

**MODEL  
COURSE  
1.01**

**BASIC TRAINING FOR OIL  
AND CHEMICAL TANKER  
CARGO OPERATIONS**

**2014 Edition**

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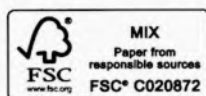


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# Foreword

Since its inception the International Maritime Organization (IMO ) has recognized the importance of human resources to the development of the maritime industry and has given the highest priority to assisting developing countries in enhancing their maritime training capabilities through the provision or improvement of maritime training facilities at national and regional levels. IMO has also responded to the needs of developing countries for postgraduate training for senior personnel in administrations, ports, shipping companies and maritime training institutes by establishing the World Maritime University in Malmö, Sweden, in 1983.

Following the adoption of the International Convention on Standards of Training, Certification and Watch-keeping for Seafarers, 1978 (STCW), a number of IMO Member Governments had suggested that IMO should develop model training courses to assist in the implementation of the Convention and in achieving a more rapid transfer of information and skills regarding new developments in maritime technology. IMO training advisers and consultants also subsequently determined from their visits to training establishments in developing countries that the provision of model courses could help instructors improve the quality of their existing courses and enhance their implementation of the associated Conference and IMO Assembly resolutions.

In addition, it was appreciated that a comprehensive set of short model courses in various fields of maritime training would supplement the instruction provided by maritime academies and allow administrators and technical specialists already employed in maritime administrations, ports and shipping companies to improve their knowledge and skills in certain specialized fields. With the generous assistance of the Government of Norway, IMO developed model courses in response to these generally identified needs and now keeps them updated through a regular revision process taking into account any amendments to the requirements prescribed in IMO instruments and any technological developments in the field.

These model courses may be used by any training institution and, when the requisite financing is available, the Organization is prepared to assist developing countries in implementing any course.

K. SEKIMIZU  
Secretary-General

## Introduction

### Purpose of the model courses

The purpose of the IMO model courses is to assist maritime training institutes and their teaching staff in organizing and introducing new training courses, or in enhancing, updating or supplementing existing training material where the quality and effectiveness of the training courses may thereby be improved.

The purpose is also to enhance the capabilities of shipboard personnel who sail on specialized carriers such as tankers. It is not the intention of the course to compartmentalize the trainee's way of thinking in terms of tanker operation. The idea is to make him/her aware of the specialization of operations specific to an oil and chemical tanker and sensitize him/her towards the responsibilities that s/he will face on such a vessel.

It is not the intention of the model course programme to present instructors with a rigid "teaching package" which they are expected to "follow blindly". Nor is it the intention to substitute audiovisual or "programmed" material for the instructor's presence. Rather, this document should be used as a guide with the course duration given as indicative of the expected time required to cover the required outcomes. The parties may modify this course to suit their respective training schemes.

As in all training endeavours, the knowledge, skills and dedication of the instructors are the key components in the transfer of knowledge and skills to those being trained through IMO model course material. For those following planned training schemes approved by the administration, it is intended that this training may form an integral part of the overall training plan and be complementary to other studies. The training may be undertaken in progressive stages; for such candidates, it is not appropriate to specify the duration of the learning, provided achievement of the specified learning outcomes is properly assessed and recorded.

Because educational systems and the cultural backgrounds of trainees in maritime subjects vary considerably from country to country, the model course material has been designed to identify the basic entry requirements and trainee target group for each course in universally applicable terms and to specify clearly the technical content and levels of knowledge and skills necessary to meet the technical intent of IMO conventions and related recommendations.

This course is meant for officers and ratings assigned basic duties and responsibilities related to cargo or cargo equipment on board oil and chemical tankers. By successfully completing this course, the aforementioned shipboard personnel will fulfil the mandatory minimum training requirements of Regulation V/1-1 of STCW 1978, as amended. The coverage of the model course is wide in scope and includes oil and chemical tanker safety, fire safety measures and systems, prevention and control of pollution, operational practice and obligations under applicable laws and regulations.

In order to keep the training programme up to date in future, it is essential that users provide feedback. New information will provide better training in safety at sea and protection of the marine environment. Information, comments and suggestions should be sent to the Head of the STCW and Human Element Section at IMO, London.

### Use of the model course

The instructor should review the course plan and detailed syllabus, taking into account the information provided under the entry standards specified in the course framework. The actual level of knowledge and skills and the prior education of the trainees should be kept in mind during the review, and any areas within the detailed syllabus which may cause difficulties because of differences between the actual trainee entry level and that assumed by the course designers should be identified. To compensate for such differences, the instructor is expected to delete from the course, or to reduce the emphasis on items dealing with knowledge or skills already attained by the trainees. S/he should also identify any academic knowledge, skills or technical training which they may not have acquired.

The instructor, using his/her professional judgement, can analyse the detailed syllabus and the academic knowledge required to allow training in the technical area to proceed. The instructor can then design the appropriate pre-entry course or alternatively insert the elements of academic knowledge required to support the technical training elements concerned at appropriate points within the course.

Within the course plan the course designers have indicated assessment of the time which should be allotted to each area of learning. However, it must be appreciated that these allocations are arbitrary and assume that the trainees have fully met all entry requirements of the course. The instructor should therefore review these assessments and may need to reallocate the time required to achieve each specific learning objective or training outcome.

## **Aims**

This course provides training to candidates to be duly qualified under section A-V/1-1 of the STCW Code with specific duties and responsibilities related to cargo or cargo equipment on oil or chemical tankers. It comprises a basic training programme appropriate to their duties, including basic training for oil and chemical tanker safety, fire safety measures, pollution prevention, operational practice and obligations under applicable law and regulations. The course covers the competence requirements as given in the table A-V/1-1-1 of the STCW Code adopted by the International Convention on Standards of Training, Certification and Watchkeeping for Seafarers, as amended.

Any of this training may be given on board or ashore. It could be by practical training on board or in a suitable shore-based installation.

During the course, there will be:

- familiarization with the equipment, instrumentation and controls used for cargo handling on a tanker
- greater awareness of the need of proper planning, the use of checklists and the time scales involved in the various cargo handling operations
- enhanced awareness to apply proper and safe procedures at all times when carrying out the various operations on board an oil or chemical tanker
- acquisition of experience in identifying operational problems and assist in solving them
- improvement in the ability to promote safety and protect the marine environment
- increased ability to assist and coordinate actions during emergencies.

## **Lesson plans**

The detailed syllabus contains specific references to the textbooks or teaching material proposed to be used in the course. Where no adjustment has been found necessary in the acquisition of knowledge and proficiency of the detailed syllabus, the lesson plans may simply consist of the detailed syllabus with keywords or other reminders added to assist the instructor in making his/her presentation of the material.

## **Presentation**

The presentation of concepts and methodologies must be repeated in various ways by assessing and evaluating the trainee's performance and achievements until the instructor is satisfied that the trainee has attained the required proficiency under each specific learning objective or training objective. The syllabus is laid out in the form of acquiring knowledge, understanding and proficiency format and each objective specifies what the trainee must know or be able to do as the learning or training outcome. Taken as a whole, these objectives aim to meet the knowledge, understanding and proficiency specified in the appropriate tables of the STCW Code.

## **Implementation**

For the course to run smoothly and to be effective, considerable attention must be paid to the availability and use of:

- properly qualified instructors
- support staff
- rooms and other spaces
- equipment
- textbooks, technical papers, and
- other reference material.

Thorough preparation on part of the instructor is the key to successful implementation of the course. IMO has produced a booklet entitled “Guidance on the implementation of IMO model courses”, which deals with this aspect in greater detail and which is appended to this model course.

In certain cases, the requirements for some or all of the training in a subject are covered by another IMO model course. In these cases, the specific part of the STCW Code which applies is given and the user is referred to the other model course.



## **Part A: Course Framework**

### **Scope**

This course provides training for officers and ratings. It comprises a basic training programme appropriate to their duties, including oil and chemical tanker safety, fire safety measures and systems, pollution prevention, operational practice and obligations under applicable laws and regulations. The course takes full account of section A-V/1-1 of the STCW Code adopted by the International Convention on Standards of Training, Certification and Watchkeeping for Seafarers as amended, including the Manila amendments 2010.

This training may be given on board or ashore. It can be supplemented by practical training on board or wherever possible on simulators in training institutions or in a suitable shore-based installation.

### **Objective**

The objective of this course is to meet the training requirements of regulation V/1-1 paragraph 2.2 of the International Convention on Standards of Training, Certification and Watchkeeping for Seafarers, as amended.

### **Entry standards**

This course is principally intended for candidates for certification for basic training for oil and chemical cargo operations as specified in section A-V/1-1 paragraph 1 of the STCW Code, as amended.

### **Course certificate**

On successful completion of the course, the trainee should be issued with a course completion document for basic training for oil and chemical tanker cargo operations.

### **Course intake limitations**

It is recommended that the number of trainees should not exceed 20 and practical training should be undertaken in small groups of not more than eight. The teacher to trainee ratio would therefore be 1:20 for classroom teaching and 1:8 for practical instruction.

### **Staff requirements**

The instructor shall have appropriate training in instructional techniques and training methods (STCW Code A-I/6, para. 7). It is recommended that all training and instruction is given by qualified personnel experienced in the handling and characteristics of oil and chemical cargoes and the safety procedures involved. Staff may be recruited among deck and engineer officers of oil and chemical tankers, and/or fleet superintendents as appropriate.

### **Teaching facilities and equipment**

Ordinary classroom facilities and an overhead projector are sufficient for most of the course. However, dedicated CBT modules to be run on an ordinary PC as well as exercises on an operational, hands-on liquid cargo handling simulator will greatly enhance the quality and result of the course. In such cases a sufficient number of PCs for use by trainees will be required. In addition, a video player will be required if using videos in the teaching programme.

The following equipment should be available:

- .1 Resuscitator
- .2 Breathing apparatus
- .3 Portable oxygen meter

- .4 Portable combustible-gas detector
- .5 Portable tankscope/Multi point flammable gas (infra-red gas analyser)
- .6 Portable toxic-gas detector and chemical absorption tubes
- .7 Portable multigas-detector
- .8 Personal multigas-detector
- .9 Tank evacuation equipment.

### **Use of simulators**

The revised STCW Convention sets standards regarding the performance and use of simulators for mandatory training, assessment or demonstration of competence. The general performance standards for simulators used in training and for simulators used in assessment of competence are given in section A-I/12. Simulator-based training and assessment is not a mandatory requirement for this course. However, it is widely recognized that well-designed lessons and exercises can improve the effectiveness of training.

If using simulator-based training, instructors should ensure that the aims and objective of these sessions are defined within the overall training programme and that tasks are selected so as to relate as closely as possible to shipboard tasks and practices. Instructors should refer to STCW, section A-I/12, Part 2.

### **Portable foam and fixed foam and dry chemical powder fire-fighting system**

To enable the trainees to undergo practical exercises and fire-fighting using portable foam and fixed foam and DCP systems, a fire-fighting mock-up will be needed to conduct realistic drills of extinguishing an oil or chemical fire by activating the fixed extinguishing systems and using the correct techniques in simulated shipboard conditions to extinguish the fire. A typical fixed foam and DCP fire-fighting installation for carrying out such training is provided in annex 5.

### **Design**

The core technical and academic knowledge, understanding and proficiency are set out in table A-V/1-1-1 of the STCW as amended in 2010, adopted by IMO as part of the 2010 STCW Convention.

To show consistency and adherence to STCW 2010, as given in table A-V/1-1-1, a mapping is provided below for easy reference from STCW's competences and training outcomes to the topics covered in this model course.

# STCW 2010 Table A-V/1-1-1 Mapping of IMO Model course 1.01 topics

STCW 2010 Table A-V/1-1-1 Mapping of IMO Model course 1.01 topics

| STCW 2010 Table A-V/1-1-1 |                                                                    |                                                                                                                                                                               | IMO Model course 1.01 |                  |                                                                                                                                                                                                                                                                                                                                                                     |
|---------------------------|--------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| S.No.                     | Competence                                                         | Knowledge, understanding and proficiency                                                                                                                                      | S.No.                 | Topic            | Knowledge, understanding and proficiency                                                                                                                                                                                                                                                                                                                            |
| 1                         | Contribute to the safe cargo operation of oil and chemical tankers | 1.0 Basic knowledge of tankers:<br>.1 types of oil and chemical tankers<br>.2 general arrangement and construction                                                            | 1                     | Tankers          | 1.1 Types of oil tankers<br>1.2 Types of chemical tankers<br>1.3 Ship arrangements of an oil and chemical tanker<br>1.4 Pumps and eductors<br>1.5 Cargo heating system<br>1.6 Inert gas system<br>1.7 Cargo measurement systems                                                                                                                                     |
|                           |                                                                    | 2.0 Basic knowledge of cargo operations:<br>.1 piping systems and valves<br>.2 cargo pumps<br>.3 loading and unloading<br>.4 tank cleaning, purging, gas freeing and inerting | 7                     | Cargo operations | 7.1 For oil and chemical tankers<br>7.2 For oil tankers<br>7.2.1 Cargo information<br>7.2.2 Inerting<br>7.2.3 Loading<br>7.2.4 Unloading<br>7.2.4.1 Cargo pump operations<br>7.2.5 Tank cleaning<br>7.2.6 Purging and gas freeing<br>7.3 For chemical tankers<br>7.3.1 Cargo information<br>7.3.2 Loading<br>7.3.3 Unloading<br>7.3.4 Tank cleaning and gas freeing |



| STCW 2010 Table A-V/1-1-1 |                                     |                                                                                                                                                                                                                                                                                                                                                    | IMO Model course 1.01 |                                             |                                                                                                                                                                                                                                                                                 |
|---------------------------|-------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|---------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| S.No.                     | Competence                          | Knowledge, understanding and proficiency                                                                                                                                                                                                                                                                                                           | S.No.                 | Topic                                       | Knowledge, understanding and proficiency                                                                                                                                                                                                                                        |
|                           |                                     | <b>3.0 Basic knowledge of the physical properties of oil and chemicals:</b><br>.1 pressure and temperature, including vapour pressure/temperature relationship<br>.2 types of electrostatic charge generation<br>.3 chemical symbols                                                                                                               | 2                     | Physical properties of oil and chemicals    | 2.1 Basic physics<br>2.2 Basic chemistry, chemical elements and groups<br>2.3 Physical properties of oil and chemicals carried in bulk                                                                                                                                          |
|                           |                                     | <b>4.0 Knowledge and understanding of tanker safety culture and safety management</b>                                                                                                                                                                                                                                                              | 3                     | Tanker safety culture and safety management | 3.0 Tanker safety culture and safety management                                                                                                                                                                                                                                 |
| 2                         | Take precautions to prevent hazards | <b>5.0 Basic knowledge of the hazards associated with tanker operations, including:</b><br>.1 health hazards<br>.2 environmental hazards<br>.3 reactivity hazards<br>.4 corrosion hazards<br>.5 explosion and flammability hazards<br>.6 sources of ignition, including electrostatic hazards<br>.7 toxicity hazards<br>.8 vapour leaks and clouds | 4.1                   | Hazards                                     | 4.1.1 Health hazards<br>4.1.2 Environmental hazards<br>4.1.3 Reactivity hazards<br>4.1.4 Corrosion hazards<br>4.1.5 Explosion and flammability hazards<br>4.1.6 Sources of ignition, including electrostatic hazards<br>4.1.7 Toxicity hazards<br>4.1.8 Vapour leaks and clouds |

| STCW 2010 Table A-V/1-1-1 |                                                               |                                                                                                                                                                                                                                                                                                 | IMO Model course 1.01 |                        |                                                                                                                                                                                                                                                                                                                                                          |
|---------------------------|---------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| S.No.                     | Competence                                                    | Knowledge, understanding and proficiency                                                                                                                                                                                                                                                        | S.No.                 | Topic                  | Knowledge, understanding and proficiency                                                                                                                                                                                                                                                                                                                 |
|                           |                                                               | <b>6.0 Basic knowledge of hazard controls:</b><br>.1 inerting, water padding, drying agents and monitoring techniques<br>.2 anti-static measures<br>.3 ventilation<br>.4 segregation<br>.5 cargo inhibition<br>.6 importance of cargo compatibility<br>.7 atmospheric control<br>.8 gas testing | <b>4.2</b>            | <b>Hazard controls</b> | 4.2.1 Inerting, water padding, drying agents and monitoring techniques<br>4.2.2 Anti-static measures<br>4.2.3 Ventilation<br>4.2.4 Cargo segregation<br>4.2.5 Cargo inhibition<br>4.2.6 Importance of cargo compatibility<br>4.2.7 Atmospheric control<br>4.2.8 Gas testing<br>4.2.9 Understanding of Information on a Material Safety Data Sheet (MSDS) |
|                           |                                                               | <b>7.0 Understanding of information on a Material Safety Data Sheet (MSDS)</b>                                                                                                                                                                                                                  |                       |                        |                                                                                                                                                                                                                                                                                                                                                          |
| 3                         | Apply occupational health and safety precautions and measures | <b>8.0 Function and proper use of gas measuring instruments and similar equipment</b>                                                                                                                                                                                                           | 5                     | <b>Safety</b>          | 5.1 Function and proper use of gas measuring instruments and similar equipment                                                                                                                                                                                                                                                                           |
|                           |                                                               | <b>9.0 Proper use of safety equipment and protective devices including:</b><br>.1 breathing apparatus and tank-evacuating equipment<br>.2 protective clothing and equipment<br>.3 resuscitators<br>.4 rescue and escape equipment                                                               |                       |                        | 5.2 Proper use of safety equipment and protective devices including:<br>5.2.1 Breathing apparatus and tank-evacuating equipment<br>5.2.2 Protective clothing and equipment<br>5.2.3 Resuscitators<br>5.2.4 Rescue and escape equipment                                                                                                                   |

| STCW 2010 Table A-V/1-1-1 |                                           |                                                                                                                                                                                                           | IMO Model course 1.01 |                                                 |                                                                                                                                                                             |
|---------------------------|-------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|-------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| S.No.                     | Competence                                | Knowledge, understanding and proficiency                                                                                                                                                                  | S.No.                 | Topic                                           | Knowledge, understanding and proficiency                                                                                                                                    |
|                           |                                           | <b>10.0 Basic knowledge of safe working practices and procedures in accordance with legislation and industry guidelines and personal shipboard safety relevant to oil and chemical tankers including:</b> |                       |                                                 | <b>5.3</b> Safe working practices and procedures in accordance with legislation and industry guidelines and personal shipboard safety relevant to oil and chemical tankers. |
|                           |                                           | .1 precautions to be taken when entering enclosed spaces                                                                                                                                                  |                       |                                                 | 5.3.1 Precautions to be taken when entering enclosed spaces                                                                                                                 |
|                           |                                           | .2 precautions to be taken before and during repair and maintenance work                                                                                                                                  |                       |                                                 | 5.3.2 Precautions to be taken before and during repair and maintenance work                                                                                                 |
|                           |                                           | .3 safety measures for hot and cold work                                                                                                                                                                  |                       |                                                 | 5.3.3 Safety measures for hot and cold work                                                                                                                                 |
|                           |                                           | .4 electrical safety                                                                                                                                                                                      |                       |                                                 | 5.3.4 Electrical safety precautions                                                                                                                                         |
|                           |                                           | .5 ship/shore safety checklist                                                                                                                                                                            |                       |                                                 | 7.2.3.2 Ship/shore safety checklist (only importance of SSCL discussed briefly)                                                                                             |
|                           |                                           | <b>11.0 Basic knowledge of first aid with reference to a Material Safety Data sheet (MSDS)</b>                                                                                                            |                       |                                                 | 5.4 First aid with reference to a Material Safety Data Sheet (MSDS)                                                                                                         |
| <b>4</b>                  | <b>Carry out fire-fighting operations</b> | <b>12.0 Tanker fire response organization and action to be taken</b>                                                                                                                                      | <b>6</b>              | <b>Fire safety and fire-fighting operations</b> | 6.1 Oil and chemical tanker fire response organization and action to be taken                                                                                               |
|                           |                                           | <b>13.0 Fire hazards associated with cargo handling and transportation of hazardous and noxious liquids in bulk</b>                                                                                       |                       |                                                 | 6.2 Fire hazards associated with cargo handling and transportation of hazardous and noxious liquids in bulk                                                                 |
|                           |                                           | <b>14.0 Fire-fighting agents used to extinguish oil and chemical fires</b>                                                                                                                                |                       |                                                 | 6.3 Fire-fighting agents used to extinguish oil and chemical fires                                                                                                          |
|                           |                                           | <b>15.0 Fixed fire-fighting foam system operations</b>                                                                                                                                                    |                       |                                                 | 6.4 Fixed fire-fighting foam system operations                                                                                                                              |
|                           |                                           | <b>16.0 Portable fire-fighting foam operations</b>                                                                                                                                                        |                       |                                                 | 6.5 Portable fire-fighting foam operations                                                                                                                                  |

| STCW 2010 Table A-V/1-1-1 |                                                                                               |                                                                                                                                                                                                                                | IMO Model course 1.01 |                                              |                                                                                                                                                                                                                               |
|---------------------------|-----------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|----------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| S.No.                     | Competence                                                                                    | Knowledge, understanding and proficiency                                                                                                                                                                                       | S.No.                 | Topic                                        | Knowledge, understanding and proficiency                                                                                                                                                                                      |
|                           |                                                                                               | 17.0 Fixed dry chemical system operations                                                                                                                                                                                      |                       |                                              | 6.6 Fixed dry chemical system operations                                                                                                                                                                                      |
|                           |                                                                                               | 18.0 Spill containment in relation to fire-fighting operations                                                                                                                                                                 |                       |                                              | 6.7 Spill containment in relation to fire-fighting operations                                                                                                                                                                 |
| 5                         | Respond to emergencies                                                                        | 19.0 Basic knowledge of emergency procedures including emergency shutdown                                                                                                                                                      | 8                     | Emergencies                                  | 8.1 Emergency procedures, including emergency shutdown<br>8.2 Organizational structure<br>8.3 Alarms<br>8.4 Emergency procedures                                                                                              |
| 6                         | Take precautions to prevent pollution of the environment from the release of oil or chemicals | 20.0 Basic knowledge of the effects of oil and chemical pollution on human and marine life                                                                                                                                     | 9                     | Pollution prevention                         | 9.1 Effects of oil and chemical pollution on human and marine life                                                                                                                                                            |
|                           |                                                                                               | 21.0 Basic knowledge of shipboard procedures to prevent pollution                                                                                                                                                              |                       |                                              | 9.2 Shipboard procedures to prevent pollution                                                                                                                                                                                 |
|                           |                                                                                               | 22.0 Basic knowledge of measures to be taken in the event of spillage, including the need to:<br>.1 report relevant information to the responsible persons<br>.2 assist in implementing shipboard spill-containment procedures |                       |                                              | 9.3 SOPEP and SMPEP<br>Measures to be taken in the event of spillage, including the need to:<br>.1 report relevant information to the responsible persons<br>.2 assist in implementing shipboard spill-containment procedures |
|                           |                                                                                               |                                                                                                                                                                                                                                | 10                    | Case Studies on oil and NLS ship emergencies | 10.1 Fire and explosion during unloading operations on an oil tanker<br>10.2 Collapsing of seamen during squeegeeing operations                                                                                               |

## Teaching Aids (A)

**Note:** while not required, the following or other equivalent teaching aids may be used as deemed fit by the instructor.

- A1 Instructor Manual (Part D of this course)
- A2 Resuscitator
- A3 Breathing apparatus
- A4 Portable oxygen meter
- A5 Portable combustible-gas detector
- A6 Portable tankscope/Multi point flammable gas (infra-red gas analyser)
- A7 Portable toxic-gas detector and chemical absorption tubes
- A8 Portable multigas-detector
- A9 Personal multigas-detector
- A10 Tank evacuation equipment
- A11 Overhead projector for PowerPoint presentations
- A12 Oil Tanker Cargo and Ballast Water Handling Simulator
- A13 Chemical Tanker Cargo and Ballast Water Handling Simulator
- A14 White board
- A15 Videos
- A16 Fire-fighting installations

## IMO references (R)

- R1 SOLAS 1974, International Convention for the Safety of Life at Sea, 1974, Consolidated Edition 2009 (IMO-II0E)
- R2 STCW 78 as amended, including 2010 Manila amendments, International Convention on Standards of Training, Certification and Watchkeeping for Seafarers, 2010 (IMO-938E)
- R3 MARPOL, International Convention for the Prevention of Pollution from Ships, Consolidated Edition 2011 (IMO-520E)
- R4 Inert Gas Systems (IG Systems) (IMO-860E)
- R5 Crude Oil Washing Systems (COW systems) (IMO-617E)
- R6 MFAG with Chemical supplement, Medical First Aid Guide for Use in Accidents Involving Dangerous Goods (IMDG Code Supplement – IMO-210E)
- R7 International Code for the Construction and Equipment of Ships Carrying Dangerous Chemicals in Bulk (BCH Code), as amended (IMO-774E)
- R8 International Code for the Construction and Equipment of Ships Carrying Dangerous Chemicals in Bulk (IBC Code), as amended (IMO-I00E)
- R9 Guidelines for the Development of Shipboard Pollution Emergency Plans (SOPEP) (IMO-586E)
- R10 International Safety Management Code (ISM Code) (IMO-117E)



- R11** IMO Model Course 2.06 – Oil Tanker Cargo & Ballast Handling Simulator
- R12** IMO Model Course 1.37 – Chemical Tanker Cargo & Ballast Handling Simulator
- R13** IMO Model Course 1.20 – Fire Prevention and Fire Fighting
- R14** IMO Resolution A.1050(27) – Revised Recommendations for Entering Enclosed Spaces Aboard Ships

### Textbooks (T)

**Note:** other textbooks may be used as deemed fit by the instructor.

- T1** Safety in Oil Tankers, International Chamber of Shipping. (International Chamber of Shipping, Carthusian Court, 12 Carthusian Street, London EC1M 6EZ, United Kingdom)
- T2** Safety in Chemical Tankers, International Chamber of Shipping (International Chamber of Shipping, Carthusian Court, 12 Carthusian Street, London EC1M 6EZ, United Kingdom)

### Bibliography (B)

- B1** International Safety Guide for Oil Tankers and Terminals. 5th ed. London, Witherby and Co. Ltd, 32/36 Aylesbury Street, London EC1R 0ET, United Kingdom, 1996 (ISBN 1-85609-081-7)
- B2** Tanker Safety Guide (Chemicals), International Chamber of Shipping, 3rd ed. London, Witherby and Co. Ltd, 2002 (ISBN 0-948691-50-6)
- B3** Safe Oil Tanker operations, 2011 edition. Capt. KSD Mistree and Mr. B. K. Sharma. MARINEX Publications. A-3, Silver Queen, Soonawala Agyari marg, Mumbai 445470, India. e-mail: marinez1@hotmail.com Tel: 91 22 24465470
- B4** Basic Safe Tanker Handbook for Oil, Chemicals, LPG and LNG, 2011. Capt. KSD Mistree, MAREX Publication, C – 209, Morya House, New Link Road, Andheri (w), Mumbai – 400 053. India. Tel.: 91 22 6734 9292 Fax: 91 22 6734 9222
- B5** Ship to Ship Transfer Guide (Petroleum), International Chamber of Shipping/Oil Companies International Marine Forum, 4th ed. London, Witherby and Co. Ltd., 2005 (ISBN 1-85609-097-3)
- B6** CHRIS Manual II, Hazardous Chemical Data, U.S. Coast Guard. Washington, D.C., Government Printing Office, 1988
- B7** Hawley's Condensed Chemical Dictionary, N. I. Sax, and R. J. Lewis, Sr. 13th ed. New York, Van Nostrand Reinhold, 1977 (ISBN 0-442-011318)
- B8** Tank Cleaning Guide, 6th ed. Rotterdam, B.V. Chemical Laboratory "Dr. A. Verwey", 1998
- B9** Drager-Tube Handbook, 11th ed. DragerSicherheitstechnik GmbH, Revalstrasse 1, D-23560 Lubeck, Germany, 1998 (ISBN 3-926762-06-3)
- B10** Measures to Prevent Accidental Pollution, INTERTANKO. 1990
- B11** Code of Safe Working Practices, PO Box 29, Norwich NR3 1GN. Telephone orders/General enquiries: 0870 600 5522. Fax orders: 0870 600 5533. Email: customer.services@tso.co.uk Textphone 0870 240 3701
- B12** Tanker Management Self-Assessment, Witherby and Co. Ltd, 32/36 Aylesbury Street, London EC1R 0ET, UK. www.witherbys.com (ISBN 10: 1905331231, ISBN 13: 9781905331239)

### Videos – DVDs, CDs, CBTs (V)

**Note:** other equivalent videos, CDs, CBTs may be used as deemed fit by the instructor.



**For Oil Tankers VO(x)**

- VO1** Portable gas detection equipment calibration procedures  
Available from: KARCO Website: <http://www.karco.in>  
email: [karco@karcoservices.com](mailto:karco@karcoservices.com)  
Contact: Capt. Pravesh Diwan  
Telephone: 91-22-67101229
- VO2** Tanker safety depends on you  
Available from: NATIONAL AUDIOVISUAL CENTRE  
National Technical Information Service  
5301 Shawnee Rd, Alexandria  
VA 22312  
email: [orders@ntis.gov](mailto:orders@ntis.gov)
- VO3** Operation and maintenance of inert gas systems
- VO4** The ship/shore interface – petroleum tankers
- VO5** Tanker practices series  
– cargo – part 4 Code No: 504
- VO6** Permit to work Code No: 621
- VO7** Entry into enclosed spaces (edition 2), Code No: 682
- VO8** Personal safety on tankers (edition 2), Code No: 970  
Available from: Videotel Marine International  
84 Newman Street, London W1T 3EU, UK  
Tel: +44(0) 20 72991800  
Fax: +44(0) 207299 1818  
email: [mail@videotelmail.com](mailto:mail@videotelmail.com)  
URL: [www.videotel.co.uk](http://www.videotel.co.uk)

**For Chemical Tankers VC(x)**

- VC1** FRAMO cargo pumping system – instruction
- VC2** Operation of FRAMO cargo pumping system  
Available from: Head Office  
Frank Mohn Services AS,  
PO Box 98, Slatthaug, 5851 Bergen, Norway  
Phone: +4755999000  
URL: [www.framo.no](http://www.framo.no)
- VC3** Static electricity on board tankers – DVD
- VC4** Nitrogen on board chemical tankers – DVD
- VC5** Explosion on board a laden chemical tanker – DVD  
Available from: KARCO Website: <http://www.karco.in>  
email ID: [karco@karcoservices.com](mailto:karco@karcoservices.com)  
Contact: Capt. Pravesh Diwan  
Telephone: 91-22-67101229
- VC6** Chemical tank cleaning & inspection (edition 2) Code No: 950
- VC7** Vapour emission control Code No: 1118
- VC8** Don't gamble with safety on chemical tankers Code No: 595  
CBTs E.g. SEAGULL  
– Liquid cargo properties (CBT # 0032)  
– COW (CBT # 0054)  
– ODME (CBT # 0055)

# Part B: Course Outline and Timetable

## Lectures

As far as possible, lectures should be presented within a familiar context and should make use of practical examples. They should be well illustrated with diagrams, photographs and charts where appropriate, and be related to matter learned during seagoing time.

An effective manner of presentation is to develop a technique of giving information and then reinforcing it. For example, first tell the trainees briefly what you are going to present to them; then cover the topic in detail; and, finally, summarize what you have told them.

## Fire-fighting mock-up

Existing installations for fire-fighting training as part of the basic training for all seafarers (as per STCW Reg. VI/1 and section A-VI/1-2) may be used for oil and chemical fire-fighting practical exercises. However, the installations may need to be enhanced with the fitting of Portable and Fixed Foam and Fixed Dry Chemical Powder Fire-fighting System.

As a guidance, a typical portable and fixed foam and DCP fire-fighting installation for carrying out such training detailed in sections 6.4, 6.5, 6.6 is provided in annex 5.

## Course outline

The tables that follow list the competencies and areas of knowledge, understanding and proficiency, together with the estimated total hours required for lectures and practical exercises. Teaching staff should note that timings are suggestions only and should be adapted to suit individual groups of trainees depending on their experience, ability, equipment and staff available for training.

## COURSE OUTLINE

| Subject Area                                                                      | Total hours for lectures | Total hours for practicals |
|-----------------------------------------------------------------------------------|--------------------------|----------------------------|
| <b>1 Tankers</b>                                                                  |                          |                            |
| 1.1 Types of oil tankers                                                          | 0.25                     |                            |
| 1.2 Types of chemical tankers                                                     | 0.25                     |                            |
| 1.3 Basic knowledge of ship arrangements of an oil tanker and chemical tanker (*) | 0.25                     |                            |
| 1.4 Pumps and eductors                                                            | 0.25                     |                            |
| 1.5 Cargo heating system                                                          | 0.25                     |                            |
| 1.6 Inert gas system                                                              | 0.50                     |                            |
| 1.7 Cargo measurement systems                                                     | 0.25                     |                            |
| <b>2 Physical properties of oil and chemicals</b>                                 |                          |                            |
| 2.1 Basic physics                                                                 | 2.0                      |                            |
| 2.2 Basic chemistry, chemical elements and 1.5 groups                             | 1.5                      |                            |
| 2.3 Physical properties of oil and chemicals 1.5 carried in bulk                  | 1.5                      |                            |
| <b>3 Tanker safety culture and safety management</b>                              | <b>2.0</b>               |                            |
| <b>4.1 Hazards</b>                                                                |                          |                            |
| 4.1.1 Health hazards                                                              | 0.50                     |                            |
| 4.1.2 Environmental hazards                                                       | 0.50                     |                            |
| 4.1.3 Reactivity hazards                                                          | 0.25                     |                            |
| 4.1.4 Corrosion hazards                                                           | 0.25                     |                            |
| 4.1.5 Explosion and flammability hazards                                          | 0.50                     |                            |
| 4.1.6 Sources of ignition, including electrostatic hazards                        | 0.50                     |                            |
| 4.1.7 Toxicity hazards                                                            | 0.25                     |                            |
| 4.1.8 Vapour leaks and clouds                                                     | 0.25                     |                            |
| <b>4.2 Hazard controls</b>                                                        |                          |                            |
| 4.2.1 Inerting, water padding, drying agents and monitoring techniques            | 0.50                     |                            |
| 4.2.2 Anti-static measures                                                        | 0.50                     |                            |
| 4.2.3 Ventilation                                                                 | 0.25                     |                            |
| 4.2.4 Cargo segregation                                                           | 0.25                     |                            |
| 4.2.5 Cargo inhibition                                                            | 0.25                     |                            |
| 4.2.6 Importance of cargo compatibility                                           | 0.50                     |                            |
| 4.2.7 Atmospheric control                                                         | 0.50                     |                            |
| 4.2.8 Gas testing                                                                 | 0.25                     |                            |
| 4.2.9 Understanding of information on a Material Safety Data Sheet (MSDS)         | 0.50                     | 0.50                       |
| <b>5 Safety</b>                                                                   |                          |                            |
| 5.1 Function and proper use of gas measuring instruments (**)                     |                          | 1.0                        |
| 5.2 Proper use of safety equipment and protective devices including:              |                          |                            |
| 5.2.1 Breathing apparatus and tank-evacuating equipment(**)/(#)                   | 0.50                     | 0.50                       |
| 5.2.2 Protective clothing and equipment(**)/(#)                                   | 0.50                     |                            |
| 5.2.3 Resuscitators(**)/(#)                                                       | 0.50                     |                            |
| 5.2.4 Rescue and escape equipment(**)/(#)                                         | 0.50                     |                            |

| Subject Area |                                                                                                                                                                 | Total hours for lectures | Total hours for practicals |
|--------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------|----------------------------|
| 5.3          | Safe working practices and procedures in accordance with legislation and industry guidelines and personal shipboard safety relevant to oil and chemical tankers |                          |                            |
| 5.3.1        | Precautions to be taken when entering enclosed spaces                                                                                                           | 1.0                      |                            |
| 5.3.2        | Precautions to be taken before and during “repair and maintenance” work in a gas dangerous area                                                                 | 0.50                     |                            |
| 5.3.3        | Safety measures for hot and cold work                                                                                                                           | 1.5                      |                            |
| 5.3.4        | Electrical safety precautions                                                                                                                                   | 0.50                     |                            |
| 5.4          | First aid with reference to a Material Safety Data Sheet (MSDS)                                                                                                 | 2.0                      |                            |
| 6            | <b>Fire safety and fire-fighting operations</b>                                                                                                                 |                          |                            |
| 6.1          | Oil and chemical tanker fire response organization and action to be taken (**)                                                                                  | 1.5                      |                            |
| 6.2          | Fire hazards associated with cargo handling and transportation of hazardous and noxious liquids in bulk                                                         | 1.5                      |                            |
| 6.3          | Fire-fighting agents used to extinguish oil and chemical fires (**)                                                                                             | 0.50                     |                            |
| 6.4          | Fixed fire-fighting foam system operations (#)                                                                                                                  | 0.50                     | 2.0                        |
| 6.5          | Portable fire-fighting foam operations(#)                                                                                                                       | 0.25                     | 1.0                        |
| 6.6          | Fixed dry chemical powder operations (#)                                                                                                                        | 0.50                     | 2.0                        |
| 6.7          | Spill containment in relation to fire-fighting operations                                                                                                       | 0.25                     |                            |
| 7            | <b>Cargo operations</b>                                                                                                                                         |                          |                            |
| 7.1          | For oil and chemical tankers                                                                                                                                    | 0.25                     |                            |
| 7.2          | For oil tankers                                                                                                                                                 |                          |                            |
| 7.2.1        | Cargo information                                                                                                                                               | 0.50                     |                            |
| 7.2.2        | Inerting                                                                                                                                                        | 1.0                      |                            |
| 7.2.3        | Loading                                                                                                                                                         | 0.50                     |                            |
| 7.2.4        | Unloading                                                                                                                                                       | 0.50                     |                            |
| 7.2.5        | Tank cleaning                                                                                                                                                   | 1.0                      |                            |
| 7.2.6        | Purging and gas freeing                                                                                                                                         | 0.50                     |                            |
| 7.3          | For chemical tankers                                                                                                                                            |                          |                            |
| 7.3.1        | Cargo information                                                                                                                                               | 0.50                     |                            |
| 7.3.2        | Loading                                                                                                                                                         | 1.0                      |                            |
| 7.3.3        | Unloading                                                                                                                                                       | 0.50                     |                            |
| 7.3.4        | Tank cleaning and gas freeing                                                                                                                                   | 1.0                      |                            |
| 8            | <b>Emergencies for oil and chemical tankers</b>                                                                                                                 |                          |                            |
| 8.1          | Emergency procedures, including emergency shutdown                                                                                                              | 0.50                     |                            |
| 8.2          | Organizational structure                                                                                                                                        | 0.25                     |                            |
| 8.3          | Alarms                                                                                                                                                          | 0.25                     |                            |
| 8.4          | Emergency procedures                                                                                                                                            | 0.50                     |                            |
| 9            | <b>Pollution prevention for oil and chemical tankers</b>                                                                                                        |                          |                            |
| 9.1          | Basic knowledge of the effects of oil and chemical pollution on human and marine life                                                                           | 0.50                     |                            |
| 9.2          | Basic knowledge of shipboard procedures to prevent pollution                                                                                                    | 0.25                     |                            |

| Subject Area                |                                                                                                                                                                                                                           | Total hours for lectures | Total hours for practicals |
|-----------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------|----------------------------|
| 9.3                         | SOPEP and SMPEP<br>Measures to be taken in the event of spillage, including the need to:<br>.1 report relevant information to the responsible persons<br>.2 assist in implementing shipboard spill-containment procedures | 0.50                     |                            |
| 10                          | <b>Case Studies on oil and NLS ship emergencies</b>                                                                                                                                                                       |                          |                            |
| 10.1                        | Fire and explosion during unloading operations on an oil tanker                                                                                                                                                           | 0.25                     |                            |
| 10.2                        | Collapsing of seamen during squeegeeing operations                                                                                                                                                                        | 0.25                     |                            |
| 11                          | <b>Discussions &amp; Assessment</b>                                                                                                                                                                                       | 0.75                     |                            |
| <b>Subtotals</b>            |                                                                                                                                                                                                                           | <b>40</b>                | <b>7.0</b>                 |
| <b>Total for the course</b> |                                                                                                                                                                                                                           | <b>47</b>                |                            |

**Note:** it is suggested that relevant topics which are marked with an asterisk (\*) may be taught on a simulator.

It is suggested that practical fire-fighting topics covering 5 hours, which are marked with a hash (#), may be conducted separately in any facility which can conduct practical exercises and instruction under approved and truly realistic training conditions (e.g. fire-fighting mock-up, etc.). The practical fire-fighting demonstrations may form part of an overall fire-fighting course. However, the theory section must be covered within the timetable frame of this course.

The relevant topics which are marked with a double asterisk (\*\*) may be demonstrated practically and may be supplemented with videos and CBTs.

Teaching staff should note that the hours for lectures and exercises are suggestions only as regards sequence and length of time allocated to each objective. These factors may be adapted by lecturers to suit individual groups of trainees depending on their experience, ability, equipment and staff available for teaching.

Course timetable

The following timetable should be considered indicative and adjusted in accordance with the needs of course participants. The topics should be covered, but with sufficient flexibility with respect to extent and depth that takes into account the differing learning needs of the participants.

COURSE TIMETABLE

|       |       |                                                                                               |
|-------|-------|-----------------------------------------------------------------------------------------------|
| Day 1 | 1.1   | Types of oil tankers                                                                          |
|       | 1.2   | Types of chemical tankers                                                                     |
|       | 1.3   | Ship arrangements of an oil and chemical tanker                                               |
|       | 1.4   | Pumps and eductors                                                                            |
|       | 1.5   | Cargo heating system                                                                          |
|       | 1.6   | Inert gas system                                                                              |
|       | 1.7   | Cargo measurement systems                                                                     |
|       | 2.1   | Basic physics                                                                                 |
|       | 2.2   | Basic chemistry, chemical elements and groups                                                 |
|       | 2.3   | Physical properties of oil and chemicals carried in bulk                                      |
| Day 2 | 3     | Tanker safety culture and safety management                                                   |
|       | 4.1.1 | Health hazards                                                                                |
|       | 4.1.2 | Environmental hazards                                                                         |
|       | 4.1.3 | Reactivity hazards                                                                            |
|       | 4.1.4 | Corrosion hazards                                                                             |
|       | 4.1.5 | Explosion and flammability hazards                                                            |
|       | 4.1.6 | Sources of ignition, including electrostatic hazards                                          |
|       | 4.1.7 | Toxicity hazards                                                                              |
|       | 4.1.8 | Vapour leaks and clouds                                                                       |
|       | 4.2.1 | Inerting, water padding, drying agents and monitoring techniques                              |
|       | 4.2.2 | Anti-static measures                                                                          |
|       | 4.2.3 | Ventilation system on oil and chemical tankers                                                |
|       | 4.2.4 | Cargo segregation                                                                             |
|       | 4.2.6 | Importance of cargo compatibility                                                             |
| Day 3 | 4.2.5 | Cargo inhibition                                                                              |
|       | 4.2.7 | Atmospheric control                                                                           |
|       | 4.2.8 | Gas testing                                                                                   |
|       | 4.2.9 | Understanding of information on a Material Safety Data Sheet (MSDS)                           |
|       | 5.1   | Function and proper use of gas-measuring instruments                                          |
|       | 5.2   | Proper use of safety equipment and protective devices including:                              |
|       | 5.2.1 | Breathing apparatus and tank-evacuating equipment                                             |
|       | 5.2.2 | Protective clothing and equipment                                                             |
|       | 5.2.3 | Resuscitators                                                                                 |
|       | 5.2.4 | Rescue and escape equipment                                                                   |
|       | 5.3   | Safe working practices relevant to oil and chemical tankers                                   |
|       | 5.3.1 | Enclosed space entry                                                                          |
|       | 5.3.2 | Precautions to be taken before and during repair and maintenance work in a gas dangerous area |



|              |         |                                                                                                         |
|--------------|---------|---------------------------------------------------------------------------------------------------------|
| <b>Day 4</b> | 5.3.3   | Safety measures for hot and cold work                                                                   |
|              | 5.3.4   | Electrical safety precautions                                                                           |
|              | 5.4     | First aid with reference to a Material Safety Data Sheet (MSDS)                                         |
|              | 6.1     | Oil and chemical tanker fire response organization                                                      |
|              | 6.2     | Fire hazards associated with cargo handling and transportation of hazardous and noxious liquids in bulk |
| <b>Day 5</b> | 6.3     | Fire-fighting agents used to extinguish oil and chemical fires                                          |
|              | 6.4     | Fixed fire-fighting foam system operations                                                              |
|              | 6.5     | Portable fire-fighting foam operations                                                                  |
|              | 6.6     | Fixed dry chemical system operations                                                                    |
|              | 6.7     | Spill containment in relation to fire-fighting operations                                               |
|              | 7.1     | Cargo operations for oil and chemical tankers                                                           |
|              | 7.2     | For oil tankers                                                                                         |
|              | 7.2.1   | Cargo information                                                                                       |
|              | 7.2.2   | Inerting                                                                                                |
|              | 7.2.6   | Purging and gas freeing                                                                                 |
|              | 7.2.3   | Loading                                                                                                 |
|              | 7.2.3.2 | Ship/shore safety checklist                                                                             |
|              | 7.2.4   | Unloading                                                                                               |
| <b>Day 6</b> | 7.3     | For chemical tankers                                                                                    |
|              | 7.3.1   | Cargo information                                                                                       |
|              | 7.3.2   | Loading                                                                                                 |
|              | 7.3.3   | Unloading (chemical tankers)                                                                            |
|              | 7.2     | For oil tankers                                                                                         |
|              | 7.2.5   | Tank cleaning (for chemical tankers)                                                                    |
|              | 7.3.4   | Tank cleaning and gas freeing                                                                           |
|              | 8.1     | Emergency procedures, including emergency shutdown                                                      |
|              | 8.2     | Organizational structure                                                                                |
|              | 8.3     | Alarms                                                                                                  |
|              | 8.4     | Emergency procedures                                                                                    |
|              | 9.1     | Effects of oil and chemical pollution on human and marine life                                          |
|              | 9.2     | Shipboard procedures to prevent pollution                                                               |
|              | 9.3     | SOPEP and SMPEP                                                                                         |
|              | 10.1    | Fire and explosion during unloading operations on an oil tanker                                         |
|              | 10.2    | Collapsing of seamen during squeegeeing operations                                                      |

Teaching staff should note that timetables are suggestions only as regards sequence and length of time allocated to each objective. These factors may be adapted by instructors to suit individual groups of trainees depending on their experience and ability and on the equipment and staff available for training.

## Part C: Detailed Teaching Syllabus

### Introduction

The detailed teaching syllabus is presented as a series of learning objectives. The objective, therefore, describes what the trainee must do to demonstrate that the specified knowledge or skill has been transferred.

Thus each training outcome is supported by a number of related performance elements in which the trainee is required to be proficient. The teaching syllabus shows the Required performance expected of the trainee in the tables that follow.

In order to assist the instructor, references are shown to indicate IMO references and publications, textbooks and teaching aids that instructors may wish to use in preparing and presenting their lessons.

The material listed in the course framework has been used to structure the detailed teaching syllabus; in particular,

- Teaching aids (indicated by A)
- IMO references (indicated by R)
- Textbooks (indicated by T) and
- Bibliography (indicated by B)

will provide valuable information to instructors.

|                                                                                                                                                                         |  |  |  |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|--|--|
| TOPIC 1 TANKERS                                                                                                                                                         |  |  |  |
| COMPETENCE 1 Contribute to the safe cargo operation of oil and chemical tankers                                                                                         |  |  |  |
| TRAINING OUTCOMES:<br>Demonstrates basic knowledge and understanding of:<br>Tankers:<br>.1 types of oil and chemical tankers<br>.2 general arrangement and construction |  |  |  |

| TOPIC 1 TANKERS                          |                                                                                                                                                                                                                           |                |                            |              |
|------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|----------------------------|--------------|
| Knowledge, understanding and proficiency |                                                                                                                                                                                                                           | IMO reference  | Textbooks/<br>Bibliography | Teaching aid |
| 1.1                                      | Types of oil tankers                                                                                                                                                                                                      | R1, R2         | B1, B3, B4                 | A1, A11, A14 |
| 1.1.1                                    | Lists important stages in the development of oil tankers                                                                                                                                                                  |                |                            |              |
| 1.1.2                                    | Describes oil tankers built with double hull and middeck design                                                                                                                                                           |                |                            |              |
| 1.1.3                                    | Describes crude oil carriers, product tankers, combination carriers – O/O & OBOs                                                                                                                                          |                |                            |              |
| 1.2                                      | Types of chemical tankers                                                                                                                                                                                                 | R1, R2, R7, R8 | B2, B4                     | A1, A11, A14 |
| 1.2.1                                    | Lists important stages in the development of chemical tankers                                                                                                                                                             |                |                            |              |
| 1.2.2                                    | Type 1, Type 2 and Type 3 Chemical Tankers                                                                                                                                                                                |                |                            |              |
| 1.2.3                                    | States that the Bulk Chemical Codes divide chemical tankers into three ship types, Type 1, Type 2 and Type 3, which reflect the hazard rating of the cargoes to be carried                                                |                |                            |              |
| 1.2.4                                    | States that a Type 1 ship is a chemical tanker intended for the transportation of products considered to present the greatest overall hazards and that Type 2 and Type 3 are for products of progressively lesser hazards |                |                            |              |
| 1.2.4.1                                  | States that a Type 1 ship is required for highly hazardous cargoes for example dodecylphenol and phosphorus                                                                                                               |                |                            |              |
| 1.2.4.2                                  | States that the most common chemical tanker cargoes require Type 2 or Type 3 ships                                                                                                                                        |                |                            |              |
| 1.2.4.3                                  | States that the term “overall hazard” includes both safety hazard and pollution hazard                                                                                                                                    |                |                            |              |
| 1.2.4.4                                  | Explains difference between Parcel Tankers, Bulk Solvent Carriers and Dedicated Small Chemical Tankers                                                                                                                    |                |                            |              |
| 1.2.5                                    | Explains survival capability and tank location                                                                                                                                                                            |                |                            |              |

| TOPIC 1 TANKERS                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                |                            |                   |
|------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|----------------------------|-------------------|
| Knowledge, understanding and proficiency |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | IMO reference  | Textbooks/<br>Bibliography | Teaching aid      |
| 1.3                                      | <b>Ship arrangements of an oil and chemical tanker</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | R1, R2, R3, R4 | B1, B3, B4                 | A1, A11, A12, A14 |
| 1.3.1                                    | Identifies with the aid of a sketch the general tank arrangements of an oil tanker, including: <ul style="list-style-type: none"><li>– cargo tanks<ul style="list-style-type: none"><li>– States that cargo tanks may also be used for ballast</li></ul></li><li>– pump-rooms</li><li>– segregated ballast tanks</li><li>– slop tanks<ul style="list-style-type: none"><li>– States that mixtures of water and cargo from tank-washing operations are called “slops”</li><li>– States that tanks which contain this sort of mixture are called “slop tanks”</li><li>– States that slop tanks should be placed inside the cargo area</li><li>– States that slops may be stored in slop tanks or in cargo tanks</li><li>– States that slops from different cargoes may be incompatible</li><li>– Describes, with the aid of a drawing, a tank-washing and slop-retaining system</li></ul></li><li>– cofferdams</li><li>– peak tanks</li><li>– deep tanks</li><li>– venting arrangements<ul style="list-style-type: none"><li>– States that the main purpose of the ventilation line is to lead vapour from the cargo tank to the cargo ventilation riser</li><li>– States that the vapour pressure may be regulated by a pressure/vacuum relief valve in the ventilation line</li><li>– States that the vent outlets are arranged to prevent the entry of water into the cargo tanks and, at the same time, to direct the vapour discharge upwards</li><li>– States that the vent outlets are provided with flame screens and may be provided with high- velocity devices</li></ul></li></ul> |                |                            |                   |
| 1.3.1.1                                  | Describes the piping arrangements of an oil tanker, including: <ul style="list-style-type: none"><li>– internal piping in tanks and pump-rooms</li></ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                |                            |                   |

| TOPIC 1 TANKERS                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                     |                            |                   |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|----------------------------|-------------------|
| Knowledge, understanding and proficiency                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | IMO reference       | Textbooks/<br>Bibliography | Teaching aid      |
| 1.3.1.2 States that some commonly fixed piping arrangements in a cargo tank are: <ul style="list-style-type: none"><li>– unloading line</li><li>– cargo ventilation line</li><li>– drop line</li></ul> With the help of a diagram point out: <ul style="list-style-type: none"><li>– external piping (deck lines)</li><li>– crossovers</li><li>– by-passes</li><li>– ring-main systems</li><li>– direct piping systems</li><li>– valves</li><li>– states that there are several types of valves used in cargo handling systems on tankers</li></ul> | R1, R2, R7, R8, R12 | B2, B4                     | A1, A11, A13, A14 |
| 1.3.1.3 States that tankers may be provided with cargo hoses                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                     |                            |                   |
| 1.3.1.4 States that the cargo hose constitutes a weak part of the cargo handling system and that incorrect handling of the hose will increase the danger of fire, health hazard and pollution                                                                                                                                                                                                                                                                                                                                                       |                     |                            |                   |
| 1.3.1.5 Describes, with the aid of a simple drawing, a cargo-loading arrangement                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                     |                            |                   |
| 1.3.1.6 Describes, with the aid of a drawing, a simple cargo-unloading arrangement                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                     |                            |                   |
| 1.3.1.7 Describes correct handling, storage and inspection of the ship's cargo hoses                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                     |                            |                   |
| 1.3.2 Ship arrangements of a chemical tanker                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                     |                            |                   |
| 1.3.2.1 States that some chemical tankers have small additional cargo tanks located on deck                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                     |                            |                   |
| 1.3.2.2 States that slop tanks are tanks designated or used for tank washings and cargo residues                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                     |                            |                   |
| 1.3.2.3 States that segregated ballast tanks are equipped with a pumping system that is independent of the cargo system, in order to avoid contamination by cargoes                                                                                                                                                                                                                                                                                                                                                                                 |                     |                            |                   |
| 1.3.2.4 States that the cargo tank may be constructed with mild steel and coated or stainless steel depending on the cargo to be carried                                                                                                                                                                                                                                                                                                                                                                                                            |                     |                            |                   |
| 1.4 Pumps and eductors                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                     |                            |                   |
| 1.4.1 States that the main cargo pumps fitted on tankers are mainly of the centrifugal type                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                     |                            |                   |
| 1.4.2 States that these pumps may be of the deep well type in the cargo tanks or placed in a pump-room                                                                                                                                                                                                                                                                                                                                                                                                                                              |                     |                            |                   |



| TOPIC 1 TANKERS                                                                                                                                                                                                                          |               |                            |              |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|----------------------------|--------------|
| Knowledge, understanding and proficiency                                                                                                                                                                                                 | IMO reference | Textbooks/<br>Bibliography | Teaching aid |
| 1.4.3 States that screw pumps and piston pumps are used also in some unloading systems                                                                                                                                                   |               |                            |              |
| 1.4.4 States that the cargo-pumping systems on tankers are designed to minimize cargo residues after unloading                                                                                                                           |               |                            |              |
| 1.4.5 States that alternative unloading may be done by means of portable cargo pumps or eductors                                                                                                                                         |               |                            |              |
| 1.4.6 Describes generally an unloading system consisting of submerged cargo pumps                                                                                                                                                        |               |                            |              |
| 1.4.7 Describes generally an unloading system consisting of pumps placed in pump-rooms                                                                                                                                                   |               |                            |              |
| 1.4.8 Describes generally the safe handling of a cargo pump                                                                                                                                                                              |               |                            |              |
| <b>1.5 Cargo heating system</b>                                                                                                                                                                                                          |               |                            |              |
| 1.5.1 States that some cargoes have to be heated by the ship's cargo heating system                                                                                                                                                      |               |                            |              |
| 1.5.2 States that the main reason for heating a cargo is to: <ul style="list-style-type: none"> <li>– prevent it from solidifying</li> <li>– keep the viscosity below a certain level during unloading</li> </ul>                        |               |                            |              |
| 1.5.3 States that the heating medium may be water, steam, or thermal oils                                                                                                                                                                |               |                            |              |
| 1.5.4 States that means are provided to ensure that cargo does not enter boilers or the engine-room through leakages in cargo heating coils                                                                                              |               |                            |              |
| 1.5.5 Describes, with the aid of a drawing, a cargo heating system: <ul style="list-style-type: none"> <li>– using heating coils fitted inside the cargo tank</li> <li>– using a heat exchanger placed outside the cargo tank</li> </ul> |               |                            |              |
| <b>1.6 Inert gas system</b>                                                                                                                                                                                                              |               |                            |              |
| 1.6.1 States that “inert gas” is a gas or vapour containing insufficient oxygen to support combustion                                                                                                                                    |               |                            |              |
| 1.6.2 States common shipboard inert gas systems are: <ul style="list-style-type: none"> <li>– flue gas system</li> <li>– nitrogen gas generator</li> <li>– stand-alone oil fired inert gas generator</li> </ul>                          |               |                            |              |
| 1.6.3 States that strict cargo quality controls are needed by shippers and thus require inert gas of extreme purity                                                                                                                      |               |                            |              |

| TOPIC 1 TANKERS                          |                                                                                                                                                                                  |               |                            |              |
|------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|----------------------------|--------------|
| Knowledge, understanding and proficiency |                                                                                                                                                                                  | IMO reference | Textbooks/<br>Bibliography | Teaching aid |
| 1.6.4                                    | Understands the piping system and components of an inert gas system                                                                                                              |               |                            |              |
| 1.6.5                                    | States that “Nitrogen” is used as inert gas on board chemical tankers                                                                                                            |               |                            |              |
| 1.6.6                                    | States that not every chemical tanker will have an inert gas system                                                                                                              |               |                            |              |
| 1.6.7                                    | States that inert gas other than nitrogen has constituents like carbon oxides, sulphur oxides, moisture, etc. which may result in cargo contamination                            |               |                            |              |
| 1.6.8                                    | States that chemical tankers may have nitrogen generators on board and in absence of such generators, arrangements are there to receive nitrogen from a shore reception facility |               |                            |              |
| 1.7                                      | Cargo measurement systems                                                                                                                                                        |               |                            |              |
| 1.7.1                                    | States that depending upon the requirements of a cargo, different gauging systems are needed in accordance with IBC/BCH Code                                                     |               |                            |              |
| 1.7.2                                    | States that gauging could be “open”, “restricted” or “closed”                                                                                                                    |               |                            |              |

| TOPIC 2 PHYSICAL PROPERTIES OF OIL AND CHEMICALS                                                                                                                                                                                                                                |  |  |  |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|--|--|
| COMPETENCE 1 Contribute to the safe cargo operation of oil and chemical tankers                                                                                                                                                                                                 |  |  |  |
| TRAINING OUTCOMES:<br><br>Demonstrates basic knowledge and understanding of:<br><br>Physical properties of oil and chemicals:<br><br>.1 pressure and temperature; vapour pressure/temperature relationship<br><br>.2 electrostatic charge generation<br><br>.3 chemical symbols |  |  |  |
|                                                                                                                                                                                                                                                                                 |  |  |  |
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| TOPIC 2 PHYSICAL PROPERTIES OF OIL AND CHEMICALS |                                                                                                                                                                                                                                                                                             |               |                            |              |
|--------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|----------------------------|--------------|
| Knowledge, understanding and proficiency         |                                                                                                                                                                                                                                                                                             | IMO reference | Textbooks/<br>Bibliography | Teaching aid |
| 2.1                                              | Basic physics                                                                                                                                                                                                                                                                               | R2            | B1, B2, B3, B4             | A1, A11, A14 |
| 2.1.1                                            | Defines the following in simple terms: <ul style="list-style-type: none"><li>– states of aggregation</li><li>– liquid density</li><li>– vapour density</li><li>– vapour pressure</li><li>– viscosity</li><li>– pour-point</li><li>– static electricity, causes and its generation</li></ul> |               |                            |              |
| 2.1.2                                            | Explains the relationships between temperature and pressure                                                                                                                                                                                                                                 |               |                            |              |
| 2.2                                              | Basic chemistry, chemical elements and groups                                                                                                                                                                                                                                               | R2, R7, R8    | B1, B2, B3, B4, B7         | A1, A11, A14 |
| 2.2.1                                            | Explains in simple terms: <ul style="list-style-type: none"><li>– chemical symbols and structures</li><li>– a hydrocarbon molecule chemical elements of acids and bases</li><li>– chemical reactions</li></ul>                                                                              |               |                            |              |
| 2.2.2                                            | Gives examples of chemical reactions                                                                                                                                                                                                                                                        |               |                            |              |
| 2.2.3                                            | States that crude petroleum as discharged at the well head is a mixture of a large number of different hydrocarbon molecules                                                                                                                                                                |               |                            |              |
| 2.2.4                                            | States that crude oil is a mixture of hydrocarbons which under normal atmospheric conditions are gaseous, liquid and solid                                                                                                                                                                  |               |                            |              |
| 2.2.5                                            | States that the crude oil may be distilled into a number of fractions resulting in various petroleum products                                                                                                                                                                               |               |                            |              |

| TOPIC 2 PHYSICAL PROPERTIES OF OIL AND CHEMICALS |                                                                                                                                                                                                                                                                                                                                                                                   |               |                            |              |
|--------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|----------------------------|--------------|
| Knowledge, understanding and proficiency         |                                                                                                                                                                                                                                                                                                                                                                                   | IMO reference | Textbooks/<br>Bibliography | Teaching aid |
| 2.3                                              | <b>Physical properties of oil and chemicals carried in bulk</b>                                                                                                                                                                                                                                                                                                                   | R2            | B1, B2, B3, B4             | A1, A11, A14 |
| 2.3.1                                            | Defines the following in simple terms and explains their practical significance in the tanker trade:<br><br>– flashpoint<br>– volatility<br>– upper flammable/explosive limit<br>– lower flammable/explosive limit<br>– auto-ignition temperature<br>– spontaneous combustion<br>– reactivity, polymerization<br>– toxicity<br>– corrosivity<br>– vapour pressure and temperature |               |                            |              |

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| TOPIC 3 TANKER SAFETY CULTURE AND SAFETY MANAGEMENT                                                                            |  |  |  |
| COMPETENCE 1 Contribute to the safe cargo operation of oil and chemical tankers                                                |  |  |  |
| TRAINING OUTCOMES:<br>Demonstrates basic knowledge and understanding of:<br><br>.1 tanker safety culture and safety management |  |  |  |



| TOPIC 3 TANKER SAFETY CULTURE AND SAFETY MANAGEMENT |                                                                                                                                                             |               |                            |              |
|-----------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|----------------------------|--------------|
| Knowledge, understanding and proficiency            |                                                                                                                                                             | IMO reference | Textbooks/<br>Bibliography | Teaching aid |
| 3.0                                                 | Tanker safety culture and safety management                                                                                                                 | R2, R10       | B1, B2, B3, B4, B11, B12   | A1, A11, A14 |
| 3.1                                                 | Explains the safe and dangerous zones on a tanker and the safe practices which needs to be followed by the seafarer when in these zones                     |               |                            |              |
| 3.2                                                 | Understanding of the best practices that constitute a good tanker safety culture on board                                                                   |               |                            |              |
| 3.3                                                 | States that good safety culture is evident by good work practices and work morale and commitment to safety, communication, crew qualifications and training |               |                            |              |
| 3.4                                                 | States that the ISM Code provides a standard framework for good management practices.                                                                       |               |                            |              |
| 3.5                                                 | States that there are other industry practices, such as COSWP, ISGOTT and Tanker safety Guide (Chemicals) that should be followed on board                  |               |                            |              |

| TOPIC 4 HAZARDS                                                                                                                                                                                                                                                                                                                                                                            |  |  |  |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|--|--|
| COMPETENCE 2 Take precautions to prevent hazards                                                                                                                                                                                                                                                                                                                                           |  |  |  |
| <b>TRAINING OUTCOMES:</b><br>Demonstrates basic knowledge and understanding of:<br><br>Hazards:<br><br>.1 health hazards<br><br>.2 environmental hazards<br><br>.3 reactivity hazards<br><br>.4 corrosion hazards<br><br>.5 explosion and flammability hazards<br><br>.6 sources of ignition, including electrostatic hazards<br><br>.7 toxicity hazards<br><br>.8 vapour leaks and clouds |  |  |  |

| TOPIC 4.1 HAZARDS                        |                                                                                                                                                                                                                                                                                                                                     |                |                            |              |
|------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|----------------------------|--------------|
| Knowledge, understanding and proficiency |                                                                                                                                                                                                                                                                                                                                     | IMO reference  | Textbooks/<br>Bibliography | Teaching aid |
| 4.1                                      | <b>Hazards</b>                                                                                                                                                                                                                                                                                                                      | R2, R6, R7, R8 | B1, B2, B3, B4, B6, B11    | A1, A11, A14 |
| 4.1.1.1                                  | Lists the hazards to health of: <ul style="list-style-type: none"><li>– skin contact with petroleum and chemical products</li><li>– ingestion (swallowing) of petroleum and chemical products</li><li>– inhalation of petroleum and chemical products vapours</li></ul>                                                             |                |                            |              |
| 4.1.1.2                                  | States that skin contact with petroleum and chemical products may cause irritation and dermatitis and may lead to serious burns                                                                                                                                                                                                     |                |                            |              |
| 4.1.1.3                                  | States that ingestion of petroleum and chemical products into the stomach may cause acute discomfort and nausea. States that the liquid ingested will tend to vaporize and the vapour could be inhaled into the lungs                                                                                                               |                |                            |              |
| 4.1.1.4                                  | States that if the vapours are inhaled into the lungs there may be a serious risk of suffocation. States that inhalation of product vapours may produce narcosis, the main symptoms being headache, eye irritation and dizziness, with very high concentrations leading to paralysis, insensibility and possibly death              |                |                            |              |
| 4.1.1.5                                  | States that effects of exposure involving dangerous petroleum products and chemicals are given in the ICS or other cargo data sheets                                                                                                                                                                                                |                |                            |              |
| <b>Oxygen deficiency</b>                 |                                                                                                                                                                                                                                                                                                                                     |                |                            |              |
| 4.1.1.6                                  | States that the oxygen content of air is 21% by volume                                                                                                                                                                                                                                                                              |                |                            |              |
| 4.1.1.7                                  | States that the oxygen content in enclosed spaces may become dangerously low                                                                                                                                                                                                                                                        |                |                            |              |
| 4.1.1.8                                  | Describes the reasons for oxygen deficiency in an enclosed space could be: <ul style="list-style-type: none"><li>– an inert atmosphere</li><li>– displaced oxygen due to presence of cargo vapour</li><li>– combustion</li><li>– chemical reactions</li><li>– rusting</li><li>– drying paint</li><li>– microbial activity</li></ul> |                |                            |              |
| 4.1.1.9                                  | States that in certain wind conditions vented gases may descend down, making the atmosphere on open deck harmful due to: <ul style="list-style-type: none"><li>– presence of gases in harmful concentration</li><li>– oxygen deficiency</li></ul>                                                                                   |                |                            |              |

| TOPIC 4.1 HAZARDS                        |                                                                                                                                                                                                                                  |               |                            |              |
|------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|----------------------------|--------------|
| Knowledge, understanding and proficiency |                                                                                                                                                                                                                                  | IMO reference | Textbooks/<br>Bibliography | Teaching aid |
| 4.1.1.10                                 | States that if harmful conditions on deck exist, all non-essential work on deck should cease and only essential personnel should remain on deck, taking all appropriate precautions                                              |               |                            |              |
| 4.1.1.11                                 | Describes the symptoms of the effect of oxygen deficiency as asphyxia                                                                                                                                                            |               |                            |              |
| 4.1.1.12                                 | States that reliance should not be placed on symptoms for indicating an oxygen-deficient atmosphere                                                                                                                              |               |                            |              |
| 4.1.1.13                                 | States that persons have varying susceptibility to oxygen deficiency but that all will suffer if the oxygen content drops below 16% by volume                                                                                    |               |                            |              |
| 4.1.1.14                                 | States that the main hazard associated with inert gas is its low oxygen content                                                                                                                                                  |               |                            |              |
| 4.1.2                                    | <b>Environmental hazards</b>                                                                                                                                                                                                     |               |                            |              |
| 4.1.2.1                                  | Defines “pollution” as inconvenience or damage, caused by human activities, to humans, animals, plants and to the environment as a whole, by spreading of hydrocarbons and chemical compounds to air, water or land              |               |                            |              |
| 4.1.2.2                                  | States that a major oil and chemical pollution can harm other industries such as fishery, tourism, etc.                                                                                                                          |               |                            |              |
| 4.1.2.3                                  | States that cargoes in oil and chemical tankers may be harmful to the environment and represent a pollution risk                                                                                                                 |               |                            |              |
| 4.1.2.4                                  | Explains hazards caused to the environment, covering the effect on human and marine life from the release of oil or chemicals                                                                                                    |               |                            |              |
| 4.1.2.5                                  | Explains the effect of the cargo vapour pressure and atmospheric conditions on the hazards to the environment                                                                                                                    |               |                            |              |
| 4.1.3                                    | <b>Reactivity hazards</b>                                                                                                                                                                                                        |               |                            |              |
| 4.1.3.1                                  | States that chemical cargo may react in a number of ways, such as with: <ul style="list-style-type: none"><li>– itself (self-reaction)</li><li>– air</li><li>– water</li><li>– another cargo</li><li>– other materials</li></ul> |               |                            |              |
| 4.1.3.2                                  | States that reactivity data of chemicals are given in the ICS or other cargo data sheets                                                                                                                                         |               |                            |              |
| 4.1.3.3                                  | States that polymerization is the formation of larger molecules as a result of self-reaction                                                                                                                                     |               |                            |              |
| 4.1.3.4                                  | States the effects of temperature on the reactivity of cargoes and polymerization                                                                                                                                                |               |                            |              |

| TOPIC 4.1 HAZARDS                        |                                                                                                                                                                                               |               |                            |
|------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|----------------------------|
| Knowledge, understanding and proficiency |                                                                                                                                                                                               | IMO reference | Textbooks/<br>Bibliography |
| 4.1.3.5                                  | States that the presence of impurities may act as catalysts on the reactivity of cargoes and polymerization                                                                                   |               |                            |
| 4.1.3.6                                  | States that polymerization may, under some circumstances, be dangerous                                                                                                                        |               |                            |
| <b>4.1.4</b>                             | <b>Corrosion hazards</b>                                                                                                                                                                      |               |                            |
| 4.1.4.1                                  | States that some cargoes may be corrosive to human tissue and to a ship's equipment and structure                                                                                             |               |                            |
| 4.1.4.2                                  | States that instructions about the use of protective clothing should be observed                                                                                                              |               |                            |
| 4.1.4.3                                  | States that care should be taken to ensure that unsuitable materials are not introduced into the cargo system                                                                                 |               |                            |
| 4.1.4.4                                  | States the effect of concentration and evolution of hydrogen on corrosion                                                                                                                     |               |                            |
| 4.1.4.5                                  | States the conditions under which iron sulphide becomes pyrophoric                                                                                                                            |               |                            |
| <b>4.1.5</b>                             | <b>Explosion and flammability hazards</b>                                                                                                                                                     |               |                            |
| 4.1.5.1                                  | Lists the three essentials necessary for a fire to commence as: <ul style="list-style-type: none"> <li>– oxygen</li> <li>– flammable material (fuel)</li> <li>– source of ignition</li> </ul> |               |                            |
| 4.1.5.2                                  | States that when flammable vapour is mixed with oxygen (usually from the atmosphere) an explosive mixture may be produced                                                                     |               |                            |
| 4.1.5.3                                  | States that the ability of petroleum and chemical products to generate flammable vapour is a major factor for starting a fire                                                                 |               |                            |
| 4.1.5.4                                  | States that the ability of a substance to vaporize is its volatility                                                                                                                          |               |                            |
| 4.1.5.5                                  | States that volatility increases with temperature and reaches a maximum at the boiling temperature of the petroleum and chemical products                                                     |               |                            |
| 4.1.5.6                                  | States that the concentration of hydrocarbon vapour present in air is used to define "flammable range"                                                                                        |               |                            |
| 4.1.5.7                                  | States that the working flammable range of a mixture of petroleum vapour and air can be taken to be from 1% to 10% by volume; other chemical vapours may have other ranges                    |               |                            |
| 4.1.5.8                                  | Explains the flammability diagram with respect to: flammable range, flammable zone and show how use of inert gas enhances safety in cargo operations                                          |               |                            |

| TOPIC 4.1 HAZARDS                        |                                                                                                                                                                                                                 |               |                            |              |
|------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|----------------------------|--------------|
| Knowledge, understanding and proficiency |                                                                                                                                                                                                                 | IMO reference | Textbooks/<br>Bibliography | Teaching aid |
| 4.1.5.9                                  | States that the flashpoint of an oil indicates the lowest temperature at which the oil will give off sufficient hydrocarbon vapour to form a flammable gas mixture with air near the surface of the oil         |               |                            |              |
| 4.1.5.10                                 | States that only the vapour from a flammable material will combine with oxygen to produce fire                                                                                                                  |               |                            |              |
| 4.1.5.11                                 | States that an explosive mixture may be produced when petroleum and chemical cargo vapours are mixed with air                                                                                                   |               |                            |              |
| 4.1.5.12                                 | States that corrosive liquids can become flammable and produce flammable gases when in contact with certain materials                                                                                           |               |                            |              |
| 4.1.5.13                                 | States that a mixture of vapour and air will only ignite and burn if its composition is within the “flammable range”                                                                                            |               |                            |              |
| 4.1.5.14                                 | States that within the flammable/explosive range, if a heat source is introduced, then it will result in a flash fire and possible sustained combustion                                                         |               |                            |              |
| 4.1.6                                    | <b>Sources of ignition, including electrostatic hazards</b>                                                                                                                                                     |               |                            |              |
| 4.1.6.1                                  | States that it is essential to keep ignition sources away from cargo areas, where flammable vapours are likely to be present                                                                                    |               |                            |              |
| 4.1.6.2                                  | Lists sources of ignition as: <ul style="list-style-type: none"><li>– direct heat</li><li>– mechanical sparks</li><li>– chemical energy</li><li>– electrical energy</li><li>– electrostatic discharge</li></ul> |               |                            |              |
| 4.1.6.3                                  | List sources of direct heat<br>List sources of mechanical sparks<br>List sources of chemical energy<br>List sources of electrical energy                                                                        |               |                            |              |
| 4.1.6.4                                  | States that it is essential to avoid the entry of flammable vapours into areas where ignition sources are present, such as living accommodation, engine-room, galley, etc.                                      |               |                            |              |
| 4.1.6.5                                  | States that static electricity can arise when two dissimilar materials (solids liquids or gases) come in contact and charge separation occurs at the interface                                                  |               |                            |              |
| 4.1.6.6                                  | States that static electricity can cause sparks capable of igniting flammable mixture                                                                                                                           |               |                            |              |

| TOPIC 4.1 HAZARDS                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |               |                            |              |
|------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|----------------------------|--------------|
| Knowledge, understanding and proficiency |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | IMO reference | Textbooks/<br>Bibliography | Teaching aid |
| 4.1.6.7                                  | Lists causes of electrostatic charge generation as: <ul style="list-style-type: none"><li>– movement of the ship through the water causes the hull to be electrically charged</li><li>– flow of liquids and gases through pipes or filters</li><li>– settling of solids or immiscible liquids through a liquid</li><li>– ejection of particles or droplets from a nozzle</li><li>– splashing or agitation of a liquid against a solid surface</li><li>– vigorous rubbing together and subsequent separation of certain synthetic polymers</li></ul> |               |                            |              |
| 4.1.6.8                                  | States that some tanker operations can give rise to electrostatic charge generation                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |               |                            |              |
| 4.1.6.9                                  | States that certain cargoes are accumulators of static electricity because of their conductivity                                                                                                                                                                                                                                                                                                                                                                                                                                                    |               |                            |              |
| 4.1.6.10                                 | States that, compared with oil and other hydrocarbons, polar solvents have unusual properties with regard to fire-fighting procedures                                                                                                                                                                                                                                                                                                                                                                                                               |               |                            |              |
| 4.1.7                                    | <b>Toxicity hazards</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |               |                            |              |
| 4.1.7.1                                  | States toxicity is the ability of a substance to harm damage and destroy living cells and is included in “health hazard”                                                                                                                                                                                                                                                                                                                                                                                                                            | R14           |                            |              |
| 4.1.7.2                                  | States that the toxicity of a substance is difficult to measure and that it is therefore rated on the basis of studies performed on animals and extrapolated for the human body and updated with changes observed over a period                                                                                                                                                                                                                                                                                                                     |               |                            |              |
| 4.1.7.3                                  | Lists the main toxic constituents of inert gas                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |               |                            |              |
| 4.1.7.4                                  | Defines the terms and explains their significance: <ul style="list-style-type: none"><li>– threshold limit value (TLV TWA)</li><li>– threshold limit value (TLV STEL)</li><li>– threshold limit value (TLV Ceiling)</li><li>– Occupational exposure limit (OEL)</li><li>– Odour threshold</li></ul>                                                                                                                                                                                                                                                 |               |                            |              |



| TOPIC 4.1 HAZARDS                                                                                                                                                                                                                                                       |               |                            |              |
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| Knowledge, understanding and proficiency                                                                                                                                                                                                                                | IMO reference | Textbooks/<br>Bibliography | Teaching aid |
| <b>4.1.8 Vapour leaks and clouds</b>                                                                                                                                                                                                                                    |               |                            |              |
| 4.1.8.1 Explains the dangers arising from a vapour cloud drift as potential fire and health hazards                                                                                                                                                                     |               |                            |              |
| 4.1.8.2 States that persistent bubbling are signs of a possible leak around the pipeline or cargo area. A pool of liquid on the deck, a dense white cloud or fog on the deck or in the pipeline are also signs of a possible leak                                       |               |                            |              |
| 4.1.8.3 States that an unusual noise/hissing sound could be a positive indication of a leak                                                                                                                                                                             |               |                            |              |
| 4.1.8.4 States that personnel safety should be considered if a leak is suspected.                                                                                                                                                                                       |               |                            |              |
| 4.1.8.5 States that any possible leak must be immediately reported                                                                                                                                                                                                      |               |                            |              |
| 4.1.8.6 Lists the precautions on discovery of a leak as: <ul style="list-style-type: none"><li>– DO NOT create any sparks or heat sources which could ignite escaping gas or liquids</li><li>– DO NOT approach a suspected vapour cloud resulting from a leak</li></ul> |               |                            |              |

| TOPIC 4.2 HAZARD CONTROLS                                                                                                                                                                                                                                                                                                                                                                                                                                               |  |  |  |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|--|--|
| COMPETENCE 2 Take precautions to prevent hazards                                                                                                                                                                                                                                                                                                                                                                                                                        |  |  |  |
| <b>TRAINING OUTCOMES:</b><br>Demonstrates basic knowledge and understanding of:<br><br>Hazards controls:<br><br>.1 inerting, water padding, drying agents and monitoring techniques<br><br>.2 anti-static measures<br><br>.3 ventilation<br><br>.4 segregation<br><br>.5 cargo inhibition<br><br>.6 importance of cargo compatibility<br><br>.7 atmospheric control<br><br>.8 gas testing<br><br>.9 understanding of information on a Material Safety Data Sheet (MSDS) |  |  |  |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |  |  |  |

| TOPIC 4.2 HAZARD CONTROLS                |                                                                                                                                                                                                                                                                                                                                                                                                                                         |                    |                            |              |
|------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------|----------------------------|--------------|
| Knowledge, understanding and proficiency |                                                                                                                                                                                                                                                                                                                                                                                                                                         | IMO reference      | Textbooks/<br>Bibliography | Teaching aid |
| 4.2.1                                    | <b>Inerting, water padding, drying agents and monitoring techniques</b>                                                                                                                                                                                                                                                                                                                                                                 | R1, R2, R4, R7, R8 | B1, B2, B3, B4             | A1, A11, A14 |
| 4.2.1.1                                  | Defines “inert gas”                                                                                                                                                                                                                                                                                                                                                                                                                     |                    |                            |              |
| 4.2.1.2                                  | States that inert gas is used in cargo tanks: <ul style="list-style-type: none"><li>– to reduce oxygen in the tank atmosphere in order to prevent fire and explosion</li><li>– to reduce hydrocarbons in an already inerted tank atmosphere</li><li>– to protect the cargo from polymerization, oxidation and humidity</li></ul>                                                                                                        |                    |                            |              |
| 4.2.1.3                                  | States that purging (inerting) is done by replacing hydrocarbon vapours with an inert gas until the concentration of vapours is below 2% by volume                                                                                                                                                                                                                                                                                      |                    |                            |              |
| 4.2.1.4                                  | States that inert gas used on tankers is flue gas from boilers, nitrogen or inert gas produced in the ship’s inert gas generator                                                                                                                                                                                                                                                                                                        |                    |                            |              |
| 4.2.1.5                                  | States that the correct inerted condition is ensured by regular checks of the tank atmosphere                                                                                                                                                                                                                                                                                                                                           |                    |                            |              |
| 4.2.1.6                                  | States that atmosphere checks are done by measuring the percentage of oxygen and cargo vapours through all designated sampling points                                                                                                                                                                                                                                                                                                   |                    |                            |              |
| 4.2.1.7                                  | States that the atmosphere in an inerted tank or void space is safe with regard to fire hazard but dangerous with regard to health hazard                                                                                                                                                                                                                                                                                               |                    |                            |              |
| 4.2.1.8                                  | States that padding means filling the ullage spaces of cargo tanks with a liquid, gas or vapour to separate the cargo from air and maintaining that condition.                                                                                                                                                                                                                                                                          |                    |                            |              |
| 4.2.1.9                                  | States that drying means filling the cargo tanks and associated piping or where required the spaces surrounding the tank with moisture free vapour having a dew point below –40° Centigrade at atmospheric pressure and maintaining that condition. This prevents the access of water or water vapour to the cargo                                                                                                                      |                    |                            |              |
| 4.2.1.10                                 | States that means of monitoring ullage spaces and other gas dangerous spaces for safety and correct atmospheric controls is provided                                                                                                                                                                                                                                                                                                    |                    |                            |              |
| 4.2.1.11                                 | States that measuring instruments are to be fitted for continuous indication and permanent recording of the pressure in the inert gas main and the oxygen content of the inert gas being supplied. These instruments are to be arranged in the cargo control room, where provided, or in a location accessible to the cargo officer. States that pressure sensing transmitters or equivalent equipment are fitted for remote monitoring |                    |                            |              |

| TOPIC 4.2 HAZARD CONTROLS                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |               |                            |              |
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| Knowledge, understanding and proficiency                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | IMO reference | Textbooks/<br>Bibliography | Teaching aid |
| <b>4.2.2 Anti-static measures</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |               |                            |              |
| <p>4.2.2.1 States that to avoid electrostatic hazard:</p> <ul style="list-style-type: none"> <li>– an important counter measure is to bond all metal objects together</li> <li>– bonding to earth is effectively accomplished by connecting all metal objects to the ship's structure</li> <li>– the ship's hull could be earthed through the seawater</li> </ul> <p>4.2.2.2 Lists anti-static measures to be taken as:</p> <ul style="list-style-type: none"> <li>– safe flow rates</li> <li>– safe procedures for ullaging, sampling and gauging</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |               |                            |              |
| <b>4.2.3 Ventilation</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |               |                            |              |
| <p>4.2.3.1 States that mechanical ventilation, normally of the extraction type, is provided for spaces normally entered during cargo operations (e.g. pump-rooms) of an oil and chemical tanker</p> <p>4.2.3.2 States that ventilation intakes are so arranged as to minimize the possibility of recycling hazardous vapours from any ventilation discharge opening</p> <p>4.2.3.3 States that the ventilation ducts are not led through engine-rooms, accommodation, working spaces or other similar spaces to ensure cargo vapours do not enter into the safe zone. Engine-rooms and accommodation spaces are kept in a positive pressure condition</p> <p>4.2.3.4 States that ventilation fans should be properly earthed for operation in explosive atmospheres when flammable cargoes are carried aboard the ship</p> <p>4.2.3.5 Describes the purpose of tank venting systems and related equipment such as individual tank P/V Valves, common venting systems, and hi- velocity vents. The VOC Plan describes the specific arrangement, operations and conditions onboard a crude oil tanker with respect to the emission and ability to control VOC emissions</p> <p>4.2.3.6 Explains the reason(s) why P/V valve settings are not to be changed without approval of the officer in charge</p> |               |                            |              |

| TOPIC 4.2 HAZARD CONTROLS                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |               |                            |              |
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| Knowledge, understanding and proficiency |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | IMO reference | Textbooks/<br>Bibliography | Teaching aid |
| 4.2.4                                    | Cargo segregation                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |               |                            |              |
| 4.2.4.1                                  | States that cargoes, residues of cargoes or mixtures containing cargoes, which react in a hazardous manner with other cargoes, residues or mixtures, shall <ul style="list-style-type: none"><li>– 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</li><li>– have separate pumping and piping systems which shall not pass through other cargo tanks containing such cargoes, unless encased in a tunnel; and have separate tank venting systems</li></ul> |               |                            |              |
| 4.2.4.2                                  | States that certain cargoes may be contaminated by failing to ensure that they do not come in contact with other cargoes and how proper segregation techniques may prevent this contamination                                                                                                                                                                                                                                                                                                                                                                                |               |                            |              |
| 4.2.4.3                                  | States that particular caution must be exercised to ensure that cargoes are not contaminated by way of common venting systems and how such contamination is prevented                                                                                                                                                                                                                                                                                                                                                                                                        |               |                            |              |
| 4.2.5                                    | Cargo inhibition                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |               |                            |              |
| 4.2.5.1                                  | Explains that products that are susceptible to polymerization are normally transported with added inhibitors to prevent the onset of the reaction                                                                                                                                                                                                                                                                                                                                                                                                                            |               |                            |              |
| 4.2.5.2                                  | States that an inhibited cargo certificate should be provided to the ship before a cargo is carried                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |               |                            |              |
| 4.2.5.3                                  | States that the action to be taken in case of a polymerization situation occurring while the cargo is on board should be covered by the ship's emergency contingency plan                                                                                                                                                                                                                                                                                                                                                                                                    |               |                            |              |
| 4.2.6                                    | Importance of cargo compatibility                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |               |                            |              |
| 4.2.6.1                                  | States that a cargo may contaminate another cargo or odorize another cargo when incompatible cargoes come in contact with each other                                                                                                                                                                                                                                                                                                                                                                                                                                         |               |                            |              |
| 4.2.6.2                                  | States that between some chemicals violent reactions may occur if the chemicals are mixed in certain proportions. The result may possibly be an eruption and tank rupture                                                                                                                                                                                                                                                                                                                                                                                                    |               |                            |              |
| 4.2.6.3                                  | States that such an occurrence must be prevented                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |               |                            |              |
| 4.2.6.4                                  | States that water may also have to be considered in this respect                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |               |                            |              |
| 4.2.6.5                                  | States that leakages through bulkheads occur at times in any tanker                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |               |                            |              |

**TOPIC 4.2 HAZARD CONTROLS**

| <b>Knowledge, understanding and proficiency</b> |                                                                                                                                                                                                                                                                                                                                                                                                           | <b>IMO reference</b> | <b>Textbooks/<br/>Bibliography</b> | <b>Teaching aid</b> |
|-------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------|------------------------------------|---------------------|
| 4.2.6.6                                         | States that legislation as expressed in the IMO Chemicals Bulk Code and ICS tanker safety guide expressly prohibits the placement of inter-reactive cargoes on both sides of a bulkhead                                                                                                                                                                                                                   |                      |                                    |                     |
| 4.2.6.7                                         | States that there must be an empty tank, a cofferdam or a tank with a cargo neutral to both products in between. "Diagonal contact" between tanks is normally considered as sufficient separation between reactive cargoes                                                                                                                                                                                |                      |                                    |                     |
| 4.2.6.8                                         | States that complete separation of piping systems are required on a chemical tanker so that one product cannot inadvertently be pumped into another. States that to this effect strategic pipe bends may have to be removed and blind flanges fitted on each pipe end                                                                                                                                     |                      |                                    |                     |
| 4.2.6.9                                         | States that particular caution must be exercised to ensure that incompatible cargoes are not mixed by way of common venting systems and how such mixing is prevented                                                                                                                                                                                                                                      |                      |                                    |                     |
| <b>4.2.7</b>                                    | <b>Atmospheric control</b>                                                                                                                                                                                                                                                                                                                                                                                |                      |                                    |                     |
|                                                 | <i>For oil tankers</i>                                                                                                                                                                                                                                                                                                                                                                                    |                      |                                    |                     |
| 4.2.7.1                                         | States that oil tankers using an inert gas system should maintain their cargo tanks in a non-flammable condition at all times                                                                                                                                                                                                                                                                             |                      |                                    |                     |
| 4.2.7.2                                         | States that tanks should be kept in an inert condition at all times, except when it is necessary for them to be gas free for inspection or work                                                                                                                                                                                                                                                           |                      |                                    |                     |
| 4.2.7.3                                         | States that the oxygen content should be not more than 8% by volume and the atmosphere should be maintained at a positive pressure                                                                                                                                                                                                                                                                        |                      |                                    |                     |
| 4.2.7.4                                         | Explains with the use of a flammability diagram that the atmosphere within the tank should make the transition from the inert condition to the 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 inert gas until the hydrocarbon content of the tank atmosphere is below the critical dilution line |                      |                                    |                     |
|                                                 | <i>For chemical tankers</i>                                                                                                                                                                                                                                                                                                                                                                               |                      |                                    |                     |
| 4.2.7.5                                         | States that for chemical tankers the IBC Code requires vapour spaces within cargo tanks to have specially controlled atmospheres, principally when the cargo is either air reactive resulting in a hazardous situation, or has a low auto-ignition temperature, or has a wide flammability range                                                                                                          |                      |                                    |                     |



| TOPIC 4.2 HAZARD CONTROLS                                                                                                                                                                                                                                                                                                                                                                                                                                      |               |                            |              |
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| Knowledge, understanding and proficiency                                                                                                                                                                                                                                                                                                                                                                                                                       | IMO reference | Textbooks/<br>Bibliography | Teaching aid |
| 4.2.7.6 States that for chemical tankers the correct atmosphere in a tank can be established either by inerting to prevent the formation of flammable mixtures of cargo vapour and air, or by padding to prevent chemical reaction between oxygen and the cargo. It may also be necessary to reduce the humidity (dew point) of the atmosphere within the cargo system                                                                                         |               |                            |              |
| 4.2.7.7 States that the extent of atmosphere control to protect the quality of the cargo will normally be specified by the cargo shippers. Some cargoes are extremely sensitive to contamination or discoloration, and for quality control reasons are carried under a blanket of nitrogen that is very pure and which must often be obtained from shore                                                                                                       |               |                            |              |
| <b>4.2.8 Gas testing</b>                                                                                                                                                                                                                                                                                                                                                                                                                                       |               |                            |              |
| 4.2.8.1 Lists circumstances when the atmosphere in cargo tanks and enclosed spaces must be tested as: <ul style="list-style-type: none"><li>– prior tank washing</li><li>– prior to entry by personnel</li><li>– to establish that there is a gas free condition prior to repair work, entry to a shipyard or dry-docking</li><li>– during inerting, gas freeing and purging operations</li><li>– as a quality control before loading/changing cargo</li></ul> |               |                            |              |
| 4.2.8.2 States that an evaluation is the only way to get correct information about the composition of the tank atmosphere                                                                                                                                                                                                                                                                                                                                      |               |                            |              |
| 4.2.8.3 Lists the information essential to evaluation of the tank atmosphere as: <ul style="list-style-type: none"><li>– the nature of the constituent gases</li><li>– flammability</li><li>– toxicity/oxygen deficiency</li><li>– reactivity</li></ul>                                                                                                                                                                                                        |               |                            |              |
| 4.2.8.4 States that the atmosphere in tanks or enclosed spaces must be considered dangerous unless proper and continuous checks prove otherwise                                                                                                                                                                                                                                                                                                                |               |                            |              |
| 4.2.8.5 States that for the control of the tank atmosphere, in addition to the oxygen analyser, explosimeter and tank scope instruments, there is a requirement for an additional portable instrument, (gas detecting tubes) for measuring toxic gas vapour concentrations.                                                                                                                                                                                    |               |                            |              |



| TOPIC 4.2 HAZARD CONTROLS                |                                                                                                                                                                                                                                                               |               |                            |              |
|------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|----------------------------|--------------|
| Knowledge, understanding and proficiency |                                                                                                                                                                                                                                                               | IMO reference | Textbooks/<br>Bibliography | Teaching aid |
| 4.2.8.6                                  | States that suitable equipment is to be provided for calibrating permanently installed and portable gas measuring appliances                                                                                                                                  | R14           |                            |              |
| 4.2.8.7                                  | States the importance of taking measurements of the atmosphere at several positions within a tank                                                                                                                                                             |               |                            |              |
| 4.2.8.8                                  | States that before entry in enclosed spaces: <ul style="list-style-type: none"><li>– oxygen content must be 21% by volume</li><li>– hydrocarbon content must be less than 1% LFL</li><li>– toxic gas concentration must be less than 50% of its OEL</li></ul> |               |                            |              |
| 4.2.8.9                                  | States that after tank washing, manual removal of residue may be necessary <ul style="list-style-type: none"><li>– that residue removal may generate more hydrocarbon gas</li><li>– that gas testing operations must therefore be continuous</li></ul>        |               |                            |              |
| 4.2.8.10                                 | States that adjacent bulkheads, pipelines and leaking heating coils may constitute additional sources of hydrocarbon gas                                                                                                                                      |               |                            |              |
| 4.2.8.11                                 | States that venting / inert gas supply to the tank should be shut off during the testing                                                                                                                                                                      |               |                            |              |
| 4.2.8.12                                 | States that carbon monoxide in the inert gas can be a potential hazard as during gas freeing operation carbon monoxide may not be easily displaced from the tank                                                                                              |               |                            |              |
| 4.2.9                                    | Understanding of information on a Material Safety Data Sheet (MSDS)                                                                                                                                                                                           |               |                            |              |
| 4.2.9.1                                  | Describes the purpose of an MSDS and understands the information contained in an MSDS                                                                                                                                                                         |               |                            |              |

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| TOPIC 5 SAFETY                                                                                                                                                                                                                                                                                                   |  |  |  |
| COMPETENCE 3 Apply occupational health and safety precautions and measures                                                                                                                                                                                                                                       |  |  |  |
| TRAINING OUTCOMES:<br>Demonstrates a basic knowledge and understanding of:<br><div><div>.1</div>function and proper use of gas measuring instruments and similar equipment<br/><div>.2</div>proper use of safety equipment and protective devices, including resuscitators and rescue and escape equipment</div> |  |  |  |
|                                                                                                                                                                                                                                                                                                                  |  |  |  |

| TOPIC 5 SAFETY                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |               |                             |                                           |
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| Knowledge, understanding and proficiency |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | IMO reference | Textbooks/<br>Bibliography  | Teaching aid                              |
| 5.1                                      | <b>Function and proper use of gas measuring instruments and similar equipment</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | R2, R7, R8    | T1, T2, B1, B2, B3, B4, B11 | A1, A4, A5, A6, A7, A8, A9, A11, A14, A15 |
| 5.1.1                                    | States that safety measuring instruments may be personal, portable or fixed types                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |               |                             |                                           |
| 5.1.2                                    | Lists the different types of gas measuring equipment common on board tankers                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |               |                             |                                           |
| 5.1.3                                    | States that gas measuring equipment for atmosphere evaluation is required on board                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |               |                             |                                           |
| 5.1.4                                    | States functions and the proper use of relevant atmospheric test equipment                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |               |                             |                                           |
| 5.2                                      | <b>Proper use of safety equipment and protective devices, including:</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | R2            | T1, T2, B1, B2, B3, B4, B11 | A1, A4, A5, A6, A7, A8, A9, A11, A14, A15 |
| 5.2.1                                    | <b>Breathing apparatus and tank-evacuating equipment</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |               |                             |                                           |
| 5.2.1.1                                  | States that spaces not normally entered (e.g. double bottoms, cofferdams and pipe tunnels) are capable of being ventilated to ensure a safe environment when entry into these spaces is necessary                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |               |                             |                                           |
| 5.2.1.2                                  | Defines “enclosed spaces” as a space which has any of the following characteristics:<br>.1 limited openings for entry and exit<br>.2 inadequate ventilation<br>.3 is not designed for continuous worker occupancy<br>and includes, but is not limited to, cargo spaces, double bottoms, fuel tanks, ballast tanks, cargo pump-rooms, cargo compressor rooms, cofferdams, chain lockers, void spaces, duct keels, inter-barrier spaces, boilers, engine crankcases, engine scavenge air receivers, sewage tanks, and adjacent connected spaces. <i>This list is not exhaustive and a list should be produced on a ship-by-ship basis to identify enclosed spaces</i> |               |                             |                                           |
| 5.2.1.3                                  | Explains why enclosed spaces are dangerous to enter                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |               |                             |                                           |
| 5.2.1.4                                  | States that no person should open or enter an enclosed space unless authorized by the master or the nominated responsible person and unless the appropriate safety procedures laid down for the particular ship have been followed                                                                                                                                                                                                                                                                                                                                                                                                                                  |               |                             |                                           |
| 5.2.1.5                                  | States that only a tank or space declared gas free can be entered by personnel without breathing apparatus and protective clothing                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |               |                             |                                           |
| 5.2.1.6                                  | Lists safety precautions when entering enclosed spaces                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |               |                             |                                           |

| TOPIC 5 SAFETY                           |                                                                                                                                                                                                                                                                                                                                    |               |                            |              |
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| Knowledge, understanding and proficiency |                                                                                                                                                                                                                                                                                                                                    | IMO reference | Textbooks/<br>Bibliography | Teaching aid |
| 5.2.1.7                                  | Lists precautions for entering cargo pump-rooms during cargo, ballast or tank-cleaning operations                                                                                                                                                                                                                                  |               |                            |              |
| 5.2.1.8                                  | States the function and proper use of: <ul style="list-style-type: none"><li>– self-contained compressed-air breathing apparatus (SCBA)</li><li>– eye protective safety goggles</li><li>– emergency escape breathing device (EEBD)</li><li>– a complete set of safety equipment, stretcher and tank-evacuating equipment</li></ul> |               |                            |              |
| 5.2.2                                    | <b>Protective clothing and equipment</b>                                                                                                                                                                                                                                                                                           |               |                            |              |
| 5.2.2.1                                  | States that for the protection of personnel engaged in loading and discharging operations, there must be suitable protective clothing on board                                                                                                                                                                                     |               |                            |              |
| 5.2.2.2                                  | States that for entering gas filled spaces in an emergency there must be adequate numbers of protective clothing and safety equipment on board                                                                                                                                                                                     |               |                            |              |
| 5.2.2.3                                  | States that all equipment for personnel protection must be kept in clearly marked lockers                                                                                                                                                                                                                                          |               |                            |              |
| 5.2.2.4                                  | States that all personnel should wear appropriate protective clothing when involved in cargo operations                                                                                                                                                                                                                            |               |                            |              |
| 5.2.2.5                                  | States that on chemical tankers, there must be respiratory and eye protection equipment for every person on board, for purposes of emergency escape                                                                                                                                                                                |               |                            |              |
| 5.2.2.6                                  | States that on chemical tankers decontamination showers and eyewash must be available in certain locations on deck                                                                                                                                                                                                                 |               |                            |              |
| 5.2.2.7                                  | States that stretchers and medical first-aid equipment must be provided on board                                                                                                                                                                                                                                                   |               |                            |              |
| 5.2.3                                    | <b>Resuscitators</b>                                                                                                                                                                                                                                                                                                               |               |                            |              |
| 5.2.3.1                                  | Lists the circumstances under which a resuscitator should be used                                                                                                                                                                                                                                                                  |               |                            |              |
| 5.2.3.2                                  | States proper use of a resuscitator                                                                                                                                                                                                                                                                                                |               |                            |              |
| 5.2.4                                    | <b>Rescue and escape equipment</b>                                                                                                                                                                                                                                                                                                 |               |                            |              |
| 5.2.4.1                                  | Explains timely evacuation and resuscitation may save lives                                                                                                                                                                                                                                                                        |               |                            |              |
| 5.2.4.2                                  | Explains proper use of tripods and evacuation and hoisting equipment to rescue an injured person from a tank or an enclosed space                                                                                                                                                                                                  |               |                            |              |
| 5.2.4.3                                  | States that pump-rooms have permanent arrangements for hoisting an injured person with a rescue line                                                                                                                                                                                                                               |               |                            |              |

| TOPIC 5 SAFETY                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                 |                                  |                   |
|------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|----------------------------------|-------------------|
| Knowledge, understanding and proficiency |                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | IMO reference   | Textbooks/<br>Bibliography       | Teaching aid      |
| 5.3                                      | <b>Safe working practices and procedures in accordance with legislation and industry guidelines and personal shipboard safety relevant to oil and chemical tankers</b>                                                                                                                                                                                                                                                                                                  | R2, R7, R8, R10 | T1, T2, B1, B2, B3, B4, B11, B12 | A1, A11, A14, A15 |
| 5.3.1                                    | <b>Precautions to be taken when entering enclosed spaces</b>                                                                                                                                                                                                                                                                                                                                                                                                            |                 |                                  |                   |
| 5.3.1.1                                  | States that when entering enclosed spaces assess safety conditions with an appropriate checklist verified by the master                                                                                                                                                                                                                                                                                                                                                 | R14             |                                  |                   |
| 5.3.1.2                                  | States that no person is permitted to enter any enclosed space as defined (cargo space cofferdam, double bottom tank, etc.) unless authorized by the master, who has ensured that the required checks have been carried out before passing these compartments as safe for entry. An enclosed space entry permit must be completed and signed in every case                                                                                                              |                 |                                  |                   |
| 5.3.1.3                                  | States that for entry purposes, steady readings of all the following should be obtained:<br><br>.1 21% oxygen by volume by oxygen content meter<br><br>.2 not more than 1% of lower flammable limit (LFL) on a suitably sensitive combustible gas indicator, where the preliminary assessment has determined that there is potential for flammable gases or vapours<br><br>.3 not more than 50% of the occupational exposure limit (OEL) of any toxic vapours and gases |                 |                                  |                   |
| 5.3.1.4                                  | States that irrespective of the type of enclosed space, precautionary measures for entering tanks shall apply equally to any enclosed space, including the pump-room                                                                                                                                                                                                                                                                                                    |                 |                                  |                   |
| 5.3.1.5                                  | States that entry permits may be made for multi cargo tank entries on chemical tankers.                                                                                                                                                                                                                                                                                                                                                                                 |                 |                                  |                   |

| TOPIC 5 SAFETY                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |               |                            |              |
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| Knowledge, understanding and proficiency |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | IMO reference | Textbooks/<br>Bibliography | Teaching aid |
| 5.3.1.6                                  | Lists requirements for cargo tank entry as: <ul style="list-style-type: none"><li>– tank to remain open to atmosphere at all times to ensure ventilation.</li><li>– rescue and resuscitation equipment easily available and ready for use</li><li>– means of communication agreed and tested</li><li>– at least one person of the entry team to carry means of continuously testing the atmosphere using a multi gas personal monitor</li><li>– communications set up between bridge and deck or between duty officer and enclosed space entry team</li><li>– duty officer to be kept informed that tank entry is in progress</li><li>– authorizing officer has verified and signed the entry permit</li><li>– a responsible crew member shall monitor the personnel who have entered the enclosed space</li></ul> |               |                            |              |
| 5.3.1.7                                  | Explains that entry into a space that is not gas free or does not contain 21% oxygen shall only be permitted in cases of an emergency or for unavoidable operational requirements wearing the appropriate PPE                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |               |                            |              |
| 5.3.1.8                                  | States that the number of persons entering the tanks shall be kept to a minimum required, but will normally be at least two, each wearing the appropriate PPE                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |               |                            |              |
| 5.3.1.9                                  | Explains that a stand by team and additional appropriate PPE equipped with the required rescue equipment shall be available outside the enclosed space in which entry has been made                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |               |                            |              |
| 5.3.1.10                                 | States that a gas free certificate is needed from a qualified chemist before man entry in a cargo tank in port prior to work being carried out. States that such certificate and permit must be reissued every day that work is carried out, or such lesser period as the port authority stipulates.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |               |                            |              |
| 5.3.2                                    | <b>Precautions to be taken before and during repair and maintenance work</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |               |                            |              |
| 5.3.2.1                                  | States that the use of appropriate PPE is mandatory to protect the crew against the various hazards                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |               |                            |              |
| 5.3.2.2                                  | States that if dangerous gas concentrations are observed, repairs and maintenance work must be stopped when working in the concerned area                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |               |                            |              |

| TOPIC 5 SAFETY                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |               |                            |              |
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| Knowledge, understanding and proficiency                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | IMO reference | Textbooks/<br>Bibliography | Teaching aid |
| <b>5.3.3 Safety measures for hot and cold work</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |               |                            |              |
| 5.3.3.1 States that hot work (defines hot work as per ISGOTT) outside the main machinery spaces (and in the main machinery spaces when associated with fuel tanks and fuel pipelines) must take into account the possible presence of flammable vapours in the atmosphere, and the existence of potential ignition sources                                                                                                                                                                                                                                                                                                                          |               |                            |              |
| 5.3.3.2 States that any hot work outside the designated hot work area in machinery room should be under SMS (safety management system) and Permit control. This would thus also include ALL work in machinery spaces outside designated hot work area.                                                                                                                                                                                                                                                                                                                                                                                              |               |                            |              |
| 5.3.3.3 States that hot work for which a hot work permit is required and should be prohibited during cargo, ballast, tank cleaning, gas freeing, purging or inerting operations                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |               |                            |              |
| 5.3.3.4 States that an additional hot work permit from port authorities is required for hot work in port                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |               |                            |              |
| 5.3.3.5 Defines cold work as:<br>Work that cannot create a source of ignition.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |               |                            |              |
| 5.3.3.6 States that cold work permits are used in hazardous maintenance work that does not involve "hot work". Cold work permits are issued when there is no reasonable source of ignition, and when all contact with harmful substances has been eliminated or appropriate precautions taken.                                                                                                                                                                                                                                                                                                                                                      |               |                            |              |
| <b>5.3.4 Electrical safety precautions</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |               |                            |              |
| 5.3.4.1 States all electrical equipment employed should be carefully inspected before each occasion of use to ensure it is in good condition. Where required it must be correctly earthed                                                                                                                                                                                                                                                                                                                                                                                                                                                           |               |                            |              |
| 5.3.4.2 Lists precautions when using electric-arc equipment as: <ul style="list-style-type: none"> <li>– electrical supply connections are made in a gas free space</li> <li>– existing supply wiring is adequate to carry the electrical current demanded without overloading, causing heating</li> <li>– insulation of flexible electric cables laid across the deck is in good condition</li> <li>– cable route to the worksite is the safest possible, only passing over gas free or inerted spaces</li> <li>– earthing connection is adjacent to the work site with the earth return cable led directly back to the welding machine</li> </ul> |               |                            |              |



| TOPIC 5 SAFETY                                                                                                                                                                                                                                                                                                                                                                                                              |                 |                                  |              |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|----------------------------------|--------------|
| Knowledge, understanding and proficiency                                                                                                                                                                                                                                                                                                                                                                                    | IMO reference   | Textbooks/<br>Bibliography       | Teaching aid |
| 5.3.4.3<br><br>Common safety precautions to be taken in hazardous zones on tankers:<br><br>– equipment which is not intrinsically safe should not be used; for example: mobile phones, cameras, torches, lighters, etc.                                                                                                                                                                                                     |                 |                                  |              |
| 5.3.5<br><br><b>Ship/shore safety checklist</b>                                                                                                                                                                                                                                                                                                                                                                             |                 |                                  |              |
| <i>States the purpose</i>                                                                                                                                                                                                                                                                                                                                                                                                   |                 |                                  |              |
| 5.4<br><br><b>First aid with reference to a Material Safety Data Sheet (MSDS)</b>                                                                                                                                                                                                                                                                                                                                           | R2, R7, R8, R10 | T1, T2, B1, B2, B3, B4, B11, B12 | A1, A11 A14  |
| 5.4.1<br><br>Explains a Material Safety Data Sheet for sample products                                                                                                                                                                                                                                                                                                                                                      |                 |                                  |              |
| 5.4.2<br><br>States that all personnel on board must always refer to the MSDS of all substances to be loaded                                                                                                                                                                                                                                                                                                                |                 |                                  |              |
| 5.4.3<br><br>Identify ‘health data’ from MSDS                                                                                                                                                                                                                                                                                                                                                                               |                 |                                  |              |
| 5.4.4<br><br>Extract first-aid procedures from MSDS                                                                                                                                                                                                                                                                                                                                                                         |                 |                                  |              |
| 5.4.5<br><br>States that when providing first aid, personnel should also be aware of the list of “don’ts”, including:<br><br>– do not attend to victim unless it is safe to do so<br><br>– do not attempt to do more than necessary<br><br>– do not delay in summoning for help and informing the master<br><br>– do not enter the enclosed spaces unless you are a trained member of a rescue team acting upon instruction |                 |                                  |              |
| 5.4.6<br><br>States that the emergency showers should be used immediately in the event of spillage of cargo liquid in eyes or on skin                                                                                                                                                                                                                                                                                       |                 |                                  |              |
| 5.4.7<br><br>States that the correct treatment for most cargoes is to flush with copious amount of water and to remove the affected clothing                                                                                                                                                                                                                                                                                |                 |                                  |              |
| 5.4.8<br><br>States that for symptoms of vapour exposure the treatment for most cargoes is:<br><br>– to remove the victim to fresh air<br><br>– to give artificial resuscitation if breathing has stopped or is weak irregular<br><br>States that all personnel should be instructed and trained in “Cardio Pulmonary Resuscitation” technique                                                                              |                 |                                  |              |

| TOPIC 6 FIRE SAFETY AND FIRE-FIGHTING OPERATIONS                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |  |  |  |
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| COMPETENCE 4 Carry out fire-fighting operations                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |  |  |  |
| <b>TRAINING OUTCOMES:</b><br>Demonstrates a basic knowledge and understanding of:<br><div><div>.1</div>oil and chemical tanker fire response organization and action to be taken<br/><div>.2</div>fire hazards associated with cargo handling and transportation of hazardous and noxious liquids in bulk<br/><div>.3</div>fire-fighting agents used to extinguish oil and chemical fires<br/><div>.4</div>fixed fire-fighting foam system operations<br/><div>.5</div>portable fire-fighting foam operations<br/><div>.6</div>fixed dry chemical system operations<br/><div>.7</div>spill containment in relation to fire-fighting operations</div><br>Practical and theoretical training may be carried out in other approved fire-fighting courses. |  |  |  |

| TOPIC 6 FIRE SAFETY AND FIRE-FIGHTING OPERATIONS |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                             |                             |                   |
|--------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------|-----------------------------|-------------------|
| Knowledge, understanding and proficiency         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | IMO reference               | Textbooks/<br>Bibliography  | Teaching aid      |
| 6.1                                              | <b>Oil and chemical tanker fire response organization and action to be taken</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | R1, R2, R4, R6, R7, R8, R10 | T1, T2, B1, B2, B3, B4, B10 | A1, A11, A14, A15 |
| 6.1.1                                            | States that on any vessel, especially oil and chemical tankers, emergencies may have catastrophic consequences, unless proper action is taken. Actions, therefore, must be prompt, timely and adequate                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                             |                             |                   |
| 6.1.2                                            | States that it is very essential for the ship's staff to know and fully understand the various properties of the cargo. The MSDS sheets are the best guides for understanding the cargo                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                             |                             |                   |
| 6.1.3                                            | States the use of checklists as a reminder of things which may be required to be done in an emergency. This in most cases will ensure that the response is a little faster in getting things under control                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                             |                             |                   |
| 6.1.4                                            | Explains the Find, Inform, Restrict and Extinguish techniques in attending to a fire emergency                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                             |                             |                   |
| 6.1.5                                            | Lists the fire-fighting procedures as required in the Emergency and Contingency plan                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                             |                             |                   |
| 6.1.5.1                                          | States that the aster must ensure that the responsible crew members are duly authorized to stop cargo in the event of an emergency or if in the opinion of the duty officer such stoppage is necessary to prevent an emergency situation                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                             |                             |                   |
| 6.1.5.2                                          | States that the duty officer must inform the cargo officer and/or the master in any event of an emergency situation at the earliest opportunity                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                             |                             |                   |
| 6.1.5.3                                          | Lists possible actions that may need to be taken in an emergency: <ul style="list-style-type: none"><li>– stop cargo work, bunkering, tank cleaning or ballasting operations immediately</li><li>– disconnect hoses if alongside the terminal or a ship</li><li>– inform the terminal/ship if alongside the terminal/ship</li><li>– if at the terminal, external help may be summoned</li><li>– cast off any boats which are alongside</li><li>– if at anchor, alert port authorities</li><li>– identify oil/chemicals involved and any other cargo which may be at risk if the fire spreads</li><li>– if at sea, manoeuvre the vessel in such a way that the spread of fire can be restricted and it can then be tackled from the windward side</li><li>– cool other compartments especially if they carry flammable cargo</li><li>– select the fire-fighting equipment to be used</li></ul> |                             |                             |                   |

| TOPIC 6 FIRE SAFETY AND FIRE-FIGHTING OPERATIONS                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                    |                             |                                              |
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| Knowledge, understanding and proficiency                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | IMO reference      | Textbooks/<br>Bibliography  | Teaching aid                                 |
| <b>6.2 Fire hazards associated with cargo handling and transportation of hazardous and noxious liquids in bulk</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | R1, R2, R6, R7, R8 | T1, T2, B1, B2, B3, B4, B11 | A1, A2, A3, A4, A5, A6, A7, A8, A9, A11, A14 |
| 6.2.1 Lists the fire hazards associated with NLS as: <ul style="list-style-type: none"> <li>– some cargoes give out oxygen when on fire, thereby supporting the fire</li> <li>– some chemical fires, the source of ignition may be heat from a reaction within the cargo itself or through mixing with other chemicals</li> <li>– some chemicals are miscible in water and hence their presence may not be recognized</li> <li>– some chemicals are heavier than water and insoluble in water. These may be smothered using water</li> <li>– some chemicals evolve large volumes of toxic vapours when heated</li> <li>– some chemicals have a low auto-ignition temperature. There is a risk of re-ignition of these chemicals</li> </ul> |                    |                             |                                              |
| <b>6.3 Fire-fighting agents used to extinguish oil and chemical fires</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                    |                             |                                              |
| 6.3.1 Lists <ul style="list-style-type: none"> <li>– water is the most common cooling agent, but not suitable for direct extinguishing of an oil or chemical fire</li> <li>– foam is an aggregation of small bubbles, of lower specific gravity than oil or water</li> <li>– carbon dioxide is an excellent smothering agent for extinguishing fires and is most beneficial in enclosed areas such as pump-rooms</li> <li>– Dry Chemical Powder (DCP) is discharged from an extinguisher as a free flowing cloud</li> <li>– alcohol resistant foams possess good low expansion properties and are adaptable to various low expansion foam generators</li> </ul>                                                                            |                    |                             |                                              |

| TOPIC 6 FIRE SAFETY AND FIRE-FIGHTING OPERATIONS |                                                                                                                                                                                                                                                                                                         |                            |                             |              |
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| Knowledge, understanding and proficiency         |                                                                                                                                                                                                                                                                                                         | IMO reference              | Textbooks/<br>Bibliography  | Teaching aid |
| 6.4                                              | Fixed fire-fighting foam system operations                                                                                                                                                                                                                                                              | R1, R2, R3, R6, R7, R8 R13 | T1, T2, B1, B2, B3, B4, B11 | A1, A11, A14 |
| 6.4.1                                            | Describes foam mains                                                                                                                                                                                                                                                                                    |                            |                             |              |
| 6.4.2                                            | States the use of monitors and cannons for large capacity monitors                                                                                                                                                                                                                                      |                            |                             |              |
| 6.4.3                                            | Describes fixed foam fire-fighting system                                                                                                                                                                                                                                                               |                            |                             |              |
| 6.4.3.1                                          | Explains the layout of fixed foam installation                                                                                                                                                                                                                                                          |                            |                             |              |
| 6.4.3.2                                          | Describes the operational principle of extinguishing oil/chemical fire                                                                                                                                                                                                                                  |                            |                             |              |
|                                                  | <ul style="list-style-type: none"><li>– using foam as an extinguishing medium</li><li>– advantages of foam as an extinguishing medium</li></ul>                                                                                                                                                         |                            |                             |              |
| 6.4.3.3                                          | States the different types of foam:                                                                                                                                                                                                                                                                     |                            |                             |              |
|                                                  | <ul style="list-style-type: none"><li>– mechanical</li><li>– chemical</li><li>– low expansion foam</li><li>– medium expansion foam</li><li>– high expansion foam</li></ul>                                                                                                                              |                            |                             |              |
| 6.4.3.4                                          | States the components and pipeline system of the fixed foam installation which includes the following:                                                                                                                                                                                                  |                            |                             |              |
|                                                  | <ul style="list-style-type: none"><li>– foam tank</li><li>– foam pump</li><li>– proportionator</li><li>– foam applicator</li><li>– fixed foam monitor</li><li>– pressure gauge</li><li>– flexible hose</li><li>– screw down valves</li><li>– fire main hydrant connection to fire main system</li></ul> |                            |                             |              |
| 6.4.3.5                                          | States the initial action on discovering the fire                                                                                                                                                                                                                                                       |                            |                             |              |
|                                                  | <ul style="list-style-type: none"><li>– isolates the source of leak</li><li>– activates the alarm</li><li>– informs the control station of the incident</li><li>– takes appropriate (immediate) measures that permit the containment of the fire as an initial action</li></ul>                         |                            |                             |              |

| TOPIC 6 FIRE SAFETY AND FIRE-FIGHTING OPERATIONS                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                            |                             |              |
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| Knowledge, understanding and proficiency                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | IMO reference              | Textbooks/<br>Bibliography  | Teaching aid |
| <p>6.4.3.6 Practical demonstration of the proper fire-fighting procedure using fixed foam system as regards</p> <ul style="list-style-type: none"> <li>– dons fire suit and personal protective gear and brings appropriate equipment</li> <li>– activates the release of the foam in the fixed foam system following the correct sequence</li> <li>– approaches the fire with a charged hose</li> <li>– extinguishes the fire by applying the proper fire-fighting technique</li> </ul>                                                                                                                                                                                                                        |                            |                             |              |
| <b>6.5 Portable fire-fighting foam operations</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | R1, R2, R3, R6, R7, R8 R13 | T1, T2, B1, B2, B3, B4, B11 | A1, A11, A14 |
| <p>6.5.1 States portable fire-fighting equipment are fire extinguishers and applicator foam system</p> <p>6.5.2 Describes applicator foam systems</p> <p>6.5.3 Practical demonstration of the proper use of portable foam fire extinguishers</p> <ul style="list-style-type: none"> <li>– dons fire suit and personal protective gear and brings appropriate equipment</li> <li>– approaches the fire with a charged hose</li> <li>– activates portable foam extinguisher and extinguishes the fire by applying the proper fire-fighting technique</li> </ul>                                                                                                                                                   |                            |                             |              |
| <b>6.6 Fixed dry chemical system operations</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | R1, R2, R3, R6, R7, R8 R13 | T1, T2, B1, B2, B3, B4, B11 | A1, A11, A14 |
| <p>6.6.1 Describes fixed dry chemical system operations</p> <p>6.6.2 Explains the layout of fixed DCP installation</p> <p>6.6.3 Describes the operational principle of extinguishing oil/chemical fire</p> <ul style="list-style-type: none"> <li>– using DCP as an extinguishing medium</li> <li>– advantages of DCP as an extinguishing medium</li> </ul> <p>6.6.4 States the initial action on discovering the fire</p> <ul style="list-style-type: none"> <li>– isolates the source of leak</li> <li>– activates the alarm</li> <li>– informs the control station of the incident</li> <li>– takes appropriate (immediate) measures that permit the containment of the fire as an initial action</li> </ul> |                            |                             |              |

| TOPIC 6 FIRE SAFETY AND FIRE-FIGHTING OPERATIONS |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                |                                  |              |
|--------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|----------------------------------|--------------|
| Knowledge, understanding and proficiency         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | IMO reference  | Textbooks/<br>Bibliography       | Teaching aid |
| 6.6.5                                            | Practical demonstration of the proper fire-fighting procedure using fixed DCP system as regards <ul style="list-style-type: none"><li>– dons fire suit and personal protective gear and brings appropriate equipment</li><li>– activates the release of the DCP in the fixed DCP system following the correct sequence of operation of valves and levers</li><li>– approaches the fire with a charged hose</li><li>– extinguishes the fire by applying the proper fire-fighting technique such as sweeping action to the overall area of the fire</li></ul>                                                                                                                                                                                                                                                                          |                |                                  |              |
| 6.7                                              | <b>Spill containment in relation to fire-fighting operations</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | R1, R2, R3, R9 | T1, T2, B1, B2, B3, B4, B10, B11 | A1, A11, A14 |
| 6.7.1                                            | Lists actions to be taken in case of an oil/chemical spillage and pool fire as: <ul style="list-style-type: none"><li>– prompt initiation of the Emergency Shut Down (ESD) will do much to limit the amount of liquid spilled and because of the fish plate, restrict the overflow of cargo overboard</li><li>– restrict sources of ignition to ignite the vapour</li><li>– foam gently spread over the pool fire will smother and restrict it from spreading</li><li>– jets of water should never be directed onto burning liquid, as this will cause a violent increase in flame and spread the fire</li><li>– when contained in drip trays, the liquid may also be spilled onto the deck and water-jet should therefore be avoided</li><li>– wear full protective clothing and take advantage of water spray protection</li></ul> |                |                                  |              |



| TOPIC 7 CARGO OPERATIONS                                                                                                                                                                                                                                                                                                                                   |  |  |  |
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| COMPETENCE 1 Contribute to the safe cargo operation of oil and chemical tankers                                                                                                                                                                                                                                                                            |  |  |  |
| TRAINING OUTCOMES:<br><br>Demonstrates a basic knowledge and understanding of:<br><br>For oil tankers<br><br>.1 cargo information<br>.2 inerting<br>.3 loading<br>.4 unloading<br>.5 tank cleaning<br>.6 purging and gas freeing<br><br>For chemical tankers<br><br>.1 cargo information<br>.2 loading<br>.3 unloading<br>.4 tank cleaning and gas freeing |  |  |  |
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| TOPIC 7 CARGO OPERATIONS                                                                                                                                                                                                                                 |                           |                            |                   |
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| Knowledge, understanding and proficiency                                                                                                                                                                                                                 | IMO reference             | Textbooks/<br>Bibliography | Teaching aid      |
| 7.1 Oil and chemical tankers                                                                                                                                                                                                                             |                           |                            |                   |
| 7.2 For oil tankers                                                                                                                                                                                                                                      | R2, R4, R5, R6,<br>R7, R8 | T1, T2, B1, B2,<br>B3, B4  | A1, A11, A12, A14 |
| 7.2.1 Cargo information                                                                                                                                                                                                                                  |                           |                            |                   |
| 7.2.1.1 States that information about cargoes to be handled is essential to the safety of the vessel and her crew                                                                                                                                        |                           |                            |                   |
| 7.2.1.2 States that such information may be found in MSDS for oil cargoes supplied by shippers. These sheets include all necessary data for the safe handling and carriage of the cargo                                                                  |                           |                            |                   |
| 7.2.1.3 States that the cargo will not be loaded unless sufficient information necessary for its safe handling and transportation is available for all concerned personnel                                                                               |                           |                            |                   |
| 7.2.1.4 States that all personnel engaged in cargo operations should familiarize themselves with the properties of the cargo to be loaded by studying the cargo data sheets / MSDS                                                                       |                           |                            |                   |
| 7.2.2 Inerting                                                                                                                                                                                                                                           |                           |                            |                   |
| 7.2.2.1 States that the inert gas system, where fitted, should be operated appropriately during tank washing, gas freeing and tank preparation operations. Additional safety precautions should be taken for vessels which do not have inert gas systems |                           |                            |                   |
| 7.2.2.2 States that inert gas supplied should have an oxygen content of not more than 5% by volume                                                                                                                                                       |                           |                            |                   |
| 7.2.2.3 States that cleaned cooled boiler flue gas is often used for this purpose, its main constituents being nitrogen and carbon dioxide                                                                                                               |                           |                            |                   |
| 7.2.2.4 States that alternatively, cleaned and filtered combustion gas from an oil-burning gas generator can be used                                                                                                                                     |                           |                            |                   |
| 7.2.2.5 States that Inert gas has to be used when the method of cleaning is crude oil washing or recirculated wash water washing                                                                                                                         |                           |                            |                   |
| 7.2.2.6 States that it is important to keep cargo tanks and slop tanks inerted at all times                                                                                                                                                              |                           |                            |                   |

| TOPIC 7 CARGO OPERATIONS                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |               |                            |              |
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| Knowledge, understanding and proficiency                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | IMO reference | Textbooks/<br>Bibliography | Teaching aid |
| <b>7.2.3 Loading</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |               |                            |              |
| <p>7.2.3.1 States the need for compliance with all safety requirements<br/>Explains, with the aid of a simple drawing:</p> <ul style="list-style-type: none"> <li>– how cargo is routed from the manifold to tanks on an oil tanker with a pump-room</li> <li>– how cargo is routed from the manifold to tanks on an oil tanker</li> <li>– how cargo vapour is removed from the tanks during loading</li> <li>– a closed loading operation</li> </ul>                                                                                                                                           |               |                            |              |
| <p>7.2.3.2 Ship/shore safety checklist</p> <ul style="list-style-type: none"> <li>– States that the ship/shore safety checklist concerns the ship, the terminal and all personnel and is to be completed jointly by the responsible officer and the terminal representative</li> <li>– States that all items need to be verified physically before it is ticked</li> <li>– Discusses the ship/shore safety checklists</li> <li>– States that the completed checklist is of no value if regarded as a paper exercise and should be physically used prior and during transfer of cargo</li> </ul> |               |                            |              |
| 7.2.3.3 States that the control valves are operated during loading according to planned sequence of filling tanks                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |               |                            |              |
| 7.2.3.4 States that the quantity of cargo is checked by measuring ullages                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |               |                            |              |
| 7.2.3.5 States that the level of cargo in the tank can be determined by sounding or by measuring ullage and the use of various measuring devices                                                                                                                                                                                                                                                                                                                                                                                                                                                |               |                            |              |
| 7.2.3.6 States that the venting of tanks into the atmosphere or through a vapour recovery system is controlled as necessary                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |               |                            |              |
| 7.2.3.7 During the loading of cargo simultaneous deballast operations to be carried out                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |               |                            |              |
| 7.2.3.8 States that events during operations are recorded                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |               |                            |              |
| 7.2.3.9 Describes cargo sampling requirements and procedures                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |               |                            |              |
| 7.2.3.10 Lists procedures and duties for personnel on watch during the loading operation                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |               |                            |              |

| TOPIC 7 CARGO OPERATIONS                 |                                                                                                                                                                                                                                                                                                                                                     |               |                            |
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| Knowledge, understanding and proficiency |                                                                                                                                                                                                                                                                                                                                                     | IMO reference | Textbooks/<br>Bibliography |
| 7.2.4 Unloading                          |                                                                                                                                                                                                                                                                                                                                                     |               |                            |
| 7.2.4.1                                  | Operating cargo pumps                                                                                                                                                                                                                                                                                                                               |               |                            |
| 7.2.4.1.1                                | Describes the operation of the following pump types: <ul style="list-style-type: none"><li>– reciprocating positive-displacement pumps</li><li>– rotary positive-displacement “screw” and screw-type pumps</li><li>– rotary positive-displacement lobe- and vane type pumps</li><li>– roto-dynamic (centrifugal) pumps</li><li>– eductors</li></ul> |               |                            |
| 7.2.4.1.2                                | States the precautions to be observed during start-up and stripping procedures                                                                                                                                                                                                                                                                      |               |                            |
| 7.2.4.1.3                                | Lists the reasons for draining and stripping tanks, lines and pumps.                                                                                                                                                                                                                                                                                |               |                            |
| 7.2.4.1.4                                | Describes the operation of the stripping system                                                                                                                                                                                                                                                                                                     |               |                            |
| 7.2.4.2                                  | States that cargo heating may be required for viscous cargo                                                                                                                                                                                                                                                                                         |               |                            |
| 7.2.4.3                                  | States that a particular viscosity range is required for storage and handling and that this is maintained by controlling the temperature of the cargo                                                                                                                                                                                               |               |                            |
| 7.2.4.4                                  | States that the methods of heating the cargo are the use of: <ul style="list-style-type: none"><li>– water heating</li><li>– steam supplied to coils or other forms of extended heating surface, for normal petroleum cargoes</li><li>– a mineral oil heating fluid supplied to heating apparatus for special (heavy) petroleum cargoes</li></ul>   |               |                            |
| 7.2.4.5                                  | States that leakage in heat-exchanger pipes may permit oil to contaminate the condensate system in steam heating systems or water to contaminate the cargo                                                                                                                                                                                          |               |                            |
| 7.2.4.6                                  | States that dangers exist in heating heavy cargoes (such as bitumen) if water is present in the cargo                                                                                                                                                                                                                                               |               |                            |
| 7.2.4.7                                  | States that steel heating coils suffer serious corrosive attack from some cargoes                                                                                                                                                                                                                                                                   |               |                            |
| 7.2.4.8                                  | States that vaporization increases with a rise in temperature                                                                                                                                                                                                                                                                                       |               |                            |
| 7.2.4.9                                  | States that cargo temperature has to be monitored                                                                                                                                                                                                                                                                                                   |               |                            |
| 7.2.4.10                                 | States that control valves are operated during unloading according to planned sequence of emptying tanks                                                                                                                                                                                                                                            |               |                            |

| TOPIC 7 CARGO OPERATIONS                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |               |                            |              |
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| Knowledge, understanding and proficiency                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | IMO reference | Textbooks/<br>Bibliography | Teaching aid |
| 7.2.4.11 States that ballast is taken as required by the unloading plan                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |               |                            |              |
| 7.2.4.12 States that during the ballasting of cargo tanks similar risks will be experienced as when loading a cargo                                                                                                                                                                                                                                                                                                                                                                                                                           |               |                            |              |
| 7.2.4.13 States that line draining and stripping is carried out with required trim being maintained by ballasting operations                                                                                                                                                                                                                                                                                                                                                                                                                  |               |                            |              |
| 7.2.4.14 States the importance of monitoring certain pressure such as: <ul style="list-style-type: none"> <li>– at manifold</li> <li>– discharge side of the pump</li> <li>– inert gas mainline</li> </ul>                                                                                                                                                                                                                                                                                                                                    |               |                            |              |
| <b>Ballast voyage</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |               |                            |              |
| 7.2.4.15 Defines clean, segregated, dirty, arrival and departure ballast<br>Lists ballast requirements criteria as: <ul style="list-style-type: none"> <li>– draft, trim, stress and stability considerations tankers with tanks solely designated for ballast, served by a dedicated ballast system are segregated ballast tanks</li> <li>– additional ballast is carried in cargo tanks if the segregated ballast capacity is insufficient</li> <li>– such ballast is put in designated cargo tanks called heavy weather ballast</li> </ul> |               |                            |              |
| 7.2.4.16 States that the ship may have only clean or segregated ballast on board upon arrival in the loading port for pollution prevention                                                                                                                                                                                                                                                                                                                                                                                                    |               |                            |              |
| 7.2.4.17 States changing ballast is a legislative requirement for pollution prevention                                                                                                                                                                                                                                                                                                                                                                                                                                                        |               |                            |              |
| 7.2.4.18 States that the slop tank is filled with an oily water mixture after tank cleaning water is transferred                                                                                                                                                                                                                                                                                                                                                                                                                              |               |                            |              |
| 7.2.4.19 States that there is a need to decant the contents of the slop tank to minimize pollution                                                                                                                                                                                                                                                                                                                                                                                                                                            |               |                            |              |
| 7.2.4.20 States that the decanting is carried out after oily water mixture is permitted at least 24 hours of settling down and separating. Then the water is discharged through the ODMCS in line with MARPOL regulations keeping the interface at least 1 metre above the discharging point                                                                                                                                                                                                                                                  |               |                            |              |
| 7.2.4.21 States that the remainder of the slop tank may be utilized for the carriage of next cargo loaded on top of the balance                                                                                                                                                                                                                                                                                                                                                                                                               |               |                            |              |
| 7.2.4.22 States that all slop handling operations on tankers are recorded in the Oil Record Book                                                                                                                                                                                                                                                                                                                                                                                                                                              |               |                            |              |

| TOPIC 7 CARGO OPERATIONS                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |               |                            |              |
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| Knowledge, understanding and proficiency |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | IMO reference | Textbooks/<br>Bibliography | Teaching aid |
| 7.2.5                                    | <b>Tank cleaning</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |               |                            |              |
| 7.2.5.1                                  | Lists procedures for tank cleaning as: <ul style="list-style-type: none"><li>– tank washing machines are used</li><li>– there are portable and fixed tank washing machines</li><li>– tanks may be cleaned with water or crude oil (COW)</li><li>– on the ballast voyage, only water is used, sometimes mixed with chemicals</li><li>– hot or cold water may be used if the tank washing system incorporates a water heater</li><li>– tank washing should preferably be carried out in a non-explosive atmosphere</li><li>– this may be an inert or, alternatively, too lean atmosphere</li><li>– if an inert gas system (IGS) is fitted and operating, tank washing should take place in an inert atmosphere</li><li>– if an IGS is not fitted, tank washing should preferably take place in a too lean atmosphere</li></ul> |               |                            |              |
| 7.2.5.2                                  | States the parameters of too lean atmosphere methods of tank cleaning                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |               |                            |              |
| 7.2.5.3                                  | States that ventilation is carried out until a too lean atmosphere is achieved                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |               |                            |              |
| 7.2.5.4                                  | States that gas freeing should be continued during tank washing to maintain the too lean atmosphere                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |               |                            |              |
| 7.2.5.5                                  | States that tank washing water is transferred to the slop tank for decanting                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |               |                            |              |
| 7.2.5.6                                  | States that tank cleaning is carried out to: <ul style="list-style-type: none"><li>– prepare tanks for the carriage of the next cargo</li><li>– prevent the build-up of oily residues</li><li>– facilitate gas freeing and tank entry for repairs/ tank mopping</li><li>– comply with charter party requirements</li><li>– comply with MARPOL regulations</li><li>– In extreme circumstances, prepare tanks for the carriage of clean ballast</li><li>– it can be accomplished by means of portable or fixed tank washing machines, or sometimes a combination of both using hot, cold, fresh or sea water and/or chemical detergents singly or in combination</li></ul>                                                                                                                                                     |               |                            |              |



| TOPIC 7 CARGO OPERATIONS                                                                                                                                                                                                                             |               |                            |              |
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| Knowledge, understanding and proficiency                                                                                                                                                                                                             | IMO reference | Textbooks/<br>Bibliography | Teaching aid |
| <b>Crude Oil Washing (COW)</b>                                                                                                                                                                                                                       |               |                            |              |
| 7.2.5.7 States that the use of tank washing equipment using high-pressure jets of crude oil from the cargo to dissolve and remove cargo residues and deposits which cling to the internal surfaces and fillings of cargo is called crude oil washing |               |                            |              |
| 7.2.5.8 States that crude oil washing may be carried out with single stage or multistage methods                                                                                                                                                     |               |                            |              |
| 7.2.5.9 States the basic knowledge of the working of a tank-washing machine                                                                                                                                                                          |               |                            |              |
| <b>7.2.6 Purging and gas freeing</b>                                                                                                                                                                                                                 |               |                            |              |
| 7.2.6.1 States that gas freeing is usually done by mechanical means                                                                                                                                                                                  |               |                            |              |
| 7.2.6.2 States that such means may be portable fans or a fixed system                                                                                                                                                                                |               |                            |              |
| 7.2.6.3 States that the IGS Blower may be used for gas freeing                                                                                                                                                                                       |               |                            |              |
| 7.2.6.4 States that gas freeing is the replacement of hydrocarbon vapours or inert gas by air                                                                                                                                                        |               |                            |              |
| 7.2.6.5 States that hydrocarbon vapours remain inside a cargo tank after cargo discharge                                                                                                                                                             |               |                            |              |
| 7.2.6.6 States that the hydrocarbon vapours are mixed with inert gas on a ship fitted with an IGS or with air in a ship not so fitted                                                                                                                |               |                            |              |
| 7.2.6.7 States that in an inerted cargo tank there is no explosive atmosphere                                                                                                                                                                        |               |                            |              |
| 7.2.6.8 States that care must be taken that the tank atmosphere does not come within flammable range during gas freeing operations                                                                                                                   |               |                            |              |
| 7.2.6.9 States that soot particles in inert gas create an additional ignition hazard in an explosive tank atmosphere                                                                                                                                 |               |                            |              |
| 7.2.6.10 States that gas freeing a non-inerted tank may bring the tank atmosphere within the explosive range for some time                                                                                                                           |               |                            |              |
| 7.2.6.11 States that oil tankers shall be supplied with meters to check oxygen content, hydrocarbon content by volume, percentage lower flammable limit (LFL) and toxic gas content                                                                  |               |                            |              |
| 7.2.6.12 States that purging a tank with inert gas will prevent the development of an explosive atmosphere in a cargo tank                                                                                                                           |               |                            |              |



| TOPIC 7 CARGO OPERATIONS                         |                                                                                                                                                                                                                                                                                                      |                        |                            |                   |
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| Knowledge, understanding and proficiency         |                                                                                                                                                                                                                                                                                                      | IMO reference          | Textbooks/<br>Bibliography | Teaching aid      |
| <i>Tank cleaning and gas freeing for repairs</i> |                                                                                                                                                                                                                                                                                                      |                        |                            |                   |
| 7.2.6.13                                         | States that procedures for tank cleaning, purging and gas freeing must be carried out                                                                                                                                                                                                                |                        |                            |                   |
| 7.2.6.14                                         | States that before personnel enter any tank, the atmosphere must be checked for oxygen content, hydrocarbon content and, after carrying some cargoes, toxic gas content                                                                                                                              |                        |                            |                   |
| 7.2.6.15                                         | States that oxygen content must be 21% by volume                                                                                                                                                                                                                                                     |                        |                            |                   |
| 7.2.6.16                                         | States that hydrocarbon content must be less than 1% LFL                                                                                                                                                                                                                                             |                        |                            |                   |
| 7.2.6.17                                         | States that the inert gas supply to the tank should be shut off                                                                                                                                                                                                                                      |                        |                            |                   |
| 7.2.6.18                                         | States that an additional hot work permit is required for hot work                                                                                                                                                                                                                                   |                        |                            |                   |
| 7.2.6.19                                         | States that permission to work should only be given for a period sufficient to complete the task. Under no circumstances should the period exceed one day                                                                                                                                            |                        |                            |                   |
| 7.3                                              | <b>For chemical tankers</b>                                                                                                                                                                                                                                                                          | R2, R3, R4, R6, R7, R8 | T1, T2, B1, B2, B3, B4     | A1, A11, A13, A14 |
| 7.3.1                                            | <b>Cargo information</b>                                                                                                                                                                                                                                                                             |                        |                            |                   |
| 7.3.1.1                                          | States that based on cargo information obtained through cargo data sheets, compatibility data sheets, coating compatibility of cargo tanks, cargo to be planned in compliance with all safety requirements providing adequate cargo segregation, keeping in mind the hazardous nature of the cargoes |                        |                            |                   |
| 7.3.1.2                                          | States that such information may be found in MSDS supplied by shippers/cargo data sheets published by ICS for chemical cargoes. These sheets include all necessary data for the safe handling and carriage of the cargo                                                                              |                        |                            |                   |
| 7.3.1.3                                          | States that the cargo will not be loaded unless sufficient information necessary for its safe handling and transportation is available for all concerned personnel                                                                                                                                   |                        |                            |                   |
| 7.3.1.4                                          | States that all personnel engaged in cargo operations should familiarize themselves with the properties of the cargo to be loaded by studying the cargo data sheets/MSDS                                                                                                                             |                        |                            |                   |

| TOPIC 7 CARGO OPERATIONS                                                                                                                                                                                                                                                                                                                                                                                                                  |               |                            |              |
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| Knowledge, understanding and proficiency                                                                                                                                                                                                                                                                                                                                                                                                  | IMO reference | Textbooks/<br>Bibliography | Teaching aid |
| <b>7.3.2 Loading</b>                                                                                                                                                                                                                                                                                                                                                                                                                      |               |                            |              |
| 7.3.2.1 States that all personnel must follow standing instructions at all times whether or not the cargo to be loaded is dangerous                                                                                                                                                                                                                                                                                                       |               |                            |              |
| 7.3.2.2 States that personnel on watch or involved in the loading operation should wear appropriate protective clothing, as indicated in the ICS or other cargo data sheets, when handling dangerous cargoes                                                                                                                                                                                                                              |               |                            |              |
| 7.3.2.3 States that cargoes are stowed according to a stowage plan that was prepared before loading                                                                                                                                                                                                                                                                                                                                       |               |                            |              |
| 7.3.2.4 States that prior to loading, cargo tanks are inspected for cleanliness and suitability for cargo according to the stowage plan                                                                                                                                                                                                                                                                                                   |               |                            |              |
| 7.3.2.5 States that prior to the loading of cargoes which present a major fire hazard, tanks may be purged with nitrogen to remove air so that the atmosphere above the cargo will be non-flammable                                                                                                                                                                                                                                       |               |                            |              |
| 7.3.2.6 States that such cargoes are kept under a nitrogen “padding” during the voyage                                                                                                                                                                                                                                                                                                                                                    |               |                            |              |
| 7.3.2.7 States that cargoes giving off vapours which present a major health hazard are loaded in a “closed circuit”, requiring a vapour-return line                                                                                                                                                                                                                                                                                       |               |                            |              |
| 7.3.2.8 States that in order to check for impurities, cargo samples are taken from lines and tanks during loading                                                                                                                                                                                                                                                                                                                         |               |                            |              |
| 7.3.2.9 States that a vessel’s trim, list and stability may be adjusted, if necessary, during loading by filling or emptying ballast tanks                                                                                                                                                                                                                                                                                                |               |                            |              |
| 7.3.2.10 States that all events during cargo operations are recorded                                                                                                                                                                                                                                                                                                                                                                      |               |                            |              |
| 7.3.2.11 Lists procedures and duties for personnel on watch during the loading operation                                                                                                                                                                                                                                                                                                                                                  |               |                            |              |
| 7.3.2.12 States the need for compliance with all safety requirements<br>Explains, with the aid of a simple drawing: <ul style="list-style-type: none"><li>– how cargo is routed from the manifold to tanks on an oil tanker with a pump-room</li><li>– how cargo is routed from the manifold to tanks on an oil tanker</li><li>– how cargo vapour is removed from the tanks during loading</li><li>– a closed loading operation</li></ul> |               |                            |              |

| TOPIC 7 CARGO OPERATIONS                 |                                                                                                                                                                                                                       |               |                            |
|------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|----------------------------|
| Knowledge, understanding and proficiency |                                                                                                                                                                                                                       | IMO reference | Textbooks/<br>Bibliography |
| 7.3.3 Unloading                          |                                                                                                                                                                                                                       |               |                            |
| Cargo pumps                              |                                                                                                                                                                                                                       |               |                            |
| 7.3.3.1                                  | States that the main cargo pumps fitted on board chemical tankers are mainly of the centrifugal type. They are submerged pumps usually integral with hydraulic motors                                                 |               |                            |
| 7.3.3.2                                  | States that a centrifugal pump creates a partial vacuum at its inlet side. The pressure above the liquid surface moves the liquid to the impeller. Be aware of the fact that pump cavitation may occur                |               |                            |
| 7.3.3.3                                  | States that there are three main ways of checking the pumps, which are: <ul style="list-style-type: none"><li>– visual inspection</li><li>– periodic maintenance</li><li>– checking for vibration and noise</li></ul> |               |                            |
| 7.3.3.4                                  | States that all personnel must follow standing instructions at all times during unloading, whether or not the cargo is considered dangerous                                                                           |               |                            |
| 7.3.3.5                                  | States that personnel on watch involved in the unloading operation should wear appropriate protective clothing, as indicated in the CS or other cargo data sheets, when handling dangerous cargoes                    |               |                            |
| 7.3.3.6                                  | States that cargoes are unloaded according to a planned sequence                                                                                                                                                      |               |                            |
| 7.3.3.7                                  | States that prior to unloading, cargo samples from each tank and from cargo lines are analysed to check if a product has been contaminated on board during passage                                                    |               |                            |
| 7.3.3.8                                  | States that in tanks containing cargoes that present a major fire hazard, inert gas or nitrogen may be used to maintain a positive tank pressure during unloading in order to avoid air entering the tank             |               |                            |
| 7.3.3.9                                  | States that a vessel's trim, list and stability may be adjusted, as necessary, during unloading by filling or emptying ballast tanks                                                                                  |               |                            |

| TOPIC 7 CARGO OPERATIONS                                                                                                                                                                                                                                                                                                           |               |                            |              |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|----------------------------|--------------|
| Knowledge, understanding and proficiency                                                                                                                                                                                                                                                                                           | IMO reference | Textbooks/<br>Bibliography | Teaching aid |
| <b>7.3.4 Tank cleaning and gas freeing</b>                                                                                                                                                                                                                                                                                         |               |                            |              |
| 7.3.4.1 Lists reasons for chemical tank cleaningcleaning as: <ul style="list-style-type: none"><li>– rules and regulations</li><li>– prevention of contamination of the cargo to be loaded</li><li>– prevention of contaminated ballast</li><li>– maintenance of cargo tanks and equipment</li><li>– inspection of tanks</li></ul> |               |                            |              |
| 7.3.4.2 States that low capacity tank-washing machines are used as the size of the cargo tanks are small                                                                                                                                                                                                                           |               |                            |              |
| 7.3.4.3 States that tank-washing machines may be fixed or portable                                                                                                                                                                                                                                                                 |               |                            |              |
| 7.3.4.4 States that tank-cleaning equipment must be properly earthed to avoid accumulation of static electricity. Personnel involved in tank-cleaning operations may be exposed to cargo vapours and should, if necessary, use equipment for personal protection. Different cargoes require different tank-cleaning procedures     |               |                            |              |
| 7.3.4.5 States that cleaning may be done: <ul style="list-style-type: none"><li>– with hot or cold seawater</li><li>– or with fresh water:</li><li>– by circulation</li><li>– or by ventilation only</li></ul>                                                                                                                     |               |                            |              |
| 7.3.4.6 States that water cannot be used for tank cleaning before or after some cargoes                                                                                                                                                                                                                                            |               |                            |              |
| 7.3.4.7 States that in some cases, detergents are added to the washing water                                                                                                                                                                                                                                                       |               |                            |              |
| 7.3.4.8 States that in some cases, solvents are used for tank cleaning                                                                                                                                                                                                                                                             |               |                            |              |
| 7.3.4.9 States the basic knowledge of the working of a tank-washing machine                                                                                                                                                                                                                                                        |               |                            |              |
| 7.3.4.10 Describes how the electric bonding of tank-cleaning hoses may be checked                                                                                                                                                                                                                                                  |               |                            |              |
| 7.3.4.11 Describes a safe procedure for the connection and disconnection of tank-cleaning equipment                                                                                                                                                                                                                                |               |                            |              |

| TOPIC 7 CARGO OPERATIONS                                                                                                                                                                                                                 |               |                            |              |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|----------------------------|--------------|
| Knowledge, understanding and proficiency                                                                                                                                                                                                 | IMO reference | Textbooks/<br>Bibliography | Teaching aid |
| 7.3.4.12<br>Lists phases in a tank-cleaning operation as: <ul style="list-style-type: none"><li>– pre-wash</li><li>– main wash</li><li>– fresh water rinse</li><li>– gas freeing</li><li>– drying</li><li>– inspection/testing</li></ul> |               |                            |              |
| 7.3.4.13<br>Explains, with the aid of a simple drawing, the cycle in a tank-washing system from the seawater inlet to the underwater discharge outlet/slop tank                                                                          |               |                            |              |
| 7.3.4.14<br>States that the purpose of gas freeing is to replace cargo vapours, inert gas or any other gases with air                                                                                                                    |               |                            |              |
| 7.3.4.15<br>States that gas freeing may be done by fixed or portable fans driven by air, steam, water or hydraulic fluid                                                                                                                 |               |                            |              |
| 7.3.4.16<br>States that the gas freeing operation is verified by regular checks of the tank atmosphere                                                                                                                                   |               |                            |              |
| 7.3.4.17<br>States that the tank atmosphere is checked by measuring the percentage of oxygen and the ppm values of cargo vapours or of toxic constituents of inert gas                                                                   |               |                            |              |
| 7.3.4.18<br>States that a cargo tank is gas free only when the oxygen content is 21% by volume, hydrocarbons less than 1% LFL and toxicity less than 50% OEL (R14)                                                                       |               |                            |              |
| <b>Slops and slops disposal</b>                                                                                                                                                                                                          |               |                            |              |
| 7.3.4.19<br>Defines “slops” as tank washings or any residue/water mixtures from pump-room bilges, engine-room bilges or slop tanks                                                                                                       |               |                            |              |
| 7.3.4.20<br>States that modern chemical tankers use cargo tanks to contain slops from tank cleaning                                                                                                                                      |               |                            |              |
| 7.3.4.21<br>States that drain water tanks may also be used to contain small quantities of slops                                                                                                                                          |               |                            |              |
| 7.3.4.22<br>States that in general, the discharge of slops into the sea is prohibited unless certain conditions are satisfied under relevant regulations                                                                                 |               |                            |              |
| 7.3.4.23<br>States that slops have to be disposed of in accordance with MARPOL Annex I or Annex II                                                                                                                                       |               |                            |              |
| 7.3.4.24<br>States that all slop handling operations on chemical tankers are recorded either in the Cargo Record Book or in the Oil Record Book                                                                                          |               |                            |              |
| 7.3.4.25<br>Identifies international regulations covering: <ul style="list-style-type: none"><li>– the discharge of slops</li><li>– the discharge of slops containing noxious chemicals</li></ul>                                        |               |                            |              |

|                                                                                                                                                                                 |  |  |  |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|--|--|
| TOPIC 8 EMERGENCIES                                                                                                                                                             |  |  |  |
| COMPETENCE 5 Respond to emergencies                                                                                                                                             |  |  |  |
| TRAINING OUTCOMES:<br>Demonstrates a basic knowledge and understanding of: <ul style="list-style-type: none"><li>– emergency procedures, including emergency shutdown</li></ul> |  |  |  |

| TOPIC 8 EMERGENCIES                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |               |                            |              |
|------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|----------------------------|--------------|
| Knowledge, understanding and proficiency |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | IMO reference | Textbooks/<br>Bibliography | Teaching aid |
| 8.1                                      | Emergency procedures, including emergency shutdown                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | R2, R3, R9    | T1, T2, B1, B2, B3, B4     | A1, A11, A14 |
| 8.1.1                                    | States that planning and preparation are essential for dealing successfully with emergencies and lists the information which should be readily available as: <ul style="list-style-type: none"><li>– type of cargo and its disposition</li><li>– location of other hazardous substances</li><li>– general arrangement plan of the ship</li><li>– stability information</li><li>– location of fire-fighting equipment and instructions for its use</li></ul>                                                                                                                                                                                               |               |                            |              |
| 8.1.2                                    | States that, in an emergency, important actions to take would include: <ul style="list-style-type: none"><li>– giving audible and visual warnings that an emergency exists by means of:<ul style="list-style-type: none"><li>– bells, whistles, klaxons or other audible devices</li><li>– flashing lights</li></ul></li><li>– advising the command centre of the location and nature of the emergency</li><li>– promptly activating the Emergency Shutdown Device (ESD) and stopping any cargo-related operations, closing valves and openings in tanks as initiated by the ESD system</li><li>– ensuring that any craft alongside are removed</li></ul> |               |                            |              |
| 8.1.3                                    | States that personnel in the vicinity of the emergency should take appropriate action to try and control the incident until the emergency team can take over                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |               |                            |              |
| 8.1.4                                    | States that all crew members should know the location of all safety equipment, such as; <ul style="list-style-type: none"><li>– breathing apparatus</li><li>– protective clothing</li><li>– approved portable electric lights</li><li>– instruments for measuring oxygen and other gases</li><li>– first-aid kits</li><li>– tank-evacuation equipment</li><li>– fire-fighting equipment with instructions for its use</li></ul>                                                                                                                                                                                                                           |               |                            |              |



| TOPIC 8 EMERGENCIES                      |                                                                                                                                                                                                                                                                                                                                                                                     |                 |                            |              |
|------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|----------------------------|--------------|
| Knowledge, understanding and proficiency |                                                                                                                                                                                                                                                                                                                                                                                     | IMO reference   | Textbooks/<br>Bibliography | Teaching aid |
| 8.1.5                                    | States that all equipment which may be needed in an emergency must be maintained in good order and always be ready for use, and lists important items as: <ul style="list-style-type: none"><li>– fire-fighting equipment</li><li>– breathing apparatus</li><li>– protective clothing</li><li>– alarm systems</li><li>– communication systems</li><li>– arrangement plans</li></ul> |                 |                            |              |
| 8.1.6                                    | States that a plan for dealing with an outbreak of fire or an explosion must be prepared and all crew members briefed on its operation                                                                                                                                                                                                                                              |                 |                            |              |
| 8.2                                      | Organizational structure                                                                                                                                                                                                                                                                                                                                                            | R2, R3, R9, R10 | T1, T2, B1, B2, B3, B4     | A1, A11, A14 |
| 8.2.1                                    | States that the planning for and the implementation of an emergency procedure require an emergency organization                                                                                                                                                                                                                                                                     |                 |                            |              |
| 8.2.2                                    | States that the basic structure of the emergency organization should consist of four elements: <ul style="list-style-type: none"><li>– command centre</li><li>– emergency party</li><li>– back-up emergency party</li><li>– engineers group or technical team</li></ul>                                                                                                             |                 |                            |              |
| 8.2.3                                    | States the need to identify a senior officer as being in control during the emergency, with another senior officer identified as his deputy                                                                                                                                                                                                                                         |                 |                            |              |
| 8.2.4                                    | States the general composition and the task of the various parties: <ul style="list-style-type: none"><li>– command centre</li><li>– emergency party</li><li>– back-up emergency party</li><li>– technical party</li></ul>                                                                                                                                                          |                 |                            |              |
| 8.2.5                                    | States their position in the emergency organization and their duty in case an emergency procedure is being initiated                                                                                                                                                                                                                                                                |                 |                            |              |
| 8.2.6                                    | States the need for realistic drills to be undertaken periodically                                                                                                                                                                                                                                                                                                                  |                 |                            |              |

| TOPIC 8 EMERGENCIES                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                 |                            |              |
|------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|----------------------------|--------------|
| Knowledge, understanding and proficiency |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | IMO reference   | Textbooks/<br>Bibliography | Teaching aid |
| 8.3                                      | Alarms                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | R2, R3, R9, R10 | T1, T2, B1, B2, B3, B4     | A1, A11, A14 |
| 8.3.1                                    | States that a fire alarm signal or general alarm signals are given in case of:<br><br>– fire<br>– collision<br>– grounding<br>– man overboard<br>– cargo spillage or vapour escape<br>– every other emergency situation which calls for emergency actions                                                                                                                                                                                                                                                         |                 |                            |              |
| 8.3.2                                    | States that other alarm signals are given in case of:<br><br>– high concentration of toxic or flammable vapours<br>– unacceptable condition in cargo tanks or cargo systems<br>– unacceptable conditions in auxiliary cargo systems<br>– system failure in cargo plant and auxiliary systems<br>– system failure in engine-room or machinery spaces<br>– a CO <sub>2</sub> discharge in engine-room or pump-rooms<br>– a high level of oxygen in inert gas<br>– high level of oil residues in overboard discharge |                 |                            |              |
| 8.3.3                                    | States that the ships muster list and emergency instructions specify details of the emergency alarm signals                                                                                                                                                                                                                                                                                                                                                                                                       |                 |                            |              |
| 8.3.4                                    | States that all personnel on board should be able to identify the different alarm signals                                                                                                                                                                                                                                                                                                                                                                                                                         |                 |                            |              |
| 8.3.5                                    | States that all crew members should be familiar with the emergency plan and act according to the plan when the alarm is raised                                                                                                                                                                                                                                                                                                                                                                                    |                 |                            |              |
| 8.3.6                                    | States that any person who discovers an emergency should raise the alarm and pass on relevant information as quickly as possible                                                                                                                                                                                                                                                                                                                                                                                  |                 |                            |              |

| TOPIC 8 EMERGENCIES                      |                                                                                                                                                                                                   |                 |                            |              |
|------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|----------------------------|--------------|
| Knowledge, understanding and proficiency |                                                                                                                                                                                                   | IMO reference   | Textbooks/<br>Bibliography | Teaching aid |
| 8.4                                      | Emergency procedures                                                                                                                                                                              | R2, R3, R9, R10 | T1, T2, B1, B2,<br>B3, B4  | A1, A11, A14 |
| 8.4.1                                    | States that the ship's muster list and emergency instructions specify action to be taken by each crew member and officer in case of an emergency                                                  |                 |                            |              |
| 8.4.2                                    | States that all personnel should be familiar with the emergency instructions and act according to the instructions when the alarm is raised                                                       |                 |                            |              |
| 8.4.3                                    | States that a vessel's safety plan and fire control plan specify details and location of all equipment for emergency use                                                                          |                 |                            |              |
| 8.4.4                                    | States that all personnel should know the location of emergency equipment and be familiar with its use                                                                                            |                 |                            |              |
| 8.4.5                                    | States that it is essential that personnel are properly trained for emergency operations                                                                                                          |                 |                            |              |
| 8.4.6                                    | States that all equipment which may be used in an emergency must be maintained in good order and be ready for use at all times                                                                    |                 |                            |              |
| 8.4.7                                    | Lists basic emergency actions to be taken in case of:<br><div><div></div><div>– fire</div><div>– collision</div><div>– grounding</div><div>– cargo spill accident involving personnel</div></div> |                 |                            |              |
| 8.4.8                                    | States that the correct emergency procedures for accidents involving dangerous cargoes are given in the ICS or other cargo data sheets                                                            |                 |                            |              |

| TOPIC 9 POLLUTION PREVENTION                                                                                                                                                                                                                                                                                                                                                                                                                     |  |  |  |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|--|--|
| COMPETENCE 6 Take precautions to prevent pollution of the environment from the release of oil or chemicals                                                                                                                                                                                                                                                                                                                                       |  |  |  |
| TRAINING OUTCOMES:<br>Demonstrates a basic knowledge and understanding of:<br><br>.1 effects of oil and chemical pollution on human and marine life<br><br>.2 shipboard procedures to prevent pollution<br><br>.3 SOPEP and SMPEP<br><br>.4 measures to be taken in the event of spillage, including the need to:<br>– report relevant information to the responsible persons<br>– assist in implementing shipboard spill-containment procedures |  |  |  |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                  |  |  |  |

| TOPIC 9 POLLUTION PREVENTION             |                                                                                                                                                                                                            |               |                             |              |
|------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|-----------------------------|--------------|
| Knowledge, understanding and proficiency |                                                                                                                                                                                                            | IMO reference | Textbooks/<br>Bibliography  | Teaching aid |
| 9.1                                      | Effects of oil and chemical pollution on human and marine life                                                                                                                                             | R2, R3, R9    | T1, T2, B1, B2, B3, B4, B10 | A1, A11, A14 |
| 9.1.1                                    | States that in the case of oil or NLS spill, the first living receptors who may come in contact with the spill are the marine life, including the various fish species.                                    |               |                             |              |
| 9.1.2                                    | States the negative effects of oil, chemical and noxious liquids on marine life                                                                                                                            |               |                             |              |
| 9.1.3                                    | States that the problem is more for the higher organisms on the food chain (who consumes other smaller organisms) and may seriously affect birds and marine mammals, as well as bigger fish and human life |               |                             |              |
| 9.2                                      | Shipboard procedures to prevent pollution                                                                                                                                                                  | R2, R3, R9    | T1, T2, B1, B2, B3, B4, B10 | A1, A11, A14 |
| 9.2.1                                    | States that the International Maritime Organization is the international body responsible for controlling marine pollution                                                                                 |               |                             |              |
| 9.2.2                                    | States that IMO achieves this by adopting the International Convention for the Prevention of Pollution from Ships commonly known as MARPOL                                                                 |               |                             |              |
| 9.2.3                                    | States that Annex I of the MARPOL convention contains regulations for control of pollution by oil cargoes carried in bulk or tank washings from such cargoes                                               |               |                             |              |
| 9.2.4                                    | States that Annex II of the MARPOL convention contains regulations for control of pollution by noxious liquid cargoes carried in bulk or tank washings from such cargoes                                   |               |                             |              |
| 9.2.5                                    | States that to prevent hazards to the environment the following should be observed                                                                                                                         |               |                             |              |

| TOPIC 9 POLLUTION PREVENTION             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |               |                            |
|------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|----------------------------|
| Knowledge, understanding and proficiency |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | IMO reference | Textbooks/<br>Bibliography |
| 9.2.5.1                                  | States that for tankers in port:                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |               |                            |
|                                          | <ul style="list-style-type: none"><li>– ship movements alongside must be restricted by adjusting moorings</li><li>– all pipelines, joints and valves must be kept under observation whilst handling cargo</li><li>– catchment trays must be fitted or placed at vulnerable points (hose connections, for example)</li><li>– strict control must be exercised whilst loading to prevent tanks overflowing</li><li>– all scuppers must be closed to prevent a discharge of cargo from the deck overboard</li><li>– all valves and blanks must be checked prior to cargo operations</li><li>– valves not used should be secured if possible</li><li>– sea valves not in use should be closed by double valves or blanked off</li><li>– if cargo is spilt, cargo operations must be stopped and warnings given to all involved</li></ul> |               |                            |
| 9.2.6                                    | States that pollution prevention procedures during the port operations include keeping a watch on: <ul style="list-style-type: none"><li>– levels in cargo, slop or ballast tanks</li><li>– cargo or ballast hoses or hard arms</li><li>– pumps, valves, gaskets, connections and hatches</li><li>– spill pans and scuppers</li><li>– alarms and instrumentation</li><li>– coordination of operation signals</li><li>– personnel on watch should be present at all times during cargo operations and regularly carry out the inspections on the pollution prevention procedures</li></ul>                                                                                                                                                                                                                                            |               |                            |

| TOPIC 9 POLLUTION PREVENTION             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |               |                            |
|------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|----------------------------|
| Knowledge, understanding and proficiency |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | IMO reference | Textbooks/<br>Bibliography |
| 9.2.7                                    | States that for oil tankers at sea: <ul style="list-style-type: none"> <li>– there are regulations for the discharge of the cargo into the sea which must be observed</li> <li>– in order to comply with these requirements, Load On Top (LOT) procedures must be observed during deballasting, decanting and tank cleaning operations</li> </ul> Most crude carriers must: <ul style="list-style-type: none"> <li>– crude oil wash their cargo tanks to minimize oily wastes</li> <li>– have segregated ballast tanks or have dedicated clean ballast tanks</li> </ul>                                                                                                                                                                      |               |                            |
| 9.2.8                                    | States that for chemical tankers at sea and in port: <ul style="list-style-type: none"> <li>– for the purpose of discharging slops containing cargo residues into the sea, Annex II divides NLS on chemical tankers into four pollution based categories</li> <li>– these categories are X, Y , Z and OS, and a cargo of category X represents the most pollutant and a cargo of category Z the least pollutant</li> <li>– all operations on board involving cargo, ballast and bunkers should be done in accordance with the applicable pollution regulations</li> <li>– carrying out operations in accordance with the ship's Procedures and Arrangements (P&amp;A) Manual ensures that pollution regulations are complied with</li> </ul> |               |                            |
| 9.2.9                                    | States that the measures to be taken in the event of spillage, are: <ul style="list-style-type: none"> <li>– immediately report all relevant information to the appropriate officials when a spill is detected or when a malfunction has occurred which poses a risk of a spill</li> <li>– promptly notify shore-based response personnel</li> <li>– properly implement shipboard spill-containment procedures</li> <li>– assist in implementing shipboard spill-containment procedures</li> </ul>                                                                                                                                                                                                                                           |               |                            |



| TOPIC 9 POLLUTION PREVENTION             |                                                                                                                                                                                    |               |                             |              |
|------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|-----------------------------|--------------|
| Knowledge, understanding and proficiency |                                                                                                                                                                                    | IMO reference | Textbooks/<br>Bibliography  | Teaching aid |
| 9.3                                      | SOPEP and SMPEP                                                                                                                                                                    | R2, R3, R9    | T1, T2, B1, B2, B3, B4, B10 | A1, A11, A14 |
| 9.3.1                                    | States that, as per the MARPOL Convention, most tankers shall carry a Shipboard Oil Pollution Emergency Plan (SOPEP) and Shipboard Marine Pollution Emergency Plan for NLS (SMPEP) |               |                             |              |
| 9.3.2                                    | States in brief that the concept of the plan is to assist personnel in dealing with an unexpected discharge of oil and NLS                                                         |               |                             |              |
| 9.3.3                                    | States that the SOPEP equipment & SMPEP equipment consist as per SOPEP manual and SMPEP manual                                                                                     |               |                             |              |
| 9.3.4                                    | States that the procedure to be followed to report a marine pollution incident is shown in the SOPEP manual and SMPEP manual                                                       |               |                             |              |

| TOPIC 10      CASE STUDY                                                                                                                                                                                |               |                            |              |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|----------------------------|--------------|
| COMPETENCE 6      Take precautions to prevent pollution of the environment from the release of oil or chemicals                                                                                         |               |                            |              |
| <b>TRAINING OUTCOMES:</b><br><br>To enhance the trainee’s awareness, the discussions of the following case studies are recommended but not required under the STCW Code.<br><br>Discusses case studies: |               |                            |              |
| Knowledge, understanding and proficiency                                                                                                                                                                | IMO reference | Textbooks/<br>Bibliography | Teaching aid |
| 10.1      Fire and explosion during unloading operations on an oil tanker                                                                                                                               | R2, R4        | T1                         | A1, A11, A14 |
| 10.2      Collapsing of seamen during squeegeeing operations                                                                                                                                            | R2, R4        | T2                         | A1, A11, A14 |

## Part D: Instructor Manual

### Introduction

The instructor manual provides guidance on the material that is to be presented during the course. The course material reflects the mandatory minimum requirements for the training and qualifications of officers and ratings on oil and chemical tankers as specified in STCW Code, regulation V/1-1, paragraph 2.2 of the International Convention on Standards of Training, Certification and Watch keeping for Seafarers, as amended.

The competences mentioned in the above mentioned STCW regulation are broken down in the following topics, reflecting how the instructor should design their course and delivery, and is for guidance only.

To show consistency and adherence to STCW Code, as amended, as given in STCW Code, chapter V, table A-V/1-1-1, a mapping is provided in part A of this model course for easy reference from STCW's competences and training outcomes to the topics covered in this model course:

- .1 Basic knowledge of oil tankers and chemical tankers
- .2 Physical properties of oil and chemicals
- .3 Tanker safety culture and safety management
- .4 Hazards and their controls
- .5 Safety
- .6 Fire safety and fire-fighting operations
- .7 Cargo operations
- .8 Emergencies
- .9 Pollution prevention
- .10 Case studies

The texts used as references throughout the course are given in part A, course framework and are: Teaching Aids (A), IMO References (R), Textbooks (T), Bibliography (B) and Videos (V).

The course outline provides guidance on the time allocations for the course material, but the instructor is free to make adjustments as necessary. The detailed teaching syllabus must be studied carefully, and lesson plans or lecture notes compiled where appropriate.

Some sketches and diagrams are provided at the end of the guidance notes. These will provide examples of the kind of material which is useful in supporting the presentation of the course.

Throughout the course it is important to stress that aboard ships rules and regulations must be strictly observed and all precautions taken to maximize safety and minimize harmful effects to the environment.

Topics marked with an asterisk (\*) could be better taught using a simulator. IMO model course 2.06, Oil tanker cargo and ballast handling simulator, and IMO model course 1.37, Chemical tanker cargo and ballast handling simulator, provide detailed training programmes for oil and chemical tanker operations using specially created cargo handling exercises on a simulator.

### Guidance Notes

Guided learning hours are suggested and may be modified or changed with respect to trainees, previous knowledge, training or experience.

## Topic 1 *Tankers* (1.5 hours)

### 1.1 *Types of oil tankers* (0.25 hour)

The trainees should have a general knowledge about the important stages in the development of tankers and oil shipping. This is a brief overview of the manner in which tankers carrying oil, petroleum and its products have developed over the years. "Safe Oil Tanker Operations", B3 will provide sufficient information in respect to dates, the carriage of oil in barrels in conventional cargo ships, their development into tank-type vessels to carry oil in bulk and subsequent development into the modern forms.

The important stages in the development of tankers and oil shipping are:

- construction of vessels to carry oil in bulk
- use of longitudinal divisions and transverse bulkhead to form tanks
- location of machinery aft
- increase in size to VLCCs and ULCCs
- transportation of liquefied gas and chemicals in bulk
- pollution problems and explosion/fire hazard leading to international controls
- the development of SOLAS and MARPOL
- increasing use of training to improve safety and reduce pollution
- the STCW Convention and chapter V of the Convention
- the development of double-hull tankers and middeck design
- the implementation of the International Safety Management (ISM) Code

Simple diagrams similar to figure 1.1 B in appendix 1, showing the introduction of longitudinal bulkheads to form tank spaces, the placing of machinery aft and the use of pump-rooms, would assist the instructors in their presentation. Such diagrams and others as shown in figures 1.1 A to 1.1 D are also useful in showing present tanker forms. The list of the important stages in the development of tankers is given in part D2, figures 1.1 A to 1.1 D.

The trainees should be able to describe different types of oil tankers such as crude oil carriers, product tankers, and combination carriers.

Combination carriers include:

- ships intended for separate carriage of oil and dry cargoes in bulk (notation: bulk carrier or tanker for oil)
- ships intended for separate carriage of oil and ore in bulk (notation: ore carrier or tanker for oil)
- combination of the two above, so-called OBO (oil/bulk/ore carrier)
- the trainees should appreciate that combination carriers are subject to demanding duties, which mean that they must be built, loaded and operated with keen attention.

### 1.2 *Types of chemical tankers* (0.25 hours)

The trainees should have a general knowledge about the important stages in the development of chemical tankers and bulk chemical shipping. This is a brief view of the manner in which chemical tankers and the bulk chemical shipping have evolved over the years.

The important stages in the development of bulk chemical shipping are:

- sea transport of chemicals started with the chemical industries rapid growth in the years after World War II
- smaller tankers specially designed and constructed for the carriage of "acids", e.g. sulphuric acid, were built during the early 1950s, the cargo tanks of which were made of special alloy steel, strengthened for cargo densities up to 2.0 kg/litre

- in order to carry chemicals of high purity and sensitive to contamination, coating techniques were developed for cargo tanks of mild steel
- the first real chemical tanker specially designed for the carriage of liquid chemicals in bulk was the *Norwegian M/T Lind*, delivered in 1960; this was the first tanker equipped with stainless-steel cargo tanks
- a modern chemical tanker has a large number of cargo tanks and is designed for carriage of a wide variety of cargoes
- the cargo-tank section on these modern ships is normally divided into some stainless steel tanks and some coated mild-steel tanks, each of which is normally equipped with deep well pumps and a separate piping system.

Chemical tankers are required to transport a wide range of different cargoes, and many tankers are designed to carry a large number of segregated products simultaneously. The operation of chemical tankers differs from any other bulk liquid transportation operations; on a single voyage a large number of cargoes with different properties, characteristics and inherent hazards may be carried.

Moreover, in port several products may be handled simultaneously at one berth, typically including different operations such as discharge and loading as well as tank cleaning. Even the less sophisticated chemical tankers are more complex to operate than oil tankers.

Transportation of bulk chemicals by sea not only requires specialist ships and equipment, but also specialist crew training, in both theoretical and practical aspects for those involved, in order to understand the characteristics of the various chemicals and be aware of the potential hazards involved in handling them. A particularly important aspect of this requirement is the provision of a data sheet, or cargo information form, giving details specific to a substance, which is required to be held on board whenever that substance is carried by the ship.

A modern chemical tanker is primarily designed to carry some of the several hundred hazardous products now covered by the IMO Bulk Chemical Codes. The following general types of chemical carriers have developed since the trade began.

### *Sophisticated parcel chemical tankers*

Typically up to 40,000 tons deadweight with multiple small cargo tanks – up to 54 – each with an individual pump and a dedicated pipeline, to carry small parcels of high grade chemicals. These ships have a significant proportion of the cargo tanks made with stainless steel, allowing maximum flexibility to carry cargoes that need their quality safeguarded. The list of the important stages in the development of bulk chemical shipping is given in part D2, figure 1.2.

### *Product/chemical tankers*

Of similar size to parcel tankers but with fewer cargo tanks, mostly of coated steel rather than stainless, and less sophisticated pump and line arrangements. Such ships carry the less difficult chemicals, and also trade extensively with clean oil products.

### *Specialized chemical carriers*

Small to medium sized ships, often on dedicated trades and usually carrying a single cargo such as an acid, molten sulphur, molten phosphorus, methanol, fruit juice, palm oil and wine. Cargo tanks are coated or stainless steel according to the trade.



### 1.3 *Ship arrangements of an oil and chemical tanker* (0.25 hour)

The trainees should be able to demonstrate/explain with a sketch the general tank arrangements of an oil tanker. Part D2 figures 1.3A to 1.3D can be used as an aid to instructors for displaying general tank arrangements, including:

- cargo tanks
- pump-rooms
- segregated ballast tanks
- slop tanks
- cofferdams
- peak tanks
- deep tanks

The trainees should also be able to describe the piping arrangements of an oil tanker, including:

- internal piping in tanks and pump-rooms
- external piping (deck lines)
- crossovers
- by-passes
- ring-main systems
- direct piping systems
- valves
- venting system

#### 1.3.2 *Ship arrangement of a chemical tanker*

##### *Tankers for carrying chemicals*

This section deals with the design and arrangements of tankers involved in transportation of chemicals in bulk. It is essential for the further progress of the course that the trainees are familiar with the different types and arrangements of chemical tankers when they have completed this section of the course.

##### *General ship arrangements*

The purpose of this lecture is to describe general arrangements of a chemical tanker; the essential message is that segregation and separation of cargoes are fundamental to the safety of a chemical tanker. Display diagrams from appendix 1, figure 1.3.2A and describe the general arrangements of a chemical tanker, its cargo equipment, pipelines and cargo systems.

##### *Ship types and tank location*

The purpose of this lecture is to explain some of the considerations for the IMO grouping of chemical tankers and the relationship between ship-type requirements and the cargo carried. It is essential to point out that a chemical tanker may have sections of its cargo tanks that provide different degrees of protection.

## ***Cargo equipment and instrumentation***

### *Tanks, piping and hoses*

The purpose of this lecture is to describe generally the different tank types and the cargo area and systems for loading and unloading cargo and ventilating cargo tanks. The ship's cargo hoses are frequently a part of these systems, and it is therefore important to discuss correct handling of the hoses.

### *Tank coatings and material of construction*

The aim of this lecture is to familiarize the trainees with material of construction, coatings of cargo tanks and cargo piping on chemical tankers. It should be emphasized that it is most important that stainless steel and tank coatings are handled correctly and that tank coating guides and maintenance instructions are strictly followed by ship's personnel.

#### **1.4    *Pumps and eductors* (0.25 hour)**

The purpose of this lecture is to describe common types of cargo pump found on chemical tankers. It is also important that the safety aspects concerning the different types and arrangements of pumps are discussed and summarized.

#### **1.5    *Cargo heating system* (0.25 hour)**

The purpose of this lecture is to describe generally the different cargo heating systems. The safety aspects concerning their use should be discussed and summarized.

#### **1.6    *Inert gas system* (0.25 hour)**

The purpose of this lecture is to explain the term 'inert gas', to describe the different types and uses of inert gas and to describe the arrangement of an inert gas generator. It is important to call attention to the composition of inert gas produced in an inert gas generator, flue gas system and nitrogen gas generator and the potential hazards that some of these constituent gases may pose.

#### **1.7    *Cargo measurement systems* (0.25 hour)**

The main purpose of this lecture is to describe different gauging devices used in cargo tanks and to explain how the user of the device may be exposed to the cargo vapour. Necessary precautions to avoid this potential hazard should be discussed.

## **Topic 2        *Physical properties of oil and chemicals* (4.5 hours)**

### **2.1    *Basic physics* (2.0 hours)**

The purpose of this lecture is to familiarize the trainees with cargo properties of oil and chemicals and the terms that are used to describe them. The learning objective is that by the end of the course the trainees should be able to read and understand the necessary data given in MSDS, ICS Guide or other cargo data sheets.

The physical properties of oil and chemical cargoes that are important in their containment, handling and transportation are explained and discussed.

#### *Properties and terminology*

At the end of the course the trainees should be able to define and explain the terminology and abbreviations commonly used on board oil and chemical tankers and in terminals. It is not considered necessary to spend the whole lecture going through a dictionary of terms, but the most commonly used trade terms should be explained and used intentionally during the course so that the trainees will become familiar to them.

It would be useful to discuss and explain some of the more complicated or technical terms or definitions, such as airlock, anesthetics, anti-static additive, auto ignition, boil-off, dangerous area, earthing, explosion-proof, flame screen, flammable, flammable range, flashpoint, gas-free, gas free certificate, hot work, inert condition, petroleum, petroleum gas, pour point, pressure surge, purging, spontaneous combustion, static electricity, TLV and toxic vapour. There may be other terms or definitions which are not listed or which may require further elaboration; these can be added to the list or dealt with during presentations.



If the necessary apparatus is available, some or all of the tests to evaluate these properties can be demonstrated or carried out as a group exercise.

## 2.2 *Basic chemistry, chemical elements and groups* (1.5 hours)

The purpose of this lesson is to familiarize the trainees with the basic chemical symbols and structure and the properties of different cargoes and/or groups of cargoes. The instructor should start with a description of atoms and know that periodic table exists that maps the various elements as proper properties (reference appendix 1, figure 2.1). A chemical reaction and the forming of simple molecules can then be explained, using the most common examples.

### *The hydrocarbon structure*

The aim here is to try and keep things simple and avoid complication. The essential message is that petroleum is made up of several different hydrocarbon molecules with molecular weights (or molecular masses) ranging from light to heavy. Although the structure consists of hydrogen atoms linking into carbon atoms, for simplicity it is only necessary to mention carbon atoms at this basic level to present a picture of a whole range of petroleum molecules, with the lightest molecules (such as methane, propane and butane, which are gaseous at atmospheric pressure) containing only small numbers of carbon atoms, with of course, an appropriate number of linked hydrogen atoms.

As more carbon atoms (with an appropriate number of linked hydrogen atoms) are used to form the petroleum molecule, the molecule will become heavier and have a higher boiling temperature at atmospheric pressure.

As it leaves the well bore, the petroleum will comprise a whole range of molecules from light to heavy.

The lightest molecules, methane, are stripped off at the well head together with any earthy solids, the remaining petroleum is termed CRUDE OIL. The process of refining the crude oil will produce a number of FRACTIONS.

Each fraction will consist of a range of petroleum molecules, which at atmospheric pressure and temperature will be gaseous, liquid or solid.

## 2.3 *Physical properties of oil and chemicals carried in bulk* (1.5 hours)

Using teaching aids T1, T2, B2 and B4, the trainees should be able to explain basic definitions with reference to:

- flashpoint
- volatility
- upper flammable/explosive limit
- lower flammable/explosive limit
- auto-ignition temperature
- spontaneous combustion
- reactivity
- toxicity
- corrosivity
- vapour pressure and temperature

The instructor should, if possible, perform the experiments to show the trainees:

- the determination of cargo temperature and the determination of cargo density

### **Topic 3      *Tanker safety culture and safety management* (2.0 hours)**

The instructors can use the checklist of a company's SMS (Safety management system) as applicable (sample copy appended as Figure 3.0, appendix 1).

The Oil Companies International Marine Forum (OCIMF) has been in the forefront of the drive to implement a common vessel inspection process through the introduction of the Ship Inspection Report Exchange (SIRE) system. This system promotes a uniformly high standard of common inspections. Member companies can then use the results within their own vetting systems.

The management and operation of vessels within a culture of safety and environmental excellence was formalized with the introduction of the International Safety Management (ISM) Code. This Code requires vessel operators to implement a safety management system that will help them to achieve incident-free operations. However, there is a clear distinction between the standards of those vessel operators that embrace the spirit of the ISM code and those that aim to fulfil only its minimum requirements. This variability may result in a charterer with due-diligence concerns requiring to re-assess the operational standards of individual vessel operators.

Good safety culture is evident by good work practices and work morale and commitment to safety, communication, crew qualifications and training.

Studies show that 80% or more of accidents are caused by operator or human error (including collective management failure).

Vessel operators are encouraged to assess their safety management systems against listed key performance indicators and provide best practice guidance. Best practice is an effective way to minimize the possibility of problems reoccurring. It creates opportunities and optimizes performance in crucial areas such as safety and environmental excellence. Companies should aim to transfer best practices across their fleet through the consistent application of improved processes and procedures.

### **Topic 4      *Hazards* (6 hours)**

#### **Topic 4.1      *Hazards* (3 hours)**

The purpose of the lesson is to make the trainees aware of the contents of the safety data sheets and make them able to read and understand the necessary data given in the ICS or other cargo data sheets.

The following topics should be explained and discussed using an MSDS. The instructor should guide the trainees in extracting information from an MSDS relevant to the safe handling and transportation of cargo. The data sheet in appendix 1, figures 4.2.9(A) and 4.2.9(B) may be used for this purpose.

#### **4.1.1      *Health hazards on tankers* (0.5 hour)**

The purpose of the lesson is to identify the different types of health hazards posed by the cargoes and inert gas on tankers.

The instructor should identify the toxicity hazards of petroleum and its products as well as that for chemicals using Reference B2, B4 which gives a rather thorough coverage of the health hazards from chemicals. Display the small handbooks T1 and T2.

The small handbooks T1 and T2 cover the same topic in a simple manner for trainees at support level.

*There are many chemicals transported by sea that can be hazardous. However, in order for them to affect your health, they must be in contact with the body or be absorbed into the body. When assessing the potential health effects from working with a particular material it is necessary to understand difference between "toxicity" and "hazard".*

*TOXICITY is the ability of a substance to produce an unwanted effect when the chemical has reached a sufficient concentration at a certain site in the body.*

*The more toxic a material is, the smaller the amount of it necessary to be absorbed before harmful effects are caused. The lower the toxicity, the greater the quantity of it necessary to be absorbed. The toxicity of a chemical is generally measured by experiments on animals (quite often rats). If it is measured in terms of the amounts of material necessary to cause death in 50% of the test animals. These values are called LD50 (lethal dose) or LC50 (lethal concentration), and are usually given in weight of material per kg of body weight or airborne concentration of material per set time period respectively.*

*HAZARD is the probability that this concentration in the body will occur.*

*Toxicity is an inherent property of the material. A material may be very toxic, but not hazardous, if it is handled properly and is not absorbed into the body. On the other hand, a material may have a very low toxicity, but be very hazardous.*

#### **4.1.2 Environmental hazards (0.5 hour)**

Pollution should be defined and discussed by the instructor. Trainees should be made aware that tankers are a major source of marine pollution. Various effects of pollution on the environment should be discussed.

Carriage of chemicals in bulk is covered by regulations in SOLAS chapter VII – Carriage of dangerous goods and MARPOL Annex II – Regulations for the Control of Pollution by Noxious Liquid Substances in Bulk.

Both Conventions require chemical tankers built after 1 July 1986 to comply with the International Bulk Chemical Code (IBC Code), which gives international standards for the safe transport by sea in bulk of liquid dangerous chemicals, by prescribing the design and construction standards of ships involved in such transport and the equipment they should carry so as to minimize the risks to the ship, its crew and to the environment, having regard to the nature of the products carried.

The basic philosophy is one of ship types related to the hazards of the products covered by the Codes. Each of the products may have one or more hazard properties which include flammability, toxicity, corrosivity and reactivity.

The IBC Code lists chemicals and their hazards and gives both the ship type required to carry that product as well as the environmental hazard rating.

Chemical tankers constructed before 1 July 1986 should comply with the requirements of the Code for the Construction and Equipment of Ships Carrying Dangerous Chemicals in Bulk (BCH Code) – the predecessor of the IBC Code.

#### **4.1.3 Reactivity hazards (0.25 hour)**

The instructor should give details of various reactivity hazards of a sample cargo. USCG compatibility chart can be referred to and trainees may be required to find out the compatible groups.

Many pure substances (i.e. uninhibited) can undergo vigorous polymerization quite easily by themselves when they are heated slightly or exposed to light. These include:

- acrylic acid
- acrylonitrile
- cyclopentadiene
- diketene
- ethyl acrylate
- hydrocyanic acid
- methacrylic acid
- methyl acrylate
- vinyl acetate



The most common form of self-reaction is polymerization. Polymerization generally results in the conversion of gases or liquids into viscous liquids or solids. It may be a slow, natural process which only degrades the product without posing any safety hazards to the ship or the crew, or it may be a rapid, exothermic reaction evolving large amounts of heat and gases. Heat produced by the process can accelerate it. Such a reaction is called a run-off polymerization that poses a serious danger to both the ship and its personnel. Products that are susceptible to polymerization are normally transported with added inhibitors to prevent the onset of the reaction.

An inhibited cargo certificate should be provided to the ship before a cargo is carried. The action to be taken in case of a polymerization situation occurring while the cargo is on board should be covered by the ship's emergency contingency plan.

#### *Reaction with air*

Certain cargoes react with air in a way that could pose a danger to both the ship and its personnel. Toxic gases may be evolved. The most noticeable examples are the isocyanates; such cargoes are carried under dry and inert condition.

#### *Reaction with water*

Certain cargoes react with water in a way that could pose a danger to both the ship and its personnel. Toxic gases may be evolved. The most noticeable examples are the isocyanates; such cargoes are carried under dry and inert condition. Other cargoes react with water in a slow way that poses no safety hazard, but the reaction may produce small amounts of chemicals that can damage equipment or tank materials, or can cause oxygen depletion.

Certain chemical cargoes, mostly ethers and aldehydes, may react with oxygen in air or in the chemical to form unstable oxygen compounds (peroxides) which, if allowed to build up, could cause an explosion. Such cargoes can be either inhibited by an anti-oxidant or carried under inert conditions.

#### *Reaction with other materials*

The materials used in construction of the cargo systems must be compatible with the cargo to be carried, and care must be taken to ensure that no incompatible materials are used or introduced during maintenance (e.g. by the material used for replacing gaskets). Some materials may trigger a self-reaction within the product. In other cases, reaction with certain alloys will be non-hazardous to ship or crew, but can impair the commercial quality of the cargo or render it unusable.

The instructor gives examples of each of the above reactions.

#### **4.1.4 Corrosion hazards (0.25 hour)**

Acids, anhydrides and alkalis are among the most commonly carried corrosive substances. They can rapidly destroy human tissue and cause irreparable damage. They can also corrode normal ship construction materials, and create a safety hazard for a ship. Acids in particular react with most metals, evolving hydrogen gas which is highly flammable. The IMO Codes address this, and care should be taken to ensure that unsuitable materials are not included in the cargo system. Personnel likely to be exposed to these products should wear suitable personal protective equipment

#### **4.1.5 Explosion and flammability hazards (0.5 hour)**

##### *Flammability*

When petroleum or a chemical is ignited, it is the gas progressively given off by the liquid which burns as a visible flame. The quantity of gas available to be given off by a liquid depends on its volatility which is frequently expressed for purposes of comparison in terms of Reid vapour pressure. A more informative measure of volatility is the true vapour pressure but unfortunately this is not easily measured.

Vapours can be ignited and will burn only when mixed with air in certain proportions. If there is too little or too much vapour the mixture cannot burn. The limiting proportions, expressed as percentage by volume of petroleum gas in air, are known as the lower and upper flammable limits. They vary amongst the different possible components of chemical vapours. For the gas mixtures from the petroleum liquids encountered in normal tanker practice the overall range is from a minimum lower flammable limit of about 1% gas by volume

in air to a maximum upper flammable limit of about 10% gas by volume in air. For chemicals the LFL and UFL vary enormously and must be checked from its MSDS sheets prior loading.

The instructor should sketch and explain the flammability diagram for oil and chemicals separately showing the differences in LFL and UFL. It should also be explained that some chemicals may have oxygen inherently in its compound and may be flammable and needs to be loaded with padding.

#### 4.1.6 Sources of ignition, including electrostatic hazards (0.5 hour)

The instructor should explain with a fire triangle stating that one side which can be controlled to prevent or put off a fire may be the source of ignition. The following are major sources of ignition.

- direct heat from a flame light, hot work,
- smoking
- spontaneous combustion, for example from oily rags
- auto ignition temperature
- mechanical sparks from frictional sparks when chipping or scraping
- chemical energy from aluminium in contact with steel-aluminium anodes, etc.
- electrical energy from electrical sparks
- pyrophores
- electrostatic discharge
- polar solvents
- non-intrinsically safe equipment

Static electricity presents fire and explosion hazards during the handling of petroleum, and tanker operations. Certain operations can give rise to accumulations of electric charge which may be released suddenly in electrostatic discharges with sufficient energy to ignite flammable hydrocarbon gas/air mixtures; there is, of course, no risk of ignition unless a flammable mixture is present. There are three basic stages leading up to a potential static hazard: charge separation, charge accumulation and electrostatic discharge. All three of these stages are necessary for an electrostatic ignition.

The sources of static hazards are:

- filters
- fixed equipment in cargo tanks
- free fall in tanks
- water mists
- inert gas
- discharge of carbon dioxide
- clothing and footwear
- synthetic materials

The instructor may list the examples of static discharges associated with the handling of static accumulator oils such as from the use of high capacity washing machines, non-earthed metallic sampling cans, metallic ullage tapes, high initial loading flow rates, etc.

#### 4.1.7 Toxicity hazards (0.25 hour)

##### *General concepts and effects of toxicity*

The trainees should have a good appreciation of the dangers and hazards due to oil and chemicals.

Acute poisoning occurs when a large dose is received by exposure to high concentrations of a short duration, i.e. a single brief exposure. Chronic poisoning occurs through exposure to low concentrations over a long period of time, i.e. repeated or prolonged exposures. Toxicity is objectively evaluated on the basis of test dosages under controlled conditions, and expressed as threshold limit values (TLVs).

##### *Threshold Limit Value (TLV)*

Airborne concentrations of substances under which it is believed that nearly all workers may be exposed day after day with no adverse effect. TLVs are advisory exposure guidelines, not legal standards, and are based on industrial experience and studies.

There are three different types of TLVs:

*Time Weighted Average (TLV-TWA)* The airborne concentration of a toxic substance averaged over an 8 hour period, usually expressed in parts per million (ppm).

*Short Term Exposure Limit (TLV-STEL)* The airborne concentration of a toxic substance averaged over any 15 minute period, usually expressed in parts per million (ppm).

*Ceiling (TLV-C)* The concentration that should not be exceeded during any part of the working exposure.

*Occupational Exposure Limit (OEL)* Limits established to protect workers from workplace exposure to certain chemical substances or physical agents. OELs have many sources; among them are legal standards (i.e. set by OSHA or by OHSAS). Prevention of exposure is achieved through a combination of cargo containment, which prevents toxic fumes or liquid from contaminating the workplace, and the use of personal protective equipment (PPE).

To ensure safety on board one must adhere to the following points:

- knowledge,
- training and
- strict routine.

It is a clear responsibility for the owner, the master and the officers to inform their personnel about the cargoes to be carried, safety procedures, etc. and to arrange for the proper training.

Information should be given partly in the form of written notices combined with informal meetings with the entire crew present when new cargoes are to be loaded or when inexperienced personnel are to be signed on. Among other things the following information should be given:

- .1 Cargoes to be loaded; their characteristics as regards handling, pumping, toxicity, corrosiveness, first aid, etc.
- .2 The cargo loading plan to be posted in places where it will be clearly seen by everyone on board and at the accommodation ladder, when in port.
- .3 Post cargo information cards for products to be loaded or are contained on board. For new" products ask the shipper for safety brochures and leaflets.
- .4 Personal safety equipment to be used by those involved in cargo handling, pumping, sampling etc.
- .5 Have available on board literature on chemical cargoes, medical advice, etc.
- .6 Inform in particular if the cargo to be loaded has an odour threshold which is higher than the TLV-value and that danger cannot always be sensed in advance (e.g. carbon tetra chloride, ethylene dichloride, etc).
- .7 Most hydrocarbon vapours are heavier than air and have a tendency to accumulate in lower spaces. Therefore work below gratings in pump-rooms, cofferdams, pipe tunnels, etc. is extra dangerous.



- .8 Never take work clothes into your cabin! Soiled clothes must be washed before being used again or in the case of toxic products, destroyed.
- .9 Wash your hands before meals!
- .10 Give information about fire-fighting methods for each type of cargo on board.
- .11 Give information if the cargo is water-reactive or reactive to other cargoes on board. Give information on segregation required.
- .12 For some very toxic cargoes mouth to mouth artificial breathing might be dangerous to the rescuer (e.g. acrylonitrile, acetone, etc.).
- .13 Information must be given particularly if the cargo danger lies primarily in vapour inhalation (e.g. acrylonitrile, trichloroethylene) or skin contact (e.g. phenol, caustic soda, sulphuric acid).
- .14 State where eye washing bottles are located (deck office, at cargo manifolds on deck, in pump-rooms, on fore deck, etc.).
- .15 Insist that nobody should work with cargo gear without anyone standing by. Have people report when going to and returning from pump-rooms.
- .16 Give information if any cargo is so toxic that an escape breathing mask must be used in an emergency.

#### *Odour threshold*

#### **4.1.8** *Vapour leaks and clouds* (0.25 hour)

Explains the dangers arising from a vapour cloud drift as potential fire and health hazards.

These clouds would directly affect the surrounding areas. In the case of flammable substances the greatest danger arises from sudden massive escape of volatile liquids. If the cloud were ignited, the effects of combustion would depend on many factors, such as wind speed and the extent to which the cloud was diluted. The area affected would generally be limited to a few hundred metres from the location of release and would cover all gas dangerous and gas safe areas.

Much larger areas can be dangerously affected in a sudden release or by very large quantities of toxic leaks and clouds. In favourable conditions such a cloud can still contain lethal concentrations of toxic chemicals several kilometres from the accident site. The extent of casualty depends on the people in the path of the cloud and on the efficiency of emergency arrangements on board, for example, evacuation before the cloud reaches the accommodation.

It will be prudent on part of the instructor to specify here typically that the training should include an evacuation technique for directing the crew to upwind areas of the vessel in such cases when vessel is in port or manoeuvring the vessel to direct the clouds away from the accommodation when at sea.

#### **Topic 4.2** *Hazard controls* (3 hours)

##### **4.2.1** *Inerting, water padding, drying agents and monitoring techniques* (0.5 hour)

Reference is made in part C which is adequate.

##### **4.2.2** *Anti-static measures* (0.5 hour)

(More information will be available from references B2, B4, ISGOTT, ICS Chemical safety guide.)

The most important counter measure that must be taken to prevent an electrostatic hazard is to bond all metal objects together. Bonding eliminates the risk of discharges between metal objects, which can be very energetic and dangerous. To avoid discharges from conductors to earth, it is normal practice to include 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. Some examples of objects which might be electrically insulated in hazardous situations and which must therefore be bonded are:

- ship/shore hose couplings and flanges if more than one length of non-conducting hose or pipe is used in a string
- portable tank cleaning machines
- conducting manual ullaging and sampling equipment
- float of a permanently fitted ullage device if it lacks an earthing path through the metal tape

The most certain method of bonding and earthing is by means of a metallic connection between the conductors. This method should be used whenever possible, although for electrostatic purposes an adequate bond can in principle be made using a material of intermediate conductivity. Certain objects may be insulated during tanker operations, for example:

- a metal object such as a can floating in a static accumulating liquid
- a loose metal object while it is falling in a tank during washing operations

#### *Use of insulating flange hoses*

Lists examples of objects which might be electrically insulated in hazardous situations and which must therefore be bonded.

Every effort should be made to ensure that such objects are removed from the tank, since there is evidently no possibility of deliberately bonding them. This necessitates careful inspection of tanks, particularly after shipyard repairs.

#### **4.2.3** *Explains why ventilation systems are provided on oil and chemical tankers (0.25 hour)*

The ventilation exhaust ducts from gas dangerous spaces should discharge upwards in locations at least 10 m in the horizontal direction from ventilation intakes and openings to accommodation, service and control station spaces and other gas safe areas.

Ventilation intakes are so arranged as to minimize the possibility of recycling hazardous vapours from any ventilation discharge opening. The ventilation ducts are not to be led through engine-rooms, accommodation, working spaces or other similar spaces.

Ventilation fans should be approved by the Administration for operation in explosive atmospheres when flammable cargoes are carried aboard the ship.

The VOC Plan describes the specific arrangement, operations and conditions onboard a crude oil tanker with respect to the emission and ability to control VOC emissions. This VOC Plan is not a safety guide and reference should be made to other publications to evaluate safety hazards. The aim of the VOC Plan is to identify the arrangements and equipment required to enable compliance with MARPOL, regulation 15.6 of the revised Annex VI and to identify for the ship's officers all operational procedures for VOC emission control.

#### *Accommodation*

The accommodation is located outside the cargo area.

Superstructures for accommodation are designed to minimize the possibility of entry of cargo vapour and that this design feature should not be impaired in any way.

No entrances, air inlets or openings to the accommodation are facing the cargo area.

Accommodation portholes and windows facing the cargo area, and those within a certain distance from the cargo area, are of the non-opening type.

All doors, portholes or windows in accommodation should be kept closed during cargo operations.

Mechanical ventilation and air-conditioning units supply air to accommodation spaces.

All ventilation systems should be stopped or operated on internal circulation mode if there is any possibility of cargo vapour being drawn into accommodation spaces.

Air intakes for accommodation and for the engine-room are subject to requirements with respect to minimum distance from ventilation outlets of gas dangerous spaces.

Access to accommodation or to the engine-room is subject to requirements with respect to the minimum distance from the forward bulkhead of the accommodation.

For the safety barrier concept to be successful it is essential that the ship's staff follow the safe operational practices.

#### **4.2.3.5** *Purpose of tank venting systems and related equipment such as individual tank P/V Valves, common venting systems and hi-velocity vents*

Venting systems are required to meet the requirements of SOLAS. They are necessary for achieving safety on board a tanker and it is essential that they are operated to meet their design intent and that they are properly maintained.

To facilitate dilution of the hydrocarbon vapours into the atmosphere clear of the tanker's deck, venting systems allow vapours to be released either:

- at a low velocity, high above the deck from a vent riser; or,
- at high velocity from a high velocity valve closer to the deck.
- This facilitates dilution of the hydrocarbon vapours in the atmosphere clear of the tanker's deck.

Vents are sited in selected locations to prevent the accumulation of a flammable atmosphere on the tank deck or around any accommodation or engine-room housings. Ship's personnel should be fully conversant with the operation and maintenance of all components of the venting system and should be aware of its limitations in order to prevent over or under-pressurization of the tank(s) the system is serving.

Why P/V valve settings are not to be changed without approval of the officer in charge. Venting may inadvertently occur at lower than the desired pressures.

#### **4.2.4** *Cargo segregation (0.25 hour)*

Cargoes, residues of cargoes or mixtures containing cargoes, which react in a hazardous manner with other cargoes, residues or mixtures, shall 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; have separate pumping and piping systems which shall not pass through other cargo tanks containing such cargoes, unless encased in a tunnel; and have separate tank venting systems.

If cargo piping 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:

- removable spool-pieces
- blank flanges at both ends of the pipeline.

Certain petroleum cargoes may be contaminated by failing to ensure that they do not come in contact with other cargoes and how proper segregation techniques may prevent this contamination.

Particular caution must be exercised to ensure that cargoes are not contaminated by way of common venting systems and how such contamination is prevented.



#### 4.2.5 *Cargo inhibition* (0.25 hour)

For the requirements of cargo inhibition of some cargoes, polymerization is the process of forming a polymer by combining large numbers of chemical units or monomers into long chains. Polymerization can be used to make some useful materials. However, uncontrolled polymerization can be extremely hazardous. Some polymerization processes can release considerable heat, can generate enough pressure to burst a cargo tank or can be explosive.

Some chemicals can polymerize on their own without warning. Others can polymerize upon contact with water, air or other common chemicals. Inhibitors are normally added to products to reduce or eliminate the possibility of uncontrolled polymerization. Most MSDS have a section called “Hazardous Polymerization” which indicates whether hazardous polymerization reactions can occur; an inhibited cargo certificate should be provided to the ship before a cargo is carried. The action to be taken in case of a polymerization situation occurring while the cargo is on board should be covered by the ship’s emergency contingency plan.

#### 4.2.6 *Importance of cargo compatibility* (0.5 hour)

Leakages through bulkheads occur at times in any tanker. Normally, however, such leakages are only minor seepages. They will not cause any violent reaction due to the great disproportion in mixture from dangerous proportions. The cargo tanks are to be gauged daily to ensure that there are no inter tank leakages. In case the ullage in any tank is found to be increasing, the cause is to be investigated. If it is due to a leakage, the space into which the cargo is going must be identified. The space must be checked for compatibility of the tank material with the cargo. Any other cargo tank where this cargo may be transferred has to be identified. The leaking tank must be transferred to such a tank. It is necessary for the ship master before taking such a decision to consider all other options and in case it is not possible to transfer the cargo to compatible tanks, the cargo MSDS must be referred to and methods to reduce the potential of the cargo to cause damage to the vessel must be worked upon. The contaminated cargo must be transferred separately into another tank, if available. No cargo shall be pumped overboard except as mentioned in case to save life or ship and all options have been considered by the ship master; only then jettisoning cargo can be considered.

Particular caution must be exercised to ensure that incompatible cargoes are not mixed by way of common venting systems and how such mixing is prevented.

#### 4.2.7 *Atmospheric control* (0.5 hour)

The section is intended to provide the trainees with the best possible understanding of different safety aspects and of the necessity of safe working routines on board.

Oil tankers using an inert gas 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 or work, i.e. the oxygen content should be not more than 8% by volume and the atmosphere should be maintained at a positive pressure.

The atmosphere within the tank should make the transition from the inert condition to the 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 inert gas 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 must be inerted prior to loading.

In order to maintain cargo tanks in a non-flammable condition the inert gas plant will be required to:

- inert empty cargo tanks
- be in operation during cargo discharge, deballasting, crude oil washing and tank cleaning
- purge tanks prior to gas freeing
- top-up the pressure in the cargo tanks when necessary during other stages of the voyage. The instructor must emphasize that the protection provided by an inert gas system depends on the proper operation and maintenance of the entire system.

It is important that the instructor states that considerations are to be made even for accommodation spaces and precautions against fire, when dealing with tank atmospheric control if cargo venting is involved

#### **4.2.8 Gas testing (0.25 hour)**

Carbon monoxide in the inert gas can be a potential hazard as during gas freeing operation carbon monoxide may not be easily displaced from the tank.

#### **4.2.9 Understanding of information on Material Safety Data Sheet (MSDS) (1.0 hour of practical session)**

The instructor should explain to the trainees that MSDS is a document containing important information about a hazardous chemical (which may be a hazardous substance and/or dangerous good) and must state:

- a hazardous substance's product name
- the chemical and generic name of certain ingredients
- the chemical and physical properties of the hazardous substance
- health hazard information
- precautions for safe use and handling
- emergency actions

The MSDS provides us with the necessary information to assist in safely managing the risk from hazardous substance exposure.

It is important that everyone in the workplace knows how to read and interpret an MSDS.

The instructor shall provide examples of MSDS of various cargoes for the trainees to obtain the necessary information.

See appendix 1, illustrations 4.2.9(A) and 4.2.9(B).

### **Topic 5 Safety (6 hours)**

#### **5.1 Functions and proper uses of gas measuring instruments**

##### **Gas-measuring instruments (1 hour of practical demonstration)**

The instructor should demonstrate the functions and proper uses of gas measuring instruments. Although different models/make/type may have different methods of operation, the basic remains the same. For the purpose of training any type/model available in the training centre (Reference – A4, A5, A6, A7, A8, A9) may be used for this practical demonstration.

The instructor should encourage the trainees to actively participate and gain hands on experience in using relevant atmospheric test equipment for example:

- Portable oxygen meter
- Portable combustible-gas detector
- Portable tankscope/Multi point flammable gas (infra-red gas analyser)
- Portable toxic-gas detector & chemical absorption tubes
- Portable multigas – detector
- Personal multigas – detector

##### **5.2.1 Proper use of breathing apparatus and tank-evacuating equipment (0.5 hour and 0.5 hour practical demonstration)**

Experience has shown that the rescue of persons from within an enclosed space can be extremely hazardous and especially so in cases of oxygen deficiency. These risks are heightened where access to a compartment can only be achieved with difficulty.

In such circumstances, it is vital that rescuers always pay strict attention to the correct procedures and the use of proper equipment and do not rush into ill-considered action. Many fatalities have resulted from failure to comply with these basic rules. For training purposes, full-scale exercises in non-hazardous atmospheres have been found extremely beneficial. Exercises involving weighted dummies, with rescuers wearing protective equipment and breathing apparatus, are essential if rescue teams are to be properly prepared for a real emergency. Such simulations are often conducted by ship's personnel. They can also involve terminal employees and shore based emergency services such as the fire brigade. A9 can be used to conduct a simulated training; include the use of SCBA (Reference A3).

#### **5.2.2 Protective clothing and equipment (0.5 hour)**

The instructors should note that it is recommended that the trainees should be drilled in the use of:

- self-contained compressed-air breathing apparatus
- Emergency Escape Breathing Device (EEBD)
- a complete set of safety equipment
- tank-evacuating equipment

Trainees should be made familiar in the use of protective clothing and equipment. All recommended PPE must be shown for demonstration purpose. (Video/CBT can be used to complement the demonstration of the physical equipment.)

#### **5.2.3 Resuscitators (0.5 hour)**

The instructor should encourage the trainees to actively participate and gain hands on experience in using resuscitation equipment (A2).

#### **5.2.4 Rescue and escape equipment (0.5 hour)**

Pump-rooms have permanent arrangements for hoisting an injured person with a rescue line. Timely evacuation and resuscitation may save lives.

### **5.3 Safe working practices and procedures in accordance with legislation and industry guidelines relevant to oil and chemical tankers**

The instructor should make use of appropriate checklist and conduct exercises using the code of safe working practices for merchant seamen; emphasize that no person is permitted to enter any enclosed space as defined (cargo tank, cofferdam, double bottom tank, etc.) unless authorized by the master, who has ensured that the required checks have been carried out before passing these compartments as safe for entry. An enclosed space entry permit must be completed in every case.

Entry permits may be made for multi cargo tank entries; however, tanks which are not entered and worked within four hours of the initial test, must be retested and a new permit issued. It is therefore advisable to only test smaller groups of tanks at one time, e.g. only test as many as can be worked in a four-hour period. However, at no given time shall a permit be granted for entry into more than six tanks.

#### **5.3.1 Precautions to be taken when entering enclosed spaces (1.0 hour)**

For entry purposes, steady readings of all the following should be obtained:

- 21% oxygen by volume by oxygen content meter;
- not more than 1% of lower flammable limit (LFL) on a suitably sensitive combustible gas indicator, where the preliminary assessment has determined that there is potential for flammable gases or vapours; and
- not more than 50% of the occupational exposure limit (OEL) of any toxic vapours and gases.

Entry into a space that is not gas free or does not contain 21% oxygen shall only be permitted in cases of an emergency or for unavoidable operational requirements with proper protective equipment. The number of persons entering the tanks shall be kept to a minimum required, but will normally be at least two, each wearing the appropriate PPE.



A stand by team and additional appropriate PPE equipped with the required rescue equipment shall be available outside the enclosed space in which entry has been made.

If entry is absolutely required without the tanks being gas free, or with the presence of gas in a tank for operational requirement, the following shall be completed prior to undertaking such an operation:

- risk assessment and hazard identification
- plan for work including briefing the concerned personnel on the required precautions, proper techniques, PPE requirement & training
- emergency response plan shall be prepared in advance and approved by the master
- suitable breathing apparatus, protective clothing and other equipment required for such entry shall be used by the persons entering the tank

(Only persons suitably trained and capable of dealing with any unexpected event that may be encountered in the tank shall be sent for such an entry after making the supporting team stand by on the scene to assist the personnel in an unlikely event of an incident.)

### **5.3.2** *Precautions to be taken before and during repair and maintenance work in a gas dangerous area (0.5 hour)*

The use of appropriate PPE is mandatory to protect the crew against the various hazards.

Monitoring and evaluation of spaces adjacent to cargo tanks for vapour content must be carried out at regular intervals.

In case of a doubt on the integrity of cargo tank, the adjacent spaces also to be monitored and logged for toxic gases/cargo vapours.

If dangerous gas concentrations are observed, repairs and maintenance work must be stopped when working in the concerned area. Additionally, the cause of the presence of gas concentration must be investigated into and the same eliminated. Other adjoining spaces must be checked for similar defects.

### **5.3.3** *Safety measures for hot and cold work (1.0 hour)*

The instructor should explain to the trainees that the checks carried out for hot and cold work by officer responsible for safety are:

- oxygen is 21% by volume
- tests with a combustible gas indicator show not more than 1% LFL. Adequate fire-fighting equipment must be laid out and be ready for immediate use
- fire-watch procedures must be established for the area of hot work, and in adjacent, non-inerted spaces where the transfer of heat, or accidental damage, may create a hazard e.g. damage to hydraulic lines, electrical cables, thermal oil lines, etc. Monitoring should be continued for sufficient time after completion of hot work
- effective means of containing and extinguishing welding sparks and molten slag must be established
- work area must be adequately and continuously ventilated. The frequency of atmosphere monitoring must be established. Atmospheres should be re-tested after each break during work periods, and at regular intervals. Checks should be made to ensure there is no ingress of flammable vapours or liquids, toxic gases or inert gas from adjacent or connected spaces
- prior carrying out any hot work or cold work, safety checks must be carried out and a permit issued by the senior officer
- if hot work or cold work is to be carried out in an enclosed space or a cargo tank, additional enclosed space entry precautions must be carried out
- instructor should refer to section 9.4 on Hot Work from ISGOTT

#### **5.3.4** *Electrical safety precautions* (0.5 hour)

The instructor should make the trainees aware that the safety precautions that need to be ensured are:

- electrical supply connections are made in a gas free space
- existing supply wiring is adequate to carry the electrical current demanded without overloading, causing heating
- insulation of flexible electric cables laid across the deck is in good condition
- cable route to the worksite is the safest possible, only passing over gas free or inerted spaces
- earthing connection is adjacent to the work site with the earth return cable led directly back to the welding machine

Common safety precautions to be taken in hazardous zones on tankers:

- equipment which is not intrinsically safe should not be used; for example: mobile phones, cameras, torches, lighters, etc.

#### *Intrinsically safe*

An electrical circuit, or part of a circuit, is intrinsically safe if any spark or thermal effect produced normally (i.e. by breaking or closing the circuit) or accidentally (e.g. by short circuit or earth fault) is incapable, under prescribed test conditions, of igniting a prescribed gas mixture.

#### **5.3.5** *Ship/shore safety checklist*

#### **5.4** *First aid with reference to a Material Safety Data Sheet (MSDS)* (2 hours)

The IMO Codes require the MSDS (Material Safety Data sheets) for the oil and NLS cargoes should be on board and the information should be available to every ship and for each cargo.

All those concerned should use the data sheet and any other relevant information to acquaint themselves with the characteristics of each cargo to be loaded. If the cargo to be loaded is a mixture, information on the composition of the mixture should be sought. First aid for inhalation, absorption and ingestion are available on each MSDS, special notes should be made for any contaminants that may be present in the cargo, e.g. water. MFAG (Medical First Aid guide) is also to be consulted for Chemical Cargoes. MSDS sheets must be placed at various spaces frequented by the ship's staff so as to enable them to familiarize themselves with the cargo. Training and drills especially fire-fighting carried out, additionally prepare the fire response organization to become familiar with their duties and equipment and to respond to emergencies in a timely and correct manner.

#### **Topic 6** *Fire safety and fire-fighting operations* (4.5 hours)

If fire-fighting practical demonstrations are done separately in another approved fire-fighting course, then documentation must be provided to secure a course completion certificate for Basic Training for Oil and Chemical tanker cargo operations.

#### **Specialized fire-extinguishing appliances**

As all trainees would have attended a fire-fighting course prior gaining eligibility for this course, the instructors would only need to stress on specialized fire-fighting appliances and the need to conduct frequent drills applicable to tankers. Annex 5 can be used as reference.

#### **6.1** *Oil and chemical tanker fire response organization and action to be taken* (1.5 hours)

On any vessel, especially oil and chemical tankers, emergencies may have catastrophic consequences, unless proper action is taken. Actions therefore, must be prompt, timely and adequate. Any fire drills carried out with shore establishments shall be taken positively and the master must take full advantage of this situation to learn from the exercise, a de-briefing of the crew must be carried out and lessons learnt from such drills pointed out.

Use of maxim "Find, Inform, Restrict and Extinguish" techniques in attending to a fire emergency.

## 6.2 *Fire hazards associated with cargo handling and transportation of hazardous and noxious liquids in bulk* (1.5 hours)

The fire hazards associated with Noxious Liquid substances (NLS) are:

- some cargoes give out oxygen when on fire, thereby supporting the fire
- some chemical fires, the source of ignition may be heat from a reaction within the cargo itself or through mixing with other chemicals
- chemicals miscible in fire will render normal foam useless. For such chemicals alcohol resistant or dual-purpose foam shall be used
- some chemicals are miscible in water and hence their presence may not be recognized.
- some chemicals are heavier than water and insoluble in water. These may be smothered using water
- some chemicals evolve large volumes of toxic vapours when heated
- some chemicals have a low auto-ignition temperature. There is a risk of re-ignition of these chemicals

## 6.3 *Fire-fighting agents used to extinguish oil and chemical fires* (0.5 hour)

Commonly used fire-fighting agents are:

- water is the most common cooling agent. This is largely because water possesses very good heat absorbing qualities and is available in ample quantities at terminals and on ships. However, it is not suited for direct extinguishing of an oil/chemical fire
- foam is an aggregation of small bubbles, of lower specific gravity than oil or water, which flows across the surface of a burning liquid and forms a coherent smothering blanket. It will also reduce the surface temperature of the liquid by the absorption of some heat
- carbon dioxide is an excellent smothering agent for extinguishing fires, when used in conditions where it will not be widely diffused. Carbon dioxide is therefore effective in enclosed areas such as machinery spaces, pump-rooms and electrical switch rooms where it can penetrate into places that cannot be reached by other means
- dry chemical powder is discharged from an extinguisher or from a fixed installation as a free flowing cloud. It is most effective in dealing with a fire resulting from an oil spill on a jetty or on the deck of a chemical tanker and can also be used in confined spaces. It is especially useful on burning liquids escaping from leaking pipelines and joints
- alcohol-resistant foam extinguishing agents possess low-expansion properties and are adaptable to various low expansion foam generators. Alcohol-resistant foam extinguishing agents may be used in chemical tankers where water-soluble flammable liquids such as alcohol, ester, ether, aldehyde, ketone, and organic acids

## 6.4 *Fixed fire-fighting foam system operations* (0.5 hour) (2.0 hours at fire mock-up can be done separately in a fire-fighting course)

### 6.4.1 *Describes foam mains*

The lines where foam mains for foam solution or concentrate are provided should have a number of accessible take off (hydrant) points, which should be spaced not more than two or three standard hose lengths apart.



The takeoff (hydrant) points generally consist of a header fitted with two outlets individually valved and fitted with a fire hose connection suitable for the particular type of fire hose coupling in use locally. Isolating valves should be fitted so as to maintain the integrity of the line in the event of fracture. Suitable pipeline drain valves and wash out facilities should be provided. A foam solution pipeline of this type should cater for a design minimum of 115 cubic metres/hour of solution. Foam concentrate can be distributed through a smaller bore pipe system to the tanks supplying the inductors of fixed or mobile foam making appliances. Fixed pipelines for generated (aerated) foam are of limited value owing to pressure losses in the system and lack of projection.

#### **6.4.2** *Foam monitors*

The cargo deck foam monitors are critical components of the deck foam system since they provide the crew with the ability to engage the fire by placing large quantities of foam where needed from a relatively safe location. Details of the monitor(s) as well as the proposed locations are summarized below:

Each monitor must have the capacity to deliver not less than 50% of the foam required. In addition, each monitor is to have a capacity of at least 3.0 L/min/m<sup>2</sup> (0.074 gpm/ft<sup>2</sup>) of the area protected by that monitor, but in no case less than 1,250 L/min (330 gpm). The capacity of the monitors should be verified by reviewing the monitor capacity curves produced by the manufacturer at the pressure indicated in the foam piping system pressure drop calculations.

The number and position of the monitors is to be adequate to provide coverage to the entire cargo tank deck area, as well as into any cargo tank that is open due to a rupture in the deck. The coverage area of any particular monitor is to be based upon the following:

- .1 Only the area forward of the monitor is to be considered to be protected by that particular monitor.
- .2 The distance to the farthest point of the coverage of a monitor is not to be more than 75% of the monitor through in still air.
- .3 Monitors are to be provided both on the port as well as starboard sides of the vessel at the front of the accommodation space. Compliance regarding the locations and capacities of the monitors with the above requirements should be verified by reviewing a deck foam system arrangement drawing in conjunction with the monitor capacity and throw data provided by the monitor manufacturer along with system pressure flow drop calculations determining the pressure at the inlet of the monitor.
- .4 Large capacity monitors would normally be on a fixed mounting. Minimum requirements for monitor operations are a jet length of 30 metres and a jet height of 15 metres in still air.

#### **6.4.3** *Fixed foam fire-fighting system*

##### **6.4.3.1** *The layout of fixed foam installation*

All foam systems consist of a water supply, foam liquid storage, a proportioning device and a distribution system. The water supply pump(s) provide(s) a certain capacity of seawater to the deck foam system, and is/are supplied by the ship's fire pumps. The foam liquid is stored in a tank. The tank must be complete with vent, contents gauge, and access manhole. The foam is delivered via a high pressure foam liquid pump to the automatic foam liquid proportionator, which will accurately proportionate foam liquid at 3% to 6% to the seawater flow, irrespective of flow rate or pressure. For satisfactory operation of the proportionator, foam liquid must be supplied with a minimum pressure of at least 10 metres head higher than the inlet water pressure under all load conditions. The electrically driven foam liquid pump is provided for this purpose. Foam solution is supplied to the deck monitors and hand lines by the deck main fitted with isolating valves. Each monitor is isolated from the main supply pipe by means of butterfly valves, which are normally closed. Four portable foam-making branch pipes are provided. Each branch pipe has a solution rate of 400 l/min.

### 6.4.3.2 Describes the operational principle of extinguishing oil/chemical fire

#### *Extinguishing effects of foam*

Fire-fighting foam is used to form a blanket on the surface of flaming liquids. The blanket prevents flammable vapours from leaving the surface and prevents oxygen from reaching the fuel. A fire cannot exist when the fuel and oxygen are separated, and therefore, a properly placed foam blanket will smother the fire. In addition, the water in the foam also has a cooling effect, which gives foam the ability to cool surrounding structure to help prevent flash back. The ideal foam should flow freely enough to cover a surface rapidly, yet have adequate cohesive properties to stick together sufficiently to establish and maintain a vapour tight blanket. In addition, the solution must retain enough water to provide a long-lasting seal. Rapid loss of water would cause the foam to dry out and break down (wither) from the high temperatures associated with fire. The foam should also be light enough to float on flammable liquids, yet heavy enough to resist winds.

### 6.4.3.3 States the different types of foam

The types of different foam would be enough for the familiarization level. Added information is only for instructor's guidance if interaction should arise in the class.

#### *Chemical foam*

Chemical foam is formed by mixing together a solution of an alkali (usually sodium bicarbonate), an acid (usually aluminium sulfate), water and a stabilizer. The stabilizer is added to make the foam tenacious and long-lived. When these chemicals react, they form a foam or froth of bubbles filled with carbon dioxide gas. The carbon dioxide in the bubbles has little or no extinguishing value. Its only purpose is to inflate the bubbles. From 7 to 16 volumes of foam are produced for each volume of water. Premixed foam powders may also be stored in cans and introduced into the water during fire-fighting operations. For this, a device called a foam hopper is used. Or, the two chemicals may be premixed with water to form an aluminium sulfate solution and a sodium bicarbonate solution.

#### *Mechanical (air) foam*

Mechanical foam is produced by mixing a foam concentrate with water to produce a foam solution. The bubbles are formed by the turbulent mixing of air and the foam solution. As the name air foam implies, the bubbles are filled with air. Aside from the workmanship and efficiency of the equipment, the degree of mixing determines the quality of the foam. The design of the equipment determines the quantity of foam produced. There are several types of mechanical foam, similar in nature, but each has its own special fire-fighting capabilities.

#### *Film Forming Fluoroprotein Foam (FFFP)*

FFFPs are a combination of fluorochemical surfactants with protein foam. They are designed to combine the burn back resistance of a fluoroprotein foam with an increased knockdown power. These foams also release a film on the surface of the hydrocarbon.

#### *Aqueous Film Forming Foam (AFFF)*

AFFFs are a combination of fluorochemical surfactants and synthetic foaming agents that create a unique characteristic – an aqueous film. This film is a thin layer of foam solution with unique surface energy characteristics that spreads rapidly across the surface of a hydrocarbon fuel causing dramatic fire knockdown.

#### *Alcohol Resistant-Aqueous Film Forming Foam (AR-AFFF)*

Alcohol-resistant foam extinguishing agents may be used in chemical tankers where water-soluble flammable liquids, for example, alcohol, ester, ether, aldehyde, ketone and organic acids are carried as cargo.

#### *Synthetic foam*

Synthetic detergent-base foam is made up of alkyl sulfonates. This form has less burn back resistance than protein formulas, but may be used with all dry chemicals. It foams more readily than the proteins and requires less water. This is important where the water supply is limited. (Section 6 – Foam Fire Extinguishing Systems.)

#### *Low expansion foams*

Low expansion foams are considered to be those foams with an expansion ratio of 12:1 when mixed with air. That is one volume of foam concentrate will create 12 volumes of foam. Low expansion foams are effective

in controlling and extinguishing most flammable liquid (Class “B”) fires. Foams typically used on tanker deck foam systems are of the low expansion foam type.

#### *Mid low expansion foams*

Mid expansion foams refer to those foams with an expansion ratio of between about 20:1 to 100:1. Few applications of mid expansion foams are found in shipboard applications.

#### *High-expansion foams*

High-expansion foams are those that expand in ratios of over 100:1. Most systems produce expansion ratios of from 400:1 to 1000:1. Unlike conventional foam, which provides a blanket a few inches over the burning surface, high-expansion foam is truly three dimensional; it is measured in length, width, height, and cubic feet. High-expansion foam is designed for fires in confined spaces. Heavier than air but lighter than oil or water, it will flow down openings and fill compartments, spaces and crevices, replacing air in these spaces. In this manner, it deprives the fire of oxygen. Because of its water content, it absorbs heat from the fire and cools the burning material. When the high-expansion foam has absorbed sufficient heat to turn its water content to steam at 100°C (212°F), it has absorbed as much heat as possible, and then the steam continues to replace oxygen and thus combat the fire.

#### *Foam system equipment*

As mentioned above, finished foam is a combination of foam concentrate, water and air. When these components are brought together in proper proportions and thoroughly mixed, foam is produced. The following is a discussion of the typical types of equipment used in the production of foam.

#### *Foam nozzles*

For the most effective and economical use, the foam solution must be properly expanded. Standard fog nozzles generally do not provide optimum expansion, and therefore do not provide for the best, most cost effective application of the foam supply. In the case of Polar Solvent fuels, these standard fog nozzles may not deliver a foam quality that is able to extinguish the fire.

Foam nozzles are specifically designed to air aspirate (expand) the foam solution and form finished foam. There are three main types of foam nozzles.

- a) Low Expansion. Low expansion nozzles expand foam solution up to 12:1, i.e. for every 3.8 litres (1 gallon) of foam solution that enters the base of the nozzle, approximately 45.6 litres (12 gallons) of finished foam is produced. These nozzles draw air at the base of the nozzle, the air and the solution mix travel up the foam tube (this is called residence time) and the properly expanded foam exits the nozzle.
- b) Medium Expansion. Medium expansion nozzles can have expansion characteristics as high as 100:1, although expansions of 50:1 are more common. They operate in much the same way as low expansion nozzles. However, the diameter of the nozzle is much larger.
- c) High Expansion. High expansion foam nozzles can expand foam in excess of 100:1, when high expansion foam concentrates are used.

#### **6.4.3.6** *Demonstrates the proper fire-fighting procedure using fixed foam system*

- dons fire suit and personal protective equipment and brings appropriate equipment
- activates the release of the foam in the fixed foam system following the correct sequence
- approaches the fire with a charged hose
- extinguishes the fire by applying the proper fire-fighting technique.

**The following techniques to be used when using foam to extinguish a liquid fire.**

#### *Bounce-off technique*

When foam nozzles are used, particular care should be taken to apply the foam as gently as possible. For straight stream use, the foam should be bounced or banked off of a wall or other obstruction when available.



*Bank-in technique*

Foam can also be rolled onto the fuel surface by hitting the ground in front of the spill, and allowing the foam to “pile up” in front of the spill. The velocity of the stream will roll the foam onto the fuel.

*Rain-down technique*

The foam nozzle is directed almost straight up and the foam stream is allowed to reach its maximum height and break into small droplets. The nozzle operator must adjust the altitude of the nozzle so the fallout pattern matches that of the spill area. This technique can provide a very fast and effective knockdown. However, if the fuel has had a significant preburn and a thermal column has developed, or if the weather is severe (high winds), the raindown method may not be practical or effective.

*Never plunge*

Plunging the stream directly into the fire can splash the fuel causing the fire to spread. If a foam blanket exists, plunging can break the existing blanket allowing vapours to escape. This usually results in spreading the fire, re-ignition or flare ups. Usually, the fire will lessen in intensity or self-extinguish once the plunging stream is removed.

**6.5 Portable fire-fighting foam operations** (0.25 hour)**6.5.1** *Applicator foam*

Medium expansion foam is used for applicator foam. It has an expansion ratio from about 15:1 up to 150:1. It is made from the same concentrates as high expansion foam, but its aeration does not require a fan. Portable applicators can be used to deliver considerable quantities of foam on to spill fires, but their throw is limited and the foam is liable to be dispersed in moderate winds.

Foam applicators are a supplement to the foam monitors. Sheltered areas not reachable by the foam monitors can be covered by a foam applicator. This gives increased flexibility. Different applicators are available, covering varying needs for proportioning ratio. Typically, an applicator needs to be supplied with a fire hose and a foam concentrate container and is stored in a foam station.

**6.5.2** *Describes applicator foam systems*

Medium expansion foam is used for applicator foam. It has an expansion ratio from about 15:1 up to 150:1. It is made from the same concentrates as high expansion foam, but its aeration does not require a fan. Portable applicators can be used to deliver considerable quantities of foam on to spill fires, but their throw is limited and the foam is liable to be dispersed in moderate winds. Foam applicators are a supplement to the foam monitors. Sheltered areas not reachable by the foam monitors can be covered by a foam applicator. This gives increased flexibility. Different applicators are available, covering varying needs for proportioning ratio. Typically, an applicator needs to be supplied with a fire hose and a foam concentrate container and is stored in a foam station.

**6.5.3** *Describes portable foam fire extinguishers*

A **fire extinguisher**, **flame extinguisher**, or simply an **extinguisher**, is an active fire protection device used to extinguish or control small fires, often in emergency situations. It is not intended for use on an out-of-control fire. Applied to fuel fires as either an aspirated (mixed & expanded with air in a branch pipe) or non-aspirated form to form a frothy blanket or seal over the fuel, preventing oxygen reaching it. Unlike DCP, foam can be used to progressively extinguish fires without flashback.

- AFFF (aqueous film forming foam), used on A and B class fires and for vapour suppression. The most common type in portable foam extinguishers. It contains fluorotensides
- AR-AFFF (alcohol-resistant aqueous film forming foams), used on fuel fires containing alcohol. Forms a membrane between the fuel and the foam preventing the alcohol from breaking down the foam blanket
- FFFP (film forming fluoroprotein) contains naturally occurring proteins from animal by-products and synthetic film-forming agents to create a foam blanket that is more heat resistant than the strictly synthetic AFFF foams. FFFP works well on alcohol-based liquids and is used widely in motorsports.

## **6.6 Fixed dry chemical system operations**

### **6.6.1 Describes fixed dry chemical system operations (0.5 hour)**

Dry chemical powder is discharged from an extinguisher or a fixed installation as a free flowing cloud. It is most effective in dealing initially with a fire resulting from an oil or chemical spill on a jetty or on the deck of a tanker but can also be used in confined spaces. It is especially useful on burning liquids escaping from leaking pipelines and joints. It is a non-conductor and therefore suitable for dealing with electrical fires. It must be directed into the flames. Dry chemical powder has a negligible cooling effect and affords no protection against re-ignition, arising, for example, from the presence of hot metal surfaces.

Certain types of dry chemical powder can cause a breakdown of a foam blanket and only those labeled 'foam compatible' should be used in conjunction with foam. Dry chemical powder clogs and becomes useless if it is allowed to become damp when stored or when extinguishers are being filled.

Instructors should have background knowledge on the SOLAS regulations governing fixed dry chemical powder installations.

#### *Piping arrangements for DCP fire-fighting systems of a chemical tanker*

A fire-extinguishing unit with two or more monitors, hand hose lines or a combination thereof should have independent pipes (with a manifold at the powder container), unless a suitable alternative means is provided to ensure proper performance. Where two or more pipes are attached to a unit, the arrangement should be such that any or all of the monitors and hand hose lines capable of simultaneous or sequential operation at their rated capacities. Where fixed piping is provided between the powder container and a hand hose line or monitor, the length of piping should not exceed that length which is capable of maintaining the powder in a fluidized state during sustained or intermittent use, and which can be purged of powder when the system is shut down.

### **6.6.2 Explains the layout of fixed DCP installation**

The following information is provided as general guidance and instruction regarding requirements for fixed dry chemical fire extinguishing systems. However, reference should always be made to the rules applicable to the specific vessel concerned for the complete set of requirements.

The components and essential elements of the system have been enumerated in annex 5.

#### *Dry Powder Units*

Vessels with a cargo capacity of 1,000 m<sup>3</sup> (35,315 ft<sup>3</sup>) or more require a dry chemical fire extinguishing system. This system must consist of at least two (2) independents and self-contained, dry chemical powder units, which include the associated controls, pressurizing medium fixed piping, monitors and/or hand hose lines. For vessels with a cargo capacity of less than 1,000 m<sup>3</sup> (35,315 ft<sup>3</sup>), only one (1) unit is necessary. This system must be activated by an inert gas such as nitrogen, used exclusively for this purpose and stored in pressure vessels adjacent to the powder containers.

#### *Pressure Vessels*

All pressure vessels associated with the powder units would be required to comply with pressure vessel regulations.

#### *Controls*

If monitors are installed, they must be capable of actuation and discharge both locally and remotely. The monitor does not have to be aimed remotely, provided it can deliver the necessary powder (from a single position) to all necessary areas of coverage.

The dry powder is non-toxic and stable at both low and high temperatures. However, it should be kept tightly closed and stored in a dry location in order to prevent absorption of moisture.

### **6.6.3 Describes the operational principle of extinguishing oil/chemical fire**

- using DCP as an extinguishing medium
- advantages of DCP as an extinguishing medium

Dry chemical agents extinguish fire to the greatest extent by breaking the combustion chain. Minor amounts of cooling, smothering and shielding of radiant heat are also present.

#### *Chain breaking*

Chain reactions are necessary for continued combustion. In these chain reactions, fuel and oxygen molecules are broken down by heat, and they recombine into new molecules, giving off additional heat. This additional heat breaks down more molecules, which then recombine and give off still more heat. The fire this builds, or at least sustains itself, through reactions that liberate enough heat to set off other reactions.

Dry chemicals (and other agents such as the halone) attack this chain of reactions. It does so by reducing the ability of the molecular fragments to recombine and form additional radicals. It also combines with the fragments of fuel and oxygen molecules so that the fuel cannot be oxidized. Chain breaking is the most effective extinguishing action of dry chemical.

#### *Cooling*

No dry chemical exhibits any great capacity for cooling. However, a small amount of cooling takes place simply because the dry chemical is at a lower temperature than the burning material. Heat is transferred.

#### *Smothering*

When dry chemical reacts with the heat and burning material, some carbon dioxide and water vapour are produced. These dilute the fuel vapours and the air surrounding the fires. The result is limited.

#### *Shielding of radiant heat*

Dry chemical produces an opaque cloud in the combustion area. This cloud reduces the amount of heat that is radiated back to the heart of the fire, i.e. the opaque cloud absorbs some of the radiation feedback that is required to sustain the fire. Less fuel vapour is produced, and the fire becomes less intense.

### **6.6.4 States the initial action on discovering the fire**

- isolates the source of leak
- activates the alarm
- informs the control station of the incident

Takes appropriate (immediate) measures that permit the containment of the fire as an initial action.

A fire on a ship is one of the most dangerous incidents which can happen on board. If the fire is detected in good time, the crew can prevent larger damage by taking immediate measures – such as fighting the fire by use of a fire hose/monitor using proper protective clothing.

The immediate action should be to:

- raise alarm that draws the attention of the crew at the earliest using one or all of the following methods
  - voice (shouting alarm condition of 'Fire' on immediately sighting the fire)
  - call bell or manual call point (engages the device for actuating vessel's fire alarm or general alarm)
  - telephone or other internal communication devices to contact the control centre
- isolate the source of leak, stop loading/discharging, shut all manifold valves, activate the ESD
- ventilation should be cut-off at the first instance possible in areas where applicable. This could be by means of shut-down activation devices or controlled flap (mechanical)
- power isolation is considered for immediate action in such instances
- use the proper fire-fighting procedures stated herein below



**6.6.5** *Demonstrates the proper fire-fighting procedure using fixed DCP system*

- approaches the fire with proper equipment and fire suit and personal protective equipment
- activates the release of the DCP in the fixed DCP system following the correct sequence of operation of valves and levers
- approaches the fire with a charged hose
- extinguishes the fire by applying the proper fire-fighting technique such as sweeping action to the base or seat of the fire

Demonstrates the donning and doffing of PPE (personal protective equipment), such as helmet with shield, hood, boots, protective coat and trousers, self-contained breathing apparatus (SCBA), and personal alert safety system (PASS).

A full PPE for fire-fighting consists of the following items:

- helmet – to protect the head from impact, scalding water, and products of combustion
- heat resistant protective hood - to protect face, ears, and neck from heat and flame
- Heat Resistant Protective coat and pants – to protect the firefighter against cut, abrasions, and burns. Also provides protection from the heat or cold, and from some corrosive liquids
- gloves – to protect the hands from cut, abrasions, and burns
- boots/footwear – to protect feet from burn injuries and puncture wounds
- eye protection – to protect eyes from hazards encountered during fire-fighting operations
- self-contained breathing apparatus (SCBA) – to protect from airborne contaminants, and heat, smoke and other toxic products of combustion. It also provides some eye protection by means of the SCBA mask.

The procedure for fighting these fires is:

- attack fire with a maximum rate of application of dry powder. Use monitor in a sweeping motion over the entire area of the fire, but direct pressure of powder jets on to the surface of the liquid should be avoided. Do not agitate the surface of any pool of liquefied gas
- a first-aid shot with only one hose or monitor may be warranted with small fires, but continuous individual efforts can never be as successful as a simultaneous attack with as many applicators as possible being brought to bear
- operators must be adequately protected and positioned to obtain downwind line-of-sight application, with the powder jet slightly depressed below the horizontal. Powder jets should be swept rapidly back and forth over the entire fire area. The direct impact of powder jets on pool surfaces or leaks should be avoided. Where possible, powder should be aimed at vertical surfaces immediately behind the seat of the fire. Fire fighters should be aware that heat propagation is as per the square root of the distance from the source of heat
- the initial recoil and subsequent force exerted by discharge means that in order to avoid the wastage of dry powder, a second person may be needed to help the operator maintain control of the gun
- remain on guard against possible re-ignition. Dry chemicals attack the flame by the absorption of free radicals in the combustion process. The trainees should also be made aware that there is no cooling effect from the use of dry powder, and that re-ignition after a fire has been extinguished is a distinct possibility

## 6.7 *Spill containment in relation to fire-fighting operations* (0.25 hour)

The actions to be taken in case of an oil/chemical spillage and pool fire are:

- prompt implementation of the ESD will do much to limit the amount of liquid spilled and because of the fish plate, restrict the overflow of cargo overboard
- restrict sources of ignition to ignite the vapour
- foam gently spread over the pool fire will smother and restrict it from spreading
- jets of water should never be directed onto burning liquid, as this will cause a violent increase in flame and shall spread the fire
- when contained in drip trays, the liquid may also be spilled onto the deck and water-jet should therefore be avoided
- wear full protective clothing and take advantage of water spray protection

## Topic 7 *Cargo Operations* (7.5 hours)

*General awareness of safe cargo operational procedures on tankers*

The lecturers should have in mind that a trainee is to be capable of assisting during cargo operations on board, and may be part of the watchkeeping team in port. The aim is therefore to make the trainees familiar with operational sequences. The duties and responsibilities of personnel on watch during operations should also be focused upon in this connection.

*For oil tankers*

This section covers an introduction to the operation of oil tankers and is divided to address the following topics:

Inerting, loading, loaded voyage, unloading, ballast voyage, tank cleaning, crude oil washing, use of inert gas, purging and gas freeing, tank cleaning and gas freeing for repairs.

*For chemical tankers*

This section covers an introduction to the operation of chemical tankers and is divided to address six topics:

Cargo information, cargo planning, loading, unloading, tank cleaning and gas freeing, slops and slops disposal.

The purpose of the lessons under this section is to give the trainees a general explanation of the different sequences in cargo, ballast and slop handling operations and to show how these are linked together.

The cargo handling, tank cleaning, and slop handling operations can be explained to the trainees by using schematic drawings as found in figures Appendix 12 Figure 7.1A and also use Simulator photographs appended therein.

(For this section the training may preferably be carried out on an oil and chemical simulator.)

### 7.1 *Oil and chemical tankers*

#### 7.2 *For oil tankers*

##### 7.2.1 *Cargo information* (0.5 hour)

Such information may be found in MSDS for Oil cargoes supplied by shippers and cargo data sheets published by ICS for Chemical cargoes. These sheets include all necessary data for the safe handling and carriage of the cargo.

##### 7.2.2 *Inerting* (1.0 hour)

### 7.2.3 Loading (1.5 hours)

- commence loading at reduced rate (to avoid static generation), watching the manifold back pressure at all times
- ullage confirmation shall be carried out to confirm cargo oil flowing as planned into the designated cargo tank
- only after receiving reports of all safety checks confirmed from all stations of deck / pump-room watch and the chief officer may instruct the opening of other loading tanks and carefully increase the loading rate. Close watch of the manifold back pressure shall be maintained, until completion of settling down of final maximum agreed loading rate
- close communication to be kept with shore side, until all parameters have stabilized
- loading cargo tanks, IG back pressure shall be adjusted to maintain minimum positive, at all times. The same shall be monitored, for any change.

#### 7.2.3.9 Cargo sampling requirements and procedures

In any bulk liquid shipment, whether chemical, petrochemical, petroleum product or crude oil, comprehensive and reliable control procedures are required to identify, and minimize the effect of, potential contamination of the cargo. The procedure of cargo sampling and sample retention provides the most effective means of determining when and/or how such contamination might have occurred and allows unfounded allegations of shipboard liability to be challenged. In practice, this is the most potent device available to ship's officers who otherwise are dependent upon the competence, and integrity, of the locally appointed surveyors.

Sampling serves two purposes. In the case of high purity cargoes, inspection of samples drawn at the manifold, or at 'first-foot' level in the cargo tanks, allows the crew to assess the quality of the incoming cargo as well as the cleanliness of the lines. Obviously analysis cannot be carried out on the samples immediately but visual inspection allows the observer to assess any change in colour, the presence of water (if water is not soluble in the cargo), the presence of foreign particulate matter and, less straightforward, odour taint. Odour is not an issue for all cargoes. Toxic or highly odoriferous cargoes should not be tested for odour.

Any observed deviation in quality should result in cargo operations being halted and further investigations conducted.

The main (shipboard) sampling points where cargo quality can be monitored are as follows:

Manifold at commencement of loading and spot checks during loading. Special care should be taken when a switch of shore tanks occurs.

- Ship's cargo tanks at 'first-foot' level.
- Ship's tanks after loading.
- Ship's tanks before discharge.
- Ship's manifold at commencement of discharge and spot checks during discharge.

Sampling should be carried out in compliance with industry standards (ASTM, IP, ISO, etc.). In general, for high purity cargoes, a 'running' sample is appropriate from each shore tank. If the cargo is not homogeneous, careful 'zone' sampling is required to assess the quality. The dangerous properties of some chemical cargoes require specialized sampling techniques using specialized equipment and sampling points. In such instances, the sampling procedure is prescribed by the specific equipment in use. Safety remains of paramount importance when dealing with toxic or dangerous cargoes.

Clear glass bottles are the most useful containers for samples as they allow rudimentary visual checks to be carried out. Some cargoes are light-sensitive (e.g. some kerosene, amines and phenol) and should be stored in brown glass bottles. Other cargoes such as caustic soda and potash require plastic sample containers. Lacquer-lined, tinsplate containers used for petroleum products are generally unsuitable for chemical cargoes. Bottle closures should be chosen for the specific cargo in question. Waxed disc types are suitable only for petroleum products and crude oils. Aluminium foil faced discs are unsuitable for acid and alkaline samples.



The preferred closures are sealed with polypropylene or PTFE inserts. Sample containers should be 500ml capacity.

Samples must be clearly labelled with the ship's name, the date, time, port, sample location, sample-type (e.g. running) and the identity of the sampler. The samples must be signed, sealed and, if possible, counter-signed by the local surveyor. Ideally samples are retained in a dedicated locker on board for 12 months but this is often impractical. If, however, there is a query on the quality of the cargo, any samples should be retained until instructed otherwise. Normally, they will be handed to a representative of the P&I Association in the event of a claim.

#### **7.2.3.10** *Deck watch and personnel arrangement*

- The deck watch shall check for oil leaks in the cargo area throughout the cargo oil loading operation.
- At the beginning of the operations, confirm that no oil leaks from piping joints and that no oil is flowing into tanks other than the tank being loaded.
- Keep continuous monitoring of the oil level of the loading tanks, until settling down of shore flow rate. Also, monitor other tanks (unused) for any change in the level.
- After reaching the desired full loading rate and confirmation reports have been received from all stations at deck/pump-room watch (including the cargo piping and sea surface around the vessel) the chief officer may dismiss the off duty crew and revert to the routine watch schedule.
- During loading operations, monitor the manifold back pressure, especially when changing over the valves / tanks.

#### *Leakage monitoring system*

Cargo leakage, however small, shall be paid attention to at an early stage of operations. Leakages from piping system, joints and valves shall be monitored. Tanks not being loaded shall be monitored to ensure that no oil is flowing into tanks other than the loading tanks.

During loading operations, watch oil loading pressure all the time, and monitor portions where oil is likely to leak. Excessive vibrations on piping systems must be attended to immediately.

#### *Cargo loading rates*

##### **a)** General

The vessel's maximum loading rate and maximum venting capacity must be posted in the cargo control room giving details of the rates for homogenous (the entire vessel), Group-by-group and Tank-wise loadings.

Such information, based on calculations, shall assist the master to determine how fast the ship can safely load a particular cargo at a particular facility, taking into account the vessel's design parameters and the cargo involved.

The chief officer should indicate, in the loading plan, rates required at stages throughout the operation.

##### **b)** Theoretical rates

The maximum flow rate into any single tanks shall be less than the maximum venting capacity (ref: SOLAS). To allow for generation of gas when loading, the venting rate shall be taken as 125% of the oil loading rate.

Maximum loading rates are affected by a number of factors:

- diameter of manifold
- number of tanks being loaded
- gas venting capacity

**c) Setting loading rates**

The initial and maximum loading rates, topping off rates and normal stopping times should be considered, having regard to:

The nature of the cargo to be handled; and

The arrangement and capacity of the ship's cargo lines and gas venting systems: the vent line pressure should not exceed that indicated by the builder and must be closely monitored at terminals where loading rates are known to be high.

Builder's maximum vent pressure may be based on a rate for loading all tanks simultaneously; rates must be reduced accordingly for a smaller number of tanks tank being loaded.

The loading rate should also be governed by the age, condition and reliability of the vessel's pipeline system and the venting system.

Precautions to be observed to avoid static electricity.

Any other limitation.

*Deballasting of clean or segregated ballast:*

- In principle, de-ballasting operations should commence, after starting of cargo operations.
- De-ballast, as per the cargo plan to achieve ample trim, especially towards the completion of de-ballasting operations.

Such period should be planned well before the level in cargo tanks are near topping-off ullages.

**7.2.4 Unloading (1.5 hours)**

**7.2.4.1 Operation of cargo pumps**

When starting to ballast, cargo pumps should be operated so that no oil is allowed to escape overboard when the sea suction valve is opened. See the ICS/OCIMF publication "Prevention of Oil Spillages through Cargo Pump room Sea Valves".

The sequence of valve operations will be determined by the person-in-charge.

*Preparation for cargo equipment*

Cargo oil transfer pumps and IGS should be well prepared for use prior to arrival at discharge port terminal.

*Display of warning notices and signs*

Should be taken into account

The "Ship/Shore Safety Checklist" or relevant "Ship to Ship Transfer Checklist" must be completed and signed for in agreement by both parties after successful completion of safety checks and confirmation and prior to starting of operations.

*Ullage measurement and cargo quantity calculation*

Ullage may be taken at the beginning of the cargo operation and monitored throughout the cargo operation. On completion of cargo operation, temperature measurement, water measurement and sampling may be carried out by the terminal side or surveyors along with a responsible officer.

Normally, one watch officer shall attend the measurement and assist to calculate the cargo quantity. Ensure that all ullage ports (vapour locks) and other openings have been closed after the measurement and prior to start of operations.

### *Lining up pipelines and valves*

Prepare the lines between tanks and pumps after the completion of ullage measurement. Tanks not to be discharged are to be suitably marked and protected from accidental mis-operation. Carry out the filling of the separator with utmost caution, taking care to avoid "Liquid Hammer". Ensure through passage of vapour so as to fill separator evenly.

Prior to commencing discharge the cargo tank line and pump-room valves to be set as per the plan for start of discharge. Use the ship specific "Valve Checklist" prudently.

Valves not in use should be secured and lashed shut.

Line/valve settings are to be supervised and checked by the watch officer and re-confirmed by the chief mate.

The order for opening of manifold valve shall be under the chief officer's permission. On opening of the manifold valves, the manifold pressure shall be monitored regularly. Operate major valves as per the terminal representative's order.

During completion of unloading, it must be emphasized by the instructor to inform the trainees about the wear on moving parts whenever flow is intermittent or fluctuating

### *Personnel arrangement at beginning of operations*

In principle, for the start up of operations, all deck crew shall be in attendance and distributed as per chief officer's instruction.

### *Tool box meeting*

The tool box meeting will draw the crew's attention to possible dangers during cargo operations.

## **7.3 For chemical tankers**

### **7.3.1 Cargo information (0.5 hour)**

- information about cargoes to be handled is essential to the safety of the vessel and her crew
- such information may be found on ICS or other cargo data sheets for each product, which also include all necessary data for the safe handling and carriage of the cargo
- cargo information for most tanker cargoes is kept on board and available for all concerned
- the cargo will not be loaded unless sufficient information necessary for its safe handling and transportation is available
- the responsible officer will see to it that the necessary cargo information is posted on the notice board prior to cargo operations
- all personnel engaged in cargo operations should familiarize themselves with the cargoes by studying the ICS or other cargo data sheets
- cargo operations on chemical tankers may involve simultaneous loading, unloading and tank cleaning

### **7.3.2 Loading (1.0 hour)**

- all personnel must follow standing instructions at all times whether or not the cargo to be loaded is dangerous
- personnel on watch or involved in the loading operation should wear appropriate protective clothing, as indicated in the ICS or other Cargo Data Sheets, when handling dangerous cargoes
- cargoes are stowed according to a stowage plan that was prepared before loading
- prior to loading, cargo tank are inspected for cleanliness and suitability for cargo according to the stowage plan

- prior to the loading of cargoes which present a major fire hazard, tanks may be purged with nitrogen to remove air so that the atmosphere above the cargo will be non-flammable
- such cargoes are kept under a nitrogen “padding” during the voyage
- how cargo is routed from the manifold to tanks on a chemical tanker with a pump-room
- how cargo is routed from the manifold to tanks on a chemical tanker with separate lines for each tank
- how cargo vapour is removed from the tanks during loading
- a “closed-circuit” loading operation
- cargoes giving off vapours which present a major health hazard are loaded in a “closed circuit”, requiring a vapour- return line
- in order to check for impurities, cargo samples are taken from lines and tanks during loading
- a vessel’s trim, list and stability may be adjusted, if necessary, during loading by filling or emptying ballast tanks
- all events during cargo operations are recorded

### 7.3.3 Unloading (0.50 hour)

- all personnel must follow standing instructions at all times during unloading, whether or not the cargo is considered dangerous
- personnel on watch or involved in the unloading operation should wear appropriate protective clothing, as indicated in the MSDS or other cargo data sheets, when handling dangerous cargoes
- cargoes are unloaded according to a planned sequence of emptying tanks
- prior to unloading, cargo samples from each tank and from cargo lines are analysed to check if a product has been contaminated on board during passage

### *Pumps and unloading systems of a chemical tanker*

Types of pump used on chemical tankers as:

- Centrifugal pumps
- Screw pumps
- Piston pumps (reciprocating pumps)

The main cargo pumps fitted on board chemical tankers are mainly of the centrifugal type. They are either submerged pumps integral with hydraulic motors or of extended shaft with deck mounted electric motors (referred to as deep well pumps).

The benefits of using centrifugal pumps:

- simple in construction
- there being no valve in its construction
- its relatively small size, because the pump can operate in high speed
- its continuous pumping and thereby no pulsation

The drawbacks of using centrifugal pumps:

- difficulty of constructing a pump with a high differential pressure per stage
- CF pump having a high efficiency only within a limited field
- its normally not being self-priming
- back flow through the pump when it stops
- difficulty of pumping high viscosity liquids



Centrifugal cargo pumps are usually supplied with a graph often referred to as pump characteristics, which gives performance curve. The graph supplied with centrifugal pump is developed on the basis of the pumping tests with a specific liquid at a specific temperature and density, with a specific impeller and at specific rate of revolution. The Q-H curve describes the relationship between total head and flow. The graph is normally supplied with curves describing the pump's power consumption efficiency and NPSH. The design point will be the efficiency, the NPSH, the power consumption and the flow give the best general result. The total head is independent of the liquid's density, but the differential pressure and the power consumption will vary proportionally to the density. When evaluating a centrifugal pump's graph it must be remembered that the curves are made for a specific liquid.

**Pump cavitation:** If the liquid's temperature is close to its boiling point, the liquid's vapour pressure is easily reached at the pump inlet side. The liquid starts to boil, the bubbles so formed may collapse along the impeller, which may result in pump cavitation. Care must be taken to avoid this and prevent damage to the pumps.

*Use simulator drawings from appendix 1 for demonstration*

- how cargo is routed from the tank to manifold on a chemical tanker
- in tanks containing cargoes that present a major fire hazard, inert gas or nitrogen is used to maintain a positive tank pressure during unloading in order to avoid air entering the tank
- a vessel's trim, list and stability may be adjusted, as necessary, during unloading by filling or emptying ballast tanks

### 7.3.4 Tank cleaning and gas freeing (1.0 hour)

Reasons for tank cleaning, for example:

- rules and regulations
- prevention of contamination of the cargo to be loaded
- prevention of contaminated ballast
- maintenance of cargo tanks and equipment
- tank-washing machines are used
- tank-washing machines may be fixed or portable
- tank-cleaning equipment must be properly earthed to avoid accumulation of static electricity personnel involved in tank-cleaning operations may be exposed to cargo vapours and should, if necessary, use equipment for personal protection different cargoes require different tank-cleaning procedures
- cleaning may be done with hot or cold seawater or with fresh water, or by ventilation only
- water cannot be used for tank cleaning before or after some cargoes
- in some cases, detergents are added to the washing water
- in some cases, solvents are used for tank cleaning
- use the diagram given in appendix 1 of this course to explain the working of a tank-washing machine
- how the electric bonding of tank-cleaning hoses may be checked
- a safe procedure for the connection and disconnection of tank-cleaning equipment
- pre-wash
- main wash
- fresh water rinse
- gas-freeing



- drying
- inspection/testing
- purpose of gas freeing is to replace cargo vapours, inert gas or any other gases with air
- gas freeing may be done by fixed or portable fans driven by air, steam, water or hydraulic fluid
- gas freeing operation is verified by regular checks of the tank atmosphere
- tank atmosphere is checked by measuring the percentage of oxygen and the ppm values of cargo vapours or of toxic constituents of inert gas
- a cargo tank is gas free only when the oxygen content is 21% by volume, hydrocarbons less than 1% LFL and toxicity less than 50 % OEL, and no vapours from cargo or toxic constituents of inert gas can be measured in values above the threshold limit value (TLV)
- slops and slops disposal
- modern chemical tankers use cargo tanks to contain slops
- in general, the discharge of slops into the sea is prohibited unless certain conditions are satisfied
- slops have to be disposed in compliance with MARPOL Annex I or Annex II

## **Topic 8**        *Emergencies* (1.5 hours)

### **8.1**        *Emergency procedures, including emergency shutdown* (0.5 hour)

This section covers the aspects of emergency operations on board. It includes emergency measures, organizational structure, alarms, emergency procedures and first-aid treatment. The syllabus provides the necessary guidelines for this topic.

The main purpose for first-aid treatment is to emphasize the importance of familiarizing with the 'emergency procedures' in the cargo data sheet of the cargo carried. In the event of an accident involving cargo, the trainee should be able to take proper action as recommended in the cargo data sheet.

Since planning and preparation are essential for dealing successfully with emergencies, the information which should be readily available:

- type of cargo and its disposition
- location of other hazardous substances
- general arrangement plan of the ship
- stability information
- location of fire-fighting equipment and instructions for its use in an emergency, important actions to take would include:
- giving audible and visual warnings that an emergency exists by means of:
- bells, whistles, klaxons or other audible devices

#### *Flashing lights*

- follow ship's emergency plan and make notification of the location and nature of the emergency
- promptly activating the ESD and stopping any cargo-related operations, closing valves and openings in tanks as initiated by the ESD system
- removing any craft alongside

#### *Location of all safety equipment, such as*

- breathing apparatus
- protective clothing

- approved portable electric lights
- instruments for measuring oxygen and other gases
- first-aid kits
- tank-evacuation equipment
- fire-fighting equipment with instructions for its use

All equipment which may be needed in an emergency must be maintained in good order and always be ready for use, and lists important items as:

- fire-fighting equipment
- breathing apparatus
- protective clothing
- alarm systems
- communication systems
- arrangement plans

## 8.2 **Organizational structure** (0.25 hour)

### Emergency Organization

An emergency organization should be set up which will come into operation in the event of an emergency. The purpose of this organization will be in each situation to:

- a) Raise the alarm and muster at designated station.
- b) Locate and assess the incident and possible dangers.
- c) Organize manpower and safety equipment.

The following suggestions are for guidance in planning an emergency organization, which should cover the following four elements:

#### *Command centre*

There should be one group in control of the response to the emergency with the master or the senior officer on board in charge. The command centre should have means of internal and external communication.

Communication is of the utmost importance and the possibility of communication failing should always be taken into account as such back up for communication means should always be provisioned for – such as spare batteries for W/T sets, spare W/T sets, loudhailers, PA system and messengers.

#### *Emergency party*

This group should be under the command of a senior officer and should assess the emergency and report to the command centre on the situation, advising what action should be taken and what assistance should be provided, either from on board or, if the ship is in port, from ashore.

#### *Backup emergency party*

The backup emergency party under the command of an officer should stand by to assist the emergency party as instructed by the command centre and to provide backup services, e.g. equipment, stores, medical services including cardio-pulmonary resuscitation, etc.

#### *Technical party*

This group should be under the command of the chief engineer or the senior engineering officer on board and should provide emergency assistance as instructed by the command centre. The prime responsibility for dealing with any emergency in the main machinery spaces will probably rest with this group. It may be called on to provide additional manpower elsewhere.

The plan should ensure that all arrangements apply equally well in port and at sea.

Duties assigned for the operation of remote controls such as:

- a) main engine stop
- b) ventilation stops
- c) lubricating and fuel oil transfer pump stops
- d) dump valves
- e) CO<sub>2</sub> discharge
- f) watertight doors

Operation of essential services such as:

- a) emergency generator and switchboard
- b) emergency fire and bilge pumps

#### *Balance crew*

The rest of the crew if not allotted any of the duties under the different groups as mentioned above would act as backup for the emergency parties.

As backup they may be utilized in various other duties such as accumulating passengers and herding them away from danger to the evacuation decks. Escorting feeble passengers or crew including any injured crew to the safe places as designated. Rendering first-aid and trauma counselling. Filling extinguishers as required, mustering fire hoses from elsewhere, recharging and supplying W/T batteries. In case of abandoning ship possibility then taking in additional provisions and clothing/water. Preparation of the survival crafts such that it does not lead to any panic. Making rounds of areas adjacent of the fire area.

#### *Preliminary action*

The person who discovers the emergency must raise the alarm and pass on information about the situation to the officer on duty who, in turn, must alert the emergency organization. While this is being done, those on the scene should attempt immediate measures to control the emergency until the emergency organization takes effect.

A fire in the galley is dangerous since it can spread very easily into the rest of the accommodation. The fire is dangerous as well as the fumes from burning plastics and any cooking oil.

The person in charge of the galley or the person first locating the fire should try and extinguish the fire himself after alerting the officer of the watch. Generally the fire as it is detected and begins is a small fire and later develops into a major one. Thus the fire may be put off by a single person with the equipment available in the galley and nearby areas.

Fire dampers should be engaged and DCP extinguishers used to put out the galley fire if anywhere on the stove area since these are electric circuits.

In case of cooking oil fire in the provision locker (rare) this may be put out using foam extinguishers and also with DCP extinguishers.

An accommodation fire may be caused by a short circuit or due to smoking or flammable material catching fire inadvertently.

The items to be available would be:

- a) DCP extinguishers
- b) Fire hoses – low to moderate pressure on the fire mains
- c) Insulated fire axe

- d) Fireman's outfit
- e) Safety lamps – many
- f) Fire blanket

### 8.3 Alarms (0.25 hour)

Use figure 9.3, appendix 1, high level alarms and overfill alarms also state the following:

- a fire alarm signal or general alarm signals are given in case of:
  - fire
  - collision
  - grounding
  - cargo hose burst
  - major cargo spillage or escape vapour
  - every other emergency situation which calls for emergency actions

*Other alarm signals are given in case of:*

- high concentration of toxic or flammable vapours
- unacceptable condition in cargo tanks or cargo systems
- unacceptable conditions in auxiliary cargo systems
- system failure in cargo plant and auxiliary systems
- system failure in engine-room or machinery spaces
- a CO<sub>2</sub> discharge in engine-room or pump-rooms
- a high level of oxygen in inert gas
- high level of oil residues in overboard discharge

### 8.4 Emergency procedures (0.5 hour)

Basic emergency actions to be taken in case of: Standard Emergencies

- fire
- collision
- grounding
- cargo hose burst
- accident involving personnel

**Note:** correct emergency procedures for accidents involving dangerous chemicals are given in the ICS or other cargo data sheets.

## Topic 9 Pollution prevention

### *Causes of marine (air and water) pollution*

Oil in the oceans is one of the ugliest forms of marine pollution. Just thinking about oil pollution in the oceans conjures up images of massive tanker spills, oiled seabirds and shorelines covered with gooey black oil. However, oil spills are not the major cause of oceanic oil pollution. Instead the majority of marine oil pollution comes from other sources. This page will examine the causes of marine oil pollution and methods for pollution prevention and spill cleanup.



### *Types of marine oil pollution*

Oil spills are actually just a small percent of the total world oil pollution problem. According to Ocean Planet there are 706 million gallons of oil pollution in a given year. That is a massive amount of oil! The following chart will indicate the different methods of oil pollution and their respective percentage of total pollution.

The definitions of the different forms of oil pollution are as follows. Offshore drilling pollution comes from operation discharges and drilling accidents during oceanic oil exploration. Large oil spills typically result from oil tanker accidents such as collisions and groundings. Natural oil pollution (seeps) comes from seepage off the ocean floor and eroding sedimentary rocks. Natural oil pollution into the marine environment has occurred for thousands if not millions of years. Up in Smoke: This type of oil pollution comes from oil consumption in automobiles and industry. Typically the oil hydrocarbons find their way into the ocean through atmospheric fallout. Oil pollution from routine maintenance occurs from ship bilge cleaning and so forth. Lastly, oil pollution occurs from people dumping oils and oil products down storm drains after oil changes, urban street runoff and so forth. The worst oil pollution comes from oil dumped into the drains and road runoff. The following images illustrate some oil spills and accidents that have occurred.

### *Prevention of marine pollution*

The section is divided into prevention of marine pollution by oil tankers and chemical tankers at sea and in port. The trainee should be made aware of regulations adopted by IMO regarding marine pollution.

The instructor should explain that air pollution is a matter of growing international concern. Trainees should be made aware that there may be local or national rules which must be complied with.

Definition of volatile organic compounds (VOCs) is given in Appendix I. Trainees should be directed to regulation 15 of Annex VI of MARPOL. Reference: R3, Annex VI

### *Measures to be taken in the event of spillage*

This lecture essentially focuses on the actions to be taken on board upon the occurrence of a spill and the importance of prompt notification to all relevant authorities.

## **9.1 *Effects of oil and chemical pollution on human and marine life* (0.5 hour)**

*For oil tankers at sea and in port:*

### **SOPEP** (0.25 hour)

A ship's SOPEP must be in the approved form, and include the following particulars:

- a) the procedure to be followed by the ship's master, or someone else having charge of the ship, in notifying a reportable incident that is a discharge or probable discharge of oil involving the ship (see below);
- b) a list of the entities to be notified by persons on board if the reportable incident happens;
- c) the procedure to be followed for coordinating with entities notified about the reportable incident;
- d) the name of the person on board through whom all communications about the reportable incident are to be made;
- e) a detailed description of the action to be taken, immediately after the reportable incident, by persons on board to minimize or control any discharge of oil from the ship resulting from the reportable incident.



*For chemical tankers at sea and in port:*

**SMPEP** (0.25 hour)

A shipboard marine pollution emergency plan for noxious liquid substances must be in accordance with the prescribed form and set out the following particulars:

- a) the procedures to be followed by the master of the ship, or any other person having charge of the ship, in notifying a prescribed incident in relation to the ship;
- b) a list of the authorities or persons that are to be notified by persons on the ship if a prescribed incident occurs in relation to the ship;
- c) a detailed description of the action to be taken, immediately after a prescribed incident, by persons on board the ship to reduce or control any discharge from the ship resulting from the incident;

**Topic 10**      *Discusses Case Studies on oil and NLS* (0.5 hour)

To enhance the trainee's awareness, the discussion of the following case studies is recommended but not required under the STCW Code.

Please use the case studies appended in this IMO model course.

Appendix 1:  
**Suggested diagrams for use by the instructor**  
**Print off as handouts**  
**or**  
**use for OHP transparencies**  
**if suitably enlarged**

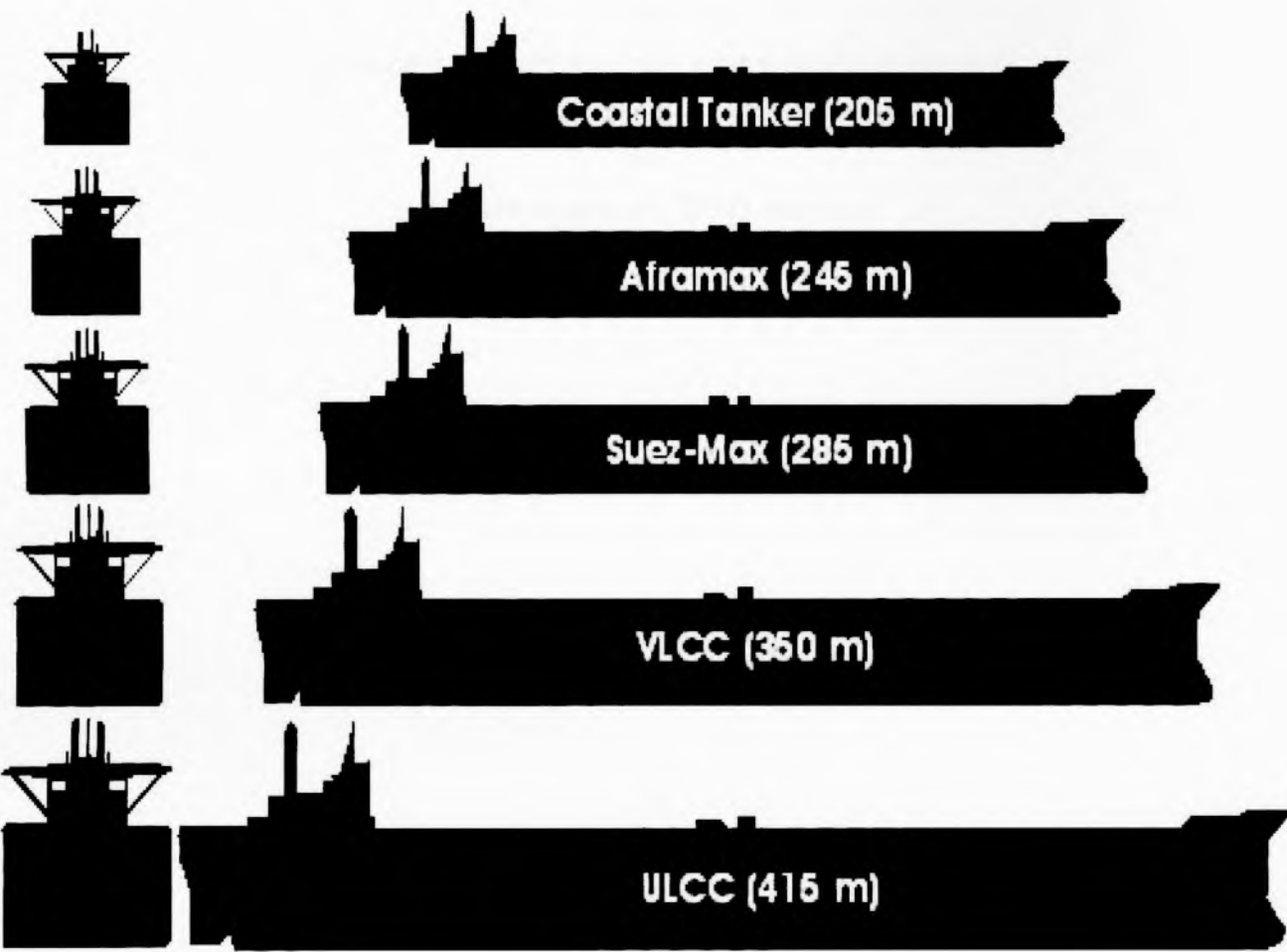


Figure 1.1 A – Types of oil tankers

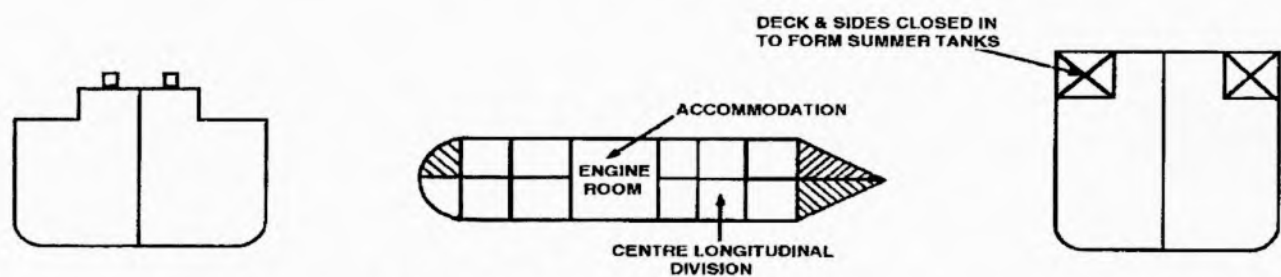


Figure 1.1 B – History of tanker development

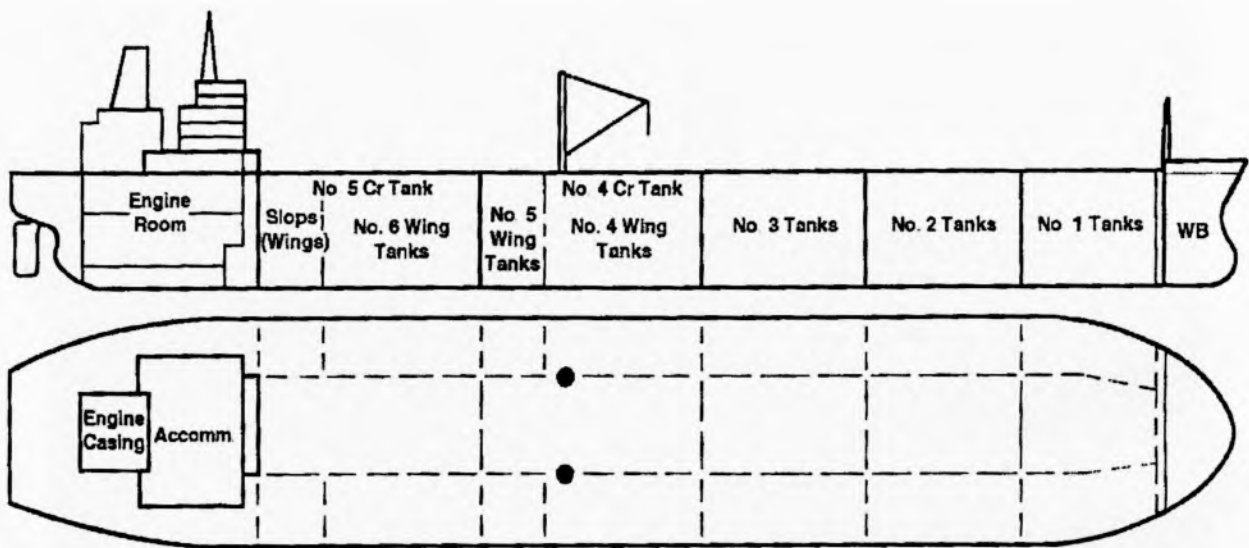


Figure 1.1 C – Single hull crude oil tanker

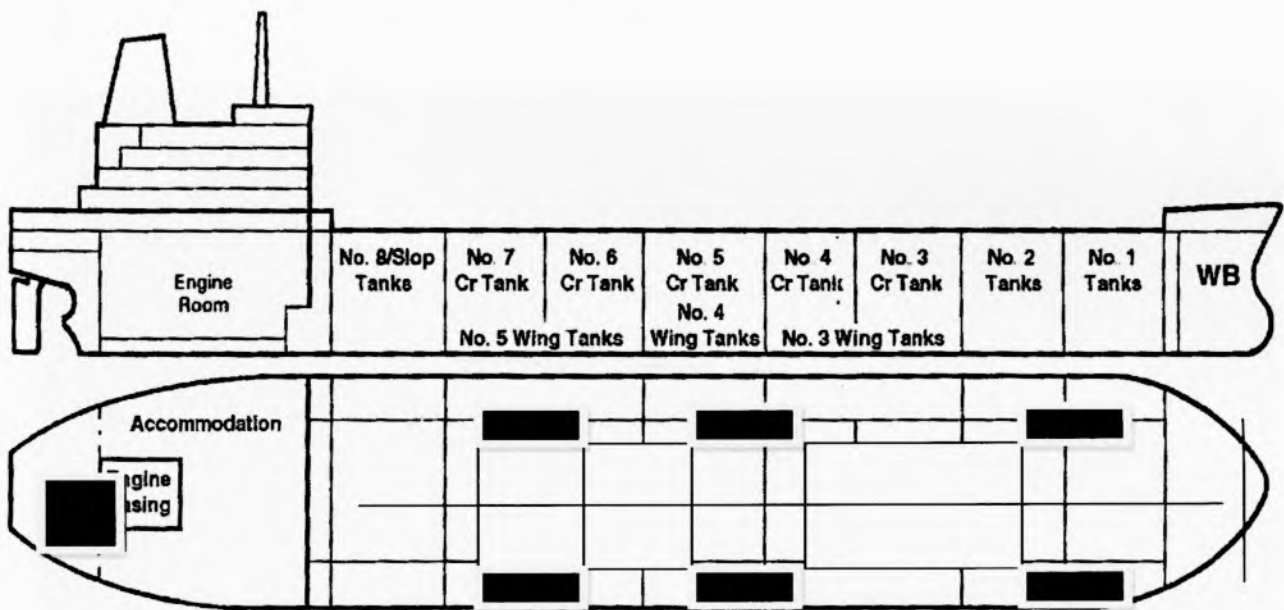
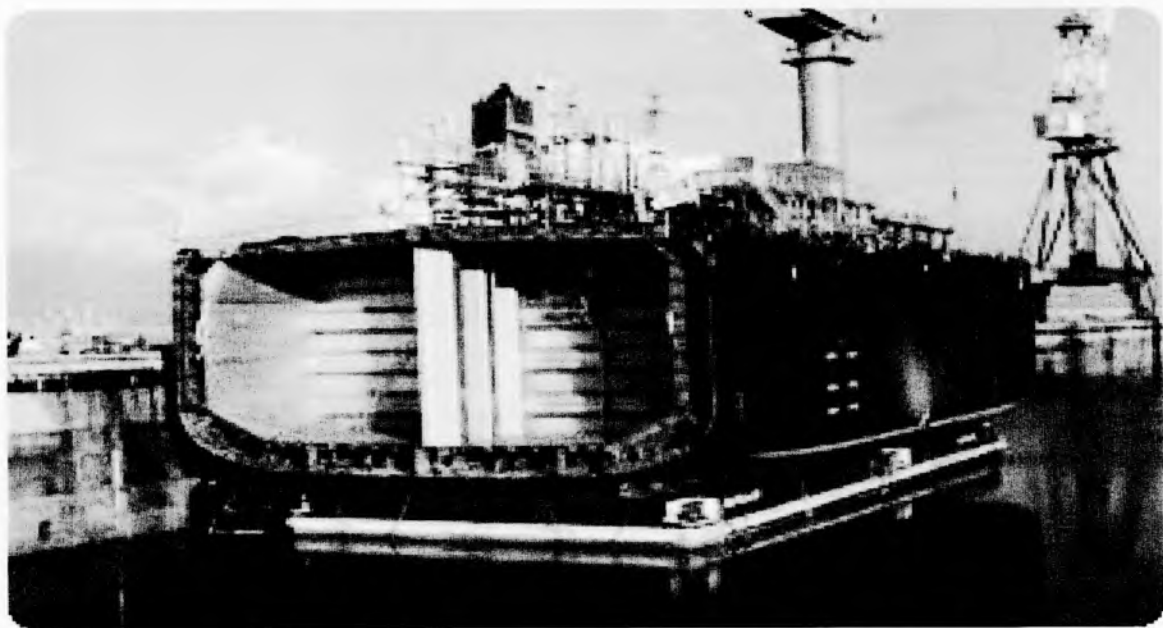
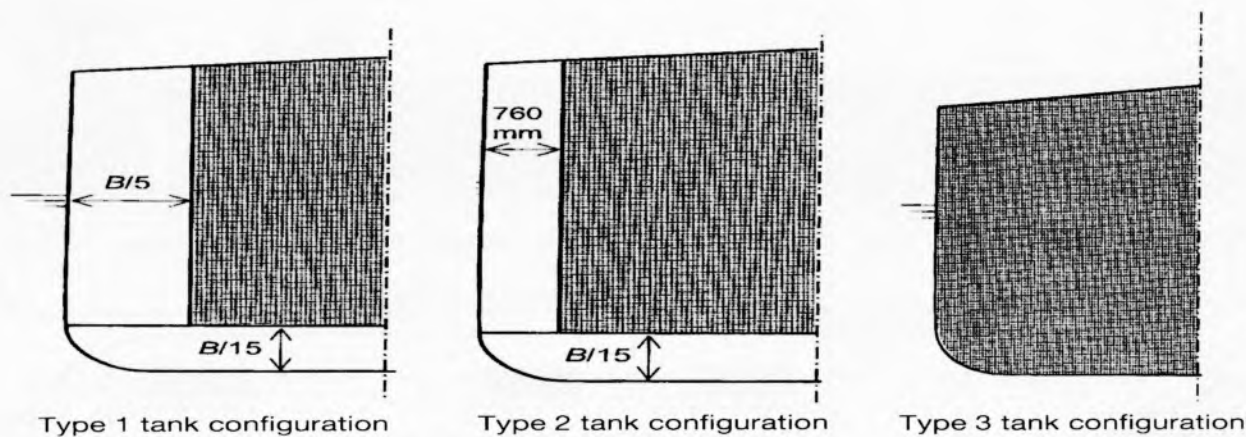


Figure 1.1 D – Double hull tanker with SBT in P/L



**Figure 1.2** – *Sophisticated parcel chemical tanker with transverse and vertically corrugated stainless steel bulkheads*



**Note:** IBC Code requirements for:  
Ship Type 1 each tank capacity not more than 1250 m<sup>3</sup>;  
Ship Type 2 each tank not more than 3000 m<sup>3</sup>;  
Ship Type 3 each tank capacity not regulated.

**Note:** IBC Code requirements for:  
Ship Type 1 each tank capacity not more than 1250 m<sup>3</sup>;  
Ship Type 2 each tank capacity not more than 3000 m<sup>3</sup>;  
Ship Type 3 each tank capacity not regulated.

**Figure 1.2.2** – *Chemical tanker ship type configuration as per IBC Code*



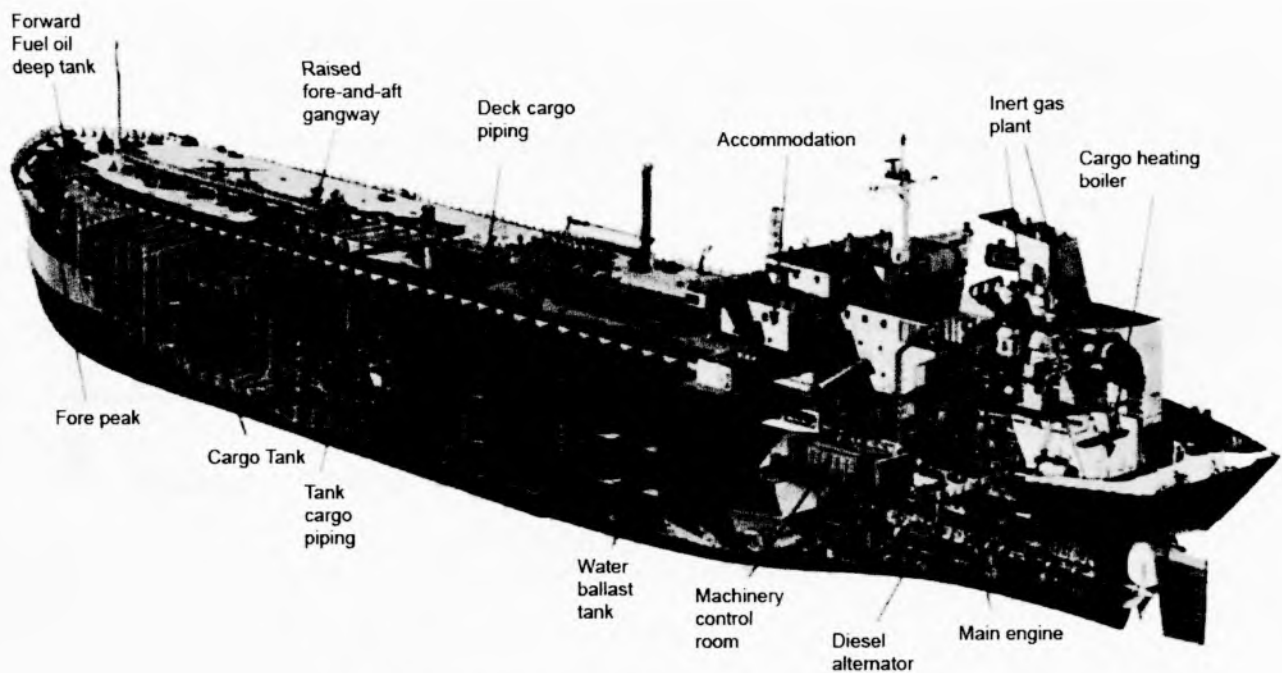


Figure 1.3.1 A – Ship arrangements of an oil tanker

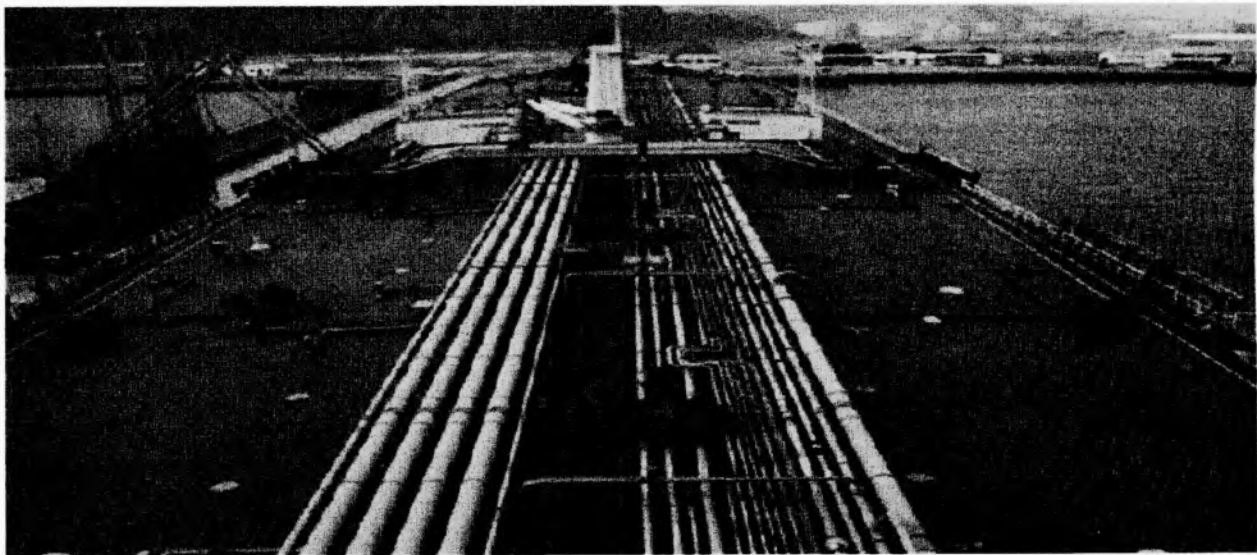


Figure 1.3.1 B – Oil tanker deck pipeline arrangements

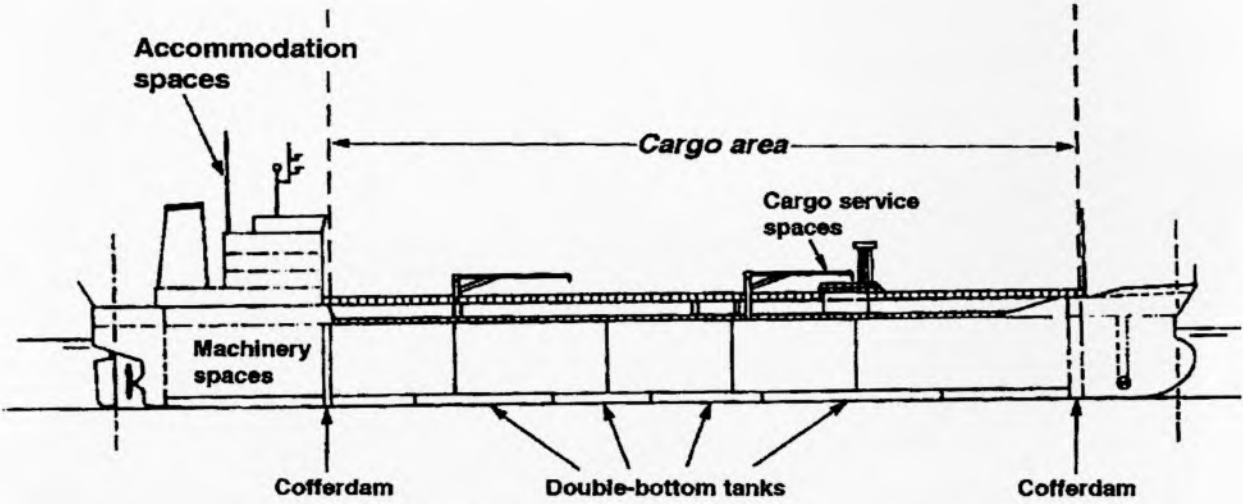


Figure 1.3.1 C – General arrangements of a tanker

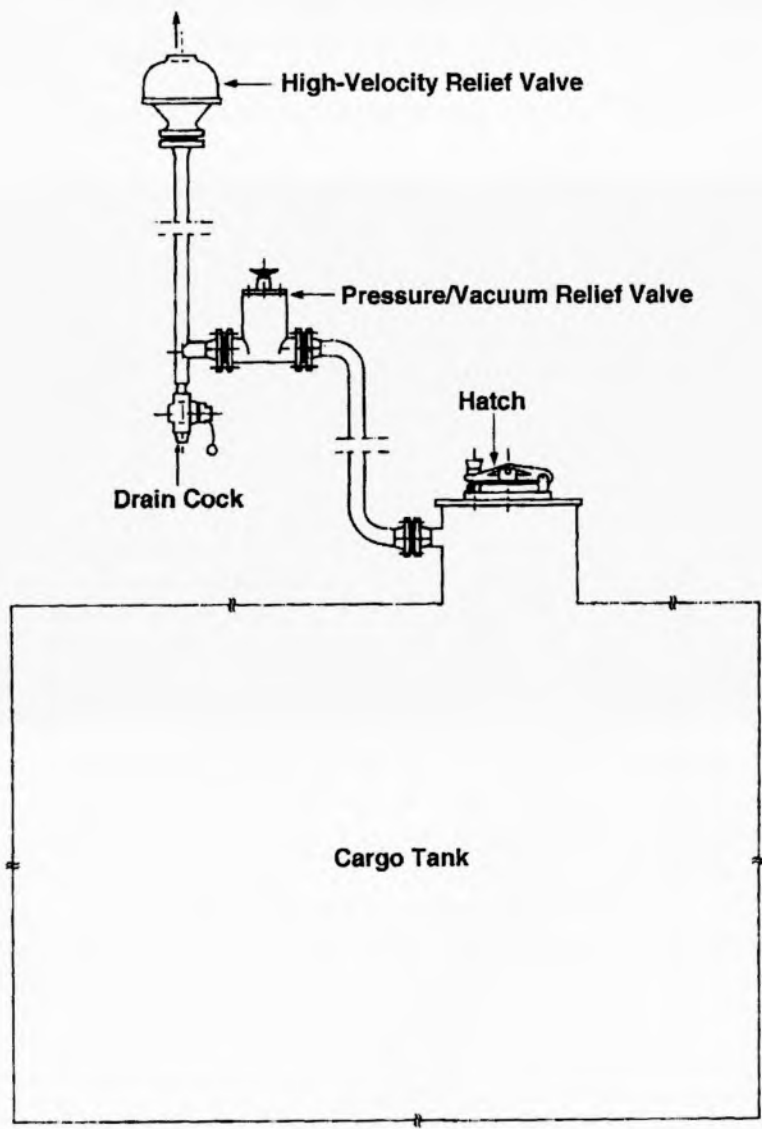
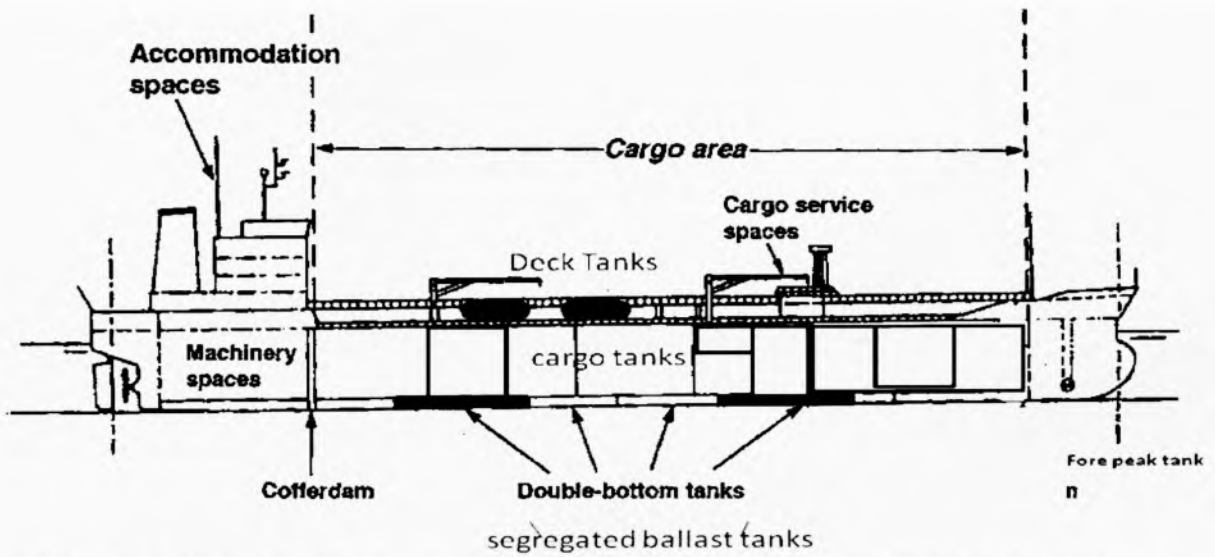
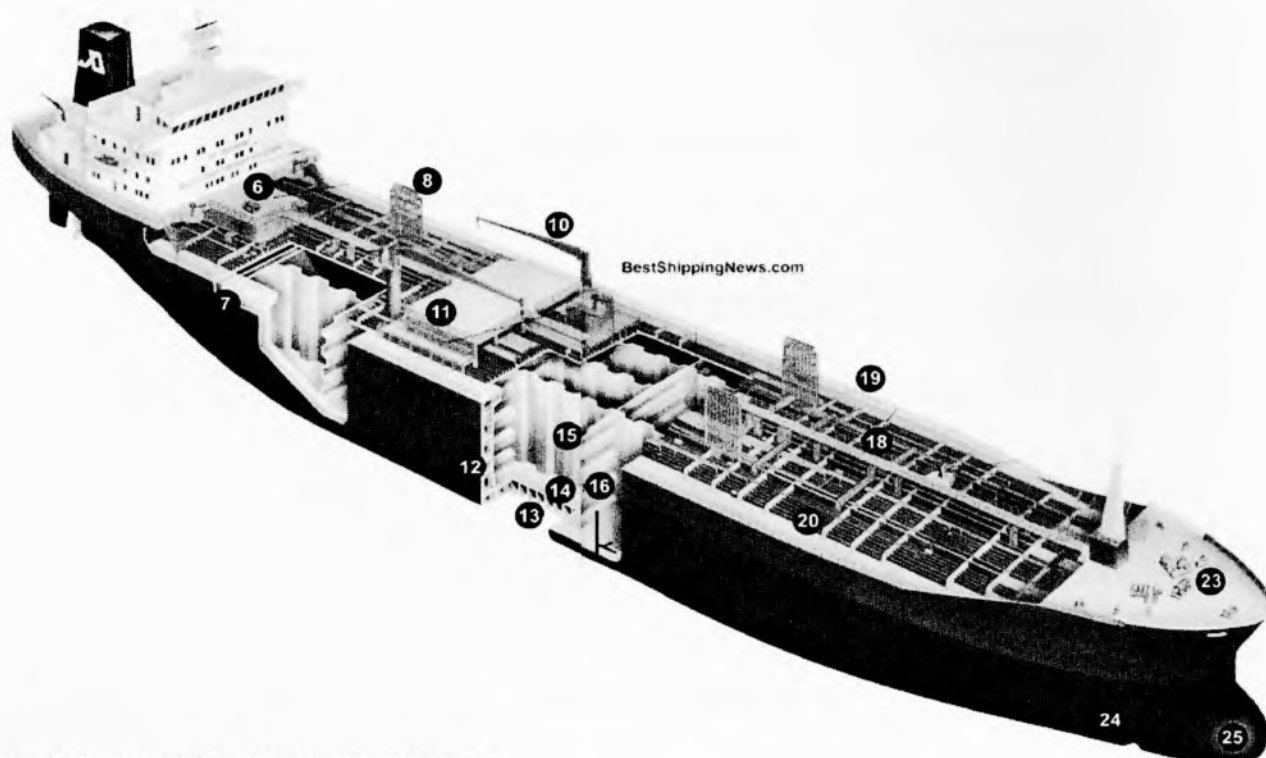


Figure 1.3.1 D – Venting arrangements of an oil tanker



SLOP Tanks: No regulatory requirements for a slop tank, any tank can be nominated

**Figure 1.3.2 A – Cargo area of a chemical tanker**

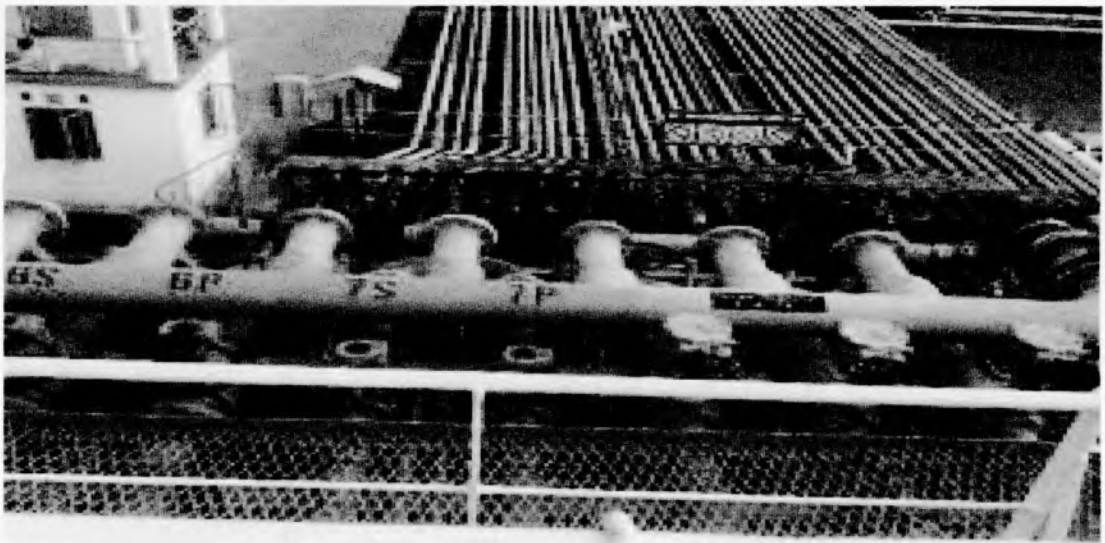


1. Balanced rudder with conventional propeller
2. Auxiliary unit
3. Lifeboat in gravity davits
4. Hydraulic prime mover
5. Cargo control room
6. Tank heating/tankwash room
7. Cofferdam, empty space between two tanks
8. Vent pipes with pressure-vacuum valves
9. Hydraulic high pressure oil and return lines for anchor and mooring gear
10. Hose crane
11. Manifold
12. Wing tank in double hull
13. Double bottom tank
14. Tank-top
15. Longitudinal vertically corrugated bulkhead
16. Transverse horizontally corrugated bulkhead
17. Cargo pump
18. Catwalk
19. Railing
20. Deck longitudinal
21. Deck transverses
22. Cargo heater
23. Forecastle deck with anchor and mooring gear
24. Bow thruster
25. Bulbous bow

**Figure 1.3.2 B – Ship arrangements of a chemical tanker**



**Figure 1.3.2 C** – *Chemical tanker deck pipeline arrangements*



**Figure 1.3.2 D** – *Manifold arrangements of a chemical tanker*



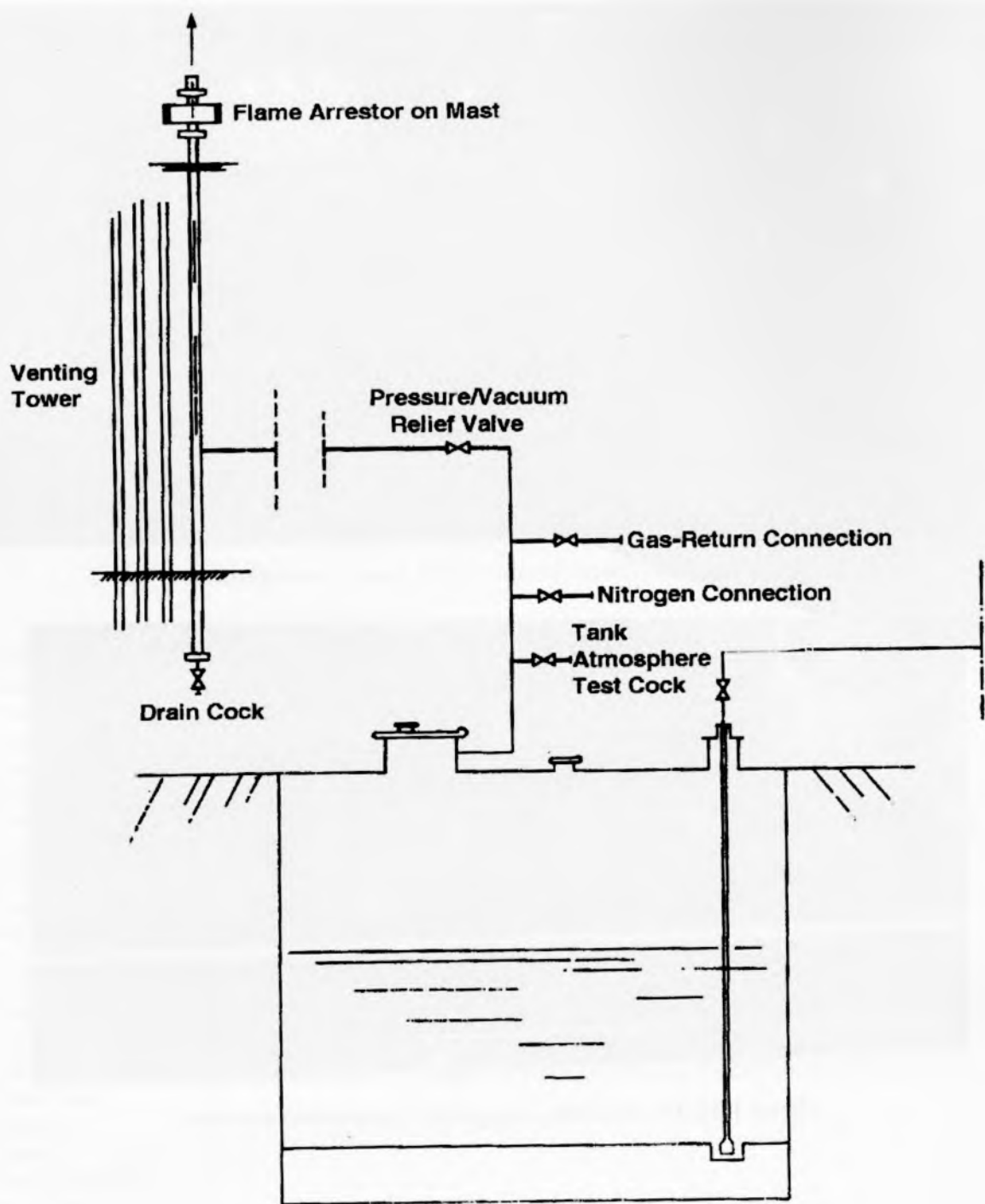


Figure 1.3.2 E – Arrangement of a chemical tanker

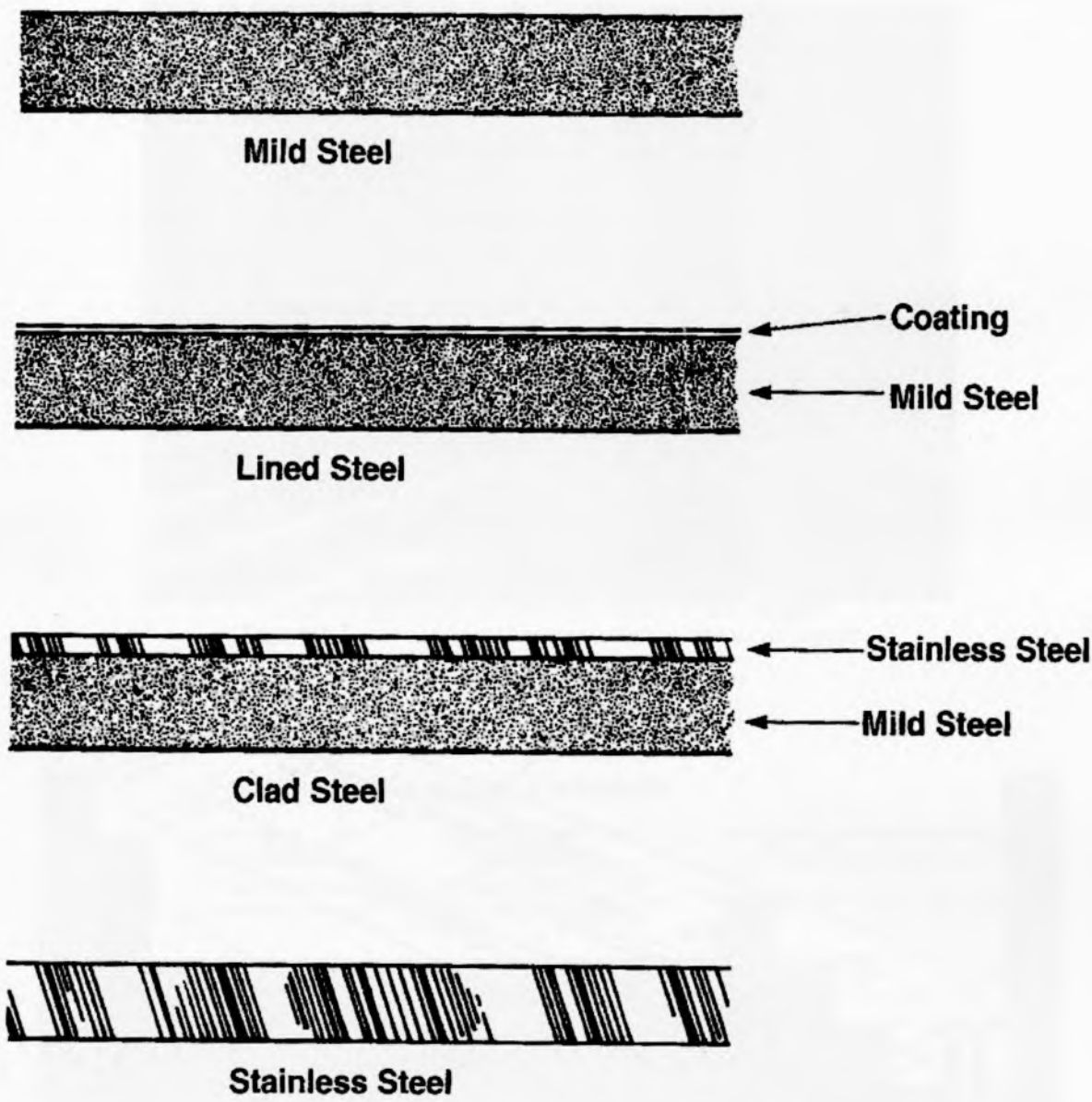


Figure 1.3.2 F – Tank construction materials and coatings



Figure 1.4 A – Eductor used for stripping oil tanks

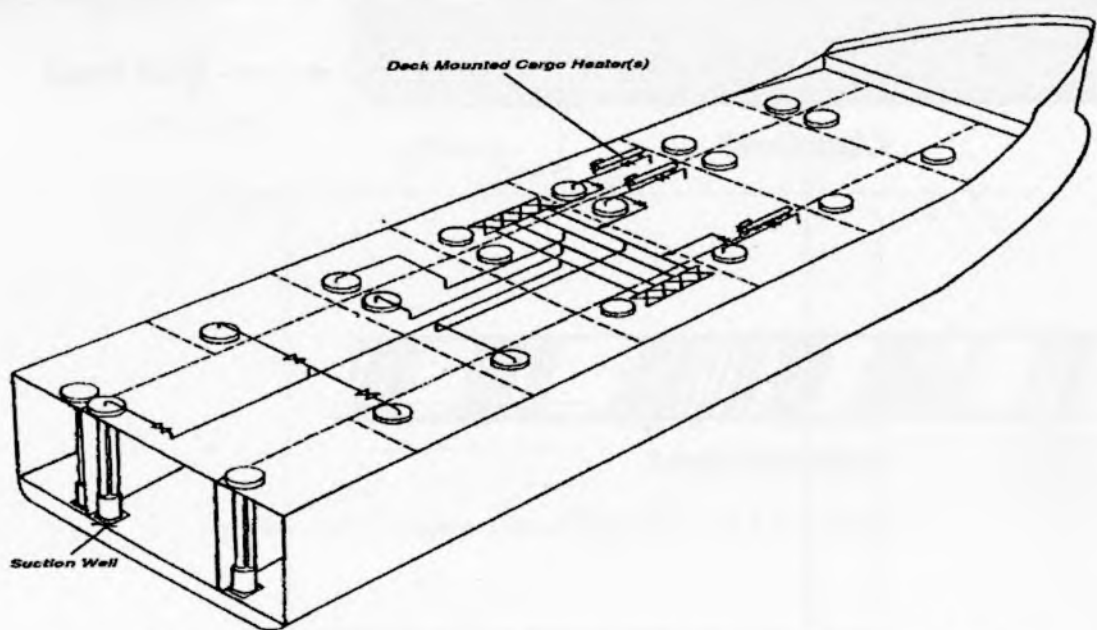


Figure 1.4 B – Tank section of a product/chemical tanker with deep well pumps



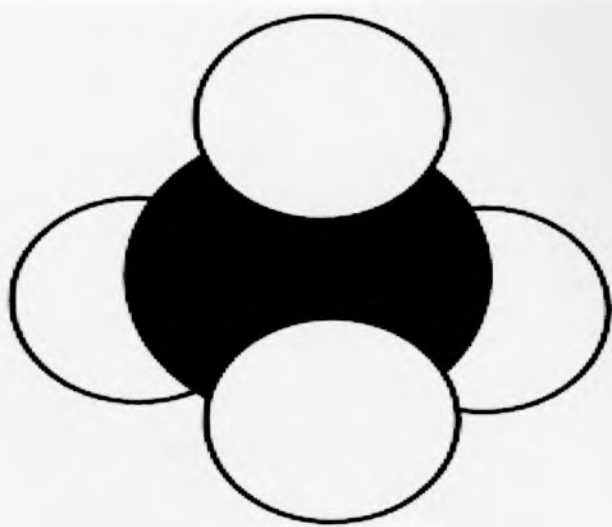


Fig 2.2 B – Methane molecule  $CH_4$

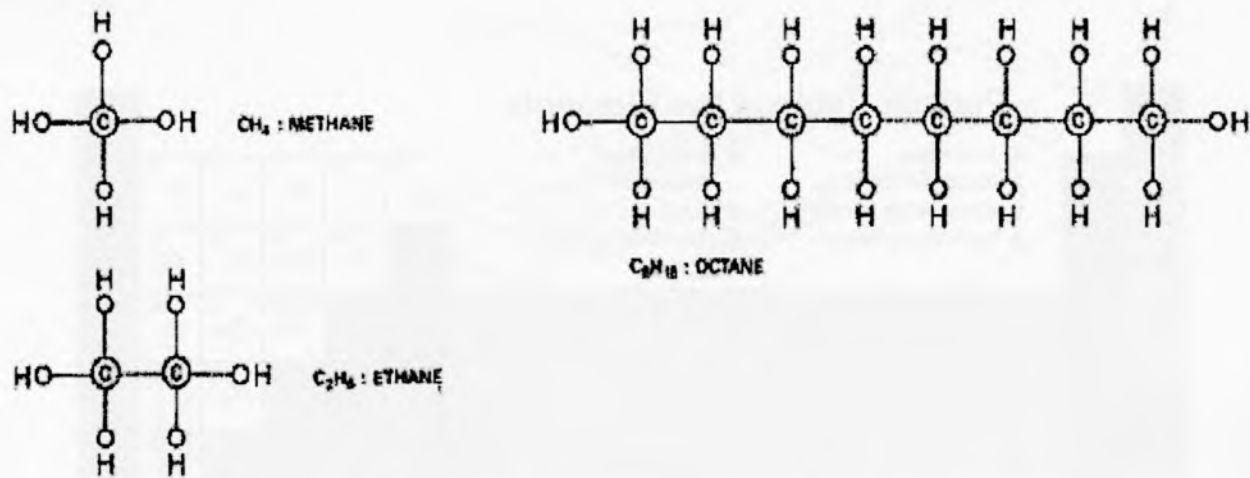


Figure 2.2 C – Schematic representation of hydrocarbon molecules



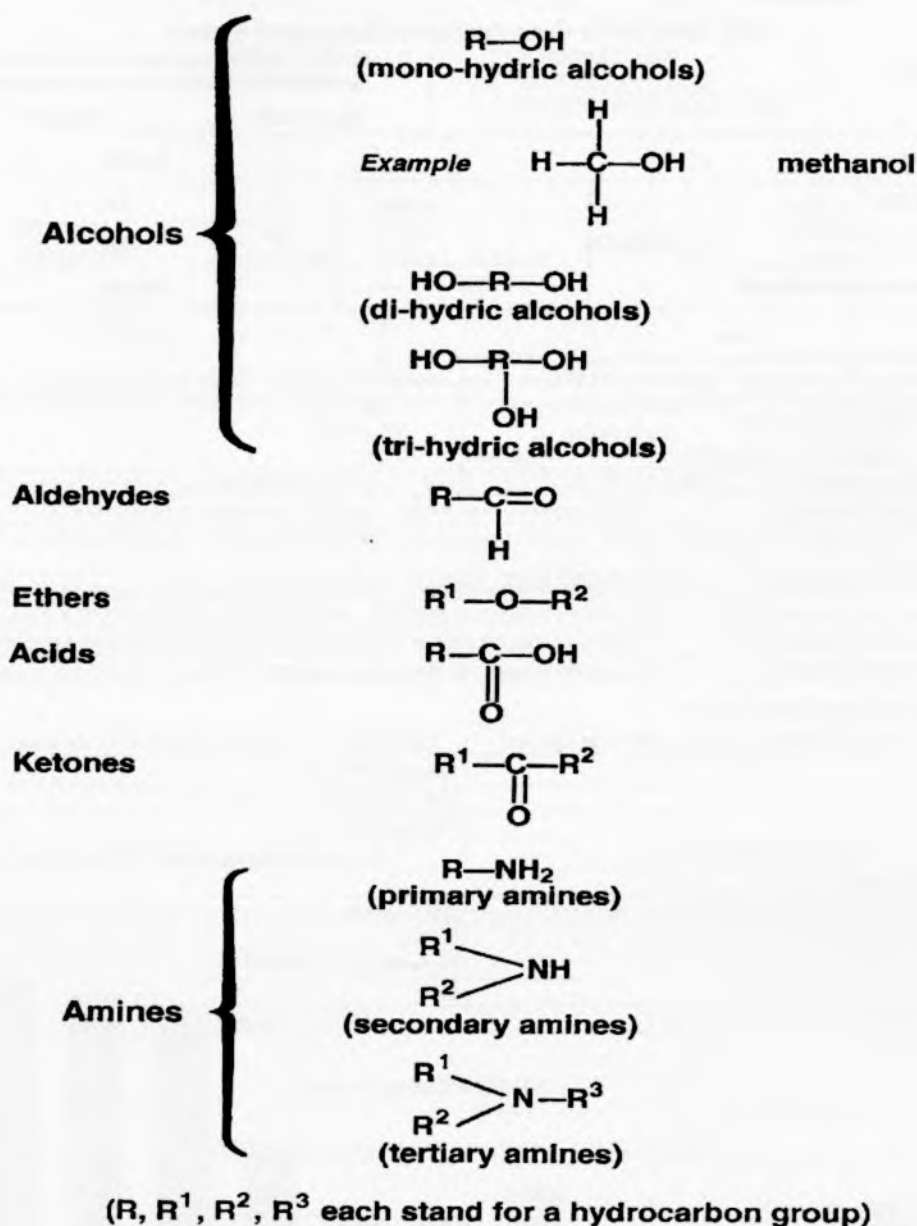


Figure 2.2 D – Molecular structure

Self Checklist for Company Safety Management System

IMO Company ID. No.: \_\_\_\_\_

Number of relevant employees who carry out or have responsibility to the SMS of the Company ashore.

Company Name: \_\_\_\_\_

Type of Audit \_\_\_\_\_

Record No. \_\_\_\_\_

Company Address: \_\_\_\_\_

Country: \_\_\_\_\_

Designated Person(s): \_\_\_\_\_

Tel.: \_\_\_\_\_

Fax: \_\_\_\_\_

Date of Checking: \_\_\_\_\_

Checked by: \_\_\_\_\_

E-mail: \_\_\_\_\_

Title & Latest Revision Date of Manual: \_\_\_\_\_

Website: \_\_\_\_\_

**Note:**  
(1) This Checklist indicates items to be included at least in the samples at self checking.  
(2) In principle, the verification over the Company's implementation of SMS should be made comprehensively for the past one year. However, in the Renewal, the verification over the Company's implementation of SMS should be extended to include the reports issued by the external audits, PSC or marine casualties, and the company's investigation and analysis conducted in response to them, for the past five years.

(1) Items to be checked prior to audit

| Items to be checked                           | CHK | Remarks                                                                                                                                                                                                                                                                           |
|-----------------------------------------------|-----|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1-1 Changes of ships under management         |     | As for new acquisition, a copy of owner's report to the Administration as required in ISM Code 3.1 to be available.<br>If there are any SMC of ships left from the Company's management, the SMC should be returned to ClassNK Head Office for "Termination of ISM registration". |
| 1-2 Changes in Company's name/address         |     | If Additional Audit has not yet started, an Additional audit for changes shall be applied to the ClassNK Local Office.                                                                                                                                                            |
| 1-3 Confirmation of ship types covered by DOC |     | If any ship type no longer exists under management for more than 1 year, rewrite of DOC shall be requested at next Audit.                                                                                                                                                         |
| 1-4 Confirmation of ship flags covered by DOC |     | If no ship under management remains with any Flag, the DOC of same Flag shall be returned at next Audit.                                                                                                                                                                          |
| 1-5 Confirmation of reporting to Flag States  |     | A copy of owner's report to the Administration as required in ISM Code 3.1 to be confirmed, for every ship.                                                                                                                                                                       |

(2) Items to be confirmed prior to audit

| Type of ship*             | Flag & number of ships under management | Type of ship*                                                    | Flag & number of ships under management |
|---------------------------|-----------------------------------------|------------------------------------------------------------------|-----------------------------------------|
| Oil Tanker                |                                         | Bulk Carrier **                                                  |                                         |
| Chemical Tanker           |                                         | Other Cargo Ship                                                 |                                         |
| Gas Carrier               |                                         | Passenger Ship                                                   |                                         |
| * Refer to SOLAS IX/1 & 2 |                                         | ** Dry cargo ships assigned with "ESP" within the Class Notation |                                         |
| Active Crew nationality   |                                         |                                                                  |                                         |
| Masters                   |                                         | Chief Engineers                                                  |                                         |
| Deck Officers             |                                         | Engineers                                                        |                                         |
| Deck Ratings              |                                         | Engine Ratings                                                   |                                         |
| Radio Operators           |                                         | Cooks                                                            |                                         |
| Language                  | Manual, Procedures and Instructions     | Working Language Onboard                                         |                                         |

Figure 3.0 – Safety Management checklist

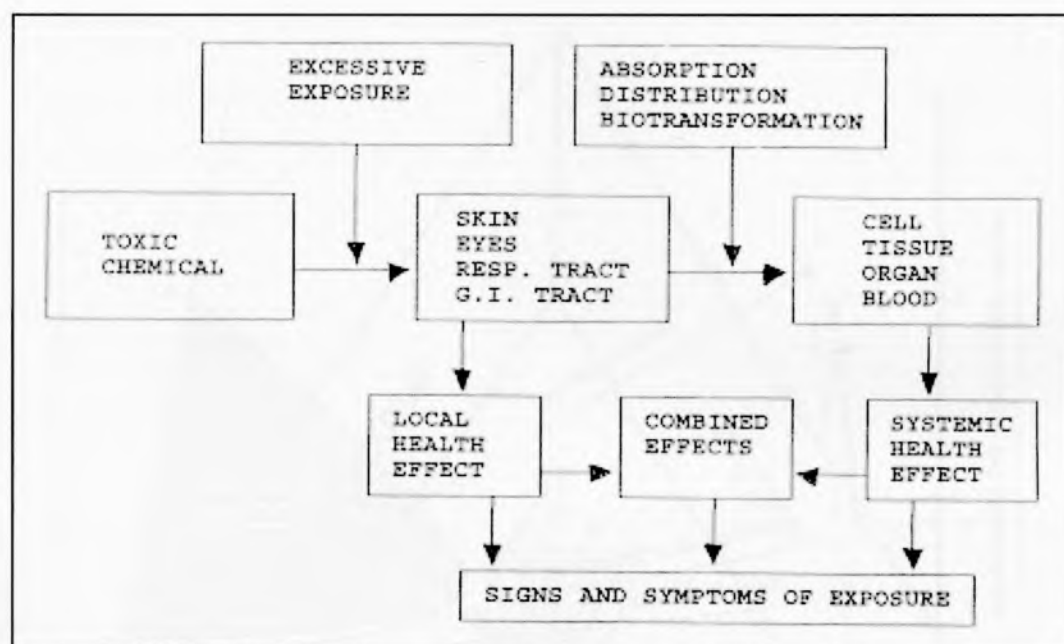


Figure 4.1.1 A – Health hazards

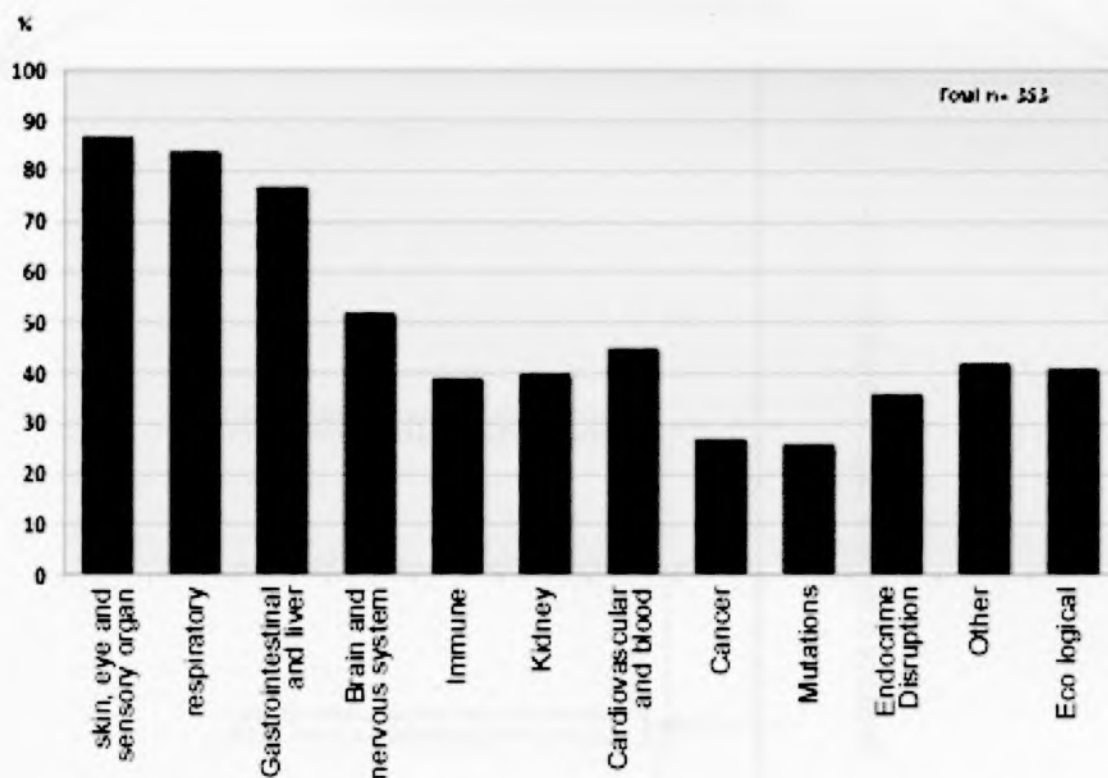


Figure 4.1.1 B – Health hazards in percentage of exposures to oil and chemicals

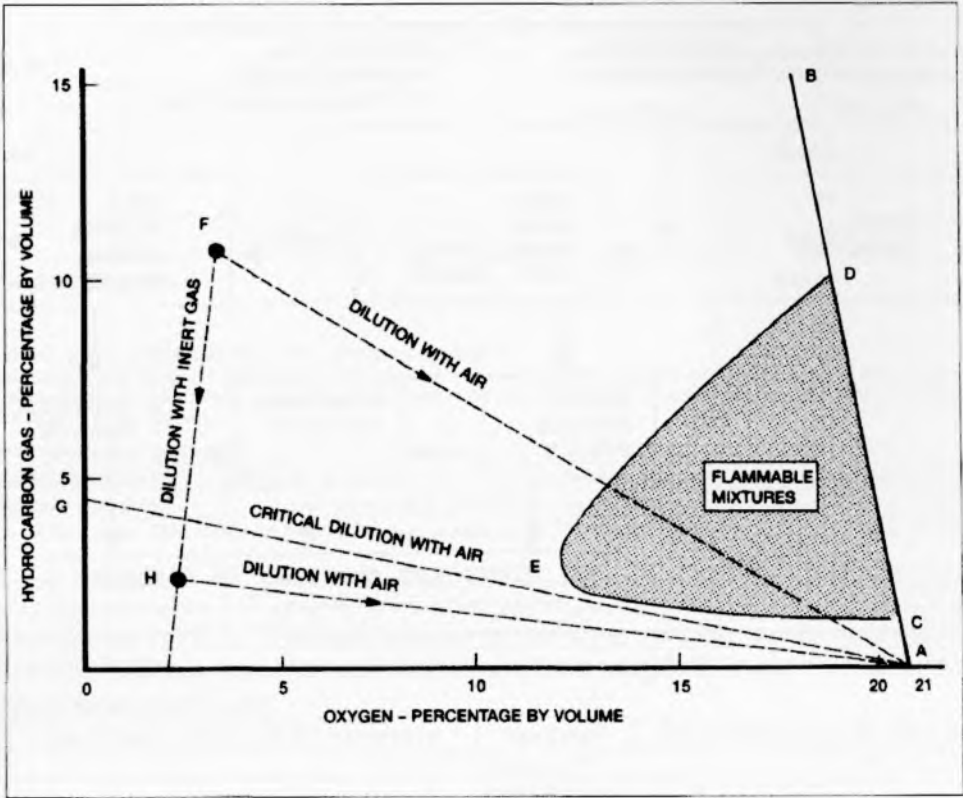


Figure 4.1.5 A – Flammability diagram

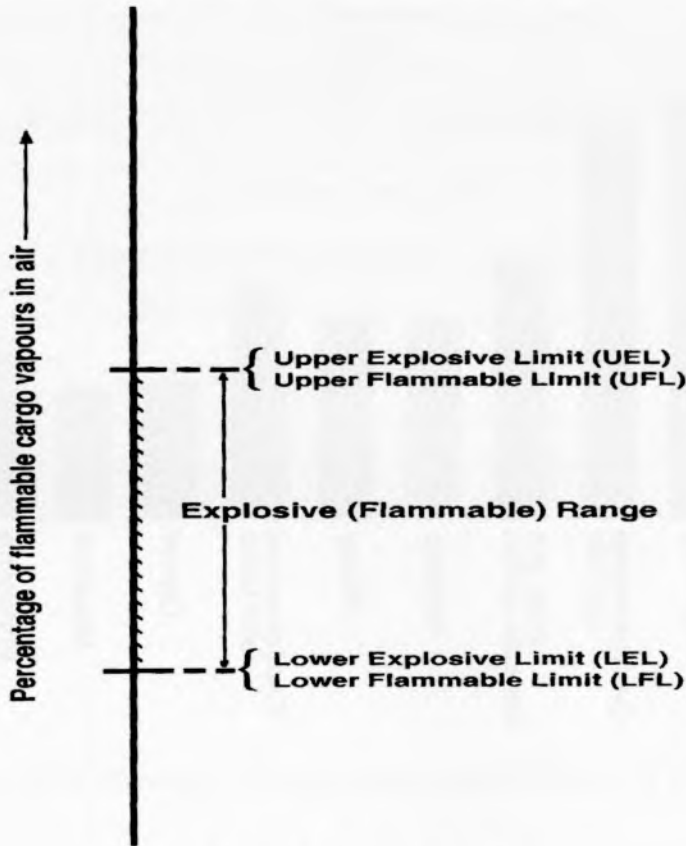


Figure 4.1.5 B – Flammable range

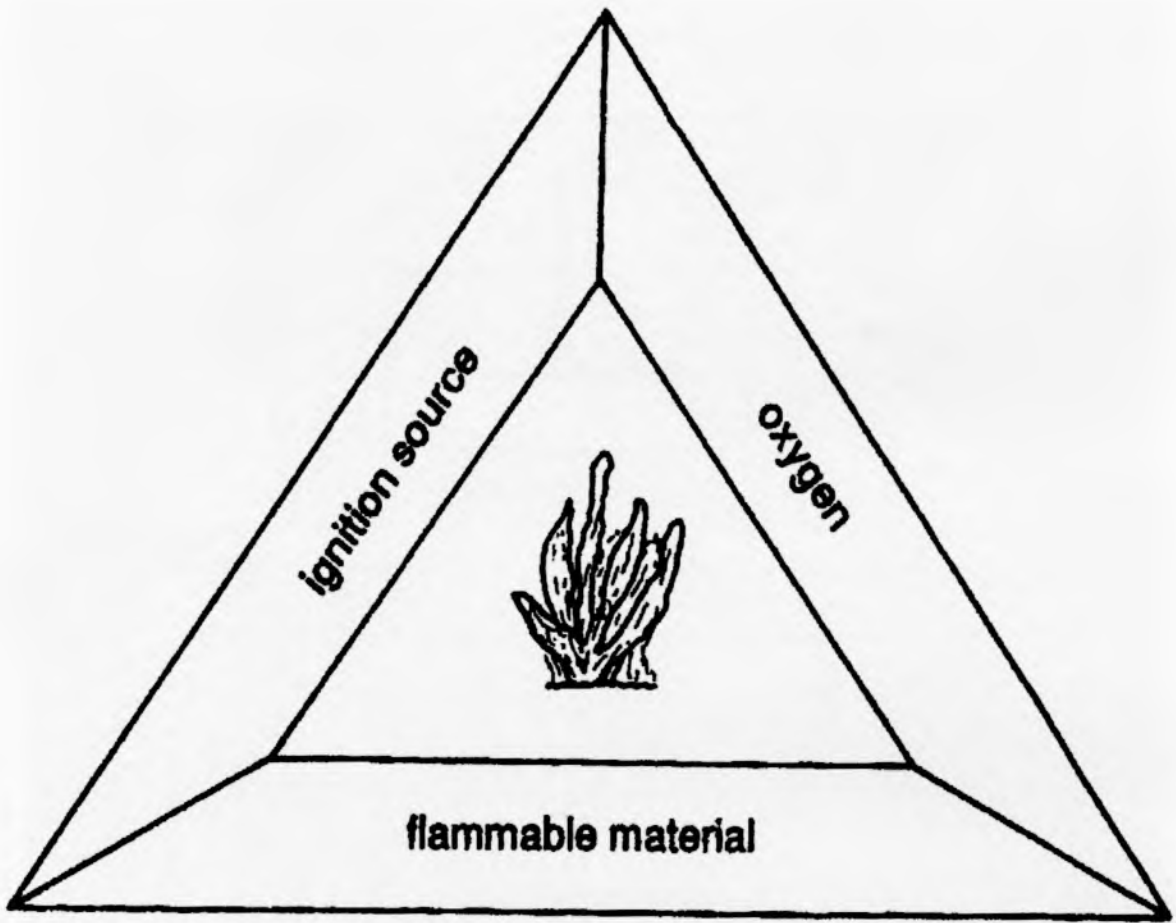
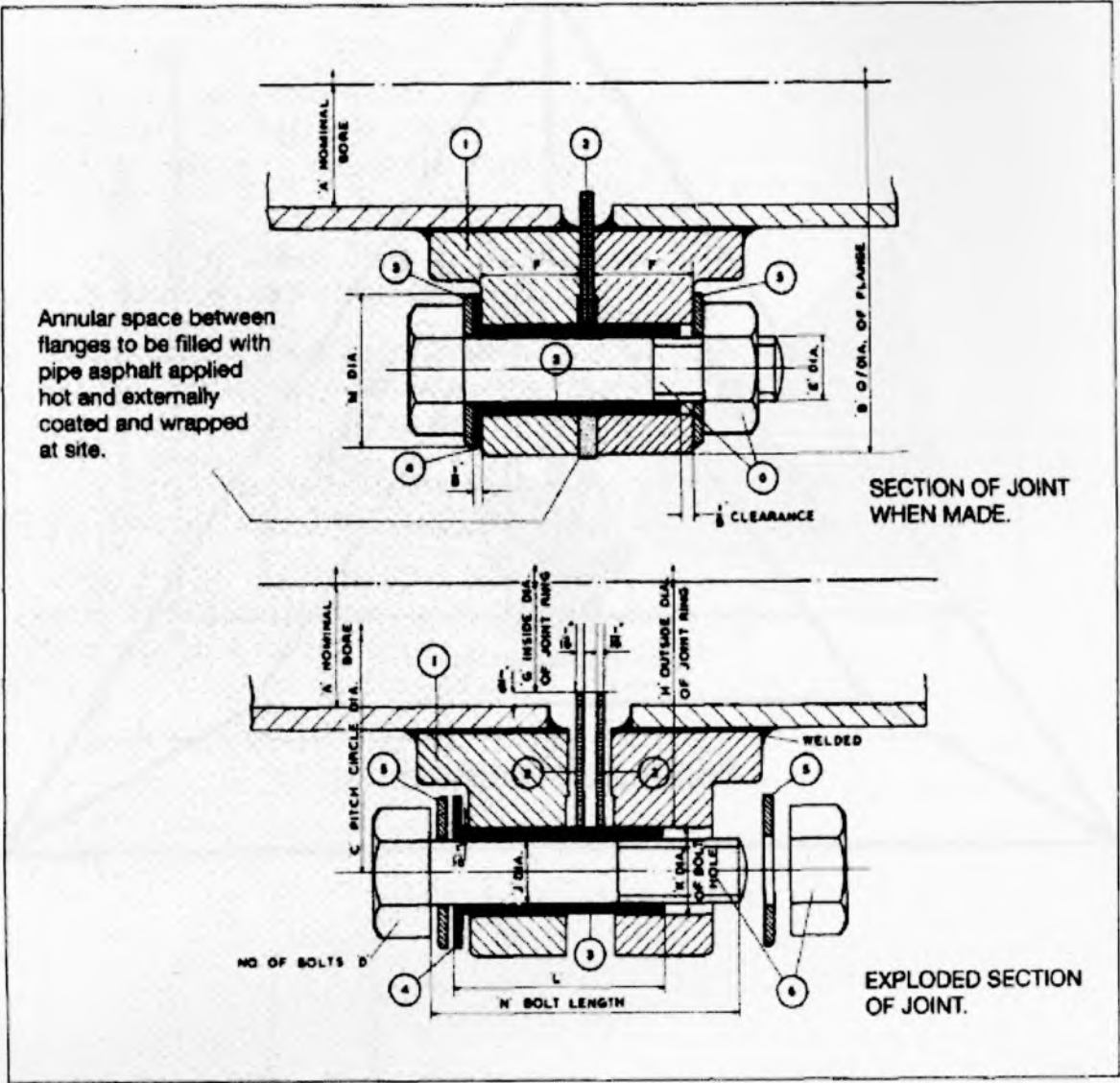


Figure 4.1.5 C – The Fire Triangle





| ITEM | MATERIAL   | DESCRIPTION                                                                                                           |
|------|------------|-----------------------------------------------------------------------------------------------------------------------|
| 1    | Steel      | Flange to ANSI B 16.5. Bolt holes drilled to suit dimensions scheduled opposite can be screw-on, slip on or weld neck |
| 2    | Klingerite | Joint rings 1/16" thick. See note                                                                                     |
| 3    | Tufnol     | Bolt insulating sleeves – Crow Grade                                                                                  |
| 4    | Tufnol     | Bolt washer 1/8" thick – Crow Grade                                                                                   |
| 5    | Steel      | Plain round washer B.S.                                                                                               |
| 6    | Steel      | B.S.W. Bright bolts and nuts                                                                                          |

Figure 4.1.6 – Typical construction of an insulating flange

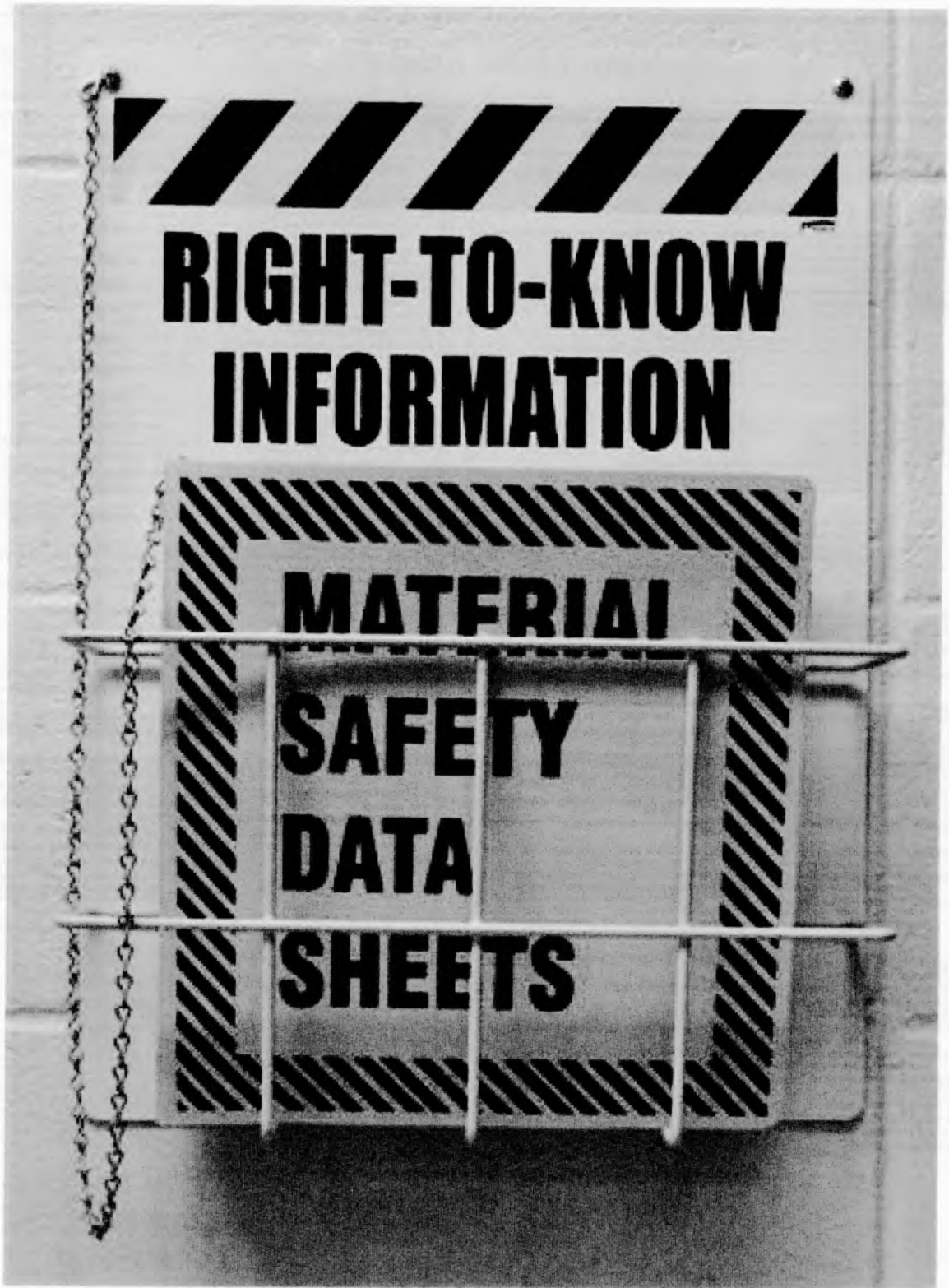


Figure 4.2.9 A – MSDS

| SULFURIC ACID                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |           |           | SFA |                                                                                                                                                                                                                                                                                                         |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|-----------|-----|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| CAUTIONARY RESPONSE INFORMATION                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |           |           |     |                                                                                                                                                                                                                                                                                                         |
| Common Synonyms:<br>Battery acid<br>Chamber acid<br>Fertilizer acid<br>Oil of vitriol                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | Only liquid                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | Colorless | Colorless |     |                                                                                                                                                                                                                                                                                                         |
| Strike and fumes violently with water. Irritating mist is produced.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |           |           |     |                                                                                                                                                                                                                                                                                                         |
| Keep people away. AVOID CONTACT WITH LIQUID.<br>Wear goggles, self-contained breathing apparatus, and rubber overclothing.<br>Notify local health and pollution control agencies.<br>Protect water intakes.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |           |           |     |                                                                                                                                                                                                                                                                                                         |
| Fire                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Not flammable.<br>May cause fire on contact with combustibles.<br>Flammable gas may be produced on contact with metals.<br>POISONOUS GAS MAY BE PRODUCED IN FIRE.<br>Wear goggles, self-contained breathing apparatus, and rubber overclothing.<br>DO NOT USE WATER ON ADJACENT FIRES.<br>Extinguish with dry chemical or carbon dioxide.                                                                                                                                                                                                                                                                                                                                         |           |           |     |                                                                                                                                                                                                                                                                                                         |
| Exposure                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | CALL FOR MEDICAL AID.<br>MIST<br>Irritating to eyes, nose and throat.<br>If inhaled, will cause coughing, difficult breathing, or loss of consciousness.<br>Move to fresh air.<br>IF IN EYES, hold eyelids open and flush with plenty of water.<br>If breathing has stopped, give artificial respiration.<br>If breathing is difficult, give oxygen.<br>LIQUID<br>Will burn skin and eyes.<br>Remove if swallowed.<br>Remove contaminated clothing and shoes.<br>Flush affected areas with plenty of water.<br>IF IN EYES, hold eyelids open and flush with plenty of water.<br>IF SWALLOWED and victim is CONSCIOUS, have victim drink water or milk.<br>DO NOT INDUCE VOMITING. |           |           |     |                                                                                                                                                                                                                                                                                                         |
| Water Pollution                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | HARMFUL TO AQUATIC LIFE IN VERY LOW CONCENTRATIONS.<br>May be dangerous if it enters water intakes.<br>Notify local health and wildlife officials.<br>Notify operators of nearby water intakes.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |           |           |     |                                                                                                                                                                                                                                                                                                         |
| 1. CORRECTIVE RESPONSE ACTIONS<br>Dilute and dispose<br>Stop discharge<br>Chemical and Physical Treatment:<br>Neutralize                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |           |           |     | 2. CHEMICAL DESIGNATIONS<br>2.1 CG Compatibility Group: 2; Sulfuric acid<br>2.2 Formula: H <sub>2</sub> SO <sub>4</sub><br>2.3 IMO/UN Designation: 8.0100<br>2.4 DOT ID No.: 1830<br>2.5 CAS Registry No.: 7664-93-9<br>2.6 NAERG Guide No.: 137<br>2.7 Standard Industrial Trade Classification: 82030 |
| 3. HEALTH HAZARDS<br>3.1 Personal Protective Equipment: Safety shower, eyewash fountain, safety goggles, face shield, approved respirator (self-contained or air-line), rubber safety shoes, rubber apron.<br>3.2 Symptoms Following Exposure: Inhalation of vapor from hot, concentrated acid may injure lungs. Swallowing may cause severe injury or death. Contact with skin or eyes causes severe burns.<br>3.3 Treatment of Exposure: Call a doctor. INHALATION: Observe victim for delayed pulmonary reaction. INGESTION: Have victim drink water if possible, do NOT induce vomiting. EYES AND SKIN: Wash with large amounts of water for at least 15 min; do not use oils or ointments in eyes; treat skin burns.<br>3.4 TLV-TWA: 1 mg/m <sup>3</sup><br>3.5 TLV-STEL: Not listed<br>3.6 TLV-Ceiling: 3 mg/m <sup>3</sup> (max)<br>3.7 Toxicity by ingestion: No effects except those secondary to tissue damage.<br>3.8 Toxicity by inhalation: Currently not available.<br>3.9 Chronic Toxicity: None<br>3.10 Vapor (Gas) Irritant Characteristics: Vapors from hot acid (77-68%) cause moderate irritation of eyes and respiratory system. Effect is temporary.<br>3.11 Liquid or Solid Characteristics: 77-68% acid causes severe second- and third-degree burns of skin on short contact and is very injurious to the eyes.<br>3.12 Odor Threshold: Greater than 1 mg/m <sup>3</sup><br>3.13 IDLH Value: 15 mg/m <sup>3</sup><br>3.14 OSHA PEL-TWA: 1 mg/m <sup>3</sup><br>3.15 OSHA PEL-STEL: Not listed<br>3.16 OSHA PEL-Ceiling: Not listed<br>3.17 EPA ADGL: Not listed |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |           |           |     |                                                                                                                                                                                                                                                                                                         |
| 4. FIRE HAZARDS<br>4.1 Flash Point: Not flammable<br>4.2 Flammable Limits in Air: Not flammable<br>4.3 Fire Extinguishing Agents: Not pertinent<br>4.4 Fire Extinguishing Agents Not to Be Used: Water used on adjacent fire should be carefully handled.<br>4.5 Special Hazards of Combustion Products: Not pertinent<br>4.6 Behavior in Fire: Not flammable<br>4.7 Auto Ignition Temperature: Not flammable<br>4.8 Electrical Hazards: None<br>4.9 Burning Rate: Not flammable<br>4.10 Adiabatic Flame Temperature: Currently not available<br>4.11 Stoichiometric Air to Fuel Ratio: Not pertinent<br>4.12 Flame Temperature: Currently not available<br>4.13 Combustion Molar Ratio (Reactant to Product): Not pertinent<br>4.14 Minimum Oxygen Concentration for Combustion (MOCC): Not listed                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |           |           |     |                                                                                                                                                                                                                                                                                                         |
| 5. CHEMICAL REACTIVITY<br>5.1 Reactivity with Water: Reacts violently with evolution of heat. Spattering occurs when water is added to the compound.<br>5.2 Reactivity with Common Materials: Extremely hazardous in contact with many materials, particularly metals and combustibles. Dilute acid reacts with most metals, releasing hydrogen which can form explosive mixtures with air in confined spaces.<br>5.3 Stability During Transport: Stable<br>5.4 Neutralizing Agents for Acids and Caustics: Dilute with water; then neutralize with lime, limestone, or soda ash.<br>5.5 Polymerization: Not pertinent<br>5.6 Inhibitor of Polymerization: Not pertinent                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |           |           |     |                                                                                                                                                                                                                                                                                                         |
| 6. WATER POLLUTION<br>6.1 Aquatic Toxicity: 24.5 ppm/24 hr (bluegill/fresh water); 42.5 ppm/48 hr (palefin/Lake trout water)<br>6.2 Waterfowl Toxicity: Currently not available<br>6.3 Biological Oxygen Demand (BOD): None<br>6.4 Food Chain Concentration Potential: None<br>6.5 GESAMP Hazard Profile: Bioaccumulation: 0<br>Damage to living resources: 2<br>Human Oral Hazard: 3<br>Human Contact Hazard: 3<br>Reduction of amenities: 3X                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |           |           |     |                                                                                                                                                                                                                                                                                                         |
| 7. SHIPPING INFORMATION<br>7.1 Grades of Purity: CP, USP, Technical, at 53% to 98% (50° Be to 66° Be)<br>7.2 Storage Temperature: Ambient<br>7.3 Inert Atmosphere: No requirement<br>7.4 Venting: Open<br>7.5 IMO Pollution Category: C<br>7.6 Ship Type: 3<br>7.7 Sarge Hull Type: 3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |           |           |     |                                                                                                                                                                                                                                                                                                         |
| 8. HAZARD CLASSIFICATIONS<br>8.1 49 CFR Category: Corrosive material<br>8.2 49 CFR Class: 8<br>8.3 49 CFR Package Group: I<br>8.4 Marine Pollutant: No<br>8.5 NFPA Hazard Classification:<br>Category Classification<br>Health Hazard (Blue)..... 3<br>Flammability (Red)..... 0<br>Instability (Yellow)..... 2<br>8.6 EPA Reportable Quantity: 1000 pounds<br>8.7 EPA Pollution Category: C<br>8.8 RCRA Waste Number: Not listed<br>8.9 EPA FWCAL: Not listed                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |           |           |     |                                                                                                                                                                                                                                                                                                         |
| 9. PHYSICAL & CHEMICAL PROPERTIES<br>9.1 Physical State at 16° C and 1 atm: Liquid<br>9.2 Molecular Weight: 98.08<br>9.3 Boiling Point at 1 atm: 544° F + 347° C + 613° K<br>9.4 Freezing Point: Not pertinent<br>9.5 Critical Temperature: Not pertinent<br>9.6 Critical Pressure: Not pertinent<br>9.7 Specific Gravity: 1.84 at 20° C (liquid)<br>9.8 Liquid Surface Tension: Not pertinent<br>9.9 Liquid Water Interfacial Tension: Not pertinent<br>9.10 Vapor (Gas) Specific Gravity: Not pertinent<br>9.11 Ratio of Specific Heats of Vapor (Gas): Not pertinent<br>9.12 Latent Heat of Vaporization: Not pertinent<br>9.13 Heat of Combustion: Not pertinent<br>9.14 Heat of Decomposition: Not pertinent<br>9.15 Heat of Solution: +10.0 (solid) + -202.2 (liq) + -4,715 x 10 <sup>3</sup> J/kg<br>9.16 Heat of Polymerization: Not pertinent<br>9.17 Heat of Fusion: Currently not available<br>9.18 Limiting Value: Currently not available<br>9.19 Reid Vapor Pressure: Low. Physical properties apply to concentrated (98%) acid unless otherwise stated. More dilute acid is more volatile.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |           |           |     |                                                                                                                                                                                                                                                                                                         |
| NOTES                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |           |           |     |                                                                                                                                                                                                                                                                                                         |

Figure 4.2.9 B – MSDS for sulphuric acid

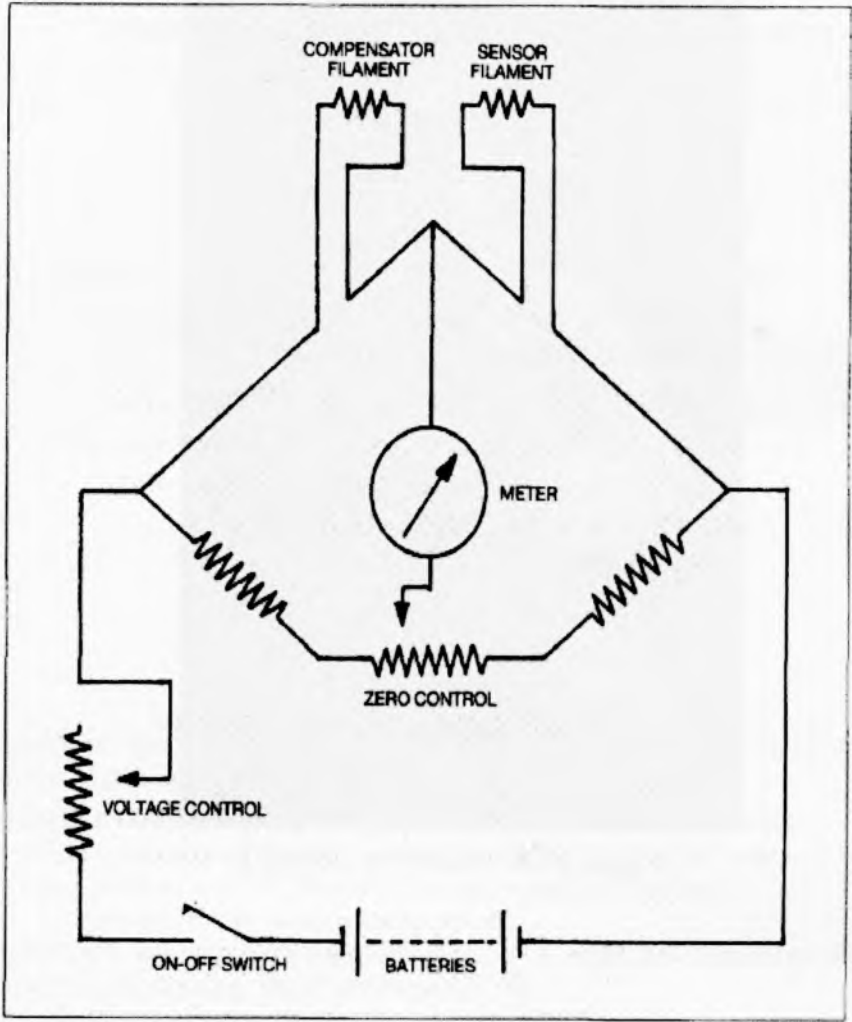


Figure 5.1 – Circuit diagram of a tankscope



Figure 5.2.2 – Protective clothing



Figure 5.3.1 – Entering enclosed space with SCBA



**TABLE 16**  
**HYDROFLUORIC ACID AND HYDROGEN FLUORIDE**

These chemicals are corrosive to living tissue. They may cause deep, slowly healing, and painful burns. Systemically, damage to the heart and convulsions may occur. Several fluorides react with water forming hydrogen fluoride.

The onset of local reactions, pain and other symptoms may be delayed up to 24 hours after exposure to lower concentrations. The surface of the skin may not be destroyed for several hours, but the increasing pain and redness indicate a continuing destruction of tissues underneath the skin.

**Treatment for EYE CONTACT in all cases of exposure, regardless of symptoms**

- IMMEDIATE washing of the eye with copious amounts of water.
- Remove contact lens.
- Keep the eyelids widely apart as illustrated.
- Direct water flow from inner to outer corner of the eye. Washing must be done thoroughly for ten minutes, timed by the clock.



- Anaesthetic eye drops should be instilled in the eye to ensure adequate irrigation of the eye. Further advice on eye treatment: See Table 7

**Treatment for SKIN CONTACT in all cases of exposure, regardless of symptoms**

- Chemical protective gloves and clothing should be used while washing the casualty's skin. After decontamination, it is not necessary to use protective clothing.
- Cut, if necessary, the clothes by using shears.
- IMMEDIATE washing with copious amounts of water for at least ten minutes while removing contaminated clothing, rings, wristwatches, etc.
- After washing with water for 10 minutes, dry skin.
- Using latex gloves, massage exposed area with calcium gluconate gel for at least 15 minutes or until pain is relieved. Leave the gel on the skin. The gel should be re-applied 4-6 times daily for 3-4 days if a chemical burn is present.
- If skin exposure exceeds 1% of body surface (approximately the size of the palm of the hand) and local symptoms (redness, pain, blisters)
- Give 5 g calcium gluconate, as effervescent tablets in 250 ml (1/2 pint) of water, to drink immediately and repeat two hours later. If calcium gluconate is not available, give milk.
- RADIO FOR MEDICAL ADVICE

Further advice on **treatment of skin burns**: See Table 8

**Treatment for INHALATION in all cases of exposure, regardless of symptoms**

- Remove the casualty from the polluted atmosphere, have him rinse his mouth and give one glass of water to drink.
- If breathlessness or wheezing are present, give oxygen at a flow rate of 8 litres per minute until symptoms resolve.
- RADIO FOR MEDICAL ADVICE
- Further advice on breathing problems: See Table 9

**Treatment for INGESTION in all cases of exposure, regardless of symptoms**

- RADIO FOR MEDICAL ADVICE
- Have the casualty rinse mouth with water.
- Give 5 g calcium gluconate, as effervescent tablets in 250 ml (1/2 pint) of water, to drink immediately and repeat two hours later. If calcium gluconate is not available, give milk.

**Figure 5.4.8 – MFAG sample extract**



Figure 6.1 – Fire safety: fire drill on a ship

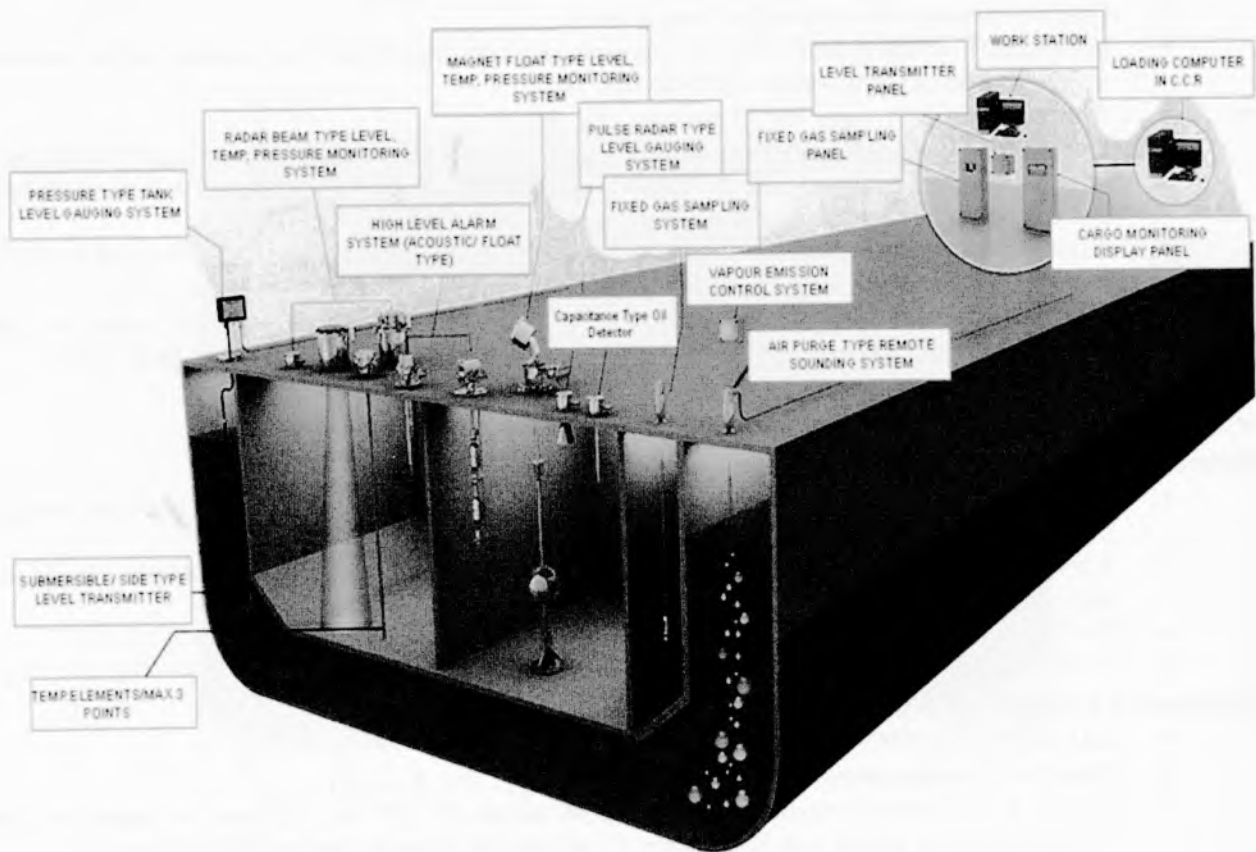
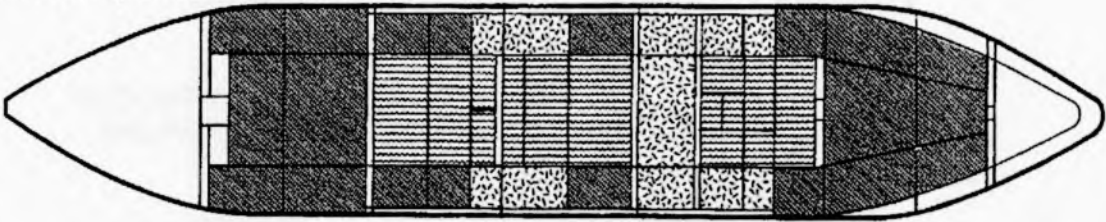
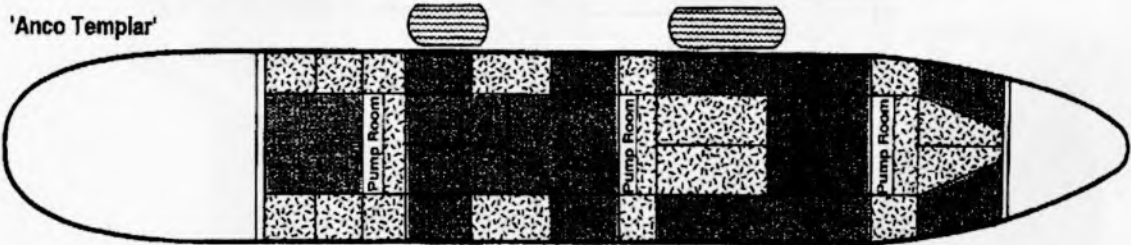


Figure 7.0 – Various tank instrumentation systems

'Stolt Pride' (individual hydraulic pumps)

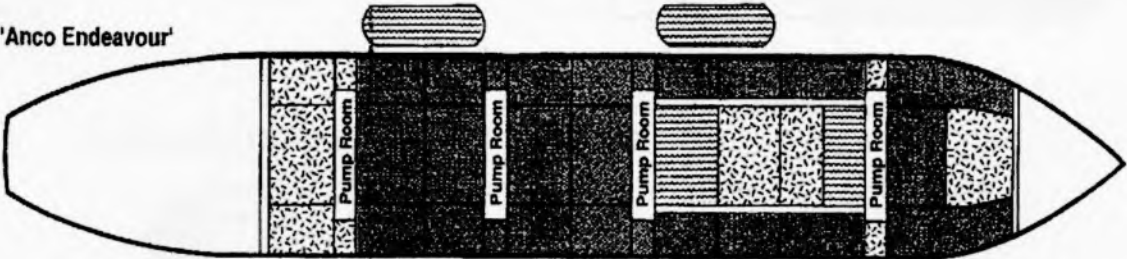


'Anco Templar'



Deck tanks

'Anco Endeavour'



Deck Tanks

■ Epoxy/Polyurethane-coated    ■ Phenolic-coated    ■ Zinc Silicate-coated    ■ Stainless Steel

Figure 7.2.3 A – Stowage planning for parcel tankers as per tank coatings



Figure 7.2.3 B – Restricted gauging and sampling equipment

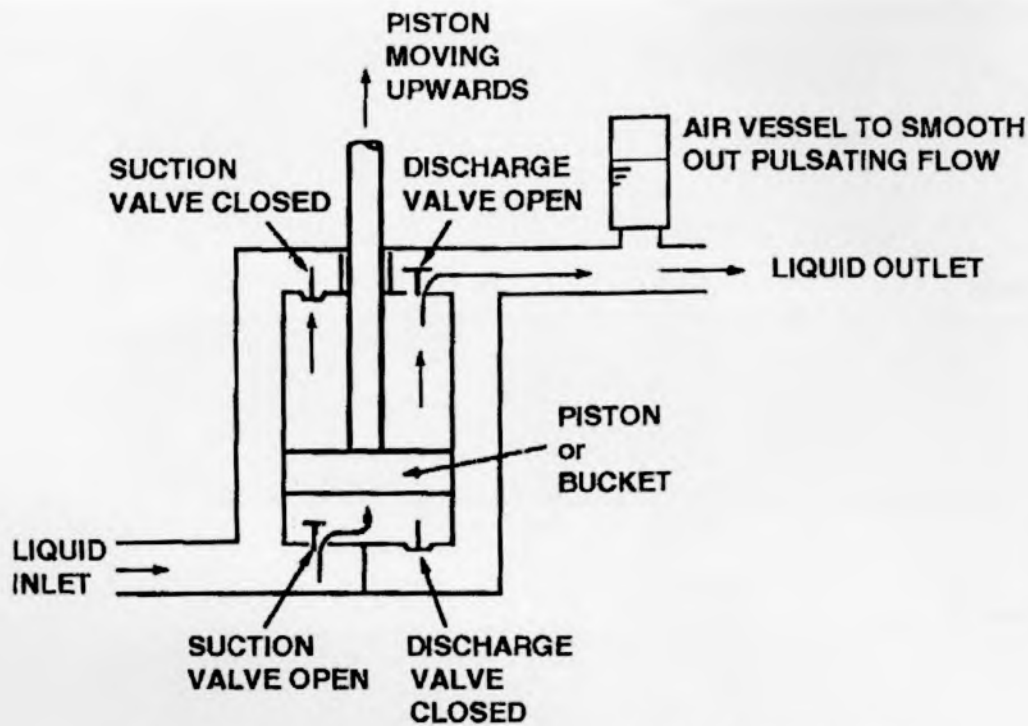


Figure 7.2.4 A – Operation of a reciprocating displacement pump

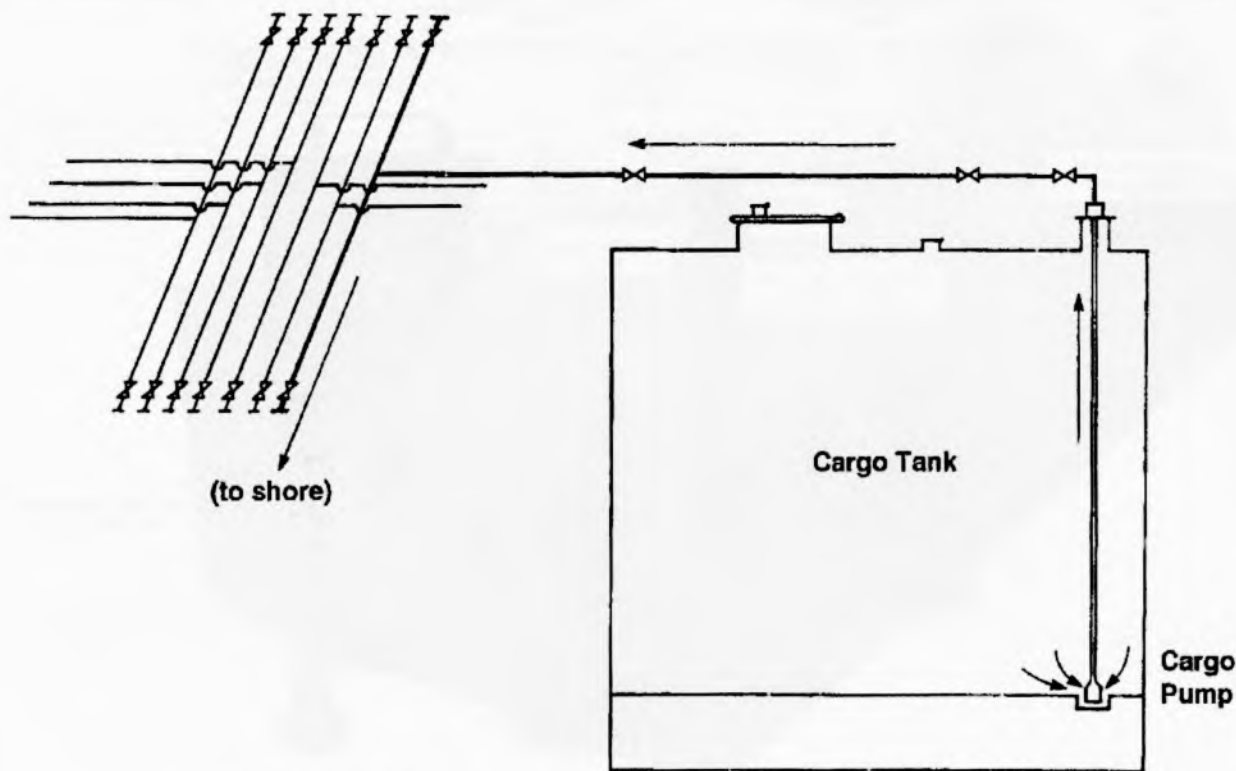


Figure 7.2.4 B – Unloading arrangements of a chemical tanker

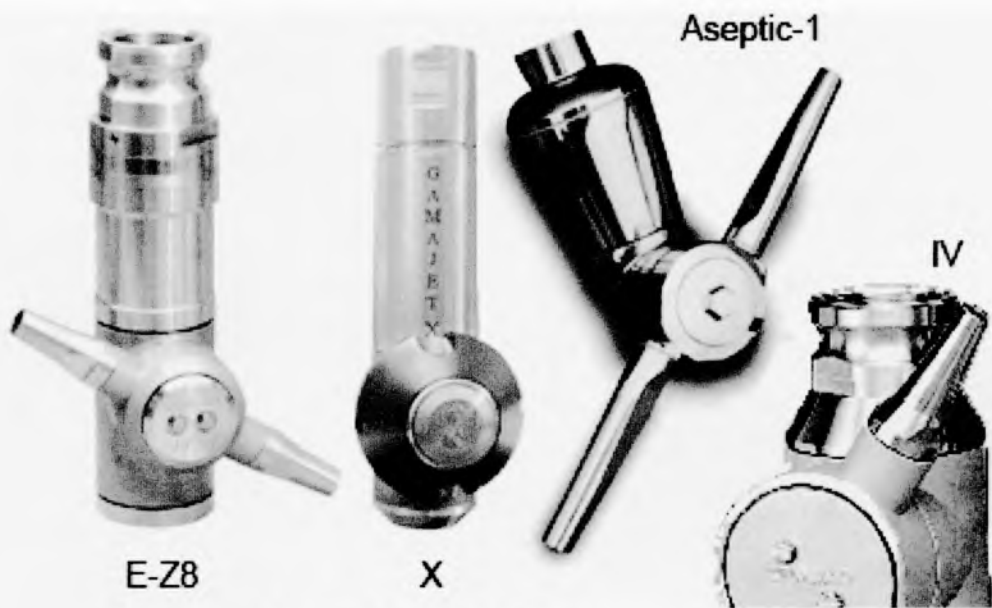


Figure 7.2.5 – Tank cleaning machines

HIGH AND OVERFILL ALARM SENSOR

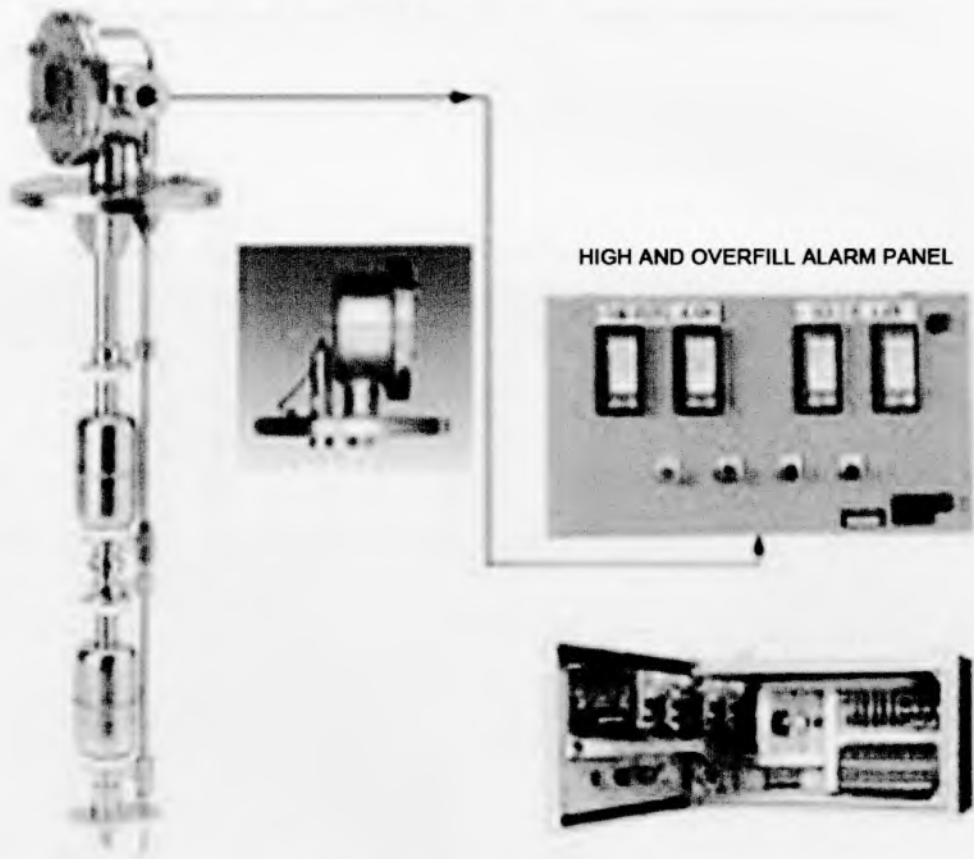
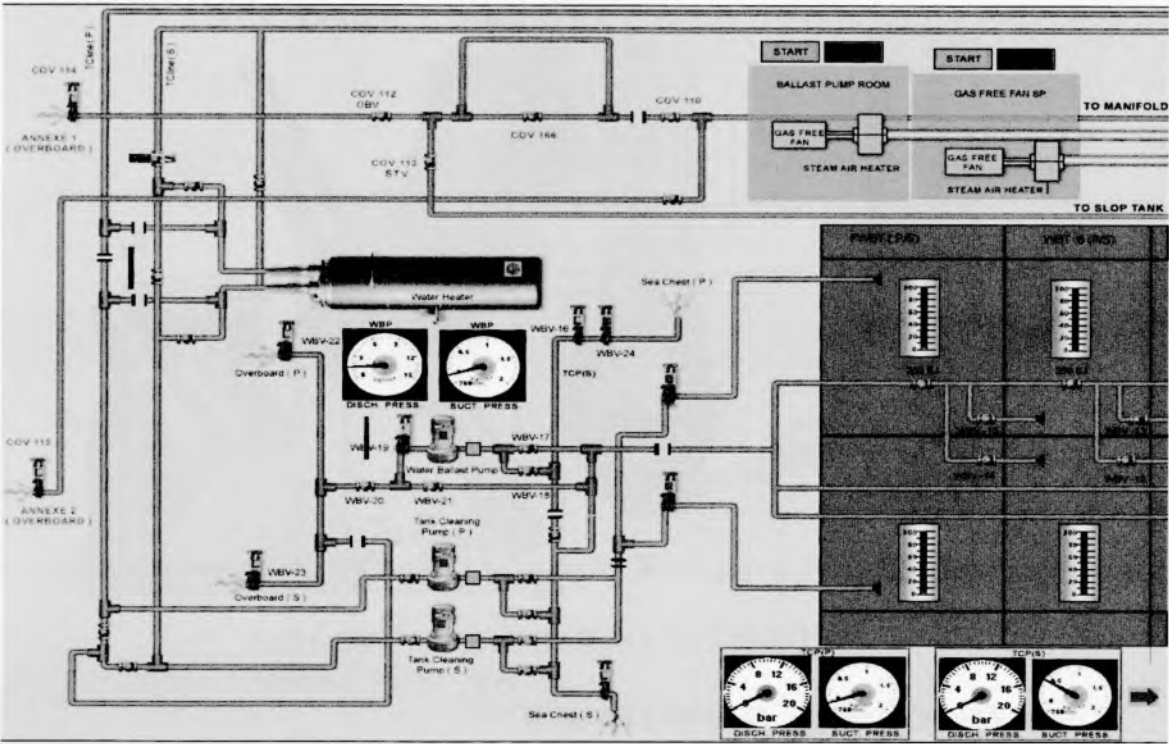
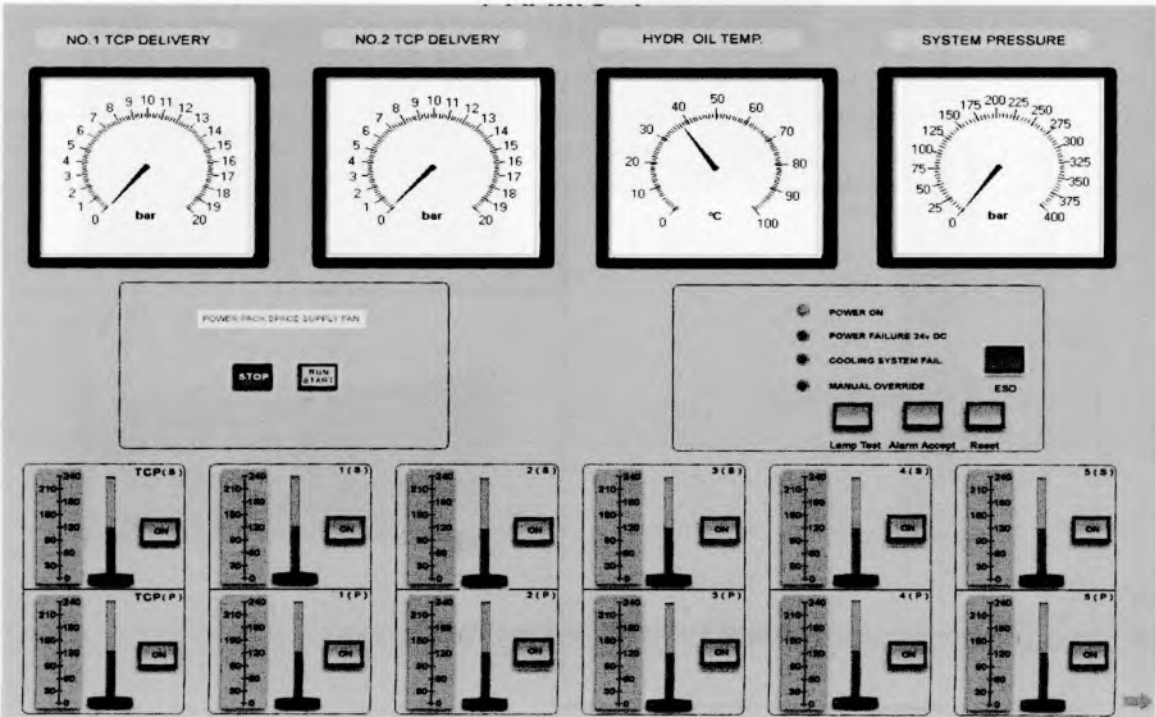


Figure 9.3 – High level and overflow alarms



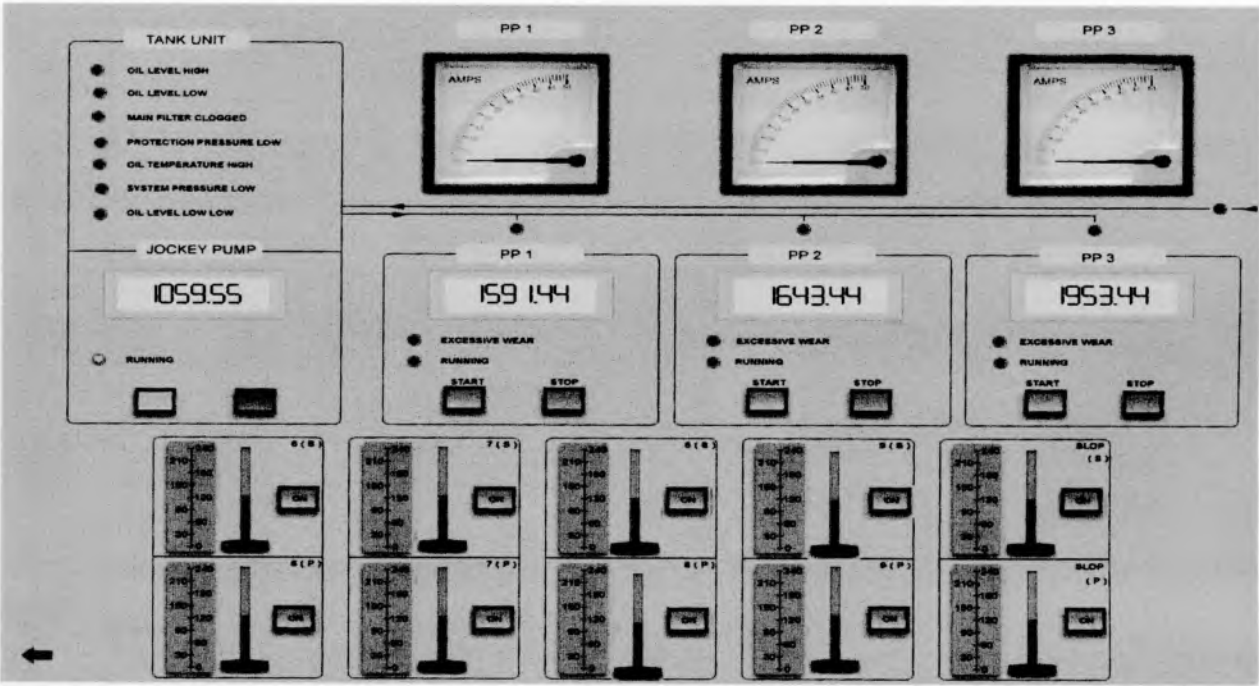


Chemical simulator Figure 1 – Ballast pump-room on a chemical tanker

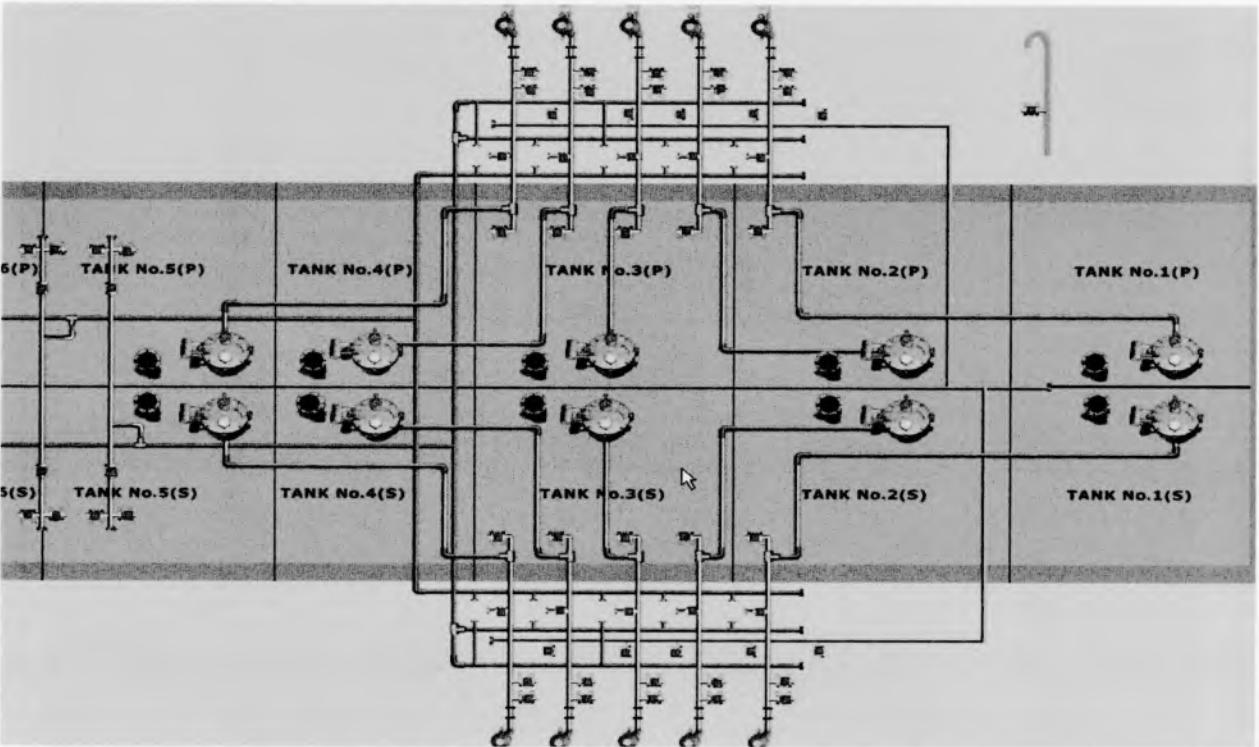


Chemical simulator Figure 2 – Pump-operating system on a tanker

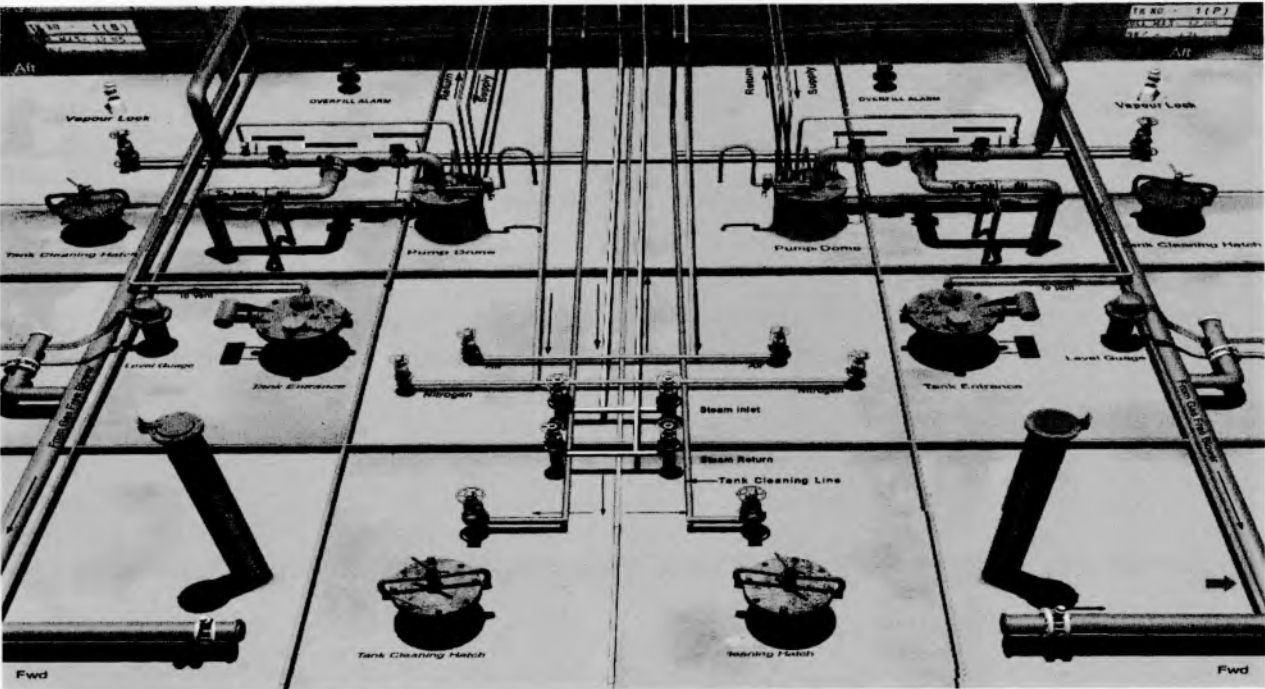




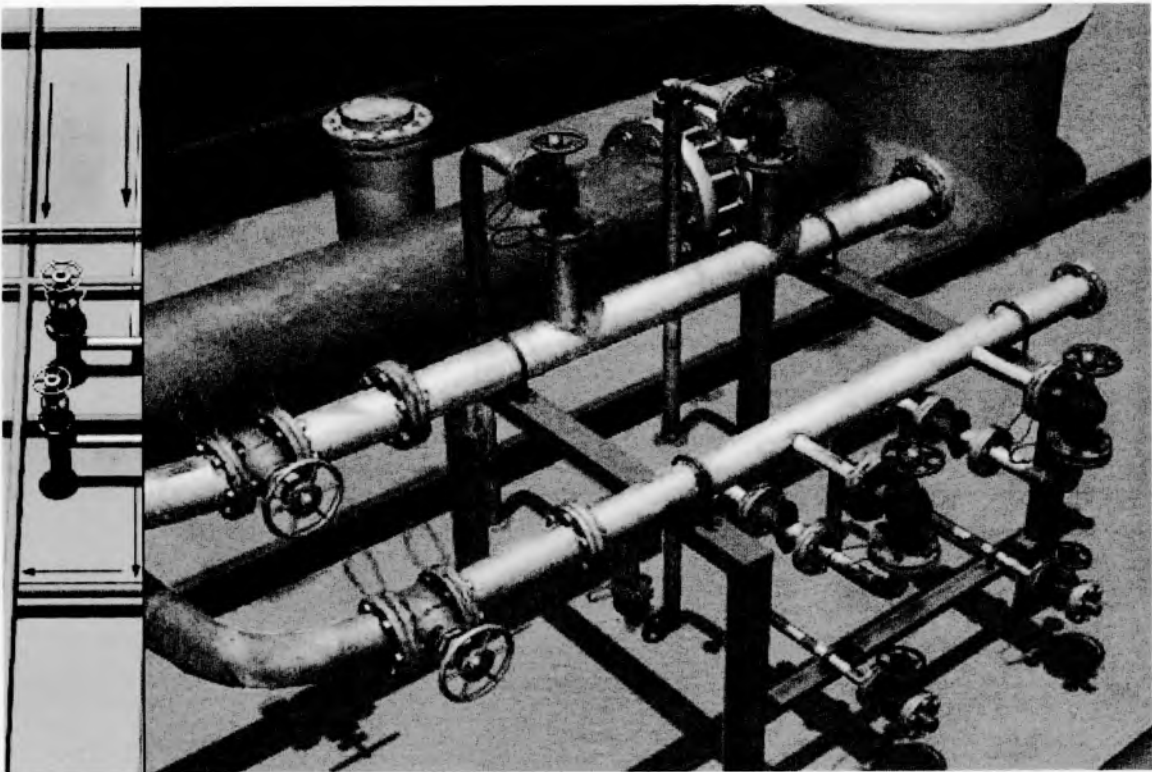
Chemical simulator Figure 3 – Power pack and hydraulic controls of a cargo pumping system



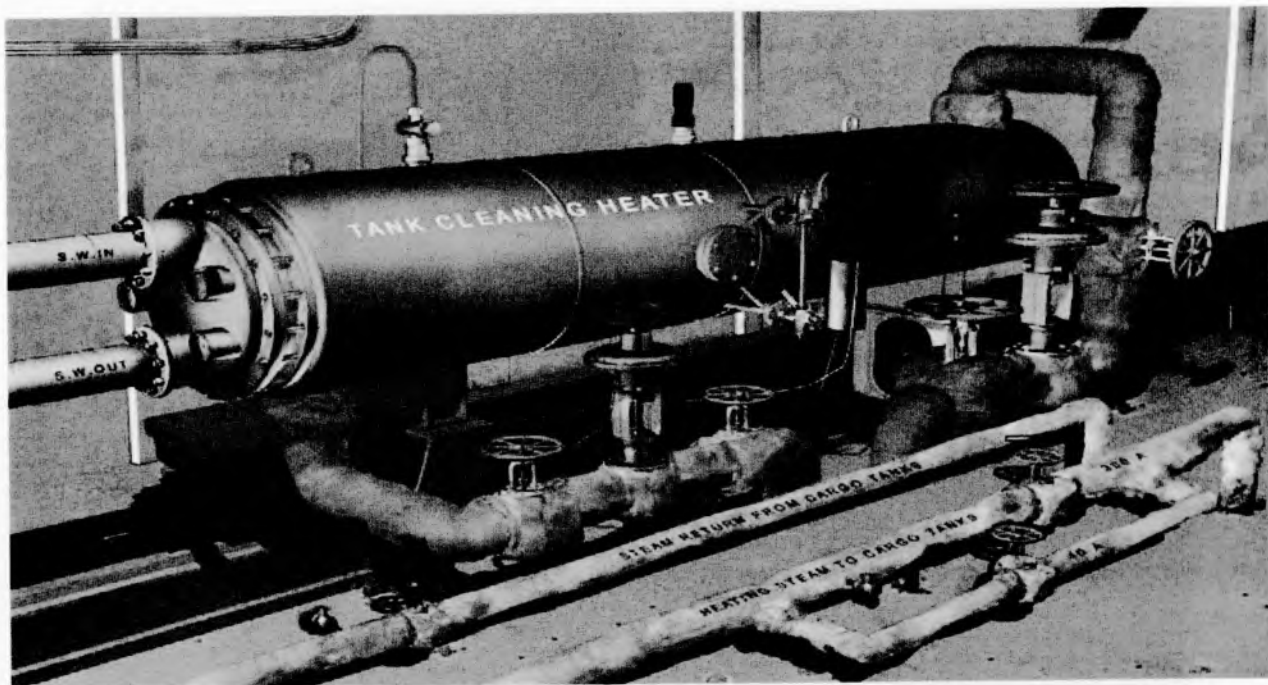
Chemical simulator Figure 4 – Venting system of a chemical tanker



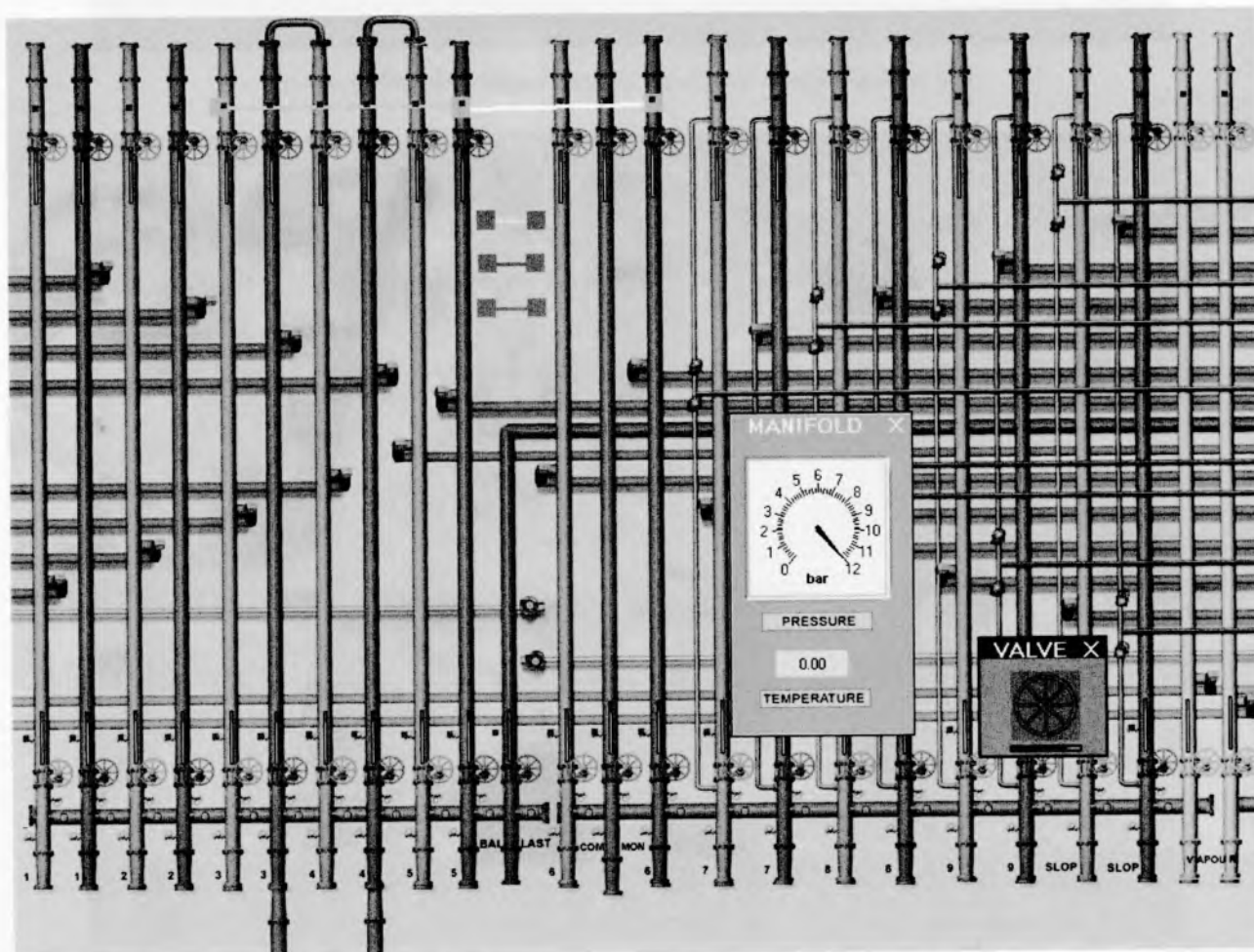
Chemical simulator Figure 5 – Main deck arrangements of a chemical tanker



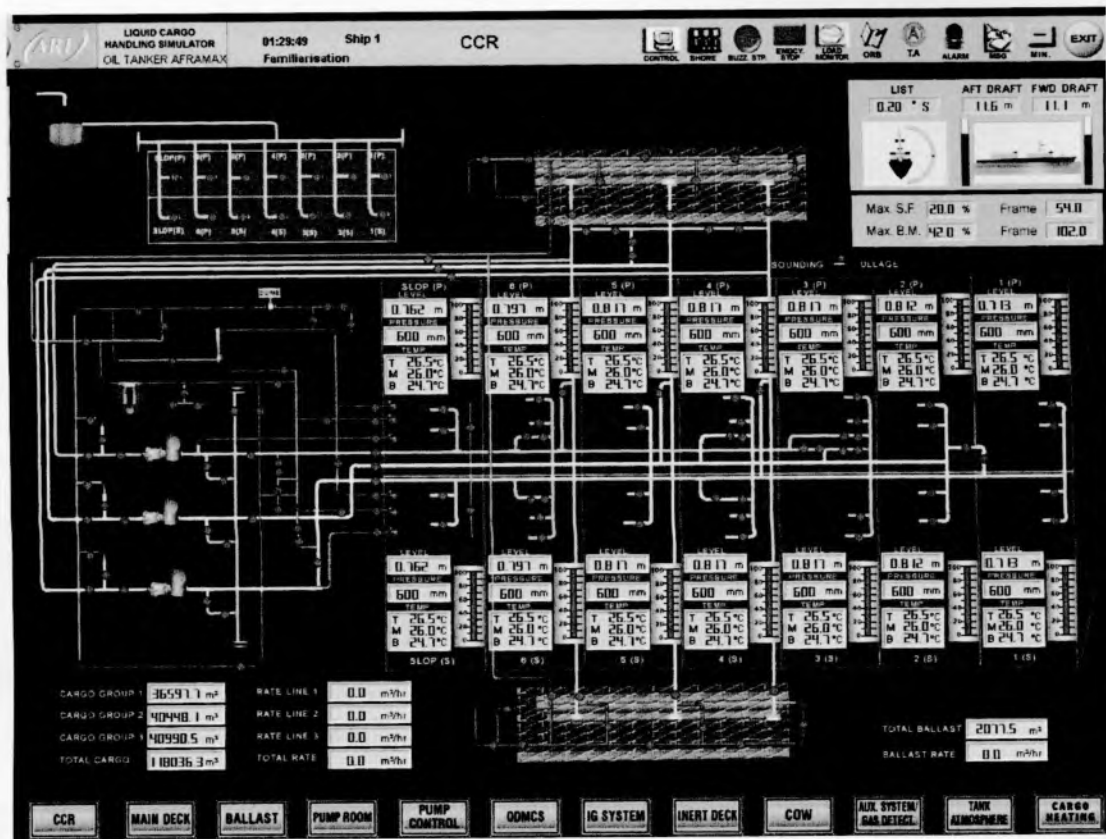
Chemical simulator Figure 6 – Tank heating arrangements on a chemical tanker's main deck



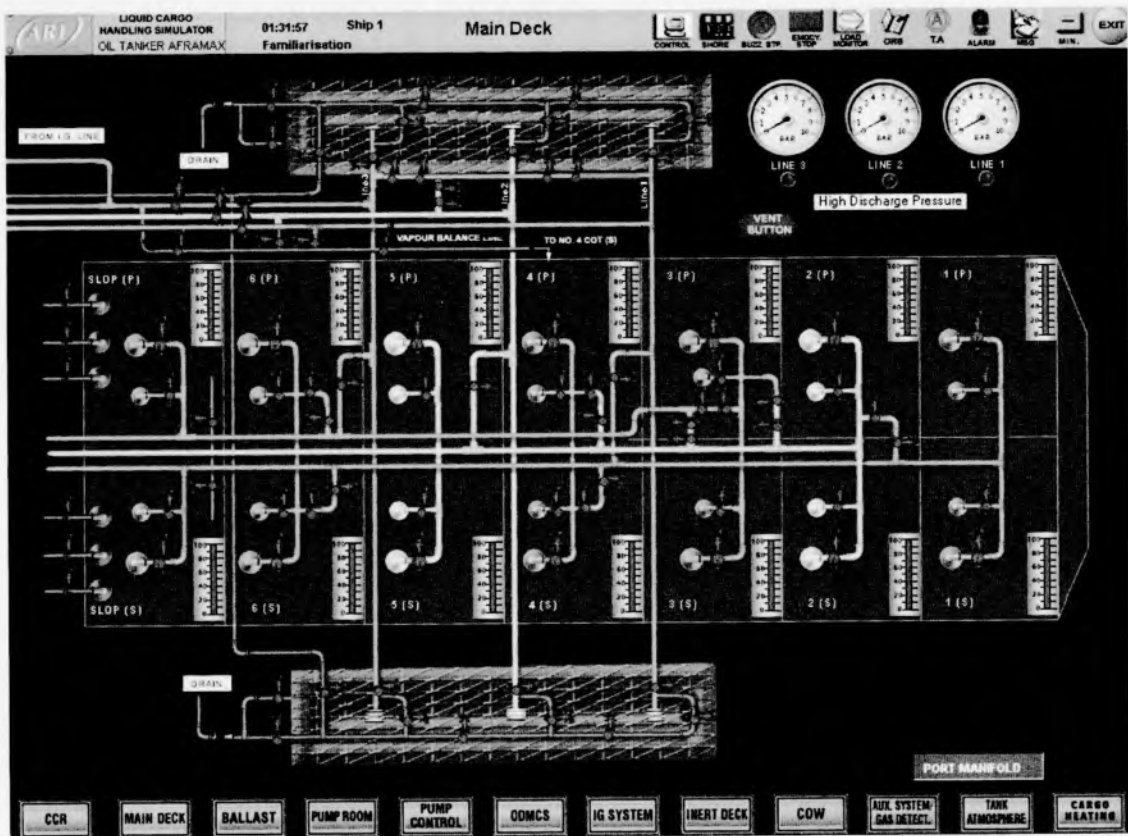
Chemical simulator Figure 7 – Tank cleaning heater



Chemical simulator Figure 8 – Manifold connections on a chemical tanker simulator

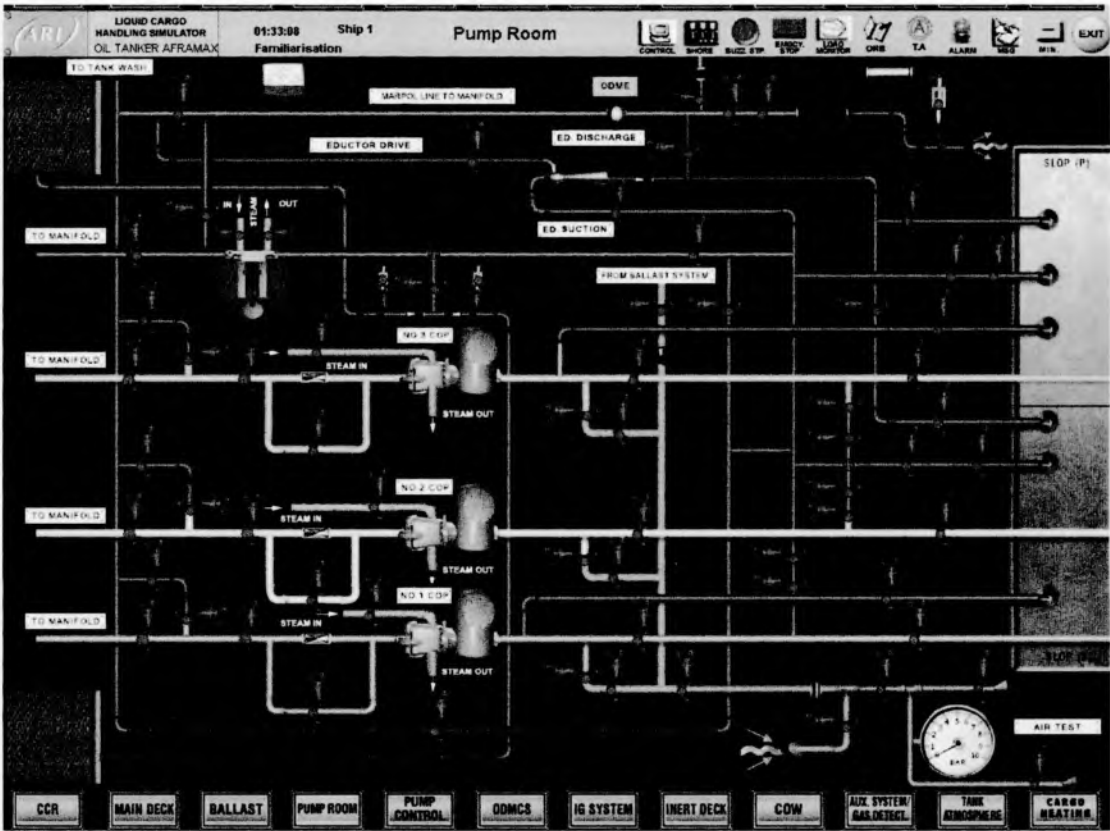


Oil tanker Figure 1 – Cargo control room simulator screen

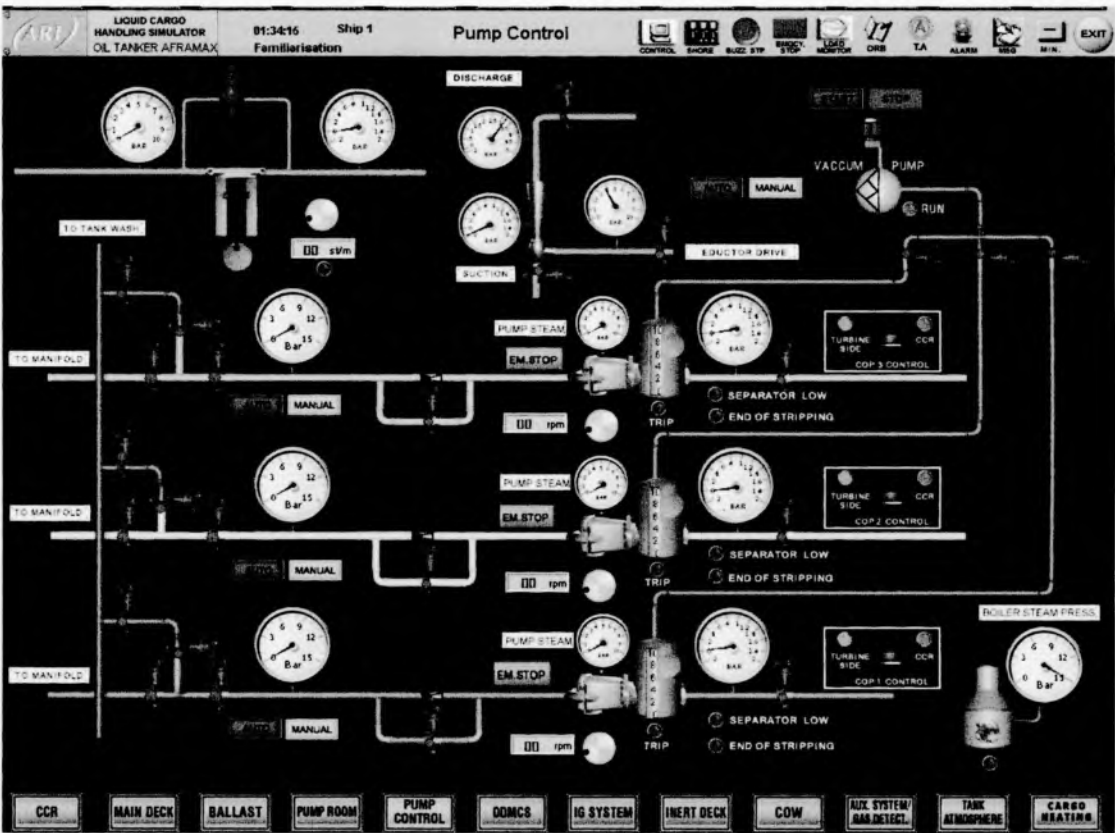


Oil tanker Figure 2 – Oil tanker pipeline arrangements simulator screen



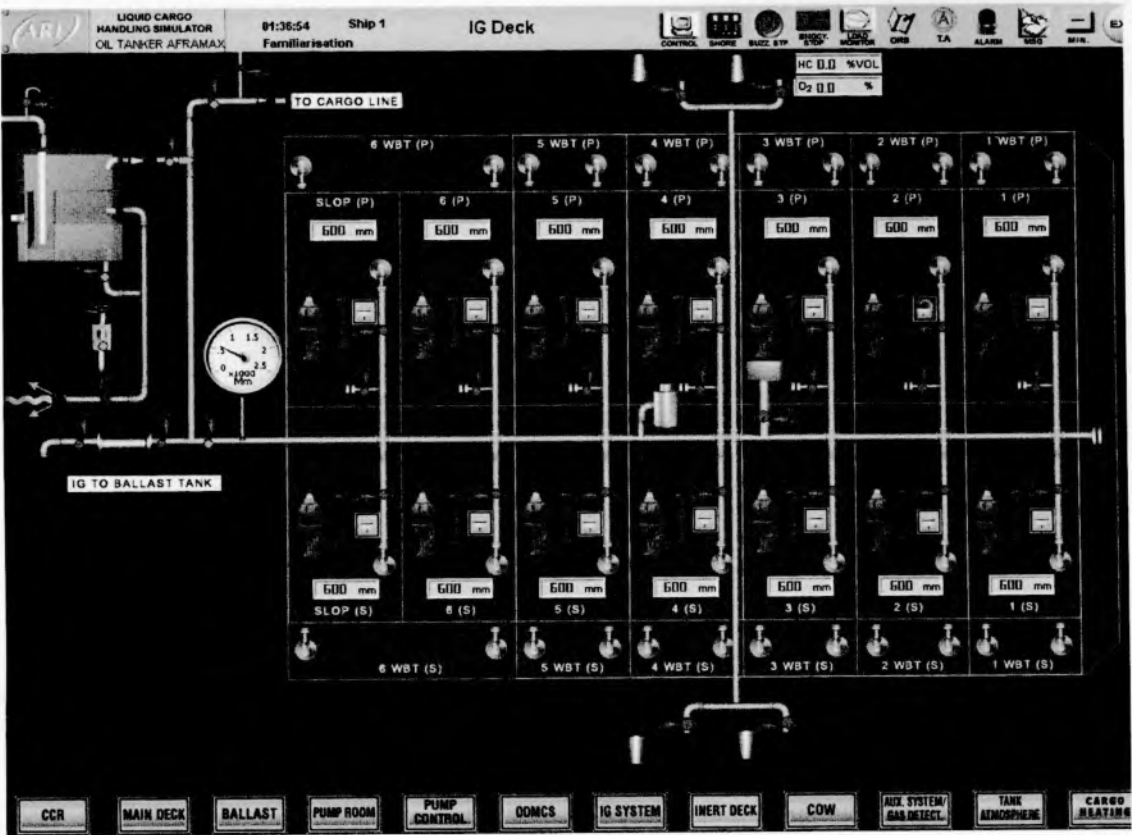


Oil tanker Figure 3 – Pump-room arrangements

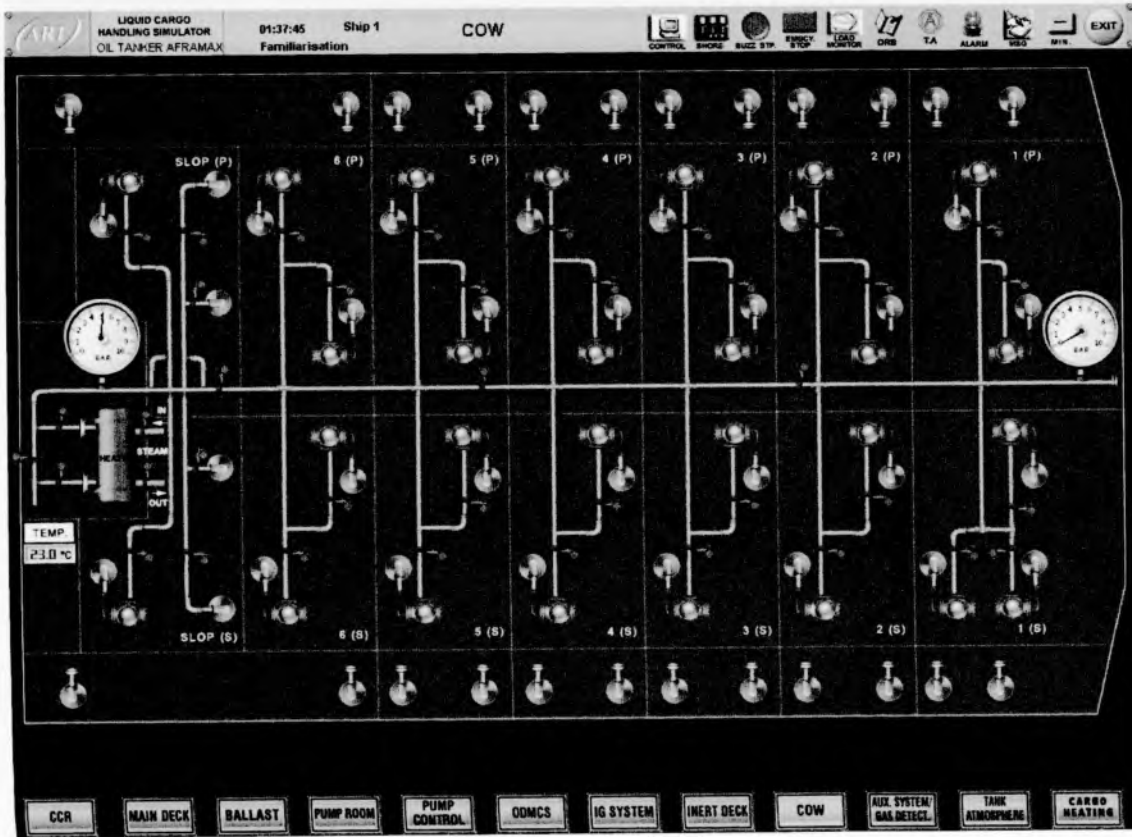


Oil tanker Figure 4 – Pump-control simulator screen





Oil tanker Figure 5 – IG and venting arrangements of an oil tanker simulator screen



Oil tanker Figure 6 – Crude oil washing arrangements oil tanker simulator screen

Appendix 2:  
**Instructor Simulator Guidance Notes**

## **Instructor Simulator Manual**

### **General**

The operational requirements of the course are recommended with the use of simulators.

### **Simulator exercises**

For guidance, preparing and conducting exercises, instructors may refer to the following IMO related model courses: 6.10 – Train the Simulator Trainer and Assessor; 1.37 – Chemical Tanker and Ballast Handling Simulator; and 2.06 – Oil Tanker Cargo and Ballast Handling Simulator.

The trainees will have varied knowledge and experience.

It is important, therefore, to encourage them to cooperate with each other, working together as a team during the exercise, and to show the initiative and enthusiasm that will bring the exercise to a successful conclusion.

An important aspect of cargo and ballast handling is safety, and it is vital to ensure that safe practices are used throughout the exercise. Safety should be stressed during the briefing. One major contribution to safety is the use of checklists, which should be prepared beforehand, possibly as part of the briefing procedure.

Role playing is an important element in the learning process, and with a number of trainees taking part in the exercises on the simulator could provide a stimulus to the process of gaining knowledge and understanding.

### **Preparing and conducting exercises**

If further exercises are to be developed, or the ones supplied in the course modified, it is important that they should not be too complex; otherwise the trainees might have difficulties in carrying out their tasks and duties within an allotted period of time.

An exercise should start with simple activities, making use of uncomplicated components such as valves, pumps, fluid systems, tanks etc. and move step by step into more complex activities.

The aim of the training programme is to use a step-by-step process to introduce the trainees to the range of activities associated with the operations of loading and unloading.

The simulator is designed to provide training for normal operational procedures. It is important that the trainees achieve a satisfactory level of competence under normal conditions.

The exercises should provide the trainees with the most realistic impression of actually being in a cargo control centre aboard ship. Realism is important for this type of learning process. For this reason, if the simulator has an associated sound system, it should be used.

### **Exercise scenarios**

The content of a scenario is governed to a large extent by the units and systems that are being simulated.

The syllabus used for the basic oil and chemical tanker course has been structured to provide some flexibility in this respect, and the scenarios can be prepared using those syllabus elements which match a specific simulator design.

For this course, scenarios should be designed to cover the operational areas contained in the syllabus; for example:

- familiarization with equipment and instrumentation
- loading
- unloading
- operational problems

The familiarization scenarios should aim at making the trainees not only feel “at home” with the units and systems being simulated, but should also provide some “hands-on” experience with the controls and some of the more basic equipment and operations, such as valves, pumps, pipe systems, instrumentation, filling and emptying tanks etc.

Further details regarding the content of the scenarios are provided in the guidance notes.

**Suggested exercise:** trace the lines on a simulator or line diagram provided for the following Cargo Operations:

- Loading liquid Cargo
- Unloading liquid Cargo

Appendix 3:  
**Suggested Case Study**



## Fire and Explosion during unloading operations

### *Incident summary*

At 0845 on September 16, 1990, the tanker vessel "M.T. ABC" caught fire and exploded during offloading operations at the Total Oil Company refinery on the Xxx river near Bay City, Michigan. A wake from a passing bulk carrier apparently caused the parting of the M.T. ABC's transfer hose, grounding cable, and all but one of its mooring lines. Residual gasoline in the broken transfer hose was believed to have been ignited by a spark on the dock. The M.T. ABC's stern swung around into the Xxx River and grounded perpendicular to the direction of the river flow. The grounding resulted in a crack in the vessel's hull from the manifold on the starboard side to 75 feet aft of the manifold on the port side.

Area was evacuated and vessel traffic was halted. The pier fire was extinguished in an attempt to save the last mooring line while the fire on board the vessel remained out of control. A shore company from Houston, Texas, was contracted to fight the fire due to the lack of locally available trained personnel and equipment. At 1315 on September 17, the shore personnel extinguished the blaze by applying foam. Carbon black accumulations falling from the overhead re-ignited the fire at 2300. This second blaze was cooled with water and extinguished with foam on September 18. The shore personnel also applied foam inside the vessel's cargo tanks to prevent re-ignition of the vessel.

River flow data were obtained to predict the oil movement. Shock waves from the explosion may have contributed to the deaths of several fish that were recovered from around the vessel. Neither pollution nor shoreline contamination was observed during the final survey of the area on October 22.

### *Behaviour of oil*

Automotive gasoline is a very lightweight, refined product with an API gravity of 60 to 63. No spill of product into the Xxx River was reported until first light on September 17 when fuel up to three inches thick was observed in the water immediately surrounding the vessel. Some of the spilled product was held against the hull of the vessel by the wind until the starboard side submerged, releasing an additional 100 barrels of the fuel. Since the gasoline was not released rapidly, little environmental damage resulted from the incident.

### *Countermeasures and mitigation*

On September 16, containment boom was deployed around the vessel as a precaution against further spillage. The boom remained in place until the vessel was re-floated on October 16 and moved to the north side of the river. No product was observed leaking from the vessel as it was relocated. Vacuum trucks were used to recover the gasoline and water mixture. Approximately 262 barrels were recovered by September 28. Small amounts of carbon residue that impacted the shoreline were manually raked from beaches in the area. On September 19, gasoline odours were reported in the sewers of a residential community near the incident site. Contractors were dispatched to flush and foam the sewers. Sections of boom and a combustible gas detector were set up to monitor the sewer outfall.

On September 27, approximately 770 barrels of product were offloaded from the M.T. ABC to a lightering barge. Gas freeing operations began on October 5, due to the explosion threat posed by some isolated pockets of product remaining in the #6 starboard cargo tank. Offloaded product was replaced with water to reduce the structural stress to the damaged vessel. Since trace concentrations of benzene, toluene, ethyl benzene, and xylene isomers were found in water samples near the M.T. ABC, water at a nearby water treatment plant was treated with ozone as a precaution.

### *Other Special Interest Issues*

The fire-fighting foam that was used on the fire was water soluble and moderately toxic. Contaminated water from the fire-fighting operation was collected and brought to a Bay City Wastewater

Sample questions for discussion with course participants

- Q1.** What is/are the main cause of fire and explosion on board MT ABC?
- Q2.** In your opinion what could be the essential precautions/good practices that might not have been followed led to this eventuality? Where are these precautions/good practices captured?
- Q3.** What other damages occurred on board and in the river Xxx near Bay City area, Michigan?
- Q4.** Discuss the actions that would have prevented fire and explosion on board MT ABC?
- Q5.** Discuss the lessons learnt from this case.

Appendix 4:  
**Suggested Case Study**

| Time                  | Event                                                                                                                                                                                                                                                        |
|-----------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 4 <sup>th</sup> April | Following personnel entered 3S COT for squeegeeing the remaining cargo of Tallow. The tank's atmosphere had been checked. Enclosed space entry permit issued. Gases were measured as O <sub>2</sub> : 20.9%; HC: 0% LEL; CO: 0 ppm; H <sub>2</sub> S: 0 ppm: |
| 1)                    | AB                                                                                                                                                                                                                                                           |
| 2)                    | AB                                                                                                                                                                                                                                                           |
| 3)                    | AB                                                                                                                                                                                                                                                           |
| 4)                    | Pump man                                                                                                                                                                                                                                                     |
| 5)                    | OS                                                                                                                                                                                                                                                           |
| 6)                    | DTSM                                                                                                                                                                                                                                                         |

**WHAT HAPPENED?**

While squeegeeing the cargo of Tallow (US packer Inedible Tallow) in 3S COT. DTSM & AB collapsed and became unconscious.

**INCIDENT:**

Both of the above mentioned crew members were among the 6 persons who went down to squeeze the cargo. While halfway through the squeezing, these men felt little uneasy and decided to come up.

At 0305LT DTSM came up and within 5 minutes AB also came up.

After coming up on deck both collapsed and became unconscious.

By that time vessel had already informed terminal and agents had called for medical help from shore.

AT 0325 both the men were transferred to the hospital by two ambulances. Before they were taken to the hospital, they were administered First Aid in the form of Oxygen and I. V. fluids by the medical staff inside the ambulance.

Both returned to the vessel and both signed off being unfit for duty for 3 weeks.

Sample questions for discussion with course participants

- Q1.** What could be the main cause(s) of collapsing of DTSM and AB?
- Q2.** In your opinion what could be the essential precautions/good practices that might not have been followed led to this eventuality? Where are these precautions/good practices captured?
- Q3.** What should be the immediate action to be taken in such cases? From where will you get the information for taking such action?
- Q4.** Discuss the lessons learnt from this case.

**Note:** The questions mentioned above are sample questions and are for reference. The lecturers/instructors are free to modify, add more questions as per the skill, level of knowledge and experience of the participants.

## **Part E: Assessment and Evaluation**

The effectiveness of any evaluation depends to a great extent on the precision of the description of what is to be evaluated. The detailed teaching syllabus is thus designed to assist the instructors, with descriptive verbs, mostly taken from the widely used Bloom's taxonomy.

Evaluation/Assessment is a way of finding out if learning has taken place. It enables the assessor (instructor) to ascertain if the learner has gained the required skills and knowledge needed at a given point towards a course or qualification.

### **The purpose of evaluation/assessment is to:**

- To assist student learning.
- To identify students' strengths and weaknesses.
- To assess the effectiveness of a particular instructional strategy.
- To assess and improve the effectiveness of curriculum programs.
- To assess and improve teaching effectiveness.

The different types of evaluation/assessment can be classified as:

### **Initial/Diagnostic assessment**

This should take place before the trainee commences a course/qualification to ensure they are on the right path. Diagnostic assessment is an evaluation of a trainee's skills, knowledge, strength and areas for development. This can be carried out during an individual or group setting by the use of relevant tests.

### **Formative assessment**

Is an integral part of the teaching/learning process and hence is a "Continuous" assessment. It provides information on trainees' progress and may also be used to encourage and motivate them.

### **Purpose of formative assessment**

- To provide feedback to students.
- To motivate students.
- To diagnose students' strengths and weaknesses.
- To help students to develop self-awareness.

### **Summative assessment**

It is designed to measure trainee's achievement against defined objectives and targets. It may take the form of an exam or an assignment and takes place at the end of a course.

### **Purpose of summative assessment**

- To pass or fail a trainee
- To grade a trainee

### **Evaluation for Quality assurance**

Evaluation can also be required for quality assurance purposes.

### **Purpose of assessment with respect to quality assurance**

- To provide feedback to instructors on trainee's learning
- To evaluate a module's strengths and weaknesses

- To improve teaching
- Assessment Planning

Assessment planning should be specific, measurable, achievable, realistic and timebound (SMART).

Some methods of assessment that could be used depending upon the course/qualification are as follows and should all be adapted to suit individual needs.

- Observation (in Oral examination, Simulation exercises, Practical demonstration)
- Questions (written or oral)
- Tests
- Assignments, activities, projects, tasks and/or case studies
- Simulations (also refer to section A-I/12 of the STCW Code as amended)
- CBT

### Validity

The evaluation methods must be based on clearly defined objectives, and it must truly represent what is meant to be assessed, for example only the relevant criteria and the syllabus or course guide. There must be a reasonable balance between the subject topics involved and also in the testing of trainees' KNOWLEDGE, UNDERSTANDING AND PROFICIENCY of the concepts.

### Reliability

Assessment should also be reliable (if the assessment was done again with a similar group/learner, would you receive similar results). We may have to deliver the same subject to different group of learners at different times. If other assessors are also assessing the same course/qualification as us, we need to ensure we are all making the same decisions.

To be reliable an evaluation procedure should produce reasonably consistent results no matter which set of papers or version of the test is used.

If the Instructors are going to assess their own trainees, they need to know what they are to assess and then decide how to do this. The *what* will come from the standards/learning outcomes of the course/qualification they are delivering. The *how* may already be decided for them if it is an assignments, tests or examinations.

The instructors need to consider the best way to assess the skills, knowledge and attitudes of our learners, whether this will be formative and/or summative and how the assessment will be valid and reliable.

All work assessed should be valid, authentic, current, sufficient and reliable; this is often known as VACSR – “valid assessments create standard results”.

- Valid – the work is relevant to the standards/criteria being assessed
- Authentic – the work has been produced solely by the learner
- Current – the work is still relevant at the time of assessment
- Sufficient – the work covers all the standards/criteria
- Reliable – the work is consistent across all learners, over time and at the required level

It is important to note that no single methods can satisfactorily measure knowledge and skill over the entire spectrum of matters to be tested for the assessment of competence.

Care should therefore be taken to select the method most appropriate to the particular aspect of competence to be tested, bearing in mind the need to frame questions which relate as realistically as possible to the requirements of the officer's job at sea.



## STCW Code as amended

The training and assessment of seafarers, as required under the Convention, are administered, supervised and monitored in accordance with the provisions of section A-I/6 of the STCW Code, as amended.

Column 3 – Methods for demonstrating competence and Column 4 – Criteria for evaluating competence in table A-V/1-1-1 (Specification of minimum standard of competence in basic training for oil and chemical tanker cargo operations) of STCW Code as amended, set out the methods and criteria for evaluation.

Instructors should refer to this table when designing the assessment.

Instructors may follow the same guidelines for evaluating competence as stated in section B-V/1-1 paragraph 20, 21 and 22, 23 for assessment as given below:

### Evaluation of competence

- .17 The arrangements for evaluating competence should be designed to take account of different methods of assessment which can provide different types of evidence about candidates' competence, e.g.:
- .1 direct observation of work activities (including seagoing service);
  - .2 skills/proficiency/competency tests;
  - .3 projects and assignments;
  - .4 evidence from previous experience; and
  - .5 written, oral and computer-based questioning techniques.
- .18 One or more of the first four methods listed should almost invariably be used to provide evidence of ability, in addition to appropriate questioning techniques to provide evidence of supporting knowledge and understanding.

Assessment is also covered in detail in another IMO model course; however, to assist and aid the instructors, some extracts from the model course are used to explain in depth.

### Multiple choice questions

Marking or scoring is easier if multiple-choice test items are used, but in some cases difficulties may arise in creating plausible distracters.

Detailed sampling allows immediate identification of errors of principle and those of a clerical nature. It must be emphasized that this holds true, in general, only if the test item is based on a single step in the overall calculation. Multiple-choice items involving more than one step may, in some cases, have to be resorted to in order to allow the creation of a sufficient number of plausible distracters, but care must be exercised to ensure that distracters are not plausible for more than one reason if the nature of the error made (and hence the distracter chosen) is to affect the scoring of the test item.

### Compiling tests

Whilst each examining authority establishes its own rules, the length of time which can be devoted to assessing the competence of candidates for certificates of competency is limited by practical, economic and sociological restraints. Therefore a prime objective of those responsible for the organization and administration of the examination system is to find the most efficient, effective and economical method of assessing the competency of candidates. An examination system should effectively test the breadth of a candidate's knowledge of the subject areas pertinent to the tasks he is expected to undertake. It is not possible to examine candidates fully in all areas, so in effect the examination samples a candidate's knowledge by covering as wide a scope as is possible within the time constraints and testing his depth of knowledge in selected areas.

The examination as a whole should assess each candidate's comprehension of principles, concepts and methodology; his ability to apply principles, concepts and methodology; his ability to organize facts, ideas and arguments and his abilities and skills in carrying out those tasks he will be called upon to perform in the duties he is to be certificated to undertake.

All evaluation and testing techniques have their advantages and disadvantages. An examining authority should carefully analyse precisely what it should be testing and can test. A careful selection of test and evaluation methods should then be made to ensure that the best of the variety of techniques available today is used. Each test shall be that best suited to the learning outcome or ability to be tested.

### **Quality of test items**

No matter which type of test is used, it is essential that all questions or test items used should be as brief as possible, since the time taken to read the questions themselves lengthens the examination. Questions must also be clear and complete. To ensure this, it is necessary that they be reviewed by a person other than the originator. No extraneous information should be incorporated into questions; such inclusions can waste the time of the knowledgeable candidates and tend to be regarded as 'trick questions'. In all cases, the questions should be checked to ensure that they measure an objective which is essential to the job concerned.

### **Please address your comments to:**

Maritime Safety Division  
International Maritime Organization  
4 Albert Embankment  
London SE1 7SR  
UK  
[Telefax (+) 44 171 587 3210]

## Annex 1 – Support Materials

This additional material is meant for guidance only and plays a secondary role to the model course.

The following support materials are designed to motivate instructors and facilitate different teaching techniques.

- Sample scheme of work
- Sample lesson plan
- Sample participant's handout and presentation

They are designed for **Basic training for oil and chemical tanker cargo operations**

*Competence* – Contribute to the safe cargo operations of oil and chemical tankers.

*Training Outcome* – Basic knowledge of tankers

*Required Performance* – Basic knowledge of cargo operations on oil and chemical tankers.

The scheme of work and sample lesson plan are provided in Word format so that

instructors can use it as a foundation to build upon and amend the content to suit their teaching style and students' needs.

### Scheme of work

The scheme of work sets out the teaching programme, batch by batch, for each course being taught. It includes the content that needs to be covered, the learning objectives involved at each stage, the main activities and resources which will enable these to be achieved and the ways in which they will be assessed. It will also identify which instructors are involved in teaching the entire unit, in case there is more than one instructor to cover the entire unit. This facilitates the same learning conditions to all the batches even if different faculty is involved.

### Lesson plan

A lesson plan is a well-structured plan of the objective, goals, activities for a particular class on a particular subject for a particular duration, say for an hour or a 3 hour lesson, and acts as a guide for the instructor in order to teach the topic efficiently in that stipulated time covering all the topics required to be taught.

It is usually developed by the instructor who is teaching or lecturing on that topic; however, departments and institutes may have their own planners or curriculum leaders who would want the instructors to teach the particular subject in a particular manner, subject to tailoring by the instructor to meet their style and students' requirement, and to improve the teaching-learning cycle.

The scheme of work and lesson plan provided is for the sake of guidance only as no two schemes of work and lesson plans are likely to be the same, and certainly no two instructors construct a scheme of work and lesson plan in the same way.

## Annex 2 – Sample Format for a Scheme of Work

| Academic Year:                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Start Date: | End Date:    | Lecturer (s): | Module/Unit/Topic:                                                                                      |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------|--------------|---------------|---------------------------------------------------------------------------------------------------------|
| 2012-13                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | XX XXX 2012 | XX XXXX 2012 | XXXX          | Contribute to the safe cargo operation of oil and chemical tankers (Topic 1 Basic knowledge of tankers) |
| <b>Aims/Outcomes:</b> To demonstrate basic knowledge of tankers                                                                                                                                                                                                                                                                                                                                                                                                                  |             |              |               |                                                                                                         |
| <b>General Learning Objectives:</b><br><br>At the end of the session the students will be able to : <ol style="list-style-type: none"> <li>1. identify and distinguish types of oil and chemical tankers</li> <li>2. list important stages in the development of oil and chemical tankers</li> <li>3. identify with the aid of a sketch the general arrangements of oil and chemical tankers</li> <li>4. describe the piping arrangements of oil and chemical tankers</li> </ol> |             |              |               |                                                                                                         |
| Duration: 2 hours                                                                                                                                                                                                                                                                                                                                                                                                                                                                |             |              |               |                                                                                                         |

### Scheme of Work

| S. No. | Week | No. of hours | Objectives                                                                                                                                   | Resources                                                                                                                                                                                                                                                                                                                                  | Lecturer | Assessment                    |
|--------|------|--------------|----------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|-------------------------------|
| 1      | XX   | 0.25         | Identify and distinguish types of oil tankers.<br><br>List important stages in the development of oil tankers.                               | Lesson plan, Participant's handout, Instructor manual, Textbooks/ Reference books PowerPoint presentation(s), Loose printouts of all Activity sheets, Transparencies and blank papers, OHP, OHP Markers, White board Pens/Black board chalks.                                                                                              | XXXX     | Q & A session                 |
| X      | XX   | 0.25         | Identify and distinguish types of chemical tankers.<br><br>List important stages in the development of chemical tankers.                     | Lesson plan, Participant's handout, Instructor manual, Textbooks/ Reference books, PowerPoint presentation(s), Loose printouts of all Activity sheets, Transparencies and blank papers, OHP, OHP Markers, White board Pens/Black board chalks (different colours), Quiz sheets for recapping previous learnt topic, Answers for above quiz | XXXX     | Verbal/ Written Q & A session |
| X      | XX   | 0.5          | Identify with the aid of a sketch the general arrangements of oil tankers.<br><br>Describe the piping arrangements of oil tankers.           | Lesson plan, Participant's handout, Instructor manual, Textbooks/ Reference books, PowerPoint presentation(s), Loose printouts of all Activity sheets, Transparencies and blank papers, OHP, OHP Markers, White board Pens/Blackboard chalks (different colours), Quiz sheets for recapping previous learnt topic, Answers for above quiz  | XXXX     | Verbal/ Written Q & A session |
| X      | XX   | 0.5          | Identify with the aid of a sketch the general arrangements of chemical tankers.<br><br>Describe the piping arrangements of chemical tankers. | Lesson plan, Participant's handout, Instructor manual, Textbooks/ Reference books, PowerPoint presentation(s), Loose printouts of all Activity sheets, Transparencies and blank papers, OHP, OHP Markers, White board Pens/Blackboard chalks (different colours), Quiz sheets for recapping previous learnt topic, Answers for above quiz  | XXXX     | Verbal/ Written Q & A session |



### Annex 3 – Sample Format for a Lesson Plan

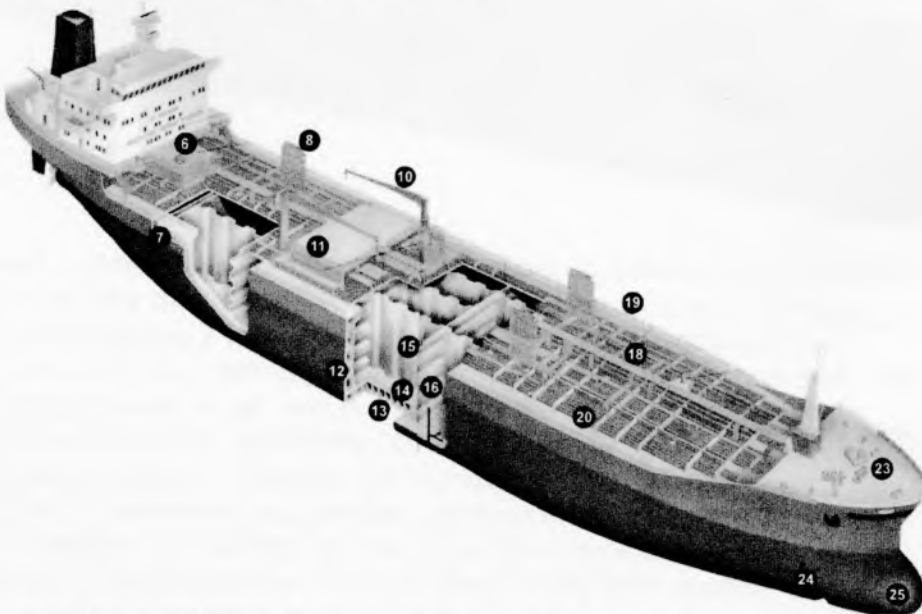
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                                              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Unit:</b> Contribute to the safe cargo operation of oil and chemical tankers                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                                              | <b>Lecturer's Name:</b> XXXX                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| <b>Topic:</b> Identify with the aid of a sketch the general arrangements of oil tankers.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                              | <b>Date:</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| <b>Week No. / Session No.:</b> XX / XX                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | <b>No. of students:</b> 24                                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| <b>Duration:</b> 0.5 hour                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | <b>Teaching method:</b> Classroom (Lecturing and explaining) |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| <b>Aim:</b> To identify the different parts of oil tankers                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| <b>General Learning Objectives:</b><br><br><b>At the end of the session the students will be able to:</b><br><br>1. Identify and illustrate the different parts of oil tankers, especially tank and piping arrangements.<br><br><b>Recap of the previous session/class/topic:</b><br><br>– Identify and distinguish types of chemical tankers.<br><br>– List important stages in the development of chemical tankers.<br><br><b>Link to the next session/class/topic:</b><br><br>– Identify with the aid of a sketch the general arrangements of chemical tankers.<br><br>– Describe the piping arrangements of chemical tankers. |                                                              | Preparation checklist for session resources (References, instructional aids, materials, or tools needed):<br><br>1. Course syllabus<br>2. Scheme of work<br>3. Lesson plan<br>4. Attendance sheet<br>5. Participant's handout<br>6. Instructor manual<br>7. Textbooks/Reference books<br>8. Computers/Laptops<br>9. Presenters/pointers<br>10. PowerPoint presentation(s)<br>11. Loose printouts of all Activity sheets<br>12. Transparencies and blank papers<br>13. OHP<br>14. OHP Markers<br>15. Colour pens sets for students<br>16. White board Pens / Blackboard chalks (different colours)<br>17. Quiz sheets for recapping previous learnt topic<br>18. Answers for above quiz<br>19. Internet connection in classroom available<br>20. Web links identified if using internet |

Lesson Plan

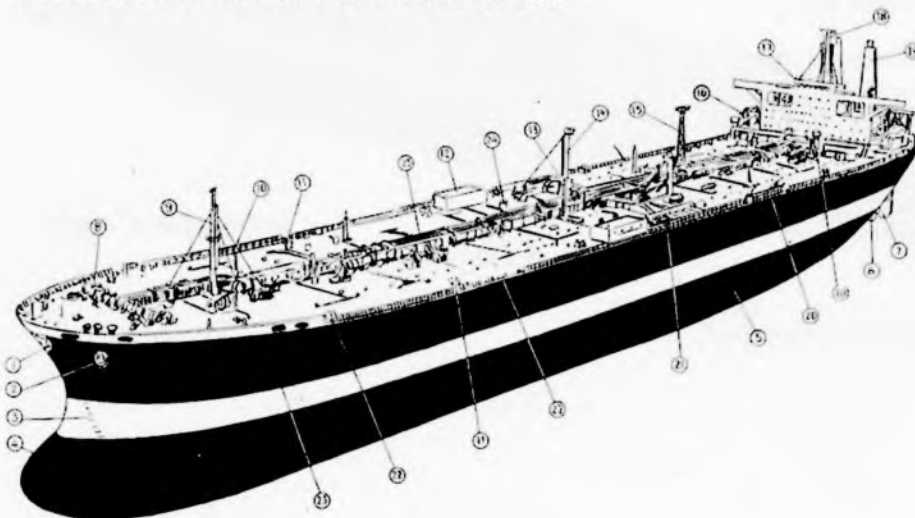
| Time From - To              | Content                                     | Objectives                                                                               | Lecturer Activity                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | Student Activity                                                                                                                                                          | Resources / References                                                                                      | Assessment     |
|-----------------------------|---------------------------------------------|------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------|----------------|
| 0900 - 0905<br>(5 minutes)  | Attendance and Introduction to the Topic    | Identifies the topics that will be covered in this session                               | Register and introduce the topic by verbal or PowerPoint presentation, list and outline the main topics on the board. Answer queries raised by students.                                                                                                                                                                                                                                                                                                                                                                                                                               | Respond to attendance call and listen to the Lecturer. Question if there is any doubt.                                                                                    | Attendance register/<br>Online register.<br>PowerPoint presentation, White board, blackboard, coloured pens | N.A            |
| 0905 – 0925<br>(20 minutes) | Quiz to recall the previously covered topic | Reinforces and recalls previously learnt topic.                                          | If verbal quiz is carried out, questions put forward to random students. Discuss the right answers. Identify weak students or analyse if learning was achieved for previously taught subject for future reference, and conclude.<br><br>If written quiz is given, distribute the quiz sheets. Once completed, let the students interchange the papers among each other and read the right answers, collect the answer papers for future reference to gauge group and individual learner's knowledge. Discuss the answers with the class.<br><br>Answer to question raised by students. | Answer questions of the quiz, mark the papers and discuss with lecturer. Note the right answers.                                                                          | Quiz sheets                                                                                                 | Verbal/Written |
|                             | Distribute participant's handout.           | Illustrates the different parts of oil tankers, especially tank and piping arrangements. | Explain and demonstrate using PowerPoint presentation on the content, addressing the page numbers from the participant's handout and elucidate wherever necessary using white board/black board/interactive board.<br><br>Answer to question raised by students.                                                                                                                                                                                                                                                                                                                       | Collect the handouts. Listen to the Lecturer. Watch the PowerPoint presentation.<br><br>Note down points if necessary.<br><br>Discuss and Question if there is any doubt. | Participants handouts, PowerPoint presentation, White board, blackboard, coloured pens.                     | Q&A session    |
| 0925 – 0930<br>(5 minutes)  | Recap and review of the session             | Summarize all the main points covered in this session.                                   | Summarize all the main points covered in this session and discuss knowledge gained by this lecture and conclude.                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | Listen to the Lecturer.<br><br>Q & A and discuss.                                                                                                                         | Participants handouts, PowerPoint presentation, White board, blackboard, coloured pens.                     | Q&A sessions   |

## Annex 4 – Sample Participant Handouts

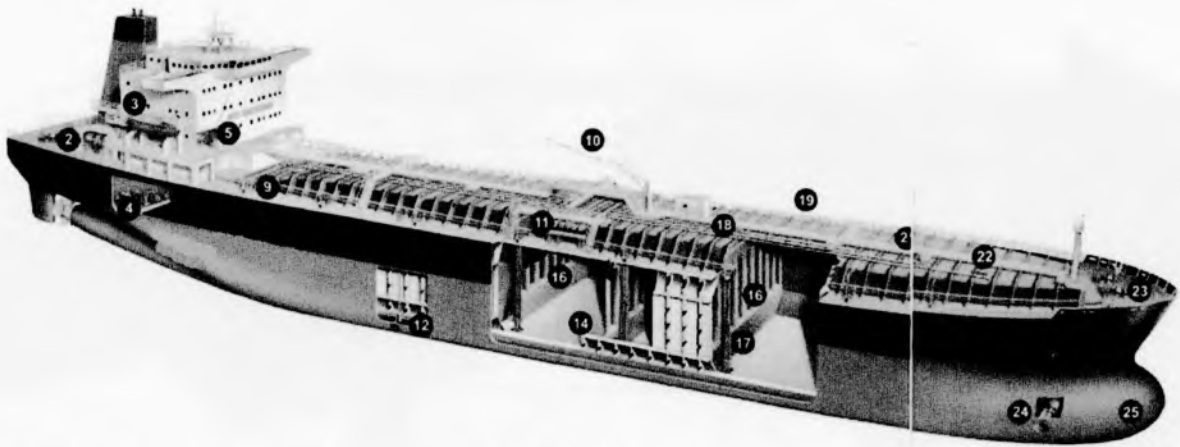
### Topic 1.3 *Ship Arrangements of an oil tanker*



1. Balanced rudder with conventional propeller 2. Auxiliary unit 3. Lifeboat in gravity davits 4. Hydraulic prime mover 5. Cargo control room 6. Tank heating / tankwash room 7. Cofferdam, empty space between two tanks 8. Vent pipes with pressure-vacuum valves 9. Hydraulic high pressure oil-and return lines for anchor and mooring gear, 10. Hose crane 11. Manifold 12. Wing tank in double hull 13. Double bottom tank 14. Tanktop 15. Longitudinal vertically corrugated bulkhead 16. Transverse horizontally corrugated bulkhead 17. Cargo pump 18. Catwalk 19. Railing 20. Deck longitudinals 21. Deck transverses 22. Cargo heater 23. Forecastle deck with anchor-and mooring gear 24. Bow thruster 25. Bulbous bow

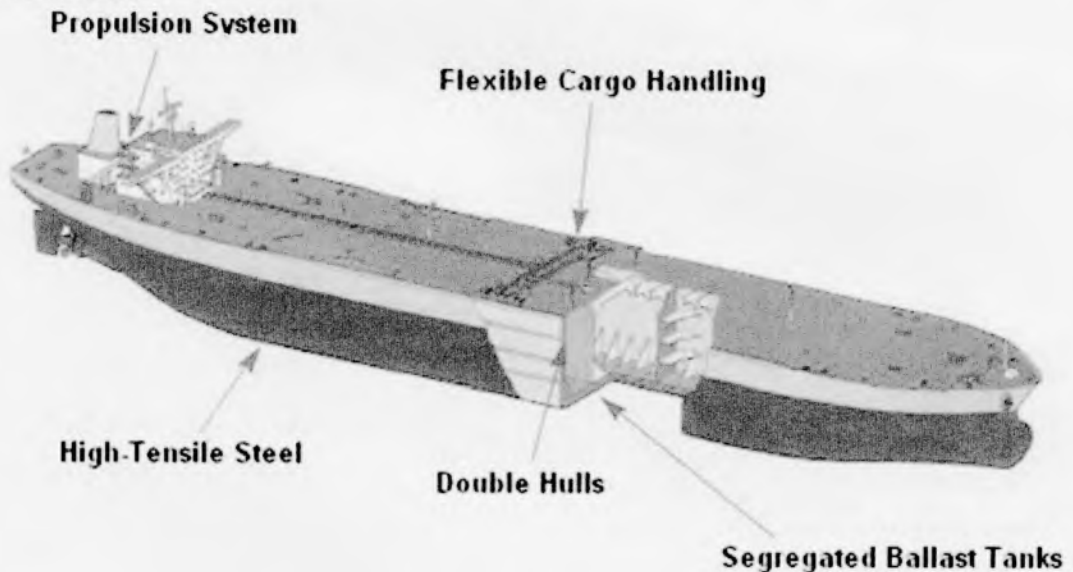


- .1 Head mark
- .2 Anchor
- .3 Forward draft marks
- .4 Bulbous bow
- .5 Midship draft marks
- .6 Propeller
- .7 Rudder
- .8 Windlass
- .9 Foremast
- .10 Ventilator
- .11 Cross bitt
- .12 Deck store
- .13 and .14 Derrick boom
- .15 Antenna poles
- .16 Lifeboat
- .17 Bridge
- .18 Radar mast
- .19 Funnel
- .20 Accommodation ladder
- .21 Loading station
- .22 Universal chock
- .23 Draft line
- .24 Cargo oil hatch
- .25 Cargo oil pipe

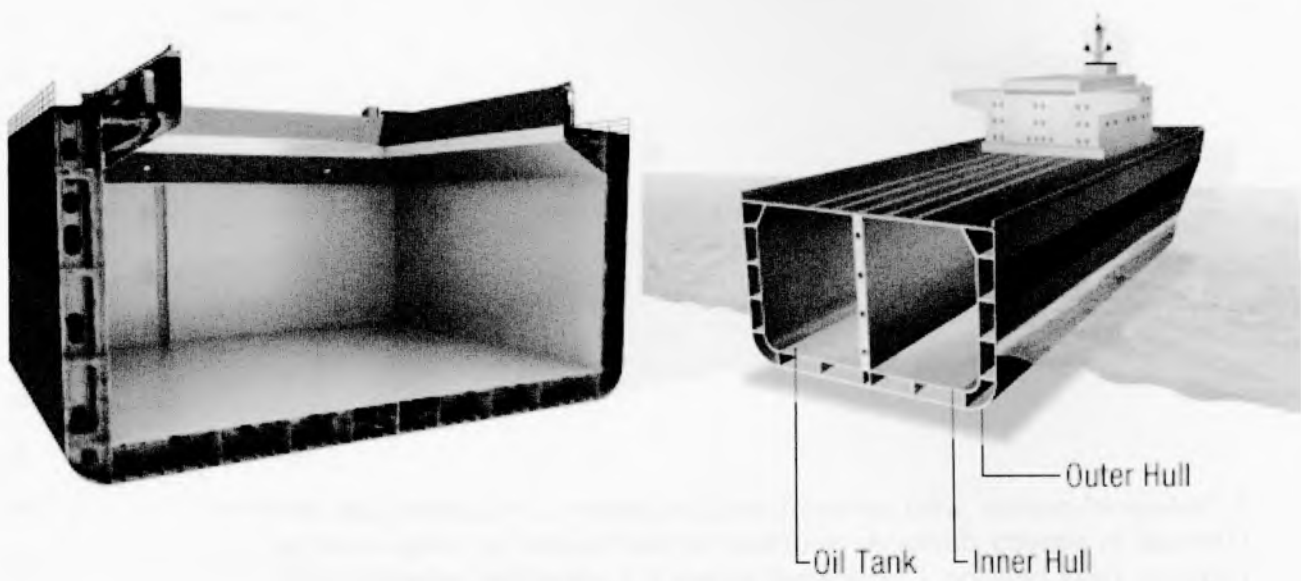


1. Balanced rudder with conventional propeller
2. Auxiliary unit
3. Lifeboat in gravity davits
4. Hydraulic prime mover
5. Cargo control room
6. Tank heating / tankwash room
7. Cofferdam, empty space between two tanks
8. Vent pipes with pressure-vacuum valves
9. Hydraulic high pressure oil-and return lines for anchor and mooring gear,
10. Hose crane
11. Manifold
12. Wing tank in double hull
13. Double bottom tank
14. Tanktop
15. Longitudinal vertically corrugated bulkhead
16. Transverse horizontally corrugated bulkhead
17. Cargo pump
18. Catwalk
19. Railing
20. Deck longitudinals
21. Deck transverses
22. Cargo heater
23. Forecastle deck with anchor-and mooring gear
24. Bow thruster
25. Bulbous bow

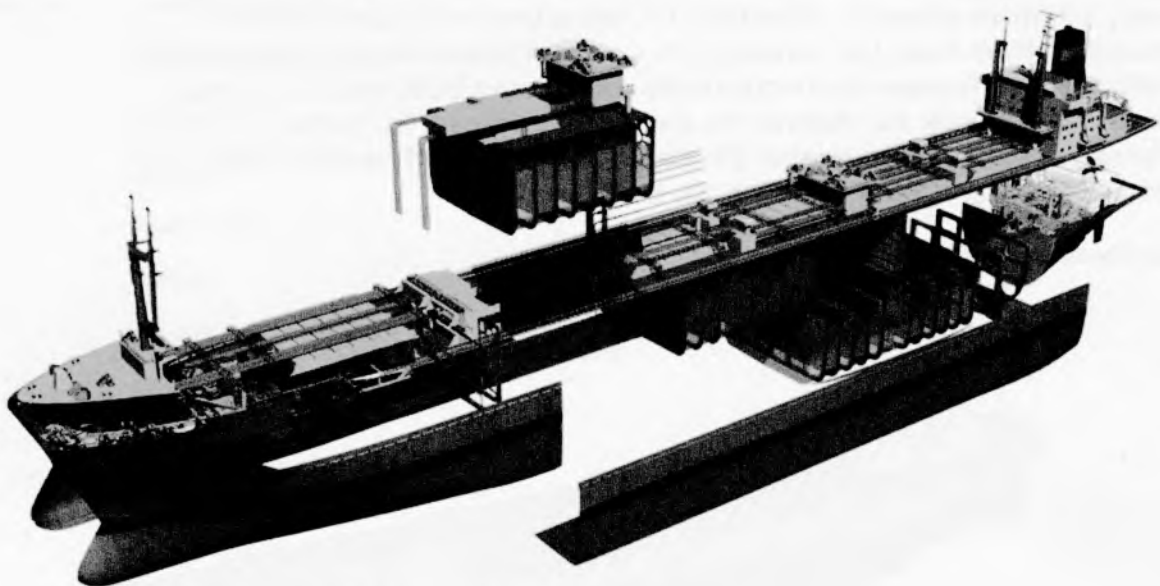
Very Large Crude Carrier (VLCC)





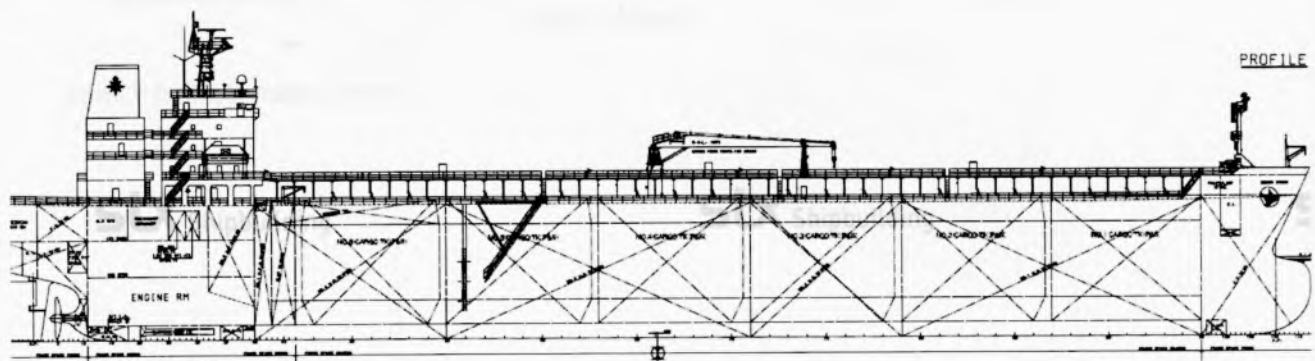


*Cut section of on product/chemical tanker*

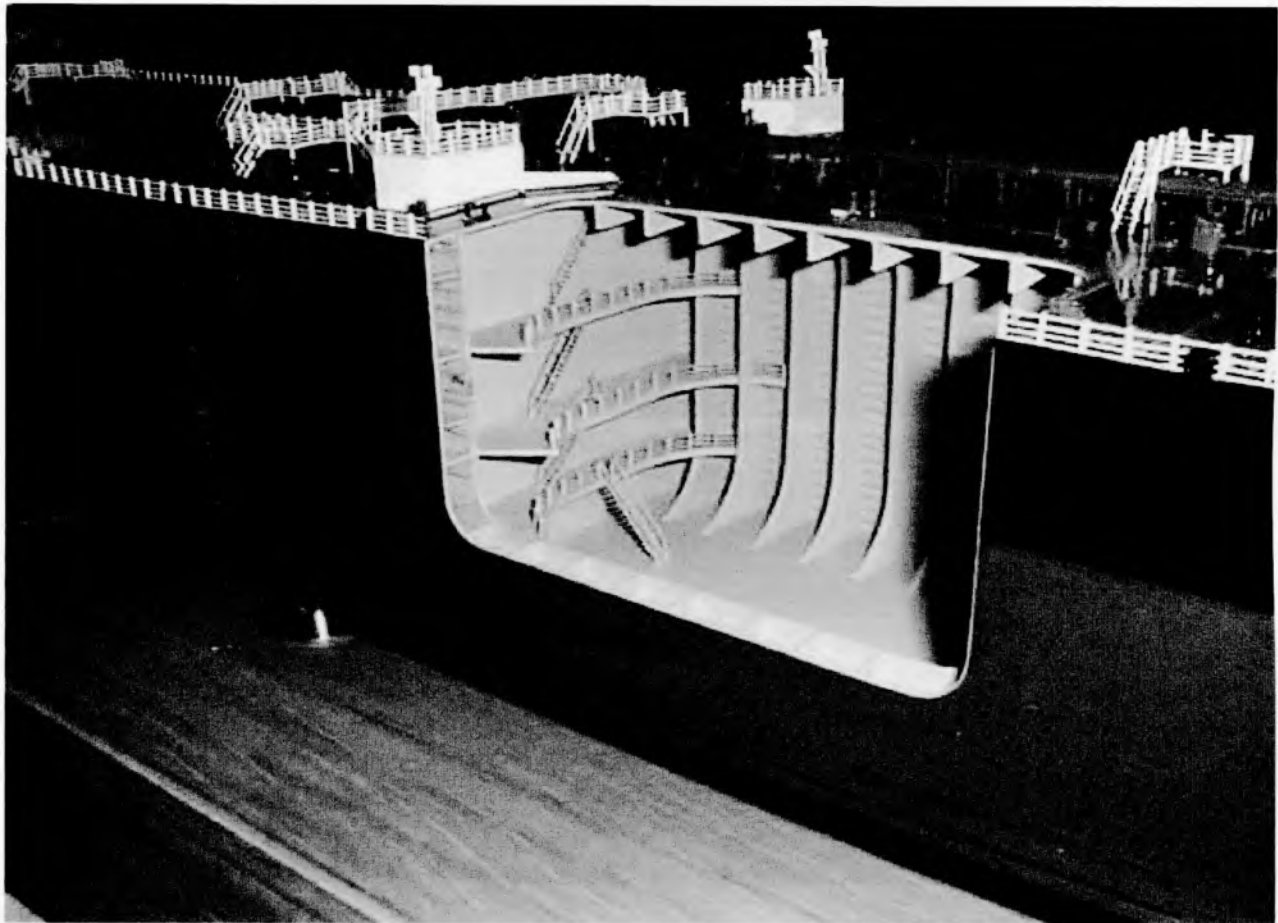
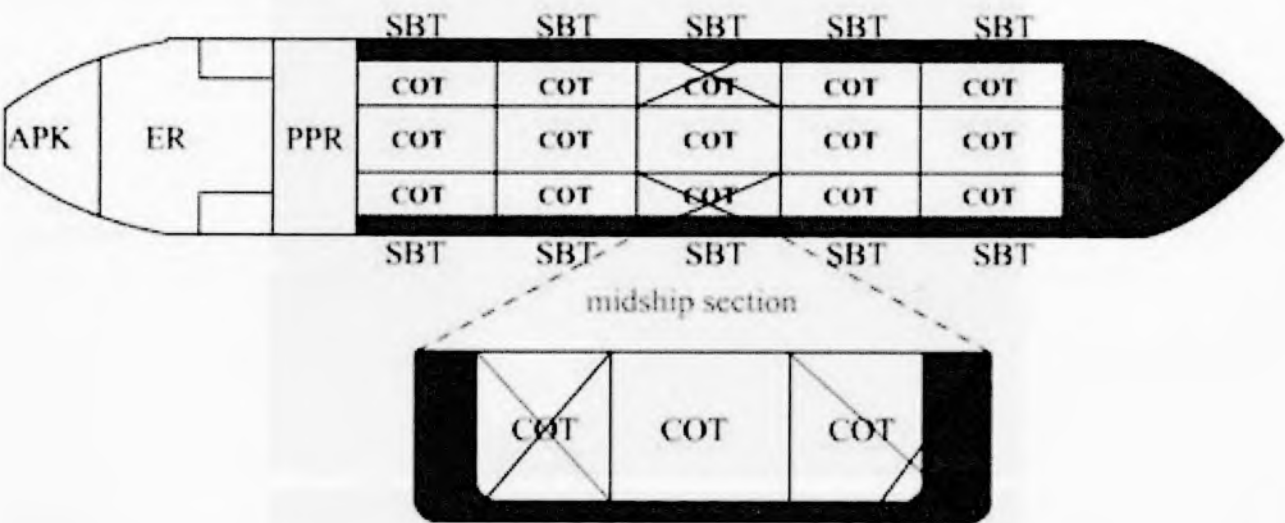


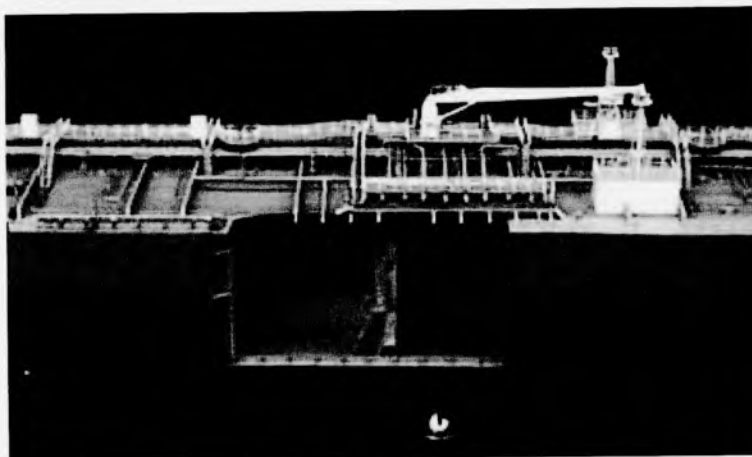
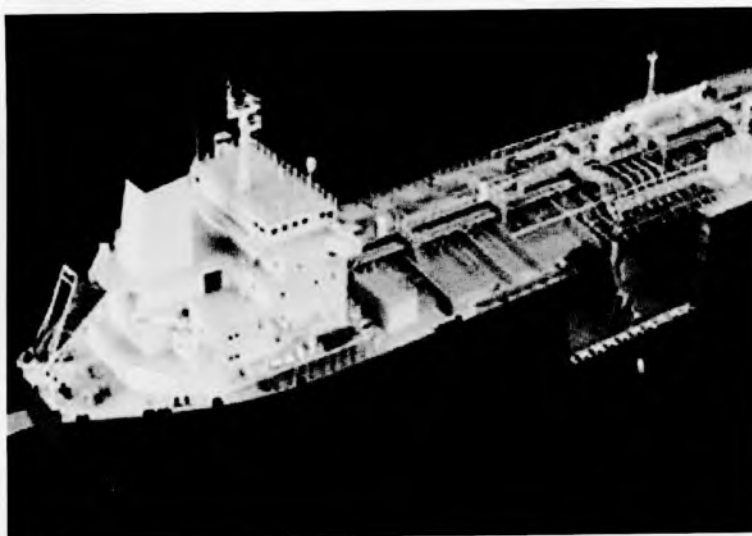
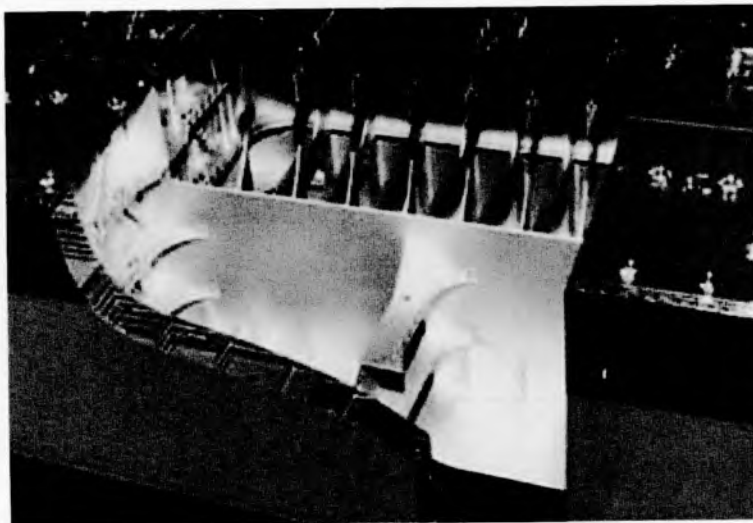
*Cut section of on product/chemical tanker*

**Profile of an Oil Tanker**



Tank layout of a crude oil tanker:





### **The Pipeline system of an Oil Tanker:**

Pipeline systems on tankers differ in their degree of sophistication, depending on employment of the tanker.

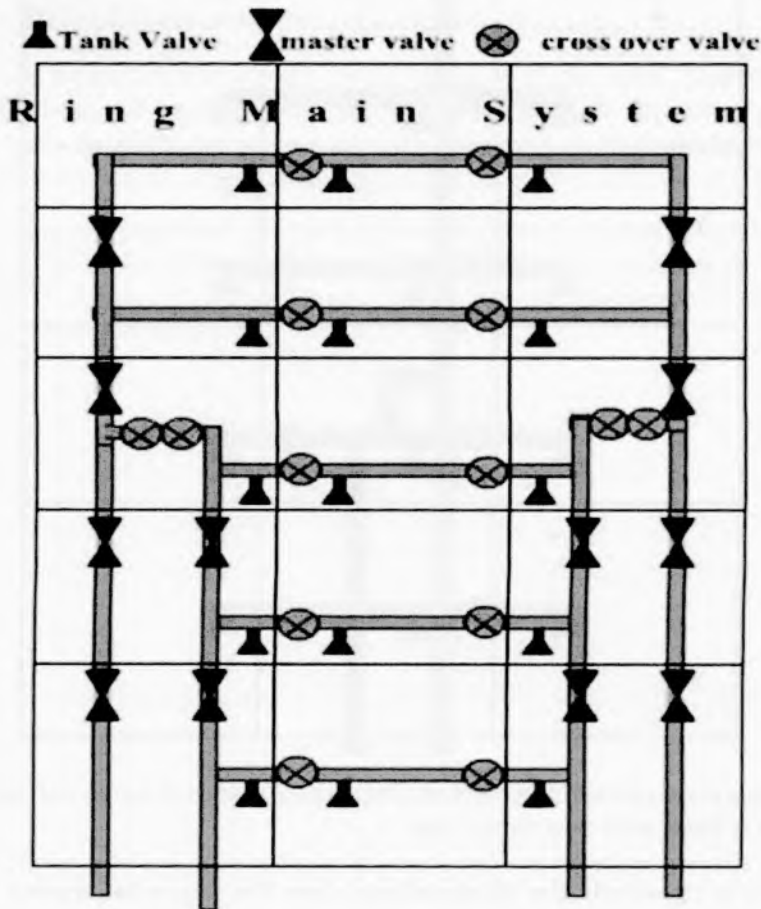
ULCCs and VLCCs have relatively simple pipeline systems usually the direct line system.

Some product (parcel) tankers may have very sophisticated piping systems. This could be the ring main system or in case of a chemical product tanker it could mean an individual pipeline and an individual pump for every tank on board.

Basically there are three systems of pipelines found on tankers, and the fourth system being the free flow system found on large crude carriers

- Ring Main system
- Direct Line system
- Single line to Single tank system (Chemical/Product ship)
- Free Flow system

*Ring Main System:*



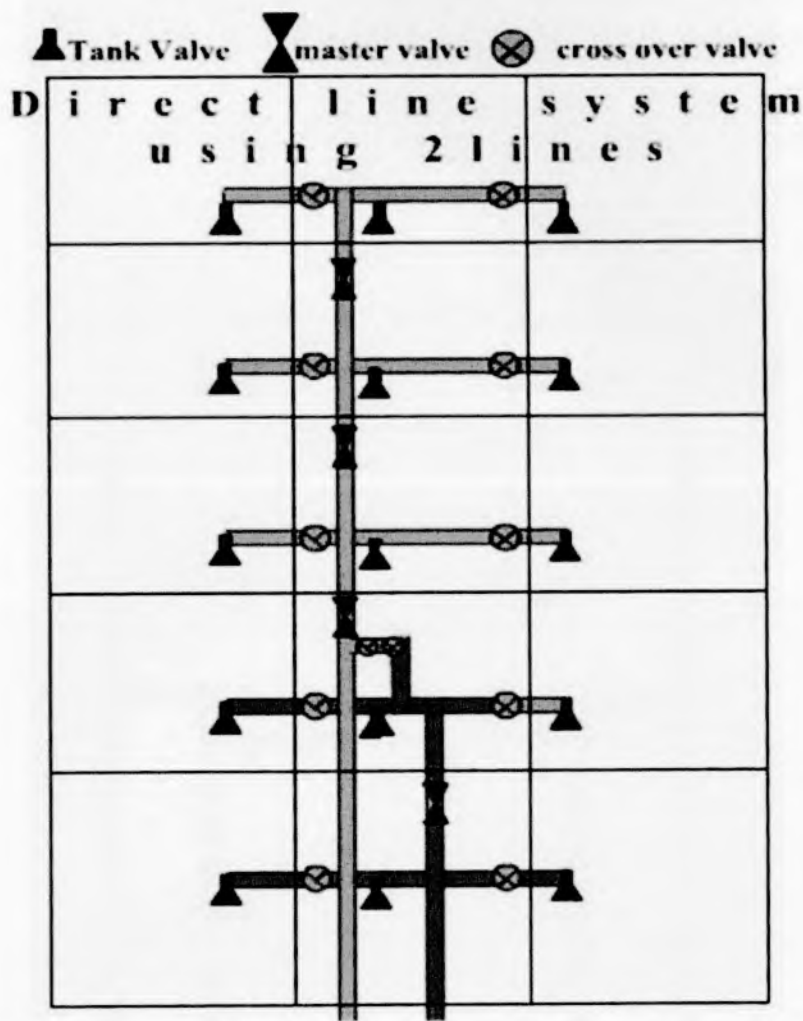
It is generally of a square or circular layout.

It is used mostly on product tankers, as segregation of cargo is required.

Though the system is expensive, as more piping, and extra number valves are used.

However, if the vessel is carrying many grades of cargo, the advantages compensate for the extra cost of the original outlay.

Direct Line System:



This system is mainly found on crude oil carriers where up to 2 grades of cargo can be carried as most of the direct pipeline systems is fitted with two direct lines.

This system is cheaper to construct. The disadvantages over the ring main system, is that line washing is more difficult, the system has fewer valves which make pipeline leaks difficult to control, as the system lacks versatility there is problem with line and valve segregation.

This system provides the vessel to carry as many grades as there are tanks.

The disadvantage is the cost factor having a multitude of pumps on board.

Free flow Tanker:

This system is usually found on large crude carriers, where the cargo piping is not used for the discharge of cargo.

Instead, gate valves are provided on the bulkheads of the tanks which when opened allow the oil to flow freely in the aftmost tank and into the COP.

The advantages of this system are primarily the cost factor, it allows for fast drainage and efficient means of pumping the cargo tanks. Disadvantages are of single crude being shipped.



*Independent System:*

This layout is not very common in the tanker trade.

This system is quite normal on chemical ships.

There are some Product Tankers that have this system fitted on the ships.

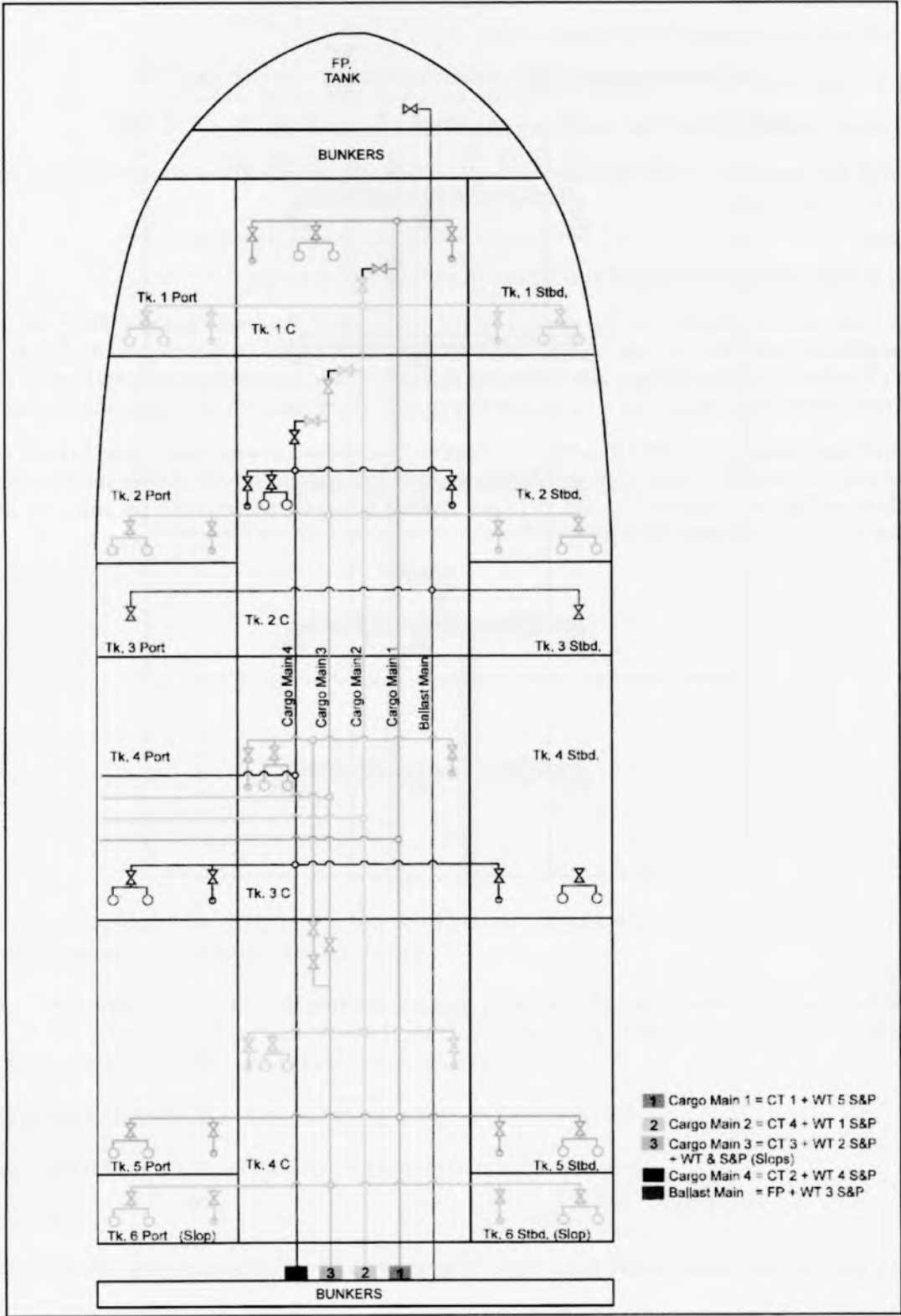
This is a single line servicing an individual tank through an independent pump that could be either a submersible pump or a deep well pump.

*Bottom lines*

The vessel is fitted with 4 centre tanks and 5 pairs of wing tanks for cargo.

The cargo main lines are located in the vessel's centre tanks. With the term "bottom lines" we understand that the location of these lines will be on the bottom of the vessel, usually supported about 4 to 6 feet above the vessel's bottom. Crossover valves, two valves on each crossover, connect the bottom lines to each other. When carrying more than one grade, a two-valve segregation complies with the regulations in force.

From the following drawing you find that from the bottom lines there are lines which lead to each cargo tank. These lines end on the cargo tanks suction bell mouth. Each bottom line serves its own set of cargo tanks; for example, bottom line no. 1 serves CT1 and WT5 p/s. Bottom line no. 2 serves WT1 p/s and CT4. Bottom line no. 3 serves WT2 p/s, CT3 and WT6 p/s.



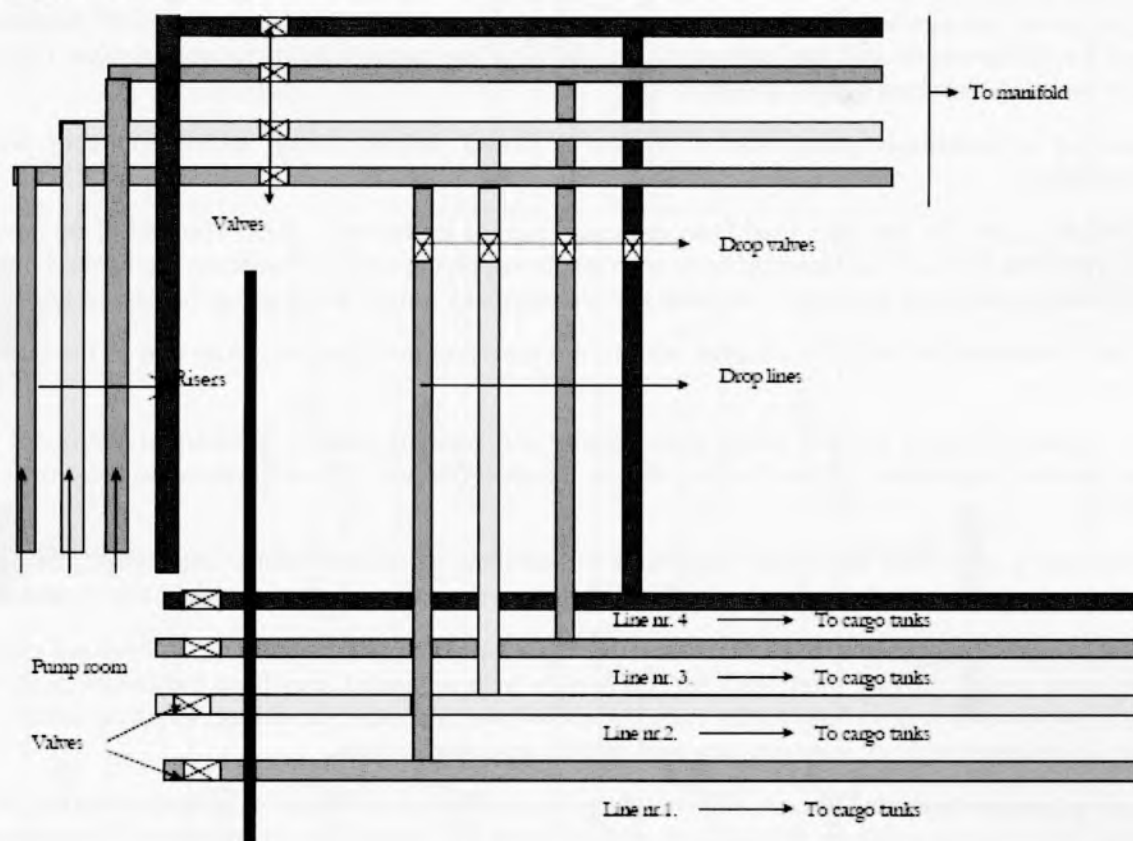
Drop lines

From the manifold area on the main tank deck, the drop line is connected to the deck main lines which leads to the bottom lines. On the drawing below you will also find the drop line and the drop valves on the lines leading vertically downwards from the main deck lines to the cargo lines in the vessel's bottom.

These drop lines are used during loading. By closing the deck line's master valves, the cargo is led to the vessel's cargo tanks when using these drop lines.

So, the pump-room is completely isolated from the cargo during loading. However, during discharging the drop lines are isolated from the cargo by keeping the drop valves closed.

You must, however, during loading not forget to keep a routine for checking the pump-room both for leaks and being gas free for entry.



### *Pump-room piping*

On a crude oil carrier the pump-room is the main point between the cargo tanks and the main deck, all the way to the manifold, where the ship lines are connected to shore lines. From the cargo tank the bottom lines lead all the way to the main cargo pumps.

To simplify the matter we divided the pump-room in two parts. One part is called the cargo pumps free flow side; the other part is called the cargo pumps deliver side. These sides are commonly called suction side and pressure side.

**Note:** a centrifugal pump does not have any ability of suction.

On the cargo pumps free flow side, the bottom lines end at the cargo pumps. On this side, some crossover lines connect the systems to each other. The first crossover after the tank area is the stripping cross, marked on the drawing as "Crude oil suction -x-over line". The stripping cross is located crosswise from the bottom lines, and connected to the bottom lines with pipe bending and valves. By using this crossover, it is possible to discharge from cargo tanks on line system no. 2 with COP no. 3. And so on.

Further towards the COP, on the bottom lines, there is a valve on each of these lines, usually called the "bulkhead valve". This is because the location is normally close to the bulkhead, separating cargo tank area and pump-room area.

Further on the free flow side of the cargo pump, is the seawater suction crossover line. This line is also crosswise from the bottom lines and is connected to the sea chest on each side (port and starboard). This line supplies the cargo pumps with seawater during water washing of tanks and lines, and used when ballasting for departure, if or when necessary. Crossing between different lines and pumps is also a possibility with this crossover line. We are now leaving the free flow side of the system, and the next step is to pay attention to the delivery side of the pumps.

The first stop is the first valve after the cargo pumps, the delivery valve or throttling valves. Names like discharging-valve, pressure-valve is also common. The most descriptive is "delivery valve". With this valve, we can adjust the backpressure and the load conditions for what the pump is going to work against. Centrifugal pumps are working their best against a certain load.

When starting a centrifugal pump, start it against a closed delivery valve, which compares with the recommendation.

On the delivery side, the rise lines lead from the cargo pumps to the main deck. The first is the cow cross over line. With this line, we can bleed off from any riser for supplying crude oil washing during discharging, or supplying water during tank washing. The same line also supplies "drive" when using the ejector for stripping.

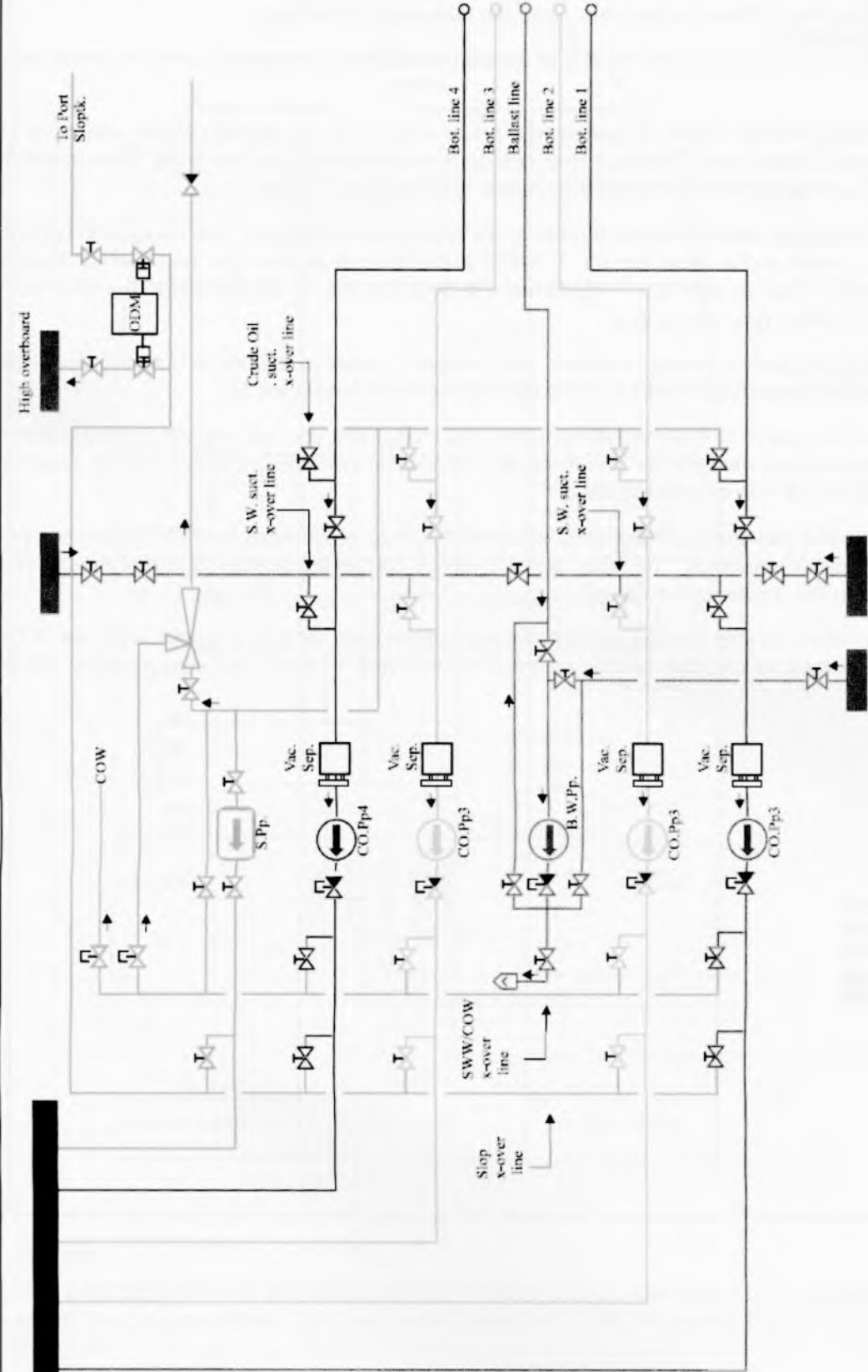
The second crossover line leads to a higher inlet in the port slop tank (primary slop) and to the line called "High Overboard".

The high overboard line is the line where ballast water and washing water is discharged overboard via oil detection monitor equipment. As the drawing shows, it is possible with any cargo pump to cross over to any of the risers.

The pumproom is also fitted with other equipment for handling cargo and ballast. The ballast pump is only used for the segregated ballast. The segregated ballast system is totally isolated from the cargo systems.

The ballast pump is connected to the FP-tank and the WT 3 s/p. The ballast system has its own sea chest. Still there are some vessels, among them M/T Seagull, which have separated lines from the ballast pump to the main deck, which end in drop lines to the cargo tanks that are dedicated for departure/arrival ballast. These tanks can be ballasted without involving any part of the cargo line systems.

The stripping pump is operating its own system, which (via a stripping crossover) strip the last amount of cargo from tanks, cargo pumps and lines, through the small diameter line and ashore. In addition to a stripping pump and an ejector, the vessel is equipped with a vacuum stripping system, which gives the cargo pumps the ability to maintain suction when only a small quantity is left in a tank.





### *Deck lines*

On a crude oil carrier, the main line system changes name, depending on where it is placed. From cargo tanks to the cargo pumps, the main lines are called “bottom lines”. From the cargo pumps delivery side, the name changes to risers. When they appear on the main deck, the names are deck lines.

Very often the systems are numbered from one side of the ship to the other, for instance from port to starboard or vice versa.

The deck lines are a lengthening of the risers from the pump-room. Each deck line can be isolated to the pump-room by the deck master valve. The deck lines end up at the manifold crossover lines. These manifolds are where the vessel is connected to the terminal by hoses, kick arms etc.

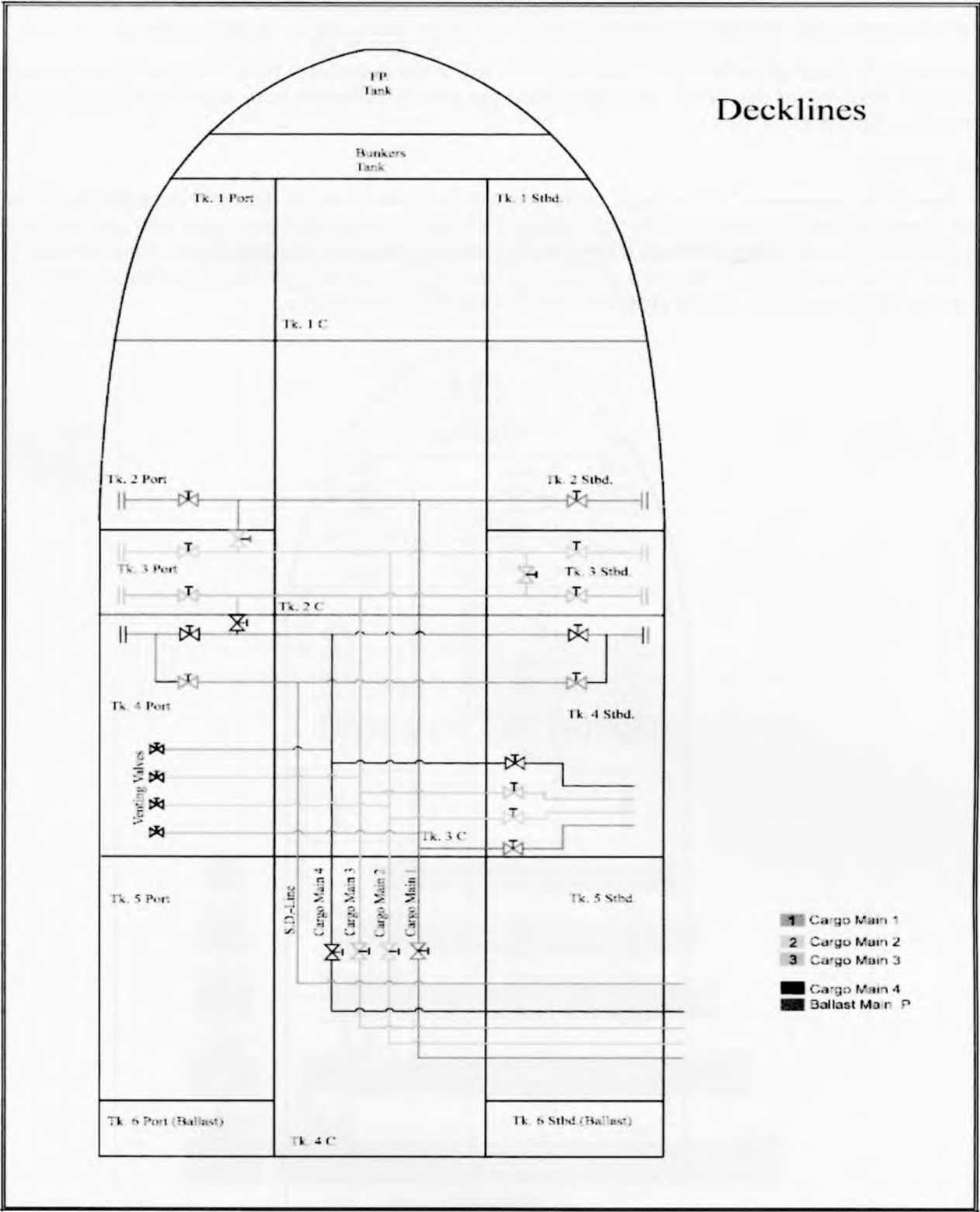
The manifold line is numbered with the same number as the main line it belongs to. The conclusion will then be: Manifold no. 1 is connected to drop line no. 1, which leads down to bottom line no. 1, which leads to cargo pump no. 1, which leads to riser no. 1, which leads to deck line no. 1, which leads to manifold no. 1. The same occurs with system nos. 2, 3, and 4.

The vessel is also equipped with manifold crossover, which makes it possible to operate between deck lines, drop lines and manifolds depending on which manifold(s) the vessel is connected to.

By studying the ships line system all over, including valves and crossovers, you will find all the possibilities of leading cargo or water through the systems. The more you are familiar with the line system and its drawings, the better you can utilize the system’s possibilities.

On the main deck you also find the small diameter line (MARPOL-line) which leads from the vessel’s stripping pump to one of the vessel’s manifolds. The small diameter line is connected on the outside of the manifold valve. It is connected to the “presentation flange”.

The purpose with this line is to strip the last amount of cargo ashore from the tanks, pumps and lines. When using this line, it is important to keep the specific manifold valve closed, to avoid the cargo returning into the vessel’s lines.



*COW lines*

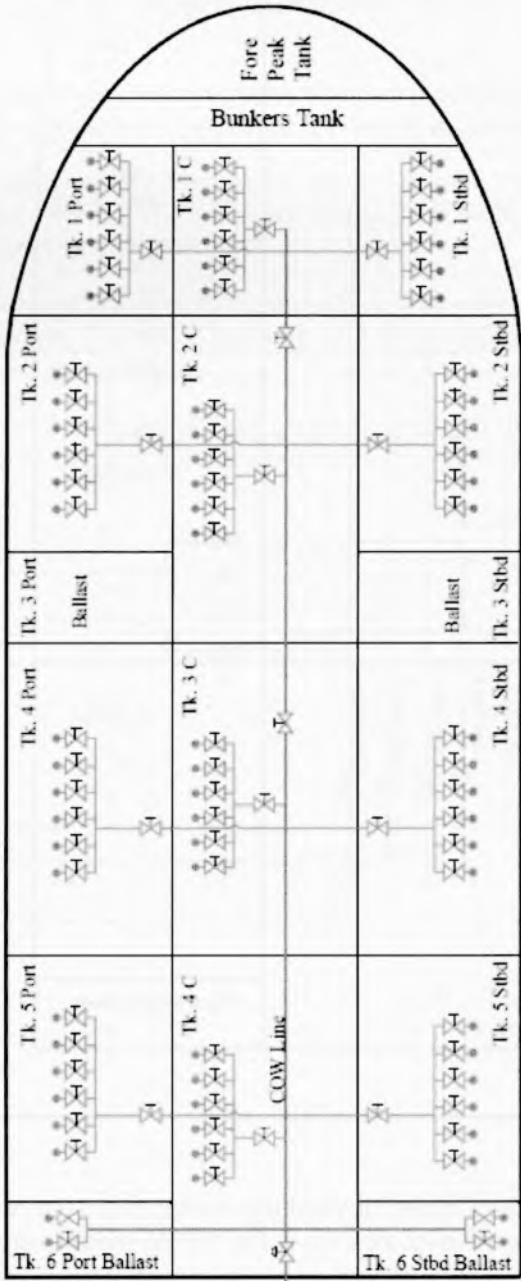
On the main deck you will find the Crude Oil Washing (COW) main line with branches leading to the ships crude oil washing machines. This line comes from the COW cross over line on the delivery side in the pump-room.

The branch lines from the COW main line are gradually reduced in dimension all the way forward to the COW machines. This reduction is to avoid pressure fall on the flow used for crude oil washing.

It is possible to bleed off to the COW main line from any of the main cargo lines. This contributes to several alternative solutions in the COW operation. There are always variations from ship to ship, but the main principle is the same.

*Inert gas lines*

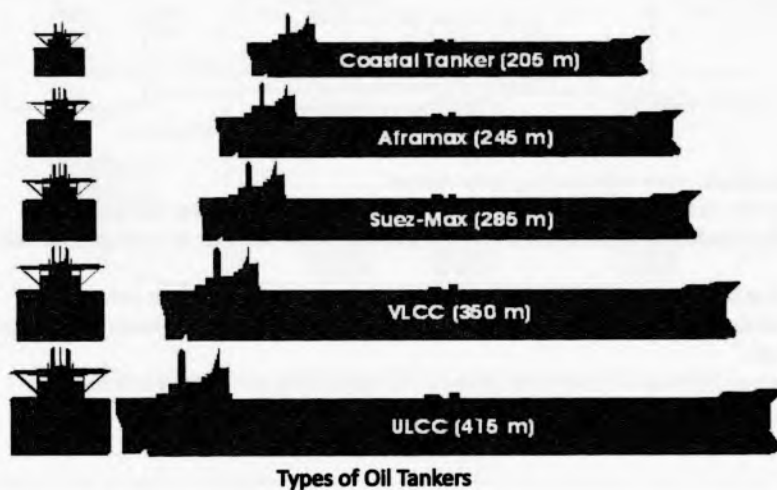
To control the atmosphere in the cargo tanks you will find inert lines on the main deck leading to each tank. These lines are for supplying inert gas during discharging or tank washing. Some inert gas systems are connected to a main riser, which are fitted with a press/vacuum valve for regulation of the pressure and vacuum in the cargo tanks. Other inert gas systems have these press/vacuum valves installed on each cargo tank with the same function as the riser.



## PowerPoint Presentation Example

### Basic Training for Oil and Chemical Tanker Cargo Operations

### Types of Oil Tankers



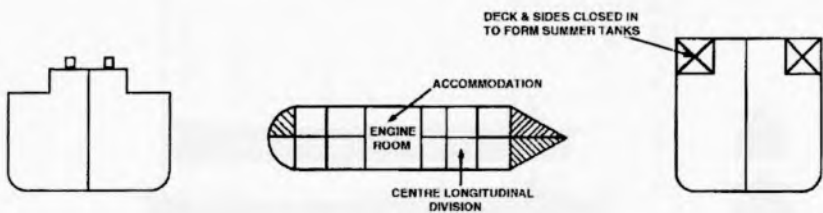
# Important stages in the development of oil tankers



The first constructed bulk oil tanker

Small Single hull tankers without Centre line bulkheads

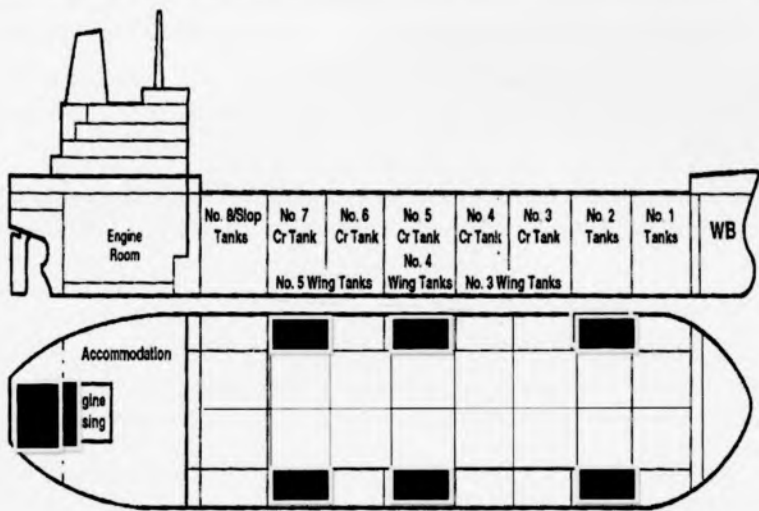
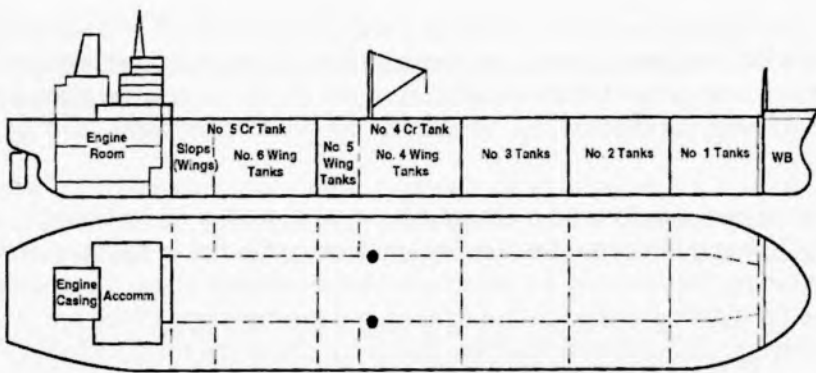
## History of Construction and Development of an oil Tanker



- The initial vessels were transporting oil in barrels
- Then came the time to carry bulk oil in small single hull without Center line bulkheads
- The stability would not allow more than 50% volumetric use for fear of spillage and loss in cargo
- A centre line bulkhead enabled quantities to be increased as free surface reduced.
- Summer tanks were developed for further increase in quantity loaded allowing for expansion in warm climate
- Then a further increase of bulkheads gave us the cargo wing tanks and a centre tank



# Single hull Crude oil Tanker



Double hull tankers with Segregated Ballast tanks in protected Locations

## **Annex 5 – Typical fixed foam and dry chemical powder fire-fighting installation**

### **Scope**

Fire Prevention and Fire-fighting training as required under STCW A-VI/1-2 is covered by IMO model course 1.20. STCW Code A-V/1-1-1 requires trainees to demonstrate competence in extinguishing an oil or chemical fire with the use of foam from a fixed foam installation or dry chemical powder from a fixed DCP installation under truly realistic training conditions (e.g. simulated shipboard conditions) and whenever possible and practicable in darkness.

This requires that the trainee should hold a charged hose, approach a live oil/chemical fire and release the low expansion foam/DCP and direct the fire-fighting medium to the fire in such a manner so that the correct technique for extinguishing the fire may be effectively demonstrated. Since the course addresses the basic level, the focus of the fire-fighting should be the fighting and extinguishing of the fire at the sharp end and not so much on the knowledge and understanding the specifications of the fixed foam/DCP installation.

### **Objectives**

On successful completion of the training the candidates shall be able to:

- .1** Describe the nature of an oil/chemical fire and enumerate the precautions when approaching the fire as well as list and implement the immediate measures or precautions when dealing with oil/chemical fires.
- .2** Approach the oil/chemical fire with fire-fighting protection equipment (fire suit and PPE) in a manner prescribed in the fire-fighting theory sessions and demonstrate the proper technique.
- .3** Deploy the fire-fighting medium (foam/DCP) from the installation by properly operating the release mechanisms and engaging the equipment that demonstrates a clear understanding of the sequence and procedure.
- .4** Extinguish the oil/chemical fire by correctly applying the fire-fighting technique with regard to the correct posture, application method, supervision of quelled flame and subsequent monitoring practices.

### **Teaching facilities and equipment**

IMO model course 1.20 on Fire prevention and fire-fighting provides a model layout of the fire-fighting mock-up and installation for the basic fire-fighting training. This annexure describes the additional installation to the existing fire-fighting mock-up, to enable demonstration of fixed foam and DCP extinguishing system.

The typical installation suggested below takes into account that this installation will be activated and used on a daily basis for demonstration of fire-fighting to the trainees, hence unlike a shipboard installation which will be very rarely operated and only in an emergency, the installation fitted in the training establishment must be smaller, easily operable, have good demonstrability, with smaller quantities of foam deployed to make the system environmentally sound and waste by-product more manageable.

The system mentioned in this annexure is a scaled down version of a shipboard installation and incorporates all the elements of the installation in a manner that permits the frequent use of the system on a daily basis.

The variation in the types of installation found on board ships in terms of complexity may be adequately addressed during classroom interaction and video instruction.

## Fixed foam installation

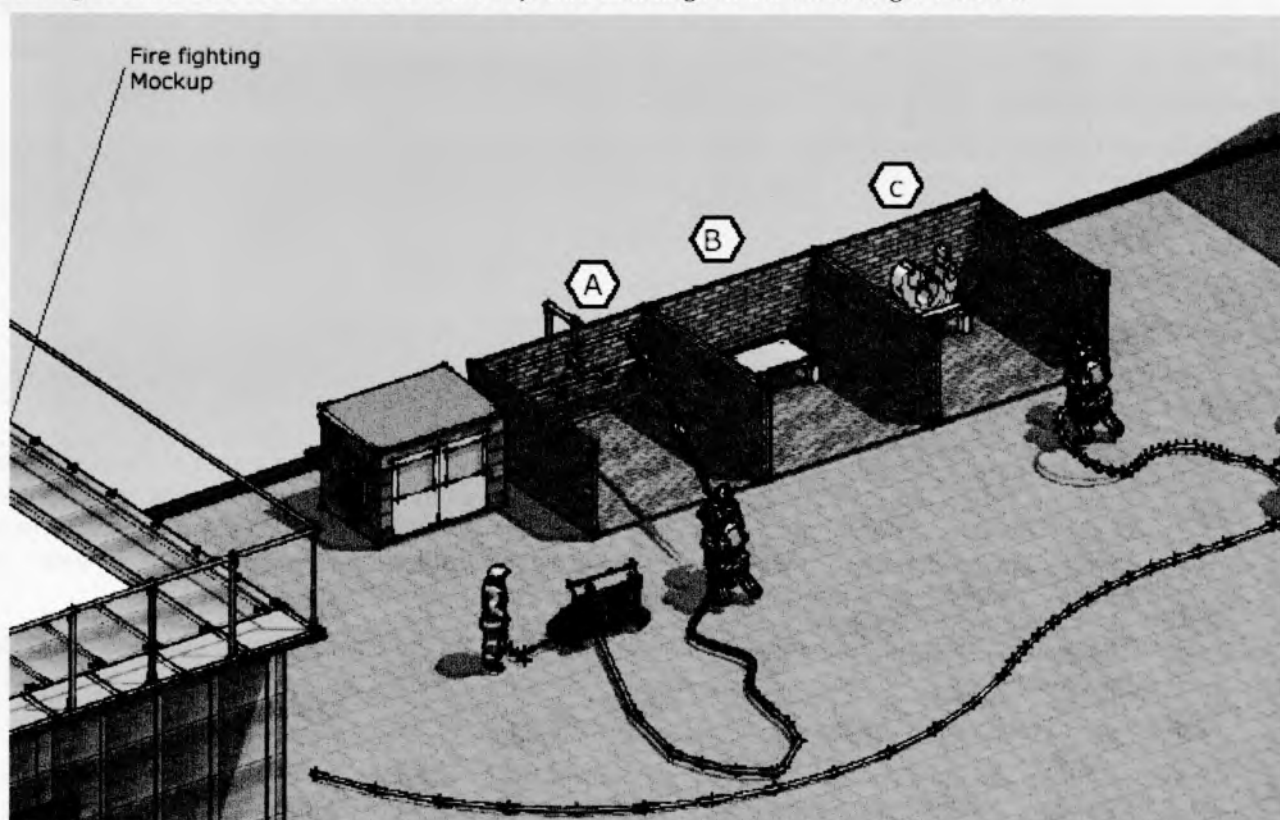
The typical installation consists of:

- Fire pit incorporating a fire tray for oil/chemical fire
- Fixed foam fire-fighting installation (mounted on a skid, which can be wheeled to the central demonstration area)
- Fire pump and piping system
- Fixed DCP fire-fighting installation (mounted on a skid, which can be wheeled to the central demonstration area)

## Fire pit (oil/chemical)

The fire pit consists of a concrete/brick and mortar tray with dimensions of 2 x 2 x 2 (L X B X D). The tray is to be equipped with a means to demonstrate with repeatability an oil/chemical fire. Other fire pits may be placed adjacent to the oil/chemical fire pit but not in a manner that affects the primary function and use of the fire pit as a demonstration area.

The fire pits may be arranged next to the fire-fighting mock-up recommended in IMO model course 1.20, bearing in mind safe radial distance from adjacent buildings or services. (Figs. 1 and 2)



**Figure 1** – General layout of the fire pits approached and demonstration of extinguishing of fire by means of fire-fighting application techniques

Sections A, B & C for gas, wood and oil fire demonstration

- A) the gas fire installation is fitted with a manifold to feed secure arrangement of LPG through a mock arrangement
- B) represents wood or Type A fire
- C) oil fire tray with floating diesel and water arrangement.

**Note:** All these niches have drain arrangement for water run-off



**Figure 2 – Oil/chemical fire pit view and demonstration of extinguishing of fire by using fixed foam system**

### ***Fixed foam fire-fighting skid***

Keeping in mind the repeated deployment of the system and better demonstrability to the trainees the fixed foam installation can be mounted on a skid with wheels so that it can be rolled out to the centre of the open ground ready for activation. The unit is serviceable by the personnel who handle the plant. It miniaturizes a typical shipboard installation and emulates in terms of function and operation all the features provided onboard ships fitted with such fire-extinguishing system.

The skid arrangement that has been recommended has the following advantages.

- .1 Small system that can be moved easily as the entire skid is on wheel arrangement thus providing better demonstrability.
- .2 The skid can be brought to the centre of the fire-fighting field. The front panel of the skid holds the hose cabinet, pressure gauges and operating system for the foam pump. The rear portion of the skid is open permitting easier and better inspection by candidates so that the various components and parts of the system can be clearly studied and comprehended in terms of function as well as position in the system integration.
- .3 The quantity of foam discharged is small thereby reducing the environmental impact of frequent releases.
- .4 Operational cost is controlled.
- .5 Multiple candidates get an opportunity to handle the foam applicator and the foam monitor and approach the oil/chemical fire to practise the correct application technique.
- .6 The system allows for multiple discharges during the same course as readying, and refilling the system will be quick and efficient requiring no special techniques.

### ***Description of the skid (fixed foam installation)***

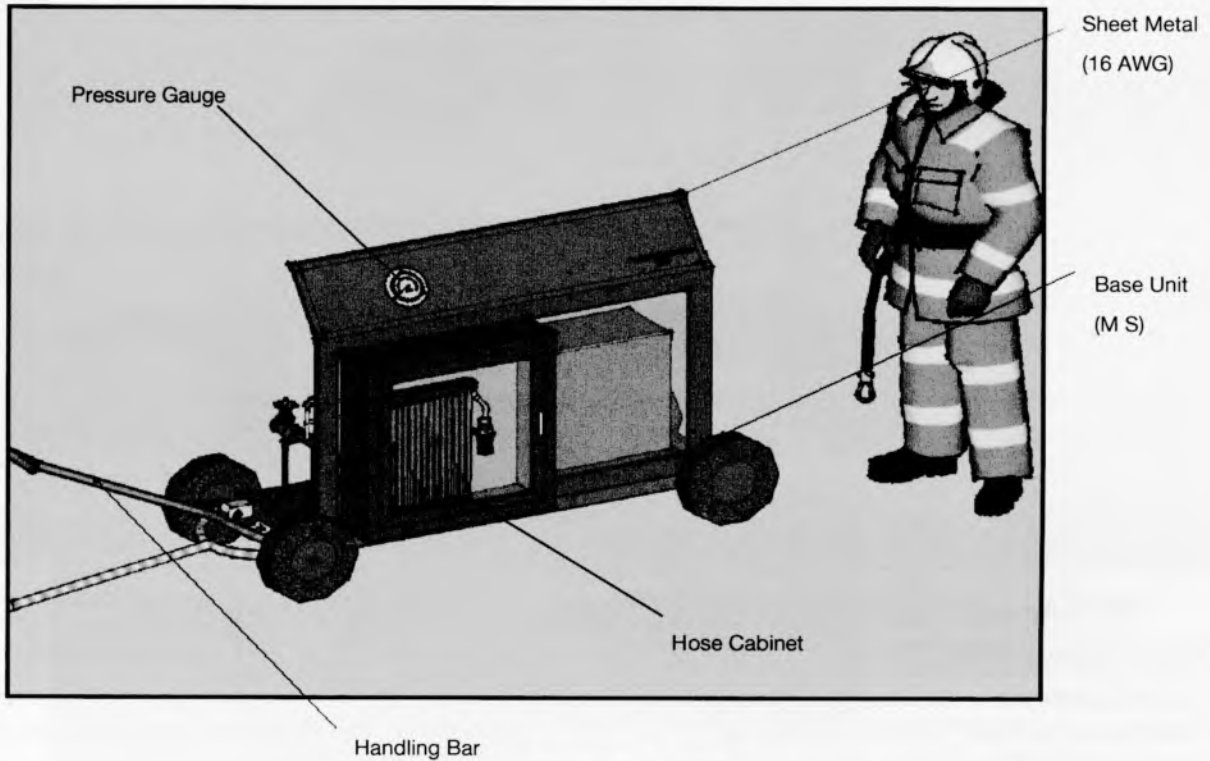
A sketch of the skid is given in figures 3 and 4. The unit is mounted on a solid steel base and houses the following components.

- Foam tank
- Foam pump
- Proportionator

- Screw down valves
- Fire main connection for water inlet
- Outlet to the fire hose cabinet

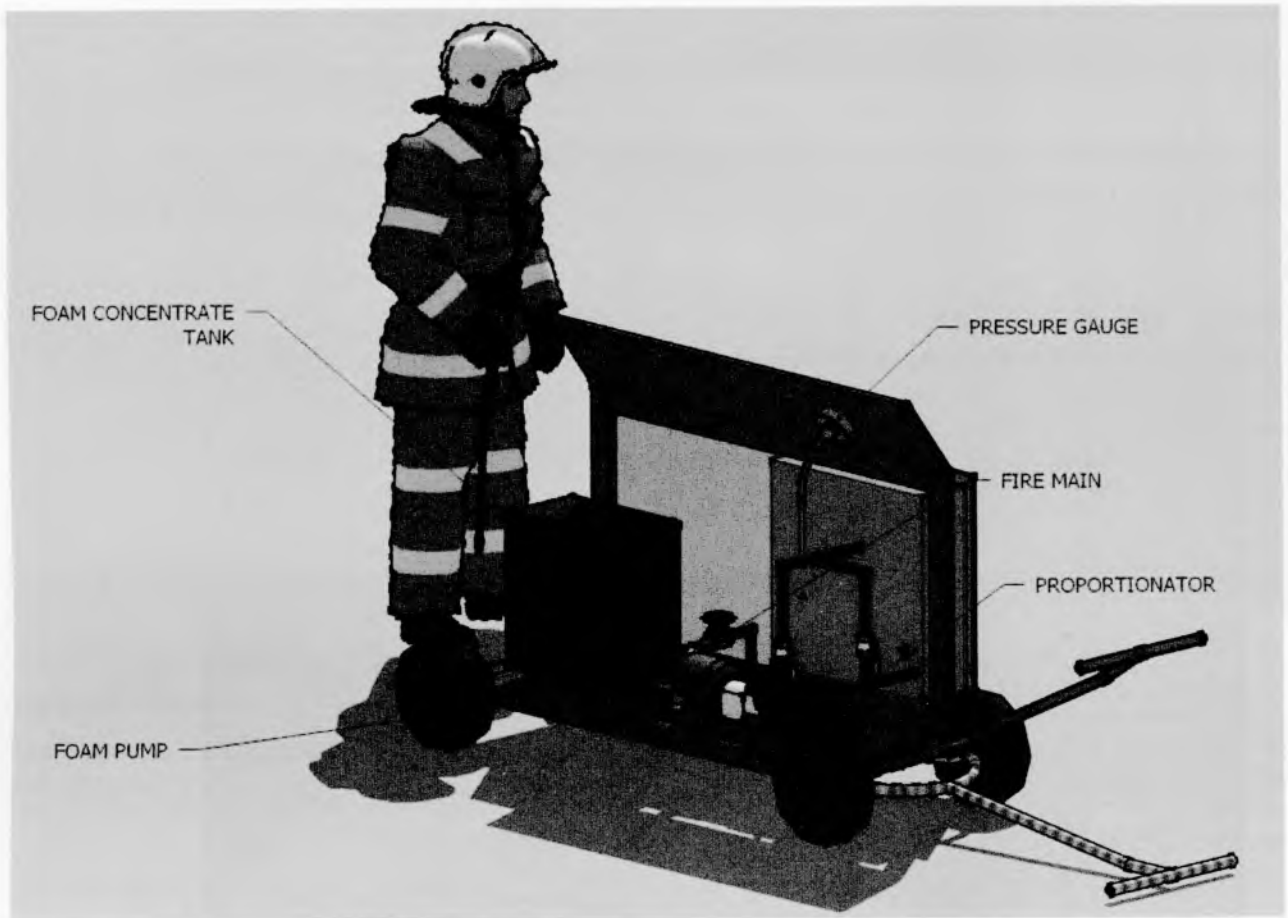
The front portion of the skid is fitted with the hose cabinet and houses the fire hose connected to the mixed inlet of foam concentrate and water properly proportioned and ready for deployment. A foam applicator nozzle is coupled to the flexible hose permitting full shut off and control of the foam discharge.

A pressure gauge on the front portion of the skid monitors the fire main pressure. The front portion also contains the necessary controls to operate the foam concentrate pump.



**Figure 3 – Foam skid (front view)**





**Figure 4 – Skid mounted on wheels showing the various elements of the system (rear view)**

#### **DCP fire-fighting skid**

The development of the DCP (dry chemical powder) skid has considered the repeatable nature of the exercise and addresses the need to demonstrate the use of DCP as a medium for fire-fighting. It follows the same concept of making the system more user friendly to the trainees.

The skid arrangement has the following advantages.

- .1 Small system that can be moved easily as the entire skid is on wheel arrangement thus providing better demonstrability.
- .2 The skid can be brought to the centre of the fire-fighting field. The front panel of the skid holds the hose cabinet, release levers, pilot bottles and pressure gauges. The rear portion of the skid is open permitting easier and better inspection by candidates so that the various components and parts of the system can be clearly studied and comprehended in terms of function as well as position in the system integration.
- .3 The quantity of DCP discharged is small thereby reducing the environmental impact of frequent releases and also keeping the DCP suspension levels down to minimum posing lesser disposal of chemical waste.
- .4 Operational cost is controlled, considering the volume of DCP discharged.
- .5 The discharge pressures are controlled thereby enhancing the safety of the installation.
- .6 Multiple candidates get an opportunity to handle the charged DCP hose and approach the oil/chemical fire to practise the correct application technique.

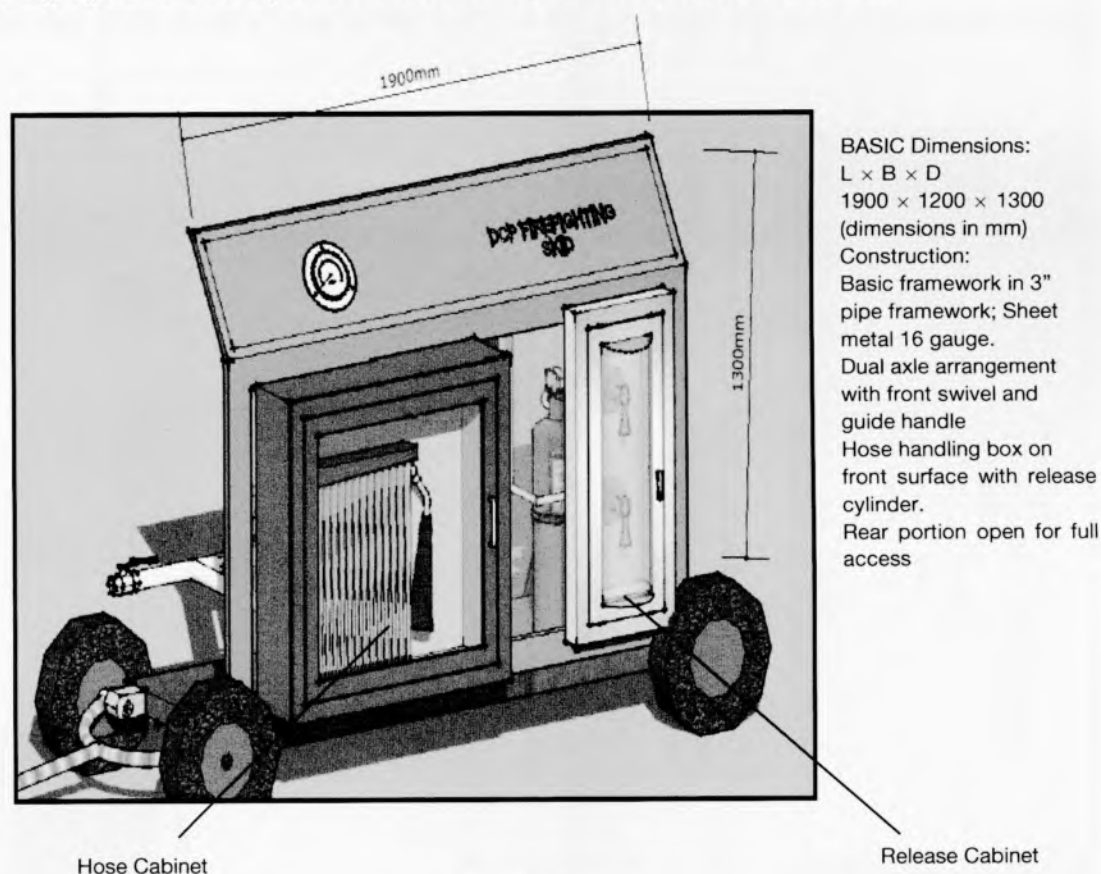
The system allows for multiple discharges during the same course as readying, and refilling the system will be quick and efficient requiring no special techniques.

### **Description of the skid (fixed DCP installation)**

A sketch of the skid is given in figs 5 and 6. The unit is mounted on a solid steel base and houses the following components.

- Main DCP container or cylinder
- Propellant bottle (nitrogen)
- Automatic remote actuation valve
- Pressure relief system
- Flexible hose with stop cock lever arrangement (auto shut-off)
- Hose cabinet and control levers

The front portion of the skid is fitted with the hose cabinet and houses the fire hose connected to the outlet of the DCP cylinder. The remote actuation valve is fitted on this line. The pilot bottle is released from the main cabinet. This is the 'pilot release station'. The pilot bottle operates a valve, whereby the propellant (nitrogen) is charged into the DCP cylinder. The pilot bottle also activates the zone remote actuation valve thereby enabling the DCP now under pressure to travel to the flexible hose. The flexible hose is capable of holding back the pressure in the system and permitting the DCP charge to be directed to the fire as required. A pressure gauge on the front portion of the skid monitors the pressure in the line.



**Figure 5 – DCP skid front view**

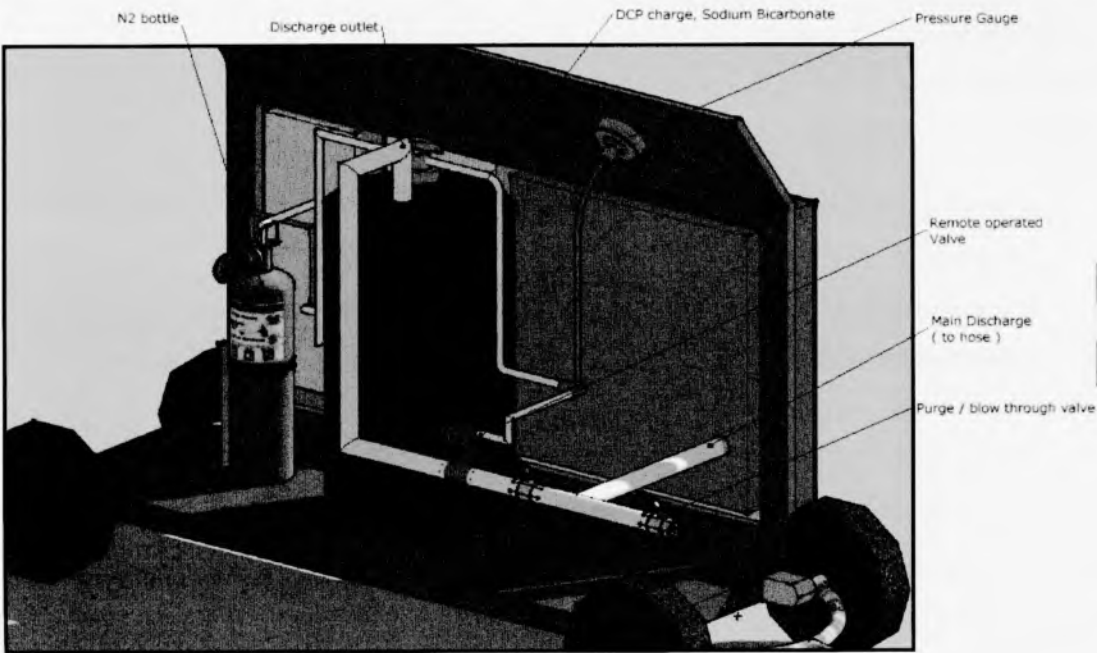
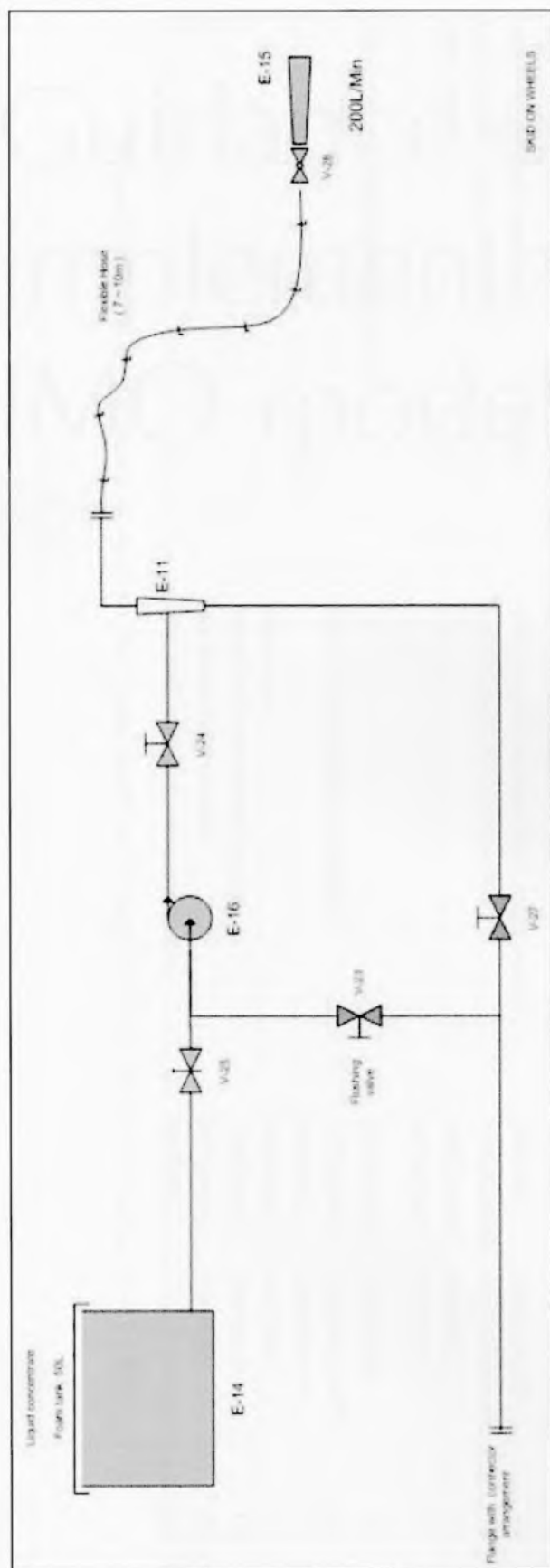


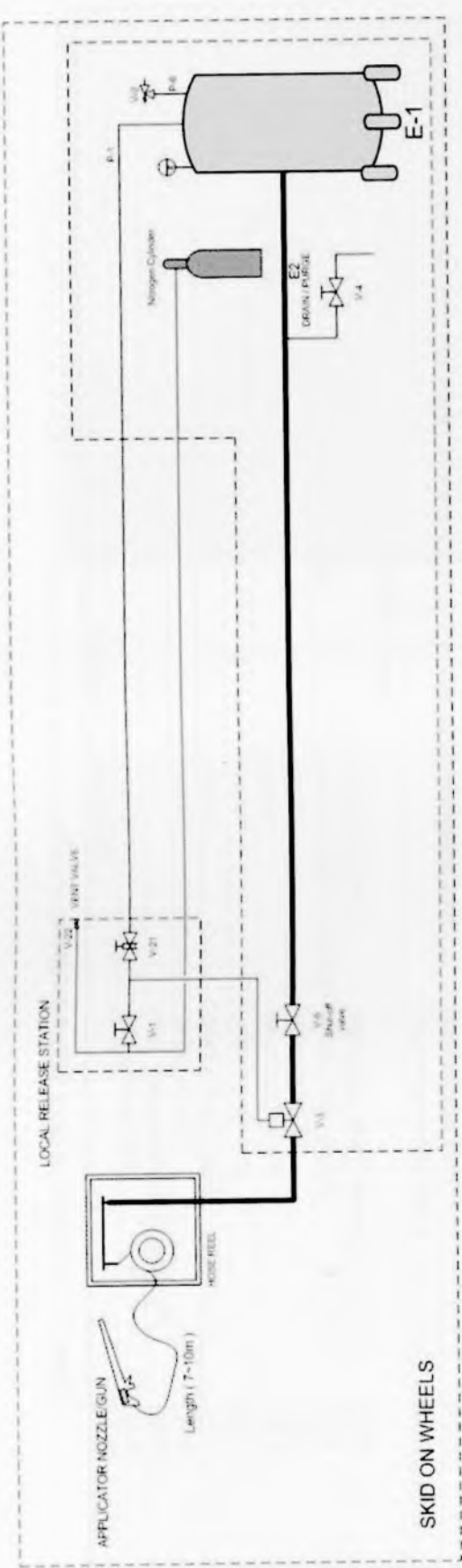
Figure 6 – DCP skid (rear view)

The schematic of the system is shown in Figure 8 along with the table of specifications of the components.



| Equipment List |                               |                             |                                             |                               |
|----------------|-------------------------------|-----------------------------|---------------------------------------------|-------------------------------|
| Displayed Text | Description                   | Manufacturer                | Material                                    | Model                         |
| E-11           | Foam Proportionator           | Tyco or equivalent          | Mild steel                                  | PL 60 ( 3% foam )             |
| E-9            | Foam concentrate tank         |                             | MS / FRP                                    | 50Litres                      |
| E15            | Portable Foam applicator      | Trident, 200L/Min           | Brass / Aluminium alloy 40 mm hose          | Type: PQ8-C ,2.5-5bar Working |
| E16            | Dosing foam pump              | Kirloskar, Crompton Greaves | Ejection Distance 20m                       | Pressure                      |
| V-25           | Control valve                 | Airmax                      | 10l/min, 1/4HP monoblock                    | 10l/min                       |
| V-24           | Pump Discharge                | Airmax                      |                                             |                               |
| V-28           | local control valve           | Airmax                      |                                             |                               |
| V-27           | Main Fire line valve          | Airmax                      |                                             |                               |
| V-23           | Flushing valve                | Airmax                      |                                             |                               |
| Foam           | 3% Foam concentrate expansion |                             |                                             |                               |
| Hose           | Fire hose braided             | 7~ 10 mtrs                  |                                             |                               |
| Skid           |                               | Mild Steel                  |                                             |                               |
|                |                               |                             | Dimensions : L X B X H = 1900 x 1200 x 1300 |                               |

**Figure 7** – Schematic of fixed foam fire-fighting installation along with the table of specifications of the components



| Equipment List |                     |                  |                                                         |                   |                                             |
|----------------|---------------------|------------------|---------------------------------------------------------|-------------------|---------------------------------------------|
| Displayed Text | Description         | Material         | Detail                                                  | Design Pressure   | Model                                       |
| E-1            | Pressure Vessel DCP | Mild Steel       | 50 Kgs Expulsion time 45 sec. Sodium Bicarbonate charge | 30bar ( IS 1079 ) | PN16 ( Pressure Class) IS 10658             |
| E-2            | Nitrogen Cylinder   | Mild Steel       | Volume 3-5 fts, working pressure 140 bar IS 7285        | 250 bar           | Hand valve / external trigger release       |
| F1             | Portable DCP Turret | Casting AL Alloy | Throw distance 10m ( Range 8-10m )                      |                   | Hand release type ( quick latch type )      |
| V1             | Line valve          | Casting AL Alloy |                                                         |                   | Manual release                              |
| V2             | Safety Valve        | Casting Alloy    |                                                         |                   |                                             |
| V3             | Release Valve       | Casting Alloy    |                                                         |                   |                                             |
| V4             | Purge / drain valve | Casting Alloy    | Purge valve to blow through the DCP line                |                   | Remote operated Quick opening latch on type |
| P              | Pressure Gauge      | Composite        |                                                         | 0-220 bar         |                                             |
| V5             | shut off valve      | Casting Alloy    | Isolation valve                                         |                   |                                             |
| V21            | shut off valve      | Casting Alloy    | Isolation / Release valvein FRP cabinet                 |                   |                                             |
| V22            | shut off valve      | Casting Alloy    | Vent valve to depressunize line                         |                   |                                             |
| Skid           |                     | Mild Steel       | Dimensions L X B X H = 1900 x 1200 x 1300               |                   |                                             |

Figure 8 – The schematic of the fixed DCP fire-fighting installation along with the table of specifications of the components



# Guidance on the implementation of IMO model courses

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## **Part 1: Preparation**

### **1 Introduction**

**1.1** The success of any enterprise depends heavily on sound and effective preparations.

**1.2** Although the IMO model course “package” has been made as comprehensive as possible, it is nonetheless vital that sufficient time and resources are devoted to preparation. Preparation not only involves matters concerning administration or organization, but also includes the preparation of any course notes, drawings, sketches, overhead transparencies, etc., which may be necessary.

### **2 General considerations**

**2.1** The course “package” should be studied carefully; in particular, the course syllabus and associated material must be attentively and thoroughly studied. This is vital if a clear understanding is to be obtained of what is required, in terms of resources necessary to successfully implement the course.

**2.2** A “checklist”, such as that set out in annex A1, should be used throughout all stages of preparation to ensure that all necessary actions and activities are being carried out in good time and in an effective manner. The checklist allows the status of the preparation procedures to be monitored, and helps in identifying the remedial actions necessary to meet deadlines. It will be necessary to hold meetings of all those concerned in presenting the course from time to time in order to assess the status of the preparation and “troubleshoot” any difficulties.

**2.3** The course syllabus should be discussed with the teaching staff who are to present the course, and their views received on the particular parts they are to present. A study of the syllabus will determine whether the incoming trainees need preparatory work to meet the entry standard. The detailed teaching syllabus is constructed in “training outcome” format. Each specific outcome states precisely what the trainee must do to show that the outcome has been achieved. An example of a model course syllabus is given in annex A2. Part 3 deals with curriculum development and explains how a syllabus is constructed and used.

**2.4** The teaching staff who are to present the course should construct notes or lesson plans to achieve these outcomes. A sample lesson plan for one of the areas of the sample syllabus is provided in annex A3.

**2.5** It is important that the staff who present the course convey, to the person in charge of the course, their assessment of the course as it progresses.

### **3 Specific considerations**

#### **3.1 Scope of course**

In reviewing the scope of the course, the instructor should determine whether it needs any adjustment in order to meet additional local or national requirements (see *Part 3*).

#### **3.2 Course objective**

- .1** The course objective, as stated in the course material, should be very carefully considered so that its meaning is fully understood. Does the course objective require expansion to encompass any additional task that national or local requirements will impose upon those who successfully complete the course? Conversely, are there elements included which are not validated by national industry requirements?
- .2** It is important that any subsequent assessment made of the course should include a review of the course objectives.

#### **3.3 Entry standards**

- .1** If the entry standard will not be met by your intended trainee intake, those entering the course should first be required to complete an upgrading course to raise them to the stated entry level. Alternatively, those parts of the course affected could be augmented by inserting course material which will cover the knowledge required.

- .2 If the entry standard will be exceeded by your planned trainee intake, you may wish to abridge or omit those parts of the course the teaching of which would be unnecessary, or which could be dealt with as revision.
- .3 Study the course material with the above questions in mind and with a view to assessing whether or not it will be necessary for the trainees to carry out preparatory work prior to joining the course. Preparatory material for the trainees can range from refresher notes, selected topics from textbooks and reading of selected technical papers, through to formal courses of instruction. It may be necessary to use a combination of preparatory work and the model course material in modified form. It must be emphasized that where the model course material involves an international requirement, such as a regulation of the International Convention on Standards of Training, Certification and Watchkeeping (STCW) 1978, as amended, the standard must not be relaxed; in many instances, the intention of the Convention is to require review, revision or increased depth of knowledge by candidates undergoing training for higher certificates.

### **3.4 Course certificate, diploma or document**

Where a certificate, diploma or document is to be issued to trainees who successfully complete the course, ensure that this is available and properly worded and that the industry and all authorities concerned are fully aware of its purpose and intent.

### **3.5 Course intake limitations**

- .1 The course designers have recommended limitations regarding the numbers of trainees who may participate in the course. As far as possible, these limitations should not be exceeded; otherwise, the quality of the course will be diluted.
- .2 It may be necessary to make arrangements for accommodating the trainees and providing facilities for food and transportation. These aspects must be considered at an early stage of the preparations.

### **3.6 Staff requirements**

- .1 It is important that an experienced person, preferably someone with experience in course and curriculum development, is given the responsibility of implementing the course.
- .2 Such a person is often termed a “course coordinator” or “course director”. Other staff, such as lecturers, instructors, laboratory technicians, workshop instructors, etc., will be needed to implement the course effectively. Staff involved in presenting the course will need to be properly briefed about the course work they will be dealing with, and a system must be set up for checking the material they may be required to prepare. To do this, it will be essential to make a thorough study of the syllabus and apportion the parts of the course work according to the abilities of the staff called upon to present the work.
- .3 The person responsible for implementing the course should consider monitoring the quality of teaching in such areas as variety and form of approach, relationship with trainees, and communicative and interactive skills; where necessary, this person should also provide appropriate counselling and support.

### **3.7 Teaching facilities and equipment**

#### **.1 Rooms and other services**

It is important to make reservations as soon as is practicable for the use of lecture rooms, laboratories, workshops and other spaces.

#### **.2 Equipment**

Arrangements must be made at an early stage for the use of equipment needed in the spaces mentioned in 3.7.1 to support and carry through the work of the course. For example:

- blackboards and writing materials
- apparatus in laboratories for any associated demonstrations and experiments

- machinery and related equipment in workshops
- equipment and materials in other spaces (e.g. for demonstrating firefighting, personal survival, etc.)

### 3.8 Teaching aids

Any training aids specified as being essential to the course should be constructed, or checked for availability and working order.

### 3.9 Audiovisual aids

Audiovisual aids (AVA) may be recommended in order to reinforce the learning process in some parts of the course. Such recommendations will be identified in Part A of the model course. The following points should be borne in mind:

#### .1 Overhead projectors

Check through any illustrations provided in the course for producing overhead projector (OHP) transparencies, and arrange them in order of presentation. To produce transparencies, a supply of transparency sheets is required; the illustrations can be transferred to these via photocopying. Alternatively, transparencies can be produced by writing or drawing on the sheet. Coloured pens are useful for emphasizing salient points. Ensure that spare projector lamps (bulbs) are available.

#### .2 Slide projectors

If you order slides indicated in the course framework, check through them and arrange them in order of presentation. Slides are usually produced from photographic negatives. If further slides are considered necessary and cannot be produced locally, OHP transparencies should be resorted to.

#### .3 Cine projector

If films are to be used, check their compatibility with the projector (i.e. 16 mm, 35 mm, sound, etc.). The films must be test-run to ensure there are no breakages.

#### .4 Video equipment

It is essential to check the type of video tape to be used. The two types commonly used are VHS and Betamax. Although special machines exist which can play either format, the majority of machines play only one or the other type. Note that VHS and Betamax are not compatible; the correct machine type is required to match the tape. Check also that the TV raster format used in the tapes (i.e. number of lines, frames/second, scanning order, etc.) is appropriate to the TV equipment available. (Specialist advice may have to be sought on this aspect.) All video tapes should be test-run prior to their use on the course.

#### .5 Computer equipment

If computer-based aids are used, check their compatibility with the projector and the available software.

#### .6 General note

The electricity supply must be checked for correct voltage, and every precaution must be taken to ensure that the equipment operates properly and safely. It is important to use a proper screen which is correctly positioned; it may be necessary to exclude daylight in some cases. A check must be made to ensure that appropriate screens or blinds are available. All material to be presented should be test-run to eliminate any possible troubles, arranged in the correct sequence in which it is to be shown, and properly identified and cross-referenced in the course timetable and lesson plans.

### 3.10 IMO references

The content of the course, and therefore its standard, reflects the requirements of all the relevant IMO international conventions and the provisions of other instruments as indicated in the model course. The relevant publications can be obtained from the Publication Service of IMO, and should be available, at least to



those involved in presenting the course, if the indicated extracts are not included in a compendium supplied with the course.

### **3.11    *Textbooks***

The detailed syllabus may refer to a particular textbook or textbooks. It is essential that these books are available to each student taking the course. If supplies of textbooks are limited, a copy should be loaned to each student, who will return it at the end of the course. Again, some courses are provided with a compendium which includes all or part of the training material required to support the course.

### **3.12    *Bibliography***

Any useful supplementary source material is identified by the course designers and listed in the model course. This list should be supplied to the participants so that they are aware where additional information can be obtained, and at least two copies of each book or publication should be available for reference in the training institute library.

### **3.13    *Timetable***

If a timetable is provided in a model course, it is for guidance only. It may only take one or two presentations of the course to achieve an optimal timetable. However, even then it must be borne in mind that any timetable is subject to variation, depending on the general needs of the trainees in any one class and the availability of instructors and equipment.

## **Part 2: Notes on teaching technique**

### **1 Preparation**

- 1.1** Identify the section of the syllabus which is to be dealt with.
- 1.2** Read and study thoroughly all the syllabus elements.
- 1.3** Obtain the necessary textbooks or reference papers which cover the training area to be presented.
- 1.4** Identify the equipment which will be needed, together with support staff necessary for its operation.
- 1.5** It is essential to use a “lesson plan”, which can provide a simplified format for coordinating lecture notes and supporting activities. The lesson plan breaks the material down into identifiable steps, making use of brief statements, possibly with keywords added, and indicating suitable allocations of time for each step. The use of audiovisual material should be indexed at the correct point in the lecture with an appropriate allowance of time. The audiovisual material should be test-run prior to its being used in the lecture. An example of a lesson plan is shown in annex A3.
- 1.6** The syllabus is structured in training outcome format and it is thereby relatively straight forward to assess each trainee’s grasp of the subject matter presented during the lecture. Such assessment may take the form of further discussion, oral questions, written tests or selection-type tests, such as multiple-choice questions, based on the objectives used in the syllabus. Selection-type tests and short-answer tests can provide an objective assessment independent of any bias on the part of the assessor. For certification purposes, assessors should be appropriately qualified for the particular type of training or assessment.

**REMEMBER – POOR PREPARATION IS A SURE WAY TO LOSE THE INTEREST OF A GROUP**

- 1.7** Check the rooms to be used before the lecture is delivered. Make sure that all the equipment and apparatus are ready for use and that any support staff are also prepared and ready. In particular, check that all blackboards are clean and that a supply of writing and cleaning materials is readily available.

### **2 Delivery**

- 2.1** Always face the people you are talking to; never talk with your back to the group.
- 2.2** Talk clearly and sufficiently loudly to reach everyone.
- 2.3** Maintain eye contact with the whole group as a way of securing their interest and maintaining it (i.e. do not look continuously at one particular person, nor at a point in space).
- 2.4** People are all different, and they behave and react in different ways. An important function of an instructor is to maintain interest and interaction between members of a group.
- 2.5** Some points or statements are more important than others and should therefore be emphasized. To ensure that such points or statements are remembered, they must be restated a number of times, preferably in different words.
- 2.6** If a blackboard is to be used, any writing on it must be clear and large enough for everyone to see. Use colour to emphasize important points, particularly in sketches.
- 2.7** It is only possible to maintain a high level of interest for a relatively short period of time; therefore, break the lecture up into different periods of activity to keep interest at its highest level. Speaking, writing, sketching, use of audiovisual material, questions, and discussions can all be used to accomplish this. When a group is writing or sketching, walk amongst the group, looking at their work, and provide comment or advice to individual members of the group when necessary.
- 2.8** When holding a discussion, do not allow individual members of the group to monopolize the activity, but ensure that all members have a chance to express opinions or ideas.

**2.9** If addressing questions to a group, do not ask them collectively; otherwise, the same person may reply each time. Instead, address the questions to individuals in turn, so that everyone is invited to participate.

**2.10** It is important to be guided by the syllabus content and not to be tempted to introduce material which may be too advanced, or may contribute little to the course objective. There is often competition between instructors to achieve a level which is too advanced. Also, instructors often strongly resist attempts to reduce the level to that required by a syllabus.

**2.11** Finally, effective preparation makes a major contribution to the success of a lecture. Things often go wrong; preparedness and good planning will contribute to putting things right. Poor teaching cannot be improved by good accommodation or advanced equipment, but good teaching can overcome any disadvantages that poor accommodation and lack of equipment can present.

## **Part 3: Curriculum development**

### **1 Curriculum**

The dictionary defines curriculum as a “regular course of study”, while syllabus is defined as “a concise statement of the subjects forming a course of study”. Thus, in general terms, a curriculum is simply a course, while a syllabus can be thought of as a list (traditionally, a “list of things to be taught”).

### **2 Course content**

The subjects which are needed to form a training course, and the precise skills and depth of knowledge required in the various subjects, can only be determined through an in-depth assessment of the job functions which the course participants are to be trained to perform (job analysis). This analysis determines the training needs, hence the purpose of the course (course objective). After ascertaining this, it is possible to define the scope of the course.

(**Note:** Determination of whether or not the course objective has been achieved may quite possibly entail assessment, over a period of time, of the “on-the-job performance” of those completing the course. However, the detailed learning objectives are quite specific and immediately assessable.)

### **3 Job analysis**

A job analysis can only be properly carried out by a group whose members are representative of the organizations and bodies involved in the area of work to be covered by the course. The validation of results, via review with persons currently employed in the job concerned, is essential if undertraining and overtraining are to be avoided.

### **4 Course plan**

Following definition of the course objective and scope, a course plan or outline can be drawn up. The potential students for the course (the trainee target group) must then be identified, the entry standard to the course decided and the prerequisites defined.

### **5 Syllabus**

The final step in the process is the preparation of the detailed syllabus with associated timescales; the identification of those parts of textbooks and technical papers which cover the training areas to a sufficient degree to meet, but not exceed, each learning objective; and the drawing up of a bibliography of additional material for supplementary reading.

### **6 Syllabus content**

The material contained in a syllabus is not static; technology is continuously undergoing change and there must therefore be a means for reviewing course material in order to eliminate what is redundant and introduce new material reflecting current practice. As defined above, a syllabus can be thought of as a list and, traditionally, there have always been an “examination syllabus” and a “teaching syllabus”; these indicate, respectively, the subject matter contained in an examination paper, and the subject matter a teacher is to use in preparing lessons or lectures.

### **7 Training outcomes**

**7.1** The prime communication difficulty presented by any syllabus is how to convey the “depth” of knowledge required. A syllabus is usually constructed as a series of “training outcomes” to help resolve this difficulty.

**7.2** Thus, curriculum development makes use of training outcomes to ensure that a common minimum level and breadth of attainment is achieved by all the trainees following the same course, irrespective of the training institution (i.e. teaching/lecturing staff).

**7.3** Training outcomes are trainee-oriented, in that they describe an end result which is to be achieved by the trainee as a result of a learning process.

**7.4** In many cases, the learning process is linked to a skill or work activity and, to demonstrate properly the attainment of the objective, the trainee response may have to be based on practical application or use, or on work experience.

**7.5** The training outcome, although aimed principally at the trainee to ensure achievement of a specific learning step, also provides a framework for the teacher or instructor upon which lessons or lectures can be constructed.

**7.6** A training outcome is specific and describes precisely what a trainee must do to demonstrate his knowledge, understanding or skill as an end product of a learning process.

**7.7** The learning process is the “knowledge acquisition” or “skill development” that takes place during a course. The outcome of the process is an acquired “knowledge”, “understanding”, “skill”; but these terms alone are not sufficiently precise for describing a training outcome.

**7.8** Verbs, such as “calculates”, “defines”, “explains”, “lists”, “solves” and “states”, must be used when constructing a specific training outcome, so as to define precisely what the trainee will be enabled to do.

**7.9** In the IMO model course project, the aim is to provide a series of model courses to assist instructors in developing countries to enhance or update the maritime training they provide, and to allow a common minimum standard to be achieved throughout the world. The use of training outcomes is a tangible way of achieving this desired aim.

**7.10** As an example, a syllabus in training-outcome format for the subject of ship construction appears in annex A2. This is a standard way of structuring this kind of syllabus. Although, in this case, an outcome for each area has been identified – and could be used in an assessment procedure – this stage is often dropped to obtain a more compact syllabus structure.

## **8 Assessment**

Training outcomes describe an outcome which is to be achieved by the trainee. Of equal importance is the fact that such an achievement can be measured OBJECTIVELY through an evaluation which will not be influenced by the personal opinions and judgements of the examiner. Objective testing or evaluation provides a sound base on which to make reliable judgements concerning the levels of understanding and knowledge achieved, thus allowing an effective evaluation to be made of the progress of trainees in a course.



Annex A1 – Preparation checklist

| Ref | Component           | Identified | Reserved | Electricity supply | Purchases | Tested | Accepted | Started | Finished | Status OK |
|-----|---------------------|------------|----------|--------------------|-----------|--------|----------|---------|----------|-----------|
| 1   | Course plan         |            |          |                    |           |        |          |         |          |           |
| 2   | Timetable           |            |          |                    |           |        |          |         |          |           |
| 3   | Syllabus            |            |          |                    |           |        |          |         |          |           |
| 4   | Scope               |            |          |                    |           |        |          |         |          |           |
| 5   | Objective           |            |          |                    |           |        |          |         |          |           |
| 6   | Entry standard      |            |          |                    |           |        |          |         |          |           |
| 7   | Preparatory course  |            |          |                    |           |        |          |         |          |           |
| 8   | Course certificate  |            |          |                    |           |        |          |         |          |           |
| 9   | Participant numbers |            |          |                    |           |        |          |         |          |           |
| 10  | Staffing:           |            |          |                    |           |        |          |         |          |           |
|     | Coordinator         |            |          |                    |           |        |          |         |          |           |
|     | Lecturers           |            |          |                    |           |        |          |         |          |           |
|     | Instructors         |            |          |                    |           |        |          |         |          |           |
|     | Technicians         |            |          |                    |           |        |          |         |          |           |
|     | Other               |            |          |                    |           |        |          |         |          |           |

Annex A1 – Preparation checklist (continued)

| Ref | Component               | Identified | Reserved | Electricity supply | Purchases | Tested | Accepted | Started | Finished | Status OK |
|-----|-------------------------|------------|----------|--------------------|-----------|--------|----------|---------|----------|-----------|
| 11  | Facilities              |            |          |                    |           |        |          |         |          |           |
|     | a) Rooms                |            |          |                    |           |        |          |         |          |           |
|     | Lab                     |            |          |                    |           |        |          |         |          |           |
|     | Workshop                |            |          |                    |           |        |          |         |          |           |
|     | Other                   |            |          |                    |           |        |          |         |          |           |
|     | Class                   |            |          |                    |           |        |          |         |          |           |
| b)  | Equipment               |            |          |                    |           |        |          |         |          |           |
|     | Lab                     |            |          |                    |           |        |          |         |          |           |
|     | Workshop                |            |          |                    |           |        |          |         |          |           |
|     | Other                   |            |          |                    |           |        |          |         |          |           |
| 12  | AVA                     |            |          |                    |           |        |          |         |          |           |
|     | Equipment and Materials |            |          |                    |           |        |          |         |          |           |
|     | OHP                     |            |          |                    |           |        |          |         |          |           |
|     | Slide                   |            |          |                    |           |        |          |         |          |           |
|     | Cine                    |            |          |                    |           |        |          |         |          |           |
| 13  | Video                   |            |          |                    |           |        |          |         |          |           |
|     | IMO Reference           |            |          |                    |           |        |          |         |          |           |
|     | Textbooks               |            |          |                    |           |        |          |         |          |           |
|     | Bibliography            |            |          |                    |           |        |          |         |          |           |
|     |                         |            |          |                    |           |        |          |         |          |           |

## Annex A2 – Example of a model course syllabus in a subject area

|                      |                                                                                                                                                                                                                                                                                               |
|----------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Subject area:</b> | Ship construction                                                                                                                                                                                                                                                                             |
| <b>Prerequisite:</b> | Have a broad understanding of shipyard practice                                                                                                                                                                                                                                               |
| <b>General aims:</b> | Have knowledge of materials used in shipbuilding, specification of shipbuilding steel and process of approval                                                                                                                                                                                 |
| <b>Textbooks:</b>    | No specific textbook has been used to construct the syllabus, but the instructor would be assisted in preparation of lecture notes by referring to suitable books on ship construction, such as <i>Ship Construction</i> by Eyres (T12) and <i>Merchant Ship Construction</i> by Taylor (T58) |

| Course outline                                                        |                            |                                                           |
|-----------------------------------------------------------------------|----------------------------|-----------------------------------------------------------|
| Knowledge, understanding and proficiency                              | Total hours for each topic | Total hours for each subject area of Required performance |
| Competence :                                                          |                            |                                                           |
| 3.1 Control trim, stability and stress                                |                            |                                                           |
| 3.1.1 Fundamental principles of ship construction, trim and stability |                            |                                                           |
| .1 Shipbuilding materials                                             | 3                          |                                                           |
| .2 Welding                                                            | 3                          |                                                           |
| .3 Bulkheads                                                          | 4                          |                                                           |
| .4 Watertight and weathertight doors                                  | 3                          |                                                           |
| .5 Corrosion and its prevention                                       | 4                          |                                                           |
| .6 Surveys and dry-docking                                            | 2                          |                                                           |
| .7 Stability                                                          | 83                         | 102                                                       |

## Part C3: Detailed Teaching Syllabus

### Introduction

The detailed teaching syllabus is presented as a series of learning objectives. The objective, therefore, describes what the trainee must do to demonstrate that the specified knowledge or skill has been transferred.

Thus each training outcome is supported by a number of related performance elements in which the trainee is required to be proficient. The teaching syllabus shows the Required performance expected of the trainee in the tables that follow.

In order to assist the instructor, references are shown to indicate IMO references and publications, textbooks and teaching aids that instructors may wish to use in preparing and presenting their lessons.

The material listed in the course framework has been used to structure the detailed training syllabus; in particular:

- Teaching aids (indicated by A)
- IMO references (indicated by R), and
- Textbooks (indicated by T)

will provide valuable information to instructors.

### Explanation of information contained in the syllabus tables

The information on each table is systematically organized in the following way. The line at the head of the table describes the **FUNCTION** with which the training is concerned. A function means a group of tasks, duties and responsibilities as specified in the STCW Code. It describes related activities which make up a professional discipline or traditional departmental responsibility on board.

The header of the first column denotes the **COMPETENCE** concerned. Each function comprises a number of **COMPETENCES**. Each competence is uniquely and consistently numbered on this model course.

In this function the competence is **Control Trim, Stability and Stress**. It is numbered 3.1, that is the first competence in Function 3. The term “competence” should be understood as the application of knowledge, understanding, proficiency, skills, experience for an individual to perform a task, duty or responsibility on board in a safe, efficient and timely manner.

Shown next is the required **TRAINING OUTCOME**. The training outcomes are the areas of knowledge, understanding and proficiency in which the trainee must be able to demonstrate knowledge and understanding. Each **COMPETENCE** comprises a number of training outcomes. For example, the above competence comprises three training outcomes. The first is concerned with **FUNDAMENTAL PRINCIPLES OF SHIP CONSTRUCTION, TRIM AND STABILITY**. Each training outcome is uniquely and consistently numbered in this model course. That concerned with fundamental principles of ship construction, trim and stability is uniquely numbered 3.1.1. For clarity, training outcomes are printed in black type on grey, for example **TRAINING OUTCOME**.

Finally, each training outcome embodies a variable number of Required performances – as evidence of competence. The instruction, training and learning should lead to the trainee meeting the specified Required performance. For the training outcome concerned with the fundamental principles of ship construction, trim and stability there are three areas of performance. These are:

#### 3.1.1.1 Shipbuilding materials

#### 3.1.1.2 Welding

#### 3.1.1.3 Bulkheads

Following each numbered area of Required performance there is a list of activities that the trainee should complete and which collectively specify the standard of competence that the trainee must meet. These are for the guidance of teachers and instructors in designing lessons, lectures, tests and exercises for use in the



teaching process. For example, under the topic 3.1.1.1, to meet the Required performance, the trainee should be able to:

- state that steels are alloys of iron, with properties dependent upon the type and amount of alloying materials used
- state that the specification of shipbuilding steels are laid down by classification societies
- state that shipbuilding steel is tested and graded by classification society surveyors who stamp it with approved marks

and so on.

IMO references (Rx) are listed in the column to the right-hand side. Teaching aids (Ax), videos (Vx) and textbooks (Tx) relevant to the training outcome and Required performances are placed immediately following the **TRAINING OUTCOME** title.

It is not intended that lessons are organized to follow the sequence of Required performances listed in the Tables. The Syllabus Tables are organized to match with the competence in the STCW Code, table A-II/2. Lessons and teaching should follow college practices. It is not necessary, for example, for shipbuilding materials to be studied before stability. What is necessary is that all of the material is covered and that teaching is effective to allow trainees to meet the standard of the Required performance.

**FUNCTION 3: CONTROLLING THE OPERATION OF THE SHIP AND CARE FOR  
PERSONS ON BOARD AT THE MANAGEMENT LEVEL**

**COMPETENCE 3.1      Control trim, stability and stress**

**IMO reference**

**Competence :**

**3.1.1      FUNDAMENTAL PRINCIPLES OF SHIP  
CONSTRUCTION, TRIM AND STABILITY**

**Textbooks:** T11, T12, T35, T58, T69

**Teaching aids:** A1, A4, V5, V6, V7

Required performance:

**1.1      Shipbuilding materials (3 hours)**

- states that steels are alloys of iron, with properties dependent upon the type and amounts of alloying materials used R1
- states that the specifications of shipbuilding steels are laid down by classification societies
- states that shipbuilding steel is tested and graded by classification surveyors, who stamp it with approved marks
- explains that mild steel, graded A – E, is used for most parts of the ship
- states why higher tensile steel may be used in areas of high stress, such as the sheer strake
- explains that the use of higher tensile steel in place of mild steel results in saving of weight for the same strength
- explains what is meant by:
  - tensile strength
  - ductility
  - hardness
  - toughness
- defines strain as extension divided by original length
- sketches a stress-strain curve for mild steel
- explains
  - yield point
  - ultimate tensile stress
  - modulus of elasticity
- explains that toughness is related to the tendency to brittle fracture
- explains that stress fracture may be initiated by a small crack or notch in a plate
- states that cold conditions increase the chances of brittle fracture
- states why mild steel is unsuitable for the very low temperatures involved in the containment of liquefied gases
- lists examples where castings or forgings are used in ship construction
- explains the advantages of the use of aluminium alloys in the construction of superstructures
- states that aluminium alloys are tested and graded by classification society surveyors
- explains how strength is preserved in aluminium superstructures in the event of fire
- describes the special precautions against corrosion that are needed where aluminium alloy is connected to steelwork

Annex A3 – Example of a lesson plan for annex A2

Subject area: 3.1 Control trim, stability and stress      Lesson Number: 1      Duration : 3 hours

Training Area: 3.1.1 Fundamental principles of ship construction, trim and stability

| Main element<br>Specific training outcome in teaching sequence, with memory keys                                      | Teaching method | Textbook | IMO reference     | A/V aid  | Instructor guidelines | Lecture notes            | Time (minutes) |
|-----------------------------------------------------------------------------------------------------------------------|-----------------|----------|-------------------|----------|-----------------------|--------------------------|----------------|
| <b>1.1 Shipbuilding materials (3 hours)</b>                                                                           |                 |          |                   |          |                       |                          |                |
| States that steels are alloys of iron, with properties dependent upon the type and amounts of alloying materials used | Lecture         | T12, T58 | STCW II/2, A-II/2 | V5 to V7 | A1                    | Compiled by the lecturer | 10             |
| States that the specifications of shipbuilding steels are laid down by classification societies                       | Lecture         | T12, T58 | STCW II/2, A-II/2 | V5 to V7 | A1                    | Compiled by the lecturer | 20             |
| Explains that mild steel, graded A to E, is used for most parts of the ship                                           | Lecture         | T12, T58 | STCW II/2, A-II/2 | V5 to V7 | A1                    | Compiled by the lecturer | 15             |
| States why higher tensile steel may be used in areas of high stress, such as the sheer strake                         | Lecture         | T12, T58 | STCW II/2, A-II/2 | V5 to V7 | A1                    | Compiled by the lecturer | 10             |
| Explains that use of higher tensile steel in place of mild steel results in a saving of weight for the same strength  | Lecture         | T12, T58 | STCW II/2, A-II/2 | V5 to V7 | A1                    | Compiled by the lecturer | 15             |