the records of regular testing of the engineers' alarm.

- Interview an engineer officer to verify their familiarity with the operation and testing of the engineers' alarm, and request they identify the locations of the alarm activation points within the machinery space.

Expected Evidence

- Company procedures for the operation and testing of the engineers' alarm.
- Records of regular testing of the engineers' alarm.

Potential Grounds for a Negative Observation

- There were no company procedures for the operation and testing of the engineers' alarm that included:
    - A description of its operation.
    - Requirements for regularly testing the alarm and recording the results.
- The accompanying officer was not familiar with the company procedures for the operation and testing of the engineers' alarm.
- The accompanying officer could not identify the locations of the engineers' alarm activation points within the machinery spaces.
- There were no records of the regular testing of the engineers' alarm.
- Records indicated the engineers' alarm had not been tested as required by company procedures.
- The engineers' alarm was defective in any respect.

10.3.5. Were the Chief Engineer and engineer officers familiar with the operation of the machinery alarm, and was the alarm in good order, tested regularly and the results recorded?

Short Question Text
Machinery alarm

Vessel Types
Oil, Chemical, LPG, LNG

ROVIQ Sequence
Interview - Deck Officer, Interview - Engineer Officer, Bridge, Engine Control Room

Publications
ICS: Engine Room Procedures Guide. First Edition.
IMO: ISM Code
IMO SOLAS
IMO: A.1021(26) Codes on Alerts and Indicators
2009.

Objective

To ensure the machinery alarm is in good order and regularly tested.

Industry Guidance

ICS: Engine Room Procedures Guide. First Edition.

8.4 Alarms and Actions

The EOOW should be familiar with the engine room's control and alarm systems. All alarms must be acknowledged and acted on. Any alarms that cannot be cleared should be reported to the Chief Engineer.

If it is necessary to inhibit an alarm, this should be done in line with SMS procedure. The reason for inhibiting the alarm should be addressed as soon as possible. Rather than accepting a long list of permanently inhibited nuisance alarms, it is better to address the underlying cause.

The IMO Code on Alerts and Indicators 2009, provides guidance on alarm management.

High-level alarms for engine room bilges should be tested at least once every watch and as part of pre-UMS checks. All other alarms should be tested as per the ship's PMS.

At the start of every watch, the EOOW should check that the alarm printers and the automation system are displaying the right time and date. This is important for demonstrating compliance during inspections and incident investigations.

IMO: A.1021(26) Codes on Alerts and Indicators, 2009.

3.3 The following alerts are classified as alarms:

1. Machinery alarm. An alarm which indicates a malfunction or other abnormal condition of the machinery and electrical installations.

6. Engineers' alarm. An alarm to be operated from the engine control room or at the manoeuvring platform, as appropriate, to alert personnel in the engineers' accommodation that assistance is needed in the engine-room.

7. Personnel alarm. An alarm to confirm the safety of the engineer on duty when alone in the machinery spaces.

8. Requirements for particular alarms

8.1 Personnel alarm

8.1.1 The personnel alarm should automatically set off an alarm on the navigation bridge or in the officers’ quarters, as appropriate, and, if it is not reset from the machinery spaces in a period satisfactory to the Administration, this should be in a period not exceeding 30 min.

8.1.2 A pre-warning signal should be provided in the machinery spaces which operates 3 min before the alarm required by 8.1.1 is given.

8.1.3 The alarm system should be put into operation:

1. automatically when the engineer on duty has to attend machinery spaces in case of a machinery alarm;
2. or manually by the engineer on duty when attending machinery spaces on routine checks.

8.1.4 The alarm system should be disconnected by the engineer on duty after leaving the machinery spaces. When the system is brought into operation in accordance with 8.1.3.1, disconnection should not be possible before the engineer has acknowledged the alarm in the machinery spaces.

8.1.5 The personnel alarm may also operate the engineers’ alarm.

8.3 Engineers’ alarm

In addition to manual operation from the machinery space, the engineers’ alarm on ships with periodically unattended machinery spaces should operate when the machinery alarm is not acknowledged in the machinery spaces or control room in a specified limited period of time, depending on the size of the ship but not exceeding 5 min.

TMSA KPI 3.1.4 requires that formal familiarisation procedures are in place for vessel personnel, including contractors.

The documented procedures may include familiarisation with:

- Vessel specific operations and equipment.

Records of familiarisation are maintained.

IMO: ISM Code

7. The Company should establish procedures, plans and instructions, including checklists as appropriate, for key shipboard operations concerning the safety of the personnel, ship and protection of the environment. The various tasks involved should be defined and assigned to qualified personnel.

IMO: SOLAS

Chapter II-1

Part C – Machinery installations

Regulation 38

Engineer's alarm

An engineer's alarm shall be provided to be operated from the engine control room or at the manoeuvring platform as appropriate and shall be clearly audible in the engineers' accommodation.

Part E - Additional requirements for periodically unattended machinery spaces

Regulation 51

Alarm system

1 An (*machinery*) alarm system shall be provided indicating any fault requiring attention and shall:

1. be capable of sounding an audible alarm in the main machinery control room or at the propulsion machinery control position, and indicate visually each separate alarm function at a suitable position;
2. have a connection to the engineers' public rooms and to each of the engineers' cabins through a selector switch, to ensure connection to at least one of those cabins. Administrations may permit equivalent arrangements;
3. activate an audible and visual alarm on the navigating bridge for any situation which requires action by or attention of the officer on watch;
4. as far as is practicable be designed on the fail-to-safety principle; and
5. activate the engineers' alarm required by Regulation 38 if an alarm function has not received attention locally within a limited time.

Inspection Guidance

The operator should have developed procedures for the operation and testing of the machinery alarm that included:

- A description of its operation.
- Requirements for regularly testing the alarm and recording the results.

The question will only be allocated to a vessel which is certified for unmanned machinery space (UMS) operations and identified by HVPQ question 12.1.10 being answered in the affirmative.

Suggested Inspector Actions

- Sight and if necessary, review the company procedures for the operation and testing of the machinery alarm.
- Review the records of regular testing of the machinery alarm.
- Interview an engineer officer to verify their familiarity with the operation and testing of the machinery alarm.
- During the inspection of the bridge, interview a navigation officer to verify their familiarity with the separate functions of the machinery alarm panel.
- Request that, if safe and permitted to do so by the terminal, the machinery alarm is tested during the inspection.

Expected Evidence

- Company procedures for the operation and testing of the machinery alarm.
- Records of regular testing of the machinery alarm.

Potential Grounds for a Negative Observation

- There were no company procedures for the operation and testing of the machinery alarm that included:
    - A description of its operation.
    - Requirements for regularly testing the alarm and recording the results.
- The accompanying officer was not familiar with the company procedures for the operation and testing of the machinery alarm.
- The accompanying engineer officer was not familiar with the separate functions of the machinery alarm panel in the engine room.
- A navigation officer was not familiar with the separate functions of the machinery alarm panel on the bridge.

- There were no records of the regular testing of the machinery alarm.
- Records indicated the machinery alarm had not been tested as required by company procedures.
- The audible alarm in the engine room was not operative.
- The visual display of the separate alarm functions in the engine room was not fully functional.
- The audible and visible alarm on the bridge was not fully functional.
- The audible and visible alarm in public rooms and in the engineers' cabins was not fully functional.
- The machinery alarm was defective in any respect.

10.3.6. Were the Master and officers familiar with the company procedures for the operation, inspection and regular testing of watertight doors, and were the watertight doors in satisfactory condition?

Short Question Text
Watertight doors.

Vessel Types
Oil, Chemical, LPG, LNG

ROVIQ Sequence
Bridge, Engine Room

Publications
IMO: ISM Code
IMO SOLAS
ICS: Engine Room Procedures Guide. First Edition.

Objective

To ensure watertight doors are regularly tested and ready to operate in an emergency.

Industry Guidance

ICS: Engine Room Procedures Guide. First Edition.

5.4.3 Watertight Doors

Many lives have been lost and serious injuries caused as a result of incorrectly operated watertight doors. These doors are designed to close against any obstructions during an emergency in order to limit the spread of fire or flooding.

Personnel should never try to cross through a watertight door if it is moving and is not fully open…

TMSA KPI 4A.1.4 requires that procedures are in place to record the testing of critical equipment and systems that are not in continuous use. Testing is performed in accordance with mandatory requirements and manufacturers' recommendations.

IMO: ISM Code

10.3 The company should identify equipment and technical systems the sudden operational failure of which may result in hazardous situations. The SMS should provide for specific measures aimed at promoting the reliability of such equipment or systems. These measures should include the regular testing of standby arrangements and equipment or technical systems that are not in continuous use.

IMO: SOLAS

Chapter II-I Regulation 13-1

2. Doors provided to ensure the watertight integrity of internal openings which are used while at sea are to be sliding watertight doors capable of being remotely closed from the bridge and are also to be operable locally from each side of the bulkhead. Indicators are to be provided at the control position showing whether the doors are open or closed, and an audible alarm is to be provided at the door closure. The power, control and indicators are to be operable in the event of main power failure. Particular attention is to be paid to minimizing the effect of control system failure. Each power-operated sliding watertight door shall be provided with an individual hand-operated mechanism. It shall be possible to open and close the door by hand at the door itself from both sides.

3. Access doors and access hatch covers normally closed at sea, intended to ensure the watertight integrity of internal openings, shall be provided with means of indication locally and on the bridge showing whether these doors or hatch covers are open or closed. A notice is to be affixed to each such door or hatch cover to the effect that it is not to be left open

Chapter III Regulation 19

3.5.2 Each fire drill shall include;

5. checking the operation of watertight doors, fire doors, fire dampers and main inlets and outlets of ventilation systems in the drill area; and

Inspection Guidance

The vessel operator should have developed procedures for the operation, inspection and regular testing of watertight doors.

There are two types of watertight door:

- Doors used while at sea, e.g. for routine access.
- Doors and hatch covers normally closed at sea.

All watertight doors must have indicators on the bridge showing whether they are open or closed.

Doors and hatch covers normally closed at sea must be marked to indicate they must not be left open.

Watertight doors which are used while at sea:

- Must be horizontally sliding doors
- May be powered by hydraulic cylinders or electric motors
- Are made watertight either by steel to steel or with a rubber gasket.
- Must be capable of being remotely closed from the bridge with local audible alarm and light.
- Must be capable of manual and emergency operation adjacent to the door.
- Must have instructions for use, local control, remote control and emergency operation, clearly posted.

Watertight sliding doors should not be left in the emergency “doors closed” mode on the bridge. This should be used for emergency and testing use only. The doors should be tested regularly, at least at every fire drill.

The vessel operator should have declared whether the vessel was outfitted with any watertight doors required by SOLAS II-I Reg 13-1 thorough the Pre-inspection questionnaire.

This question will only be allocated to vessels provided with watertight doors.

<u>Suggested Inspector Actions</u>

- Sight, and if necessary, review the company procedures for the operation, inspection and regular testing of watertight doors.
- Review records of the inspection and testing of watertight doors.
- During the tour of the bridge inspect the indication and control panel for the watertight doors.
- During the course of the inspection inspect the watertight doors and request the accompanying officer to demonstrate remote and/or local operation of a sliding watertight door.

- Interview the accompanying officer to verify their familiarity with the company procedures for the operation, inspection and regular testing of watertight door.
- Interview a rating and request that they describe or demonstrate the local operation of a watertight door.

Expected Evidence

- Company procedures for the operation, inspection and regular testing of watertight doors.
- Records of the inspection and testing of watertight doors.

Potential Grounds for a Negative Observation

- There were no company procedures for the operation, inspection and regular testing of watertight doors.
- The accompanying officer was not familiar with the company procedures for the operation, inspection and regular testing of watertight doors.
- An interviewed rating was unable to describe or demonstrate the local operation of a watertight door.
- The rubber gasket on a sliding watertight door was damaged, in poor condition or missing.
- There was hydraulic oil leakage from the operating mechanism of a sliding watertight door.
- A sliding watertight door could not be closed from the bridge.
- The local audible alarm and/or light for a sliding watertight door was inoperative when the door was remotely closed from the bridge.
- The watertight doors open/closed indication on the bridge was not fully operative.
- A sliding watertight door could not be operated using the manual and/or emergency operation adjacent to the door.
- There were no instructions for use, local control, remote control and emergency operation, clearly posted adjacent to a sliding watertight door.
- The remotely operated sliding watertight doors had been left in the emergency “doors closed” mode on the bridge.
- A door or hatch cover that was required to be normally closed at sea was not clearly marked to that effect.
- A door or hatch cover that was required to be normally closed at sea was indicated as closed on the bridge but was in fact open, or vice-versa.
- Watertight doors had not been tested at least at every fire drill.
- A watertight door was defective in any respect.

10.3.7. Was gas welding and cutting equipment in good order, and spare oxygen and acetylene cylinders stored apart in a well-ventilated location outside of the accommodation and engine room?

Short Question Text
Gas welding and cutting equipment.

Vessel Types
Oil, Chemical, LPG, LNG

ROVIQ Sequence
Engine Room, Exterior Decks

Publications
UK HSE: Safety in gas welding
cutting and similar processes
IMO: ISM Code
UK MCA: Code of Safe Working Practices for Merchant Seafarers
USCG: Code of Federal Regulations. Title 46.
BCGA: Code of Practice 7. The safe use of oxy-fuel gas equipment (individual portable or mobile cylinder supply)
BCGA: Technical Information Sheet 29. Oxy-Fuel Gas Equipment – Selection and Assembly

Objective

To ensure gas welding and cutting equipment is properly installed and in satisfactory condition.

Industry Guidance

UK MCA: Code of Safe Working Practices for Merchant Seafarers

24.4.1 Personal protective equipment complying with the relevant standard specifications or their equivalent must be worn by the operator and as appropriate by those assisting with the operation to protect them from particles of hot metal and slag and protect their eyes and skin from ultra-violet and heat radiation. The operator should normally wear:

- welding shields or welding goggles with appropriate shade of filter lens to EN 169 (goggles are only recommended for gas welding and flame cutting);
- leather gauntlets;
- leather apron (in appropriate circumstances); and
- long-sleeved natural-fibre boiler suit or other approved protective clothing.

24.4.2 Clothing should be free of grease and oil and other flammable substances.

24.8.1 Compressed gas cylinders should always be handled with care, whether full or empty. They should be properly secured and stored in a location appropriate to their intended use and risks, which an inadvertent release of gas may present. The cylinders should be so secured as to be capable of quick and easy release, e.g. in the case of fire. Where appropriate, cylinder trolleys should be used to transport cylinders from one place to another.

24.8.2 If the cylinder design permits protective caps over the valve, such caps should be screwed in place when the cylinders are not in use or are being moved. Where the cylinder design does not permit protective caps over the valve, the valve system should be protected from inadvertent damage, e.g. from impact. Valves should be closed when cylinders are empty.

24.8.3 Care should be taken in the storage of flammable gases used for hot work. The storage should:

- be separated according to type of gas, and empty cylinders kept separate from full ones;

- be well ventilated;
- not be subject to extremes of temperatures;
- not contain any sources of ignition, including electronic devices; and
- be prominently marked 'No smoking' and have safety signs in accordance with the standards in Chapter 9, Safety signs and their use, Annex 9.1.

24.8.4 The following precautions also need to be taken in the case of compressed gas cylinders:

Cylinders' valves, controls and associated fittings should be kept free from oil, grease and paint; controls should not be operated with oily hands.

Gas should not be taken from such cylinders unless the correct pressure-reducing regulator has been attached to the cylinder outlet valve.

Cylinders found to have leaks that cannot be stopped by closing the outlet valve should be taken to the open deck away from any sources of heat or ignition and slowly discharged to the atmosphere.

24.9 Gas welding and cutting

24.9.4 Non-return valves should be fitted adjacent to the torch in the oxygen and acetylene supply lines.

24.9.5 Flame arrestors should be provided in the oxygen and acetylene supply lines and will usually be fitted at the low-pressure side of regulators, although they may be duplicated at the torch.

24.9.21 To prevent a build-up of dangerous concentrations of gas or fumes during a temporary stoppage or after completion of the work, supply valves on gas cylinders and gas mains should be securely closed and blowpipes, hoses and moveable pipes should be removed to lockers that open onto the open deck.

USCG: Code of Federal Regulations. Title 46.

56.50-103 Fixed oxygen-acetylene distribution piping.

c. Acetylene distribution piping and pipe fittings must be seamless steel. Copper alloys containing less than 65 percent copper may be used in connection with valves, regulators, gauges, and other equipment used with acetylene.

d. Oxygen distribution piping and pipe fittings must be seamless steel or copper.

g. Pipe joints on the low-pressure side of the regulators shall be welded.

BCGA: Code of Practice 7. The safe use of oxy-fuel gas equipment (individual portable or mobile cylinder supply)

Appendix 1 Guidance on inspection and maintenance

Provides detailed guidance in a table format for inspection and maintenance of oxy-fuel gas equipment which includes:

Flashback arrestors and regulators:

- Inspect and check annually. *(Typically, this will include a creep test to ensure regulator integrity)*
- 5 years from date of manufacture or manufacturer's recommendations, replace with a new, or refurbished unit.

Note 1: Components such as elastomers, seals and diaphragms, will wear and deteriorate from their date of manufacture whether in gas service or not. Items stored out of gas service for one year or over should receive checks in accordance with the annual requirements.

BCGA: Technical Information Sheet 29. Oxy-Fuel Gas Equipment – Selection and Assembly

Flexible Hoses

The good condition of hoses is of vital importance to safety. Hoses shall be protected from heat, mechanical damage, traffic, sparks, hot splatter, slag and contamination, for example, by oil or grease. Always discard hoses when the general condition shows signs of deterioration (refer to BCGA CP 7 (2). Localised repairs are not recommended. Correct hose connections, properly fitted and tested and retained by suitable clips or ferrules, are essential. Hoses are not to be secured using worm drive clips.

UK HSE: Safety in gas welding, cutting and similar processes

Turn the gas supply off at the cylinder when the job is finished or before the cylinders are moved or transported.

Gas leaks are often the result of damaged or poorly maintained equipment, poor connections or not closing valves properly after use.

Leaking hoses should not be repaired, but they can be shortened to remove a damaged section.

Make sure the blowpipe is fitted with spring-loaded non-return valves.

Protecting cylinders from flashbacks: Fit flashback arresters to both the oxygen and fuel gas hoses near to the regulators. For long lengths of hose, fit arresters on both the torch and the regulator.

Oxygen leaks also increase the fire risk. Clothing contaminated with oxygen, even fire-retardant clothing, will catch fire easily and burn very fiercely. Oxygen can cause explosions if used with incompatible materials. In particular, oxygen reacts explosively with oil and grease.

You must take the following precautions:

- never allow oil or grease to come into contact with oxygen valves or cylinder fittings;
- only use equipment designed for use with oxygen. In particular, check that the regulator is safe for oxygen and for the cylinder pressure.

TMSA KPI 9A.1.1 requires that safety inspections are conducted at scheduled intervals by a designated Safety Officer.

IMO: ISM Code

7 The Company should establish procedures, plans and instructions, including checklists as appropriate, for key shipboard operations concerning the safety of the personnel, ship and protection of the environment. The various tasks involved should be defined and assigned to qualified personnel.

Inspection Guidance

Fixed piping for the distribution of oxygen and acetylene carried in cylinders should be of welded construction and bolted flanges are prohibited. Acetylene piping must be steel, oxygen piping should be steel or copper. Rubber or braided lines should not be used. However braided lines may be used for the short length from the cylinder heads to the manifolds within the storage space. In open air locations it may be acceptable for a short length of piping from the bottle to an isolation valve to be flanged. This is the only exception, however.

Acetylene is 92.3% carbon and 7.7% hydrogen, is lighter than air and is highly flammable with an LEL of 2.5%.

- Acetylene cylinders are normally coloured maroon.
- The colour of oxygen cylinders, although commonly blue, may vary.
- The use of propane in gas cutting and welding systems is prohibited.
- The contents of a gas cylinder should always be confirmed from the label.
- Acetylene hoses are normally red, oxygen hoses are normally blue.

Oxygen and acetylene should be kept in separate compartments except in the case of the cylinders that are in use, which may be stored in the same compartment. Cylinders should be stowed away from heat sources and should not be in heavy traffic areas to prevent accidental knocking over or damage from passing or falling objects. Cylinders should be stored with the valve end up. Storage areas should be free of combustible material and not exposed to salt or other corrosive chemicals.

Suggested Inspector Actions

- Inspect the gas cutting and welding equipment including:
    - Cylinder storage location.
    - Distribution piping and manifolds.
    - In use and spare cylinders.
    - Regulators and flashback arrestors.
    - Oxygen and acetylene hoses.
    - Torches/blowpipes and non-return valves.
    - Associated PPE.
- Review the records of periodic inspection and replacement of flashback arrestors and regulators in the gas cutting and welding equipment.

Expected Evidence

- Records of periodic inspection and replacement of flashback arrestors and regulators in the gas cutting and welding equipment.

Potential Grounds for a Negative Observation

- Gas cylinders were not properly secured in their location.
- Gas cylinders were not secured such that they could be easily released in the case of fire.
- Protective caps were not screwed in place on cylinders not in use or being moved.
- The valve on an empty cylinder was open.
- A supply valve on a gas cylinder had been left open after completion of work.
- Oxygen and acetylene cylinders were stored together.
- Empty cylinders were not kept separate from full ones.
- Cylinders were stored with the valve end down.
- The cylinder storage location was:
    - Subject to extreme temperatures.
    - Exposed to salt or other corrosive chemicals.
- The cylinder storage location was not:
    - Well ventilated and outside of the accommodation and engine room.
    - Away from heavy traffic areas.
    - Free of sources of ignition and/or combustible material.
    - Clearly marked with suitable signage, including ‘No Smoking’.
- Cylinders’ valves, controls and associated fittings were contaminated with oil, grease or paint.
- A gas cylinder was in use without the correct pressure-reducing regulator.
- Spring-loaded non-return valves were not fitted adjacent to the torch in the oxygen and acetylene hoses.
- Flashback arrestors were not provided in the oxygen and acetylene hoses at the low-pressure side of regulators.

- Flashback arrestors were not fitted on both the torch and the regulator for long lengths of oxygen and acetylene hose.
- Acetylene distribution piping and pipe fittings were not of seamless steel.
- Oxygen distribution piping and pipe fittings were not of seamless steel or copper.
- There were bolted flanged joints in the fixed piping for the distribution of oxygen and/or acetylene.
- Rubber hoses were used in the oxygen and/or acetylene distribution piping.
- There was no evidence that flashback arrestors and regulators had been
    - Inspected and checked annually.
    - Replaced with a new or refurbished unit 5 years from the date of manufacture or as per manufacturer's recommendations.
- Oxygen and/or acetylene hoses were in visibly poor condition or damaged.
- Leaking oxygen and/or acetylene hoses had been repaired rather than cropped or replaced.
- Propane was in use in the gas welding and cutting system.
- The appropriate PPE was not available for gas cutting and welding operations.
- The PPE for gas cutting and welding operations was contaminated with oil, grease or other flammable substances.
- The gas cutting and welding equipment was defective in any respect.

10.3.8. Were engineer officers and ratings familiar with the safety precautions for the use of electric welding equipment, were these safety precautions posted, and was the equipment in satisfactory condition?

Short Question Text
Electric welding equipment.

Vessel Types
Oil, Chemical, LPG, LNG

ROVIQ Sequence
Engine Room, Interview - Engine Rating

Publications
IMO: ISM Code
OCIMF/ICS: International Safety Guide for Oil Tankers and Terminals. Sixth Edition.
UK MCA: Code of Safe Working Practices for Merchant Seafarers

Objective

To ensure that electric welding equipment is always used safely.

Industry Guidance

OCIMF/ICS: International Safety Guide for Oil Tankers and Terminals. Sixth Edition

9.5 Electric welding equipment

Electric welding equipment should be carefully inspected before each use to ensure it is in good condition. If necessary, it should be correctly earthed. When using electric arc equipment, pay special attention to ensure:

- Electrical supply connections are made in a gas free space.
- Existing supply wiring is adequate to carry the electrical current demand without overloading, causing heating.
- Insulation of flexible electrical cables is in good condition.
- Cable route to the work site is the safest possible, only passing over gas freed or inerted spaces.
- Earthing connection is next to the work site and the earth return cable leads directly back to the welding machine. The ship’s structure should not be used as an earth return.

UK MCA: Code of Safe Working Practices for Merchant Seafarers.

24.4.1 Personal protective equipment complying with the relevant standard specifications or their equivalent must be worn by the operator and as appropriate, by those assisting with the operation to protect them from particles of hot metal and slag and protect their eyes and skin from ultra-violet and heat radiation. The operator should normally wear:

- welding shields or welding goggles with appropriate shade of filter lens to EN 169 (goggles are only recommended for gas welding and flame cutting);
- leather gauntlets;
- leather apron (in appropriate circumstances); and
- long-sleeved natural-fibre boiler suit or other approved protective clothing.

24.4.2 Clothing should be free of grease and oil and other flammable substances.

Precautions to be taken during electric arc welding

24.7.1 In addition to the protective clothing specified in section 24.4.1, the welding operator should wear non-conducting safety footwear complying with BS 7193:1989. Clothing should be kept as dry as possible as some protection against electric shock; it is particularly important that gloves should be dry because wet leather is a good conductor.

24.6 Electric welding equipment

24.6.1 In order to minimise personal harm from electric shock, electric welding power sources for shipboard use should have a direct current (DC) output not exceeding 70V, with a minimum ripple. Further information on DC power sources is given in section 24.6.11.

24.6.2 When DC equipment is not available, AC output power sources may be used providing they have an integral voltage-limiting device to ensure that the idling voltage (the voltage between electrode and workpiece before an arc is struck between them) does not exceed 25 V rms. The proper function of the device (which may be affected by dust or humidity) should be checked each time a welding set is used. Some voltage-limiting devices are affected by their angle of tilt from the vertical, so it is important that they are mounted and used in the position specified by the manufacturers. This requirement can be affected by adverse sea conditions.

24.6.7 Cables should be inspected before use; if the insulation is impaired or conductivity reduced, they should not be used.

24.6.10 A local switching arrangement or other suitable means should be provided for rapidly cutting off current from the electrode should the operator get into difficulties, and also for isolating the holder when electrodes are changed.

24.7.8 When the welding operation is completed or temporarily suspended, the electrode should be removed from the holder.

24.7.10 Spare electrodes should be kept dry in their container until required for use.

TMSA KPI 9A.1.1 requires that safety inspections are conducted at scheduled intervals by a designated Safety Officer.

IMO: ISM Code

7 The Company should establish procedures, plans and instructions, including checklists as appropriate, for key shipboard operations concerning the safety of the personnel, ship and protection of the environment. The various tasks involved should be defined and assigned to qualified personnel.

Inspection Guidance

Comprehensive safety precautions for electric welding should be posted in the engine room workshop or other appropriate location.

Electric cables should not be worn damaged or spliced.

Electrode holders should be fully insulated.

The maximum output voltage of the electric welding equipment should be:

- Rectifiers and inverters delivering DC: 70 V.
- Transformers delivering AC: 25 V.

Suggested Inspector Actions

- Inspect the electric welding equipment including the nameplate, local switching arrangement, electric cabling, electrode holder and spare electrodes.
- Sight the safety precautions for electric welding posted in the engine room workshop or other appropriate location.

- Interview the accompanying officer or if available, an appropriate rating e.g. a fitter, to verify their familiarity with the safety precautions for using the electric welding equipment provided onboard.

Expected Evidence

- Safety precautions for electric welding.
- Equipment nameplate or documentation confirming the output voltage of the electric welding equipment.

Potential Grounds for a Negative Observation

- The accompanying officer was not familiar with the safety precautions for electric welding.
- An interviewed rating was not familiar with the safety precautions for electric welding.
- Safety precautions for electric welding were not posted in the engine room workshop or other appropriate location.
- Equipment, such as welding curtains or screens, required by the safety precautions for electric welding were missing or in unsatisfactory condition.
- The supply wiring was not adequate to carry the electrical current demand without overloading.
- There was evidence that the ship's structure had been used as the earth return.
- In the case of a welding work station, the earthing connection was not next to the work site with the cable leading directly back to the welding machine.
- Insufficient earth return cable was provided to match the length of the welding cable.
- The insulation of flexible electrical cables was worn, damaged or spliced.
- The electric welding power source had a direct current (DC) output exceeding 70V.
- The electric welding power source had an alternating current (AC) output exceeding 25V.
- There was no local switching arrangement or other suitable means provided for rapidly cutting off current from the electrode.
- An electrode had been left in the holder after completion of work.
- The electrode holder was not fully insulated.
- Spare electrodes were not stored in suitably dry conditions.
- The electric welding equipment was defective in any respect.
- The appropriate PPE was not available for electric welding operations.
- The PPE for electric welding operations was contaminated with oil, grease or other flammable substances.

10.4. Planned Maintenance Systems

10.4.1. Were the responsible vessel staff familiar with the company procedure for managing and using the planned maintenance system, and was the system updated with an accurate record of onboard maintenance and spare parts in accordance with the procedure?

Short Question Text
Planned maintenance system (PMS)

Vessel Types
Oil, Chemical, LPG, LNG

ROVIQ Sequence
Engine Control Room, Chief Engineer's Office, Cargo Control Room

Publications
OCIMF: Safety Critical Equipment and Spare Parts Guidance. First Edition.
IMO: ISM Code
IACS: A Guide to Managing Maintenance in accordance with the requirements of the ISM Code.

Objective

To ensure that vessel structure, machinery and equipment is maintained in accordance with class requirements, manufacturer's recommendations and company instructions.

Industry Guidance

OCIMF: Safety Critical Equipment and Spare Parts Guidance. First Edition.

4. Safety critical spare parts and safety management systems

It is recommended that a proactive risk-based approach to the carriage of safety critical spare parts is taken for the management of hazardous situations. This approach may need to be above and beyond minimum regulatory requirements. Companies should apply this approach to both new-builds and to existing vessels

IACS: A guide to managing maintenance in accordance with the requirements of the ISM Code.

Introduction

… The objective must be to ensure the safe and reliable operation of the ship and its equipment, and compliance with all the applicable regulations. How this is achieved will depend on the size and complexity of the company and the types of ships that it operates. The system may be entirely electronic, entirely paper-based, or a combination of the two, and the level of shore-based supervision will vary from one organization to another. All that matters is that the system works, and that it works in a way that best suits the company. If it does, it can pose no threat to the company's ISM certification.

TMSA KPI 4.1.1 requires that each vessel in the fleet is covered by a planned maintenance system and spare parts inventory which reflects the company strategy.

The company identifies all equipment and machinery required to be included in the planned maintenance system, for example:

- Navigation equipment.
- Engine machinery.
- Deck machinery.

- Cargo handling machinery/equipment.
- Hull structure.
- Electronic equipment.

The spare parts inventory may be standalone or integrated into the planned maintenance system.

The planned maintenance system, which may be computer-based, covers all identified onboard equipment and machinery and includes a schedule of planned maintenance tasks and a record of completed planned and unplanned maintenance.

IMO: ISM Code

10.1 the company should establish procedures to ensure that the ship is maintained in conformity with the provisions of the relevant rules and regulation and with any additional requirements which may be established by the company.

Inspection Guidance

The vessel operator should have developed a planned maintenance system along with procedures to ensure that it is managed correctly. The procedures should define:

- Which structure, machinery, equipment and components are managed through the planned maintenance system.
- The identities and responsibilities of vessel staff for management and use of the planned maintenance system.
- The responsibility for completing planned and unplanned tasks within the due date, but where this is not possible, any grace periods allowable before escalating the matter to shore-based management.
- The process for gaining shore-based approval for deferring a planned or unplanned task beyond the due date and any grace period permitted elsewhere in the procedure.
- The process for maintaining an accurate inventory of spare parts, including minimum stock inventory for equipment identified as critical.
- The management and reporting of defective equipment either through the planned maintenance system as an unplanned maintenance task or a separate defect reporting system.

The planned maintenance system should establish:

- The inspection, maintenance and test schedules for the structure, machinery, equipment, components and associated alarms.
- The identification of critical systems, their alarms and components.

<u>Suggested Inspector Actions</u>

- Sight, and where necessary review, the company procedure for managing the planned maintenance system provided onboard.
- Review the planned maintenance system filtered for overdue planned or unplanned tasks and identify tasks that were either overdue by the original due date or by more than the company's documented grace period where such periods had been defined.
- Review the planned maintenance system filtered for deferred planned or unplanned tasks and verify that any such tasks had been deferred in accordance with company procedures and with documented management approval.
- Review the planned maintenance system filtered for equipment identified as critical, select a piece of equipment and verify that the spare parts listed either met or exceeded the stated minimum required stock level.
- Select one item from the listed spare parts for the critical equipment reviewed above and note the part number, minimum stock level, reported stock level, store location and box number for later physical verification.

- Select one item of non-critical equipment and select one spare part listed as being available and note the part number, reported stock level, store location and box number for later physical verification.

- Interview one deck officer and one junior engineer officer regarding their responsibilities for conducting and recording planned maintenance tasks and, where the planned maintenance system was computer-based, request that they demonstrate the records for one task assigned to them.

Expected Evidence

- The company procedure for managing the planned maintenance system provided onboard.
- The planned maintenance system.
- The manufacturer's instructions for operating the planned maintenance system provided onboard. (where the system was computer based)
- The spare parts inventory with critical equipment and spare parts identified, if not contained within the planned maintenance system.
- The defect reporting system if not incorporated within the planned maintenance system.

Where a vessel is not provided with a computer based planned maintenance system, it is an expectation that vessel staff will prepare records in advance to permit the required inspector actions to be undertaken quickly and efficiently.

Potential Grounds for a Negative Observation

- There was no company procedure for managing the planned maintenance system.
- The accompanying responsible officer was unfamiliar with the company procedure for managing the planned maintenance system.
- The accompanying responsible officer was unfamiliar with the operation of the planned maintenance system.
- An interviewed deck officer or junior engineer was unfamiliar with the process of completing and recording tasks assigned to them within the planned maintenance system
- Defects to structure, machinery or equipment were recorded in the planned maintenance system but were not transferred to the defect reporting system, if not a combined system.
- Defects to structure, machinery or equipment were entered in the defect reporting system but the work necessary to rectify the defect had not been entered into the planned maintenance system as an unplanned task against the appropriate vessel component.
- Planned or unplanned maintenance tasks within the planned maintenance system were overdue, either by the original due date or by more than the permitted grace period allowed by the company procedure, where defined, without documented shore-based approval on a case by case basis.
- An item of equipment required for the safe operation of the vessel was not included in the planned maintenance system.
- Tasks had been deferred within the planned maintenance system without documented shore management approval.
- Spare parts inventories for equipment identified as critical were not marked/tagged with minimum stock levels.
- Spare parts inventory listed in the planned maintenance system for equipment identified as critical was less than the required minimum stock.
- Spare parts listed in the planned maintenance system for either critical or non-critical equipment were not found in the designated store location, or the stock levels were incorrect as compared to the stock declared in the planned maintenance system.

10.4.2. Did the vessel operator subscribe to a lube oil and hydraulic oil analysis program and was a procedure in place to act on the results and trends identified by the analysis?

Short Question Text
Lube oil and hydraulic oil analysis program

Vessel Types
Oil, Chemical, LPG, LNG

ROVIQ Sequence
Chief Engineer's Office

Publications
IACS Rec. 36 Recommended procedure for the determination of contents of metals and other contaminants in stern tube lubricating oil.
IACS: UR_Z21 Surveys of Propeller Shafts and Tube Shafts.

Objective

To ensure that the quality of lube oils and hydraulic oils is monitored, and action taken when necessary to avoid machinery damage.

IACS: UR_Z21 Surveys of Propeller Shafts and Tube Shafts.

1.2.14 Lubricating oil analysis

Lubricating oil analysis is to be carried out at regular intervals not exceeding six (6) months taking into account IACS Rec. 36.

The documentation on lubricating oil analysis is to be available on board. Oil samples, to be submitted for the analysis, should be taken under service conditions

IACS Rec. 36 Recommended procedure for the determination of contents of metals and other contaminants in stern tube lubricating oil.

1 General

As provided by paragraph 1.2.14 of IACS UR Z21(Rev.4), a lubricating oil analysis should be carried out at the required intervals.

The documentation on lubricating oil analysis is to be available on board. Each analysis, to be performed by an appropriate method, should include the minimum parameters as listed:

- water contents, refer Section 4
- chloride contents, refer Section 4
- contents of bearing metal particles, refer Section 4 and 6
- oil ageing (resistance to oxidation), refer Section 5

TMSA KPI 4.3.3 requires that performance indicators have been developed to monitor fleet reliability. The performance indicators are measured for individual vessels and fleet wide.

Examples of possible performance indicators include:

- Results of lub oil and hydraulic oil analyses.

IMO: ISM Code

10.1 The Company should establish procedures to ensure that the ship is maintained in conformity with the provisions of the relevant rules and regulations and with any additional requirements which may be established by the Company.

Inspection Guidance

The vessel operator should have established an oil analysis programme to monitor the quality of lubrication and hydraulic oils used in key items of machinery. The programme should be aligned with manufacturer's recommendations and Classification Society requirements.

The vessel operator should have developed a procedure setting out the actions to be taken when a deficiency in a sampled oil is identified in an oil analysis report. This procedure may form part of the vessel's maintenance plan.

The oils subject to routine analysis may include:

- Stern tube lubricating oil
- Main engine sump oil
- Main engine stuffing box/piston rod scraper ring drain oil
- Auxiliary engine sump oil
- Emergency generator engine sump oil
- Cargo and ballast pump turbine gearcase oil
- Deep-well pump system hydraulic oil.
- Deep-well pump power pack sump oil
- Steering system hydraulic oil.
- Bow and stern thruster gearcase oil
- Controllable pitch propeller hydraulic oil
- Mooring system hydraulic oil
- Cargo and ballast system valve remote control system.
- Mooring winch and windlass gearcase oil.
- Hose handling crane hydraulic oil
- Cargo system thermal heating oil

The vessel operator should have declared through the pre-inspection questionnaire whether the vessel was enrolled in a lube oil testing programme, and if so:

- Which oils were subject to routine analysis.
- The frequency of analysis for each oil included in the programme(s).

This data will be inserted in the inspection editor and reproduced in the final inspection report.

Where the vessel was not enrolled in a lubricating and hydraulic oil analysis program this question will not be allocated and marked as no in the final report.

Suggested Inspector Actions

Review the vessel's lubricating and hydraulic oil analysis records and verify that:

- Each oil declared as being included within the lube oil analysis program had been tested within the required time frame.
- Where the results of oil analysis had resulted in either a "critical" (red) or "warning" (amber) alert:
    - The testing company or shore-based management had provided recommendations or instructions to rectify the condition.
    - There was evidence available that the recommendations or instructions to rectify the situation provided by the testing company or shore based management had been complied with.

Expected Evidence

- The lubricating and hydraulic oil analysis programme information documenting the oils subject to analysis.
- The lubricating and hydraulic oil analysis records for the previous two cycles of analysis.
- Where analysis had resulted in a “critical” (red) or “warning” (amber) status, any follow up communications from shore-based management.
- Maintenance records to demonstrate that the recommended or instructed actions had been taken to correct any “critical” or “warning” status.

Potential Grounds for a Negative Observation

- The vessel did not have a programme for the routine sampling and analysis of lubricating and hydraulic oils.
- The accompanying officer was unfamiliar with the company procedure for managing the lubricating and hydraulic oil analysis programme.
- One or more oils required to be sampled and analysed had not been landed for analysis in alignment with the programme, unless the analysis due date was during the previous voyage or there was objective evidence of vessel had not been able to land the samples in previous ports / regions.
- One or more oils analysed during the previous two cycles of oil analysis had resulted in a “critical” (red) status.
- There was no evidence that the recommended or instructed actions to correct the condition of an oil analysed with a “critical” or “warning” status had been undertaken.

10.5. Conventional Bunkering Management

10.5.1. Were the Master, Chief Engineer, officers, and ratings involved in bunkering operations, familiar with the company bunkering procedures, and were records available to demonstrate that bunker operations had been planned and conducted in accordance with the company procedure?

Short Question Text
Conventional bunkering operations

Vessel Types
Oil, Chemical, LPG, LNG

ROVIQ Sequence
Engine Control Room, Chief Engineer's Office, Engine Room

Publications
IMO: ISM Code
OCIMF/ICS: International Safety Guide for Oil Tankers and Terminals. Sixth Edition.

Objective

To ensure that bunkering operations are planned and conducted in accordance with Industry best practice guidance.

Industry Guidance

OCIMF: International Safety Guide for Oil Tankers and Terminals. Sixth Edition.

Chapter 24.1 Bunkering in General

Bunkering is a critical operation and requires care to ensure safety and to reduce the risk of pollution.

Bunkering operations should be planned and carried out in-line with legislation, standards and best practice guidelines to minimize the risk from the flammability, toxicity, cryogenic nature, volatility or pressure of the fuel being handled.

Vessel operators should manage the risks by ensuring that the crew is familiar with the management procedures for bunker operations and that they have all completed the appropriate training.

The crew designated to bunkering on board should have no other tasks during the operation. This is particularly important when bunkers are being loaded at the same time as cargo. Spills often occur when staff are distracted by other jobs.

24.6 Bunker checklists

Safe bunker operations depend on good communications between the bunker vessel and the receiving ship, from pre-arrival to post-departure, and on complying with the agreed safe procedures at all stages. The bunker checklists are a way to ensure that all the appropriate checks are formally agreed, carried out and recorded.

- ISGOTT Bunker checklist: pre-arrival
- ISGOTT Bunker checklist: checks after mooring
- ISGOTT Bunker checklist: pre-transfer conference
- ISGOTT Bunker checklist: pre-bunkering
- ISGOTT Bunker checklist: repetitive checks
- ISGOTT Bunker checklist: Post bunkering

TMSA KPI 6.2.5 requires that comprehensive procedures cover all aspects of bunkering operations for each vessel type within the fleet

Operational procedures address:

- Pre-arrival checks.
- Pipeline/hose connection including supervision of third-party personnel.
- Bunker safety checklist including interface and communications.
- Bunker tank gauging.
- Agreed initial bulk transfer and topping off rates.
- Draining/blowing lines and disconnection of hoses.
- Bunker sample analysis.
- Monitoring of bunker tank atmospheres for hydrocarbon gas, benzene and H2S

IMO: ISM Code

7. The company should establish procedures, plans and instructions, including checklists as appropriate, for key shipboard operations concerning the safety of the personnel, ship and protection of the environment. The various tasks should be defined and assigned to qualified personnel.

Inspection Guidance

The vessel operator should have developed bunkering procedures which require a formal bunkering plan to be developed for each bunkering operation.

The procedure and supporting checklists should consider the following:

- Determining that there is adequate space for the volume of bunkers to be loaded.
- Establishing maximum loading volume for all tanks.
- Controls for the setting of bunker system valves.
- Determining loading rates for the start of loading, bulk loading and topping-off.
- Special precautions when loading into double bottom tanks.
- Arrangements of bunker tank ventilation.
- Internal tank overflow arrangements.
- Verification of gauging system operation and accuracy.
- Alarm settings on overfill alarm units.
- Communication with the terminal to establish when bunkering can be undertaken.
- Communications with the bunker supplier prior to commencement, to establish and record the loading procedure to be followed and to determine how quantity and quality checks may be carried out, particularly if safe access is needed between the ship and a barge.
- Methods of managing the handling of bunkers which have or may have a hydrogen sulphide (H2S) content.
- Testing procedures for determining the presence of hydrocarbon or H2S vapours.
- Method of determining the temperature of the bunkers during loading.
- Communications procedure for the operation, including emergency stop.
- Manning requirements to execute the operation safely.
- Monitoring of the bunkering operation and checking it conforms to the agreed procedure.
- Changing over tanks during loading.
- Containment arrangements and clean-up equipment to be available.
- Draining manifolds upon completion of bunkering.

<u>Suggested Inspector Actions</u>

- Sight, and where necessary review, the company procedures for bunkering operations.
- Review a recent bunker transfer plan and verify that it:

    - Identified the personnel involved in the bunkering operation and their designated duties.
    - Ensured that personnel involved in the bunkering operation were not assigned conflicting tasks during the bunkering.
    - Contained all information required by the company procedures.
    - Identified checks for flammable and toxic gas vapours within bunker tank ullage spaces that were required to be taken before, during and after bunkering.
    - Was signed for understanding by all officers involved in the bunkering operation.
    - Was signed by both the Master and Chief Engineer for approval.
- Review the records of the same bunker operation and verify that:
    - Checklists were completed before, during and after the bunkering operation to ensure that all required safety and environmental protection measures were completed.
    - The bunker transfer followed the plan as presented.
    - The atmosphere of ullage spaces within the bunker tanks were tested in according with the plan.
    - Records were sufficiently detailed to identify which tanks were being loaded at any given time.

- Where the vessel was involved in a bunkering operation during the inspection or had been involved in a bunkering operation during the previous two months, interview one engine room rating to gauge their familiarity with the bunkering plan and their role in the bunkering operation.

Expected Evidence

- The company procedure for developing bunker transfer plans.
- The company procedure for bunker operation record keeping.
- The plans for recent bunker transfer operations.
- The records for recent bunker transfer operations.

Potential Grounds for a Negative Observation

- There was no company procedure that required bunker transfer plans to be prepared with defined content in alignment with ISGOTT Chapter 24 and TMSA KPI 6.2.5.
- There were no supporting checklists for pre-arrival, checks after mooring, pre-transfer conference, pre-bunkering, repetitive checks or post-bunkering.
- There was no company procedure which defined the record-keeping requirements for bunkering operations.
- The accompanying officer was unfamiliar with the company procedures for bunker transfer planning.
- The accompanying officer was unfamiliar with the company requirement for maintaining records of bunkering operations.
- Where interviewed, an engine room rating was unfamiliar with the duties assigned to them within the bunkering plan during a recent bunkering operation.
- Bunker tank ullage space atmosphere checks for flammable or toxic vapours required to be taken before, during or after the bunkering operation had not been taken and recorded in accordance with the company procedure.
- The reviewed bunkering plan was missing key information required by the company procedure.
- The bunkering plan did not identify the personnel, and their assigned roles, required to be involved in the bunkering operation.
- The reviewed bunkering plan was not signed by all officers involved and/or was not approved by the Master and Chief Engineer.
- The reviewed bunker transfer records indicated that the bunkering plan was not followed.
- The reviewed bunkering records were insufficiently detailed to permit the reconstruction of the bunkering operation for comparison with the bunker transfer plan.
- Checklists required to be completed before, during and/or after the bunkering operation had not been completed.

10.5.2. Were the Chief Engineer and engineer officers familiar with the company procedures for bunker fuel oil sampling and analysis, and were records available to demonstrate that samples had been taken and retained or analysed in accordance with the procedure?

Short Question Text
Bunker fuel oil sampling and analysis

Vessel Types
Oil, Chemical, LPG, LNG

ROVIQ Sequence
Engine Control Room, Chief Engineer's Office

Publications
IMO: MARPOL
IMO Resolution MEPC.182(59) 2009 Guidelines for the sampling of fuel oil for determination of compliance with the revised MARPOL Annex VI
IACS: No.151 (July 2017) Recommendation for petroleum fuel treatment systems for marine diesel engines.

Objective

To ensure that marine distillate and residual fuel oils meet the defined quality and environmental standards for use onboard in propulsion and power generating machinery.

Industry Guidance

IACS No.151 (July 2017) Recommendation for petroleum fuel treatment systems for marine diesel engines.

3.4 Verification requirements.

3.4.2.4 Records of fuel sample analysis according to ISO 8217 (latest revision) should be retained on board the ship and should be presented to the surveyor during regular surveys.

3.4.2.5 It is recommended that a drip sample of fuel should be taken during bunkering at the bunker manifold in accordance with ISO 3170 or 3171 and ISO 13739, where applicable.

3.4.2.6 It is recommended that once a new bunker has started to be used, a fuel system audit is performed by a responsible person on board, taking fuel samples from before and after the treatment plant and at the engine fuel rail.

TMSA KPI 6.2.5 requires that comprehensive procedures cover all aspects of bunkering operations for each vessel type within the fleet:

Operational procedures address:

- Bunker sample analysis.

Specific guidance is provided for:

- The unavoidable use of new bunkers before the receipt of analysis results.

IMO: ISM Code

7. The Company should establish procedures, plans and instructions, including checklists as appropriate, for key shipboard operations concerning the safety of the personnel, ship and protection of the environment. The various tasks should be defined and assigned to qualified personnel.

IMO: MARPOL

Annex VI

Chapter 3 Regulation 18

8.1 The bunker delivery note shall be accompanied by a representative sample of the fuel oil delivered...

Resolution MEPC.182(59) 2009 Guidelines for the sampling of fuel oil for determination of compliance with the revised MARPOL Annex VI

The primary objective of these Guidelines is to establish an agreed method to obtain a representative sample of the fuel oil for combustion purposes delivered for use on board ships.

Inspection Guidance

The vessel operator should have developed procedures which required bunker samples to be taken or obtained during each bunkering operation as follows:

- A representative sample of each delivery of fuel oil delivered accompanied by a bunker delivery note to be retained for MARPOL Annex VI compliance verification purposes.
- Representative samples of each delivery of marine residual fuel oil delivered for quality analysis and retention in accordance with the contracted fuel quality testing service provider.
- Where sampling for quality analysis was not required at every bunkering, the frequency of taking samples of marine distillate fuel for retention and analysis in accordance with contracted fuel analysis testing services.

The procedures should provide guidance as to the actions to be taken in the circumstance that:

- Fuel oil analysis determine that the required specification was not met.
- The vessel suffered any problems relating to fuel oil quality.
- Fuel quality was found to contravene MARPOL Annex VI.
- The use of new bunkers before receipt of analysis results was unavoidable.

The vessel operator should have provided details of the marine distillate and marine residual fuel analysis program through the pre-inspection questionnaire.

Suggested Inspector Actions

- Sight, and where necessary review, the company procedures for managing fuel oil samples, arranging fuel oil analysis and, where necessary, the remedial actions to be taken where fuel oil quality raises a concern.
- Review recent bunkering records and verify that bunker samples had been taken and either retained or analysed as required by company procedures.
- Review recent bunker analysis reports and verify that any advisory notes had been complied with.
- Review Oil Record Book Part 1 and verify that recent bunkering operations were accurately recorded.

Expected Evidence

- The company procedures for managing fuel oil samples, arranging fuel oil analysis and remedial actions to be taken where fuel oil quality raises a concern.
- Bunker delivery notes for the previous twelve months.

- Bunker analysis reports for the previous twelve months.
- Oil Record Book Part 1 covering all fuel oil bunkering operations for the previous six months and the last bunkering if more than six months previously.

Potential Grounds for a Negative Observation

- There was no company procedure for managing fuel oil samples, arranging fuel oil analysis and the remedial actions to be taken where fuel oil quality raised a concern.
- The accompanying engineer officer was not familiar with the company procedures for fuel oil sampling, sample retention or fuel oil analysis.
- Bunker delivery notes were not available for each delivery of marine distillate and residual fuel oil.
- Bunker samples had not been retained for each delivery of marine distillate and residual fuel oil.
- There was no company requirement to arrange for fuel oil analysis on every occasion marine residual fuel oil was loaded for consumption onboard.
- There was no guidance regarding the required frequency of marine distillate fuel oil analysis.
- Fuel oil analysis had not been performed in accordance with company procedure and/or the instructions from the fuel oil analysis contractor.
- Fuel oil samples had not been retained in accordance with company procedures or as required by MARPOL annex VI.
- There was no evidence that advisory notes contained within bunker analysis reports had been complied with.

10.5.3. Were the Chief Engineer and senior engineer officers familiar with the company and vessel specific fuel changeover procedures, and were records available to demonstrate that fuel grade changeovers had been completed in compliance with the procedures and MARPOL regulations?

Short Question Text
Fuel change over procedures

Vessel Types
Oil, Chemical, LPG, LNG

ROVIQ Sequence
Engine Control Room, Chief Engineer's Office

Publications
ICS: Engine Room Procedures Guide. First Edition.
IMO: MARPOL
Joint Industry Guidance: The supply and use of 0.50% sulphur marine fuel
OCIMF / INTERTANKO Recommendations on the Hazard Assessment of Fuel Change Over Processes (July 2013)

Objective

To ensure that fuel grade changeovers are conducted in accordance with regulations while maintaining the safe and continuous availability of propulsion and electrical power.

Industry Guidance

ICS: Engine Room Procedures Guide. First Edition.

10.3.4 Changeover Procedure

The issues associated with changing between different grades of fuel can be managed by using a system-specific procedure. All ships should have a system-specific changeover calculator, which should give enough time to ensure a complete and smooth change between different grades.

See checklist B4: Fuel changeover for examples of fuel changeover procedures.

Joint Industry Guidance: The supply and use of 0.50%- sulphur marine fuel.

Any new crew members joining a ship should be familiarized and trained before participating in the fuel switching process. The proper implementation of fuel switching and reliable operation of the propulsion machinery during switching and while operating on the different grades of fuel is essential. This is particularly the case if switching is being carried out close to ports and coastal waters where there is the greatest risk to the ship and the environment from loss of, or reduction in, the ship’s propulsion power. Great care should be taken when switching fuel so as to avoid situations that may jeopardize the safety of the ship, e.g. by considering the distance to the coastline and the density of traffic

OCIMF / INTERTANKO: Recommendations on the Hazard Assessment of Fuel Changeover Processes (July 2013).

5 Summary

It is recommended that fuel changeover procedures are subjected to a thorough hazard analysis (HAZID) to identify risks and necessary preventative and mitigation measures

TMSA KPI 10.2.4 requires that the environmental management plan includes procedures for fuel management in order to ensure regulatory compliance, energy efficiency and reduced emissions.

Onboard fuel management procedures may include:

- Requirements prior to entering and leaving Emission Control Areas.

IMO: ISM Code

7 The Company should establish procedures, plans and instructions, including checklists as appropriate, for key shipboard operations concerning the safety of the personnel, ship and protection of the environment. The various tasks should be defined and assigned to qualified personnel.

IMO: MARPOL

Annex VI

Regulation 14

1. The sulphur content of any fuel oil used on board ships shall not exceed the following limits:

1.3. 0.50% m/m on and after 1 January 2020.

4. While ships are operating within an emission control area, the sulphur content of fuel oil used on board ships shall not exceed the following limits:

4.3. 0.10% m/m on and after 1 January 2015.

6. Those ships using separate fuel oils to comply with paragraph 4 of this regulation and entering or leaving an emission control area set forth in paragraph 3 of this regulation shall carry a written procedure showing how the fuel changeover is to be done, allowing sufficient time for the fuel oil service system to be fully flushed of all fuel oils exceeding the applicable sulphur content specified in paragraph 4 of this regulation prior to entry into an emission control area. The volume of low sulphur fuel oils in each tank as well as the date time and position of the ship when any fuel changeover operation is completed prior to the entry into an emission control area or commenced after exit from such an area shall be recorded in such logbook as prescribed by the Administration.

Inspection Guidance

The vessel operator should have developed procedures, based on risk assessment, describing the changeover of fuel grades used onboard.

Due to the complexity of vessel types, available fuels, regulation and means to maintain compliance, there will be a variety of changeovers required. Procedures should be developed for the following fuel changeovers, as applicable to the vessel:

- Non-compliant residual fuel oil with use of a scrubber to compliant residual or distillate fuel oil.
- Compliant residual fuel oil to compliant distillate fuel oil.
- Compliant residual fuel oil to non-compliant residual fuel oil with use of a scrubber.
- Compliant distillate fuel oil to compliant residual fuel oil.
- LNG to compliant residual or distillate fuel oil.
- Compliant residual or distillate fuel oil to LNG.
- Incompatible fuel grades.
- The use of cargo condensate or other forms of novel fuel sources.

The fuel changeover procedures, supplemented by checklists where applicable, should be vessel specific and describe in detail the process to change from one grade of fuel to another.

Where the fuel change process could potentially lead to blackout or loss of propulsion, the company should define the circumstances or location where the fuel grade changeover may take place.

Suggested Inspector Actions

- Sight, and where necessary review, the company procedures describing the changeover of fuel grades onboard.
- Review fuel change over records for a recent voyage where fuel grades had been changed and verify that the change had been completed in accordance with the company procedures.
- Review the location of the vessel during the changeover process and verify that it was completed in accordance with any geographic or situational safety restrictions put in place by the company.

Expected Evidence

- The company procedures describing the changeover of fuel grades onboard .
- The vessel specific procedures for changing of fuel grades for main engines, generators and boilers.
- Onboard records demonstrating that fuel changes had been completed in accordance with MARPOL Annex VI regulations, company procedures and vessel specific instructions, including:
    - Engine Room Log Book
    - Any other Log Book used to record fuel changeovers as required by MARPOL Annex VI, Regulation 14.6 (which may be an electronic log book).

Potential Grounds for a Negative Observation

- There was no company procedure describing the changeover of fuel grades onboard.
- There were no ship specific fuel grade changeover procedures.
- The accompanying engineer officer was unfamiliar with the company procedures describing the changeover of fuel grades onboard .
- The accompanying engineer officer was unfamiliar with the vessel specific fuel grade changeover procedures.
- Records for changing of fuel grades were either missing or inaccurate.
- Entries had not been made in the appropriate Log Book to record the volume of low sulphur fuel oils in each tank as well as the date, time and position of the ship on:
    - The completion of the fuel changeover process prior to entering an ECA.
    - The start of the fuel changeover process when departing an ECA.
- The vessel had conducted a fuel changeover in contravention of any geographical or situational safety restrictions contained within the company procedures.
- The vessel had been operating at any stage of the voyage in contravention of MARPOL Annex VI regulations.

10.6. LNG Bunkering Management

10.6.1. Were the Master and officers familiar with the location, purpose and operation of the LNG fuel tank water-spray system for cooling and fire prevention on deck, and was the equipment in good working order, regularly inspected, tested and maintained?

Short Question Text
LNG fuel tank water-spray system

Vessel Types
Oil, Chemical, LPG

ROVIQ Sequence
Main Deck

Publications
IMO: ISM Code
IMO: MSC.1/Circ.1432 Revised guidelines for the maintenance and inspection of fire protection systems and appliances.
IMO: IGF Code

Objective

To ensure that crewmembers can respond effectively to a fire situation in accordance with the shipboard emergency plan.

Industry Guidance

IMO: MSC.1/Circ.1432 Revised guidelines for the maintenance and inspection of fire protection systems and appliances

2 Operational readiness

All fire protection systems and appliances should at all times be in good order and readily available for immediate use while the ship is in service. If a fire protection system is undergoing maintenance, testing or repair, then suitable arrangements should be made to ensure safety is not diminished through the provision of alternate fixed or portable fire protection equipment or other measures. The onboard maintenance plan should include provisions for this purpose.

3 Maintenance and testing

3.1 Onboard maintenance and inspections should be carried out in accordance with the ship's maintenance plan, which should include the minimum elements listed in sections 4 to 10 of these Guidelines.

3.2 Certain maintenance procedures and inspections may be performed by competent crew members who have completed an advanced fire-fighting training course, while others should be performed by persons specially trained in the maintenance of such systems. The onboard maintenance plan should indicate which parts of the recommended inspections and maintenance are to be completed by trained personnel.

3.3 Inspections should be carried out by the crew to ensure that the indicated weekly, monthly, quarterly, annual, two-year, five-year and ten-year actions are taken for the specified equipment, if provided. Records of the inspections should be carried on board the ship or may be computer-based. In cases where the inspections and maintenance are carried out by trained service technicians other than the ship's crew, inspection reports should be provided at the completion of the testing.

3.4 In addition to the onboard maintenance and inspections stated in these Guidelines, manufacturer's maintenance and inspection guidelines should be followed.

3.5 Where particular arrangements create practical difficulties, alternative testing and maintenance procedures should be to the satisfaction of the Administration.

(These guidelines set out requirements applicable to fixed water spray or water mist systems for:

- *Weekly tests and inspections*
- *Monthly tests and inspections*
- *Annual tests and inspections*
- *Five-year servicing)*

TMSA KPI 3.1.4 requires that formal familiarisation procedures are in place for vessel personnel, including contractors. The documented procedures may include familiarisation with:

- Vessel specific operations and equipment.

IMO: ISM Code

6.3 The Company should establish procedures to ensure that new personnel and personnel transferred to new assignments related to safety and protection of the environment are given proper familiarisation with their duties. Instructions which are essential to be provided prior to sailing should be identified, documented and given.

IMO: IGF Code

6.5 Regulations for portable liquefied gas fuel tanks

6.5.1 The design of the tank shall comply with 6.4.15.3. The tank support (container frame or truck chassis) shall be designed for the intended purpose.

6.5.2 Portable fuel tanks shall be located in dedicated areas fitted with:

1. mechanical protection of the tanks depending on location and cargo operations.
2. if located on open deck: spill protection and water spray systems for cooling; and
3. if located in an enclosed space: the space is to be considered as a tank connection space.

11.4 Regulations for fire main

11.4.1 The water spray system required below may be part of the fire main system provided that the required fire pump capacity and working pressure are sufficient for the operation of both the required numbers of hydrants and hoses and the water spray system simultaneously.

11.4.2 When the fuel storage tank(s) is located on the open deck, isolating valves shall be fitted in the fire main in order to isolate damaged sections of the fire main. Isolation of a section of fire main shall not deprive the fire line ahead of the isolated section from the supply of water.

11.5 Regulations for water spray system

11.5.1 A water spray system shall be installed for cooling and fire prevention to cover exposed parts of fuel storage tank(s) located on open deck.

11.5.2 The water spray system shall also provide coverage for boundaries of the superstructures, compressor rooms, pump-rooms, cargo control rooms, bunkering control stations, bunkering stations and any other normally occupied deck houses that face the storage tank on open decks unless the tank is located 10 metres or more from the boundaries.

11.5.3 The system shall be designed to cover all areas as specified above with an application rate of 10 l/min/m2 for the largest horizontal projected surfaces and 4 l/min/m2 for vertical surfaces.

11.5.4 Stop valves shall be fitted in the water spray application main supply line(s), at intervals not exceeding 40 metres, for the purpose of isolating damaged sections. Alternatively, the system may be divided into two or more sections that may be operated independently, provided the necessary controls are located together in a readily accessible position not likely to be inaccessible in case of fire in the areas protected.

11.5.5 The capacity of the water spray pump shall be sufficient to deliver the required amount of water to the hydraulically most demanding area as specified above in the areas protected.

11.5.6 If the water spray system is not part of the fire main system, a connection to the ship's fire main through a stop valve shall be provided.

11.5.7 Remote start of pumps supplying the water spray system and remote operation of any normally closed valves to the system shall be located in a readily accessible position which is not likely to be inaccessible in case of fire in the areas protected.

11.5.8 The nozzles shall be of an approved full-bore type, and they shall be arranged to ensure an effective distribution of water throughout the space being protected.

Inspection Guidance

The vessel operator should have developed a maintenance plan for the vessel’s fire protection systems and fire-fighting systems and appliances which should include the water-spray system for cooling and fire prevention on deck.

Maintenance tasks may include:

- Periodic removal of the installed orifice plates and piping end caps and flushing any debris from the system.
- Cleaning the in-line filters.
- Back flushing the system with fresh water.

Suggested Inspector Actions

- Inspect the space(s) containing the remote controls for the water-spray system for cooling and fire prevention on deck.
- Review the operating instructions for the system posted in the space(s) and verify that the system valves and controls are properly marked and set.
- Review inspection and servicing data available in the space(s).
- Inspect the system piping, particularly on the underside, for external indications of corrosion and for patching.
- Examine a random sample of nozzles for evidence of clogging by debris.
- Request an accompanying crew member to randomly check the isolating valves and stop valves to verify they are operating freely.
- If necessary, review the records of inspections, tests and maintenance carried out contained in the maintenance plan.

- Interview the accompanying officer to verify their familiarity with the purpose and operation of the water spray system with reference to:
    - Starting the pumps.
    - The purpose and location of the isolating valves and stop valves.
    - The purpose and location of the drain point for the deck piping.

Expected Evidence

- The vessel’s maintenance plan for vessel’s fire protection systems and fire-fighting systems and appliances.
- The records of inspections, tests and maintenance carried out on the water-spray system for cooling and fire prevention on deck

Potential Grounds for a Negative Observation

- The operating instructions for the system were not posted at the control station.
- The accompanying officer was not familiar with the location, purpose and operation of the vessel’s water-spray system for cooling and fire prevention on deck.
- Access to the system controls was obstructed.
- The system valves and controls were not properly marked or set.
- Stop valves or isolating valves did not operate freely.
- The stop valves or isolating valves were not clearly marked.
- There was evidence of clogged or overpainted water spray nozzles.
- There was hard rust, deterioration or temporary repairs to the system pipework.
- There was no maintenance plan for the vessel’s fire protection systems and fire-fighting systems and appliances available.
- The maintenance plan for the vessel’s fire protection systems and fire-fighting systems and appliances did not include the vessel’s water-spray system for cooling and fire prevention on deck or, all the required inspections, tests and maintenance.
- Records of inspections, tests and maintenance carried out were incomplete.
- The accompanying officer was unfamiliar with the maintenance plan for the vessel’s fire protection systems and fire-fighting systems and appliances.
- Inspection of the water-spray system for cooling and fire prevention on deck indicated that actions recorded in the maintenance plan had not in fact taken place.
- The water-spray system for cooling and fire prevention on deck was defective in any respect.

10.6.2. Were the Chief Engineer, and those officers and ratings, involved in LNG bunkering operations, familiar with the functions of the vessel's LNG (or other low-flashpoint fuel) bunkering Emergency Shut Down (ESD) systems, and was the equipment in good working order, regularly inspected, tested and maintained?

Short Question Text
LNG gas fuel bunkering ESD system

Vessel Types
Oil, Chemical, LPG

ROVIQ Sequence
Cargo Manifold

Publications
IMO: ISM Code
OCIMF/ICS: International Safety Guide for Oil Tankers and Terminals. Sixth Edition.
IMO: IGF Code
IACS: Rec 142. LNG Bunkering Guidelines (2016)

Objective

To ensure that crewmembers can respond effectively to an emergency while bunkering LNG (or other low-flashpoint fuel) in accordance with the shipboard emergency plan.

Industry Guidance

OCIMF/ICS: International Safety Guide for Oil Tankers and Terminals. Sixth Edition

24.3.2 Transfer equipment requirements for LNG bunkering

Different types of equipment are used to perform LNG bunker transfers: rigid arms, hybrid systems, (rigid structure handling flexible lines) and flexible hoses.

All LNG transfer systems must be equipped with ERS and ESD systems connected via a bunkering safety link. The primary function of the bunkering safety link is to connect the supplier's and receiver's ESD systems, ensuring that in an emergency, either one can initiate a shutdown of liquid and vapour transfer, in a safe coordinated and controlled manner.

SGMF: Gas as a marine fuel. Recommendations for linked emergency shutdown (ESD) arrangements for LNG bunkering. Version 1

Purpose

This Technical Guidance Note (TGN) provides recommendations for the Emergency Shutdown System arrangements, integration, data and voice communication and interfaces for the LNG bunkering of gas-fuelled vessels. It specifically addresses the functional safety principles of the linked ESD system to ensure a controlled shutdown of the bunkering operation in the case of an emergency.

The document responds to the demand for a common approach across the industry for emergency shutdown. It also addresses concerns regarding differing interpretations of emergency shutdown functional requirements, the functional safety principles, and the means of control between a gas fuel supplier and a receiver gas-fuelled vessel over the bunkering operation.

IACS: Rec 142. LNG Bunkering Guidelines (2016)

2.1.6 Emergency Shut-Down (ESD)

These are systems installed as part of the LNG transfer system that are designed to stop the flow of LNG and/or prevent damage to the transfer system in an emergency. The ESD may consist of two parts, they are:

- ESD - stage 1, is a system that shuts the LNG transfer process down in a controlled manner when it receives inputs from one or more of the following; transfer personnel, high or low level LNG tank pressure alarms, cables or other means designed to detect excessive movement between transfer vessels or vessel and an LNG bunkering facility, or other alarms.
- ESD - stage 2, is a system that activates decoupling of the transfer system between the transfer vessels or between a vessel and an LNG bunkering facility. The decoupling mechanism contains quick acting valves designed to contain the contents of the LNG transfer line (dry break) during decoupling.

2.1.7 Emergency Release Coupling (ERC)

The ERC is normally linked to the ESD system where this may be referred to as ESD2 as per SIGTTO “ESD arrangements & linked ship/shore systems for liquefied gas carriers”.

An emergency release coupling is activated:

- By excessive forces applied to the predetermined section, or
- By manual or automated control, in case of emergency.

2.1.8 Emergency Release System (ERS)

A system that provides a positive means of quick release of the transfer system and safe isolation of receiving vessel from the supply source.

5.5 ESD systems

The bunkering facility and receiving ship should be fitted with a linked ESD system such that any activation of the ESD systems should be implemented simultaneously on both bunkering facility and receiving ship. Any pumps and vapour return compressors should be designed with consideration to surge pressure in the event of ESD activation. The bunkering line should be designed and arranged to withstand the surge pressure that may result from the activation of the emergency release coupling and quick closing of ESD valves.

On ESD activation, manifold valves on the receiving ship and bunkering facility and any pump or compressor associated with the bunkering operation are to be shut down except where this would result in a more hazardous situation (see Table 3).

An ESD activation should not lead to LNG being trapped in a pipe between closed valves. An automatic pressure relief system is to be provided that is designed to release the natural gas to a safe location without release to the environment.

If not demonstrated to be required at a higher value due to pressure surge considerations, a suitably selected closing time up to 5 seconds should be selected, depending on the pipe size and bunkering rate from the trigger of the alarm to full closure of the ESD valves, in accordance with the IGF Code.

The emergency shutdown system ESD should be suitable for the capacity of the installation. The minimum alarms and safety actions required for the transfer system are given in Table 3 below:

Table 3: Alarms and safety actions required for the transfer system

- Low pressure in the supply tank
- Sudden pressure drop at the transfer pump discharge

- High level in the receiving tank
- High pressure in the receiving tank
- LNG leakage in bunker station (gas detection/low temperature detection)
- Gas detection in the ducting around the bunkering lines (if applicable). Alert at 20% LEL, ESD activation at 40% of LEL
- Manual activation of shutdown from either the ship to be bunkered or the bunkering installation (ESD1)
- Manual activation of the emergency release coupling from either the ship to be bunkered or the bunkering installation (ESD2)
- Safe working envelope of the loading arm exceeded
- Fire detection (any fire detection on receiving ship or bunker facility)
- Electrical power failure (supplied by independent source of energy, e.g. battery)

Notes:

- Alert is to be made at both the delivery and receiving ends of the transfer system to clearly identify the reasons for the ESD activation.
- In each case, audible/visual alert to be made at bunker station/discharging station and ESD system to be activated.
- Where the parameter that triggers the ESD is such that closure of vapour connection valves and shut down of vapour return compressors would increase the potential hazard (for example a receiving tank high level alarm) these are to remain open/active where appropriate.

The manual activation position for the ESD system should be outside the bunker station and should have a clear view of the manifold area (the ‘clear view’ may be provided via CCTV).

LNG bunker transfer should not be resumed until the transfer system and associated safety systems (fire detection, etc.) are returned to normal operation condition.

TMSA KPI 6.1.2 requires that procedures for pre-operational tests and checks of cargo and bunkering equipment are in place for all vessel types within the fleet. Tests and checks of equipment may include:

- ESD system operation.

IMO: ISM Code

7. The Company should establish procedures, plans and instructions, including checklists as appropriate, for key shipboard operations concerning the safety of the personnel, ship and protection of the environment. The various tasks involved should be defined and assigned to qualified personnel.

IMO: IGF Code

8 Bunkering

8.5.7 A ship-shore link (SSL) or an equivalent means for automatic and manual ESD communication to the bunkering source shall be fitted.

15 Control, Monitoring and Safety Systems

15.4.2 Overflow control

.1 Each liquefied gas fuel tank shall be fitted with a high liquid level alarm operating independently of other liquid level indicators and giving an audible and visual warning when activated.

.2 An additional sensor operating independently of the high liquid level alarm shall automatically actuate a shutoff valve in a manner that will both avoid excessive liquid pressure in the bunkering line and prevent the liquefied gas fuel tank from becoming liquid full.

.4 All elements of the level alarms, including the electrical circuit and the sensor(s), of the high, and overfill alarms, shall be capable of being functionally tested. Systems shall be tested prior to fuel operation in accordance with 18.4.3.

.5 Where arrangements are provided for overriding the overflow control system, they shall be such that inadvertent operation is prevented. When this override is operated continuous visual indication is to be provided at the navigation bridge, continuously manned central control station or onboard safety centre.

15.5 Regulations for bunkering control

15.5.1 Control of the bunkering shall be possible from a safe location remote from the bunkering station. At this location the tank pressure, tank temperature if required by 15.4.11, and tank level shall be monitored. Remotely controlled valves required by 8.5.3(*manifold valve*) and 11.5.7 (*water spray system*) shall be capable of being operated from this location. Overfill alarm and automatic shutdown shall also be indicated at this location.

15.5.3 If gas is detected in the ducting around the bunkering lines an audible and visual alarm and emergency shutdown shall be provided at the bunkering control location.

18.2 Functional requirements

.3 the ship shall be provided with operational procedures including a suitably detailed fuel handling manual, such that trained personnel can safely operate the fuel bunkering, storage and transfer systems.

18.4 Regulations for bunkering operations

18.4.2.1 The fuel handling manual required by 18.2.3 shall include but is not limited to:

.8 emergency shutdown and emergency release systems, where fitted: and

.9 a description of the procedural actions to take in an emergency situation, such as leakage, fire or potential fuel stratification resulting in rollover.

18.4.2.2 A fuel system schematic/piping and instrumentation diagram (P&ID) shall be reproduced and permanently mounted in the ship's bunker control station and at the bunker station.

18.4.3 Pre-bunkering verification

18.4.3.1 Prior to conducting bunkering operations, pre-bunkering verification including, but not limited to the following, shall be carried out and documented in the bunker safety checklist:

.1 all communications methods, including ship shore link (SSL), if fitted.

.4 operation of remote-controlled valves.

18.4.4.4 The ship shore link (SSL) or equivalent means to a bunkering source provided for automatic ESD communications, shall be compatible with the receiving ship and the delivering facility ESD system.

Inspection Guidance

The vessel operator should have developed procedures for the operation, inspection, maintenance and testing of the vessel’s LNG (or other low-flashpoint fuel) bunkering Emergency Shut Down (ESD) system which defined the:

- Functions and operation of the ESD systems.
- Actions to take in the event of an ESD system failure.
- Contingency plans in the event of non-availability of the ESD ship/shore link system, if fitted.
- Frequency and method of inspection, maintenance and testing of the ESD systems, including pre-operational checks.

The fuel handling manual may form part of these procedures.

The Chief Engineer and engineer officers should be familiar with the bunkering ESD systems installed on their vessel, its initiators and its shutdown actions.

Deck officers and ratings involved in the bunkering operation should be familiar with the manual activation of the bunkering ESD systems.

Suggested Inspector Actions

- Sight, and where necessary review, the company procedures that defined the operation, inspection, maintenance and testing of the vessel's bunkering emergency shutdown (ESD) systems.
- Sight and review any checklists used to conduct tests of the bunkering ESD systems.
- If necessary, review the records of inspections, maintenance and tests carried out contained within the planned maintenance system.
- Inspect the bunker station and the remote bunker control station, including control panels and the fuel system schematic/piping and instrumentation diagram.
- Where the ESD system is fitted with an override function, verify that there are clear procedures to ensure that this function can only be used under the direct authority of the Master.

- Interview the accompanying officer to verify their familiarity with the purpose, operation, and testing of the bunkering ESD systems.
- Interview a rating and verify their familiarity with the location of the manual bunkering ESD controls and circumstances in which the bunkering ESD system should be manually activated.

Expected Evidence

- The company procedures for the operation, inspection, maintenance and testing of the vessel's bunkering ESD systems.
- The completed checklist used to conduct the pre-arrival tests on the bunker ESD system prior to the previous LNG bunker transfer operation.
- Records of the inspection, maintenance and testing of the vessel's bunkering ESD systems.
- The fuel handling manual.

Potential Grounds for a Negative Observation

- The Chief Engineer and officers directly involved in bunker operations were not familiar with the vessel's bunkering ESD systems.
- Instrumentation and controls at the bunker control station were not fully operative.
- A fuel system schematic/piping and instrumentation diagram was not posted at the bunker station or at the remote bunker control station.
- There was no fuel handling manual available.
- The fuel handling manual did not describe the bunkering ESD system.
- There was no record of checks and tests of the bunkering ESD systems before bunkering operations began.
- Records of inspections, maintenance and tests carried out were incomplete.
- The accompanying officer was not familiar with the purpose, operation and testing of the ESD systems.

- An interviewed rating directly involved in LNG bunkering operations was not familiar with the location of the manual control of the bunker ESD or the circumstances under which it should be activated.
- Inspection of the bunkering ESD systems indicated that actions recorded in the planned maintenance system had not in fact taken place.
- The ESD link system was not available for use.
- Company procedures did not include a contingency plan for the circumstances where the ESD link system, if fitted, was not available.
- The bunkering ESD system was defective in any respect.
- The bunkering ESD system had been overridden during a bunkering operation without the documented authorisation of the Master.

10.6.3. Were the Chief Engineer, and those officers and ratings involved in LNG bunkering operations, familiar with the company LNG (or other low-flashpoint fuel) bunkering procedures, and were records available to demonstrate that bunker operations had been planned and conducted in accordance with the company procedures?

Short Question Text
LNG (or other low-flashpoint fuel) bunkering procedures.

Vessel Types
Oil, Chemical, LPG

ROVIQ Sequence
Engine Control Room, Chief Engineer's Office, Interview - Engine Rating

Publications
IMO: ISM Code
OCIMF/ICS: International Safety Guide for Oil Tankers and Terminals. Sixth Edition.
IMO: IGF Code

Objective

To ensure that LNG (or other low-flashpoint fuel) bunkering operations are planned and conducted in accordance with industry best practice guidance.

Industry Guidance

OCIMF/ICS: International Safety Guide for Oil Tankers and Terminals. Sixth Edition

24.1 Bunkering in General

Bunkering is a critical operation and requires care to ensure safety and to reduce the risk of pollution.

Bunkering operations should be planned and carried out in line with legislation, standards and best practice guidelines to minimize the risk from the flammability, toxicity, cryogenic nature, volatility or pressure of the fuel being handled.

Vessel operators should manage the risks by ensuring that the crew is familiar with the management procedures for bunker operations and that they have all completed the appropriate training.

The crew designated to bunkering on board should have no other tasks during the operation. This is particularly important when bunkers are being loaded at the same time as cargo. Spills often occur when staff are distracted by other jobs.

24.3 Liquefied Natural Gas fuelled ships and Liquefied Natural Gas bunkering

The cryogenic nature and volatility of LNG means that its properties, characteristics, and behaviour are very different to conventional marine fuels. This means additional precautions are needed as described below.

24.3.2.4 Boil-Off Gas and pressure control

Boil-Off Gas (BOG) is produced by LNG fuel systems when the storage tanks absorb heat from the environment. Additional BOG may be produced during bunkering operations due to flashing, etc. If this BOG is not managed, it may result in an increase of temperature and pressure in the storage tank. Eventually the pressure relief valves may operate, allowing a release of LNG to the environment.

Vapour control during bunkering operations is critical and can be handled in several different ways including:

- Vapour return Line (VRL) allowing the vapour displaced from the receiving tank to be returned to the supplier’s tank.
- Pressure accumulation in suitably constructed tanks.
- BOG and LNG conditioning provisions, such as sub-cooler.
- Burning of BOG in an approved consumer, such as a Gas Combustion unit (GCU) or Dual Fuel Diesel Engine (DFDE).
- Cooling via top spraying/filling in storage tanks.

Personnel responsible for LNG bunkering operations should be fully familiar with the means fitted to their ship or facility to control BOG and the associated procedures.

The IGF Code states that venting of fuel vapour for the control of the tank pressure is not acceptable except in emergency situations and that LNG fuelled ships must be fitted with means of maintaining tank pressure below the set pressure of the relief valves, with the ship in idle condition, for 15 days.

24.5 Alternative fuels

The characteristics and behaviour of alternative fuels, such as Liquefied Petroleum Gas (LPG), hydrogen (H2), ammonia (NH4) and methanol (CH3OH), are significantly different to conventional marine fuels and LNG. Risks should be mitigated and avoided. Throughout the alternative fuel bunker chain, each element should be carefully designed and constructed. Dedicated safety, operational and maintenance procedures should be in place to be executed by trained personnel.

Most of the guidelines in section 24.1 apply to all possible alternative fuels.

24.6 Bunker checklists

Safe bunker operations depend on good communication between the bunker vessel and the receiving ship, from pre-arrival to post-departure, and on compliance with the agreed safe procedures at all stages. The bunker checklists help to ensure that all the appropriate checks are formally agreed, carried out and recorded.

24.7 Liquefied Natural Gas bunkering safety checklists

ISO have produced LNG bunker checklist to support the IGF Code. These are contained in ISO 20519:2017 Ships and marine technology - Specification for bunkering of liquefied natural gas fuelled vessels.

In addition, the International Association of Ports and Harbours (IAPH) has developed harmonised checklists for known LNG bunkering scenarios: STS, shore to ship and truck to ship. These checklists are available on the lngbunkering.org website and aim to standardised procedures across different ports/countries. ISO 20519 allows alternative checklist to be used as long as they contain at least the same information that is listed in its own checklists.

The checklists developed by IAPH may be used in place of the standard ISO 20519 checklists if:

1. Both parties agree to use the alternative checklists.
2. The competent authorities permit their use.
3. The checklists are used from pre-operations through to the completion of the transfer (no mixing of checklists).

TMSA KPI 6.2.5 requires that comprehensive procedures cover all aspects of bunkering operations for each vessel type within the fleet.

Operational procedures address:

- Pre-arrival checks.
- Pipeline/hose connection including supervision of third-party personnel.

- Bunker safety checklist including interface and communications.
- Bunker tank gauging.
- Agreed initial bulk transfer and topping off rates.
- Draining/blowing lines and disconnection of hoses.

IMO: ISM Code

7 The Company should establish procedures, plans and instructions, including checklists as appropriate, for key shipboard operations concerning the safety of the personnel, ship and protection of the environment. The various tasks involved should be defined and assigned to qualified personnel.

IMO: IGF Code

1 Preamble

The current version of this Code includes regulations to meet the functional requirements for natural gas fuel. Regulations for other low-flashpoint fuels will be added to this Code as, and when, they are developed by the Organization. In the meantime, for other low-flashpoint fuels, compliance with the functional requirements of this Code must be demonstrated through alternative design.

18 Operation

18.2 Functional requirements

1. the ship shall be provided with operational procedures including a suitably detailed fuel handling manual, such that trained personnel can safely operate the fuel bunkering, storage and transfer systems;

18.4 Regulations for bunkering operations

18.4.1 Responsibilities

18.4.1.1 Before any bunkering operation commences, the master of the receiving ship or his representative and the representative of the bunkering source (Persons in Charge, PIC) shall:

1. agree in writing the transfer procedure, including cooling down and if necessary, gassing up; the maximum transfer rate at all stages and volume to be transferred;
2. agree in writing action to be taken in an emergency; and
3. complete and sign the bunker safety check-list.

18.4.2 Overview of control, automation and safety systems

18.4.2.1 The fuel handling manual required by 18.2.3 shall include but is not limited to:

1. overall operation of the ship from dry-dock to dry-dock, including procedures for system cool down and warm up, bunker loading and, where appropriate, discharging, sampling, inerting and gas freeing;
2. bunker temperature and pressure control, alarm and safety systems;
3. system limitations, cool down rates and maximum fuel storage tank temperatures prior to bunkering, including minimum fuel temperatures, maximum tank pressures, transfer rates, filling limits and sloshing limitations;
4. operation of inert gas systems;
5. firefighting and emergency procedures: operation and maintenance of firefighting systems and use of extinguishing agents;
6. specific fuel properties and special equipment needed for the safe handling of the particular fuel;
7. fixed and portable gas detection operation and maintenance of equipment;
8. emergency shutdown and emergency release systems, where fitted; and

9. a description of the procedural actions to take in an emergency situation, such as leakage, fire or potential fuel stratification resulting in rollover.

18.4.3 Pre-bunkering verification

18.4.3.1 Prior to conducting bunkering operations, pre-bunkering verification including, but not limited to the following, shall be carried out and documented in the bunker safety checklist:

1. all communications methods, including ship shore link (SSL), if fitted;
2. operation of fixed gas and fire detection equipment;
3. operation of portable gas detection equipment;
4. operation of remote controlled valves; and
5. inspection of hoses and couplings.

18.4.3.2 Documentation of successful verification shall be indicated by the mutually agreed and executed bunkering safety checklist signed by both PIC's.

Inspection Guidance

The vessel operator should have developed LNG (or other low-flashpoint fuel) bunkering procedures and suitable bunker safety checklists (e.g., ISO or IAPH) which included:

- The preparation of a detailed bunker transfer plan for each operation.
- Roles and responsibilities for personnel involved in the bunkering operation.
- Description of the bunkering system, including emergency shutdown (ESD) and emergency release systems (ERS), where fitted.
- Hazards when connecting/disconnecting hoses or hard arms.
- Pre-bunkering verification of:
    - All communication methods, including ship shore link (SSL), if fitted.
    - Operation of fixed gas and fire detection equipment.
    - Operation of portable gas detection equipment.
    - Operation of remote controlled valves.
    - Inspection of hoses and couplings.
- Procedures for cooling down and if necessary, gassing up.
- Line draining method and nitrogen purging sequence/arrangements.
- Method for tank pressure control and boil-off gas (BOG) return if provided.
- Protection arrangement for the ship’s side against possible leaks.
- Maximum tank filling limits, transfer rates and topping off rates.
- Manning for deck and control room operations.
- Actions to be taken in an emergency.
- Records to be kept.

These procedures may form part of the Fuel Handling Manual required by the IGF Code.

Where the vessel uses a low-flashpoint fuel other than LNG, procedures and checklists should comply, as far as possible, with the requirements of the IGF Code.

Suggested Inspector Actions

- Sight, and where necessary review the company procedures for bunkering operations of LNG (or other low-flashpoint fuel).
- Sight, and where necessary review the Fuel Handling Manual required by the IGF Code.
- Review a recent bunker transfer plan and verify that it:
    - Identified the personnel involved in the bunkering operation and their designated duties.
    - Ensured that personnel involved in the bunkering operation were not assigned conflicting tasks during the bunkering.

    - Contained all information required by the company procedure.
    - Had been signed for understanding by all officers involved in the bunkering operation.
    - Had been signed by both the Master and Chief Engineer for approval.
- Review the records of the same bunker operation and verify that:
    - Suitable checklists had been used consistently (e.g., ISO or IAPH).
    - Checklists were completed before, during and after the bunkering operation to ensure that all required safety and environmental protection measures were completed.
    - The bunker transfer followed the plan as presented.
    - Records included sufficient detail, e.g., tank pressures, temperatures and transfer rates of the transfer operation.

- Where the vessel was involved in an LNG bunkering operation during the inspection or had been involved in an LNG bunkering operation within the previous two months, interview one officer or rating identified in the bunkering plan as having a role or responsibility in the bunkering operation, to gauge their familiarity with the bunker transfer plan and their role in the bunkering operation.

Expected Evidence

- Company procedures for bunkering operations of LNG (or other low-flashpoint fuel).
- Fuel Handling Manual required by the IGF Code.
- Plans for recent bunker transfer operations.
- Records for recent bunker transfer operations, including completed checklists.

Potential Grounds for a Negative Observation

- There were no company procedures that included:
    - The preparation of a detailed bunker transfer plan for each operation.
    - Roles and responsibilities of the personnel involved in the bunkering operation.
    - Description of the bunkering system, including emergency shutdown (ESD) and emergency release systems (ERS), where fitted.
    - Hazards when connecting/disconnecting hoses or hard arms.
    - Pre-bunkering verification of:
        - All communication methods, including ship shore link (SSL), if fitted.
        - Operation of fixed gas and fire detection equipment.
        - Operation of portable gas detection equipment.
        - Operation of remote controlled valves.
        - Inspection of hoses and couplings.
    - Guidance on cooling down and if necessary, gassing up.
    - Line draining method and nitrogen purging sequence/arrangements.
    - Method for tank pressure control and boil-off gas (BOG) return if provided.
    - Protection arrangement for the ship’s side against possible leaks.
    - Maximum tank filling limits, transfer rates and topping off rates.
    - Manning for deck and control room operations.
    - Actions to be taken in an emergency.
    - Records to be kept.
- Suitable LNG (or other low-flashpoint fuel) bunker safety checklists (e.g., ISO or IAPH) were not available.
- The accompanying officer was unfamiliar with the company procedures for bunkering operations of LNG (or other low-flashpoint fuel).
- There was no suitably detailed Fuel Handling Manual available.
- When interviewed, a person identified as having a role or responsibility in a bunkering operation was unfamiliar with the duties assigned to them within the bunker transfer plan.
- The reviewed bunker transfer plan did not contain key information required by the company procedure.
- The bunker transfer plan did not identify the personnel, and their assigned roles, required to be involved in the bunkering operation.
- The reviewed bunker transfer plan was not signed by all officers involved and/or was not approved by the Master and Chief Engineer.

- The reviewed bunker transfer records indicated that the bunker transfer plan was not followed.
- The reviewed bunkering records were insufficiently detailed to permit the reconstruction of the bunkering operation for comparison with the bunker transfer plan.
- Checklists required to be completed before, during and/or after the bunkering operation had not been completed.
- Mixed checklists (ISO/IAPH) had been completed at different stages of the operation.
- Bunker transfer plans did not include calculations of temperature, volume and vapour pressure of the LNG (or other low-flash point fuel) to be transferred and/or the tank to be loaded.
- The bunkering safety checklist had not been signed by both PICs.
- The bunker transfer plan did not identify conditions under which bunkering should be stopped, and the conditions to be met before the bunkering operation could be restarted.
- A pre-bunkering verification, prior to conducting bunkering operations, had not been carried out and documented in the bunker safety checklist.

10.6.4. Were the safety measures at the bunkering control station and bunkering manifold area in satisfactory condition?

Short Question Text
LNG fuel bunkering control station and manifold.

Vessel Types
Oil, Chemical, LPG

ROVIQ Sequence
Main Deck, Aft Mooring Deck

Publications
IMO: ISM Code
IMO: IGF Code
IACS: Rec 142. LNG Bunkering Guidelines (2016)

Objective

To ensure safety measures at the bunker control station and in the bunker manifold area are in satisfactory condition.

Industry Guidance

IACS: Rec 142. LNG Bunkering Guidelines (2016)

1.5.6 Protection of the hull plate, shell side and ship structure

Protection from cryogenic brittle fracture of the receiving ship deck and structure caused by leakage of LNG should be fitted as per IGF code requirements. When appropriate one or more of the following protective measures may be utilised:

- A water curtain may be installed to protect the ship's hull.
- A cover of suitable material grade to withstand LNG temperatures may be installed underneath the transfer hose to protect deck plating.
- A drip tray of suitable material grade to withstand LNG temperatures may be fitted below the pipe coupling to collect LNG spill.

5.4 Leakage detection

CCTV is recommended to observe the bunkering operation from the bridge or operation control room. The CCTV should provide images of the bunker connection and also, if possible, the bunker hose, such that movement of the transfer system during bunkering is visible. CCTV is particularly recommended for enclosed bunker stations. Where CCTV is not provided, a permanent watch should be maintained from a safe location.

TMSA KPI 6.2.5 requires that comprehensive procedures cover all aspects of bunkering operations for each vessel type within the fleet.

Operational procedures address:

- Pre-arrival checks.
- Pipeline/hose connection including supervision of third-party personnel.
- Bunker safety checklist including interface and communications.
- Bunker tank gauging.
- Agreed initial bulk transfer and topping off rates.
- Draining/blowing lines and disconnection of hoses.

IMO: ISM Code

7 The Company should establish procedures, plans and instructions, including checklists as appropriate, for key shipboard operations concerning the safety of the personnel, ship and protection of the environment. The various tasks involved should be defined and assigned to qualified personnel.

IMO: IGF Code

5.10 Regulations for drip trays

5.10.1 Drip trays shall be fitted where leakage may occur which can cause damage to the ship structure or where limitation of the area which is affected from a spill is necessary.

5.10.2 Drip trays shall be made of suitable material.

5.10.3 The drip tray shall be thermally insulated from the ship's structure so that the surrounding hull or deck structures are not exposed to unacceptable cooling, in case of leakage of liquid fuel.

5.10.4 Each tray shall be fitted with a drain valve to enable rainwater to be drained over the ship's side.

5.10.5 Each tray shall have a sufficient capacity to ensure that the maximum amount of spill according to the risk assessment can be handled.

8.5.3 A manually operated stop valve and a remote operated shutdown valve in series, or a combined manually operated and remote valve shall be fitted in every bunkering line close to the connecting point. It shall be possible to operate the remote valve in the control location for bunkering operations and/or from another safe location.

11.5.7 Remote start of pumps supplying the water spray system and remote operation of any normally closed valves to the system shall be located in a readily accessible position which is not likely to be inaccessible in case of fire in the areas protected.

15.5 Regulations for bunkering control

15.5.1 Control of the bunkering shall be possible from a safe location remote from the bunkering station. At this location the tank pressure, tank temperature if required by 15.4.11, and tank level shall be monitored. Remotely controlled valves required by 8.5.3 and 11.5.7 shall be capable of being operated from this location. Overfill alarm and automatic shutdown shall also be indicated at this location.

15.5.2 If the ventilation in the ducting enclosing the bunkering lines stops, an audible and visual alarm shall be provided at the bunkering control location, see also 15.8.

15.5.3 If gas is detected in the ducting around the bunkering lines an audible and visual alarm and emergency shutdown shall be provided at the bunkering control location.

18.4.6.1 Warning signs shall be posted at the access points to the bunkering area listing fire safety precautions during fuel transfer.

18.4.6.2 During the transfer operation, personnel in the bunkering manifold area shall be limited to essential staff only. All staff engaged in duties or working in the vicinity of the operations shall wear appropriate personal protective equipment (PPE). A failure to maintain the required conditions for transfer shall be cause to stop operations and transfer shall not be resumed until all required conditions are met.

Inspection Guidance

At the bunkering control location, which should be in a safe area, the following controls and instrumentation should be available and operational:

- Controls for the remote operated shutdown valve at the manifold.
- Controls for the remote operated valves in the water spray system.
- Indicators for fuel tank pressure, temperature and tank level.
- Overfill and automatic shutdown alarm.
- Audible and visual alarms for ventilation failure and gas detection in the ducting around the bunker lines.

If CCTV of the bunkering manifold area is fitted, it should be operational. If it is not fitted, a manifold watch should be maintained from a safe location during bunkering operations.

At the bunkering manifold area, suitable protection against cryogenic brittle fracture of the ship's deck or structure should be provided such as a:

- Water curtain to protect the ship's hull.
- Thermal blanket or cover to protect deck plating.
- Drip tray of suitable size and material that is thermally insulated from the ship's structure and fitted with a drain valve.

The bunker manifold area should be visibly restricted to essential personnel only, and fire safety warning signs should also be posted at the access points. All personnel in the vicinity of the bunkering operations should wear appropriate PPE taking into account the cryogenic hazards.

Suggested Inspector Actions

- Inspect the bunkering manifold area.
- Inspect the bunkering control location and as far as is safe and practicable, verify the controls, instrumentation and alarms located there are operational.

Expected Evidence

None

Potential Grounds for a Negative Observation

- The bunkering control location was not in a safe area.
- The bunkering control location was not equipped with one or more of the following, or one or more of the controls or instruments was not operational:
    - Controls for the remote operated shutdown valve at the manifold.
    - Controls for the remote operated valves in the water spray system.
    - Indicators for fuel tank pressure, temperature and tank level.
    - Overfill and automatic shutdown alarm.
    - Audible and visual alarms for ventilation failure and gas detection in the ducting around the bunker lines.
- CCTV of the bunkering manifold area was fitted but not operational or in use.
- At the bunkering manifold area, there was no suitable protection against cryogenic brittle fracture of the ship's deck or structure.
- Thermally insulated drip tray(s) were not fitted where fuel leakage may reasonably be expected, e.g., at the manifold connection.
- The water curtain protecting the ship's hull was not operational or was not being utilised during bunkering operations.
- The bunkering manifold area was not visibly restricted to essential personnel only.
- There were no fire safety signs at the access points to the bunkering manifold area.
- Personnel working or on duty at the bunkering manifold area were not wearing suitable PPE.

10.7. Fire Protection Measures

10.7.1. Were the Master and officers familiar with the location, purpose, testing and operation of the vessel's remote controls for fuel and lube oil valves, emergency fuel and lube oil pump shut-offs and oil tank quick closing valves, and were the systems in good working order?

Short Question Text
Remote controls for fuel and lube oil system valves

Vessel Types
Oil, Chemical, LPG, LNG

ROVIQ Sequence
Engine Room, Engine Control Room, Emergency Headquarters.

Publications
IMO: ISM Code
IMO SOLAS
IMO: MSC.1/Circ.1432 Revised guidelines for the maintenance and inspection of fire protection systems and appliances.

Objective

To ensure that crewmembers can respond effectively to a fire situation in accordance with the shipboard emergency plan.

Industry Guidance

IMO: MSC.1/Circ.1432 Revised guidelines for the maintenance and inspection of fire protection systems and appliances.

2 Operational readiness

All fire protection systems and appliances should at all times be in good order and readily available for immediate use while the ship is in service. If a fire protection system is undergoing maintenance, testing or repair, then suitable arrangements should be made to ensure safety is not diminished through the provision of alternate fixed or portable fire protection equipment or other measures. The onboard maintenance plan should include provisions for this purpose.

3 Maintenance and testing

3.1 Onboard maintenance and inspections should be carried out in accordance with the ship's maintenance plan, which should include the minimum elements listed in sections 4 to 10 of these Guidelines.

3.2 Certain maintenance procedures and inspections may be performed by competent crew members who have completed an advanced fire-fighting training course, while others should be performed by persons specially trained in the maintenance of such systems. The onboard maintenance plan should indicate which parts of the recommended inspections and maintenance are to be completed by trained personnel.

3.3 Inspections should be carried out by the crew to ensure that the indicated weekly, monthly, quarterly, annual, two-year, five-year and ten-year actions are taken for the specified equipment, if provided. Records of the inspections should be carried on board the ship or may be computer-based. In cases where the inspections and maintenance are carried out by trained service technicians other than the ship's crew, inspection reports should be provided at the completion of the testing.

3.4 In addition to the onboard maintenance and inspections stated in these Guidelines, manufacturer's maintenance and inspection guidelines should be followed.

3.5 Where particular arrangements create practical difficulties, alternative testing and maintenance procedures should be to the satisfaction of the Administration.

TMSA KPI 3.1.4 requires that formal familiarisation procedures are in place for vessel personnel, including contractors. The documented procedures may include familiarisation with:

- Vessel specific operations and equipment.

IMO: ISM Code

6.3 The Company should establish procedures to ensure that new personnel and personnel transferred to new assignments related to safety and protection of the environment are given proper familiarisation with their duties. Instructions which are essential to be provided prior to sailing should be identified, documented and given.

IMO: SOLAS

Remote controls for fuel and lube oil valves

Chapter II-2 Regulation 4

2.2.3.4 Oil fuel pipes, which, if damaged, would allow oil to escape from a storage, settling or daily service tank having a capacity of 500 l and above situated above the double bottom, shall be fitted with a cock or valve directly on the tank capable of being closed from a safe position outside the space concerned in the event of a fire occurring in the space in which such tanks are situated. In the special case of deep tanks situated in any shaft or pipe tunnel or similar space, valves on the tank shall be fitted, but control in the event of fire may be effected by means of an additional valve on the pipe or pipes outside the tunnel or similar space. If such an additional valve is fitted in the machinery space it shall be operated from a position outside this space. The controls for remote operation of the valve for the emergency generator fuel tank shall be in a separate location from the controls for remote operation of other valves for tanks located in machinery spaces.

Emergency fuel and lube oil pump shut-offs

Chapter II-2 Regulation 5

2.2.3 Means of control shall be provided for stopping forced and induced draught fans, oil fuel transfer pumps, oil fuel unit pumps, lubricating oil service pumps, thermal oil circulating pumps and oil separators (purifiers). However, paragraphs 2.2.4 and 2.2.5 need not apply to oily water separators.

2.2.4 The controls required in paragraphs 2.2.1 to 2.2.3 and in regulation 4.2.2.3.4 shall be located outside the space concerned so they will not be cut off in the event of fire in the space they serve.

Chapter II-2 Regulation 14

2.2 Maintenance, testing and inspections

2.2.1 Maintenance, testing and inspections shall be carried out based on the guidelines developed by the Organization, (Refer to the Revised Guidelines for the maintenance and inspection of fire protection systems and appliances (MSC/Circ.1432)) and in a manner having due regard to ensuring the reliability of fire-fighting systems and appliances.

2.2.2 The maintenance plan shall be kept on board the ship and shall be available for inspection whenever required by the Administration.

2.2.3 The maintenance plan shall include at least the following fire protection systems and firefighting systems and appliances, where installed:

.6 emergency shut down of fuel supply.

2.2.4 The maintenance programme may be computer-based.

Inspection Guidance

The vessel operator should have developed procedures which defined the frequency and method of inspection, testing and maintenance of:

- The remote controls for fuel and lube oil quick closing valves.
- The emergency fuel and lube oil pump shut-offs.

Suggested Inspector Actions

- Sight, and where necessary review the company procedures for the inspection, testing and maintenance of the remote controls for fuel and lube oil valves and emergency fuel and lube oil pump shut-offs and oil tank quick closing valves.
- Inspect the remote controls for fuel and lube oil valves and emergency fuel and lube oil pump shut-offs as shown on the vessel's fire control plan and ensure they are:
    - In good order.
    - Not obstructed.
    - Clearly marked and identified with the equipment they control.
- Inspect the oil tank quick closing valves and ensure they are:
    - In good order.
    - Properly armed.
    - Not secured open by external means.
- Where necessary review the inspection, testing and maintenance records for:
    - The fuel and lube oil quick closing valves including their remote-control systems.
    - The emergency fuel and lube oil pump shut-off.

- Interview the accompanying officer to verify their familiarity with the location, purpose and operation of the remote controls for fuel and lube oil valves and emergency fuel and lube oil pump shut-offs, and oil tank quick closing valves.

Expected Evidence

- The company procedures for the inspection, testing and maintenance of the remote controls for fuel and lube oil valves and emergency fuel and lube oil pump shut-offs and oil tank quick closing valves.
- The vessel's maintenance plan for vessel's fire protection systems and fire-fighting systems and appliances.
- The records of inspections, tests and maintenance carried out on the remote controls for fuel and lube oil valves and emergency fuel and lube oil pump shut-offs and oil tank quick closing valves.

Potential Grounds for a Negative Observation

- There was no company procedure for the inspection, testing and maintenance of the remote controls for fuel and lube oil valves and emergency fuel and lube oil pump shut-offs and oil tank quick closing valves.
- The remote controls for fuel and lube oil valves and emergency fuel and lube oil pump shut-offs were not clearly marked and identified.
- The access to remote controls for fuel and lube oil valves and emergency fuel and lube oil pump shut-offs was obstructed.

- Quick closing valve(s) were not properly armed.
- Quick closing valve(s) were secured open by external means.
- The accompanying officer was unfamiliar with:
  - The purpose, location and operation of the remote controls for fuel and lube oil valves and emergency fuel and lube oil pump shut-offs.
  - The purpose, location and operation of the oil tank quick closing valves.
- The maintenance plan for the vessel's fire protection systems and fire-fighting systems and appliances did not include the remote controls for fuel and lube oil valves and emergency fuel and lube oil pump shut-offs, and quick closing valves or all the required inspections, tests and maintenance.
- There was no maintenance plan for the vessel's fire protection systems and fire-fighting systems and appliances available.
- The accompanying officer was unfamiliar with the maintenance plan for the vessel's fire protection systems and fire-fighting systems and appliances.
- Records of inspections, tests and maintenance carried out were incomplete.
- Inspection of the remote controls for fuel and lube oil valves and emergency fuel and lube oil pump shut-offs, and quick closing valves indicated that actions recorded in the plan had not in fact taken place.
- The remote controls for fuel and lube oil valves and emergency fuel and lube oil pump shut-offs, or quick closing valves were defective in any way.

10.7.2. Were the Master and officers familiar with the measures to prevent fire in the machinery spaces caused by flammable liquid spraying onto a hot surface and, were the protective measures provided regularly inspected and properly maintained?

Short Question Text
Fire prevention in machinery spaces - hot surfaces and oil spray

Vessel Types
Oil, Chemical, LPG, LNG

ROVIQ Sequence
Engine Room

Publications
IMO SOLAS
IMO: MSC.1/Circ. 1321 Guidelines for measures to prevent fires in engine-rooms and cargo pump-rooms.
IMO: ISM Code
IACS: Recommendation No.18. Fire Prevention in Machinery Spaces of Ships in Service – Guidance to Owners.

Objective

To ensure fire prevention measures relating to hot surfaces and flammable liquids in the machinery space are understood and properly maintained.

Industry Guidance

IMO: MSC.1/Circ.1321 Guidelines for measures to prevent fires in engine-rooms and cargo pump-rooms

Part 2 Chapter 2 Piping system

2 Flexible pipes, hoses and hose assemblies

2.5.1 Hose assemblies should be inspected frequently and maintained in good order or replaced when there is evidence of distress likely to lead to failure. Any of the following conditions may require replacement of the hose assembly:

- leaks at fitting or in flexible hose.
- damaged, cut or abraded cover.
- kinked, crushed, flattened or twisted flexible hose.
- hard, stiff, heat cracked or charred flexible hose.
- blistered, soft, degraded or loose cover.
- cracked, damaged or badly corroded fittings; and
- fitting slippage on flexible hose.

5 Insulation materials

5.3 Inspection and maintenance

A regular check of equipment should be made to confirm that the insulation is in place. When maintenance or repair of equipment has been carried out, checks should be made to ensure that the insulation covering the high temperature or hot surfaces has been properly reinstalled or replaced; surface temperature should be measured if considered necessary.

7 Pipe fittings

7.2 Installation

Pipe fittings, including flanged connections should be carefully tightened without exceeding permissible torque. If necessary, suitable spray shields or sealing tape should be used around flange joints and screwed pipe fittings to prevent oil spraying onto hot surfaces in the event of a leakage.

Part 3 Chapter 1 Control of flammable oils

2 Spray shields for joints of pressurized flammable oil piping systems

2.1 Application

Spray shields should be fitted around flanged joints, flanged bonnets and any other flanged or threaded connections of oil fuel and lubricating oil systems having an internal pressure exceeding 0.18 N/mm2 which have the possibility of being in contact with potential ignition sources by direct spray or by reflection. The purpose of spray shields is to prevent the impingement of sprayed flammable oils onto a high temperature surface or other source of ignition.

2.2 Design and installation

2.2.1 Many types of spray shields are possible to avoid spray at flanged connections. For example, the following may be treated as spray shield:

- *thermal insulation having sufficient thickness*
- *anti-splashing tape made of approved materials*
- *an anti-spray cover wrapped around the side of flange*

2.3 Inspection and maintenance

Spray shields should be inspected regularly for their integrity and any which have been removed for maintenance purposes should be refitted on completion of the task according to the manufacturer’s instructions

3 Jacketed high-pressure fuel lines of internal combustion engines

3.1 Application

3.1.1 All external high-pressure fuel delivery lines between the high-pressure fuel pumps and fuel injectors are required to be protected with a jacketed piping system capable of containing fuel from a high-pressure line failure.

3.4 Inspection and maintenance

Regardless of the system selected, little additional maintenance or periodic inspection is required to keep the jacketed fuel lines in proper working order. However, jacketed pipes should be inspected regularly and any drainage arrangement which may have been disconnected for maintenance purposes should be refitted on completion of the task.

Part 3 Chapter 2 Control Of Ignition Source

1 Insulation of hot surfaces and high temperature surfaces

1.2 Inspection and maintenance

1.2.1 A regular check of equipment or material should be made to confirm that the insulation is correctly installed. When maintenance or repair to equipment has been carried out, checks should be made to ensure that the insulation covering the heated surfaces has been properly reinstalled or replaced. Special attention should be paid to the following:

- insulation areas where vibration may be present.
- discontinuous part of exhaust gas piping and turbo charger; and
- other suspect parts.

IACS: Recommendation No.18 (Rev.2). Fire Prevention in Machinery Spaces of Ships in Service – Guidance to Owners.

1.1 Based in past experience it is known that the combination of combustible materials and sources of ignition are the main causes of machinery space fires. The combustible material involved in the majority of cases oil, i.e. fuel oil, lubricating oil, thermal oil or hydraulic oil…

1.2 There is a large variety of potential ignition sources and the most common are hot surfaces, e.g. exhaust pipes and steam pipes, overheating of machinery or ignition from electrical installations due to short circuiting or sparks caused by operation of switchgear…

TMSA KPI 4.1.1 requires that each vessel in the fleet is covered by a planned maintenance system and spare parts inventory which reflects the company's maintenance strategy. The company identifies all equipment and machinery required to be included in the planned maintenance system, for example:

- Engine machinery.

IMO: ISM Code

10.1 The Company should establish procedures to ensure that the ship is maintained in conformity with the provisions of the relevant rules and regulations and with any additional requirements which may be established by the Company.

IMO: SOLAS

Chapter II-2 Regulation 4

2.2.5.2 External high-pressure fuel delivery lines between the high-pressure fuel pumps and fuel injectors shall be protected with a jacketed piping system capable of containing fuel from a high-pressure line failure. A jacketed pipe incorporates an outer pipe into which the high-pressure fuel pipe is placed, forming a permanent assembly. The jacketed piping system shall include a means for collection of leakages and arrangements and shall be provided with an alarm in case of a fuel line failure.

2.2.5.3 Oil fuel lines shall not be located immediately above or near units of high temperature including boilers, steam pipelines, exhaust manifolds, silencers or other equipment required to be insulated by paragraph 2.2.6. As far as practicable, oil fuel lines shall be arranged far apart from hot surfaces, electrical installations or other sources of ignition and shall be screened or otherwise suitably protected to avoid oil spray or oil leakage onto the sources of ignition. The number of joints in such piping systems shall be kept to a minimum.

2.2.6.1 Surfaces with temperatures above 220 degrees C which may be impinged as a result of a fuel system failure shall be properly insulated.

2.2.6.2 Precautions shall be taken to prevent any oil that may escape under pressure from any pump, filter or heater from coming into contact with heated surfaces.

Inspection Guidance

The vessel operator should have developed procedures that set out the actions to be taken to ensure the integrity of measures in place to prevent fires in the machinery spaces caused by a flammable liquid spraying onto a hot surface.

The procedures should require that periodic inspections of the machinery space take place to verify fire prevention measures remain properly fitted or applied. The inspections should be included in the planned maintenance system as a distinct task or tasks.

An appropriate ship-specific checklist should have been developed to facilitate the inspection of the fire prevention measures in all machinery spaces.

The procedure may also include the identification of risk areas and the detection of "hot-spots" using laser-based infrared heat tracers or thermographic imaging.

Suggested Inspector Actions

- Sight, and where necessary review, the company procedures that set out the actions to be taken to ensure the integrity of the measures in place to prevent fires in the machinery spaces caused by a flammable liquid spraying onto a hot surface.
- Where necessary review the records of periodic inspections of the fire prevention measures in the machinery spaces including associated checklists.
- During the inspection of the machinery spaces, check that:
    - There was no evidence of leakage from the fuel or lube oil piping systems within the machinery space.
    - The outer protective skin of fuel oil pump discharge lines were free from damage or deterioration.
    - Flexible fuel hoses were free from damage or deterioration.
    - Any drainage arrangement for jacketed fuel lines which may have been disconnected for maintenance purposes had been refitted on completion of the task.
    - Spray shields were fitted around flanged joints, flanged bonnets and any other threaded connections in fuel oil piping systems under high pressure which were located above or near units of high temperature and that these were in good order.
    - The insulation covering high temperature or hot surfaces, such as steam pipelines and exhaust manifolds was adequate and had been properly reinstalled or replaced after maintenance or repair of machinery and their associated systems.

- Interview the accompanying officer to verify their understanding of:
    - Which protective measures were required to be fitted, and to which systems, to provide effective fire protection in the machinery spaces.
    - How and when the checks of the protective measures were required to be conducted.
- Request the accompanying officer to demonstrate the correct functioning of one dedicated engine fuel oil system leakage alarm.

Expected Evidence

- The company procedures that set out the actions to be taken to ensure the integrity of measures in place to prevent fires in the machinery spaces caused by a flammable liquid spraying onto a hot surface.
- The records of periodic inspections of the fire prevention measures relating to hot surfaces and flammable liquids in the machinery spaces.
- The ship-specific checklist to facilitate the inspection of the fire prevention measures, which included the measures relating to hot surfaces and flammable liquids, in the machinery spaces.

Potential Grounds for a Negative Observation

- There was no company procedure that set out the actions to be taken to ensure the integrity of the measures in place to prevent fires in the machinery spaces caused by a flammable liquid spraying onto a hot surface.
- The records of periodic inspections verifying that fire prevention measures in the machinery spaces relating to hot surfaces and flammable liquids were missing or incomplete.

- There was no ship-specific checklist to facilitate the inspection of the fire prevention measures, which included the measures relating to hot surfaces and flammable liquids in the machinery spaces.
- The accompanying officer was unfamiliar with the company procedures that set out the actions to take to ensure the integrity of the measures in place to prevent fires in the machinery spaces caused by a flammable liquid spraying onto a hot surface.
- The accompanying office was unfamiliar with the fire prevention measures required to be fitted in the machinery spaces.
- There was ongoing leakage from the fuel or lube oil piping systems within the machinery space.
- The outer protective skin of a fuel pump discharge line was visibly damaged or in poor condition.
- A flexible fuel hose was visibly damaged or in poor condition.
- The drainage arrangement for jacketed fuel lines was found to be disconnected.
- The accompanying officer was unable to demonstrate the correct functioning of a dedicated engine fuel oil system leakage alarm.
- A dedicated engine fuel oil system leakage alarm was not functioning correctly.
- A spray shield was missing or was in poor condition around a flanged joint, ï¬‚anged bonnet or any other threaded connection in fuel oil piping systems under high pressure which were located above or near units of high temperature.
- Main or auxiliary engine indicator cocks were not capped with their insulated covers fitted while the engine was running.
- Insulation covering high temperature or hot surfaces, such as steam pipelines and exhaust manifolds was missing or improperly installed.
- Insulation covering high temperature or hot surfaces, such as steam pipelines and exhaust manifolds was damaged or soaked in oil.

10.7.3. Were the main engine crankcase oil mist detectors, engine bearing temperature monitors or equivalent devices and associated alarms in good order?

Short Question Text
Main engine crank case monitoring.

Vessel Types
Oil, Chemical, LPG, LNG

ROVIQ Sequence
Engine Room, Engine Control Room

Publications
ICS: Engine Room Procedures Guide. First Edition.
IMO: ISM Code
IMO SOLAS
IACS Unified Requirements M67 Type Testing Procedure for Crankcase Oil Mist Detection and Alarm Equipment

Objective

To ensure the monitoring arrangements to warn of potential crankcase explosion are always effective.

Industry Guidance

ICS: Engine Room Procedures Guide. First Edition.

Emergency checklists

C6 – Oil Mist in Crankcase

IACS: Unified Requirements M67 Type Testing Procedure for Crankcase Oil Mist Detection and Alarm Equipment

6.3 The oil mist detector monitoring arrangements are to be capable of detecting oil mist in air concentrations of between:

(a) 0 and 10% of the lower explosive limit (LEL) or

(b) between 0 and a percentage of weight of oil in air determined by the Manufacturer based on the sensor measurement method (e.g. obscuration or light scattering) that is acceptable to the Society taking into account the alarm level specified in 6.4.

Note: The LEL corresponds to an oil mist concentration of approximately 50mg/l (~4.1% weight of oil in air mixture).

6.4 The alarm set point for oil mist concentration in air is to provide an alarm at a maximum level corresponding to not more than 5% of the LEL or approximately 2.5mg/l.

TMSA KPI 4.1.1 requires that each vessel in the fleet is covered by a planned maintenance system and spare parts inventory which reflects the company's strategy.

The company identifies all equipment and machinery required to be included in the planned maintenance system, for example:

- Engine machinery.

IMO: ISM Code

8.1 The Company should identify potential emergency shipboard situations and establish procedures to respond to them.

IMO: SOLAS

Chapter II-1 Regulation 47

Fire precautions

2. Internal combustion engines of 2250 kW and above or having cylinders of more than 300 mm bore shall be provided with crankcase oil mist detectors or engine bearing temperature monitors or equivalent devices.

Inspection Guidance

The vessel operator should have developed procedures for the operation, testing and maintenance of the crankcase oil mist detectors, engine bearing temperature monitors or equivalent devices which described:

- Alarm set points.
- Actions to be taken in the event of an alarm.
- Testing procedures and frequency.

These procedures may refer to the vessel's maintenance plan and/or the manufacturer's instructions for the equipment.

Equivalent devices to oil mist detectors or engine bearing temperature monitors include splash-oil temperature monitors, crankcase pressure monitors, and recirculation arrangements.

The vessel operator should have declared through the pre-inspection questionnaire what system, if any, is fitted to the main and/or auxiliary engines to warn of potential crankcase explosions. This information will be inserted in the inspection editor and the final report.

The question will only be allocated where a crank case monitoring system was fitted and HVPQ 12.1.1 was recorded as Motor or Diesel-Electric.

Suggested Inspector Actions

- Sight, and where necessary, review the company procedures for the operation and maintenance of the crankcase oil mist detectors, engine bearing temperature monitors or equivalent devices.
- Where necessary, review the records for the testing and servicing of the crankcase oil mist detectors, engine bearing temperature monitors or equivalent devices.
- Where possible, verify that the alarm for oil mist concentration in air is set at a maximum level corresponding to not more than 5% of the LEL or approximately 2.5mg/l.

- If safe to do so, request that the accompanying officer tests the alarm for the oil mist detector or equivalent device in accordance with manufacturer's instructions.

Expected Evidence

- Company procedures for the operation of the crankcase oil mist detectors or engine bearing temperature monitors or equivalent devices.
- Manufacturer's instructions for the operation and maintenance of the oil mist detectors, engine bearing temperature monitors or equivalent devices.

- Records for the testing and servicing of the oil mist detectors, engine bearing temperature monitors or equivalent devices.
- Where oil mist detector(s) were fitted, evidence that the sensors had been calibrated in accordance with the manufacturer's instructions and at the recommended frequency.

Potential Grounds for a Negative Observation

- There was no company procedure for the crankcase oil mist detectors, engine bearing temperature monitors or equivalent devices which described:
    - Alarm set points.
    - Actions to be taken in the event of an alarm.
    - Testing procedures and frequency.
- The accompanying officer was not familiar with the action to be taken in the event of an alarm from the crankcase oil mist detector, engine bearing temperature monitor or equivalent device.
- The accompanying officer was unable to demonstrate a test of the oil mist detector or equivalent device alarm.
- The testing and servicing of the oil mist detectors, engine bearing temperature monitors or equivalent devices had not been completed in accordance with company procedures.
- The calibration of the oil mist detector sensors had not been completed in accordance with the manufacturer's instructions and/or at the recommended frequency.
- The alarm for the oil mist detector, engine bearing temperature monitor or equivalent device was inoperative.
- The alarm set point for the oil mist detector was set above 5% of the LEL or approximately 2.5mg/l.
- The oil mist detector, engine bearing temperature monitor or equivalent device was defective in any respect.

10.7.4. Where hydraulic power packs were located within the main engine compartment, were fire protection measures provided, and if so, where they in satisfactory condition?

Short Question Text
Hydraulic power packs fire protection measures.

Vessel Types
Oil, Chemical, LPG, LNG

ROVIQ Sequence
Engine Room

Publications
IMO: ISM Code
IMO: MSC.1/Circ. 1321 Guidelines for measures to prevent fires in engine-rooms and cargo pump-rooms.
OCIMF: Safety Critical Equipment and Spare Parts Guidance. First Edition.
ISO 16437:2012 Ships and marine technology - Lifesaving and fire protection — Atmospheric oil mist detectors for ships

Objective

To ensure the machinery space is protected from a fire or explosion resulting from a hydraulic oil mist caused by high pressure leakage.

Industry Guidance

OCIMF: Safety Critical Equipment and Spare Parts Guidance. First Edition.

3.2 Safety critical equipment

Safety critical equipment is an individual piece of equipment, a control system or an individual protection device which in the event of a single point failure may:

- Result in a hazardous situation which could lead to an accident, or
- Directly cause an accident that results in harm to people or the environment.

At the highest level, the company may consider loss of key vessel safety critical functions, which may include (but are not limited to) the following:

- Gas detection, oil mist detection, temperature monitoring.

ISO 16437:2012 Ships and marine technology - Lifesaving and fire protection — Atmospheric oil mist detectors for ships

1.1 This International Standard specifies requirements, test methods and performance criteria for resettable oil mist detectors for use in fire hazard alarm systems installed on marine vessels. Oil mist detectors may be installed where an identified risk of fire caused by ignition of flammable liquids, such as hydraulic, fuel and lubricating oil systems, exists.

1.2 This International Standard specifies requirements for the following detectors:

- point type detectors employing a point aspirating sampling device or relying on dispersion of oil mist;
- aspirating detectors, whereby the sampling point is separated from the sensing unit(s) and uses a pipe network for carrying the sampling air to the sensing unit(s);
- open path or beam type detectors, whereby the concept of the point detector is expanded to a sampling path which can be 20m or more, as opposed to a few centimetres in the point type detector.

TMSA KPI 4A.1.4 requires that procedures are in place to record the testing of critical equipment and systems that are not in continuous use. Testing is performed in accordance with mandatory requirements and manufacturers' recommendations.

IMO: ISM Code

10.3 The company should identify equipment and technical systems the sudden operational failure of which may result in hazardous situations. The SMS should provide for specific measures aimed at promoting the reliability of such equipment or systems. These measures should include the regular testing of standby arrangements and equipment or technical systems that are not in continuous use.

IMO: MSC.1/Circ. 1321 Guidelines for measures to prevent fires in engine-rooms and cargo pump-rooms.

Part 3 Chapter 5 Equipment installation

5 Hydraulic power packs

5.1.1 Hydraulic power packs of more than 50 kW with a working pressure more than 100 bar should be installed in specially dedicated spaces, with a separate ventilation system.

Inspection Guidance

In vessels fitted with deep-well pumps driven by hydraulic power packs, pressure in the transmission pipes can be very high with the attendant risk of a flammable oil mist developing in the event of a leak.

Where the power packs are located within the main machinery space, but not in a specially dedicated space, it is advisable that an oil mist detector be fitted. The oil mist detector should be regularly tested in accordance with manufacturers' recommendations.

Where the power packs are fitted in the main machinery space, and in a specially dedicated space, this is intended to prevent hydraulic oil mist or vapours from reaching an ignition source in an adjacent compartment, and therefore:

- The space should have a separate ventilation system.
- Doors should be self-closing and kept closed when the power packs are in operation.
- Any wire runs, kick-pipes, or other passes through a bulkhead to the space should be sealed with a fire-retardant putty or similar material.
- However, doors, hatches, wire runs etc. do not need to be watertight.

Some hydraulic power units are designed to encapsulate the aggregate pumps and high pressure piping. A save-all and level alarm are provided to warn of hydraulic oil leakage within the encapsulation. This design prevents hydraulic mists or vapours from reaching an ignition source.

<u>Suggested Inspector Actions</u>

- During the tour of the main machinery space, inspect the hydraulic power packs and their location and:
    - If fitted in the main machinery space, determine whether:
        - An oil mist detector is fitted, or
        - The design encapsulated the pumps and high pressure piping and provided warning of leakage by means of a level alarm or other means.
    - If fitted in a specially dedicated space, verify that:
        - Doors were closed.
        - Any wire runs, kick-pipes, or other passes through a bulkhead to the space were sealed.
        - The separate ventilations system was in operation.
- If fitted, and safe to do so, request that the accompanying officer demonstrate the testing of the oil mist detector.

- If fitted, and safe to do so, request that the accompanying officer demonstrates the testing of the level alarm or other means of leak detection for an encapsulated power pack system.
- If fitted, review the records of regular testing of the oil mist detector and/or level alarm.

Expected Evidence

- If fitted, records of regular testing of the oil mist detector.
- If fitted, records of regular testing of the level alarm or other means of leak detection.

Potential Grounds for a Negative Observation

- Hydraulic power packs of more than 50 kW with a working pressure more than 100 bar were not installed in specially dedicated spaces with a separate ventilation system.
- The hydraulic power packs were located within the main machinery space, not in a specially dedicated space, but there was either:
    - No oil mist detector fitted, or
    - No encapsulation of the pumps and high pressure piping protected by a leak detection device.
- The accompanying officer was not familiar with the fire protection measures associated with the hydraulic power packs.
- If fitted, the oil mist detector had not been regularly tested in accordance with manufacturers' recommendations.
- If fitted, the oil mist detector was defective in any respect.
- If fitted, the level alarm or other means of leak detection had not been regularly tested in accordance with the manufacturer's recommendations.
- If fitted, the level alarm or other means of leak detection was defective in any respect.
- Where a hydraulic power pack system was of an encapsulated design, parts of the encapsulation had been removed or were damaged.
- Wire runs, kick-pipes, or other passes through a bulkhead to the specially dedicated space were not sealed with a fire-retardant putty or similar material.
- A door to the specially dedicated space was left/tied open while the hydraulic power packs were in operation.
- There were leaks from the hydraulic power packs or associated pipework.

11. General Appearance and Condition – Photograph Comparison

11.1.1 to 11.1.36: All vessels

11.1.1. Was photograph no.1, bow area from dead ahead, representative of the condition as seen onboard at the time of the inspection and, if so, was it free of any areas for concern?

Short Question Text
Bow area from dead ahead

Vessel Types
Oil, Chemical, LPG, LNG

ROVIQ Sequence
Forecastle

Objective

To ensure that the condition of the vessel is accurately reflected in the SIRE 2.0 vessel inspection report.

TMSA KPI 12.1.2 requires that an inspection plan covers all vessels in the fleet, with at least two inspections of each vessel a year.

The inspection process provides company management with a comprehensive overview of the condition of the fleet at specified intervals.

Inspection Guidance

THE GUIDANCE BELOW APPLIES TO ALL CHAPTER 11 PHOTOGRAPH COMPARISON QUESTIONS.

The vessel operator should have developed an inspection programme which provides shore management with an accurate understanding of a managed vessel's cosmetic and physical condition at least twice a year.

The vessel operator should have uploaded a standard set of photographs, as specified by the SIRE 2.0 programme for the ship type, at the time of requesting an inspection.

Photographs will remain in the OCIMF SIRE 2.0 database for twelve months or until they are superseded by a more recent photograph.

It is recommended that photographs are refreshed at approximately six months intervals, but operators may leave older photographs on the database for continued use in further inspections.

By uploading photographs to the OCIMF SIRE 2.0 database, the vessel operator is warranting that the images were representative of the true condition of the ship at the date the photographs were taken.

By leaving a photograph older than six months on the OCIMF SIRE 2.0 database for review during an inspection, the vessel operator is warranting that the photograph remained representative of the true condition of the ship at the time of requesting an inspection.

Suggested Inspector Actions

- During the physical inspection of the vessel, review the photograph provided by the vessel operator for the location specified and verify that it represented the condition as seen.
- In the case of more general views of the ship, the inspector should not restrict the review of the ship's condition to exactly what is shown in the photograph but consider the photograph to represent the average condition for all similar areas. Photographs that selectively show recently upgraded areas are not to be considered as representative.

Expected Evidence

- The appropriate photograph will be inserted in the inspection editor for review.
- Where no photograph was uploaded to the OCIMF SIRE 2.0 database the question will be automatically entered as Not Seen in the final report

Potential Grounds for a Negative Observation

- The photograph uploaded for a specified location did not represent the actual condition of the vessel as it existed at the time of the inspection.

- Where the photograph uploaded for a specified location was representative of the actual condition of the vessel as it existed at the time of the inspection, but the condition of an item pictured was considered to warrant further review by the user of the report:
    - Select photo representative - item to be highlighted.
    - Add additional photographs as considered necessary.
    - Add a **comment** to identify the areas that are considered to merit further review.

11.1.2. Was photograph no.2, hull forward end starboard side, representative of the condition as seen onboard at the time of the inspection and, if so, was it free of any areas for concern?

Short Question Text
Hull forward end starboard side

Vessel Types
Oil, Chemical, LPG, LNG

ROVIQ Sequence
Main Deck

11.1.3. Was photograph no.3, hull forward end port side representative, of the condition as seen onboard at the time of the inspection and, if so, was it free of any areas for concern?

Short Question Text
Hull forward end port side

Vessel Types
Oil, Chemical, LPG, LNG

ROVIQ Sequence
Main Deck

11.1.4. Was photograph no.4, hull aft end starboard side, representative of the condition as seen onboard at the time of the inspection and, if so, was it free of any areas for concern?

Short Question Text
Hull aft end starboard side

Vessel Types
Oil, Chemical, LPG, LNG

ROVIQ Sequence
Main Deck

11.1.5. Was photograph no.5, hull aft end port side, representative of the condition as seen onboard at the time of the inspection and, if so, was it free of any areas for concern?

Short Question Text
Hull aft end port side

Vessel Types
Oil, Chemical, LPG, LNG

ROVIQ Sequence
Main Deck

11.1.6. Was photograph no.6, transom from right astern, representative of the condition as seen onboard at the time of the inspection and, if so, was it free of any areas for concern?

Short Question Text
Transom from right astern

Vessel Types
Oil, Chemical, LPG, LNG

ROVIQ Sequence
Aft Mooring Deck

11.1.7. Was photograph no.7, forecastle port side looking towards fairleads, representative of the condition as seen onboard at the time of the inspection and, if so, was it free of any areas for concern?

Short Question Text
Forecastle port side looking towards fairleads

Vessel Types
Oil, Chemical, LPG, LNG

ROVIQ Sequence
Forecastle

11.1.8. Was photograph no.8, forecastle starboard side looking towards fairleads, representative of the condition as seen onboard at the time of the inspection and, if so, was it free of any areas for concern?

Short Question Text
Forecastle starboard side looking towards fairleads

Vessel Types
Oil, Chemical, LPG, LNG

ROVIQ Sequence
Forecastle

Publications

11.1.9. Was photograph no.9, port or starboard windlass, representative of the condition as seen onboard at the time of the inspection and, if so, was it free of any areas for concern?

Short Question Text
Port or starboard windlass

Vessel Types
Oil, Chemical, LPG, LNG

ROVIQ Sequence
Forecastle

11.1.10. Was photograph no.10, forward main deck showing condition of deck (and external framing), representative of the condition as seen onboard at the time of the inspection and, if so, was it free of any areas for concern?

Short Question Text
Forward main deck showing condition of deck (and external framing)

Vessel Types
Oil, Chemical, LPG, LNG

ROVIQ Sequence
Main Deck

11.1.11. Was photograph no.11, Forward main deck showing condition of piperack, representative of the condition as seen onboard at the time of the inspection and, if so, was it free of any areas for concern?

Short Question Text
Forward main deck showing condition of Piperack

Vessel Types
Oil, Chemical, LPG, LNG

ROVIQ Sequence
Main Deck

11.1.12. Was photograph no.12, one mooring winch including the brake setting arrangement, representative of the condition as seen onboard at the time of the inspection and, if so, was it free of any areas for concern?

Short Question Text
One mooring winch including the brake setting arrangement

Vessel Types
Oil, Chemical, LPG, LNG

ROVIQ Sequence
Mooring Decks

11.1.13. Was photograph no.13, one hose crane with an overall view, representative of the condition as seen onboard at the time of the inspection and, if so, was it free of any areas for concern?

Short Question Text
One hose crane with an overall view

Vessel Types
Oil, Chemical, LPG, LNG

ROVIQ Sequence
Main Deck

11.1.14. Was photograph no.14, one hose crane hoisting winch, stowed wire and limit switches, representative of the condition as seen onboard at the time of the inspection and, if so, was it free of any areas for concern?

Short Question Text
One hose crane hoisting winch, stowed wire and limit switches

Vessel Types
Oil, Chemical, LPG, LNG

ROVIQ Sequence
Main Deck

11.1.15. Was photograph no.15, starboard manifold looking from aft to forward, representative of the condition as seen onboard at the time of the inspection and, if so, was it free of any areas for concern?

Short Question Text
Starboard manifold looking from aft to forward

Vessel Types
Oil, Chemical, LPG, LNG

ROVIQ Sequence
Cargo Manifold

11.1.16. Was photograph no.16, starboard manifold looking forward to aft representative of the condition as seen onboard at the time of the inspection and, if so, was it free of any areas for concern?

Short Question Text
Starboard manifold looking forward to aft

Vessel Types
Oil, Chemical, LPG, LNG

ROVIQ Sequence
Cargo Manifold

11.1.17. Was photograph no.17, aft main deck showing condition of deck (and external framing), representative of the condition as seen onboard at the time of the inspection and, if so, was it free of any areas for concern?

Short Question Text
Aft main deck showing condition of deck (and external framing)

Vessel Types
Oil, Chemical, LPG, LNG

ROVIQ Sequence
Main Deck

11.1.18. Was photograph no.18, aft main deck showing condition of Piperack, representative of the condition as seen onboard at the time of the inspection and, if so, was it free of any areas for concern?

Short Question Text
Aft main deck showing condition of Piperack

Vessel Types
Oil, Chemical, LPG, LNG

ROVIQ Sequence
Main Deck

11.1.19. Was photograph no.19, poop deck looking from midships to starboard including fairleads, representative of the condition as seen onboard at the time of the inspection and, if so, was it free of any areas for concern?

Short Question Text
Poop deck looking from midships to starboard including fairleads

Vessel Types
Oil, Chemical, LPG, LNG

ROVIQ Sequence
Aft Mooring Deck

11.1.20. Was photograph no.20, aft emergency towing equipment storage arrangement, representative of the condition as seen onboard at the time of the inspection and, if so, was it free of any areas for concern?

Short Question Text
Aft emergency towing equipment storage arrangement

Vessel Types
Oil, Chemical, LPG, LNG

ROVIQ Sequence
Aft Mooring Deck

11.1.21. Was photograph no.21, aft emergency towing equipment deployment system, representative of the condition as seen onboard at the time of the inspection and, if so, was it free of any areas for concern?

Short Question Text
Aft emergency towing equipment deployment system

Vessel Types
Oil, Chemical, LPG, LNG

ROVIQ Sequence
Aft Mooring Deck

11.1.22. Was photograph no.22, lifeboat and davit, representative of the condition as seen onboard at the time of the inspection and, if so, was it free of any areas for concern?

Short Question Text
Lifeboat and davit

Vessel Types
Oil, Chemical, LPG, LNG

ROVIQ Sequence
Lifeboat deck

11.1.23. Was photograph no.23, the emergency generator or accumulator batteries, representative of the condition as seen onboard at the time of the inspection and, if so, was it free of any areas for concern?

Short Question Text
The emergency generator or accumulator batteries

Vessel Types
Oil, Chemical, LPG, LNG

ROVIQ Sequence
Exterior Decks

11.1.24. Was photograph no.24, engine room general view showing top of main engine, representative of the condition as seen onboard at the time of the inspection and, if so, was it free of any areas for concern?

Short Question Text
Engine room general view showing top of main engine

Vessel Types
Oil, Chemical, LPG, LNG

ROVIQ Sequence
Engine Room

11.1.25. Was photograph no.25, one generator engine, representative of the condition as seen onboard at the time of the inspection and, if so, was it free of any areas for concern?

Short Question Text
One generator engine

Vessel Types
Oil, Chemical, LPG, LNG

ROVIQ Sequence
Engine Room

11.1.26. Was photograph no.26, the oil filtering equipment, representative of the condition as seen onboard at the time of the inspection and, if so, was it free of any areas for concern?

Short Question Text
The oil filtering equipment

Vessel Types
Oil, Chemical, LPG, LNG

ROVIQ Sequence
Engine Room

11.1.27. Was photograph no.27, the incinerator, representative of the condition as seen onboard at the time of the inspection and, if so, was it free of any areas for concern?

Short Question Text
The incinerator

Vessel Types
Oil, Chemical, LPG, LNG

ROVIQ Sequence
Engine Room

11.1.28. Was photograph no.28, one boiler from the front, representative of the condition as seen onboard at the time of the inspection and, if so, was it free of any areas for concern?

Short Question Text
One boiler from the front

Vessel Types
Oil, Chemical, LPG, LNG

ROVIQ Sequence
Engine Room

11.1.29. Was photograph no.29, one boiler from the top showing control equipment, representative of the condition as seen onboard at the time of the inspection and, if so, was it free of any areas for concern?

Short Question Text
One boiler from the top showing control equipment

Vessel Types
Oil, Chemical, LPG, LNG

ROVIQ Sequence
Engine Room

11.1.30. Was photograph no.30, purifier room general view, representative of the condition as seen onboard at the time of the inspection and, if so, was it free of any areas for concern?

Short Question Text
Purifier room general view

Vessel Types
Oil, Chemical, LPG, LNG

ROVIQ Sequence
Engine Room

11.1.31. Was photograph no.31, main engine side showing local control station, representative of the condition as seen onboard at the time of the inspection and, if so, was it free of any areas for concern?

Short Question Text
Main engine side showing local control station

Vessel Types
Oil, Chemical, LPG, LNG

ROVIQ Sequence
Engine Room

11.1.32. Was photograph no.32, steering gear room general view showing access, representative of the condition as seen onboard at the time of the inspection and, if so, was it free of any areas for concern?

Short Question Text
Steering gear room general view showing access

Vessel Types
Oil, Chemical, LPG, LNG

ROVIQ Sequence
Steering Gear

11.1.33. Was photograph no.33, main steering gear, representative of the condition as seen onboard at the time of the inspection and, if so, was it free of any areas for concern?

Short Question Text
Main steering gear

Vessel Types
Oil, Chemical, LPG, LNG

ROVIQ Sequence
Steering Gear

11.1.40 to 11.1.42: Addition for Crude / Product / Chemical / Shuttle / OBO

11.1.40. Was photograph no.40, IG system pressure/vacuum-breaking (P/V) device, representative of the condition as seen onboard at the time of the inspection and, if so, was it free of any areas for concern?

Short Question Text
IG system pressure/vacuum-breaking (P/V) device

Vessel Types
Oil, Chemical

ROVIQ Sequence
Main Deck

11.1.41. Was photograph no.41, IG system first non-return device (deck seal or double block and bleed arrangement), representative of the condition as seen onboard at the time of the inspection and, if so, was it free of any areas for concern?

Short Question Text
IG system first non-return device (deck seal or double block and bleed arrangement)

Vessel Types
Oil, Chemical

ROVIQ Sequence
Main Deck

11.1.42. Was photograph no.42, one main cargo pump and, if in pump room, including bilges, representative of the condition as seen onboard at the time of the inspection and, if so, was it free of any areas for concern?

Short Question Text
One main cargo pump and, if in pump room, including bilges

Vessel Types
Oil, Chemical

ROVIQ Sequence
Pumproom, Main Deck

11.1.50 to 11.1.52: Additional for LPG Pressurised

11.1.50. Was photograph no.50, a cargo tank liquid dome including load and discharge valve, representative of the condition as seen onboard at the time of the inspection and, if so, was it free of any areas for concern?

Short Question Text
A cargo tank liquid dome including load and discharge valve

Vessel Types
LPG

ROVIQ Sequence
Main Deck

11.1.51. Was photograph no.51, electric motors for deepwell pumps, representative of the condition as seen onboard at the time of the inspection and, if so, was it free of any areas for concern?

Short Question Text
Electric motors for deepwell pumps

Vessel Types
LPG

ROVIQ Sequence
Main Deck

11.1.52. Was photograph no.52, compressor / motor room, representative of the condition as seen onboard at the time of the inspection and, if so, was it free of any areas for concern?

Short Question Text
Compressor / motor room

Vessel Types
LPG

ROVIQ Sequence
Main Deck

11.1.60 to 11.1.62: Additional for LPG Refrigerated

11.1.60. Was photograph no.60, a cargo tank liquid dome including load and discharge valve, representative of the condition as seen onboard at the time of the inspection and, if so, was it free of any areas for concern?

Short Question Text
A cargo tank liquid dome including load and discharge valve

Vessel Types
LPG

ROVIQ Sequence
Main Deck

11.1.61. Was photograph no.61, electric motors for deepwell pumps, representative of the condition as seen onboard at the time of the inspection and, if so, was it free of any areas for concern?

Short Question Text
Electric motors for deepwell pumps

Vessel Types
LPG

ROVIQ Sequence
Main Deck

11.1.62. Was photograph no.62, compressor room internal view, representative of the condition as seen onboard at the time of the inspection and, if so, was it free of any areas for concern?

Short Question Text
Compressor room internal view

Vessel Types
LPG

ROVIQ Sequence
Compressor Room

11.1.70 to 11.1.72: Additional for LNG Membrane Type

11.1.70. Was photograph no.70, a cargo tank liquid dome including load and discharge valve, representative of the condition as seen onboard at the time of the inspection and, if so, was it free of any areas for concern?

Short Question Text
A cargo tank liquid dome including load and discharge valve

Vessel Types
LNG

ROVIQ Sequence
Main Deck

11.1.71. Was photograph no.71, a cargo tank vapour dome including cargo system relief valves, representative of the condition as seen onboard at the time of the inspection and, if so, was it free of any areas for concern?

Short Question Text
A cargo tank vapour dome including cargo system relief valves

Vessel Types
LNG

ROVIQ Sequence
Main Deck

11.1.72. Was photograph no.72, compressor house internal view, representative of the condition as seen onboard at the time of the inspection and, if so, was it free of any areas for concern?

Short Question Text
Compressor house internal view

Vessel Types
LNG

ROVIQ Sequence
Compressor Room

11.1.80 to 11.1.82: Additional for LNG Moss Type

11.1.80. Was photograph no.80, a cargo tank liquid dome including load and discharge valve, representative of the condition as seen onboard at the time of the inspection and, if so, was it free of any areas for concern?

Short Question Text
A cargo tank liquid dome including load and discharge valve

Vessel Types
LNG

ROVIQ Sequence
Main Deck

11.1.81. Was photograph no.81, general view of one Moss sphere, representative of the condition as seen onboard at the time of the inspection and, if so, was it free of any areas for concern?

Short Question Text
General view of one moss sphere

Vessel Types
LNG

ROVIQ Sequence
Main Deck

11.1.82. Was photograph no.82, compressor house internal view, representative of the condition as seen onboard at the time of the inspection and, if so, was it free of any areas for concern?

Short Question Text
Compressor house internal view

Vessel Types
LNG

ROVIQ Sequence
Compressor Room

11.1.90 to 11.1.95: Additional for Specialised Bow Loading Shuttle Tanker

11.1.90. Was photograph no.90, bow mooring arrangement from forward looking aft showing chain stopper, representative of the condition as seen onboard at the time of the inspection and, if so, was it free of any areas for concern?

Short Question Text
Bow mooring arrangement from forward looking aft showing chain stopper

Vessel Types
Oil

ROVIQ Sequence
Bow Loading Area

11.1.91. Was photograph no.91, bow mooring arrangement from aft looking forward showing winch, representative of the condition as seen onboard at the time of the inspection and, if so, was it free of any areas for concern?

Short Question Text
Bow mooring arrangement from aft looking forward showing winch

Vessel Types
Oil

ROVIQ Sequence
Bow Loading Area

11.1.92. Was photograph no.92, general view of hose connection area, representative of the condition as seen onboard at the time of the inspection and, if so, was it free of any areas for concern?

Short Question Text
General view of hose connection area

Vessel Types
Oil

ROVIQ Sequence
Bow Loading Area

11.1.93. Was photograph no.93, hose coupling arrangement, representative of the condition as seen onboard at the time of the inspection and, if so, was it free of any areas for concern?

Short Question Text
Hose coupling arrangement

Vessel Types
Oil

ROVIQ Sequence
Bow Loading Area

11.1.94. Was photograph no.94, general view forward bow thruster room, representative of the condition as seen onboard at the time of the inspection and, if so, was it free of any areas for concern?

Short Question Text
General view forward bow thruster room

Vessel Types
Oil

ROVIQ Sequence
Bow Loading Area

11.1.95. Was photograph no.95, forward bow thruster room showing one azimuth thruster, representative of the condition as seen onboard at the time of the inspection and, if so, was it free of any areas for concern?

Short Question Text
Forward bow thruster room showing one azimuth thruster

Vessel Types
Oil

ROVIQ Sequence
Bow Loading Area

12. Ice Operations

12.1. Ice operations training

12.1.1. Where the vessel traded in polar waters, had the Master, Chief Mate and officers in charge of a navigational watch undertaken the additional training required by the Polar Code?

Short Question Text
Polar Code training

Vessel Types
Oil, Chemical, LPG, LNG

ROVIQ Sequence
Documentation

Publications
IMO: Polar Code
OCIMF: Guidelines for the Development of a Polar Water Operational Manual.

Objective

To ensure that ships operating in polar waters are appropriately manned by adequately qualified, trained and experienced personnel.

Industry Guidelines

OCIMF: Guidelines for the Development of a Polar Water Operational Manual.

Section 2.1.6 Human Resources Management.

Guidance: The PWOM should provide guidance for the human resources management, taking into account the anticipated ice conditions and requirements for ice navigation, increased levels of watchkeeping, hours of rest, fatigue and a process that ensures that these requirements will be met.

The following should be considered:

- Certification, experience and training:
  - Provide information and procedures about the certification, training and familiarisation of personnel.

TMSA KPI 5.3.2 requires that a formal programme ensures that Senior Officers receive appropriate ship-handling training before promotion to Master or assignment to a new vessel type.

Ship-handling experience is gained by training under supervision on board, as a part of a documented competency development system, and may be supplemented by:

- Specialist training e.g. navigation in ice.

IMO: ISM Code

6.5 The Company should establish and maintain procedures for identifying any training which may be required in support of the SMS and ensure that such training is provided for all personnel concerned.

IMO: STCW Code

Regulation V/4

Mandatory minimum requirements for the training and qualification of Masters and deck officers on ships operating in polar waters.

1 Masters, chief mates and officers in charge of a navigational watch on ships operating in polar waters shall hold a certificate in basic training for ships operating in polar waters, as required by the Polar Code.

3 Masters and chief mates on ships operating in polar waters, shall hold a certificate in advanced training for ships operating in polar waters, as required by the Polar Code.

IMO: Polar Code

Chapter 12 Manning and training.

12.3.1 In order to meet the functional requirements of paragraph 12.2 above while operating in polar waters, masters, chief mates and officers in charge of a navigational watch shall be qualified in accordance with Chapter V of the STCW Convention and the STCW Code, as amended as follows (for tankers):

- Ice Free- not applicable.
- Open waters – Basic training for master, chief mate and officers in charge of a navigational watch.
- Other waters – Advanced training for master and chief mate. Basic training for officers in charge of a navigational watch.

12.3.2 The administration may allow the use of a person(s) other than the master, chief mate or officers of the navigational watch to satisfy the requirements for training. As required by paragraph 12.3.1, provided that….

Inspection Guidance

The vessel operator should have developed procedures to identify the necessary mandatory and non-mandatory training required to be completed by each individual onboard before being assigned to a vessel or prior to promotion. The training for navigation officers assigned to a vessel issued with a Polar Code certificate and operating within waters governed by the Polar Code will include;

- Basic training for officers in charge of a navigational watch.
- Advanced training for Master and Chief Mate.

Where the vessel operator uses a person(s) other than the Master or Chief Mate to fulfil the role of Ice Navigator, then the Master and Chief Mate will only be required to have obtained the basic training. Such arrangements should be described in the procedures.

This question will only be generated if the vessel has been issued with a Certificate for Ships Operating in Polar Waters as declared through the pre-inspection questionnaire.

Suggested Inspector Actions

- Review the vessel’s Polar Water Operational Manual (IMO Structure) section 2.1.4, Human Resources Management, and identify the bridge manning requirements for ice operations, noting particularly where the Master or Chief Mate may be substituted as Ice Navigator by a person other than the Master or Chief Mate.
- Review the certificates for training for Ships Operating in Polar Waters for the Master, Chief Mate and officers in charge of the navigational watch and verify that each had the appropriate training certificate.
- Where the Master and/or Chief Mate had been substituted by a person(s) other than the Master and/or Chief Mate for the role of ice navigator review a copy of the Certificate of Competency and certificate of advanced training for ships operating in polar waters for the persons engaged as Ice Navigator.

Expected Evidence

- The vessel’s Polar Water Operational Manual.
- The training certificates for ships operating in polar waters for the Master, Chief Mate and officers in charge of a navigational watch.
- A copy of the certificate of competency and advanced training for the person(s) who had substituted for the Master and/or Chief Mate in the role of ice navigator.

Potential Grounds for a Negative Observation

- The Polar Water Operational Manual did not define what additional training the Master, Chief Mate and officers of the navigational watch must have to comply with the company Ice Navigator policy and the Certificate for Ships Operating in Polar Waters.
- Where the Master and/or Chief Mate were not substituted they were not in possession of a certificate of Advanced Training for Ships Operating in Polar Waters (unless the vessel was operating in open waters only).
- Where the Master and/or Chief Mate were not required to have Advanced Training for Ships Operating in Polar Waters, due to substitution or exclusively open water operations, the Master and/or Chief Mate did not have a certificate for Basic Training for Ships Operating in Polar Waters.
- The officers in charge of a navigational watch were not in possession of a certificate for Basic Training for Ships Operating in Polar Waters.
- The person(s) used to substitute for Master and/or Chief Mate in the role of Ice Navigator did not have the appropriate certificate of competency and Advanced Training for Ships Operating in Polar Waters.

12.2. Sub-zero LSA & FFA procedures

12.2.1. Were the Master and officers familiar with the company procedures to ensure the operability of the life-saving and fire-fighting systems and equipment in sub-zero temperatures, and had these procedures been complied with?

Short Question Text
Life-saving and fire-fighting systems and equipment in sub-zero temperatures

Vessel Types
Oil, Chemical, LPG, LNG

ROVIQ Sequence
Cargo Control Room, Exterior Decks, Main Deck

Publications
IMO: ISM Code
IMO: Polar Code
OCIMF: The Use of Large Tankers in Seasonal First-Year Ice and Severe Sub-Zero Conditions

Objective

To ensure the continuing operability of life-saving and fire-fighting equipment when operating in sub-zero temperatures.

Industry Guidance

OCIMF: The Use of Large Tankers in Seasonal First-Year Ice and Severe Sub-Zero Conditions

5.4 Safety and Life Saving Equipment

Periodic inspections of all safety-related systems should be undertaken during the exposure to extreme temperatures to ensure the effectiveness of the precautions being taken.

All available space heaters and engine sump heaters and/or heat lamps should be fully utilised. Ships that do not regularly trade in such conditions may require additional equipment to be supplied.

Survival Craft

All life rafts should be rated for safe operation according to the environmental conditions likely to be experienced.

Ice accretion should be regularly removed from the life rafts, cradles, cradle release pins and launching equipment to retain their preparedness for launching and inflation.

Similar precautions should be taken for lifeboats, rescue boats and their launching appliances. Particular checks should be made to ensure that brake release securing pins are free to be extracted.

An ice removal mallet should be readily available in the vicinity of survival craft. Care should be exercised when using mallets to avoid permanently damaging any equipment.

The overall condition of the gel coat of lifeboats should be inspected for any damage, particularly penetration of the gel coat and fibre sub-structure, in good time prior to entering the cold zone. Repairs should be undertaken in a warm dry climate to limit water ingress, which, if subjected to freezing, can cause severe damage to the boat's structure.

Lifeboat Engines

Lifeboat engines should at all times remain available for immediate use and be capable of starting within two minutes in the environmental conditions likely to be experienced.

The process of starting an extremely cold engine is quite different from normal starting procedures. The correct procedure should be drawn to the attention of all persons likely to be involved in starting the engine in very cold conditions to ensure they are familiar with the operation.

Manufacturer's instructions for the grade of oil to be added to the cold starting pots, if fitted, should be followed. This oil should be readily available in the lifeboats. It should be borne in mind that in cold conditions the performance of the starting batteries might be diminished.

If fitted, heaters in lifeboat engines should be used. Consideration should also be given to fitting trace heating around the doors of enclosed lifeboats to ensure that they do not freeze in the closed position.

Lifeboat Fuel Systems

An appropriate grade of diesel or gas oil should be used to prevent waxing in fuel systems leading to lack of engine start and impaired reliability. When replacing the fuel grade, lifeboat fuel tanks and the fuel line contents should be changed out and the engine run on the new fuel to ensure that the system is properly flushed and primed.

Lifeboat Cooling Water Systems

The lifeboat cooling system, if of a recirculating self-contained type, should be adequately protected with an anti-freeze solution. If the system is not self-contained it should be checked to ensure that no obstructions or contamination prevent the natural drainage of the system.

Lifeboat Water Spray Systems

The spray systems, including pumps, on the lifeboats, should be drained of water. In some classes of boat, if the spray pump is frozen it will inhibit starting of the lifeboat engine by locking the propeller shaft.

Lifeboat Water Rations

Precautions should be taken to avoid the freezing of water rations stowed in lifeboats.

Stern Launched Lifeboats

It is not safe to free-fall release a stern launched lifeboat onto ice. It will be necessary to break the ice, either by judicial use of the ship's engines or by other craft. The lifeboat may be winched out and down to rest upon the ice surface.

Rescue Boats with Water Jet Engines

The rescue boat should be maintained in a condition that will allow immediate use but will also protect the boat from the extremes of weather.

Subsidiary LSA Equipment

Immersion Suits

Commonly supplied immersion suits have a design operational range in immersed (seawater) temperatures from minus 1.9°C up to 35°C. Immersion suits are available that have enhanced insulation properties.

TPAs (Thermal Protective Aids)

TPAs should be effective within a temperature range appropriate to the temperatures likely to be encountered.

Lifebuoys

It should be ensured that lifebuoys are not iced into position and are free to be removed and used.

External Pyrotechnics

The release pins for bridge wing lifebuoys/smoke floats should be well greased to ensure their proper operation.

EPIRBs

EPIRBs should be maintained ice-free.

Breathing Apparatus and Oxygen Therapy Units

In sub-zero conditions, the use of compressed air/oxygen breathing, or resuscitation apparatus should be considered with care. The hazards involved include the freezing of the demand valve and exhale valve due to the freezing of exhaled vapours from the user leading to premature emptying of the gas bottle or failure of the system. The effect of low temperature (below minus 4°C) on the lungs of the user, can lead in protracted cases to frostbite of the lung tissue.

Eye Wash Stations

Eye wash fluid is typically effective in a fluid temperature range of 5°C to 25°C. Below 5°C the effectiveness of the fluid may be reduced. At 0°C fluid temperature, it is recommended not to use the fluid except in cases of extreme urgency as it may cause damage to the eye. Consideration should be given to temporarily withdrawing exposed eyewash stations into the accommodation while the vessel is operating in sub-zero conditions.

Hard Hats

The safe operating temperature range for hard hats is marked within the hat by the manufacturer. Some hard hats are certified for safe operation to minus 40°C and their use should be considered.

5.5 Fire-Fighting Systems and Equipment

Fire extinguishing systems should be designed or located so that they are not made inaccessible or inoperable by ice or snow accumulations or low temperatures.

Equipment, appliances, systems and extinguishing agents should be protected from freezing and the minimum temperatures anticipated for the voyage.

Precautions should be taken to prevent the nozzles, piping and valves of any fire extinguishing system from becoming clogged by impurities, corrosion or ice build-up.

The exhaust gas outlets and pressure/vacuum arrangements on gas detection systems should be suitably protected from ice build-up that could interfere with the system's effective operation.

Water or foam extinguishers should not be located in any position that is exposed to freezing temperatures. These locations should be provided with extinguishers capable of operation under such conditions.

General guidance on typical operating temperatures for portable extinguishers follows. Operators should check the actual performance limitations of extinguishers by referencing manufacturer's data.

Water, Gas and Low Expansion Foam

Fire extinguishers located in exposed areas are susceptible to freezing. Foam extinguishers will be ineffective and, when they do thaw out, the foam compound will have been ‘frost damaged’, rendering them useless.

Unprotected Foam and Water Extinguishers

Unprotected foam and water extinguishers are rated for safe and effective operation to 1°C. If protected with ethylene glycol, this figure may be revised downward to minus 10°C.

If an additive is used, it may enable water and foam extinguishers to be operable at temperatures down to minus 20°C.

CO2 Extinguishers

CO2 extinguishers are typically rated for safe and effective operation to minus 20°C. However, if operated at these temperatures extreme caution should be taken to avoid contact with any part of the extinguisher or expelled gas to avoid low temperature burns.

Dry Powder Extinguishers

These types of extinguishers are typically rated for safe operation from minus 30°C to 60°C. The extinguishing medium presents no additional special precautions. However, the propellant, CO2 needs to be treated with caution to avoid personnel injury through exposure to the cold gas.

AFFF

AFFF (Aqueous Film Forming Foam) extinguishers typically have a nominal safe operational range of temperatures between 5°C and 60°C.

Fire and Foam Systems Hoses and Nozzles

Most hoses are typically rated for safe operation at temperatures down to minus 20°C and nozzles to minus 25°C. Cold weather hoses are available that are rated to minus 40°C and are marked accordingly.

Fire and Foam Lines

The fire and foam lines on deck should be well drained and maintained ready for immediate use at all times. Monitors, hydrant valves and any other moving parts should be well greased and protected by canvas covers to avoid ice/snow accumulation that may prevent their immediate operation. Their movement should be regularly checked to ensure that they remain free.

The pipework serving water curtains and spray systems should be checked drained and empty.

To avoid any ‘dead-legs’, any items drawing water from the fire main, such as hawse pipe cable washer lines, should be drained, particularly if a re-circulatory fire main line is in use.

The storage locations of fixed foam system bulk storage tanks may need heating to ensure that the temperature in these spaces remains above zero. Consideration may have to be given to using temporary space heaters to maintain an adequate temperature.

Portable Foam Equipment

Drums and canisters of foam for portable branch pipe appliances are subject to the same considerations as portable fire extinguishers.

Fire Hose Boxes

The catches, locks, dogs and hinges on fire hose boxes should be kept ice-free. Spray nozzles and couplings should be well greased and water free. All hoses should be completely drained of water to avoid damage and to facilitate their rapid use.

TMSA KPI 1A.1.1 requires that management ensures that company policy and the supporting procedures and instructions cover all the activities undertaken.

IMO: ISM Code

7 The Company should establish procedures, plans and instructions, including checklists as appropriate, for key shipboard operations concerning the safety of the personnel, ship and protection of the environment. The various tasks involved should be defined and assigned to qualified personnel.

IMO: Polar Code

Appendix II Model table of contents for the Polar Water Operational manual (PWOM)

1 – Operational capabilities and limitations

Chapter 2

Operation in low air temperatures

System design

Guidance: The PWOM (Polar Water Operational Manual) should list all ship systems susceptible to damage or loss of functionality by exposure to low temperatures, and the measures to be adopted to avoid malfunction

Inspection Guidance

The vessel operator should have developed procedures to ensure that life-saving and fire-fighting systems and equipment remain operable in sub-zero temperatures. The procedures should list all safety systems susceptible to damage or loss of functionality by exposure to low temperatures, and the measures to be adopted to avoid malfunction.

Winterisation checklists should be used to facilitate preparations prior to entering an area of sub-zero temperatures. Periodic inspections of all safety-related systems should be undertaken during the exposure to sub-zero temperatures to ensure the effectiveness of the precautions being taken, which may include:

- Draining fire and foam lines from the lowest point and then closing the drain valve in order to keep the system ready for operation. The drained condition of the line should be regularly checked by operating the drain valve.
- Removal of snow and ice accretions from equipment and escape and access routes.
- Protection of lifeboat cooling/water spray systems and drinking water from freezing.
- Ensuring lifeboat engines are supplied with suitable fuel.
- Checking the capacity of lifeboat batteries at low temperatures.
- The use of space heaters as necessary.
- Relocating fire-extinguishers to avoid freezing.
- Outlining measures to be taken to ensure the operability of eye wash stations and de-contamination showers.
- Maintaining air intakes and fire flaps operable.

These procedures may form part of a Polar Water Operational Manual (PWOM).

This question will only be assigned where the vessel operator had declared through the pre-inspection questionnaire that the vessel met one or more of the following criteria:

- Was assigned an ice class notation.
- Was assigned a winterisation class notation.
- Had been issued with a Polar Ship Certificate.
- The vessel traded in areas where sub-zero temperatures may be routinely expected.

Suggested Inspector Actions

- Sight, and where necessary review, the company procedures to ensure that life-saving and fire-fighting systems and equipment remain operable in sub-zero temperatures.
- Review winterisation checklists and records of periodic inspections of safety-related systems during exposure to sub-zero temperatures.

- Interview the accompanying officer to verify their familiarity with the company procedures to ensure that life-saving and fire-fighting systems and equipment remain operable in sub-zero temperatures.
- If applicable, during the physical inspection of the vessel confirm the precautions being taken to ensure that life-saving and fire-fighting systems and equipment remain operable in sub-zero temperatures.

Expected Evidence

- Company procedures to ensure that life-saving and fire-fighting systems and equipment remain operable in sub-zero temperatures.
- Winterisation checklists.
- Records of periodic inspections of safety-related systems during exposure to sub-zero temperatures.

Potential Grounds for a Negative Observation

- There were no company procedures to ensure that life-saving and fire-fighting systems and equipment remain operable in sub-zero temperatures.
- The accompanying officer was not familiar with the company procedures to ensure that life-saving and fire-fighting systems and equipment remain operable in sub-zero temperatures.
- The accompanying officer could not identify the locations of the drain points for the deck fire and/or foam line.
- There were no winterisation checklists available for use.
- There were no measures to ensure the operability of eye wash stations and de-contamination showers during freezing temperatures.
- Where fire and lifesaving systems were provided with insulation and/or heat tracing, either the insulation was missing, or the heat tracing system was not fully functional.
- Periodic inspections of all safety-related systems had not been undertaken during exposure to sub-zero temperatures to ensure the effectiveness of the precautions being taken.
- Life rafts were not rated for safe operation according to the environmental conditions likely to be experienced.
- Existing damage to a lifeboat hull would allow water ingress which, if subjected to freezing, could cause severe damage to the boat’s structure.
- The accompanying officer was not familiar with the procedure for starting an extremely cold lifeboat engine.
- The procedure for starting an extremely cold lifeboat engine was not posted in the lifeboat.
- During an inspection taking place when the vessel was prepared for sub-zero temperatures:
    - The correct grade of oil to be added to the lifeboat engine cold starting pots was not available in the lifeboat.
    - The heaters in the lifeboat engines were not being used.
    - The doors of an enclosed lifeboat were frozen shut.

- The lifeboat engine fuel was not an appropriate grade of diesel or gas oil.
- The recirculating lifeboat engine cooling system was not protected with an anti-freeze solution.
- The lifeboat spray system had not been drained.
- Precautions had not been taken to avoid the drinking water freezing.
- There was no ice removal mallet readily available in the vicinity of survival craft.
- Eye wash stations were inoperable or unavailable.
- Water or foam fire extinguishers were exposed to freezing temperatures.
- Water or foam extinguishers had been removed to prevent freezing and not replaced with suitable extinguishers.
- Fire and/or foam lines had not been drained from their lowest point.
- Drain valves to fire and/or foam lines had not been closed after draining.
- Monitors and hydrants were not protected by canvas covers to prevent snow/ice accumulation.
- Water curtain and spray systems had not been drained.
- The temperature in a space containing bulk storage tanks for fixed foam systems and/or drums and canisters of foam for portable branch pipe appliances was below zero.
- Any item of lifesaving or firefighting system or equipment was not operable or ready for immediate use due to freezing, snow accumulation or ice accretion.
- Escape routes and access to fire-fighting and life-saving equipment were obstructed by snow and/or ice accumulations

Where a lifesaving or firefighting system was provided with a working heating arrangement (e.g. insulation and either recirculation or trace heating), an observation should not be recorded if such a system was not drained down as would be expected if no heating system was provided.

12.3. Sub-zero machinery operation procedures

12.3.1. Were the Master and officers familiar with the company procedures to ensure the operability of the engine room machinery and systems in sub-zero temperatures, and had these procedures been complied with?

Short Question Text
Engine room machinery and systems in sub-zero temperatures

Vessel Types
Oil, Chemical, LPG, LNG

ROVIQ Sequence
Engine Room, Engine Control Room

Publications
IMO: ISM Code
IMO: Polar Code
OCIMF: The Use of Large Tankers in Seasonal First-Year Ice and Severe Sub-Zero Conditions
Transport Canada: Mandatory Winter Navigation Information on Sea Water Cooling Types. December 2013

Objective

To ensure the continuing operability of the engine room machinery and systems when operating in sub-zero temperatures.

Industry Guidance

OCIMF: The Use of Large Tankers in Seasonal First-Year Ice and Severe Sub-Zero Conditions

5.3 Engine Rooms, Machinery and Systems

Prior to entering cold weather areas, the engine room should be prepared for the anticipated conditions. Particular consideration should be given to deciding when the engine room should be manned.

The provision of heaters in the engine room/machinery spaces will assist in maintaining temperatures above freezing. The use of hot-air-blown space heaters may also be considered within these spaces.

The following points should be considered to maintain the safe and effective operation of the ship's propulsion and ancillary systems.

Cooling System Intakes (Sea Chests)

The maintenance of effective cooling arrangements is a prime consideration in sub-zero sea temperatures. It is important that all seawater strainers are cleaned since a clogged filter will lead to reduced flow, resulting in rapid ice formation within the strainer.

Particular care should be taken to ensure that the heating arrangements of the cooling water sea chests are working at optimum efficiency. Steam heating systems to sea chests should be checked to confirm their good working condition and be operated continuously when the ship is in ice infested waters.

Consideration should also be given to the following:

- The risk of damage to the engine as a result of severely overcooling the jackets.
- Optimising the number of coolers in service.
- Raising cooling temperatures.

- Adjusting charge air coolers.
- Monitoring the scavenge temperatures to ensure that they are maintained within limits.

When re-circulating cooling systems are fitted, the correct levels of cooling water should be available before entering sub-zero conditions and the condition of all valves and pumps should be verified. The system should be placed in service before entering ice conditions.

Fuel Systems

It should be ensured that heating systems are operating on all bunker storage tanks, bilge tanks, bilge overflow tanks and main engine sump settling and service tanks. Bunker storage tank temperatures should be kept at least 5°C above the minimum transfer temperature given in the fuel’s specification.

Consideration should be given to changing over from heavy fuel oil to diesel oil prior to closing down the main engine so that the fuel lines are primed with diesel oil instead of fuel oil. This ensures that any cooling of fuel lines will not result in oil solidifying within the lines.

Stern Tube

Stern tube oil should not contain any free water or be contaminated with water/oil emulsion. Consideration should be given to draining any water from the system or replacing the stern tube oil charge.

It is recommended that stern tube bearings and seals located outside the hull are designed not to leak pollutants. In this context, non-toxic biodegradable lubricants are not considered to be pollutants.

The temperature of the stern tube cooling water tank should be closely monitored. Consideration should be given to sourcing a suitable additive or temporarily draining the tank when the contents approach 0°C.

Ventilation

Consideration should be given to stopping all but one main engine room ventilation fan to maintain a reasonable ambient temperature in the machinery space. However, suitable air flow should be maintained to allow the correct operation of boilers, main and auxiliary engines if they are not provided with separate ducting.

It should be ensured, so far as possible, that vents feeding off the main ventilation system do not blow directly onto fuel lines or pipes containing fuel oil or onto heavy fuel oil transfer pumps.

Ventilation fans in the steering gear space should be stopped and vent flaps closed to maintain a reasonable ambient temperature.

Accommodation heating systems should be activated, and a comfortable temperature and humidity maintained in accommodation spaces.

Pneumatic and manual fan flaps should be regularly operated to ensure their correct operation and to prevent freezing/seizing.

Hydraulic Machinery

Hydraulic pumps should be regularly run to maintain the temperature of the oil and machinery.

Electrical Systems

Trace heating tape is an adhesive tape with wire contained in it that can be used to heat pipes and machinery. It comes with the necessary documentation to calculate current, load and wattage. It provides a temporary, quick and cost-effective solution to heating pipes and machinery. If the tape is to be used in hazardous areas, it should be appropriately rated for such use.

Generators

The fuel temperature of any generator running on diesel or gas oil should be monitored and arrangements made for temporary local heating if the temperature approaches the fuel’s cloud point.

Emergency Generators

The emergency generators on some ships have electric heating on the alternator end. This should be tested to ensure its satisfactory operation.

The emergency generator room external vent flaps and supply fan damper should be kept closed. Notices advising of the status of the flaps and dampers should be posted in the emergency generator room and main engine control room. It should be ensured that the emergency generator’s cooling water contains the correct amount of anti-freeze.

Emergency Batteries and Battery Lockers

Emergency batteries and power for communications equipment should be protected from extreme low temperatures. Spaces containing batteries may need to be provided with space heaters, depending on their location/exposure.

General service batteries are unlikely to freeze in expected conditions but, as a precaution, they can be covered with plastic sheet.

Water

When not Generating Water

Domestic/Distilled Tanks.

Where possible, gauge glasses to these tanks should be drained. If gauge glasses are not drained there is a possibility that the lower section of the gauge glass will become frozen and shatter. Remote sensing gauging cannot be relied upon.

If the evaporator is not in use, lines to the storage tanks should be drained.

When Generating Water

The temperature of the water in the storage tanks should be monitored and water made to the tanks as necessary to maintain a reasonable temperature. As the distillate from the evaporator is at about 50°C, it should prevent the water in the tanks becoming cold enough to freeze. The supply lines from domestic freshwater tanks to pressurising pumps are generally susceptible to freezing, depending upon their location, and appropriate precautions should be taken. Boiler water sensing lines should be protected from freezing.

Compressed Air

If ice contaminates the general service and/or instrument air system, there is a possibility of problems with the onboard instrumentation air supply. It is recommended that driers are fitted to all air systems.

Steering Gear

Steering gear motors should be kept running at all times to keep the oil warm. Space heaters should be used in the steering flat to ensure that the equipment is maintained at a satisfactory temperature. The use of heaters in the steering flat may result in significant condensation forming on deckheads and bulkheads so equipment may have to be protected from condensate dripping from these surfaces.

Lubricants and Oils

It should be ensured that only oils and greases are used that are suitable for the anticipated temperature.

Diesel Oil Blends

Diesel oil may be blended with kerosene to depress the pour point, as indicated in the table below:

Ratio Diesel/ Kerosene Pour Point °C

- 50:50 minus 14°
- 40:60 minus 18°
- 30:70 minus 23°

It should be noted that, as the proportion of kerosene is increased, the lubricity of the blend will be reduced, and machinery may require more frequent checks and maintenance. In addition, it should be ensured that the flash point of the final blend conforms with IMO regulations.

Transport Canada: Mandatory Winter Navigation Information on Sea Water Cooling Types. December 2013

Marine Safety Guide Checklist for operation in Ice Infested Waters

TMSA KPI 1A.1.1 requires that management ensures that company policy and the supporting procedures and instructions cover all the activities undertaken.

IMO: ISM Code

7 The Company should establish procedures, plans and instructions, including checklists as appropriate, for key shipboard operations concerning the safety of the personnel, ship and protection of the environment. The various tasks involved should be defined and assigned to qualified personnel.

IMO: Polar Code

Appendix II Model table of contents for the Polar Water Operational manual (PWOM)

1 – Operational capabilities and limitations

Chapter 2

Operation in low air temperatures

System design

Guidance: The PWOM (Polar Water Operational Manual) should list all ship systems susceptible to damage or loss of functionality by exposure to low temperatures, and the measures to be adopted to avoid malfunction.

Inspection Guidance

The vessel operator should have developed procedures to ensure that engine room machinery and systems remain operable in sub-zero temperatures. The procedures should list all engine room machinery and systems susceptible to damage or loss of functionality by exposure to low temperatures and the measures to be adopted to avoid malfunction.

Winterisation checklists should be used to facilitate preparations prior to entering an area of sub-zero temperatures. Precautions to be taken may include:

- Prior to entering an area of low temperatures, checking, where applicable:
    - Fore and aft draughts are within the limits required by the ice class notation.
    - Sea-chest strainers.
    - Steam heating and/or other arrangements to keep sea-chests clear of ice.
    - Heating systems in fuel, bilge and lubricating oil tanks.
    - Heating systems for the emergency generator.
    - Anti-freeze in the emergency generator cooling system.
    - Water levels in recirculating cooling systems.
    - Water content of stern tube oil.
    - Suitability of oils and greases.
    - Arrangements to ensure control air is dry.
    - Arrangements to prevent the icing up of air pipes to settling and service tanks required for the operation of the main propulsion plant and essential auxiliaries.
- While operating in an area of low temperatures:
    - Operating with the engine room manned when appropriate.
    - Applying steam heating on sea-chests continuously.
    - Using space heaters in engine, steering gear, emergency battery rooms and emergency fire pump space.
    - Keeping emergency generator room external vent flaps and supply fan damper closed.
    - Changing over from heavy fuel oil to diesel oil prior to closing down the main engine.
    - Keeping hydraulic motors, including steering motors, running continuously.
    - Operating pneumatic and manual vent flaps to keep them free.
    - Adjusting engine room ventilation to maintain suitable temperatures and avoid local cooling of fuel systems.
    - Monitoring freshwater tanks and piping for freezing.

These procedures may form part of a Polar Water Operational Manual (PWOM).

This question will only be assigned where the vessel operator had declared through the pre-inspection questionnaire that the vessel met one or more of the following criteria:

- Was assigned an ice class notation.
- Was assigned a winterisation class notation.
- Had been issued with a Polar Ship Certificate.
- The vessel traded in areas where sub-zero temperatures may be routinely expected.

Suggested Inspector Actions

- Sight, and where necessary review, the company procedures to ensure that engine room machinery and systems remain operable in sub-zero temperatures.
- Review completed winterisation checklists.

- Interview the accompanying officer to verify their familiarity with the company procedures to ensure that engine room machinery and systems remain operable in sub-zero temperatures.
- If applicable, during the physical inspection of the vessel confirm the precautions being taken to ensure that engine room machinery and systems remain operable in sub-zero temperatures.

Expected Evidence

- Company procedures to ensure that engine room machinery and systems remain operable in sub-zero temperatures.
- Winterisation checklists.

Potential Grounds for a Negative Observation

- There were no company procedures to ensure that engine room machinery and systems remain operable in sub-zero temperatures.
- The accompanying officer was not familiar with the company procedures to ensure that engine room machinery and systems remain operable in sub-zero temperatures.
- There were no winterisation checklists available for use.
- Company procedures to ensure that engine room machinery and systems remain operable in sub-zero temperatures had not been complied with, which may include:
    - Prior to entering an area of low temperatures, failing to check, where applicable:
        - Fore and aft draughts were within the limits required by the ice class notation.
        - Sea-chest strainers.
        - Steam heating and/or other arrangements to keep sea-chests clear of ice.
        - Heating systems in fuel, bilge and lubricating oil tanks.
        - Heating systems for the emergency generator.
        - Anti-freeze in the emergency generator cooling system.
        - Water levels in recirculating cooling systems.
        - Water content of stern tube oil.
        - Suitability of oils and greases.
        - Arrangements to ensure control air is dry.
        - Arrangements to prevent the icing up of air pipes to settling and service tanks required for the operation of the main propulsion plant and essential auxiliaries.
    - While operating in an area of low temperatures, not:
        - Operating with the engine room manned when appropriate.
        - Applying steam heating on sea-chests continuously.
        - Using space heaters in engine, steering gear, emergency battery rooms and emergency fire pump space.
        - Keeping emergency generator room external vent flaps and supply fan damper closed.
        - Changing over from heavy fuel oil to diesel oil prior to closing down the main engine.
        - Keeping hydraulic motors, including steering motors, running continuously.
        - Operating pneumatic and manual vent flaps to keep them free.
        - Adjusting engine room ventilation to maintain suitable temperatures and avoid local cooling of fuel systems.
        - Monitoring freshwater tanks and piping for freezing.
- Any system or equipment required to maintain the engine room machinery and equipment functional in sub-zero temperatures was defective in any respect.

12.4. Sub-zero cargo and ballast operation procedures

12.4.1. Were the Master and officers familiar with the company procedures to ensure the operability of the cargo and ballast systems in sub-zero temperatures, and had these procedures been complied with?

Short Question Text
Cargo and ballast systems in sub-zero temperatures

Vessel Types
Oil, Chemical, LPG, LNG

ROVIQ Sequence
Cargo Control Room, Pumproom, Compressor Room, Main Deck

Publications
OCIMF: The Use of Large Tankers in Seasonal First-Year Ice and Severe Sub-Zero Conditions
IMO: ISM Code
IMO: Polar Code

Objective

To ensure the continuing operability of the cargo and ballast systems when operating in sub-zero temperatures.

Industry Guidance

OCIMF: The Use of Large Tankers in Seasonal First-Year Ice and Severe Sub-Zero Conditions

5.1 Cargo and Ballast Systems

Cargo System Valves

Prior to entering cold areas, all cargo, bunker, ballast and subsidiary valves that will be required to be used for operations should be inspected to ensure that their gearboxes contain no water and that they are well greased. A small amount of water in the gearbox of a hydraulic valve or in the valve bonnet will, when frozen, have a detrimental effect upon that valve and, in extreme cases, will render the valve inoperable.

Hydraulic cargo or Crude Oil Washing (COW) valves on deck should be protected with canvas covers and the valves should be frequently activated while in sub-freezing temperatures to avoid freezing/blockage.

If any valves are left 'cracked' open to avoid fracturing of valve bodies, it is recommended that each open valve is clearly marked, both locally and on the pipeline mimic diagram.

The condition of portable steam hoses and their connections on deck should be verified prior to use.

Cargo Tank Pressure/Vacuum (P/V) Valves

It is strongly recommended that the P/V valves are thoroughly overhauled prior to entry into an area of sub-zero temperatures. While on passage, valves should be protected from the effects of ice accumulation/ accretion with canvas covers or steam heating. In extremely low temperatures canvas covers have been shown to be more effective than steam heating. However, it should be ensured that the presence of a canvas cover does not inhibit the effective operation of the P/V valve.

Before any cargo operation commences, it is recommended that any canvas covers are removed and that pressure/vacuum arrangements are checked to be free of ice blockage. In particular, it should be ensured that drain holes are clear and free to operate. Painting the seat faces of Hi-Jet valves with anti-freeze may assist in protecting them from freezing in the shut position and will prevent an ice film forming.

Inert Gas (IG) Deck Water Seal Heating

The deck water seal heating should be operational in freezing temperatures. It should be ensured that the inlet and outlet of the sealing water is not frozen and/or blocked by ice. Frequent checks should be undertaken to confirm a positive water flow.

P/V Breakers – Liquid (anti-freeze)

The deck breaker should be filled with anti-freeze (glycol as opposed to methanol based) as per the manufacturer's instructions. It is important that the correct concentration of ethylene glycol and water is used in the P/V breaker as excessive concentrations may not be effective, as illustrated in the following graph.

Frequent checks should be undertaken to ensure that the correct level is maintained in the breaker. Once clear of the cold weather, the density of the liquid in the P/V breaker will need to be tested and returned to the value necessary to ensure correct operation.

Mast Vent Riser (where fitted)

The mast vent riser valve should be protected with grease and a canvas cover. Flame arresters should be checked free of ice before the start of cargo operations. Prior to arrival, mast risers and inert gas (IG) lines should be drained of any liquid.

If fitted, automatic and manual valves on the IG main line and tank inlets should be kept greased and protected with canvas covers. The operation of piston breather valves on IG lines should be checked before operations commence and covers should be removed and de-icer sprayed in way of the valves.

It is recommended that the diameter of drainage lines on mast riser systems should be at least 50 mm.

Cargo Pumps

Deepwell Pumps

The motors and shafts of pumps located on deck should be protected with canvas covers to avoid delays caused by having to de-ice the pumps before discharging.

Submerged Hydraulic Pump Systems

The grade of hydraulic oil used in the submerged pump system will typically be suitable for operation in air temperatures down to minus 25°C, but its properties should be verified. The hydraulic system should be started on low load at least 30 minutes before the system is required for operations.

Some thickening of the hydraulic oil, due to the increased viscosity, may be experienced when ambient temperatures fall to zero and below. Minimising 'dead-legs' will assist in the pump's operation and, when initially starting the pump, it should be started very slowly to enable the warm hydraulic oil from the main to slowly displace the cold oil in the pump and consequently warm the pump through slowly. An increase in the normal loading may be placed upon the supply pump when starting a hydraulic pump, due to the change in viscosity of the hydraulic oil.

Cargo Stripping Systems

Any systems using water seal vacuum pumps need both the pumps and the seal supply header tanks to be protected from freezing. The manufacturer's recommendation should be followed, and the required percentage of anti-freeze added to ensure safe operation.

COW and Tank Cleaning Systems

COW machine gearboxes should be protected with canvas covers. The gearbox oil should be renewed in order to avoid damage, particularly if the presence of any moisture is suspected. Tank cleaning lines should be drained of all water and isolated from the drive system. If tank cleaning is to be undertaken in cold regions, the sub-division of the cleaning system should be reviewed to limit the amount of pipework containing water. COW isolator valves should be drained of any water.

Cargo Tank Heating Coils

If not in use, heating coils and lines should be drained and blown through with air. To avoid 'dead-legs', steam delivery lines should be blanked off, preferably where they spur off from the main line.

Tank Cleaning Heater

When located in an exposed location, the tank cleaning heater will need to be protected and, in any event, should be drained.

Cargo Lines

Differences in temperature experienced by the ship can cause contraction of the deck lines that may not be taken up in the usual manner. There is a possibility of flange leakage and it would be prudent to check the integrity of the lines prior to use to ensure they are tight.

All cargo, ballast, tank cleaning and COW lines on deck should be well drained after their pressure testing or use. Particular attention should be paid to ballast systems, including ballast monitors and lines.

After loading, discharging or bunkering in cold climates, ship's lines should be drained, and the drain valves left open until the ambient temperature rises sufficiently. Where possible, it is recommended that at least one tank filling valve is left open to allow the line to drain, thereby preventing the line from becoming pressurised due to temperature changes.

The pour point of the cargo being carried or to be loaded should be checked to determine whether line blockages may occur if cargo operations are stopped for any reason. Similarly, bunker fuel specifications should be checked for pour point.

Pump Rooms

Without compromising safety, pump room fans should be used only as required for ventilating the space to minimise the effect of sub-zero temperatures inside the pump room. Pump room doors should be kept closed, if possible.

Steam lines in the pump room, including those serving the tank-washing heater, should be drained down. If fitted, steam stripping pumps may be kept warming through if they are likely to be required for cargo operations or to provide some warmth in the pump room.

If fitted, pump room heaters should be turned on and, if provided on different floors, at least one on each floor should be used to promote convection currents in the space.

Oil Discharge Monitoring Equipment (ODME)

The fresh water supply to the ODME should be drained down together with the water supply/flushing pump. Particular care should be taken when isolating and draining down the ODME as this is a well-documented source of failure or damage in cold climates.

Ballast Systems

Hydraulic ballast valves in empty tanks should be frequently activated to avoid freezing/blockage unless other positive means are employed to prevent freezing.

Ballast tank vents may become frozen if not protected by canvas covers or steam heating on passage. However, to avoid the risk of over or under pressurisation of ballast tanks, the use of covers on vents should be strictly supervised to ensure that the vents can still operate as designed. It is recommended that any covers are removed prior to the commencement of operations. Frequent removal of any accumulated ice will be required.

Ice Accumulation in Ballast Tanks

Before entering cold climates, the Master should determine the density of the water contained within the ballast tanks. The more saline the water, the lower the freezing temperature will be. Consideration may be given to exchanging the ballast water to increase its salinity.

The surface of ballast water may freeze in ballast tanks. A considerable danger exists during de-ballasting operations should a layer of ice remain suspended in the tank, to fall at a later time, risking damage to internal structure and fittings. If possible, and if free surface stability calculations show it to be acceptable, ballast levels should be kept at or below the level of the sea surface. However, sea suctions should not be too close to the sea surface where there is increased risk of them getting blocked with ice.

Where fitted, ballast tank heating or bubbling systems should be in operation prior to entering areas with sub-zero temperatures, particularly when ballast levels are above the water line.

If stability and the ice belt depth allow and where no ballast tank heating or bubbling systems are fitted, periodic lowering and re-filling of the ballast may avoid the water's surface becoming frozen.

TMSA KPI 1A.1.1 requires that management ensures that company policy and the supporting procedures and instructions cover all the activities undertaken.

IMO: ISM Code

7 The Company should establish procedures, plans and instructions, including checklists as appropriate, for key shipboard operations concerning the safety of the personnel, ship and protection of the environment. The various tasks involved should be defined and assigned to qualified personnel.

IMO: Polar Code

Appendix II Model table of contents for the Polar Water Operational manual (PWOM)

1 – Operational capabilities and limitations

Chapter 2

Operation in low air temperatures

System design

Guidance: The PWOM (Polar Water Operational Manual) should list all ship systems susceptible to damage or loss of functionality by exposure to low temperatures, and the measures to be adopted to avoid malfunction.

Inspection Guidance

The vessel operator should have developed procedures to ensure that cargo and ballast systems remain operable in sub-zero temperatures. The procedures should list all cargo and ballast systems susceptible to damage or loss of functionality by exposure to low temperatures, and the measures to be adopted to avoid malfunction. Winterisation checklists should be used to facilitate preparations.

Precautions to be taken may include, where applicable:

- Testing the integrity of deck lines prior to use to ensure they are tight.
- Checking ballast water salinity and exchanging if necessary.
- Where fitted, operating ballast tank heating or bubbling systems in good time.
- Protecting equipment on deck with canvas covers, including:
    - Hydraulic cargo and COW valves.
    - COW machines.
    - P/V valves.
    - Mast riser vent valve.
    - IG main and inlet valves.
    - Deepwell pump motors and shafts.
    - Ballast tank vents.
- Checking that:
    - Valves on deck are well greased and their gearboxes free of water.
    - Deck seal heating arrangements are operational.
    - Anti-freeze levels in P/V breaker and stripping system vacuum pumps are correct.
    - Cargo compressors that require antifreeze and/or a heating system are identified and prepared for cold weather.
- Draining equipment, including:
    - Cargo, COW, and tank cleaning lines and valves, after testing or use.
    - Tank cleaning heater.
    - Heating coils.
    - Manifold drip-trays.
    - Deck air-line.
    - Ballast system, including ballast monitor.
    - Oil discharge monitoring system.
    - Pumproom steam lines, if not to be used.
- Activating hydraulic cargo, COW and ballast valves frequently while in sub-freezing temperatures to avoid freezing/blockage.
- Checking P/V breaker, P/V valves and flame screens immediately before commencing and during cargo operations.
- Starting cargo pump and valve hydraulic systems in good time before they are needed.
- Ensuring deck seal heating is functioning and checked regularly during cargo operations.
- Checking canvas covers are removed from ballast tank vents before ballasting/deballasting.

These procedures may form part of a Polar Water Operational Manual (PWOM).

This question will only be assigned where the vessel operator had declared through the pre-inspection questionnaire that the vessel met one or more of the following criteria:

- Was assigned an ice class notation
- Was assigned a winterisation class notation
- Had been issued with a Polar Ship Certificate
- The vessel traded in areas where sub-zero temperatures may be routinely expected.

<u>Suggested Inspector Actions</u>

- Sight, and where necessary review, the company procedures to ensure that cargo and ballast systems remain operable in sub-zero temperatures.
- Review completed winterisation checklists and records of equipment tests and checks prior to, during and on completion of cargo operations.

- Interview the accompanying officer to verify their familiarity with the company procedures to ensure that cargo and ballast systems remain operable in sub-zero temperatures.
- If applicable, during the physical inspection of the vessel confirm the precautions being taken to ensure that cargo and ballast systems remain operable in sub-zero temperatures.

Expected Evidence

- Company procedures to ensure that cargo and ballast systems remain operable in sub-zero temperatures.
- Winterisation checklists.
- Records of equipment tests and checks prior to, during and on completion of cargo operations.

Potential Grounds for a Negative Observation

- There were no company procedures to ensure that cargo and ballast systems remain operable in sub-zero temperatures.
- The accompanying officer was not familiar with the company procedures to ensure that cargo and ballast systems remain operable in sub-zero temperatures.
- There were no winterisation checklists available for use.
- Company procedures to ensure that cargo and ballast systems remain operable in sub-zero temperatures had not been complied with, which may include failing to:
    - Test the integrity of deck lines prior to use to ensure they are tight.
    - Check ballast water salinity and exchange if necessary.
    - Where fitted, operate ballast tank heating or bubbling systems in good time.
    - Protect equipment on deck with canvas covers, including:
        - Hydraulic cargo and COW valves.
        - COW machines.
        - P/V valves.
        - Mast riser vent valve.
        - IG main and inlet valves.
        - Deepwell pump motors and shafts.
        - Ballast tank vents.
    - Check that:
        - Valves on deck are well greased and their gearboxes free of water.
        - Deck seal heating arrangements are operational.
        - Anti-freeze levels in P/V breaker and stripping system vacuum pumps are correct.
        - Cargo compressors that require antifreeze and/or a heating system are properly prepared for cold weather.
    - Drain equipment, including:
        - Cargo, COW, and tank cleaning lines and valves, after testing or use.
        - Tank cleaning heater.
        - Heating coils.
        - Manifold drip-trays.
        - Deck air-line.
        - Ballast system, including ballast monitor.
        - Oil discharge monitoring system.
        - Pumproom steam lines, if not to be used.
    - Activate hydraulic cargo, COW and ballast valves frequently while in sub-freezing temperatures to avoid freezing/blockage.
    - Check P/V breaker, P/V valves and flame screens immediately before commencing and during cargo operations.
    - Start cargo pump and valve hydraulic systems in good time before they are needed.
    - Ensure deck seal heating is functioning and checked regularly during cargo operations.
    - Check canvas covers are removed from ballast tank vents before ballasting/deballasting.

12.5. Sub-zero deck machinery operation procedures

12.5.1. Were the Master and officers familiar with the company procedures to ensure the operability of the deck machinery, including mooring systems, in sub-zero temperatures, and had these procedures been complied with?

Short Question Text
Deck machinery and mooring equipment in sub-zero temperatures

Vessel Types
Oil, Chemical, LPG, LNG

ROVIQ Sequence
Cargo Control Room, Main Deck, Mooring Decks

Publications
IMO: ISM Code
IMO: Polar Code
OCIMF: The Use of Large Tankers in Seasonal First-Year Ice and Severe Sub-Zero Conditions

Objective

To ensure the continuing operability of the deck machinery when operating in sub-zero temperatures.

Industry Guidance

OCIMF: The Use of Large Tankers in Seasonal First-Year Ice and Severe Sub-Zero Conditions

Section 5 The Winterisation of Ships

5.2 Deck

All void spaces, empty tanks, chain lockers and spaces should be sounded prior to entering cold weather. If any water is found, it should be educted dry, as far as is practical, to avoid ice damage when these residues freeze. The spaces should be regularly sounded to ensure that they remain water-free.

Sounding pipes, vents and remote gauges should be protected and remain operational as far as possible.

As well as the natural consequences of sub-zero temperatures, e.g., freezing of liquids, another area that should be managed is the accumulation of ice on deck from freezing spray and rain. Consequently, many of the actions below relate to covering equipment with canvas, heavy-duty plastic sheet or similar material. Ice accumulations on unprotected equipment will render the equipment inoperable.

Cargo handling cranes and derricks should be operated and tested prior to the vessel entering sub-zero temperatures. The operation of any heating arrangements provided, for example, in crane cabs, should also be confirmed.

The pneumatic or electrical motors used for raising or lowering accommodation ladders should be adequately covered to prevent ice accretion.

The main air valve to deck should be closed and the airline drained down, taking care to remove any moisture that may be contained within the line, particularly at the ends. If air has to be supplied to deck, an air drier should be used.

Deck Equipment

With hydraulic equipment, such as winches and hose handling cranes, particular attention needs to be paid to the operating temperature range of the hydraulic fluid.

Control boxes and motion levers should be protected by canvas covers.

For hydraulically driven systems, oil should be circulated continuously when the external temperature is below 0°C to ensure that the fluid systems are maintained at working temperatures. If this is to be achieved by leaving machinery (e.g., winches) running, careful attention should be paid to the regular lubrication of the equipment. The oil manufacturer's stated operating temperature range/viscosity should be checked for suitability. Oils may have to be treated with an appropriate viscosity additive or, in extreme cases, the oil may have to be changed for a more suitable grade.

Mooring wires and synthetic ropes should be protected by canvas covers to stop ice accretion until they are required for use. Ice crystals can form within unprotected ropes and can cause damage to the rope's fibres.

Ice Accretion on Windlasses

Due to their exposed location, windlasses and winches are likely to be subjected to heavy ice accretion. Prior to arrival in port, winches and windlasses should be proven to be operational and additional time may have to be allowed to clear any ice accretion. In addition, both anchors should be lowered to prove that they are free to run from the pipe (i.e., not frozen in) when safe navigation permits. However, the anchors should be brought fully home prior to mooring.

Other

Particular care should be taken in sealing the chain locker, spurling and hawse pipes.

TMSA KPI 1A.1.1 requires that management ensures that company policy and the supporting procedures and instructions cover all the activities undertaken.

IMO: ISM Code

7 The Company should establish procedures, plans and instructions, including checklists as appropriate, for key shipboard operations concerning the safety of the personnel, ship and protection of the environment. The various tasks involved should be defined and assigned to qualified personnel.

IMO: Polar Code

Appendix II Model table of contents for the Polar Water Operational manual (PWOM)

1 – Operational capabilities and limitations

Chapter 2

Operation in low air temperatures

System design

Guidance: The PWOM (Polar Water Operational Manual) should list all ship systems susceptible to damage or loss of functionality by exposure to low temperatures, and the measures to be adopted to avoid malfunction

Inspection Guidance

The vessel operator should have developed procedures to ensure that deck machinery, including mooring systems, remains operable in sub-zero temperatures. The procedures should list all deck machinery susceptible to damage or loss of functionality by exposure to low temperatures, and the measures to be adopted to avoid malfunction.

Winterisation checklists should be used to facilitate preparations prior to entering an area of sub-zero temperatures. Periodic inspections of all deck machinery should be undertaken during the exposure to sub-zero temperatures to ensure the effectiveness of the precautions being taken, which may include:

- Ensuring hydraulic systems contain a suitable grade of hydraulic oil.
- Circulating hydraulic system oil continuously when the external temperature was below 0°C to ensure that the fluid systems are maintained at working temperatures.
- When leaving machinery (e.g., winches) running, paying careful attention to the regular lubrication of the equipment.
- Operating and testing cargo handling cranes prior to the vessel entering sub-zero temperatures.
- Checking heating arrangements in cranes are operational.
- Adequately covering the pneumatic or electrical motors used for raising or lowering accommodation ladders to prevent ice accretion.
- Closing the main air valve to deck and draining the airline down.
- Protecting control boxes and motion levers for deck machinery with canvas covers.
- Protecting mooring wires and synthetic ropes with canvas covers to stop ice accretion until they are required for use.
- Prior to arrival in port, proving winches, windlasses and anchors to be operational.
- Ensuring the continued operability of pneumatic oil spill pumps, where provided.

These procedures may form part of a Polar Water Operational Manual (PWOM).

This question will only be assigned where the vessel operator had declared through the pre-inspection questionnaire that the vessel met one or more of the following criteria:

- Was assigned an ice class notation
- Was assigned a winterisation class notation
- Had been issued with a Polar Ship Certificate
- The vessel traded in areas where sub-zero temperatures may be routinely expected.

Suggested Inspector Actions

- Sight, and where necessary review, the company procedures to ensure that deck machinery, including mooring systems, remains operable in sub-zero temperatures.
- Review winterisation checklists and records of periodic inspections of all deck machinery during exposure to sub-zero temperatures.
- Interview the accompanying officer to verify their familiarity with the company procedures to ensure that deck machinery, including mooring systems, remains operable in sub-zero temperatures.
- If applicable, during the physical inspection of the vessel confirm the precautions being taken to ensure that deck machinery, including mooring systems remains operable in sub-zero temperatures.

Expected Evidence

- Company procedures to ensure that deck machinery, including mooring systems, remains operable in sub-zero temperatures.
- Winterisation checklists.
- Records of periodic inspections of all deck machinery during exposure to sub-zero temperatures.

Potential Grounds for a Negative Observation

- There were no company procedures to ensure that deck machinery, including mooring systems, remains operable in sub-zero temperatures.
- The accompanying officer was not familiar with the company procedures to ensure that deck machinery, including mooring systems, remains operable in sub-zero temperatures.
- There were no winterisation checklists available for use.
- Periodic inspections of all deck machinery had not been undertaken during exposure to sub-zero temperatures to ensure the effectiveness of the precautions being taken.
- Company procedures to ensure that deck machinery, including mooring systems, remains operable in sub-zero temperatures had not been complied with, which may include not:
    - Ensuring hydraulic systems contained a suitable grade of hydraulic oil.
    - Circulating hydraulic system oil continuously when the external temperature was below 0°C to ensure that the fluid systems were maintained at working temperatures.
    - When leaving machinery (e.g., winches) running, paying careful attention to the regular lubrication of the equipment.
    - Operating and testing cargo handling cranes prior to the vessel entering sub-zero temperatures.
    - Checking heating arrangements in cranes were operational.
    - Adequately covering the pneumatic or electrical motors used for raising or lowering accommodation ladders to prevent ice accretion.
    - Closing the main air valve to deck and draining the airline down.
    - Protecting control boxes and motion levers for deck machinery with canvas covers.
    - Protecting mooring wires and synthetic ropes with canvas covers to stop ice accretion until they were required for use.
    - Prior to arrival in port, proving winches, windlasses and anchors to be operational.
    - Ensuring the continued operability of pneumatic oil spill pumps, where provided.
- Inspection of the vessel during periods of sub-zero temperatures determined that deck machinery and/or mooring systems required for planned or emergency use were inoperative due to freezing and/or ice accretion.

12.6. Ice navigation procedures

12.6.1. Were the Master and officers familiar with the company procedures for navigating in areas affected by ice, and had they received suitable training?

Short Question Text
Navigating in areas affected by ice

Vessel Types
Oil, Chemical, LPG, LNG

ROVIQ Sequence
Documentation, Bridge

Publications
OCIMF: The Use of Large Tankers in Seasonal First-Year Ice and Severe Sub-Zero Conditions
BIMCO: The Ice Navigation and Seamanship Handbook 1st Edition 2019
IMO: ISM Code

Objective

To ensure the Master and officers are prepared for navigating in areas affected by ice.

Industry Guidance

BIMCO: The Ice Navigation and Seamanship Handbook 1st Edition 2019

Introduction

As with all navigation, careful preparation significantly reduces the risk of an accident. In icy environments consideration should be given to the nature of the ice, its dangers and the regions where it is encountered, ship handling, passage planning, crew training and preparing the ship for the expected weather. This manual will allow seafarers to acquire the necessary knowledge and understanding which, when combined with practical experience, will enable safe navigation in ice.

Chapter 8 Navigation in Ice

8.1 Passage Planning

The passage plan should recognise any limitations of navigation or communication equipment on board, and take into account the availability of nav aids, availability and reliability of charts, SAR provision and infrastructure (all of which may be limited) in the intended region.

The passage plan for ice will consider pack ice and iceberg limits indicated on the navigational chart and other available material (some regions will have more information than others) such as:

- Information from commercial or government sources.
- Forecasts for the intended location and estimated date of passage.
- Historic data, including previous ice information, as well as knowledge gained from local experience and/or previous visits on the route.

8.1.1 Appraisal

8.1.2 Planning

8.1.3 Execution

8.1.4 Monitoring

8.1.5 Routeing in Ice Waters

8.2 Watchkeeping Practices

Navigation inside ice waters requires maximum input by all participants in the watchkeeping arrangements of the ship. This includes the navigation officers as well as the engineering personnel and relevant members of the crew. The lookout and helmsman will perform vital roles within the bridge team and should be fully briefed as to their duties and actions.

8.2.2 Watch Officer’s Briefing Prior to Entry into Ice Limits

8.2.3 Under Pilotage in Ice

The presence of a Pilot or Ice Advisor on the bridge in ice conditions does not change the established Master/Pilot relationship. However, it is important that the Master and officers closely listen to the advice and guidance of the pilot and or Ice Advisor. If there is any misunderstanding or lack of clarity, all personnel should be encouraged to ask for clarification.

8.3 Evidence of Ice

8.3.1 Freezing Spray

8.4 Navigation in Pack Ice

Navigation in pack ice requires the ship’s main engines to be kept in a state of immediate readiness with the ship on continuous manoeuvring speed.

8.5 Visibility and Heating

8.6 Position Fixing in Ice Conditions

8.6.1 Charts and Positions

In certain remote areas, chart depths can be no more than track soundings from previous passages. The accuracy of charts in the Arctic and Antarctic varies widely depending on the date of the survey. Charts in developed coastal regions, such as the Baltic Sea and Saint Lawrence Gulf, will be surveyed to more modern standards. In any event, navigators should always be aware of the source of charted data, either by looking at the paper chart Source Classification Diagram or by interrogating the ECDIS CATZOC function.

8.6.2 Floating Marks and Buoys

8.6.3 Leading Lights and Sectored Lights

8.7 Radar Use in Ice Conditions

8.7.1 Settings, Tuning and Detection

8.8 Compasses

Chapter 9 Shiphandling

9.1 Entering the Ice

9.2 Approaching the Ice Edge

9.3 Underway in Ice

9.4 Pinch Points

9.5 Beset by Ice

9.6 Anchoring in Ice

9.7 Inland navigation: Canal and Lock Systems

9.8 Damage in Ice

9.9 Berthing in Ports with Ice

Chapter 11 Working with Icebreakers

OCIMF: The Use of Large Tankers in Seasonal First-Year Ice and Severe Sub-Zero Conditions

Section 8   Proficiency of Ship's Crew

The safe operation of a ship trading in ice requires skill and technical proficiency in excess of those required during normal operating conditions. It is, therefore, important that suitable training is offered to complement existing experience. All ship's officers and crew should be adequately trained for circumstances likely to be encountered when operating in low temperatures, undertaking ice navigation and/or icebreaker escort. This may take the form of in-service training, simulator training and/or Computer Based Training (CBT) and should include cold weather survival. The following provides an example outline content to form the basis of an ice operations training course.

- Types of ice, its formation and properties.
- Ice regulations.
- Technical aspects of ice class and 'winterisation' notations, design and construction.
- Ship performance in ice and cold climates.
- Ice broadcasts and ice charts.
- Passage planning considerations for ice.
- Operating, navigating and ship handling in ice.
- Icebreaker operations.
- Berthing and mooring operations in ice.
- Risk assessment.
- Contingency planning and emergency response.
- Cargo and ballast operations in cold weather.
- Environmental issues.
- Limitations of shore support.
- Simulator module.

Masters, officers in charge of a navigational watch and officers in charge of an engineering watch should have relevant experience and training with regard to operating ships in ice and severe sub-zero conditions.

TMSA KPI 5.1.2 requires that comprehensive procedures to ensure safe navigation are in place. These procedures may include:

- Berth-to-berth passage planning.
- Actions upon encountering adverse weather, restricted visibility or ice.
- Supporting checklists.

IMO: ISM Code

7 The Company should establish procedures, plans and instructions, including checklists as appropriate, for key shipboard operations concerning the safety of the personnel, ship and protection of the environment. The various tasks involved should be defined and assigned to qualified personnel.

Inspection Guidance

The vessel operator should have developed procedures for navigating in areas affected by ice, including checklists where appropriate. The procedures should include as appropriate, guidance on:

- Passage planning in areas affected by ice.
- Watchkeeping requirements in areas affected by ice.
- Pilotage in ice.
- Actions to take when ice is detected.
- Freezing spray.
- Navigation in pack ice.
- Position fixing in ice conditions.
- Charts and positions in remote locations.
- Radar use in ice conditions.
- Limitations of compasses in high latitudes.
- Shiphandling in ice.
- Anchoring in ice.
- Avoiding hull and propeller/propulsion system damage in ice.
- Berthing/unberthing in ports with ice.
- Working with icebreakers.

The procedures may reference or incorporate industry publications such as The Ice Navigation and Seamanship Handbook or equivalent best practice guidance. The procedures may form part of the Polar Waters Operational Manual, where carried.

Masters, officers in charge of a navigational watch and officers in charge of an engineering watch should have relevant training with regard to operating ships in ice and severe sub-zero conditions.

This may take the form of in-service training, simulator training and/or Computer Based Training (CBT).

This question will only be assigned where the vessel operator had declared through the pre-inspection questionnaire that the vessel met one or more of the following criteria:

- Was assigned an ice class notation.
- Was assigned a winterisation class notation.
- Had been issued with a Polar Ship Certificate.
- The vessel traded in areas where sub-zero temperatures may be routinely expected.

Suggested Inspector Actions

- Sight, and where necessary review, the company procedures for navigating in areas affected by ice.
- Review completed checklists for the last voyage affected by ice.
- Review the passage plan for the last voyage affected by ice.
- Review the Bridge Log Book for the last period navigating in an area affected by ice.
- Review records of crew training with regard to operating ships in ice.

- Interview the accompanying officer to verify their familiarity with the company procedures for navigating in areas affected by ice.

Expected Evidence

- Company procedures for navigating in areas affected by ice.
- Passage plan for the last voyage affected by ice.
- Completed checklists for the last voyage affected by ice.
- Bridge Log Book for the last period navigating in an area affected by ice.
- Records of crew training with regard to operating ships in ice.

Potential Grounds for a Negative Observation

- There were no company procedures for navigating in areas affected by ice that included, as appropriate, guidance on:
    - Passage planning in areas affected by ice.
    - Bridge/engine room team composition in areas affected by ice.
    - Pilotage in ice.
    - Actions to take when ice is detected.
    - Freezing spray.
    - Navigation in pack ice.
    - Position fixing in ice conditions.
    - Charts and positions in remote locations.
    - Radar use in ice conditions.
    - Limitations of compasses in high latitudes.
    - Shiphandling in ice.
    - Anchoring in ice.
    - Avoiding hull and propeller/propulsion system damage in ice.
    - Berthing/unberthing in ports with ice.
    - Working with icebreakers.
- The accompanying officer was not familiar with the company procedures for navigating in areas affected by ice.
- The company procedures for navigating in areas affected by ice were not supported by suitable checklists.
- Checklists for navigating in ice had not been completed to company requirements.
- The passage plan for the last voyage affected by ice did not take into account the additional factors presented by navigation in areas affected by ice, such as:
    - The limits of ice pack, ice bergs and sea ice.
    - The verification of draughts to meet the min/max draughts required by the vessel's ice notation.
    - The change in status of manoeuvring machinery.
    - The change in status of bridge and/or machinery space manning levels.
- Records showed that while navigating in an area affected by ice:
    - The required bridge/engine room team composition had not been complied with.
    - The vessel's draught had not been adjusted to meet the min/max draught required by the vessel's ice notation.
- There were no records of crew training with regard to operating ships in ice.
- When navigating in or near areas affected by ice, the Master, an officer in charge of a navigational watch or an officer in charge of an engineering watch had not received suitable training for operating ships in ice.

Our vision

A global marine industry that causes no harm to people or the environment

Oil Companies
International Marine Forum
29 Queen Anne's Gate
London SW1H 9BU
United Kingdom

T +44 (0)20 7654 1200
E enquiries@ocimf.org

ocimf.org