INTERNATIONAL MARITIME ORGANIZATION

IMO

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SUB-COMMITTEE ON STANDARDS OF TRAINING AND WATCHKEEPING
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Agenda item 3

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VALIDATION OF MODEL TRAINING COURSES

Model course - Liquefied petroleum gas tanker (LPG) cargo and ballast handling simulator

Note by the Secretariat

SUMMARY

Executive summary:	This document provides a draft model course on Liquefied petroleum gas (LPG) cargo and ballast handling simulator
Action to be taken:	Paragraph 5
Related documents:	MSC 50/27, STW 17/11 and STW 37/18

1 The Maritime Safety Committee, at its fiftieth session (MSC 50/27, paragraph 12.10), had approved the procedures developed by the Sub-Committee, at its seventeenth session (STW 17/11, annex 5), for validation of model courses related to the implementation of the STCW Convention.

2 The Sub-Committee, at its thirty-seventh session (23 to 27 January 2006), had concurred with the proposal by India to develop a simulator model training course relating to Liquefied petroleum gas (LPG) cargo (STW 37/3/2) and to submit it to the Sub-Committee for validation in due course (STW 37/18, paragraphs 3.7 and 3.10).

3 The preliminary draft of this model course was forwarded to members of the validation panel for their comments. The comments received have been incorporated as appropriate.

4 The final draft model course is set out in annex.

Action requested of the Sub-Committee

5 The Sub-Committee is invited to consider the above information and decide as appropriate.

***

ANNEX

Model Course X.YY

Draft

LIQUEFIED PETROLEUM GAS TANKER (LPG) CARGO AND BALLAST HANDLING SIMULATOR

International Maritime Organization

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ACKNOWLEDGEMENTS

This course is based on training guidelines as produced by SIGTTO and training material developed by the Directorate General of Shipping, Government of India.

It has been prepared by training institutions based in Mumbai.

IMO wishes to express its sincere appreciation to the government of India for its provision of expert assistance, valuable cooperation, and generous funding in support of this work.

Introduction

▪ Purpose of the model course

The purpose of the model course is to assist maritime training institute 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 course may thereby be improved.

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 audio-visual or "programmed" material for the instructor's presence. As in all training endeavours, the knowledge, skills and dedication of the instructor are the key components in the transfer of knowledge and skills to those being trained through model course material.

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 skill necessary to meet the technical intent of IMO conventions and related recommendations.

In order to keep the training programme up to date in the future, it is essential that users provide feedback. New information will provide better training in safety at sea and protection of the marine environment.

▪ Use of the model course

To use the model course the instructor should review the course outline 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 prior technical education of the trainees should be kept in mind during this 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 designer should

be identified. To compensate for such differences, the instructor is expected to delete from the course, or reduce the emphasis on, items dealing with knowledge or skills already attained by the trainees. He should also identify any academic knowledge, skills or technical training which they may not have acquired.

Adjustment of the course objectives, scope and content may also be necessary if in your maritime industry the trainees completing the course are to undertake duties which differ from the objectives specified in the model course.
Within the course plan the course designers have indicated their assessment of the amount of time, which should be allotted to each area of learning. Teaching staff should note that the sequence and length of time allocated to each subject are suggestions only.

These factors may be adapted by lecturers to suit individual groups of students according to their experience and ability as well as equipment and staff available for training.

By analysing the detailed syllabus and the academic knowledge required to allow training in the technical area to proceed, the instructor can design an 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 technical course.

Within the course outline, Part B, the course designers have indicated their assessment of time, which should be allotted to each subject area. However, it must be appreciated that these allocations are suggestions only. These factors may be adapted by lectures to suit individual groups of students according to their experience and ability as well as equipment and staff available for training 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.

Lesson plans

Having adjusted the course content to suit the trainee intake and any revision of the course objectives, the instructor should draw up lesson plans based on the detailed syllabus. The detailed syllabus contains specific references to the textbooks or teaching material proposed to be used in the course. An example of a lesson plan is included in the instructor manual in most model courses, but in this course, the exercise scenarios supplied as an appendix to the instructor manual serve this purpose. Where no adjustment has been found necessary in the learning objectives 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 presentation of the material.

■ Presentation

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

■ Evaluation or assessment of trainees' progress

The nature of this course involves all the trainees and the instructors in an ongoing process of individual and group evaluation.

■ 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 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. A copy of this booklet is included as an attachment to this course.

▪ Training and the STCW'95

The standards of competence that have to be met by seafarers are defined in Part A of the STCW Code in the Standards of Training, Certification and Watch keeping for Seafarers Convention, as amended in 1995. This IMO model course has been designed to cover the competence in STCW 1995. It sets out the education and training to achieve those standards.

Special training requirements for masters, chief engineer officers, chief mates, second engineer officers and any person with immediate responsibility for loading, discharging and care in transit or handling of cargo on liquefied gas tankers, are detailed in Section A-V/1 of the STCW Code.

This model course aims to provide a practical experience of the subjects specified in paragraphs 24, 29, 30,31,32,33 & 34 of Section A-V/1 & in paragraphs 15 of Section B-V/1of the STCW Code.

For ease of reference, the course is divided into separate sections.

Part A provides the framework for the course with its aims and objectives and notes on the suggested teaching facilities and equipment. A list of useful teaching aids, IMO references and textbooks is also included.

Part B provides an outline of lectures, demonstrations and exercises for the course, together with a suggested sequence and timetable. From the teaching and learning point of view, it is more important that the trainee achieves the minimum standard of competence defined in the STCW Code that a strict timetable for each topic is followed.

Depending on their experience and ability, some students will naturally take longer to become proficient in some topics than in others.

Part C gives the Detailed Teaching Syllabus. This is based on the theoretical and practical knowledge specified in the STCW Code. It is presented in a logical sequence starting with basic knowledge and information on liquefied gas and its hazards, safety and pollution prevention, and concluding with inert gas system, reliquefaction systems and control of boil-off operations. Each subject area is covered by a series of required performances, in other words what the trainee is expected to be able to do as a result of the teaching and training. In this way the overall required performance of knowledge, understanding and proficiency is met. IMO references, textbook references and suggested teaching aids are included to assist the teacher in designing lessons.

Part D contains an instructor Manual with additional explanations, an example lesson plan and an example of a simulator exercise for instructors that may have access to a liquefied gas tanker cargo and ballast handling simulator.

The Convention defies the minimum standards to be maintained in Part A of the STCW Code. Mandatory provisions concerning Training and Assessment are given in Section A-1/6 of the STCW Code. These provisions cover: qualification of instructors; supervisors as assessors; in-service training; assessment of competence; and training and assessment within an institution. A corresponding Part B of the STCW Code contains non-mandatory guidance on training and assessment.

Part E provides guidance in the methods to be employed for evaluation of the trainees during and at conclusion of the course

A separate IMO Model course addressed Examination and Assessment of Competence. This course explains the use of various methods for demonstrating competence and criteria for evaluating competence as tabulated in the STCW Code and may be helpful in developing any necessary assessments.

Part A: Course Framework

▪ Aims

The course is essentially a practical one and consists of a series of exercises structured around the operation of the cargo and ballast installation of a liquefied gas tanker and carried out in conjunction with a simulator.

The exercises are controlled by an instructor and, initially, allow the trainees to become familiar with the layout of the cargo tanks, hold spaces & ballast tanks forming the system and the instrumentation and controls that are used.

The exercises continue with the simulation of the normal procedures and operations for the followings.

- the cargo-handling system, including piping systems; pumps; valves; expansion devices and vapour systems; service requirements and operating characteristics of the cargo-handling systems and liquid re-circulation;

- instrumentation systems, including cargo level indicators: gas-detection systems; pressure monitoring system; hull and cargo temperature monitoring systems; the various methods of transmitting a signal from a sensor to the monitoring station and automatic shutdown systems;

- compressors; heat exchanger; gas piping and ventilation in machinery and manned spaces; diesel engines; emergency venting and reliquefaction;

- auxiliary systems, including ventilation and inerting; quick-closing, remote control, pneumatic, excess flow, safety relief, and pressure/vacuum valves; steam systems for holds, ballast tanks and condenser; and

- general principles of operating the cargo-handling plant, including inerting cargo tanks and hold spaces by IG/N_2; tank cool-down and loading; operations during loaded and ballasted voyages; discharging and tank stripping; change of grade; emergency procedures, and pre-planned action in the event of leaks, fires, collision, stranding, emergency cargo discharge and personnel casualty.

The importance of loading and discharging so as to avoid undue stressing of the hull and the use of cooling down procedure to minimize thermal stress are introduced at appropriate points of the simulator programme.

Each simulator exercise is preceded by a briefing lecture and followed up by a debriefing lecture during which the actions and decisions of the trainees are analysed.

During the series of exercises the trainees will assume specific roles in the cargo or other operation that is being simulated, with one trainee taking the role of the officer in charge of the particular operation being simulated.

Note: Masters, chief engineer officers, chief mates, second engineer officers and any person with immediate responsibility for loading, unloading and care in transit or handling of cargo aboard liquefied gas tanker are required by paragraphs 2 of Regulation V/1 of the International Convention on Standards of Training, Certification and Watchkeeping for Seafarers, 1978, as amended in 1995 (STCW' 95) to have appropriate experience aboard operational liquefied gas tanker and to have completed an approved shore-based specialized training related to liquefied gas tanker operations.

The IMO Model Course 1.06 have been designed to meet the requirements of Regulation V/1 of STCW 1978, as amended in 1995 in respect of shore-based training; this course, using simulation, would provide them with relevant support.

Objective

The trainees who successfully complete the course will make a safer and more effective contribution to the operation and control of the cargo and ballast installation of a liquefied gas tanker, which will improve ship safety and provide greater protection of the environment.

In particular, there will be:

- familiarization with the publication, equipment, instrumentation and controls used for cargo handling on a liquefied gas tanker
- a greater awareness of the need for proper pre-planning, the use of checklists and the time scales involved in the various cargo handling operations
- an enhanced awareness to apply proper and safe procedures at all times when carrying out the various operations on board a liquefied gas tanker
- an acquisition of experience in identifying operational problems and solving them
- an improvement in the ability to make decisions which promote safety and protect the environment.

▪ Entry standards

Entry to the course is open to Masters, chief engineer officers, chief mates, second engineer officers and any person with immediate responsibility for loading, discharging and care in transit or handling of cargo on liquefied gas tankers, who wish to improve their knowledge and understanding of the safe operation and effective control of cargo and ballast operations, and other related operations on liquefied gas tankers. The candidate shall have:

(i) completed an approved specialized training programme on liquefied gas tanker operations and,
(ii) has completed the requisite approved seagoing service and approved education and training programme under regulation 2/1 and III/1 of STCW 95.

The course will provide a more practical based training to consolidate and enhance the knowledge gained from liquefied gas tanker specialized training course.

▪ Course certificate

On successful completion of this course, a certificate should be issued confirming that the holder has successfully completed liquefied gas tanker cargo and ballast handling simulator course.

▪ Course intake limitations

The number of trainees who can utilize the simulator for any given activity regulates the course intake. For this reason the maximum number of trainees should normally be twelve. When circumstances demand it, the trainees can be split into two sub- groups of up to six in each group.

▪ Staff requirements

The instructor shall have appropriate training in instructional techniques and training methods (STCW Code section A-I/6). It is recommended that the instructor in charge of the course should hold a management level certificate of competency, and should have experience in the operation and control of cargo-handling operations on liquefied gas tanker, including the use of inert gas system, cargo compressors, reliquefaction system and control of boil-off operations, with training and use of a simulator as a training aid. To operate the course successfully, at least one other instructor is required, preferably with similar qualifications and experience as the instructor-in-charge.

▪ 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 simulators used in assessment of competence are given in section A-I/12.Section B-I/12 provides guidance on the use of simulators in these activities.

Simulator-based training and assessments is not mandatory requirement for liquefied gas tanker training programme. However, it is widely recognized that well-designed lessons and exercises can improve the effectiveness of training and shorten training times compared to traditional methods.

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

▪ Teaching facilities and equipment

The cargo-handling system being simulated by the training installation should be modelled on an authentic cargo-handling system of a modern Liquefied Petroleum Gas (LPG), and / or, Liquefied Ethylene Gas (LEG) tanker, including its equipment, instrumentation and centralized cargo operations control centre, taking into account national, international and other requirements relating to safety and pollution prevention.

The simulator complex should comprise a "cargo control centre", “at least six desktop stations with log printer”, “an instructor unit with log printer”, “Local operating stations” and a “separate space for briefing and debriefing with tables and chairs” “a whiteboard” and where such audio-visual aids are to be used, an “an overhead/video projector” and “laptop”.

The simulator unit should be based on a general-purpose minicomputer with real time operating programs connected to the cargo control centre and the instructor unit.

Information print-out machines and visual display units should be incorporated into the system for trainees and instructors. The cargo control centre should contain a number of consoles covering the cargo and related systems, each with its own mimic diagram showing the system layout. The consoles will cover pumps, valves, instrumentation, communication, alarms etc. Various operations such as ballasting, deballasting, gas freeing, drying, inerting, gassing-up, cooling-down, loading, unloading, warming-up and control of boil off by using reliquefaction systems, the use of inert gas plant, nitrogen plant, air-drying system, cargo vaporiser, deep well pump, booster pump, ballast pump, cargo compressor, cargo condenser and loadmaster will be set up and controlled from the control centre.

The instructor unit should, preferably, be separate from the control centre and fitted with a window for observing and monitoring the trainee activity and progress.

The instructor unit will have an appropriate console for monitoring the various processes and operations being simulated, and be capable of introducing commands and specific malfunctions in accordance with the training programme.

▪ Teaching aids (A)

A1 Instructor manual (Part D of the course)

A2 Appendix to Instructor Manual

A3 Videos:

V1 An Introduction to Liquefied Gas Carriers (Catalogue Code No.103)

V2 Cargo Fire fighting on Liquefied Gas Carriers (Catalogue Code No.254)

V3 Permit to Work (Catalogue Code No.621)

V4 Portable Gas Detectors–A Breath of Fresh Air (Code No.650)

V5 Ballast water management (code No.698)

Available from: Videotel Marine International Ltd.
84 Newman Street
London W1T 3EU, UK
Tel: +44 171 299 1800
Fax: +44 171 299 1818
E-mail: mail@ videotel.co.uk
Web site: www. videotel.co.uk

A4 CBT modules:

CD# 07: Inert Gas generator

CD# 37: Gas Tanker Training System

CD# 48: Gas Measurement

CD# 52: Fire Fighting

Available from: Seagull AS
Gamleveien 36, PO Box 1062
N-3194 Horten, Norway
Tel: +47 33 04 79 30
Fax: +47 33 04 62 79
E-mail: seagull@sgull.com
URL: www. sgull.com

Audio-visual examples listed above may be replaced by other similar audio-visual material at the discretion of the training provider and administration.

▪ Bibliography (B)

B1. Drager – Tube Handbook. 11th ed. (Drager Sicherheitstechnik GmbH, Revalstrasse 1, D-23560 Lubeck, Germany 1998) (ISBN 3-926762-06-3)

B2. ICS, Tanker Safety Guide (Liquefied Gas). *2nd* edition 1, (Edward Mortimer Ltd., England 1995) (ISBN 0-906270-03-0).

B3. ICS/OCIMF SIGTTO, Ship to Ship Transfer Guide (Liquefied Gases), 2nd ed. (London; Witherby & Co. Ltd., 1995)(ISBN 1-85609 082 5)

B4. Bureau Veritas Gas Carrier Safety Handbook. (London, LLP Limited, 1997) (ISBN 1-85978-109-8)

B5. SIGTTO / IACS Applications of Amendments to Gas Carrier Codes Concerning Type “C” Cargo Tank Loading Limits. (London, Witherby & Co. Ltd., 1997) (ISBN 1-85609-125-2)

B6. SIGTTO / An Introduction to Design and Maintenance of Cargo System Pressure Relief Valves on board Gas Carriers (London, Witherby & Co. Ltd., 1998)

B7 SIGTTO / Recommendations and Guidelines for Linked Ship / Shore Emergency shut-down of Liquefied Gas Cargo Transfer (London, Witherby and Co. Ltd., 1987).

IMO references (R)

R1 International convention on standard of training, certification and watch keeping for seafarers, 1978, as amended in 1995 (STCW '95).

R2 International Convention for Safety of Life at Sea, 1974 (SOLAS 1974) Consolidated edition 2004

R3 Regulations for the prevention of Pollution by Noxious Liquid substances Annex II, MARPOL 73/78. Consolidated edition.

R4 Inert Gas Systems (IMO-860E).

R5 Medical First Aid Guide for use in Accidents Involving Dangerous Goods (MFAG) (IMO-251E)

R6 Code for the construction and Equipment of ships carrying liquefied Gases in Bulk, as amended. (IMO – 782)

R7 International Code for the Construction and Equipment of Ships Carrying Liquefied Gases in Bulk, IGC code 1993 edition (IMO-104E and IMO-782E).

R8 Dedicated Clean Ballast Tanks.(IMO-619E)

R9 International Safety Management Code (ISM Code) (IMO-117E).

R10 IMO Model Course 2.06 "Oil Tanker Cargo and Ballast Handling Simulator" 2002 Edition (IMO-TA206E).

▪ Textbooks

T1 SIGTTO Liquid Cargo Handling Principles on Ships and in Terminals. McGuire and White, 3rd edition (Witherby & Co. Ltd., London 2000, ECIR 0ET, England(ISBN 185609 164 3)

T2 Safe Gas Tanker Operations- Capt. KSD Mistree & Mr. BK Sharma.

T3 T.W.V. Woolcott, Liquefied Petroleum Gas Tanker Practice, 2nd edition

Part B: Course Outline and Timetable

Subject Area		Approximate Time (Hours)	
		Lecture/ Discussion	Practical
1.	**Familiarization**	**1.5**	**4.5**
1.1.	Ship type simulation		
1.2.	Tank arrangement of the simulated liquefied Gas tanker		
1.3.	Cargo containment system		
1.4.	Pipeline arrangement		
1.5.	Pipe system control valves		
1.6.	Pumps, compressors and reliquefaction plant		
1.7.	Instrumentation and auxiliary system		
1.8.	Controls		
1.9.	Basic operations and procedures		
2.	**Special Operations and Procedures**	**3**	**8.5**
2.1.	Tank atmosphere evaluation		
2.2.	Cargo ventilation system		
2.3.	Reliquefaction system & control of boil-off		
2.4.	Procedure for changing cargo and tank cleaning		
2.5.	Use of inert gas		
2.6.	Draining and stripping procedures		
2.7.	Gas freeing		
3.	**Ballast Operations**	**1**	**1.5**
3.1.	General provisions		
3.2.	Ballasting		
3.3.	Deballasting		
4.	**Cargo Operations**	**1.5**	**4.5**
4.1.	General cargo handling provisions		
4.2.	Cargo measurement & calculation		
4.3.	Cargo Condition maintenance on passage & in port		
4.4.	Procedure for preparation for loading cargo		
4.5.	Procedure for preparation for unloading cargo		
5.	**Operational Problems**	**1**	**3**
5.1.	Cargo and related operations Normal working		
5.2.	Introduction of system faults, malfunctions & Accidents		
5.3.	Remedial actions		
	SUB - TOTAL	**8**	**22**
	TOTAL	**30 hrs**	
	Review and Assessment		

Course Timetable

PERIOD / DAY	DAY 1	DAY 2	DAY 3	DAY 4	DAY 5
1st Period (1.5 hours)	1.Familiarization	2. Special Operation	2. Special Operation	3. Ballast Operations	4. Cargo Operations
BREAK					
2nd Period (1.5 hours)	1.Familiarization	2. Special Operation	2. Special Operation	3. Ballast Operations 4. Cargo Operations	4. Cargo Operations 5. Operational Problems
LUNCH BREAK					
3rd Period (1.5 hours)	1.Familiarization	2. Special Operation	2. Special Operation	4. Cargo Operations	5. Operational Problems
BREAK					
4th Period (1.5 hours)	1.Familiarization	2. Special Operation	2. Special Operation 3. Ballast Operations	4. Cargo Operations	5. Operational Problems Test, Feedback and issue of certificate

Note: Teaching staff should note timetables are suggestions only as regards sequence and length of time allocated to each objective. These factors may be adapted by lectures 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

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 specific knowledge or skill has been transferred and competence achieved.

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

In order to assist the instructor, references are shown against the learning objective to indicate IMO references and publications, textbooks and teaching aids, which the instructor may wish to use when preparing and presenting course material.

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

- *Teaching aids (indicated by A),*
- *Text books (indicated by T)*
- *IMO references (indicated by R)*
- *Bibliography (indicated by B),*

will provide valuable information to instructors. The abbreviations used are:

- *App. appendix*
- *Reg. regulation*
- *Ex. exercise*
- *P. page*
- *Pa. paragraph*
- *Ch. chapter*
- *Sec. section*
- *Ta. table*

The following is an example of the use of references:

"A1" refers to Instructor manual in Part D of this model course.
"R1 - Reg. V/1" refers to regulation V/1 of the International Convention on Standards of Training, Certification and Watch keeping for Seafarers, 1978 as amended in 1995.

■ **Note**

Throughout the course, safe working practices are to be clearly defined and emphasized with reference to current international requirements and regulations.

It is expected that the national institution implementing the course will insert references to national requirements and regulations as necessary.

■ Competence

The competences required by candidates may be expressed in terms of the Convention as follows.

- Plan and ensure safe loading, care during the voyage and unloading of liquefied gas cargoes.
- Safely and efficiently perform the carriage of dangerous cargoes.
- Control trim, stability and stress.
- Monitor and control compliance with legislative requirements and measures to ensure safety of life and protection of the marine environment.

■ Training outcome (as stated in Table A-II/2 & A-III /2)

The standard of knowledge, understanding and proficiency associated with the above competences is therefore considered to be tabulated below.

- Demonstrate knowledge of and ability to apply relevant international regulations, codes and standards concerning the safe handling and transport of liquefied gas cargoes.
- Plan and execute liquefied gas tanker loading and unloading operations
- Demonstrate a practical knowledge of liquefied gas tankers and liquefied gas tankers operations
- Demonstrate a knowledge of the carriage of dangerous, hazardous and harmful cargoes; the precautions during loading and unloading and care during the voyage.
- Demonstrate an understanding of the factors affecting trim, stability and stress as applicable to liquefied gas tankers.
- Demonstrate a knowledge of maritime law embodied in international agreements and conventions, with special regard to:
  - responsibilities under the relevant requirements of the International Convention for Safety of Life at Sea:
  - responsibilities under the International Convention for the prevention of Pollution from ships as applicable to liquefied gas tankers; and
  - methods and aids to prevent pollution of the marine environment by liquefied gas tankers.

The individual syllabus areas with training outcomes or objectives covered in Part C of this liquefied gas tanker cargo and ballast handling simulator course may be listed as follows.

The text aims to show how the basic competences for planning, loading and carriage of liquefied gas cargoes are addressed in this model course. The numbering of the sub-heading follows the numbering employed in Part B of this model course.

- Plan and execute liquefied gas tanker loading and unloading operations
  - Cargo ventilation system
  - Reliquefaction system & control of boil-off
  - Use of inert gas

- Demonstrate an understanding of the factors affecting trim, stability and stress as applicable to liquefied gas tankers.

  - General cargo handling provisions
  - Cargo measurement & calculation
  - Cargo Condition maintenance on passage & in port
  - Procedure for preparation for loading cargo
  - Procedure for preparation for unloading cargo

- Demonstrate a practical knowledge of liquefied gas tankers cargo operations

  - Tank atmosphere evaluation
  - Procedure for changing cargo and tank cleaning
  - Gas freeing

- Demonstrate a knowledge of maritime law embodied in international agreements and conventions, with special regard to:

  - responsibilities under the relevant requirements of the International Convention for Safety of Life at Sea:
  - responsibilities under the International Convention for the prevention of Pollution from ships as applicable to liquefied gas tankers; and
  - methods and aids to prevent pollution of the marine environment by liquefied gas tankers.

Knowledge, understanding and proficiency		IMO Reference	Textbooks, Bibliography	Teaching Aid
1	**Familiarization** (6 hours)	R1- Reg V/1	T1	A1 A2- App. Ex.1
1.1	**Ship type simulation**			
	.1 list the methods of carriage as:			
	- fully pressurised	R1-		A2-.
	- fully refrigerated	Sec. A -V/1	B2	App. Ex.1
	- semi pressurised	Pa. 24		
	.2 list the types of ship with respect to survival capability and location of cargo tanks as:	R7-	T1	A2-
	- a type 1G Ship	Ch. 2	B2	App. Ex.1
	- a type 2G Ship			
	- a type 2PG Ship			
	- a type 3G Ship			
1.2	**Tank arrangement of the simulated liquefied gas tanker**			
	.1 list the tanks as:			
	- cargo tanks	R7-	T1	A2-
	- ballast tanks	Ch. 3	B2	App. Ex.1
	- hold spaces			
	.2 shows the tank arrangement on a simple line diagram			
	.3 describes the features of a LPG/LEG ship and shows the cut sections			
1.3	**Cargo containment system**	Sec A -V/1	B2	A2-
	1 lists the containment systems and shows the cut sections for:	Pa.24		App.Ex.1
	- membrane Tanks			
	- semi membrane Tanks			
	- integral Tanks			

Knowledge, understanding and proficiency		IMO Reference	Textbooks, Bibliography	Teaching Aid
1.4	**Pipeline arrangement** .1 shows the pipelines of the simulated system on a simple line diagram .2 compares the line diagram with the simulator mimic diagram	R1- Sec.A -V/1 Pa. 24	T1	A2- App. Ex.1
1.5	**Pipe system control valves** .1 shows on the line diagram developed for 1.4 the control valves and states their function .2 describes the control valves used in the system and explains how they function	R1- Sec.A -V/1 Pa. 24	T1	A2- App.Ex.1
1.6	**Pumps, compressors and reliquefaction plant** .1 list the type of pumps and compressors used in the system as: - multistage centrifugal deep well p/p - centrifugal booster pump - eductor for hold space - centrifugal compressors - 2 stage reciprocating compressor - double stage screw compressor .2 describes in simple terms, using simple line sketches where appropriate, the operation of the pumps, compressors and reliquefaction plant used in the system .3 instrumentation for pumps and pump seal system			

Knowledge, understanding and proficiency		IMO Reference	Textbooks, Bibliography	Teaching Aid
	.4 instrumentation for compressors and bulkhead seal arrangement .5 instrumentation for reliquefaction plant .6 describes an eductor and explains how it functions .7 facility to show no damage to pump, if discharge valve is closed / effect of cavitations et .8 Describes in simple terms using simple line sketches where appropriate the operations of the IG system, the Nitrogen system, Cargo Vaporizers and Cargo heaters .9 Instrumentation for IG Plant, Nitrogen system, Cargo Vaporizers and Cargo heaters			
1.7	**Instrumentation and auxiliary system** .1 lists and briefly describes the instrumentation used in the simulated system of: - liquid level in tanks (level gauges) - liquid and vapour temperature monitoring system - liquid pressure monitoring in process piping system - vapour pressure monitoring in cargo tanks and process piping system - pressure/vacuum monitoring system for hold spaces - temperature monitoring system for hold spaces	R7 – Ch.10, 13	T1 B2	A2-App. Ex.1

Knowledge, understanding and proficiency		IMO Reference	Textbooks, Bibliography	Teaching Aid
	- fixed gas detection system - emergency shut down operation due to hydraulic pump failure - emergency shut down operation by manual activation - emergency shut down operation due to low control air pressure - emergency shut down operation due to low tank pressure. - emergency shut down operation due to low differential pressure in motor room and air locker space - alcohol injection system to reduce / prevent the formation of ice (hydrate) - ampere resetting method for trips - rate of liquid flow			
1.8	**Controls** .1 lists the controls in the simulated system for: - valve actuators - cargo heating - pumps, compressors and reliquefaction plant	R1 – Sec. A V/1 Pa. 24		
1.9	**Basic operations and procedures** .1 states that safe practices must be used at all times .2 states that cargo, ballast, venting and inerting operations must not result in environmental pollution .3 states that as far as practicable a 'checklist' should be prepared and used in each operation	R1 – Sec. A V/1 Pa 24, 31	T1 B2	A2- App. Ex.1

Knowledge, understanding and proficiency	IMO Reference	Textbooks, Bibliography	Teaching Aid
.4 constructs checklists for: - loading cargo with vapour return to ashore - loading cargo with vapour return to ashore on LPG ships - loading cargo without vapour return to ashore and using ship's reliquefaction plant - gassing up cargo tanks with vapour return to shore - cool-down of cargo tanks with vapour return to shore tank - cool-down of cargo tanks without vapour return to shore and by using ship's reliquefaction plant - unloading cargo with vapour return from shore tank - unloading cargo without vapour return from shore and by using ship's vaporiser - ballasting - deballasting - draining and stripping .5 under supervision and using the checklists, sets (prepares) the simulator system for the operations of : - loading cargo with vapour return to ashore - loading cargo with vapour return to ashore on LPG ships - loading cargo without vapour			

Knowledge, understanding and proficiency		IMO Reference	Textbooks, Bibliography	Teaching Aid
	- return to ashore and using ship's reliquefaction plant - gassing up cargo tanks with vapour return to shore - cool-down of cargo tanks with vapour return to shore tank - cool-down of cargo tanks without vapour return to shore and by using ship's reliquefaction plant - unloading cargo with vapour return from shore tank - unloading cargo without vapour return from shore and by using ship's vaporiser - ballasting and deballasting - draining and stripping			
2	**Special Operations & Procedures** (11.5 hours)	R1 – Sec. A -V/1 Pa 24, 31	T1 B2	A1

Knowledge, understanding and proficiency		IMO Reference	Textbooks, Bibliography	Teaching Aid
2.1	**Tank atmosphere evaluation** .1 states that operations such as loading and unloading cargo are hazardous because of the danger of flammability, toxicity, oxygen deficiency, reactivity and frostbite .2 states that for reasons of safety the tank atmosphere should be maintained in a non-explosive condition .3 states that this may be an inert atmosphere or, alternatively, one which is too lean or too rich for an explosion to take place .4 states that oxygen percentage is less than 0.1% in 99.9% nitrogen atmosphere or, alternatively, certain cargoes like vinyl chloride may polymerise .5 states that a mixture of hydrocarbon vapour and air will only burn, or explode, if the concentration of hydrocarbon gas is within the flammable range .6 defines: - dew point temperature - limits of flammability - lines of critical dilution - lower flammable limit - upper flammable limit	R7- Ch. 18.4	B4 T1	A2- App. Ex. 2, 3, 8.

Knowledge, understanding and proficiency	IMO Reference	Textbooks, Bibliography	Teaching Aid
.7 explains that the ship's SMS requires special procedures to be followed if entering enclosed spaces .8 states that no one should enter a cargo tank unless their entry is sanctioned by a responsible officer .9 states that personnel should only enter empty tanks when they have been 'gas freed' and the atmosphere in the tank has: - a hydrocarbon concentration 1 % LEL, or less - toxic components below TLV value - oxygen content 21 % by volume .10 states that portable gas analysers are used to ensure that the tank atmosphere has been properly gas freed .11 states that the gas analysers are usually of three categories: - oxygen meters - combustible gas indicators or, - non combustible gas indicators - multi gas detector or chemical absorption tubes .12 states that fixed oxygen analysers and fixed dew point meters are used to monitor the oxygen content and dew point temperature in the inert gas / dry air supply to the cargo tanks and hold spaces	R9		

Knowledge, understanding and proficiency		IMO Reference	Textbooks, Bibliography	Teaching Aid
2.2	**Cargo ventilation system** .1 states that cargo tanks to be provided with pressure relief devices with: - variable relief setting up to Maximum Allowable Relief Valve Setting (MARVS) depending on the type of ship .2 states that cargo tanks to be provided with vacuum protection devices with: - two pressure switches, which first activate an alarm and subsequently emergency shut down will activate and stop all cargo operations .3 states that mast vents will have with IG / N_2 arrangement to shut off flames .4 states that a liquid accumulator may be connected to the Mast Vent Riser to prevent the overflow of the liquid from the Vent Riser .5 states that the cargo lines are fitted with a Pressure Relief Valve	R7- Ch. 8	T1	A2 – App. Ex.2
2.3	**Reliquefaction system and control of boil-off** .1 list the methods of controlling vapour pressure in the cargo tank as: - lead the boil-off to ship's reliquefaction plant, where the vapour is liquefied and then sprayed into the cargo tank via condensate line .2 describes a single stage direct reliquefaction system and its limitations	R7- Ch. 7 R 1- Sec. A-V /1 Pa. 30	T1 B2	A2 – App. Ex.3

Knowledge, understanding and proficiency		IMO Reference	Textbooks, Bibliography	Teaching Aid
	.3 describes a two-stage direct reliquefaction system and its limitations .4 describes method of emergency venting through vent riser or manifold			
2.4	**Procedure for changing cargo and tank cleaning** .1 states that there are general requirements for a cargo tank's condition prior to loading a cargo other than the forgoing one .2 states that such requirements may include - compatibility between previous and next cargo - maximum vapour concentration from last cargo - maximum oxygen percentage - maximum dew point temperature - cleanliness of the tank .3 States that the procedure for changing next cargo may include may include : - liquid freeing - warming up - venting - purging with inert gas to remove previous cargo vapour and to maintain dew point temperature - purging with the vapour of the next cargo for gassing-up - cool-down of cargo tank - loading coolant for conditioning of other tanks - gassing-up of other tanks away from terminal - cool-down of other cargo tanks loading all cargo tanks with next cargo	R7- Ch.17	T1 B2	A2 – App. Ex.3,8

Knowledge, understanding and proficiency	IMO Reference	Textbooks, Bibliography	Teaching Aid
.4 states that prior to loading certain gas cargoes, the requirements may include: - liquid freeing - warming up - venting - purging with inert gas to replace previous cargo vapour - gas freeing to increase oxygen content to 21% - tank cleaning - visual inspection - inerting to reduce oxygen content & dew point temperature as required for next cargo - purging with the vapour of the next cargo - cool-down of cargo tank - loading coolant for conditioning of other tanks - gassing-up of other tanks away from terminal - cool-down of other cargo tanks - loading of all cargo tanks with next cargo .5 explains the effect of density of ammonia, nitrogen, air, inert gas and LPG vapours to use liquid/vapour line by displacement method for inerting, gas freeing and gassing-up operations .6 explains that if repairs are to be carried out in any tanks, they must be "gas-freed" as explained in 2.4.4 .7 explains the various purging operations .8 maintains a record (log) of the operation			

Knowledge, understanding and proficiency		IMO Reference	Textbooks, Bibliography	Teaching Aid
2.5	**Use of inert gas** .1 states that the inert gas is usually produced from the combustion of a sulphur free diesel oil or gas oil with atmospheric air .2 states that the inert gas can be made by on-board process of fractional distillation of air which involves the storage of cryogenic liquefied nitrogen for subsequent release .3 states that inert gas is produced by removing oxygen from air by means of physical absorption or separation .4 states that the composition of the inert gas produced by an inert gas generator as: - app 84% nitrogen - app 15% carbon dioxide - app 0.5% carbon monoxide; oxides of nitrogen and sulphur dioxide - app 0.5% or less oxygen .5 states that combustion of the fuel with air is closely controlled to minimize excess oxygen and the formation of carbon monoxide .6 explains the different methods of drying inert gas to reduce dew point temperature .7 states the limitations of using inert gas produced by inert gas generator	R4, R7- Ch. 9.4,9.5 R1- Sec. A -V /1 Pa. 34	T1 B2	A2 – App.Ex.3 CD# 07

Knowledge, understanding and proficiency		IMO Reference	Textbooks, Bibliography	Teaching Aid
	.8 states that the dry inert gas is supplied to the cargo tanks and hold spaces to displace air and water .9 vapour (and thereby oxygen and humidity) .10 states that the inert gas being supplied to the cargo tanks and hold spaces which is continuously monitored for oxygen content and dew point temperature .11 states that if the oxygen content and dew point temperature in the inert gas supply exceeds the set limit a warning alarm is given .12 states that if the oxygen content reaches 0.5% by volume, the inert gas system will automatically shut down with an alarm .13 states that the hold spaces must be filled with dry inert gas / dry air at all times .14 constructs a plan of operation to start up the inert gas system and supply inert gas to a specified hold spaces or, cargo tanks which is to be inerted .15 sets (prepares) the simulator system to produce inert gas and supply it according to the plan of operation .16 maintains a record (log) of the operation			

Knowledge, understanding and proficiency		IMO Reference	Textbooks, Bibliography	Teaching Aid
2.6	**Draining & Stripping procedures** .1 states that reliquefaction plant is provided with safety relief valves and drain valves .2 states that safety relief valves are piped to the vent and drain system .3 states that drain lines are connected to cargo tanks .4 states that on completion of the discharge of cargo, the cargo pumps & lines are drained by gravity/evaporation into cargo tank .5 states that as each cargo tank is emptied by the use of a centrifugal deep well pump .6 constructs a plan of operation for draining and stripping, taking into account safe handling of a deep well pump, booster pump and environmental pollution prevention .7 maintains a record (log) of the operation	R1- Sec. A -V/1 Pa.30	T1 B2	*A2-* App. Ex.6,7
2.7	**Gas freeing** .1 explains the procedure of gas freeing .2 states during gas freeing operations the tank is safe with regard to: - flammability hazards - health hazards	R7- Pa.18.4 R1- Sec. A -V/1 Pa.31	T1 B2	*A2-* App.Ex.8 *CD# 48*

Knowledge, understanding and proficiency		IMO Reference	Textbooks, Bibliography	Teaching Aid
	.3 states that if personnel are to enter any cargo tank / hold space, the tank atmosphere must be free of flammable and toxic vapours, and its oxygen content must be 21 % by volume, **as specified in objective 2.1.9** .4 defines gas-freeing as the replacement of cargo vapours with inert gas and subsequently inert gas with air .5 states that gas-freeing on large liquefied gas tankers is done by mechanical means such as portable or fixed blower systems .6 states that the inert gas blowers may be used to carry out gas-freeing operation .7 states that care must be taken to ensure that the atmosphere does not come within the flammable range during the gas-freeing operation on an inerted tank .8 states that instruments for monitoring the tank atmosphere vapours are used to indicate the presence of oxygen, toxic cargo vapours, hydrocarbon cargo vapours and certain toxic components of hydrocarbon gas and inert gas, with their concentrations			

Knowledge, understanding and proficiency		IMO Reference	Textbooks, Bibliography	Teaching Aid
	.9 constructs a plan of operation for gas-freeing the cargo tanks/hold spaces from an inert condition .10 sets (prepares) the simulator and carries out gas-freeing in accordance with the plan of operation .11 maintains a record (log) of the operation			
3	**Ballast Operations** (2.5 hours)	R1-	B2	A2-
3.1	**General provisions**	Sec.A -V/1		App.
	.1 states that ballast operations will be governed by national, international & other appropriate rules and regulations in order to prevent marine pollution .2 uses procedures at all times which promote safety and protect the environment .3 states that ballast is required during and after unloading of cargo for: - maintaining the ship in the correct trim for unloading, stripping and draining - establishing the required displacement and trim for manoeuvring and making a sea voyage	Pa.31		Ex. 5,6

Knowledge, understanding and proficiency		IMO Reference	Textbooks, Bibliography	Teaching Aid
	.4 states that some gas carriers will have to undertake ballasting or deballasting during cargo operations to maintain an adequately stable condition			
	.5 explains measures to ensure adequate stability of vessel as: - correct use of valves in the centre line bulkhead - correct distribution of ballast	R1- Sec. A -V/1 Pa.31	B2	A2- App.Ex.6
3.2	**Ballasting**			
	.1 constructs a checklist covering the ballasting operation .2 compiles a ballast operation plan given the desired draught and trim for sea passage and taking into account: - the tanks to be used - the total ballast capacity - the stability of the vessel - the induced stress in the hull structure - the unloading programme .3 sets (prepares) the simulator system and carries out the operation .4 maintains a record (log) of the operation			
3.3	**Deballasting**	R1-	B2	A2-
	.1 constructs a checklist covering the deballasting operation .2 explains generally the effect of free surfaces in cargo tanks and ballast tanks .3 constructs a plan for the deballasting operation, given the trim conditions needed for tanks stripping draining and taking into account:	Sec. A -V/1 Pa.31		App.Ex.5

Knowledge, understanding and proficiency		IMO Reference	Textbooks, Bibliography	Teaching Aid
	- the total ballast capacity - the tanks containing ballast - the stability of the vessel - induced stresses in the hull - the loading programme .4 sets (prepares) the simulator system and carries out the operation, applying strict measures and control to prevent pollution .5 maintains a record (log) of the operation			
4	**Cargo Operations** (6 hours)			
4.1	**General provisions** .1 lists the main sources of regulatory & other requirements as: - Local regulation - National regulations and requirements - International regulations - ICS, Tanker Safety Guide (Liquefied Gas) - IGC code .2 states that all procedures must be "approved procedures" which promote safety and the protection of the environment .3 states the importance of function tests of all equipment in the cargo system prior to any cargo operations .4 states that to ensure proper liaison between ship and terminal prior to and during cargo- transfer operation	R7- Pa.18.6, 18.7,18.8, 18.9 R1- Sec. A -V/1 Pa.30, 34	B2	A1

Knowledge, understanding and proficiency		IMO Reference	Textbooks, Bibliography	Teaching Aid
4.2	**Cargo measurement and calculation** .1 states that the IGC code stipulate rigid requirements for the maximum allowable filling limits of cargo tanks .2 states that the maximum loading limit to which a cargo tank may be loaded - determined by taking into account - relative density of the cargo at the reference temperature - relative density of the cargo at the loading temperature and pressure value of reference temperature - shape of tank .3 arrangement of pressure relief valves defines the formula for calculating the maximum loading limit to which a cargo tank may be loaded .4 States that when calculating quantities of liquid gas cargo the procedure includes: - calculation of the liquid phase - calculation of the vapour phase 5 States that the parameters are used for calculating quantity of liquefied gas cargo as: - draft F/A - vessel's trim and list - molecular weight of the cargo - liquid sounding - liquid temperature	R7 Ch.15	T1	A2- App.Ex.9

Knowledge, understanding and proficiency		IMO Reference	Textbooks, Bibliography	Teaching Aid
	- vapour temperature - tank pressure - full tank volume - density of cargo - density at 15 deg C			
	.6 states that the parameters obtained for calculating quantity of liquefied gas cargo as: - shrinkage factor - volume reduction factor - litre weight - gas laws - weight in vacuum - weight in air			
4.3	**Cargo Condition maintenance on passage and in port** .1 states that cargo condition maintenance is achieved by reliquefaction .2 describes by means of a drawing and an arrangement for reliquefaction of cargo vapour .3 lists general precautions for the operation of a reliquefaction plant .4 states that the reliquefaction plant efficiency can be calculated or read from a performance diagram	R1- Sec. A -V/1 Pa.30	T1	A2- App.Ex.4

	Knowledge, understanding and proficiency	IMO Reference	Textbooks, Bibliography	Teaching Aid
	.5 states that when loading cargoes with a temperature which results in the pressure in the cargo tanks exceeds MARVS, the cargo loading time depends on one, or a combination, of the following factors: - the capacity of ships reliquefaction plant - the capacity of the ship's cargo compressors - the capacity of the terminal's cargo compressors - the capacity of the terminal's reliquefaction plant .6 explains the factors that have an influence on cargo cool down time and cargo loading time			
4.4	**Procedure for preparation for Loading cargo** .1 constructs a checklist for the loading operation .2 states that gas tanker may be loaded in different ways - with vapour return - without vapour return .3 compiles a loading plan which lists the sequence of tank filling, bearing in mind: - requirements for stability	R1- Sec. A -V/1 Pa.31	T1 B2	A2- App. Ex.4,5

Knowledge, understanding and proficiency		IMO Reference	Textbooks, Bibliography	Teaching Aid
	- limits on stresses induced in the hull structure - the prevention of overflows - establishing tank sounding values - two or more cargoes carried simultaneously they are segregated from each other to avoid contamination and chemical reaction - use of spool pieces and blank flanges - the discharge of ballast .4 states that a loading plan to consider - cool down of loading arm and ship's line - efficiency of reliquefaction plant - set pressure of MARVS - applies an emergency stop procedure at some point during the loading operation - maintenance of an inert/dry air atmosphere in hold spaces .5 lists a valve control sequence to confirm to the loading plan .6 explains how loading time is calculated .7 sets (prepares) the simulator system for loading and loads the ship according to the plan .8 uses sounding measurement to check the quantity of cargo in the tanks .9 deballast tanks as required by draught and trim considerations			

Knowledge, understanding and proficiency		IMO Reference	Textbooks, Bibliography	Teaching Aid
	.10 applies an emergency stop procedure at some point during the loading operation .11 controls the final stages of loading and "topping up" by reducing flow rates .12 describes how samples are taken, sealed and identified .13 maintains a record (log) of the operation			
4.5	**Procedure for preparation for unloading cargo** .1 constructs a checklist for the unloading operation .2 explain procedure for ship to ship transfer compiles a unloading plan which lists the sequence in which the tanks will be unloaded, bearing in mind: - requirements for stability - limits on stresses induced in the hull structure - vapour pressure of the cargo tanks - trim required for tank stripping - two or more cargoes carried simultaneously they are segregated from each other to avoid contamination and chemical reaction - the ballasting sequence .3 states that a unloading plan to consider:	R1- Sec. A -V/1 Pa.30 R6- Pa.18.8	T1 B2	A2- App. Ex.6,7

Knowledge, understanding and proficiency		IMO Reference	Textbooks, Bibliography	Teaching Aid
	- ESD operation - cool down of ship's line and unloading arm - filling of spill tray and starting water curtain on ship's side - efficiency of pumps - pressure and temperature of cargo tanks - cargo to be left in tank as required for voyage (heel management) .4 explain the relevance and methods of unloading such as - unload by pressurising vapour space - unload by deep well alone - unload by deep well pump and booster pump in series - unload by deep well pump , booster pump and cargo Heater vaporiser in series .5 lists a valve control sequence to conform to the unloading plan .6 explains how unloading time is calculated and makes a calculation for the operation to be carried out .7 sets (prepares) the simulator system for unloading cargo and unloads the ship according to the plan .8 uses sounding measurements to check the quantity of cargo in the tanks before unloading is commenced			

Knowledge, understanding and proficiency		IMO Reference	Textbooks, Bibliography	Teaching Aid
	.9 states that positive pressure should be maintained in cargo tank during unloading .10 explains the ways of maintaining positive pressure if it tends to fall during unloading .11 maintains an inert/dry air atmosphere within the hold space .12 in the final stages of unloading cargo applies procedures for draining and tank stripping .13 loads ballast as required by the unloading plan. .14 maintains a record (log) of the operation			

Knowledge, understanding and proficiency		IMO Reference	Textbooks, Bibliography	Teaching Aid
5	**Operational Problems** (4 hours)			
5.1	**Cargo and related operations - normal working** .1 uses the simulator system to obtain one or more operational situations as specified in the syllabus sections 2, 3 or 4, to serve as a starting point for the introduction of faults, malfunctions or accidents .2 states examples of such operational situations as: - vessel making a ballast voyage to a loading port with all cargo tanks inerted, ballast tanks full, thereafter loading all cargo tanks and taking into account: ▪ a deep well pump in a cargo tank has to be examined during ballast voyage ▪ the draught required for going alongside on arrival ▪ all cargo tanks are to be filled up to maximum loading limit with: - liquefied petroleum gas(LPG), or, - liquefied ethylene gas(LEG), or, - liquefied chemical gas ▪ use of deck tank / cargo vaporiser for gassing up operation	R1- Sec. A -I/12	B2	A1

Knowledge, understanding and proficiency		IMO Reference	Textbooks, Bibliography	Teaching Aid
	▪ use of spray pump for cooling down of tanks, pipelines and loading arm. ▪ use of vapour return line to vent the mixture of inert gas and cargo vapour ▪ environmental pollution control ▪ cool-down period ▪ considerations of stability and hull deflection ▪ fire detection and prevention - vessel making a loaded voyage to a unloading port with all cargo tanks filled up to maximum loading limits with liquefied gas and taking into account: ▪ after going alongside, all cargo is to be unloaded ▪ required draught and trim for tank stripping and making a ballast voyage			

Knowledge, understanding and proficiency		IMO Reference	Textbooks, Bibliography	Teaching Aid
	▪ pollution control during controlled/un controlled release of liquid and/or, vapours ▪ considerations of stability and hull deflection			
5.2	**Introduction of system faults, malfunctions, accidents** .1 states that during cargo handling, ballasting and other associated operations, visual vigilance must be maintained, with instrument and meter readings being kept under constant scrutiny in order that any variation from the normal working conditions can be detected quickly .2 states that any deviation from the normal must be followed up to determine what is happening .3 states that considerations of safety and pollution prevention are paramount, and that if necessary an operation must be shut down if the deviation from normal becomes excessive .4 ESD 1 & 2 activation for operating envelope athwart ship and fore and aft		B2	A1

Knowledge, understanding and proficiency		IMO Reference	Textbooks, Bibliography	Teaching Aid
5.3	**Remedial actions** .1 with visual observation and/or instrument and meter readings indicating a deviation from normal operational conditions, action must be taken to: - identify what is happening as quickly as possible - bring the operational conditions back to normal by alteration of settings if this is possible - slow the operation down, or shut the operation down if a hazard involving safety or pollution is imminent - investigate the possible causes for the deviation from normal and take remedial action once the cause has been properly established	R1- Sec. A -I/12	B2	

Part D: Instructor Manual

▪ General

This manual reflects the views of the course designer on methodology and organization, and what is considered relevant and important in the light of his experience as an instructor. Although the guidance given should be of value initially, the course instructor should work out his own methods and ideas, refine and develop what is successful, and discard ideas and methods, which are not effective.

Preparation and planning constitute a major contribution to effective presentation of the course.

▪ Lectures

The main training components in the course are the practical exercises carried out under supervision on the simulated cargo-handling plant, an example of which is shown in Fig.1 on page 66. A typical configuration between instructor station and student work stations and routine cargo handling guidance is also shown in Fig.2 & and Fig.3 on page 67 & 68. However, before each exercise commences, a briefing and discussion on important aspects of the exercise has been found effective, and provision has been made for this in the course structure.

As far as is possible, the briefing for the exercise should use practical examples involving real shipboard equipment and systems, vessel's particulars, referring to diagrams, layout plans, technical drawings, photographs and other related technical documents to supplement and reinforce the briefing. A typical example of a "LPG/Ethylene Carrier" with other particulars including outline sketches of cargo tank, ballast tank, hold space, inert gas plant etc. are attached to the sample exercise scenarios.

A technique which ha proved effective is to outline what is to be done and achieved by the exercise, then explain in detail those aspects which are felt to be important, and finally, to summarize the exercise, using key words, and phrases.

There should always be a final discussion to make sure that each trainee understands the role he will play and what is to be done and achieved by the exercise.

A useful teaching aid during the briefing is an overhead/ video projector; copies of the transparencies used can be distributed to the trainees for reference purposes during the exercises.

▪ Simulator exercises

The cargo-handling plant and systems used aboard merchant ships, which transport liquefied gases in bulk listed in chapter 19 of IGC code can differ in their layout and in the types of machinery units and associated systems, so that the trainees will have varied knowledge and experience of such plant.

It is important, therefore, to use the briefing period to explain precisely which machinery units and systems are being simulated in the exercise, as well as their function, how they interact with each other and the role of the trainees during the exercise.

The trainees should be encouraged to co-operate 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.

During an exercise it is useful if one trainee assumes the role of officer-in-charge, with the responsibility of ensuring that the requirements and activities of the exercise are properly carried out. Role-playing is an important element in the learning process, and with a number of trainees taking part in the exercises on the simulator, this aspect 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 a liquefied gas cargo.

For this reason a number of activities termed "pecial Operations and Procedures" have been grouped together to form section B of the course outline.

Of course, on board ship these operations would not be carried out in isolation, because they are all linked to other operations. For example, use of cargo heater and booster pump in series with deep well pump during unloading.

However, initially it is beneficial to study such operations in isolation, so that what is taking place can be observed and studied without reference to some other activity.

When the course has progressed to section D of the syllabus, all activities dealt with in sections A, B, and C will be used in the simulated activity of loading and unloading a liquefied gas cargo.

The simulator is designed to provide training for normal operational procedures and for the input of abnormal or malfunction conditions. It is important that the trainees achieve a satisfactory level of competence under normal conditions before proceeding to abnormal operations due to the introduction of faults.

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 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***
- ***Special Operations and Procedures***
- ***Ballast Operations***
- ***Cargo Operations***
- ***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.

The operational scenarios should aim at providing experience in preparing and carrying out the various tasks and procedures that are involved with the safe transportation of liquefied gases in bulk.

The trouble-shooting scenarios should be designed to provide experience in identifying malfunctions and faults, and applying remedial procedures. It should be noted that most

simulator designs can introduce a large number of malfunctions and faults. In this course, the scenarios can only deal with a few faults because of time constraints. The course implementer is free to introduce additional faults if time allows, or to change the faults to comply with a particular simulator design.

Further details regarding the content of the scenarios are provided in the guidance notes (pages 56 - 60 of the instructor manual).

▪ Monitoring the exercises

During the exercises the instructor should monitor the trainees' progress and record particular events, which relate to safety or correct procedure in the exercise, making a summary for use in the debriefing period. However, even an experienced instructor may occasionally find things going wrong when trainees are trying to control all the parameters and actions involved in an exercise, and any resulting incidents should be noted and discussed at the debriefing.

If a second instructor is available, he should assist in monitoring the trainees in their work. His task will vary according to the trainees' abilities and competence. He will be involved not only in the briefing and debriefing activities, but also when the trainees become more experienced, assisting and guiding them in the use of the equipment. He should follow their work closely, but should avoid interrupting them and save important observations for the debriefing.

▪ Debriefing

The time spent on debriefing should generally occupy between 10 and 15 per cent of the total time used for simulator exercises. Various facilities may be used in debriefing, such as playback (in which the whole exercise is recorded and any sequence is available for discussion), multi-channel recorder or data-logging equipment or snap shots.

The instructor should refer to the summary made during the exercise, raise important points and direct the discussion among the trainees. He should encourage them to examine critically the actions taken during the exercises. He should try to avoid

imposing his own views, but should ensure that the trainees have used safe and correct procedures at all times.

▪ Guidance on specific subject areas

The guidance notes, which follow, contain advice on the treatment of the subject areas listed in the course outline. The instructor should develop a methodology based on his own experience, together with the advice and guidance provided with the simulator being used in the course.

Guidance Notes

These notes contain advice on the content of the course as given in the course outline and the syllabus, and will provide a basis for the construction of suitable scenarios.

1. Familiarization 6 hours

Initially it is important that the trainees become familiar with what is being simulated and the simulator layout and controls.

Therefore the first briefing and discussion must cover at least:

- the cargo-handling plant, its systems and equipment in general arrangement and in specifics such as the cargo system and arrangements for ballast and hold spaces
- the instrumentation being used and what parameters are indicated and recorded
- the controls that are used and where they are located
- the alarms that are fitted and what they protect
- the observance and use of safe practices and procedures at all times
- the importance of proper planning before undertaking any activity in the machinery spaces
- the use of checklists to ensure that actions and activities are safe and carried out in the correct sequence.

The practical exercises should start with simple activities involving such operations as:

- *opening and closing valves*
- *starting and stopping pumps*
- *using* a *checklist to prepare the simulator for loading cargo and filling* a *cargo tank*

- *using a checklist to prepare the simulator for unloading cargo and stripping a cargo tank*
- *using a checklist to prepare the simulator for ballasting and deballasting*

The trainees should note and record important instrument readings during the exercise.

The aim is to make everyone familiar with the layout of the plant, the instrumentation used, and the location and use of controls.

2. Operational Exercises 20 hours

The aim of these exercises is to make the trainees familiar with the cargo-handling units and the associated systems that are being simulated, and to gain experience in the correct and safe procedures for preparation, start up, putting on line, and setting the normal operating mode.

Sufficient procedures and operations have been identified in the syllabus to cover most simulator designs, so that adequate practice can be obtained in the operations that are used in the transport of a liquefied gas cargo.

With the trainees becoming familiar with the simulator and the range of activities it can handle, scenarios can be constructed covering the various operations contained in the syllabus objectives, and specimen scenarios are provided as an appendix to the instructor manual.

It is important that the trainees become accustomed to making up and using checklists for each operation, so that all actions are carried through in the correct sequence and in a safe manner.

3. Trouble shooting 4 hours

These exercises aim at developing skill and confidence in handling operational problems. A number of possible faults can be listed, such as:

- insufficient heating of cargo, because of

    - low flow of sea water into cargo heater, or
    - temperature gauges are not calibrated, or
    - more cargo flows into vaporiser, or
    - ineffective control being exercised, or
    - wrongly set of bypass valve, or
    - tubes inside vaporiser is chocked/damaged

- flow rate from pump insufficient, because of

    - too much clearance between impeller and casing in a centrifugal pump (usually because of wear or corrosion), or
    - too much vibration/noise, or
    - damage to the impeller, or
    - discharge valve fully open, or
    - discharge valve fully closed, or
    - level of liquid is low

but the particular simulator design will determine which faults and malfunctions can be introduced.

It is important that the number of faults, which, are introduced, can be dealt with in the time available.

Only one fault should be dealt with at a time, and the next fault should not be introduced until all the trainees are satisfied with the way they have handled the previous one.

The instructors should not intrude too much in these exercises, and should allow the trainees to sort the problem out for themselves.

It is essential to allow sufficient time in debriefing to explore thoroughly the way in which the fault was identified, located and dealt with.

Each simulator design will incorporate its own catalogue of faults and malfunctions, and the manufacturer's guidance should be used to construct appropriate scenarios.

Bibliography (B)

The detailed teaching syllabus together with the instructor manual and its guidance notes and the user guidance from the simulator manufacturer is all that is required to implement the course. However, if supplementary reading or reference is desired, the following publications may prove suitable.
(as mentioned in Bibliography section)

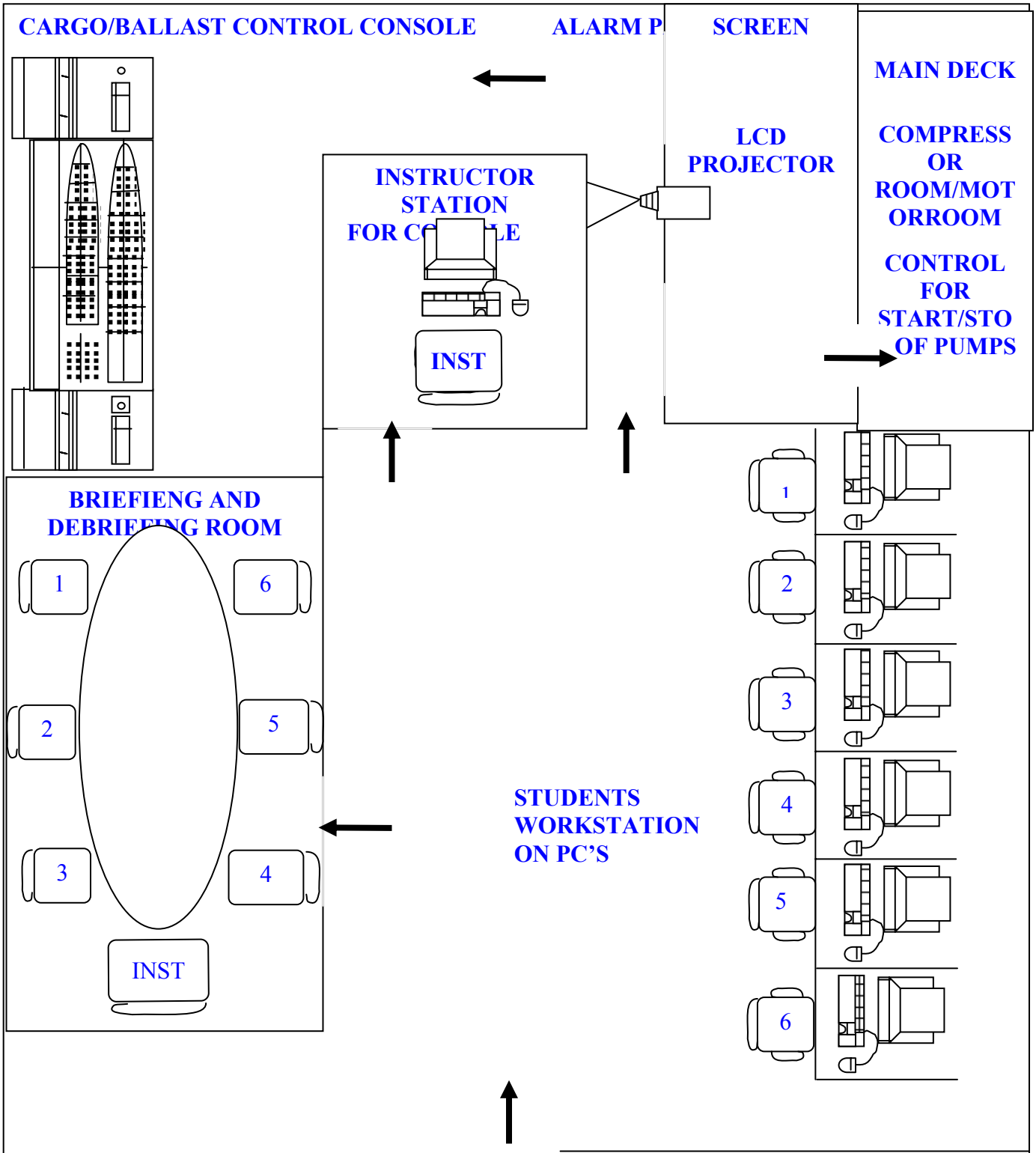
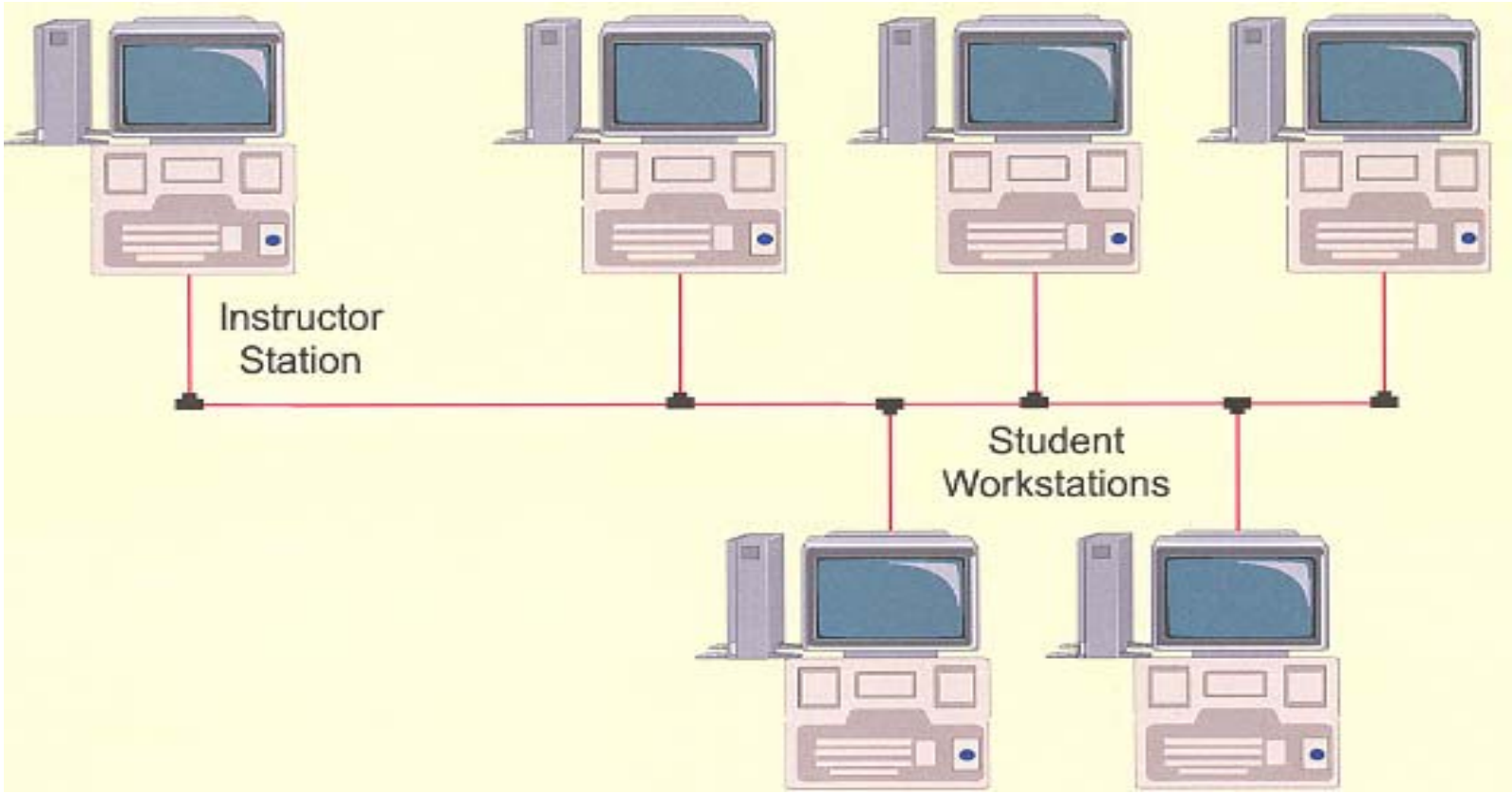


Fig 1: Outline sketch of a Liquefied Gas Tanker cargo and ballast handling Simulator installation

Fig. 2. Outline sketch of cargo handling simulator configuration between instructor station and student workstation



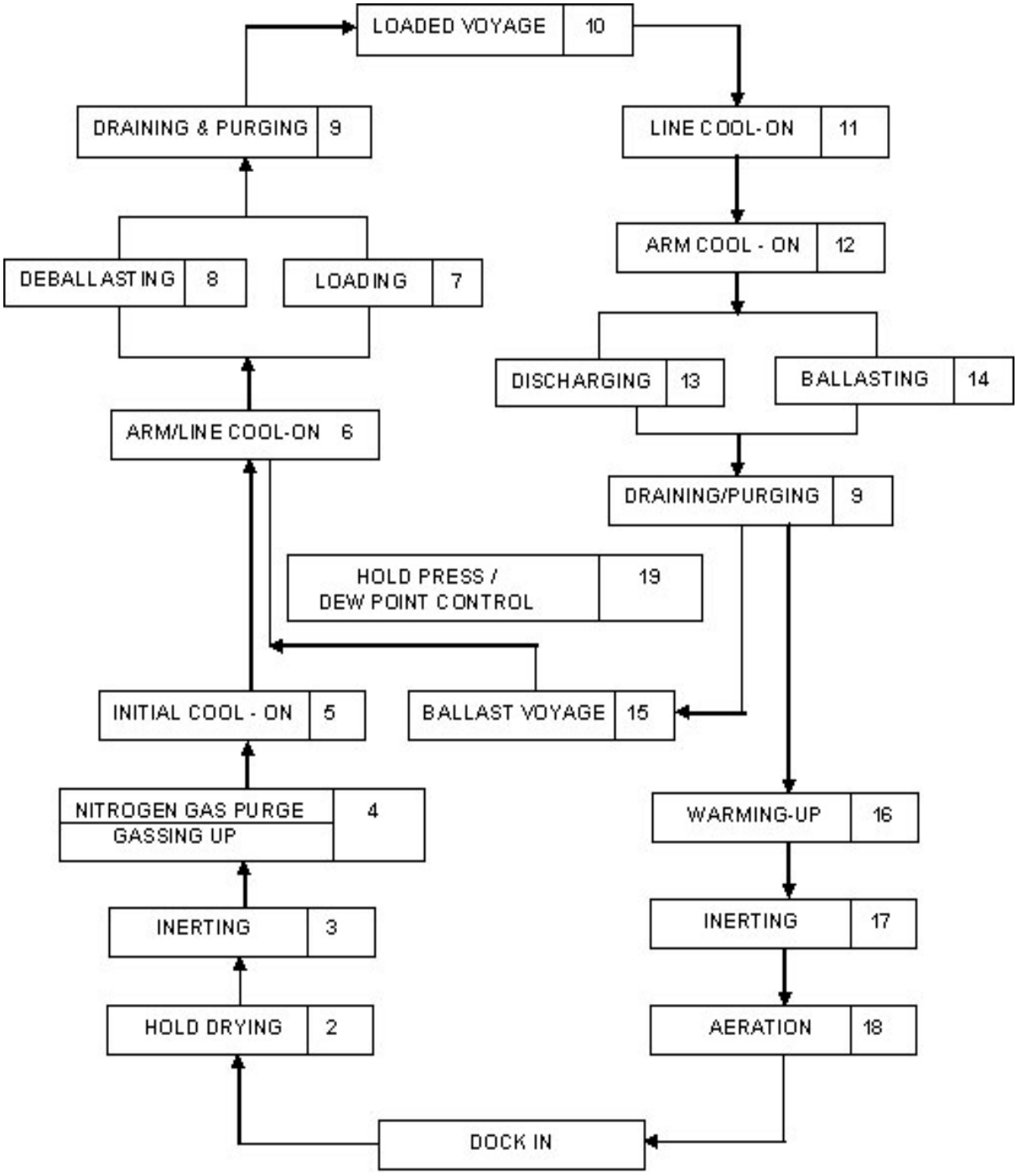


Fig 3: Routine Cargo Handling Guidance

Appendix 1

Liquefied Gas Tanker Cargo and Ballast Handling Simulator Sample Exercise Scenarios

This appendix contains 10 sample exercise scenarios relating to liquefied gas tanker cargo and ballast operations which can be used in most designs of liquefied gas tanker cargo and ballast handling simulator.

Exercise no. 1 "LPG/Ethylene Carrier":
Liquefied gas tanker cargo and ballast handling simulator layout.

Exercise no. 2 "LPG/Ethylene Carrier":
Drying and inerting of cargo tanks and hold spaces.

Exercise no. 3 "LPG/Ethylene Carrier":
Gassing up and cooling down of cargo tanks.

Exercise no. 4 "LPG/Ethylene Carrier":
Loading plan, cargo, stability and stress calculation

Exercise no. 5 "LPG/Ethylene Carrier":
Loading full cargo without vapour return and using ship's reliquefaction plant.

Exercise no. 6 "LPG/Ethylene Carrier":
Loading full cargo with vapour return to onshore facility and deballasting.

Exercise no. 7 “LPG/Ethylene Carrier”:

Unloading of cargo by using deep well centrifugal pump and ballasting.

Exercise no. 8 “LPG/Ethylene Carrier”:

Unloading of cargo by using cargo heater in series with deep well pump and booster pump.

Exercise no. 9 “LPG/Ethylene Carrier”:

Warming, venting, inerting and aerating cargo tanks for entry.

Exercise no. 10 “LPG/Ethylene Carrier”:

Loading two different grades of liquefied gases using heater / booster pump and incorporating Faults in system for diagnosis by trainee

Exercise No.1 "LPG/Ethylene Carrier": Liquefied Gas Tanker cargo and ballast handling Simulator layout.

Duration	:	3 hours.
Objectives	:	Understanding of the subsystems and their overall interactivity in the cargo handling simulator and the operations involved. Becoming familiar with terminology used in liquefied gas cargo transport and operations. The trainees will learn to use and practice working with gas data sheets for the products which to be carried.
Prerequisites	:	The theoretical aspects of the various kinds of liquefied gas cargo transport should be known to the trainees. Basic naval architecture related to liquefied gas tankers, with reference to ship survival capability and location of cargo tanks as per standards of type 1G, 2G, 2PG and 3G ships will have been studied prior to simulator exercises. Basic stability, strength and stress theory will have to be known by the trainees. Be familiar with the Gas Carrier Code relevant to their vessel and the restrictions indicated from the gas data sheets.
Training materials	:	OHP (Over Head Projector) sheets of the mimic diagrams used in the CHT (Cargo Handling Trainer) LPG workstation version. Layout and general arrangements of the vessel modelled in the liquefied gas tanker cargo and ballast handling simulator.
Simulator Condition	:	Not applicable.

Briefing : Explanation of the ship type modelled.
Explanation of the various subsystems and how they interconnect in real life.
Explanation of the reliquefaction plant, compressors, cargo vaporiser, inert gas plant, cargo heaters.
Explanation of the Load Master Functions, trim, draft, heel indicators in the simulator.

Student action : Attend lecture.
Repeat previous theory learned on cargo systems, naval architecture, stability and stress.

Instructor action : Apart from system mimics emphasize overall connection of the systems in the vessel.
Explain symbols used in mimics.
Explain Load Master.
Explain pumping system and cargo heating system.
Explain the operation of inert gas generator, cargo heater and vaporiser.
Explain operation of the reliquefaction plant & cargo compressors.

Debriefing : Check if all systems understood and interconnection of system in simulator.
Discuss if relationships with previous theory are properly understood.

Evaluation : By means of one or more diagrams have trainees show understanding of subsystems and symbols by describing system and/or indicating various symbols etc.

Exercise No.2 "LPG/Ethylene Carrier": Drying and inerting of cargo tanks and hold spaces

Duration : 3 hours

Objectives : By purging with dry air / inert gas, cargo tanks and hold spaces will be dried / inerted.
The trainees will realize that the cargo tanks and hold spaces have to be dried before inerting operation.
Understanding the principles, operations & safety precautions, involved with drying and inerting of cargo tanks and hold spaces.

Prerequisites : Introductory exercises will have been completed (exercise no.1). Theory of dew point, UEL, LEL and explosive mixtures will have been covered as well as explosion triangles

Training materials : OHP sheets of the IG system, onboard drier, the IG distribution lines.
Mimics diagram of:

- cargo tanks and their connection
- IG manifold and connection to liquid/vapour lines
- hold spaces and their connection

Simulator Condition : Cargo tanks empty, filled with moist air, ambient temperature and atmospheric pressure.
Normal ballast condition.
Hold spaces filled with moist air, ambient temperature and atmospheric pressure

Briefing : Composition of tank atmospheres to be checked and students explained levels of safe drying and inerting.

After drying the tanks will have to be inerted; inert gas to be supplied at the bottom of the tanks as air is lighter than the inert gas, air will be pushed out of the top of the tanks.

Student action : After checking tank atmospheres, choices to be made for which tanks/hold spaces to start drying and inerting.
The trainees will have to prepare the route from IG blower to the manifold through the cooler and drier where fitted and a connection at the manifold from IG line to cargo tank through liquid line to be made.
Start IG fan.
Start up onboard drier.
Continuous monitoring of dry air flow and dew point temperature after drier and in the cargo tanks/hold spaces.
The drying operation continuous until the required dew point temperature is attained.
Start up IG/N_2 plant.
Continuous monitoring of IG/N_2 flow, O_2 content and dew point temperature in the cargo tanks and hold spaces.
The inerting operation continuous until the required O_2 content and dew point temperature in the tanks is attained.

Instructor action : Check the correct route is set up for the drying / inerting operation.
Check choices of tanks and system used for drying / inerting.
Check quality of dry air / IG / N_2 supplied.
Monitor the tank atmosphere.

Debriefing : The instructor should ascertain that the tank atmosphere is at the required level of dew point temperature and O_2
Check that students have understood the principles of drying and inerting of cargo tanks and hold spaces.

The purpose and results of the various actions taken in the operation should be discussed with the trainees.

Evaluation : By question and answer confirm that students have understood the principles of, and reasons for, drying and inerting of cargo tanks and hold spaces.

Based on the achieved levels of IG/N_2 and dew point temperature / O_2% in the cargo tanks / hold spaces the trainees' understanding and skills in drying and inerting can be evaluated.

Exercise No.3 "LPG/Ethylene Carrier": Gassing up and cooling down of cargo tanks.

Duration : 3 hours.

Objectives : By admitting small quantities of liquid cargo received from shore to ship's vaporiser the tanks will be gassed-up and consequently cooled in preparation for loading cargo.
The trainees will learn to use and practice working with gas data sheets for the products which to be carried.
The trainees will realize that the tanks have to be dried as well as inerted before gassing up and cooling down commences.
Understanding the principles, operations & safety precautions, involved with gassing up and cool-down of cargo tanks.

Prerequisites : The trainees will have performed familiarization exercises on the simulator and they will have knowledge of drying and inerting operation (exercise no.1 & 2)
and have:

- a knowledge of the procedures and temperatures described for a certain cargo for a certain type of tank and thermal stress on the cargo tank.
- be familiar with the IGC Code relevant to their vessel and the restrictions indicated from the gas data sheets.

Training materials : OHP sheets of cargo deck lines.
General plan of "LPG/Ethylene Carrier" and other particulars.
Mimics diagram of:

- cargo tanks and their connection
- the relevant cargo and gas pipeline systems and tank plans
- liquid/vapour lines and their connection
- temperature/vapour pressure diagrams

Simulator Condition : Cargo tanks empty, tanks and hold spaces dried and inerted.
Ballast tanks are partly full, assuming the ship is at, the loading berth.

Briefing : The trainees will have to be informed of the status of the ship, cargo tanks, hold spaces and ballast tanks.
After inerting the tanks will have to be gassed up; gas from the cargo will be supplied at the bottom of the tanks when the inert gas is lighter than the gas to be loaded, as is the case with LPG, inert gas will then be pushed out of the top of the tanks.
Depending on the ship's system the cargo gas can be drawn from a deck storage tank, or be supplied from the shore. As the vessel is alongside the terminal, during gassing-up the ship will not be allowed to vent the mixture of inert gas and cargo gas to atmosphere, but a vapour return line will have to be used to send the mixture of inert gas and cargo vapour to shore. After gassing-up, cooling down of the tank commences either by reliquefaction system or by spraying the cargo into the tanks.
Composition of tank atmospheres to be checked and students explained precaution for safe gassing up and cooling down operation.

Student action : The trainees will have to prepare the gas pipeline route from the deck storage tank using cargo vaporizer where available to the cargo tanks. If no deck storage tanks are

available or too little capacity, a connection at the manifold will have to be made to have cargo liquid / vapour supplied from shore; once tanks have been gassed up, the cooling down of the tanks started with the use of reliquefaction system on LPG vessels.

The overpressure, which is thus created, can be compensated by means of the reliquefaction system or through the gas return line to shore for utilisation.

The cooling down continuous until liquid starts to form in the tank. At this point cargo loading commences.

Continuous monitoring of gas flow, tank temperature, tank pressure, percentage volume of gas and dew point temperature in the tanks.

Instructor action : The instructor will check if the correct route is set up for the gassing up procedure. Then the tank atmospheres should be monitored.

The instructor will check that the tanks are gassed up to the right level. After that the cooling down will commence. Depending on the facilities of the vessel, the reduction of the built-up overpressure in the tank during the cooling down should be handled carefully in order to avoid damage to the tank construction.

Check tanks cooled in order to keep thermal stresses within limits.

If the exercise of gassing up and cooling down of all tanks takes too long in real time, a start can be made with all tanks for gassing up and cooling down and then continued with one set of tanks until final cooling down takes place.

Debriefing : At the debriefing attention should be paid to the sequence of the procedures and actions taken from inerting to cooling down, which have to be carried out depending on the type of product.

The purpose and results of the various actions taken in the whole operation should be discussed with the trainees. The session should be conducted in a positive manner to create the right atmosphere for learning from individual actions and those of others.

The final tank atmosphere, temperatures and amount of liquid in the tanks will have to be checked.

Evaluation : By assessing the final status of the tank an evaluation can be made to see if the trainees have met the objectives of the exercise and if these operations were performed with due regard to safety and operating procedures and the criteria set by the instructor.

Exercise No.4 "LPG/Ethylene Carrier": Loading plan, cargo, stability and stress calculation.

Duration	:	2 hours.
Objectives	:	Set up a loading plan from available cargo data sheet. Give the trainees an overall view of cargo calculations involved in liquefied gas tanker and operations resulting from a certain loading plan. Proper operation of off-line loadmaster. Use of cargo and ballast tank calibration table.
Prerequisites	:	Familiarisation exercices. Cargo loading exercise no.4 & 5. Theoretical knowledge of hydrostatic data, stability, stress, draft and displacement calculations.
Training materials	:	Mimic diagrams of cargo barograph tank survey; loadmaster shear force; loadmaster bending moment; loadmaster deflection; loadmaster stability; bunkers/water barographs; General and capacity plan simulated vessel; Cargo calculation flowchart and list.
Simulator Condition	:	Cargo tanks empty; Ballast tanks full; Off-line loadmaster operational.
Briefing	:	Trainees to understand which calculations are involved and relevant. Cargo is not meant to be loaded on simulator, but off-line loadmaster is to be used for required planning and calculations.

Cargo details to be loaded are explained.
Initial condition of the vessel to be explained.
Cargo planning should take all elements of draft, trim, stress, and stability into account.

Student action : From details of cargo a loading sequence to be set up regarding space and weight available.
Trim, stress and stability to be calculated.
Total amount of cargo to be loaded to be calculated up to certain tank filling levels.

Instructor action : By means of tank capacity plans total amount of cargo to be loaded to be calculated.
Check that trainees set up proper cargo plan.
By means of hydrostatic data trim, list heel and stability are to be calculated.
It is not meant to actually perform the loading of the cargo.

Debriefing : Make sure trainees have overall understanding of all elements involved by means of questions and answers
Discuss difficulties in planning and calculations.
Compare loading sequences, total cargo to be loaded and trim draft and stress.

Evaluation : By means of mimic diagrams in loadmaster check values reached for trim, draft, stress, stability and total cargo loaded.

Exercise No.5 "LPG/Ethylene Carrier": Loading full cargo without vapour return and using ship's reliquefaction plant.

Duration : 3 hours

Objectives : By loading a full cargo into the vessel, appreciating efficient cargo planning, efficiency of reliquefaction plant, stability and stress criteria and maximum allowable draft and trim.
By admitting liquefied gas the tanks will be loaded and consequently topped off in preparation for full loading of cargo.
The trainees will realize that the tanks have to be cooled, reliquefaction plant in operation before loading commences.
Understanding the principles, operations & safety precautions, involved with full loading of cargo.

Prerequisites : The trainees will have performed familiarization exercises on the simulator and they will have knowledge of drying, inerting, gassing up and cooling-down operation (exercise no.1, 2 & 3) and have:

- a knowledge of the procedures for loading and operation of reliquefaction plant;
- knowledge of loading zones, stability, shear forces and bending moments;
- be familiar with the Gas Carrier Code;
- emergency shut down procedures.

Training materials : OHP sheets of the mimic diagrams of reliquefaction plant;
cargo deck lines and cargo tanks;
General plan "LPG / Ethylene Carrier" and other particulars;
Displacement scales.
Loading Zone chart.

Simulator Condition : Assuming the ship is at, the loading berth.
Shore connection for liquid line to load one grade of cargo in all tanks
Although not realistic, no ballast.
Vessel cargo tanks and pipelines cooled-down.
Reliquefaction plant in operation.
Tank pressures are minimum.

Briefing : Trainees should be told that all cargo tanks are cooled and ready for loading and deballasting operation to commence more or less simultaneously with loading.
Tanks have to be filled up to maximum loading limits.
Shear forces and bending moments to be kept within limits, preliminary check can be done by off-line Load Master.
During loading, boil-off gas from cargo tank to be lead to the ship's reliquefaction plant through vapour line.
After cooling-own the tanks will have to be loaded; liquefied gas from the shore tank will be supplied at the bottom of the tanks, vapours will then be drawn out of the top of the tanks to reliquefaction plant, where vapour is liquefied.
During loading, the ship will not be allowed to send the cargo vapour to ashore, but vapour pressure will have to be controlled by reliquefaction system.
Composition of tank atmospheres to be checked and students explained precaution for safe loading operation.

Student action : Trainees can perform preliminary stress check with the Load Master.
Connection of shore manifold to ship's liquid line to be made and tank filling to commence simultaneously by running reliquefaction plant and according to stress limitations.
During loading; liquid levels, tank temperatures, tank pressures as well as shear forces and bending moments to be monitored.

The trainees will have to prepare the gas pipeline route from the liquid manifold to the cargo tanks and vapour from cargo tank to ship's reliquefaction plant.
The overpressure which is thus created can be compensated by means of the reliquefaction system.
The bulk loading continuous until liquid level is reached 90% of loading limits. At this point topping off commences.
Continuous monitoring of flow of liquefied gas and operation of reliquefaction plant.
Loading rate to be reduced if tank pressure goes up to 60%of MARVS.
Loading to be stopped in the case of tank pressure goes up to 70% of MARVS.
Note: Some vessels may be fitted with two MARV settings, for sea 250 mb (say) and for port 400 mb (say).

Instructor action : Check preliminary stress calculations
Check tanks loaded in planned sequence in order to keep stresses within limits.
Check tank levels during filling and topping off.
Check the operation of high and high high level alarm.
If the exercise of filling all tanks takes too long in real time, a start can be made and then continued fast time until a further stage whereby topping off of tanks is again a useful learning experience.
The instructor will check if the correct route is set up for the loading. Then the tank temperature and pressure should be monitored.
The instructor will check that the tanks are loaded up to the pre-calculated maximum loading limits.
Depending on the facilities of the vessel; the reduction of the built-up overpressure in the tank during the loading should be handled carefully in order to lifting up tank relief valves.

Debriefing : Trainees should understand possibilities and limitations of a full cargo being loaded.

Trainees should understand limitations of maximum loading rate depend on reliquefaction capacity.

Stresses and stability to be monitored.

Final draft, heel, tank soundings, tank temperatures, tank pressures, quantity of liquid will have to be checked.

At the debriefing attention should be paid to the sequence of the procedures and actions taken from initial loading to topping off.

The purpose and results of the various actions taken in the whole operation should be discussed with the trainees.

The session should be conducted in a positive manner to create the right atmosphere for learning from individual actions and those of others.

Evaluation : By means of observation of final condition assessing if trainees have reached required condition and that all values of level, temperature, pressure, volume, trim, list, shear force and bending moment are within the determined limits. In alarm log check that tank high-pressure alarm have not been activated during the operation.

Exercise No.6 "LPG/Ethylene Carrier": Loading full cargo with vapour return to onshore facility and deballasting

Duration : 4 hours.

Objectives : By loading full cargo into the vessel, appreciating efficient cargo planning, deballasting sequence, stability and stress criteria and maximum allowable draft and trim.
By admitting liquefied gas, the tanks will be cooled and consequently loaded in preparation for full loading of cargo.
The trainees will learn to use and practice working with gas data sheet.
The trainees will realize that the tanks have to be cooled, vapour line connected to ashore before loading commences.
Understanding the principles, operations & safety precautions, involved with full loading of cargo and deballasting.

Prerequisites : The trainees will have performed familiarization exercises on the simulator and they will have knowledge of drying, inerting, gassing-up and cooling down operation (exercise no.1, 2 &3) and have:

- a knowledge of the procedures for loading cargo and operation of compressors;
- a knowledge of ballast lines and compressors;
- a knowledge of loading zones, stability, shear forces and bending moments;
- be familiar with the Gas Carrier Code;
- emergency shut down procedures.

Training materials : OHP sheets of the mimic diagrams of cargo deck lines, ballast lines, cargo tanks and ballast tanks.
General plan “LPG / Ethylene Carrier” and other particulars.
Displacement scales.
Loading Zone chart.

Simulator Condition : Assuming the ship is at, the loading berth.
Shore connection for liquid line to load LPG cargo in all tanks.
Ballast tanks full.
Vessel cargo tanks and pipelines are cooled down.
Tank pressures are minimum.

Briefing : Trainees should be told that all cargo tanks are cooled and ready for loading.
Deballasting operation to commence more or less simultaneously with loading.
All ballast to be discharged by the time vessel loaded with 90% of loading limits so that cargo tank topping off can be monitored carefully.
Tanks cool-down and have to be filled up to maximum loading limits.
Shear forces and bending moments to be kept within limits.
Preliminary check can be done by off-line Load Master.
During loading, boil-off gas to be send to the shore base.
After cooling-down the tanks will have to be loaded; liquefied gas from the shore tank will be supplied at the bottom of the tanks.
When starting the loading operation, care must be taken because the atmosphere in the tank cools and contracts rapidly and pressure in the hold space tends to drop.

Student action : Trainees can perform preliminary stress check with the Load Master.

Connection of shore manifold to ship's liquid line to be made and loading to commence simultaneously deballasting according to stress limitations.

During loading; liquid levels, tank temperature, tank pressure as well as shear forces and bending moments to be monitored.

The trainees will have to prepare the gas pipeline route from the liquid manifold to the cargo tanks and vapour from cargo tank to shore tank via vapour manifold.

The overpressure which is thus created can be discharged to shore base.

The bulk loading continuous until liquid level is reached 90% of loading limits. At this point topping off commences.

Continuous monitoring of flow of liquefied gas.

The temperature and pressure of cargo tank and hold spaces are measured periodically.

Deballasting should be started as soon as bulk loading starts and it should be completed by the time topping off commences.

Loading rate to be reduced if tank pressure goes up to 60% of MARVS and loading to be stopped in the case of tank pressure goes up to 70% of MARVS.

Instructor action : Check preliminary stress calculations;

Check tanks loaded /deballasted in planned sequence in order to keep stresses within limits;

Check tank levels during filling and topping off;

Check the operation of high and high level alarm;

If the exercise of filling all tanks takes too long in real time, a start can be made and then continued fast time until a

further stage whereby topping off of tanks is again a useful learning experience.

The instructor will check if the correct route is set up for the cooling/loading. Then the tank temperature and pressure should be monitored.

The instructor will check that the tanks are loaded up to the pre-calculated maximum loading limits.

The instructor will check that the ballast tanks are deballasted properly.

Depending on the facilities of the vessel; the reduction of the built-up overpressure in the tank during the loading should be handled carefully in order to lifting up tank relief valves.

Debriefing : Trainees should understand possibilities and limitations of a full cargo being loaded and all ballast being discharged.

Trainees should understand limitations of maximum loading rate depend on vapour discharge to ashore.

Stresses and stability to be monitored.

Final draft, heel, tank soundings, tank temperatures, tank pressures, quantity of liquid will have to be checked.

At the debriefing attention should be paid to the sequence of the procedures and actions taken from initial loading to topping off.

The purpose and results of the various actions taken in the whole operation should be discussed with the trainees.

The session should be conducted in a positive manner to create the right atmosphere for learning from individual actions and those of others.

Evaluation : By means of observation of final condition assessing if trainees have reached required condition and that all values of level, temperature, pressure, volume, trim, list, shear force and bending moment are within the determined limits. In alarm log check that tank high-pressure alarm have not been activated during the operation.

Exercise No.7 "LPG/Ethylene Carrier": Unloading of cargo by using deep well centrifugal pump and ballasting

Duration : 4 hours.

Objectives : By means of this exercise the relationship between the various subsystems is supposed to be demonstrated and the overall understanding of simultaneously unloading, stripping and ballasting to be demonstrated and realised.

By unloading cargo from the vessel, appreciating efficient cargo planning, stripping procedure, ballasting sequence, stability and stress criteria and maximum allowable draft and trim.

The trainees will learn to use and practice working with gas data sheet.

The trainees will realize the quantity of the vapour return during unloading shall be controlled on the shore to maintain the tank pressure within an allowable range.

The trainees will realize that the pipelines have to be cooled, one pump running and liquid in recirculation before unloading commences.

Understanding the principles, operations & safety precautions, involved with unloading of cargo and ballasting.

Prerequisites : Familiarisation exercices;
Unloading exercise;
Drying/inerting exercise;
Gassing-up and cool-down exercise;
Loading/deballasting exercise;
Use of submerged pump and compressor;
Theoretical knowledge of shear force, stress, trim and heel;

Pollution prevention rules and procedures have been discussed.
The trainees will have:

- a knowledge of the procedures for unloading cargo
- a knowledge of the stripping procedure
- a knowledge of ballast lines and procedure for deballasting
- be familiar with the Gas Carrier Code
- emergency shut down procedures

Training materials : Mimic diagram of cargo tanks, ballast tanks;
Liquid, vapour and spray lines;
Pumping system;
OHP sheets of the mimic diagrams of cargo deck lines,
Ballast lines, cargo tanks and ballast tanks;
General plan "LPG/ Ethylene Carrier" and other particulars;
Displacement scales.

Simulator Condition : Cargo tanks loaded with liquefied gas;
Ballast tanks empty;
Assuming the ship is at, the unloading berth;
Shore connection for liquid line to unload LPG cargo from all tanks;
Shore connection for vapour line to receive LPG vapour to maintain tank pressure;
One pump running; circulating cargo by keeping liquid fill valve open;
Vessel pipelines are cooled-down.

Briefing : The trainees should be convinced of the complexity of the exercise, which should be built up step by step;
Unloading should be started slowly by closing liquid fill

valve;
Stress, trim and heel to be monitored;
Unloading and ballasting according to pre-prepared plan;
Trainees should be told that all pipelines are cooled and ready for unloading;
Ballasting to commence more or less simultaneously with unloading;
Ballasting to be completed by the time stripping of cargo tank starts;
A certain amount of liquid cargo shall be left for cooling the cargo tanks during ballast voyage;
If necessary, residual liquid should be removed by running deep well pump;
Shear forces and bending moments to be kept within limits. Preliminary check can be done by off-line Load Master;
While unloading, vapour shall be returned from shore or generated by feeding LPG liquid to the ship's vaporiser to maintain the tank pressure within an allowable range.
While unloading at a faster rate, care must be taken because the tank pressure may drop.

Student action : The trainees will start with preparing a unloading and ballasting plan, which will keep stress, trim and heel within the acceptable limits.
Bulk unloading and, ballasting will take place simultaneously.
Stripping operation will continue until all tanks left with certain amount of liquid for cooling;
Ballasting according to IMO requirements;
Trainees can perform preliminary stress check with the Load Master;

Connection of shore manifold to ship's line to be made and unloading to commence by running pumps, simultaneously ballasting according to stress limitations.

During unloading: liquid levels, tank temperature, tank pressure as well as shear forces and bending moments to be monitored;

The trainees will have to prepare the gas pipeline route from the cargo tanks to liquid manifold and vapour from shore to cargo tank;

The low pressure, which is thus created can be compensated returning cargo vapour from shore base or by feeding LPG liquid to the ship's vaporiser;

The unloading continuous until liquid level is reached to minimum. At this point stripping commences;

Continuous monitoring of flow of liquefied gas and number of pumps in use;

The temperatures and pressure of cargo tank and hold spaces are measured periodically.

Instructor action : The instructor should ascertain that the choice of unloading order takes stress, trim and heel into consideration;

Check preliminary stress calculations;

Check tanks unloaded /ballasted in planned sequence in order to keep stresses within limits;

Check tank levels during unloading and stripping;

If the exercise of unloading all tanks takes too long in real time, a start can be made and then continued fast time until a further stage whereby stripping of tanks is again a useful learning experience;

The instructor will check if the correct route is set up for the unloading. Then the tank pressure should be monitored;

The instructor will check that the tanks are unloaded and left with certain amount of liquid for cooling during ballast voyage;
The instructor will check that the ballast tanks are ballasted properly;
Depending on the facilities of the vessel, the reduction of the pressure in the tank during the bulk unloading should be handled carefully in order to activation of vacuum relieving system.

Debriefing : Trainees should understand possibilities and limitations of a full cargo being unloaded and ballast being loaded.
Check which order tanks have been handled and in which order ballast has been loaded;
Check how much ballast has been loaded in order to create suitable draft, trim and heel;
Trainees should understand maximum unloading rate depend on number of pumps in use and distance of shore tank etc;
Stresses and stability to be monitored;
Final draft, heel, tank soundings, tank temperatures, tank pressures, quantity of liquid left in the tank will have to be checked;
At the debriefing attention should be paid to the sequence of the procedures and actions taken from initial unloading to stripping of cargo tanks;
The purpose and results of the various actions taken in the whole operation should be discussed with the trainees;

The session should be conducted in a positive manner to create the right atmosphere for learning from individual actions and those of others.

Evaluation	:	By means of observation of final condition assessing if trainees have reached required condition and that all values of cargo level, temperature, pressure, volume, trim, list, shear force and bending moment are within the determined limits; Time needed to complete operations will be a measure of efficient conduct of operations; In alarm log check that cargo tank low-pressure alarm has not been activated.

Exercise No.8 "LPG/Ethylene Carrier": Unloading of cargo by using cargo heater in series with deep well pump and booster pump

Duration : 3 hours.

Objectives : By means of this exercise the relationship between the various subsystems is supposed to be demonstrated and the overall understanding of unloading of cargo by using cargo heater in series with deep well pump and booster pump to be demonstrated and realised;

By unloading cargo from the vessel, appreciating efficient cargo planning, capacity of cargo heater, stability and stress criteria and maximum allowable draft and trim;

The trainees will realize that one deep well pump running and liquid in recirculation before unloading commences;

Understanding the principles, operations & safety precautions, involved with unloading of cargo by using cargo heater in series with deep well pump and booster pump;

Preparation of cargo for unloading into pressurised storage from a fully refrigerated ship.

Prerequisites : Familiarization exercises;

Basic theory of thermodynamics;

Basic knowledge of cargo heating principles;

Drying/inerting exercise;

Gassing-up and cool-down exercise;

Loading exercise;

Unloading exercise;

Use of deep well p/p, booster p/p & cargo heater in series;

Theoretical knowledge of shear force, stress, trim, and heel is required;

Pollution prevention rules and procedures have been discussed;

The trainees will have:

- a knowledge of the procedures for unloading cargo
- be familiar with the Gas Carrier Code
- emergency shut down procedures

Training materials : Mimic diagram of cargo tanks, ballast tanks;
Liquid and vapour lines;
Pumping plan;
OHP sheets of the mimic diagrams of cargo deck lines and cargo tanks;
General plan “LPG/ Ethylene Carrier” and other particulars.
Displacement scales.

Simulator Condition : Cargo tanks 50% loaded with liquefied gas;
Normal ballast condition;
Cargo temp close to Boiling point temperature, tank pressure positive and sea water temp 20 deg.C;
Assuming the ship is at, the unloading berth;
Shore connection for liquid line to unload LPG cargo from all tanks;
One pump running; circulating cargo by keeping liquid fill valve open.

Briefing : The trainees should be explained why heating cargo, which system is available, layout of pipeline on deck;
Unloading should be started only after establishing sea water flow through the heater. Thereafter, the booster pump and heater may be slowly cooled down by very slow throughput of liquid from the deep well pump discharge;
Temperature and pressure required and permissible by terminal should be given;
Dangers of sea water low flow inside cargo heater;
Stress, trim and heel to be monitored;

A certain amount of liquid cargo shall be left for cooling the cargo tanks during ballast voyage;
Shear forces and bending moments to be kept within limits. Preliminary check can be done by off-line Load Master;
Risk of freezing the circulating water in the cargo heater should be explained;
While unloading, provision shall be made for taking vapour from cargo heater to tank for maintaining the tank pressure within an allowable range;
While unloading at a faster rate, care must be taken because the tank pressure may drop.

Student action : The trainees will start with preparing unloading plan, which will keep stress, trim and heel within the acceptable limits;
Unloading operations will continue until all tanks left with certain amount of liquid for cooling;
Connection of shore manifold to ship's line to be made and unloading to commence by running deep well pump, booster pump and cargo heater in series;
By means of heater by-pass valve and booster by-pass valve trainees will maintain temp and pressure required by terminal;
Attention should be paid to SW outlet temperature;
During unloading: liquid levels, tank temperature, tank pressure as well as shear forces and bending moments to be monitored;
The trainees will have to prepare the gas pipeline route from the cargo tanks to liquid manifold via booster pump and cargo heater;
The low pressure, which is thus created, can be compensated by returning cargo vapour from heater or by bleeding the discharge to cargo vaporizer if fitted, to create gas and return the created gas to the cargo tanks to increase the Tank pressure;

The bulk unloading continuous until liquid level is reached to minimum. At this point stripping commences;
Continuous monitoring of flow of liquefied gas through cargo heater and booster pump.

Instructor action : The instructor should ascertain that the choice of unloading order takes stress, trim and heel into consideration;
Check tank levels during unloading and stripping;
Check flow of liquefied gas through cargo heater and booster pump;
Check flow of sea water through cargo heater.
Check that trainees unload cargo with the required temperature and pressure;
The instructor will check if the correct route is set up for the unloading via booster pump and cargo heater;
Then the tank pressure should be monitored;
The instructor will check that the tanks are unloaded and left with certain amount of liquid for cooling during ballast voyage;
Depending on the facilities of the vessel; the reduction of the pressure in the tank during the bulk unloading should be handled carefully in order to activation of ESD and vacuum relieving system.

Debriefing : Trainees should understand possibilities and limitations of cargo being unloaded by using cargo heater in series with deep well pump and booster pump;
Check which order tanks have been handled;
Trainees should understand maximum unloading rate depend on capacity of cargo heater;
Stresses and stability to be monitored;
Final draft, heel, tank soundings, tank temperature, tank pressure, quantity of liquid left in the tank and tank

atmospheres will have to be checked;
At the debriefing attention should be paid for the risk of freezing the circulating water in the cargo heater;
The purpose and results of the various actions taken in the whole operation should be discussed with the trainees;
The session should be conducted in a positive manner to create the right atmosphere for learning from individual actions and those of others.

Evaluation : By means of observation of final condition assessing if trainees have reached required condition and that all values of cargo levels, temperature, pressure, volumes, trim, list, shear force and bending moments are within the determined limits;
In alarm log check that heater outlet temperature and pressure have been maintained during unloading.

Exercise No.9 "LPG/Ethylene Carrier": Warming, venting, inerting and aerating cargo tanks for entry.

Duration : 3 hours.

Objectives : Preparing cargo tanks for entry by following operations:

- Warming of residual liquid by using heated cargo vapour
- Venting of cargo vapour to a shore tank / vent mast
- Purging out cargo vapour by inert gas
- Ventilating cargo tanks by air

The trainees will learn how to make liquid free by raising temperature and procedure for venting;

The trainees will learn warming up to ambient temperature is necessary to avoid freezing of CO_2 in inert atmosphere.

The trainees will learn how to purge cargo tanks with inert gas to safe level before starting to ventilate with air;

By means of this exercise the relationship between the various subsystems is supposed to be demonstrated and the overall understanding of warming, venting, inerting and aerating of cargo tanks will be demonstrated and realised.

Understanding the principles, operations & safety precautions involved with the above operations.

Prerequisites : Familiarization exercise no. 1;
Inerting exercise no. 2;
Knowledge of thermal stress;
Theory of explosion limits – LEL and UEL;
Threshold Limit values (TLV);
Basic theory of thermodynamics;
Basic knowledge of cargo heating principles;
Use of compressors, heaters, vaporisers, inert gas plant and nitrogen plant;

Pollution prevention rules and procedures have been discussed.

Training materials : Tank atmosphere diagrams;
IG/N_2 plant diagram;
IG/N_2 connection diagram;
Mimic diagram of cargo tanks;
Liquid and vapour lines
OHP sheets of the mimic diagrams of cargo deck lines and cargo tanks;
General plan "LPG/ Ethylene Carrier" and other particulars.

Simulator Condition : Vessel ballasted to normal seagoing condition;
Cargo tanks are in liquid free condition;
Assuming the ship is at, sea;
Connection from vapour line to vent mast / shore tank;
One cargo heater running and drawing cargo vapour from tank and putting back through liquid line.

Briefing : The status of the tanks to be explained to trainees;
Temperature differences to be pointed out;
Use of compressors, heaters, vaporisers IG/N_2 system and venting system;
Objective to maintain proper tank atmosphere composition during whole operation;
The trainees should be explained why warming up cargo, which system is available, layout of pipeline on deck;
Inerting should be started only after removing residual liquid and venting;
Aerating should be started only after concentration of combustible gas is reduced to safe percentage, taking safety into account;
Risk of condensation in the tank during inerting and creation of combustible mixed gas during aerating should be explained.

Student action : Warming and venting of cargo tanks with hot vapour should be continued till the temperature goes up to ambient;
Continue purging cargo tanks with inert gas and bring safe HC concentration before ventilating with air;
Make tanks gas free for entry;
Tank atmosphere to be constantly monitored;
Gas freeing operations will continue until all tanks have reached 21% of oxygen, toxic gas below TLV, hydrocarbon content below 1%LEL;
Connection of flexible from ship's vapour/liquid manifold to be made and venting commences by opening manifold valve;
During warming and venting of cargo, tank temperature and tank pressure to be monitored;
During inerting of cargo tanks, hydrocarbon content to be monitored;
During aerating, oxygen, toxic gas and hydrocarbon content to be monitored;
Continuous monitoring of flow of inert gas and air through cargo tanks;
The trainees will have to prepare different pipeline route from the cargo tanks to compressor/heater and to shore via liquid/vapour manifold or to ship's vent mast for warming, venting, inerting and aerating operation.

Instructor action : Check proper operation of compressors, heaters, IG/N_2 plant;
Check that trainees warm up the cargo tank to the ambient temperature before inerting by inert gas;
Check that trainees observe tank atmosphere diagrams and tanks are at safe HC level before starting to ventilate with air;

Check that trainees observe tank atmosphere and confirm safe levels of oxygen, hydrocarbon content and toxic gas before entry (1% LEL of HC, Toxic gas less than TLV and 21% O_2);
Check tank atmosphere during inerting/aerating;
Check flow of inert gas/nitrogen/air through cargo tanks;
Check that trainees warm up the cargo tank to the ambient temperature before inerting by inert gas;
The instructor will check if the correct route is set up for the warming, venting, inerting and aerating cargo tanks;
The instructor will check that the tanks are not having liquid before inerting;
Depending on the facilities of the vessel; rate of increase of the temperature in the tank during warming should be handled carefully in order to avoid thermal stress.

Debriefing : Ensure trainees have understood correct use of tank atmosphere diagrams;
The importance of liquid freeing/warming tanks to reach ambient temperature before inerting to be discussed;
The importance of proper purging with IG /N2 down to safe HC concentration before ventilating with air to be stressed;
Trainees should understand possibilities and limitations of cargo tank being warmed by using compressors and heaters;
Check which order tanks have been handled;
Trainees should understand the time required for inerting/ventilating cargo tanks will depend on the capacity of IG/N_2 plant.;
Final tank atmospheres will have to be checked;
At the debriefing attention should be paid for the risk of condensation in the tank during inerting and creation of combustible mixed gas during aerating;

The purpose and results of the various actions taken in the whole operation should be discussed with the trainees;

The session should be conducted in a positive manner to create the right atmosphere for learning from individual actions and those of others.

Evaluation : By means of the tank atmosphere screens, the oxygen, toxic gas and hydrocarbon contents in the ventilated tanks can be monitored;

By means of observation of final condition assessing if trainees have reached required condition and that all values within the safe limits.

Exercise No.10 "LPG/Ethylene Carrier": Loading two different grades of liquefied Gases and insertion of faults in system for diagnosis by trainee.

Duration	:	2 hours.
Objectives	:	Loading two different types of cargo into the vessel taking into account possible pipeline admixtures, previous cargo, possible contamination effects and cargo limitations; Prevention of atmosphere pollution by means of fixed gas detection system; Stress, stability, trim and heel limitations to be taken into consideration and planning accordingly.
Prerequisites	:	Deballasting exercise; Theoretical knowledge of different types of liquefied gas and their characteristics.
Training materials	:	Mimic diagrams of loading/unloading; cargo deck lines; cargo tanks; tank atmosphere; IG distribution; loadmaster shear force; loadmaster bending moment; cargo baragraph; fixed gas detection system; loading checklists; product admixture tables; cargo compatibility tables; data sheet.
Simulator Condition	:	Cargo tanks empty and inerted; Shore manifold connections not established; Vessel ballasted to normal arrival condition.

Briefing : Trainees to be told which products to load and amounts on each tank; status of tank, pumps and pipelines;
Choice of location of liquefied gas depending on availability, chance of contamination, stress and trim/heel considerations;
Cargo vapours to be returned ashore through vapour return line;
Deballasting to commence more or less simultaneously with loading and all ballast discharged when topping off starts;
Cargo tanks to be topped off at maximum loading limits.

Student action : A loading sequence will have to be set up, taking the types of liquefied gas and the previous cargo carried in the tank into consideration;
The stress and trim will then have to be evaluated;
Tank atmosphere checked, liquefied gas routes designated and boil off gas lined up to reliquefaction plant / compressor;
Density and temperatures of different products to be noted;
Ballast system to be lined up and first tanks deballasted as cargo intake commences;
Diagnoses of faults and taking quick and safe measures to prevent pollution or prevent contamination and avoid any accidents.

Instructor action : Check that trainees set proper cargo characteristics and take possible limitations into consideration when starting to load;
Check that reliquefaction plant / compressors are lined up separately and that tank atmospheres are regularly monitored;
Insert various available faults in the system like valve failure/ jamming, pressure /temperature gauge errors etc;
Check that stress and trim are kept within allowable limits;
Check that tanks are properly topped off without increasing the predetermined loading limits.

Debriefing : Students should be able to explain choice of tanks and types of liquefied gas as well as considerations of loading and topping off order;
Use of cargo lines should be fully understood and possible types of liquefied gas contamination appreciated;
Commend if faults have been rectified and detail those students who may have not been able to assess the situation correctly.

Evaluation : By means of cargo barographs and tank contents the result of loading operations to be monitored;
Trim, heel, shear force and bending moments to be checked and within limits;
Tank atmosphere to be monitored;
Total time for detection of faults, taking remedial actions and successful completion within stipulated time can be a measure of efficiency;
In alarm and variable pages tank parameters, if any, will be registered as well as high level alarms.

Appendix 2

Particulars on a typical "LPG/ETHYLENE CARRIER"

Fig. 4. "LPG/ Ethylene Carrier" 8,200 cub.m
(3 bilobe independent tank type C cargo tanks)

1. Vessel's Main Particulars

Length overall	126.20 m
Length between perpendiculars	122.02 m
Draught on summer freeboard	8.60 m
Deadweight	9470 MT
Displacement	13846 MT
Other details	Type: Independent C (-104^{0}C, 970 kg/m^3, 5.5 bars abs)

2.1 Cargo Tanks

The cargo containment system is of the independent IMO type C. The tanks are of bilobe construction, divided by a closed longitudinal bulkhead into two tank halves connected by a balance line in the vapour face.

The cargo tanks are designed to carry all liquefied petroleum gases (LPG), Ammonia (NH_3) and Ethylene (LEG) with a minimum temperature of -104^{0}C and a maximum tank pressure of 4,5 bar g. Some noxious liquid substances may also be carried.

The cargo tanks are also designed for a permissible vacuum of 0.5 bar abs.

The cargo tank is fitted with a central pipe tower. The tower supports and contains the cargo pumps, discharge and filling lines, Whessoe float gauge system, purge lines, spray lines and gas sampling pipe. Access to the tank is via a manhole fitted on the dome top.

2.2 Tank capacities:

Tanks	Capacity m^3
No 1 Port	1182,2
No 1 Starboard	1182,18
No 2 Port	1468,07
No 2 Starboard	1469,26
No 3 Port	1468,57
No 3 Starboard	1468,18
Total cargo capacity	8238,46

2.3 Ballast System

All ballast tanks are connected to a ring main piping system via one suction/filling line. The ballast tanks are used to maintain the vessel at a safe draught, trim and stability throughout all cargo operations and transport.

2.3.1 Ballast tank capacities

Ballast tank no	Type	Capacity (m^3)
1 Centre	DB	52,5
2 Port	DBW	106,0
2 Starboard	DBW	106,8
2 Port	DB	143,2
2 Starboard	DB	143,2
3 Port	DB	141,7
3 Starboard	DB	141,7
4 Port	DBW	127,9
4 Starboard	DBW	127,9
4 Centre	DB	196,7
5 Port	DB	142,6
5 Starboard	DB	142,6
6 Forepeak	FP	194,6

1 Port	WT	129,0
1 Starboard	WT	129,0
2 Port	WT	99,6
2 Starboard	WT	99,6
3 Port	WT	62,3
3 Starboard	WT	62,3
4 Port	WT	99,6
4 Starboard	WT	99,6
5 Port	WT	112,1
5 Starboard	WT	112,1
28 *Aft peak	FW	62,5
Totals:		2835,1

- Not on ballast system

2.3.2 Ballast pumps capacity

Type	Centrifugal
Capacity	500 m^3 /h
Drive	Electric

2.3.3 Ballast ejector

One ballast ejector is provided with a capacity of 75m^3/h at 20 mlc. It is driven by a separate pump (normally) used for deck water spray system with a capacity of 900 m^3/h. As pump started ejector drive, discharge and suction pressures will alter accordingly. Discharge pressure will also change dependent on draught and hence discharge head.

2.4. Cargo pumps

Each cargo tank is fitted with two multistage, centrifugal pumps of the deep well type, lubricated by the cargo. The pump suctions are located 75mm above tank bottom within the central pipe tower.

2.4.1 Cargo pump capacities

Type	Multistage Centrifugal deep well type
Number & Capacity	6 sets & 170 m^3 /h x 125 mlc
Drive	Electric

2.5. Booster pumps

The vessel is fitted with 2 cargo booster pumps. These are used in addition to the cargo pumps in order to handle high back pressure during discharge.

2.5.1 Cargo booster pump capacities

Type	Centrifugal
Number & Capacity	2 sets & 300 m^3 /h x 120 mlc
Drive	Electric

2.6. Liquefaction Plant

The liquefaction plant is installed in the cargo compressor room and comprises the following main components:

- 3 surge drums
- 3 cargo compressors
- 2 flash drums
- 2 LPG condensers/vaporisers/C2 de-superheater
- 2 Ethylene condensers
- 2 cargo receivers
- 2 R22 plants
- control valves

The liquefaction plant can be connected to one cargo system.

Alternatively, the liquefaction plant can be split into two independent liquefaction groups for cooling two grades of cargo.

Each liquefaction group consists of the following main components:

- one cargo compressor with surge drum
- one flush drum
- one LPG condenser/ vaporizer /de superheater
- one ethylene condenser
- one cargo receiver
- one complete R22 screw compressor system

The third cargo compressor with surge drum acts as a spare and can be connected to liquefaction group I or II.

2.6.1 Cargo Compressors

- oil free type for 2 stage compression
- double acting 2- cylinder compression
- driving gear is force lubricated by an integral oil pump
- cylinder heads
- cross heads and guide bearings are cooled by an external glycol water circuit
- manual capacity control 50/100%
- directly coupled motor

2.6.2 Droplet Separator (surge drum)

There is a droplet separator in the 1st stage suction line of each compressor. The droplet separator is designed to vaporise any possible liquid droplets in the vapour by means of hot-gas. A high level switch stops the compressor.

2.6.3 Cargo condenser, vaporiser, desupherheater (LPG condenser)

The heat exchanger is designed to decrease the superheat of hot gas before condensed with R22 circuit, to condensate cargoes of the DIRECT CYCLE and to vaporise several cargoes by seawater.

The heat exchanger is a shell and tube heat exchanger, seawater flows in tubes. For condensing, the heat exchanger is fitted with an HR valve to vent incondensable gases (Nitrogen).

For vaporizing of cargo, the heat exchanger is fitted with a pressure control valve and level control valve to avoid freezing or overfilling, respectively.

If the seawater temperature drops too low, the temperature switch inside the tubes closes the pressure control valve and level control valve.

If the cargo temperature drops to low, another temperature switch inside the shell also closes the pressure control valve and the level control valve.

2.6.4 Intermediate cooler (flash drum)

The cargo flash drum is a vertical vessel. It is designed to desuperheat the discharge gas from cargo compressor 1st stage by mixing with flash gas or by vaporising of condensate, if the hot gas is submerged in the liquid.

2.6.5 Cargo receiver

This is designed to accumulate the condensed cargo.

2.6.6 R22 Plant

The R22 compressors are used together with the cargo compressors in a cascade cooling circuit for colder cargoes like ethylene, or when the differential pressure between 1st stage suction and condenser pressure be too high.
Each R22 plant comprises the following main components:

2.6.7 R22 Compressor

- double stage screw compressor with economiser part
- lubricated by external oil pump
- manual and automatic capacity control 0 - 100%
- directly coupled to electric motor via intermediate shaft, same as for cargo compressor

2.6.8 R22 Condenser

The R22 condenser is a shell and tube heat exchanger with receiver. R22 is condensed on shell side by warming up of seawater in the tubes. The condenser is fitted with a pressure indicator on shell side and a temperature indicator for seawater outlet temperature. The combination R22 receiver/condenser is designed to accumulate the whole charge R22 of the circuit. It is fitted with a temperature indicator and level indicator.

2.6.9 R22 Evaporator/Ethylene condenser

Shell and tube heat exchanger for dry expansion of R22 refrigerant. Tube side is divided into three compartments, each fitted with a thermostatic expansion valve for R22 injection.

Ethylene, ethane, commercial propane and propylene can be condensed on shell side.

2.6.10 R22 Economiser

Injection cooler, designed to subcool the R22 condensate and to avoid high compressor discharge temperature.

2.6.11 R22 Filter/Dryer

Welded in liquid line, with shut off valves

2.6.12 Oil Separator

Designed to separate the oil from R22 discharge gas to a value of approx. 200 ppm. The separator is fitted with a level glass, and a heating coil by external glycol circuit.

2.6.13 Oil Cooler

Shell and tube type to cool oil by seawater in tubes.

2.6.14 Refrigerant control

The R22 evaporator is divided into 3 compartments, each with its own refrigerant control. Each control set comprises:

- A thermostatic expansion value (TV), to control the flow
- A hydraulically operated on/off value
- A solenoid GV to initiate closing of the on-off value
- A strainer in liquid line upstream expansion value

Liquefaction capacity at seawater temperature +32^0 C and air temperature + 45^{0}C.

2.7 Cargo heaters

The vessel is equipped with a cargo heater in order to heat cargo during discharge or for heating cargo during laden voyage.

The cargo heater can be connected to any cargo system. The cargo heater is a shell and tube type heat exchanger, designed for warming up the liquid cargo.

2.7.1 Cargo heater capacities

Type	Tube/ Shell
Capacity/propane at SW temp.: 15^0 C	220m^3 /h with cargo temp.: 0^0 C
Capacity/ammonia at SW temp.: 15^0 C	150m^3 /h with cargo temp.: 0^0 C
Heating medium	seawater

2.8 Vent and Drain System

The gas plant is provided with safety relief valves and drain valves. Piping sections where liquid can be trapped are fitted with relief valves for thermal expansion. These valves are piped to the vent and drain system.

There are four vaporisation pipes in the system to vaporise liquid from drains, relief valves or remnants after purging.

The Liquid accumulator if fitted is connected to the mast vent riser as part of a safety feature, when activated will trigger the ESD.

2.9 Blow-off system

For two-grade, the vent system can be divided into two systems.

The safety relief valves of the cargo tanks are firmly piped to the vent masts; valves of each tank to a separate vent mast.

Each vaporisation pipe in the vent and drain system can be connected to each vent mast in the same way as the vents of the liquefaction plants.

2.10 Inert Gas Generator

One inert gas plant is provided, located within the Engine room. Burning gas oil in a combustion chamber produces inter gas. The resulting exhaust gas is then cooled and dried before being led into the inert gas distribution system. The plant is also used to supply dry air when required.

The plant comprises an inert gas generator and support systems, refrigerating cooling unit and two regenerative dryers.

The capacity of the plant when operating on dry air supply is as follows:

Nominal capacity 2 x 1500$m^{3/}$ h

Air dewpoint < -5^0 C

The capacity of the plant when on inert gas service is as follow:

Item	Capacity
Nominal capacity	800m^3 /h
Oxygen content	Max 1%, min 0.4%
Carbon-dioxide	Max 14%
Carbon-monoxide	Max 100ppm
Sulphur dioxide	Max 10ppm
Nitrogen	balance
Temperature after generator	> 40^0 C
Dewpoint temp after drier	< -50^0 C

10.1 Inert gas generator

The inert gas generator consists of a combustion chamber and a cooling/washing tower. In the combustion chamber, fuel oil and air are burnt and inert gas is generated. The inert gas is sent to the cooling/washing tower. At the cooling washing tower, a seawater shower cools the inert gas and washes out sulphur oxides, which are contained in the gas.

The LPG cooling pump supplies seawater to the cooling/washing tower and the cooling jacket of the combustion chamber.

The IGG fuel oil pump supplies fuel oil from IGG gas oil tanks. The combustion air is supplied by roots type air blowers.

The final discharge pressure of the dryer unit is maintained by the air blowers, and the pressure is controlled by a pressure control valve.

2.10.2.1 Inert gas refrigerating unit (Freon R-22)

The inert gas refrigerating unit cools the inert gas as the first step of drying.

The inert gas refrigerating unit consists of a Freon compressor with capacity control, a Freon condenser, a Freon evaporator and a demister.

The Freon evaporator is a shell and tube cooler. Direct expanded Freon "R-22" cools inert gas and condenses excess water in the inert gas.

2.10.3 Inert gas dryer unit

The dryer unit absorbs water in the inert gas with activated alumina.

The inert gas dryer unit has two dryer vessels. When one vessel is working the other vessel is regenerating. The change-over between working/regenerating is carried out automatically every 8 hours.

In the regenerating phase, the vessel is heated by hot air for at least 4 hours, and then cooled.

The hot air is generated by both electric and steam heaters. The temperature of hot air is controlled about 220^0 C by electric heater.

Fig. 5. Outline sketch of Cargo Tank overview of “LPG/ Ethylene Carrier”

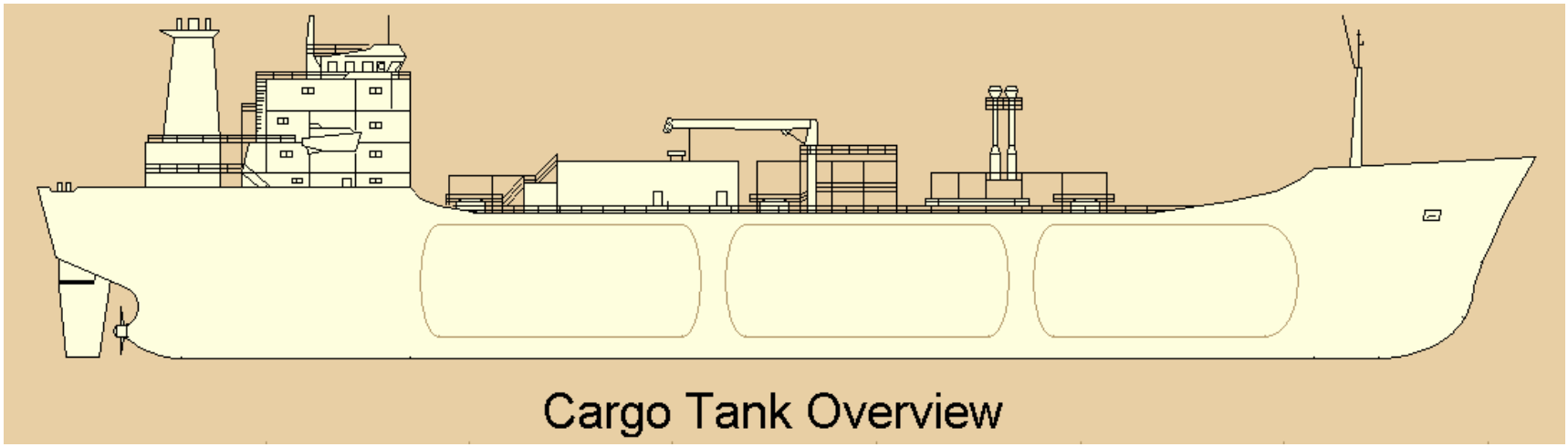


Fig. 6. Outline sketch of Ballast Tank overview of "LPG/ Ethylene Carrier"

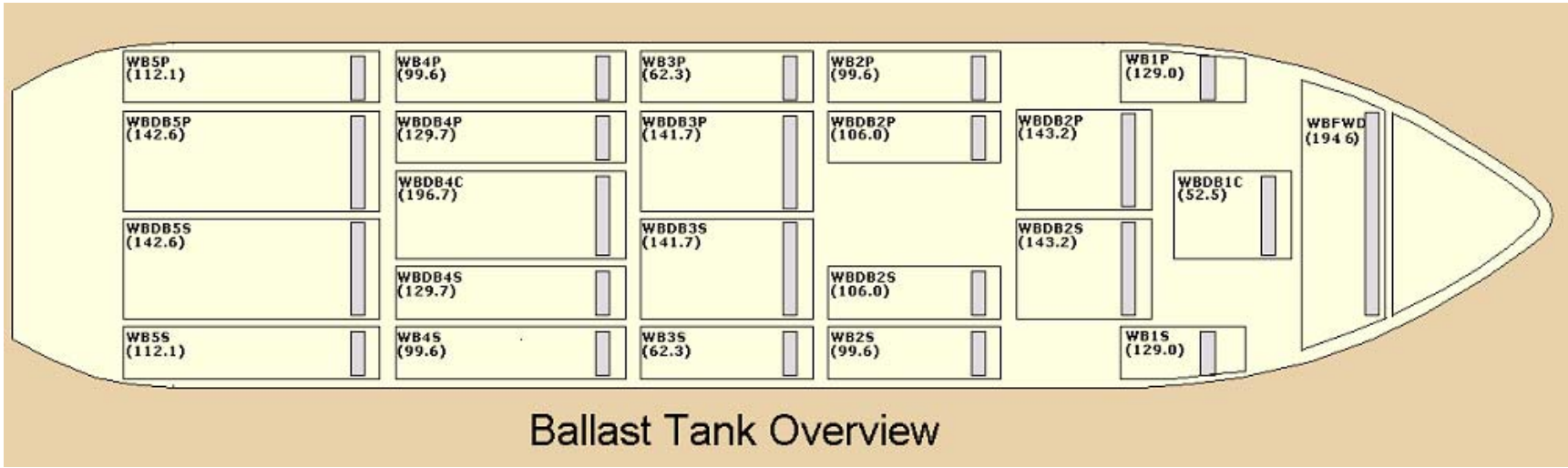


Fig.7. Outline sketch of Hold Space overview of "LPG/ Ethylene Carrier"

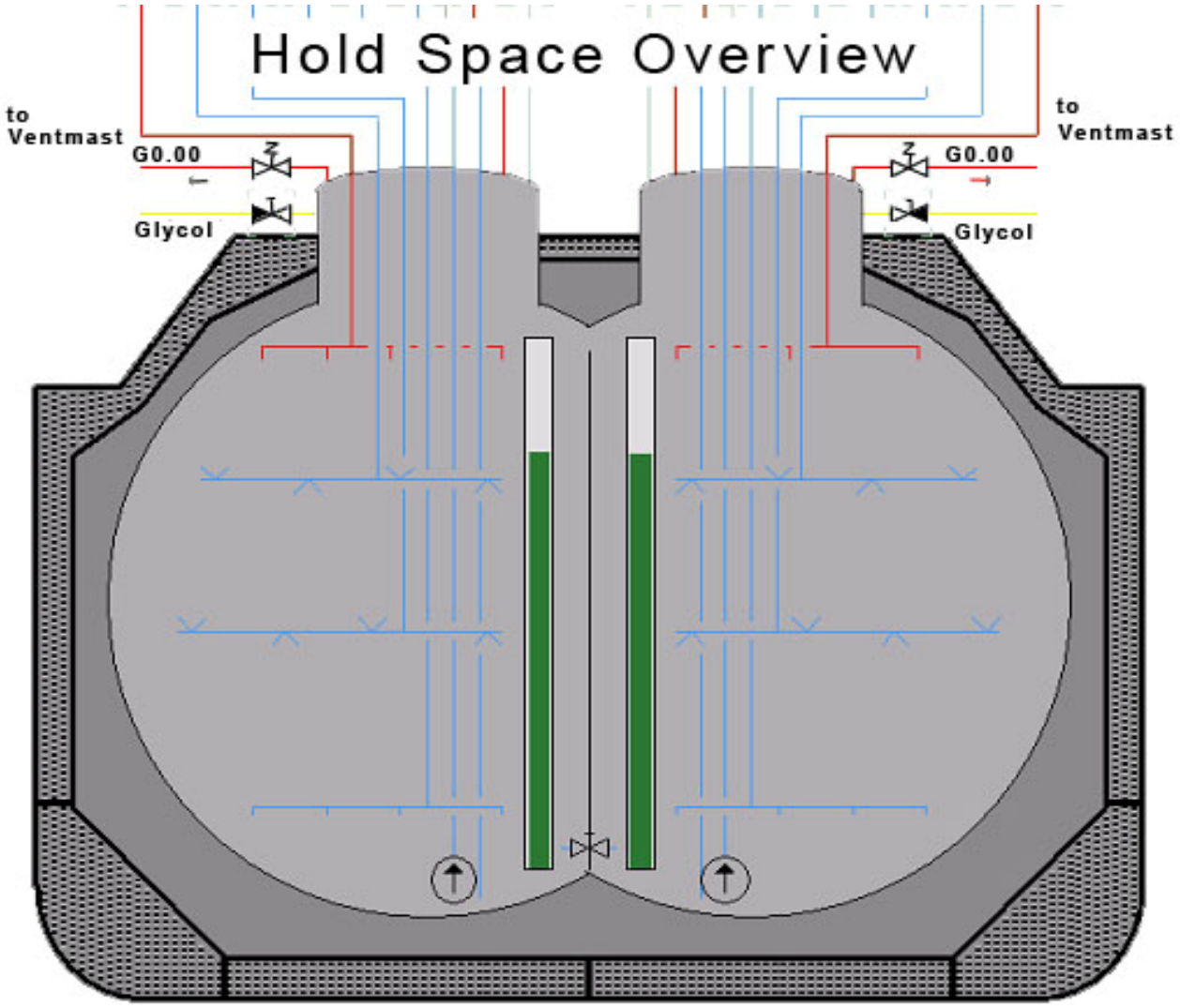


Fig. 8. Outline sketch of Inert Gas Plant of "LPG/ Ethylene Carrier"

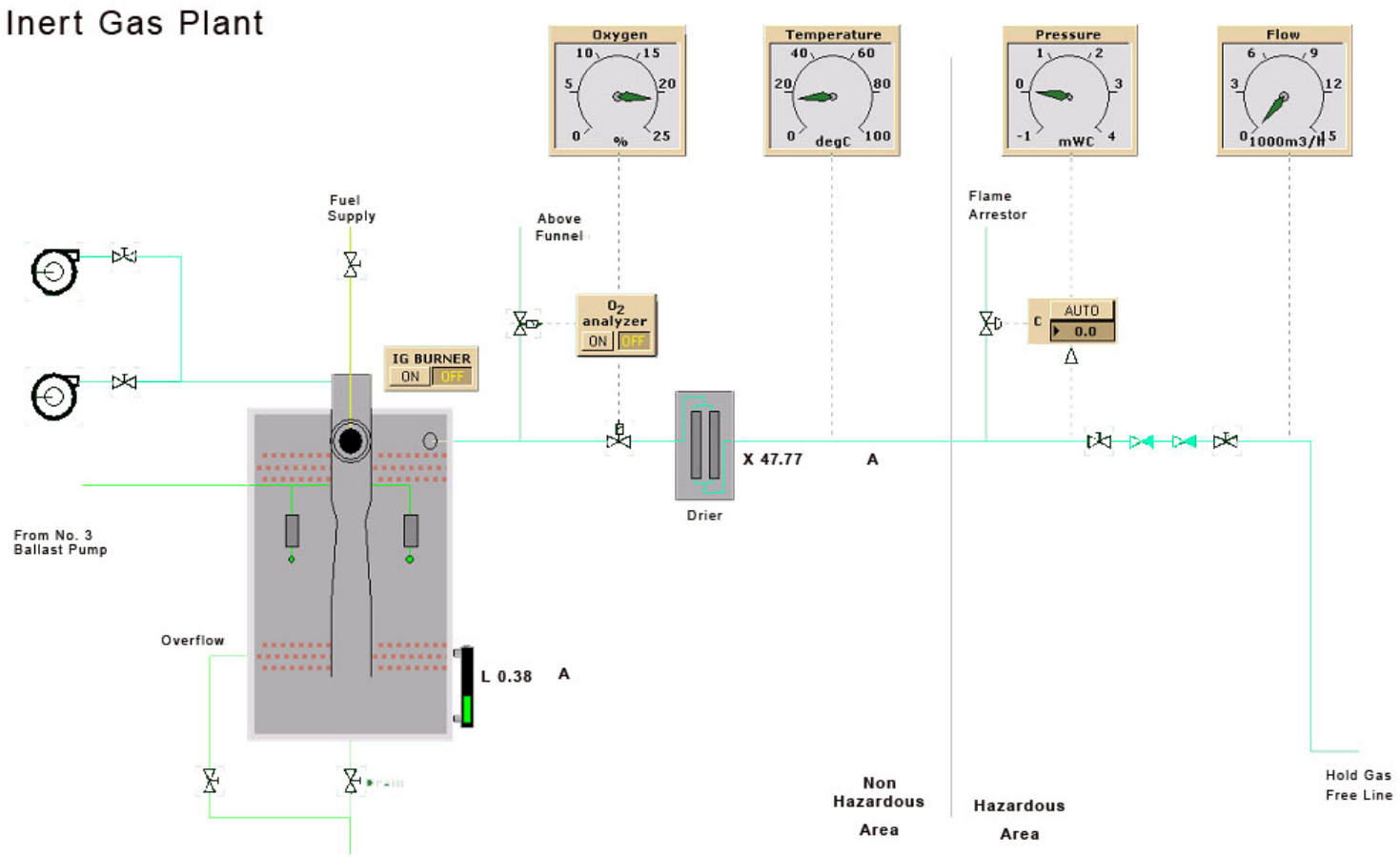


Fig. 9. Layout of typical Liquefied Gas Tanker

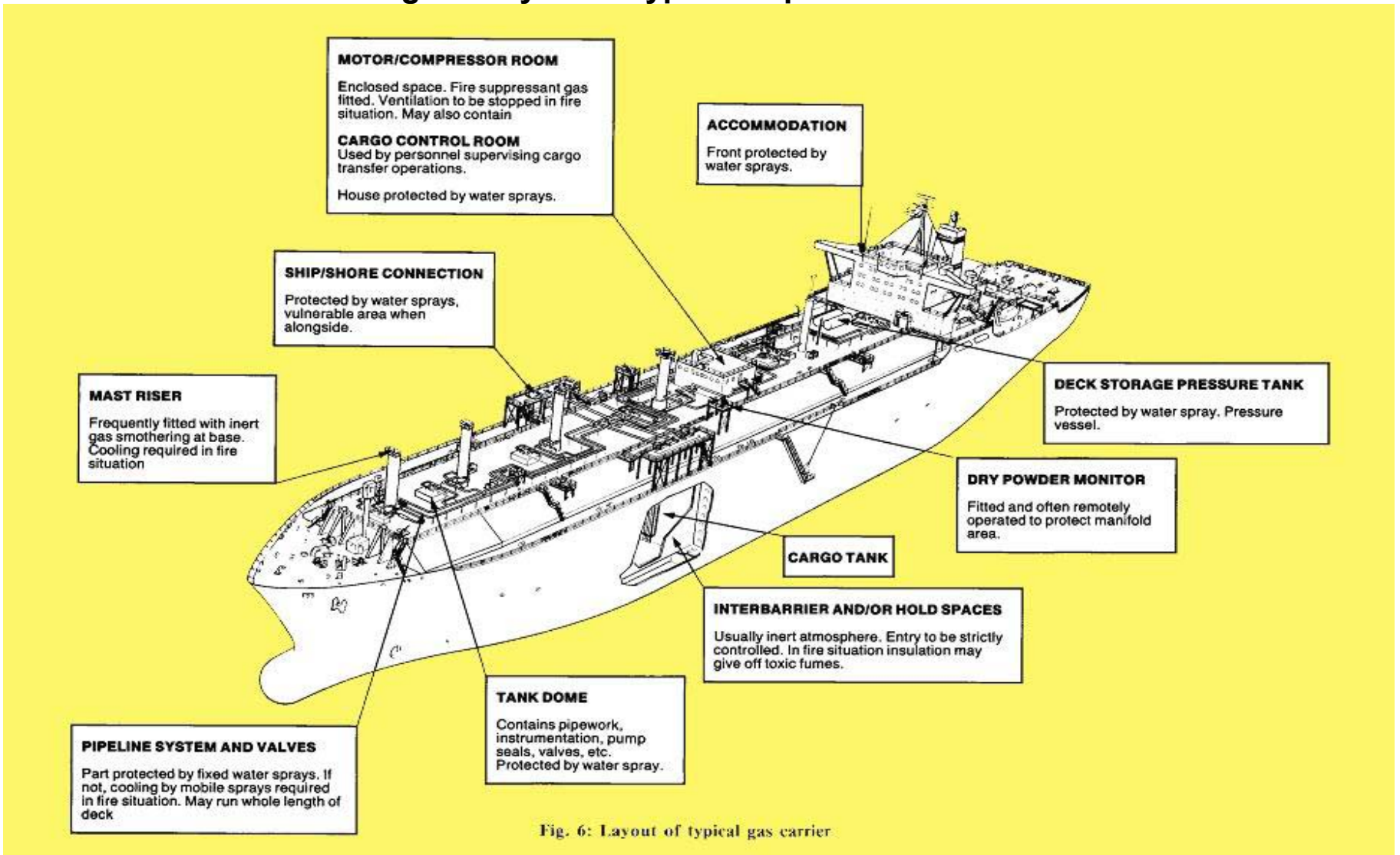


Fig. 6: Layout of typical gas carrier

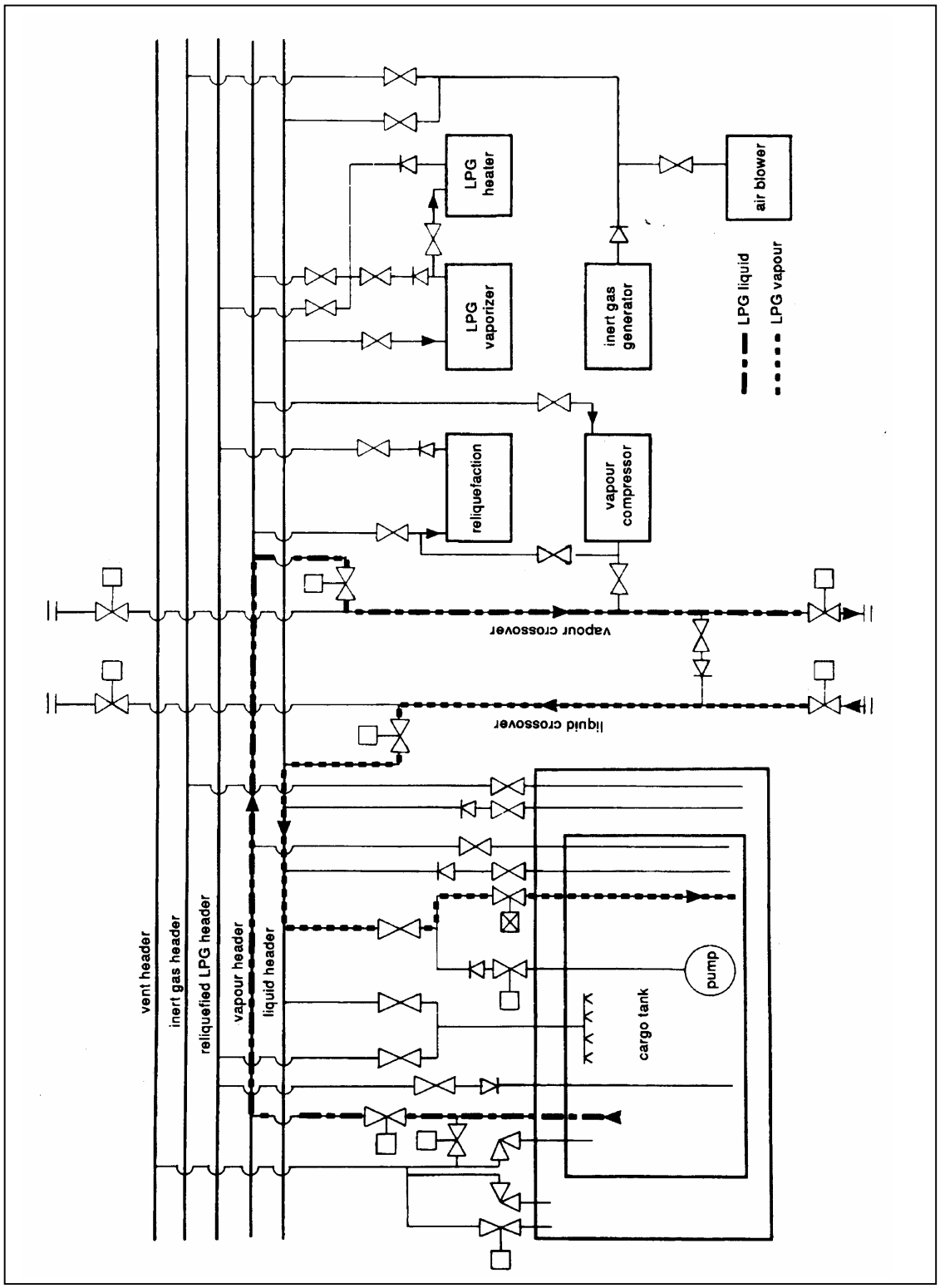


Fig 10: Purging of a cargo tank, using vapour from shore

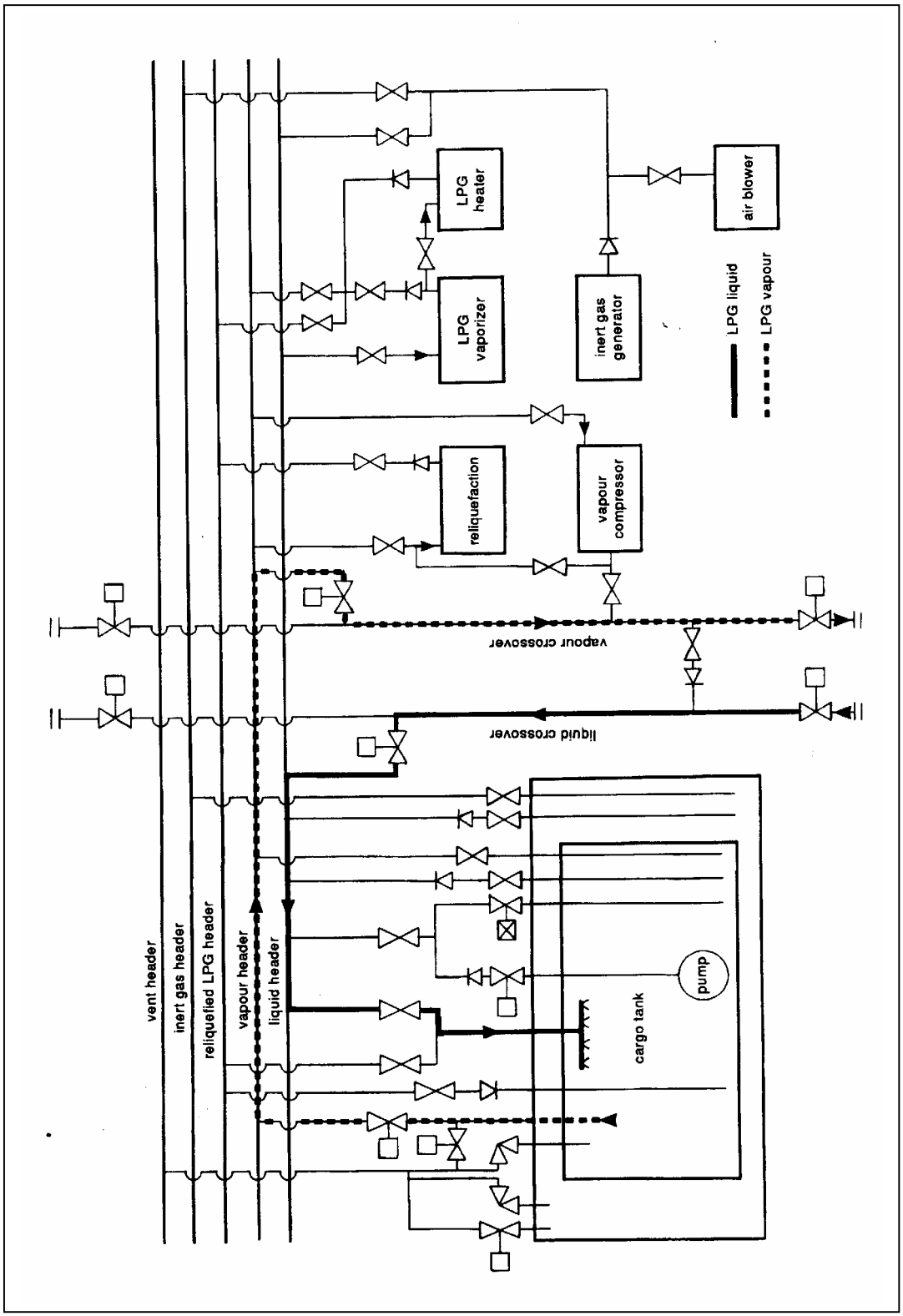


Fig 11: Cooling down of a cargo tank, using liquid from shore and vapour return

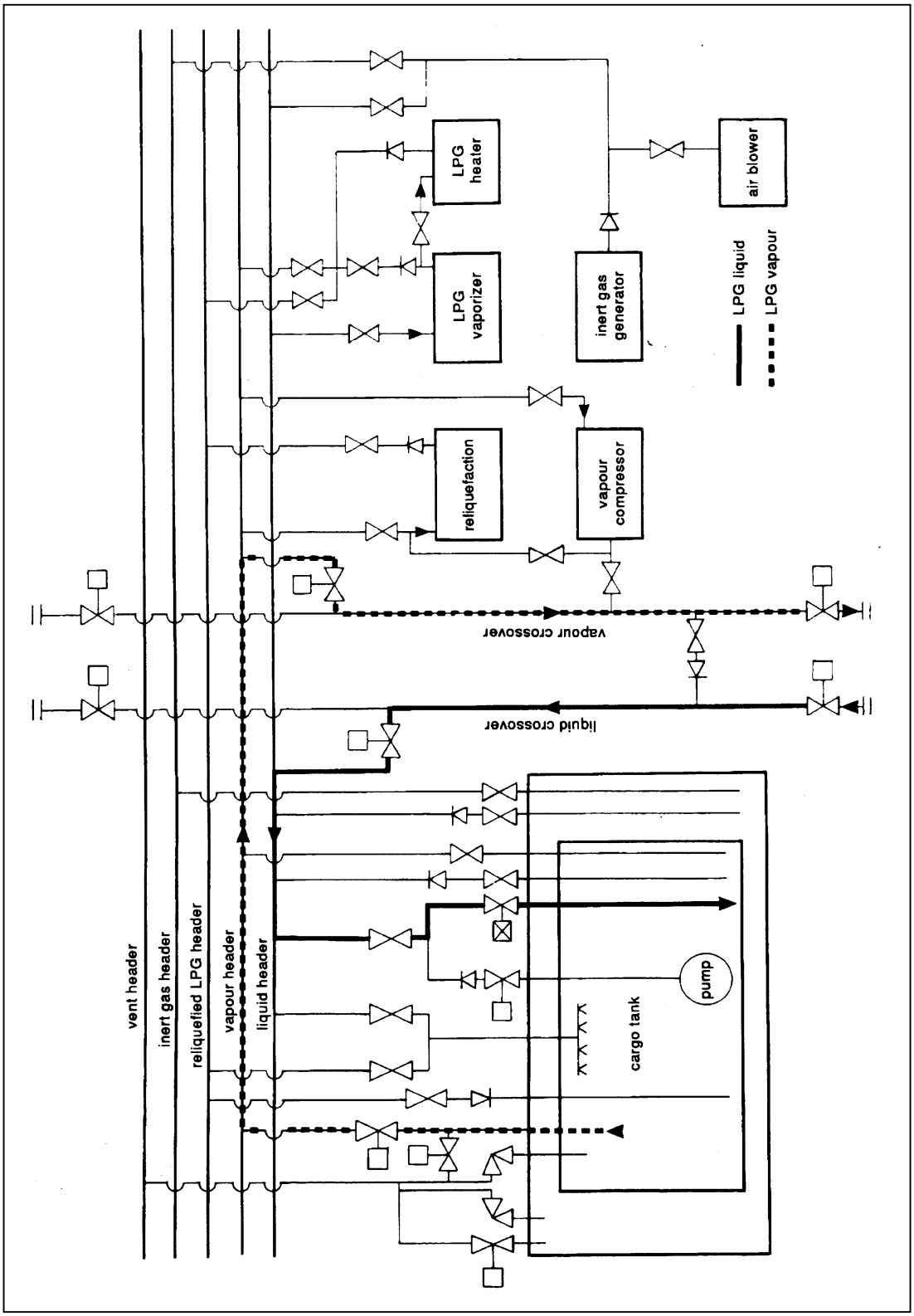


Fig 12: Loading, with vapour return

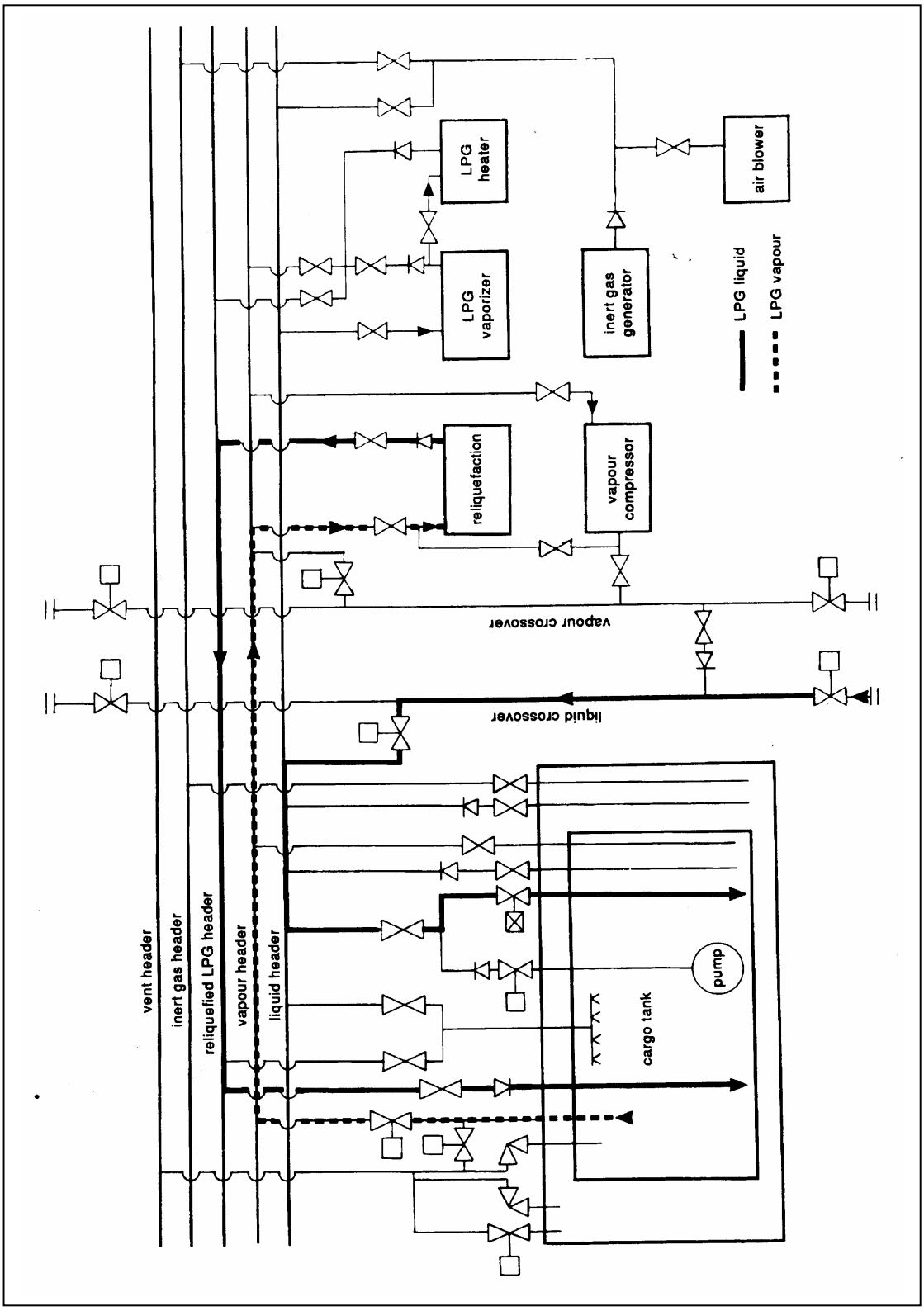


Fig 13: Purging of a cargo tank, using vapour from shore

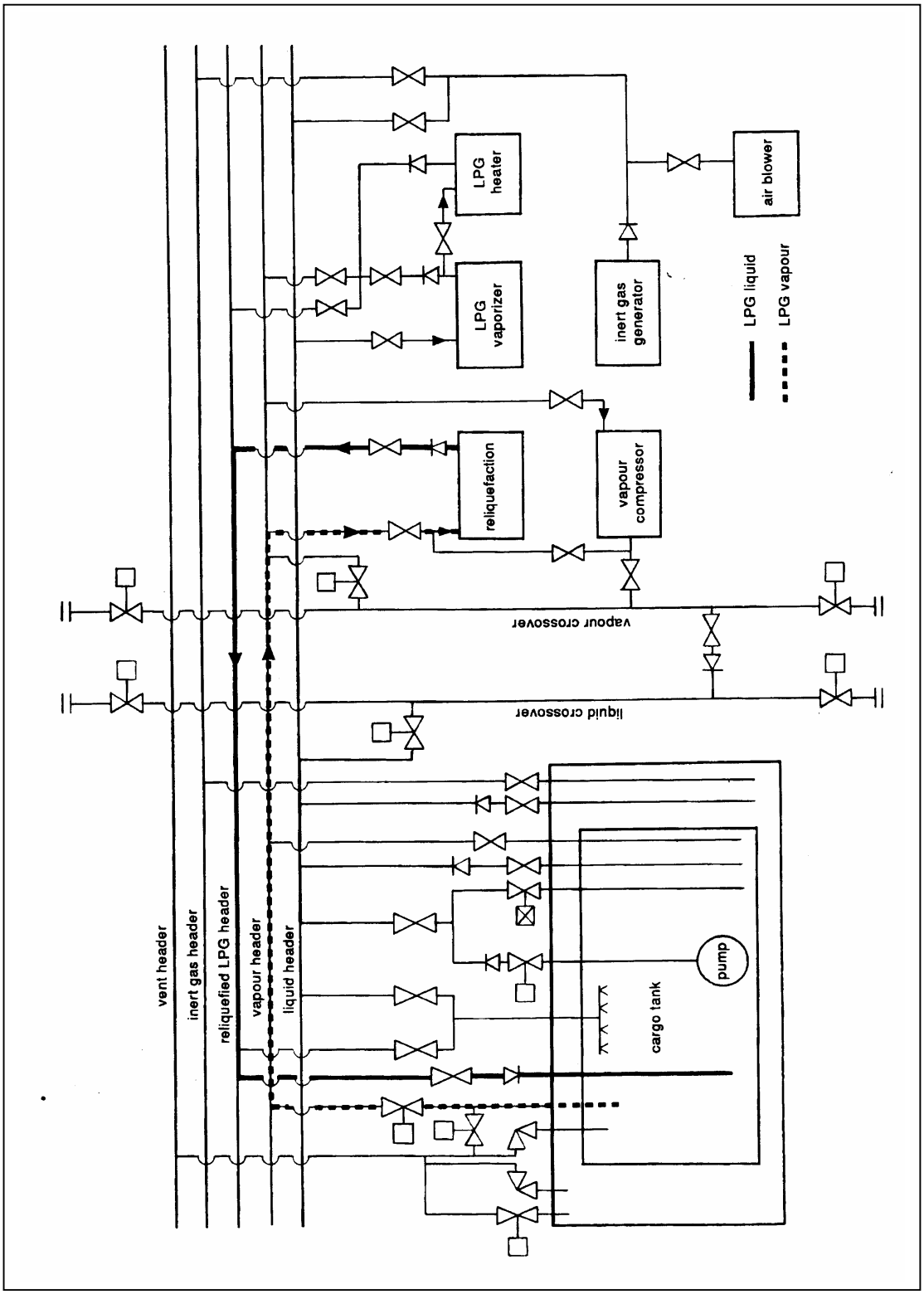


Fig 14: Cooling down of tanks during loaded passage

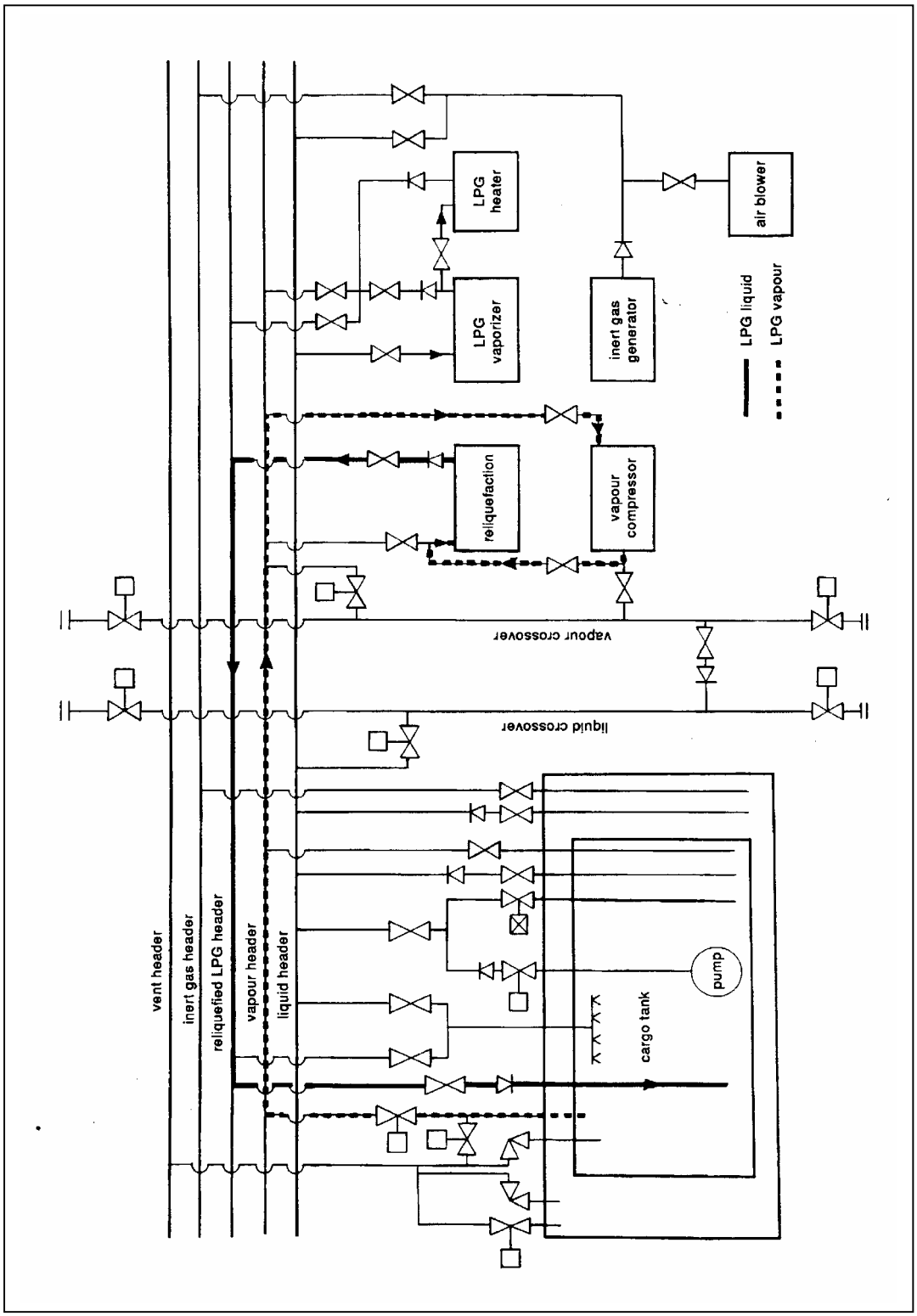


Fig 15: Cargo conditioning during loaded passage

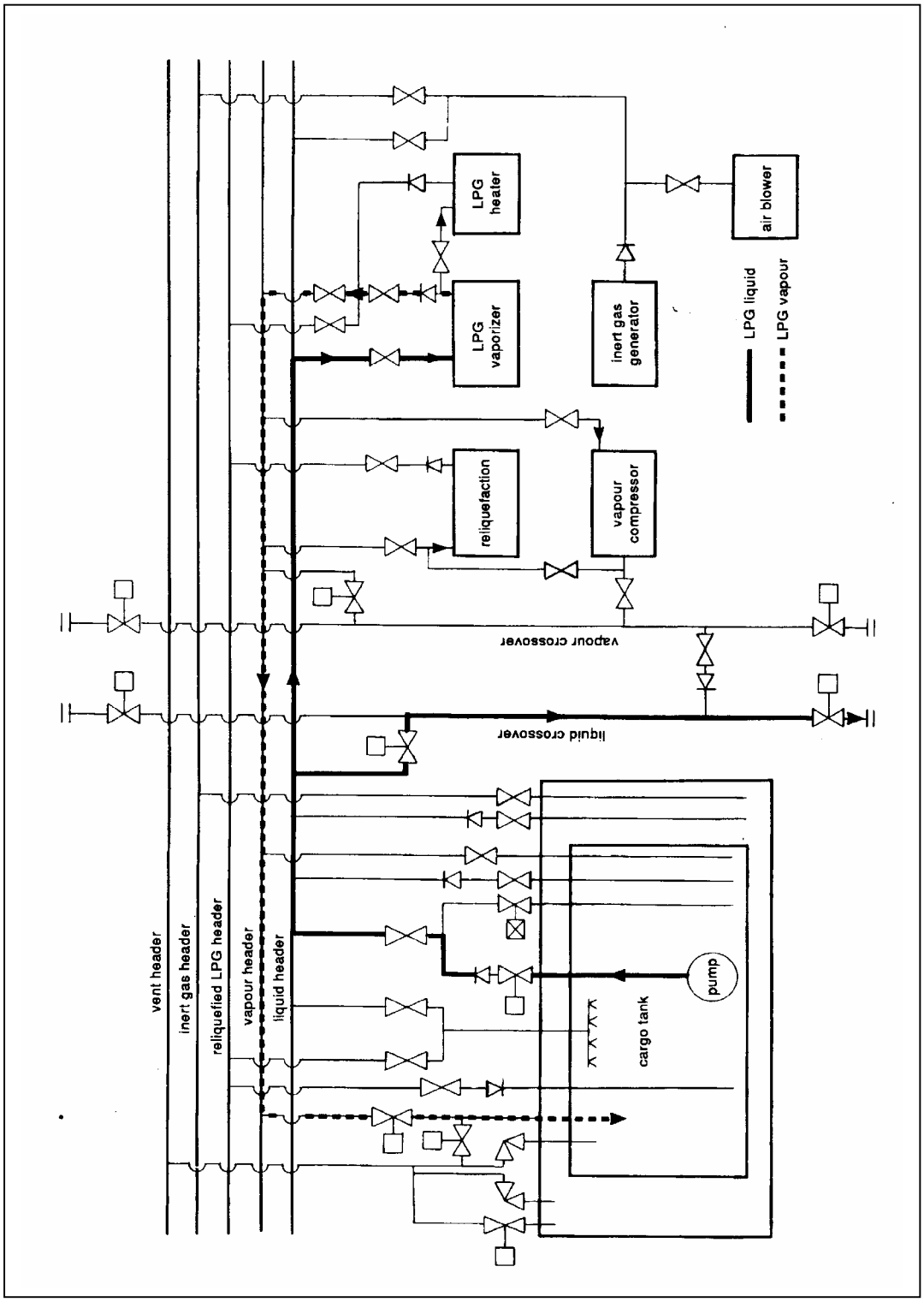


Fig 16: Cargo discharging, without vapour return

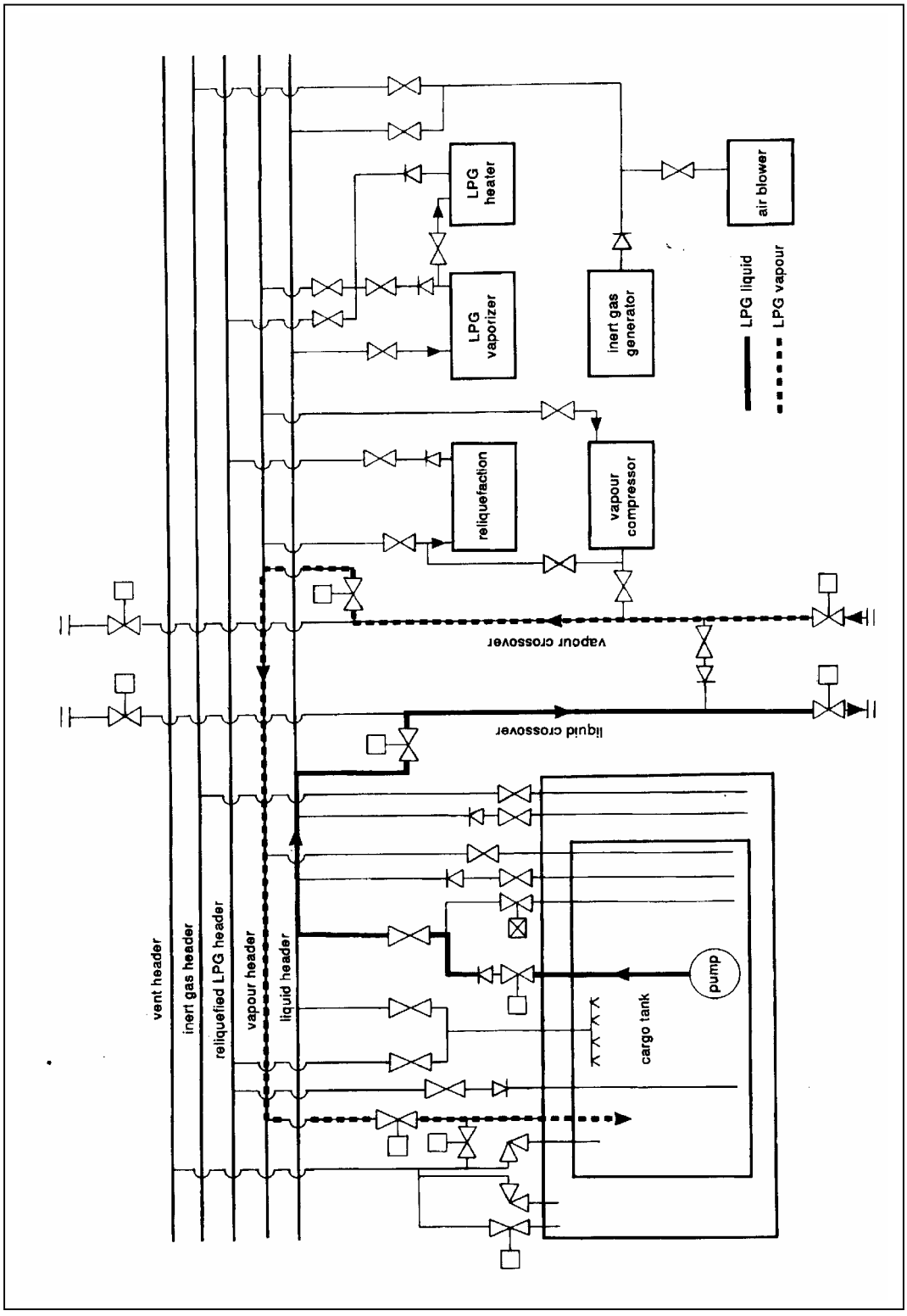


Fig 17: Cargo discharging, with vapour return

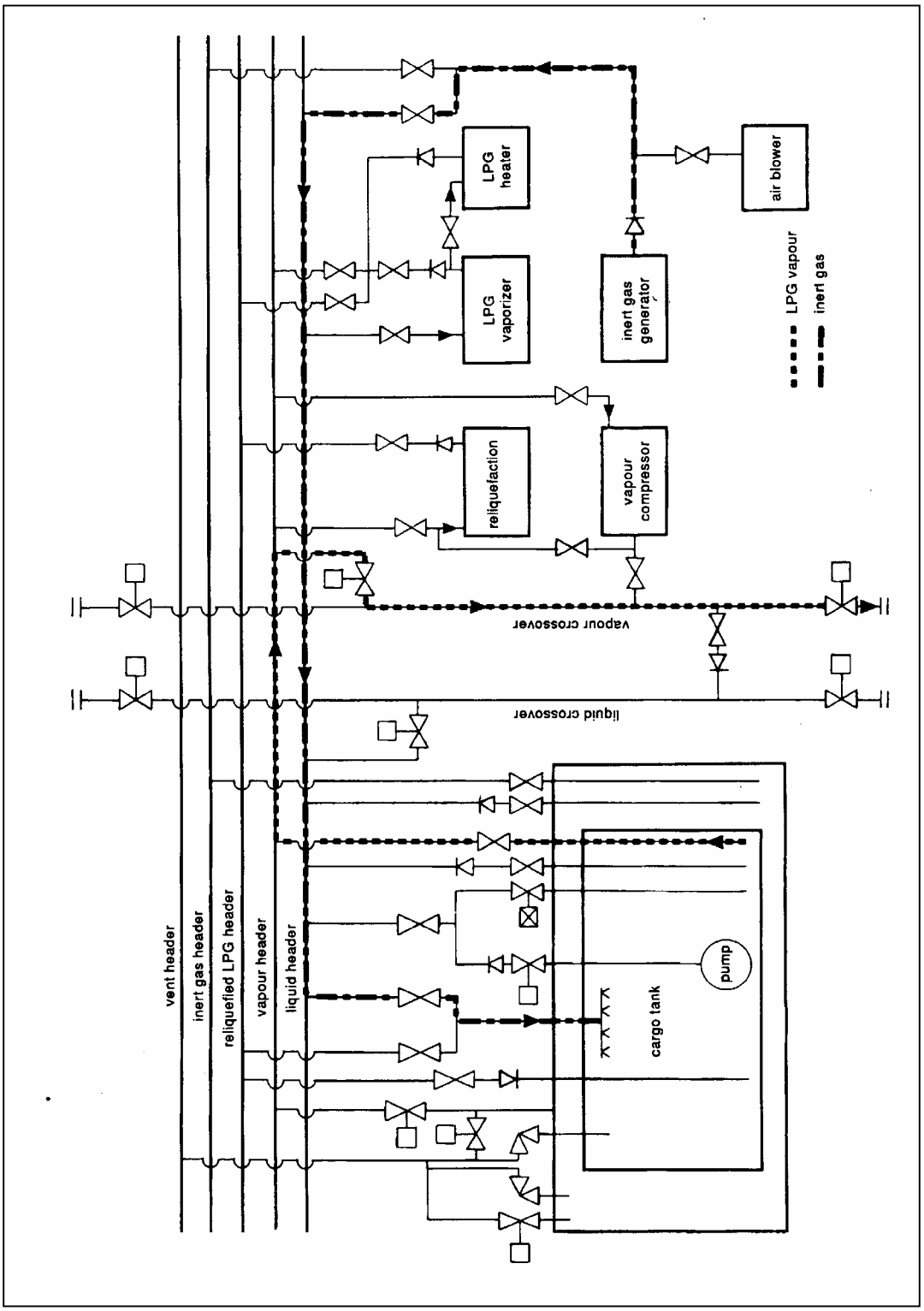


Fig 18: Inerting of a cargo tank

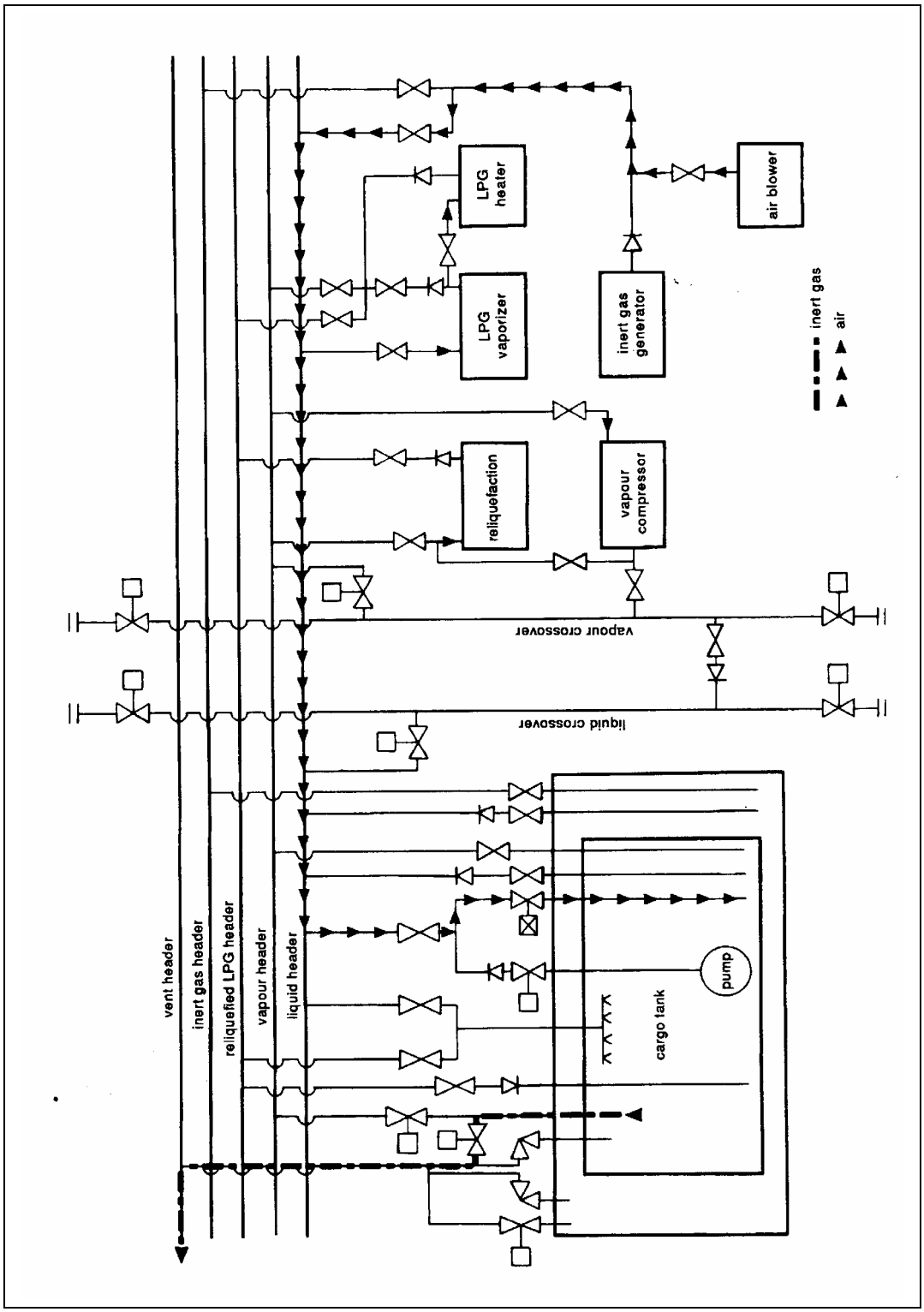


Fig 19: Aerating (venting) of a cargo tank

SAMPLE CARGO CALCULATION SHEET

VESSELS NAME: _____ PORT: _____ BERTH: _____

LOADING/UNLOADING

DRAFT FWD/AFT: _____/____ Meters; TRIM: _____ Meters; Mol. Wt: _____

LIST: _____ Deg PORT/ STBD GRADE (NAME OF CARGO) :_____

A) SOUNDING (OBSERVED) mm	
B) TRIM CORRECTION (FROM TRIM CORRECTION TABLE) mm	
C) LIST CORRECTION (FROM LIST CORRECTION TABLE) mm	
D) CORRECTED SOUNDING (D= A +/- B +/- C) mm	
E) LIQUID TEMPERATURE (MEAN OF BOTTOM OR (MIDDLE + BOTTOM)) ^{O}C	
F) VAPOUR TEMPERATURE (MEAN OF TOP OR (TOP+ MIDDLE)) ^{O}C	
G) TANK PRESSURE (FROM TOP) Bar. gauge	
H) FULL TANK VOULUME (FROM TANK PARTICULARS) m^3	
I) LIQUID VOLUME (CORRESPONDING TO CORRECTED SOUNDING FROM TANK CALIBRATION TABLE AT AMBIENT TEMPERATURE AND PRESSURE) m^3	
J) SHRINKAGE FACTOR (CORRESPONDING TO THE MEAN LIQUID TEMPERATURE)	
K) CORRECTED LIQUID VOLUME (CONVERTED TO TANK TEMPERATURE AND PRESSURE) m^3	
L) VOLUME REDUCTION FACTOR (Table 54 B OF ASTM, CORRESPONDING WITH OBSERVED TEMPERATURE OF LIQUID AND DENSITY AT 15^{o}C)	
M) VOULME AT 15^{o}C (K x L) m^3	
N) DENSITY AT 15^{o}C (OBTAINED FROM TERMINAL AUTHORITY) tons/ m^3	
O) LIQUID MASS (VOULME x DENSITY AT 15^{o}C) tons	
P) VAPOUR VOLUME (FULL TANK VOULME – LIQUID VOLUME) m^3	
Q) SHRINKAGE FACTOR (CORRESPONDING TO THE MEAN VAPOUR TEMP.)	
R) CORRECTED VAPOUR VOLUME (CONVERTED TO TANK TEMPERATURE AND PRESSURE) m^3	
S) VAPOUR VOULME AT 0^{O}C, 1 atm (1.013 BAR ABSOLUTE PRESSURE BY USING GAS LAW P1V1/T1 = P2V2/T2) m^3	
T) DENSITY OF VAPOUR (MOL. Wt /22414) tons/ m^3	
U) MASS OF VAPOUR (U= S x T) tons	
V) TOTAL MASS IN VACCUM (LIQUID + VAPOUR) (O+ U) tons	
W) TOTAL WEIGHT IN AIR V((N -.0011)/N) tons	

NOTE: Table 54B of petroleum Measurement Tables is only applicable to saturated hydrocarbons e.g. Propane and Butane.

GUIDELINES FOR COMPLETING THE SHIP/SHORE

SAFETY CHECK LIST

PART C - Bulk Liquefied Gases

1. Is information available giving the necessary data for the safe handling of the cargo including, where applicable, a manufacturer's inhibition certificate?
2. Is the water spray system ready for use?
3. Is sufficient suitable protective equipment (including self-contained breathing apparatus) and protective clothing ready for immediate use?
4. Are holds and inter-barrier spaces properly inerted or filled with dry air as required?
5. Are all remote control valves in working order?
6. Are the required cargo pumps and compressors in good order, and have maximum working pressures been agreed between ship and shore?
7. Is reliquefaction or boil off control equipment in good order?
8. Is the gas detection equipment properly set for the cargo, calibrated and in good order?
9. Are cargo system gauges and alarms correctly set and in good order?
10. Are emergency shutdown systems working properly?
11. Does the shore know the closing rate of ship's automatic valves; does the ship have similar details of shore system?
12. Has information been exchanged between ship and shore on the maximum/ minimum temperatures/pressures of the cargo to be handled?
13. Are cargo tanks protected against inadvertent overfilling at all times while any cargo operations .are in progress?
14. Is the compressor room properly ventilated, the electrical motor room properly pressurised and the alarm system working?
15. Are cargo tank relief valves set correctly and actual relief valve settings clearly and visibly displayed?

Part E: Evaluation

1 Introduction

The effectiveness of any evaluation depends on the accuracy of the description of what Is to be measured.

The learning objectives that are used in the detailed teaching syllabus will provide a sound base for the construction of suitable tests for evaluating trainee progress.

2 Method of evaluation

The methods chosen to carry out an evaluation will depend upon what the trainee is expected to achieve in terms of knowing, comprehending and applying the course content.

The methods used can range from a simple question-and-answer discussion with the trainees (either individually or as a group) to prepared tests requiring the selection of correct or best responses from given alternatives, the correct matching of given Items, the supply of short answers or the supply of more extensive written responses to prepared questions.

Where the course content is aimed at the acquisition of practical skills, the test would involve a practical demonstration by the trainee making use of appropriate equipment, tools, etc.

The responses demanded may therefore consist of:

- the recall of facts or information, by viva-voce or objective tests
- the practical demonstration of an attained skill
- the oral or written description of procedures or activities
- the identification and use of data from sketches, drawings, maps, charts, etc.

- carrying out calculations to solve numerical problems
- the writing of an exercise log.

3 Validity

The evaluation must be based on clearly defined objectives, and it must truly represent what is to be measured. There must be a reasonable balance between the subject topics involved and also in the testing of trainees' KNOWLEDGE, COMPREHENSION and APPLICATION of concepts.

The time allocated for the trainee to provide a response is very important. Each question or task must be properly tested and validated before It is used to ensure that the test will provide a fair and valid evaluation.

4 Reliability

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

5 Subjective testing

Traditional methods of evaluation require the trainee to demonstrate what has been learned by stating or writing formal answers to questions.

Such evaluation is subjective In that It invariably depends upon the judgement of the evaluator. Different evaluators can produce quite different scores when marking the same paper or evaluating oral answers.

6 Objective testing

A variety of objective tests have been developed over the years. Their common feature Is that the evaluation does not require a judgement by the evaluator. The response is either right or wrong.

One type of objective test involves supplying an answer, generally a single word, to complete the missing portion of a sentence. Another involves supplying a short answer of two or three words to a question. Such tests are known as ‘completion tests’ and ‘short answer tests’.

Another form of objective testing consists of ‘selective response tests’ in which the correct, or best, response must be selected from given alternatives. Such tests may consist of ‘matching tests’, in which items contained in two separate lists must be matched, or they may be of the true/false type or of the multiple-choice type.

The most flexible form of objective test is the multiple-choice test, which presents the trainee with a problem and a list of alternative solutions, from which he must select the most appropriate.

Action on a simulator can be recorded and objectively analysed during a replay or debrief using log printouts.

7 Distracters

The incorrect alternatives in multiple-choice questions are called ‘distracters’, because their purpose is to distract the uninformed trainee from the correct response. The distracter must be realistic and should be based on misconceptions commonly held, or on mistakes commonly made.

The options “none of the above” or “all of the above” are used in some tests. These can be helpful, but should be used sparingly.

Distracters should distract the uninformed, but they should not take the form of ‘trick’ questions that could misleed the knowledgeable trainee (for example, do not insert “not” into a correct response to make It a dlstracter).

8 Guess factor

The ‘guess factor’ with four alternative responses in a multiple-choice test would be 25%. The pass mark chosen for all selective-response questions should take this into account.

9 Scoring

In simple scoring of objective tests one mark may be allotted to each correct response and zero for a wrong or nil response.

A more sophisticated scoring technique entails awarding one mark for a correct response, zero for a nil response and minus one for an incorrect response. Where a multiple-choice test Involves four alternatives, this means that a totally uninformed guess involves a 25% chance of gaining one mark and a 75% chance of losing one mark.

Scores can be weighted to reflect the relative Importance of questions, or of sections of an evaluation.

Information Requested of Instructors Who Implement IMO Model Courses

Introduction

1. IMO model courses are periodically revised to take into account the changes which have taken place in relevant Conventions, resolutions and other matters affecting each course. To help IMO to improve the content of courses when they are revised, the assistance of all instructors who implement or participate in implementing courses is requested, whether the implementation Is part of an IMO technical co-operation project or part of a Maritime Training Academy’s regular programme.

Information requested and its format

2. To simplify their consolidation by IMO, the technical comments and suggestions for the Improvement of model courses should follow the format that Is outlined below. If no comments or suggestions are to be provided under a topic, please Insert “no comment’ against the Item.

3. Please identify:
   .1 the course number and title;
   .2 the date and location of its implementation;
   .3 the approximate number of IMO model courses you have implemented to date; and
   .4 the approximate number of times you have Implemented this particular model course.

4. In commenting on Part A — Course Framework, please comment on the Items (‘Scope’, ‘Objectives’, etc.) in the order In which they appear In the course; In all cases, please Indicate:

   1. the number of participants who met the entry standards and the number who did not;
   2. the course intake and, if the recommendations In ‘Course Intake limitations’ were exceeded, the reasons for this and your observations on the effect of this on the qualify of the course;
   3. If the conditions under ‘Staff requirements’ were met; If not, please Indicate the nature of the deficiency and give your observations of the effect of this on the quality of presentation of the course; and -
   4. any lack of equipment or facilities as compared with the recommendations under ‘Teaching facilities and equipment’ and your observations of the effect of this lack on the quality of presentation of the course.

5. In commenting on Part B — Course Outline, please bear in mind that minor variations In time allocations are Inevitable. Major difficulties with allocations of time and any omissions or redundancies of subject areas should be briefly explained.

6. In commenting on Part C — Detailed Teaching Syllabus, please identify the specific learning objectives concerned by their paragraph numbers.

7. In commenting on Part D — Instructor's Manual, please clearly identify the section concerned. If the bibliography or the practical exercises are found to be unsatisfactory, please

   Identify suitable alternative texts, as far as is possible, or outline alternative exercises, as appropriate.

8. Any further comments or suggestions you may have which fall outside the scope of the items listed above may be added at the end. In particular, your views on the usefulness of the course material to you in implementing the course would be appreciated, as would the contribution to IMO of any additional teaching material you found useful in implementing it.

Please address your comments to:

Maritime Safety Division
International Maritime Organization
4 Albert Embankment
London SE1 7SR
U.K.
Telefax (+) 44 171 587 3210

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