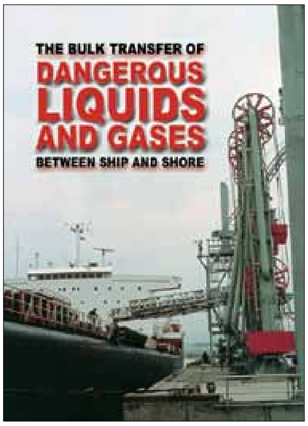
The bulk transfer of dangerous liquids and gases between ship and shore



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It sets out practical measures on the design, construction, operation and maintenance of the equipment, pipelines, jetties, etc, used in the bulk transfer. These measures are designed to protect people at work (including shore staff and ships' crews) and others who may be affected by the operations.

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This guidance is issued by the Health and Safety Executive. Following the guidance is not compulsory and you are free to take other action. But if you do follow the guidance you will normally be doing enough to comply with the law. Health and safety inspectors seek to secure compliance with the law and may refer to this guidance as illustrating good practice.

Contents

Preface

This book provides information on the fire, explosion, toxic and environmental hazards associated with the bulk transfer of dangerous liquids and gases between ship and shore.

It sets out practical measures on the design, construction, operation and maintenance of the equipment, pipelines, jetties, etc, used in the bulk transfer. These measures are designed to protect people at work (including shore staff and ships' crews) and others who may be affected by the operations.

The guidance is aimed at those directly responsible for the safe transfer of dangerous liquids and gases between ship and shore. Those responsible include the harbour or port authority, and the owners, operators or users of the berth.

It applies to all berths used by seagoing ships and to those used by inland waterway traffic.

The book replaces the previous HSE guidance note *The loading and unloading of bulk flammable liquids and gases at harbours and inland waterways*, first published in 1986.

While references to British or other standards made in this book, including codes of practice, specify their year of issue, it is recognised that they are regularly updated and many are harmonised into a common European Standard. Invariably, any such replacement standards or codes may be used in place of those quoted.

Introduction

General

1 This book provides guidance on the control measures for the safe transfer of dangerous liquids and gases between ship and shore. It describes how to control the risk of fire and explosion, and the risk of toxic releases affecting both people and the environment.

2 The objectives of the book are to:

- help in the assessment of the risks from the transfer of dangerous liquids and gases between ship and shore, and advise on how to control these risks;
- increase the awareness of the potential fire, explosion, toxic and environmental hazards associated with the transfer of dangerous liquids and gases between ship and shore;
- advise on safe management procedures and appropriate precautions to prevent or reduce injuries and damage caused to property or the environment associated with the transfer of dangerous liquids and gases between ship and shore;
- give guidance on the appropriate standards for the design and construction of berths, pipelines and associated equipment used for the transfer operations;
- advise on the need for maintenance, training and information where dangerous liquids and gases are transferred between ship and shore.

3 It is aimed at all those directly responsible for the transfer operations. In this context, where the text mentions 'you', it means the operator or company engaged in the transfer.

4 The guidance applies to all transfer operations at berths used by seagoing ships and those used by inland waterways traffic. It applies to new berths, and to existing berths if it is reasonably practicable to apply it.

Legal requirements

5 The book will help you in your assessment of the risks arising from the transfer of dangerous liquids and gases between ship and shore, and it gives advice on how you may control the risks.

6 Assessment by employers, of the risks to employees and others who may be affected by the work activities, is one of the requirements of the Management of Health and Safety at Work Regulations 1992.[1] These Regulations have recently been amended by the Fire Precautions (Workplace) Regulations 1997[2] which require an employer to carry out an assessment of the risk to employees in case of fire while they are at work.

7 This book also advises you on how to comply with the relevant parts of the Health and Safety at Work etc Act 1974[3] and, where applicable, with the Highly Flammable Liquids and Liquefied Petroleum Gases Regulations 1972,[4] the Docks Regulations 1988,[5] the Dangerous Substances in Harbour Areas Regulations 1987[6] and other relevant legislation (see Appendix 1).

8 Current legislation, guidance literature, and the standards and codes of practice referred to in the text are listed in the reference section. They are subject to amendment from time to time. You need to ensure that these standards, at the time any work or alterations are carried out, reflect the current legal requirements and good accepted practice.

What is risk assessment?

9 A risk assessment is an organised look at your work activities using the following five steps:

Step 1: Look for the hazards.
Step 2: Decide who may be harmed and how.
Step 3: Evaluate the risks arising from the hazards and decide whether existing precautions are adequate or if more should be done.
Step 4: Record your significant findings.
Step 5: Review your assessment from time to time and revise it if necessary.

Advice on carrying out risk assessments is contained in an HSE leaflet.[7]

10 The remaining sections of the book will help you to identify many of the hazards associated with the transfer of dangerous liquids and gases between ship and shore, and it gives guidance on how to both assess and reduce the risks.

11 The guidance describes many of the issues you should consider when carrying out your risk assessments. It will help in deciding which precautions are needed concerning the transfer of dangerous liquids and gases between ship and shore. A complete risk assessment made under the Management of Health and Safety at Work Regulations 1992[1] also has to consider other hazards, for example manual handling and transport safety, which are not within the scope of this book.

12 For the majority of installations handling bulk dangerous liquids and gases, there are five main events which individually or jointly have the potential to cause significant harm or damage:

- fire;
- explosion;
- release of a toxic substance;
- release of a corrosive substance;
- release of a marine pollutant.

Your risk assessment needs to consider how the above events could occur. Examples include:

Fire	-	ignition following a spill or release;
	-	arson;
	-	hazardous activities - welding, smoking, etc;
	-	external events - lightning, impact, fire at an adjacent location.
Explosion	-	fire;
	-	ignition following a spill or release.
Large spills	-	containment failure;
	-	impact;
	-	human error.

13 The precautions needed not only include engineering design and installation standards, but also good management practices and operational procedures. The remainder of this book considers the various precautionary measures that can help to ensure safety during the transfer of dangerous liquids and gases between ship and shore.

14 You do not have to do anything if the risks are already low enough. However, if there is a significant risk that people may be harmed from an incident, you may have to consider additional measures.

15 If the CIMAH Regulations[8] apply at your installation, then your risk assessment needs to be very detailed, covering off-site risks to people and the environment. HSE has issued guidance[9] on these Regulations, and in particular on what information should be included in a safety report under regulation 7(1). The CIMAH Regulations will be replaced in early 1999 by the Control of Major Accident Hazards Regulations (COMAH). The COMAH Regulations will have much in common with the CIMAH Regulations.

16 Essentially you need to identify the pathways to those events which could lead to a major accident. The safeguards in place to minimise the likelihood and the consequences of a major accident need to be of a high standard.

Definitions

17 Certain terms in this guidance have a specific meaning or legal interpretation. These are explained in the following paragraphs. The glossary at the end of the book explains some of the other terms used.

Dangerous substance

18 In this guidance, a dangerous substance is any liquid or gas that is classified as flammable, toxic (poisonous), corrosive or marine pollutant in the International Maritime Dangerous Goods (IMDG) Code.[10] You should note that the Dangerous Substances in Harbour Areas Regulations 1987[6] do not apply to marine pollutants unless they are also hazardous to health or safety.

Flammable liquid

19 In this guidance, flammable liquid means a liquid of Class 3 stated in the International Code for the Construction and Equipment of Ships Carrying Dangerous Chemicals in Bulk (IBC Code)[11] and the Code for the Construction and Equipment of Ships Carrying Dangerous Chemicals in Bulk (BCH Code).[12]

20 This definition includes:

- any liquid classified as flammable, highly flammable or extremely flammable for supply according to the Chemicals (Hazard Information and Packaging for Supply) Regulations 1994;[13] and
- a highly flammable liquid as defined in the Highly Flammable Liquids and Liquefied Petroleum Gases Regulations 1972.[4]

21 Any liquid with a flashpoint above 60.5°C (as measured by an equilibrium closed-cup method) is therefore not covered in this book.

Flammable gas

22 In this guidance, flammable gas means a gas of Class 2 in the International Code for the Construction and Equipment of Ships Carrying Liquefied Gases in Bulk (IGC Code),[14] the Code for the Construction and Equipment of Ships Carrying Liquefied Gases in Bulk[15] and the Code for Existing Ships Carrying Liquefied Gases in Bulk.[16]

Bulk cargo

23 The definition of bulk cargo in this book means cargo which is carried in the ship's hold, tank or any cargo space that is a structural part of the ship, or permanently attached to the ship. The definition also extends to cargo which is loaded into or unloaded from such areas.

24 This definition therefore excludes mobile containers, freight containers, drums and cylinders, and as such, they are not covered in this book.

Berth

25 The definition of berth includes:

- that part of a dock, pier, jetty, quay/wharf or similar structure (whether floating or not) at which a ship may tie up; and
- any plant or premises within the berth's boundary, other than a ship, which is used for purposes ancillary or incidental to the loading or unloading of dangerous substances.

26 It does not, however, include a monobuoy or a sea island.

Berth operator

27 The definition of berth operator is the person or company who has day-to-day responsibility for the running of the berth. This definition includes the lessee of a berth.

Jetty

28 The definition of a jetty is a pier projecting out into the waterway, with facilities for mooring ships at its head or along its flank.

Applying the standards

29 The advice in this book provides suitable standards for the design and location of bulk transfer facilities for moving dangerous liquids and gases between ship and shore.

30 It may be inappropriate or impractical for you to adopt all the recommendations in this book to existing berths. However, you should make any improvements that are reasonably practicable, taking into account the risks at the berth and the cost and feasibility of additional precautions. Providing adequate facilities and procedures is a continuing responsibility rather than a one-off exercise. A definition of the term 'reasonably practicable' is given in the glossary.

31 The book describes a number of ways of achieving an adequate standard of safety. Further advice on how to use it at specific sites can be obtained from whoever inspects the site for health and safety, usually HSE.

Environmental protection

32 The spillage of dangerous liquids or gases can have environmental consequences and may be subject to controls under the Environmental Protection Act 1990.[17] Under this Act, the statutory harbour or port authority has a responsibility to develop plans to deal with pollution incidents.

33 Although this guidance does not attempt to cover environmental issues in detail, the advice it contains for safe transfer conditions will generally also provide some protection for the environment by minimising the risk of spillage.

34 Further guidance is available from the Environment Agency (in Scotland, the Scottish Environment Protection Agency (SEPA)) or the Marine and Coastguard Agency.

Additional advice and information

35 You can find additional advice in documents listed in the Further reading section at the end of the book.

Hazards during bulk cargo transfer

Main hazards

36 The main hazards from the transfer of dangerous bulk cargoes between ship and shore occur when there is a release of a dangerous substance. Loss of containment leads to the release of the dangerous substance with the potential consequences of fire and explosion, or toxic release to air, sea or land, resulting in damage to the health of people, property and the environment.

37 Common causes of such incidents include:

- inadequate design, installation or maintenance of installations and equipment;
- inadequate management of operations;
- operator error, due to lack of training and/or supervision;
- lack of awareness of the properties of the dangerous substance;
- arson or vandalism.

The dangerous substance can be released in a number of ways: tanks can be overfilled; hoses can burst.

Hazardous properties of dangerous substances

Flammability

38 Fires or explosions are likely to occur when flammable gases, vapours or liquids are released from a controlled environment to areas where there may be an ignition source, or, alternatively, when an ignition source is introduced into the controlled environment.

39 Combustion occurs when the gas, or the flammable vapours released from the surface of the liquid, ignite. The extent of any fire or explosion hazard (see Figure 1) depends on the amount of flammable vapour or gas present. This is determined by:

- the temperature of the liquid;
- the volatility of the liquid;
- how much of the surface area is exposed;
- how long the liquid is exposed;
- the initial pressure of a gas release;
- the size of the release; and
- the air movement.

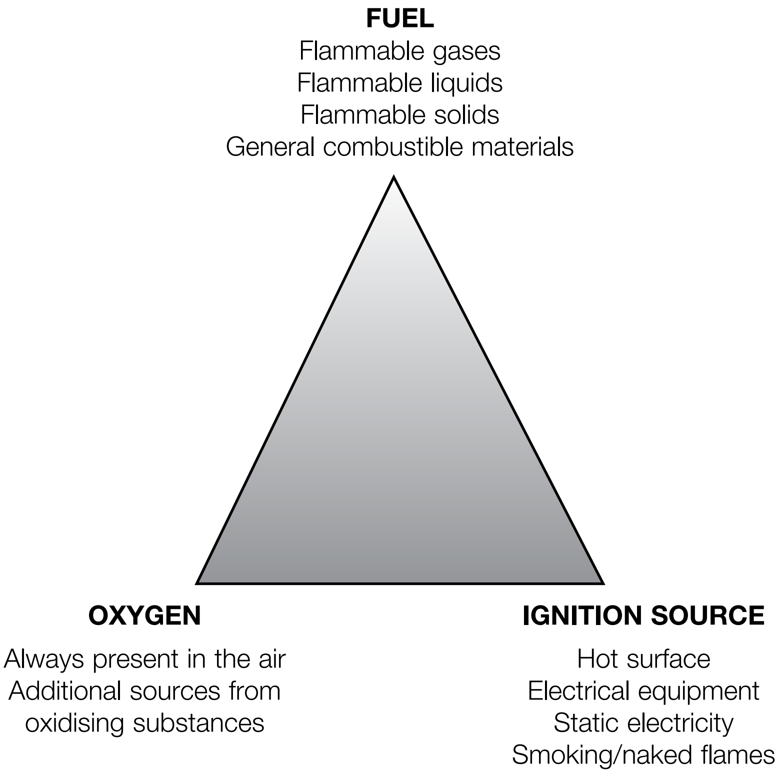


Figure 1 The fire triangle

40 Other physical properties of the liquid or gas give additional information about how vapour/air mixtures may develop and about the potential hazards. These physical properties include:

- flashpoint;
- auto-ignition temperature;
- viscosity;
- boiling point;
- vapour density;
- lower and upper explosion or flammability limits.

41 The flashpoint is the lowest temperature at which a liquid gives off vapour in sufficient concentration to form a combustible mixture with air near the surface of the liquid, under specified test conditions. Generally, a liquid with a flashpoint below the ambient temperature gives off a vapour that can mix with air and be ignited. Liquids with a flashpoint above the ambient temperature are less likely to give off flammable concentrations of vapour unless they are heated, mixed with low flashpoint materials or released under pressure as a mist or spray.

42 Explosion or flammable limits define the range of concentrations (normally by volume) of vapour/air mixtures at a specified pressure and temperature that produce a flame, and if confined, generate an overpressure (explosion). Explosion limits vary greatly for different substances, but for many, they are in the range 1% to 10%. Above the upper explosion or flammable limit, flammable mixtures still burn at their interface with the surrounding air.

43 In many cases, the flammable vapour is heavier than air, and therefore it tends to accumulate in low areas or in depressions such as gullies, pits and drains. You need to bear in mind that the vapour can spread away from the liquid spill, and that if the vapour is ignited, the flame can travel or 'flash' back to the liquid.

Toxicity

44 Toxic substances vary widely in the hazard they create. Acute hazards arising from short-term exposure are more likely to arise than chronic effects from low-level long-term exposure.

45 Exposure to a chemical substance through inhalation, ingestion or skin absorption can lead to poisoning or other ill health. Among these routes of exposure, inhalation is generally the most serious as the probability of exposure to vapours during routine operations and incidents involving spills is much greater than from skin exposure or ingestion.

Corrosivity

46 Corrosive substances include acids and alkalis that can quickly destroy human tissue and corrode normal construction materials at an excessive rate. Acids often react to emit toxic fumes when exposed to other chemicals such as sulphides and phosphides. Hydrogen, which is an extremely flammable gas, can be produced by contact between acids and many common metals.

General safety precautions at installations

Introduction

47 Although this book describes ways in which you can achieve an adequate standard of safety, variations from these may be appropriate to meet local conditions. You may use therefore alternative designs, materials and methods where your risk assessment shows that they provide an equivalent or higher overall level of safety.

48 The precautions outlined are designed to minimise the risks from the bulk transfer of dangerous liquids and gases between ship and shore. There are four basic principles for safe operations at transfer facilities:

- the provision of adequate equipment, engineered to an appropriate standard and positioned in due regard to separation and access;
- a high standard of management control, to ensure that the operations are carried out in accordance with safe operating procedures by trained and experienced personnel;
- regular maintenance, inspection and testing of all equipment to a pre-planned schedule; and
- periodic refresher training and drill practices for employees.

Responsibilities between 'authorities'

49 One of the underlying characteristics of the precautions, concerning the transfer of dangerous liquids and gases between ship and shore, is the number of 'authorities' which have a controlling influence. These include:

- the harbour authority;
- the berth operator; and
- the master of the ship.

50 Virtually all the harbours used at the present time for the loading and unloading of dangerous substances are managed by statutory harbour authorities. The duties of the harbour authority are stated in the Dangerous Substances in Harbour Areas Regulations 1987.[6] The harbour authority controls the marine traffic into and through the harbour, and controls the berthing and mooring of ships. The actual movement of ships in the harbour, for example if the ship requires the use of tugs, are often operations which are sub-contracted out to other companies. These tugs may also provide fire-fighting facilities. Similarly, many mooring operations are carried out by sub-contracted companies.

51 In some cases, the actual berths are owned by the harbour authority and leased to the user company.

52 The master of a ship is responsible for the control of the normal shipboard activities carried out by the ship's crew. The ship, under this control, is regulated by the Department of the Environment, Transport and the Regions under the various Merchant Shipping Acts[18] including the Merchant Shipping Act 1995[19] and the Merchant Shipping (Dangerous Substances and Marine Pollutants) Regulations 1997.[20] Enforcement of this legislation is carried out by the Maritime and Coastguard Agency. The Dangerous Substances in Harbour Areas Regulations 1987[6] also place duties on the master of a ship when the ship is carrying dangerous substances in a harbour or harbour area.

53 Clearly the major requirement to ensure the safe transfer of dangerous substances is **communication** between all parties. The many forms of communication necessary are described fully in this guidance. The requirements of each party need to be considered and defined in writing.

Health precautions

54 Many of the precautions needed to control the release of dangerous substances also control the health risks. However, additional precautions may be necessary since the concentrations of those vapours capable of damaging human health are significantly below the levels needed to enable, for example, combustion.

55 The Personal Protective Equipment Regulations 1992[21] require employers to provide suitable personal protective equipment to employees who may be exposed to a risk to their health or safety while at work, unless the risk has been adequately controlled by other means which are equally or more effective.

56 The Control of Substances Hazardous to Health Regulations 1994[22] (COSHH) require employers to prevent or control exposure to harmful substances. Guidance on these Regulations is contained in the Approved Codes of Practice (ACOPs).[23]

57 Many dangerous substances are harmful to health if they are inhaled, ingested or come into contact with the eyes or skin. An obvious precaution to take against skin and eye contact is to provide such items as gloves, protective clothing and eye protection (goggles). Decontamination facilities such as eyewash stations and showers should also be made available. Personnel may need suitable respiratory protection when the transfer of toxic gases takes place. Such protection may be needed in emergency situations to deal with spills and leaks, and possibly to enable evacuation.

Maintenance and modifications

58 Many incidents occur as a consequence of maintenance and repairs. The likelihood is increased if the work is done by staff or outside contractors who have little knowledge of the hazards associated with the liquids or gases handled. You need to ensure that any contractors who work on the berth and the associated transfer systems are competent to carry out the work required.

59 The Health and Safety at Work etc Act 1974[3] and the Management of Health and Safety at Work Regulations[1] place duties to ensure safe working practices on both the company using the services and the contractor. Guidance on selecting and managing contractors is available in an HSE publication.[24]

60 It is essential that no maintenance work is started before:

- the potential hazards of the work have been clearly identified and assessed;
- the precautions needed have been specified in detail;
- the necessary safety equipment has been provided; and
- adequate and clear instructions have been given to all those concerned.

61 Certain maintenance or repairs may require entry into confined spaces. In such cases, the Confined Spaces Regulations 1997[25] apply. The Regulations address those hazards that arise from the confined nature of the work and from the possible presence of substances or conditions which, if taken together, could increase the risk to the safety or health of people. The most likely hazards are:

- flammable substances and oxygen enrichment;
- toxic gas, fume or vapour;
- oxygen deficiency.

HSE has produced guidance[26] and a leaflet[27] on the Regulations.

62 In most cases, a permit-to-work (PTW) system[28] should be used to control maintenance operations, particularly maintenance or repairs involving hot work on systems which contain flammable materials. A PTW is a formal management document. Only those with the relevant authority should issue a PTW, and the requirements of the PTW must be complied with before the permit is issued and before the work covered by it is undertaken. A PTW needs to relate to a clearly defined individual piece of work. A PTW (see also Figure 2) should normally contain:

- the location and nature of the work intended;
- identification of the hazards, including any residual hazards and those introduced by the work itself;
- the precautions necessary, for example isolations;
- the personal protective equipment required;
- the proposed time and duration of the work;
- the length of time for which the permit is valid; and
- the person in direct control of the work.

Further advice on PTWs is available in an HSE leaflet.[29]

63 The Dangerous Substances in Harbour Areas Regulations 1987[6] state specified activities which should not be carried out on board ship without the permission of the harbour master and berth operator.

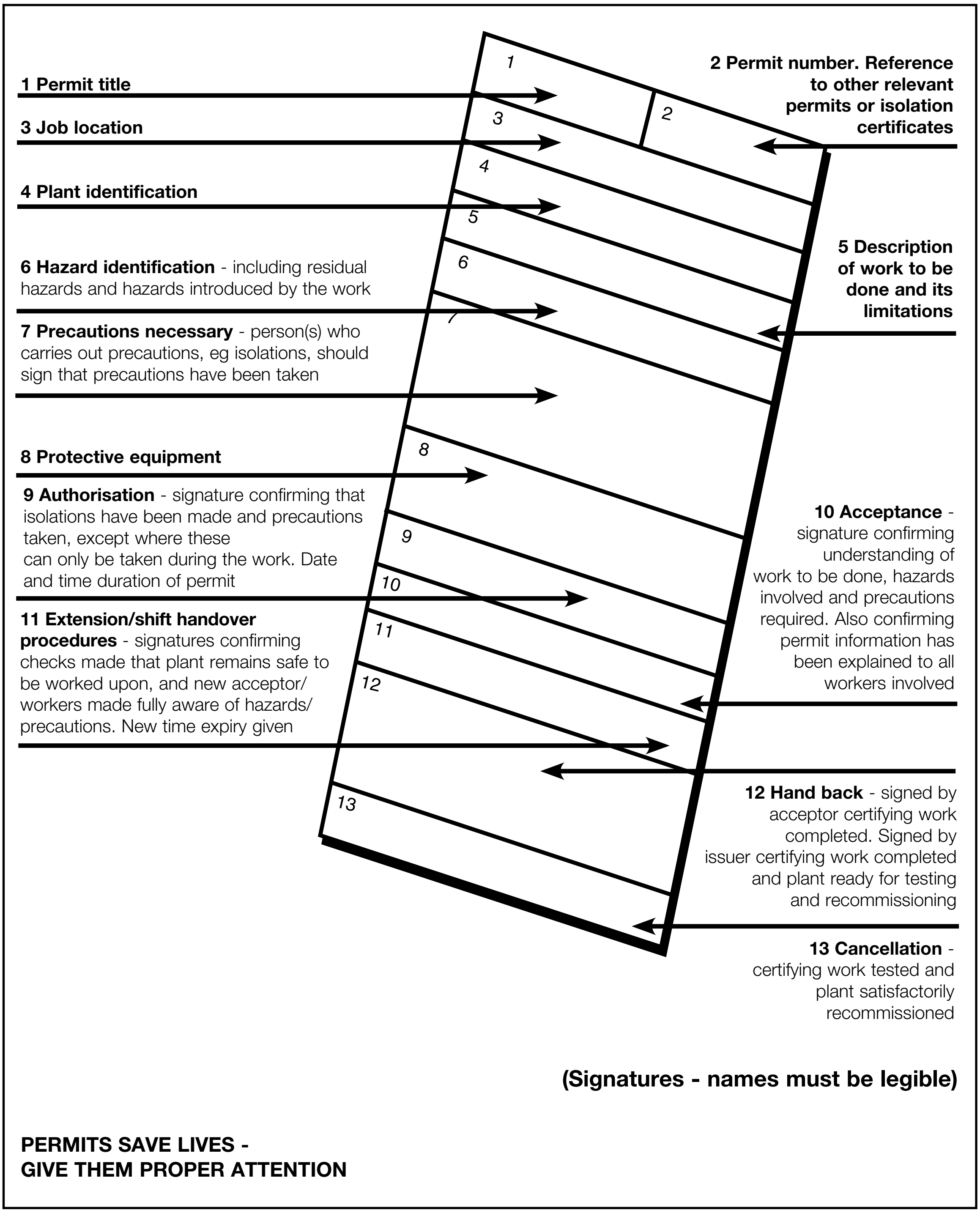


Figure 2 PTW

Information and training

64 Adequate training and knowledge of the properties of the liquids and gases handled are essential for safe operations. Training is a requirement of the Management of Health and Safety at Work Regulations 1992.[1] Carrying out risk assessments required by these Regulations will identify how much information, training and retraining are needed. Further guidance on these Regulations is contained in an Approved Code of Practice.[30] HSE has produced two leaflets concerning training and identifying training needs.[31,32]

65 You need to inform all staff on the site about the hazards of the various materials handled, and about the precautions needed for ensuring safety. Those directly responsible for the operations at the berth should also receive specific training in emergency procedures. Periodic retraining will normally be required. The training should include the following aspects:

- the types of cargo handled, their properties and hazards;
- general procedures for safe handling;
- use of personal protective equipment and clothing;
- housekeeping;
- reporting of faults and incidents, including minor leaks and spills;
- emergency procedures, including raising the alarm, calling the emergency services and the use of appropriate fire-fighting, dispersal or anti-pollution equipment.

There should be written procedures for controlling the risks from the cargo handling operations, and these should be used as the basis for training. These procedures should be updated when any modifications have taken place. Also they should be audited at regular intervals to ensure that the procedures are still valid and that they are being complied with.

Precautions in the design of jetties and berths

Introduction

66 There are many different designs of jetties, wharves, docks, etc. However, for those installations handling bulk cargo transfers of dangerous liquids or gases, there are a number of common issues concerning layout and equipment provisions. These issues are discussed in the following paragraphs.

General

Means of access

67 In all cases, access to the berth is needed so that various operations can be carried out. You also need to remember that access is important in emergency situations.

68 You need to ensure that access to the berth is adequate for the rapid deployment of any additional fire-fighting equipment or pollution control equipment. On long jetties, passing places may be necessary.

69 Obviously such access needs to be available at all times when ships are at berth, which may not be possible if other non-essential vehicles are allowed in the area, or parking on the jetty is not controlled. Where vehicles cannot be accommodated, you need to consider alternative transport (eg rail tracks or trollies) for the rapid deployment of emergency equipment, particularly on long jetties. In these cases, you need to provide vehicle access for the emergency services close to the jetty foot.

70 The fire brigade may require access to open water for their pumps. You are recommended to consult the local fire authority to discuss their requirements, and once access points have been agreed, you need to clearly mark them and keep them clear.

71 Just as important as access to the berth are escape routes from the berth for use in an emergency, particularly involving fire or toxic gas release.

Means of escape from the berth

72 The underlying principle of a means of escape is to ensure that people do not become trapped by fire, or enveloped in a toxic gas cloud. This is most readily achieved by providing two independent routes to safety from the berth. From any point on the berth, the question to ask yourself is: 'If a fire or release occurred here, could I turn my back on it and escape to a place of safety?'.

73 If the answer to this question is 'No', then you need to consider providing alternatives. These may include:

- additional walkways;
- the provision of boats;
- water sprays to protect the means of escape;
- breathing apparatus to allow the means of escape to be used; or
- shelters for people awaiting rescue, to protect against heat radiation or exposure to toxic gas.

74 In the case of fire, you should discuss the means of escape with the fire authority. Once the routes are determined, you need to maintain them so they can be used at all necessary times. To achieve this, the means of escape need to be kept clear of obstructions and, if the berth is used at night, adequately illuminated.

75 In some cases, such as T-head jetties or long jetties where berths are present alongside the jetty, alternative fixed walkways may not be reasonably practicable. In this situation, if fire broke out during cargo transfer at the ship moored alongside the jetty and you are positioned at the jetty head, your means of escape down the jetty towards the shore may not be useable.

76 The only alternative then is to provide rescue boats. Such boats may be kept permanently at the end of the jetty, or kept within the vicinity and capable of being crewed and made available for immediate use at all relevant times. In deciding which option is adequate, the following matters need to be considered:

- the distance between the berth and shore;
- likely winds and currents;
- the number of people who may be at risk;
- the distance the boat may need to travel;
- the nature of the cargo, particularly the fire hazard if it is spilt into the water.

In all cases, you need to provide access ladders or steps from the jetty to the water, and keep them serviceable and free from excessive marine growth.

Security

77 You need to consider the security arrangements at the jetty area. Physical control measures allow the risks from fire or explosion, toxic release or pollution incidents to be minimised. But such controls can easily be defeated if trespassing or tampering, whether deliberate or otherwise, is allowed to take place. Security arrangements, both during the working day and outside normal hours, should take into account the possibility of arson.

78 The standard of security required depends, among other factors, on the consequences of a major incident. Where security fencing is installed around the area, its design needs to take full account of the general fire precautions required.

79 While a berth is in use for cargo transfer it should not be possible for an unauthorised person to enter the jetty area unchallenged. Visitors to the ship should be checked and given authorised access. They should also be given information on the safety precautions to follow, and on the precautions to take in the case of leakage of cargo.

Separation

80 Where the cargo consists of liquefied flammable gases or flammable liquids there is always a risk of fire and explosion. One simple means of protection from the effects of fire and explosion is to have separation distances between the cargo transfer facilities and the site boundaries, occupied buildings (except small shelters), storage tanks and fixed sources of ignition.

81 These separation distances are designed to:

- minimise the effect of heat on the transfer facilities from a fire outside the site boundary;
- minimise the effect of a fire at the jetty operations on buildings, plant and people inside or outside the site boundary; and
- facilitate the safe dilution of flammable releases.

82 The distances quoted in Table 1 are based on what is considered to be good practice and have been widely accepted by industry. Although they will not provide complete protection from a major incident, they will normally help to prevent the risk of injury by making the evacuation of people in the area easier.

Table 1 Minimum separation distance between cargo transfer facilities and:	
occupied buildings, storage tanks and fixed sources of ignition	**20 metres**
site boundaries	**30 metres**
passenger ferries and their associated assembly areas	**75 metres**

Control of ignition sources

83 The main objective when handling flammable liquids or gases is to avoid the creation of flammable concentrations of vapours, by using containment and ventilation. However when flammable concentrations of vapour do occur, either during normal operations or during accidental spillage, etc, there must be controls to counter the wide variety of potential sources of ignition (see Figure 3).

84 Hazardous area classification is widely used to determine the extent of hazardous zones created by releases of flammable liquids, vapours or gases. This type of classification is discussed further in Appendix 2.

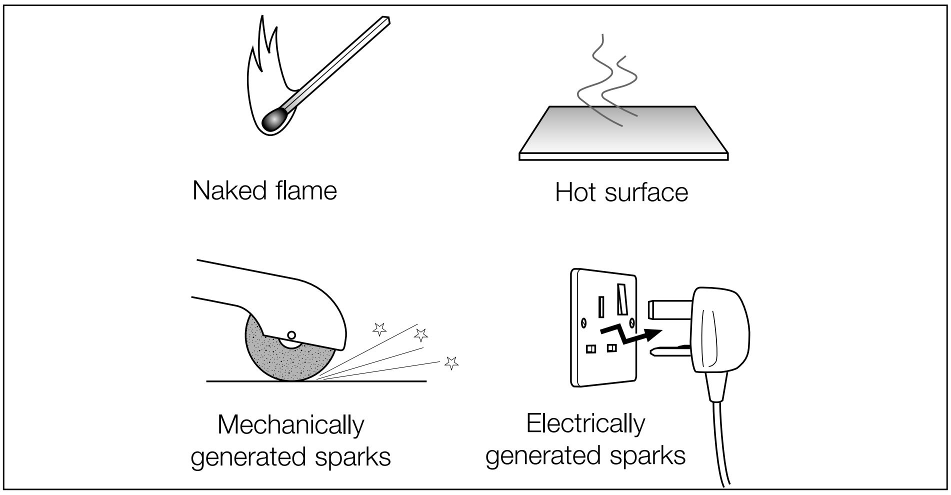


Figure 3 Sources of ignition

85 The concept of hazardous area classification has, in the past, been used solely as the basis for selecting fixed electrical equipment. However, you can use it to help prevent the introduction of potential ignition sources, such as portable electrical equipment, vehicles, hot surfaces, etc, into areas which may contain flammable atmospheres.

86 Obviously any hazardous area classification needs to take full account of the operations at the berth, for example the size and type of ship and the venting arrangements during handling of cargo and ballast.

87 Potential sources of ignition include:

- naked flames, including welding and cutting equipment;
- smoking;
- electrical lighting, power circuits and equipment which are not suitably protected against igniting a flammable vapour, eg not explosion protected;
- processes or vehicles that involve friction or the generation of sparks;
- radio frequency emissions;
- hot surfaces; and
- static electricity.

88 Examples of controls for some ignition sources are given in the following paragraphs.

Smoking and naked lights

89 Smoking and naked lights are obvious ignition sources and should be prohibited except in places designated by the berth operator. You need to prominently display 'No smoking' and other suitable signs that comply with the Health and Safety (Safety Signs and Signals) Regulations 1996,[33] in addition to your management systems.

90 Maintenance and other work activities should not be carried out in the area around the cargo handling operation until you have made a suitable risk assessment and introduced the appropriate control measures. Where the work introduces ignition sources into the area, such as with welding, cutting or grinding operations, the necessary control measures need to be implemented using a written permit-to-work system[28] (see paragraphs 58-63).

Electrical equipment

91 Where possible, electrical equipment should be located in non-hazardous areas. However, if such equipment needs to be in a hazardous environment, and so exposed to flammable substances, it should be constructed or protected so as to prevent danger.

92 This is a requirement of the Electricity at Work Regulations 1989[34] and might be achieved by selecting equipment built to explosion-protected standards or equipment that is intrinsically safe. Advice on selecting, installing and maintaining explosion-protected electrical equipment is given in BS EN 60079-14[35] and in a short guide published by the Institution of Chemical Engineers.[36]

93 There are also regulations which apply to both electrical and non-electrical equipment: the Equipment and Protective Systems Intended for Use in Potentially Explosive Atmospheres Regulations 1996.[37] These are aimed at manufacturers and suppliers, requiring them to ensure the equipment is safe. Such equipment should carry CE marking. From July 2003 you will have to select CE-marked equipment but, until then, you can select equipment that does not carry CE marking provided it is safe.

Jetty earthing

94 The ignition of flammable vapours can be caused by static electricity. Adequately earthing the jetty will prevent the build-up of electrostatic charge. Any electrical cables passed between the vessel and shore need to be adequately insulated and supported, and protected against overload and mechanical damage. Where necessary, you should make sure that adequate earthing connections are present at the jetty. More details on this matter is contained in the ACOP to the Dangerous Substances in Harbour Areas Regulations 1987.[38] Further precautions necessary during cargo handling are detailed in paragraphs 248-252.

Protection of vehicles

95 Vehicles with internal combustion engines should not be permitted within a hazardous zone on a berth during cargo transfer, unless they are protected and not able to ignite flammable vapour. The general view is that petrol powered internal combustion engines can not be made safe.

96 Where only flammable liquids with a flashpoint above 32°C are present, vehicle protection is not required.

97 The HSE publication HSG113[39] provides further advice on the use and protection of lift trucks in potentially flammable atmospheres.

Radio frequency ignitions

98 During medium and high-frequency radio transmission (300 kHz - 30 MHz), significant amounts of energy are radiated. This can, at distances extending to 500 metres from the transmitting antennae, induce an electrical potential in unearthed 'receivers' (derricks, rigging, mast stays, etc), capable of producing an incendive discharge. Transmissions can also cause arcing over the surface of antenna insulators when they have a surface coating of salt, dirt or water. It is recommended that:

- all stays, derricks, and fittings on the ship are earthed; and
- transmissions are not permitted during periods when there is likely to be a flammable vapour in the region of the transmitting antennae.

99 Low energy transmissions, such as those used for satellite and VHF communications, do not produce the same source of ignition. A guide[40] is available on the prevention of inadvertent ignition of flammable atmospheres by radio frequency radiation.

Equipment design

General

100 The actual equipment used to undertake the cargo transfer needs to be engineered to an appropriate standard. All equipment used for the transfer of dangerous substances should be:

- suitable for the cargo to be handled at the appropriate temperatures and pressures;
- regularly inspected; and
- maintained, tested and replaced as appropriate.

101 The major connections between a ship's manifolds and shore pipelines consist of articulated metal cargo arms, flexible hoses or both. Tidal variations and changes in displacement during cargo transfer mean that these engineering systems must be flexible.

102 If pipelines or hoses are positioned such that they could be damaged by, for example, impact with the ship or a vehicle using the berth, then there is a need to consider re-routing them, where reasonably practicable, to a less vulnerable part of the berth. An alternative precaution against vehicle impact is to provide barriers or bollards and to restrict access to essential vehicles only.

103 The size and layout of the transfer lines between ship and shore storage are clearly dependent on the operational requirements necessary. In some cases, the storage tanks may be located a considerable distance from the berth. However most pipeline and associated systems have similar requirements in terms of the precautionary measures required to ensure safe use.

104 These requirements form the basis for the following section in this guidance, but it is important to note that a risk assessment of the system as a whole should be carried out. The risk assessment should follow a structured approach and consider all aspects of the design or installation with respect to the hazards involved and their potential consequences.[41,42]

105 The results of the risk assessment may require additional precautionary equipment to be installed, or the improvement of written procedures, etc.

Prevention of spillage

Cargo arms

106 Articulated metal cargo arms can be operated manually or hydraulically. They need to be suitable for the berth, taking into account the berth size and structure, ship sizes, tides and weather conditions.[43]

107 They need to be able to move fore, aft and outward within safe limits, ie the cargo arm envelope configuration. You can install alarms or visual indicators on the cargo arm which are activated when the envelope configuration limits are approached. You need to decide what action should be taken if the alarms are activated.

108 This may involve temporarily stopping the cargo transfer until adjustments to the mooring of the vessel have been carried out, or until bad weather has ceased. Temporarily interrupting the cargo transfer may mean that the pumps should be stopped and the isolation valves closed at the berth and on the ship, but the action necessary should be considered as a result of a structured risk assessment.

Hoses

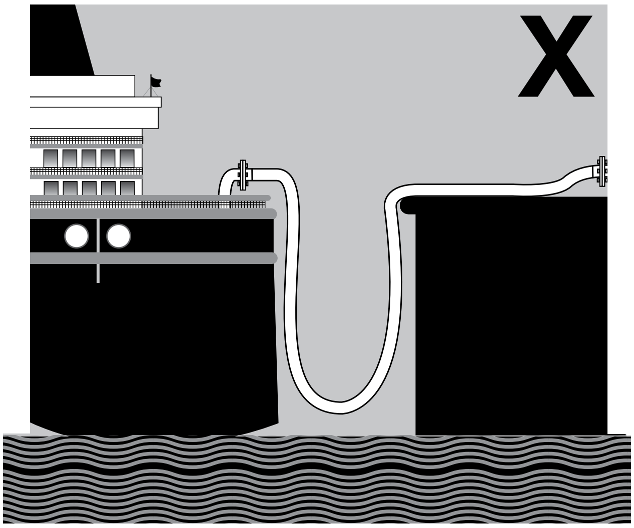
109 Flexible hoses should be manufactured to a standard suitable for the application and should be compatible with the substances to be handled. They need to be adequately supported (for example, by slings or saddles) so that the bend radius is not less than the minimum recommended by the manufacturer (see Figure 4). Single rope slings and wires are not considered acceptable as these can easily cause kinking of the hose. Suitable cranes or hose rigs should be used where an assessment under the Manual Handling Operations Regulations 1992[44] concludes that manual handling of large hoses is not safe.

110 When the hoses are not in use they need to be stored to avoid accidental damage, extremes of temperature and direct sunlight.[45] It is good practice to provide blank ends for the additional sealing of couplings that are frequently broken and remade. Further details on the handling and care of flexible hoses is given in an Oil Companies International Marine Forum (OCIMF) guide.[46]

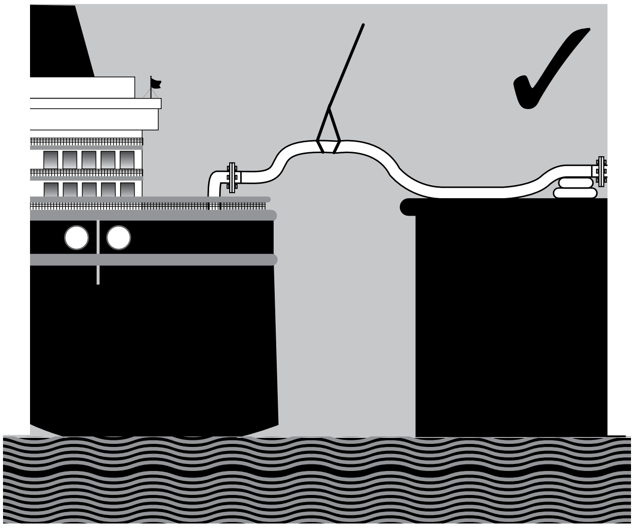
111 You should externally inspect all hoses for damage and deformation on each day that they are used, and preferably on each occasion they are used. More detailed examination, including appropriate internal inspection and hydrostatic pressure testing should be carried out at least annually.

112 More details on hose testing can be found in the Approved Code of Practice for the Dangerous Substances in Harbour Areas Regulations 1987.[38]

113 In some cases, the Pressure Systems and Transportable Gas Containers Regulations 1989[47] may apply, which require a competent person to draw up, or certify as suitable, a written scheme of examination which defines the scope and specifies the nature and frequency of examination of equipment and pipework. This requirement applies to all pressure systems onshore, not just the hoses.



Don't allow a hose to become overbent or to let it hang between the ship and the quay



Use slings to support a hose

Figure 4 Supporting a hose between ship and shore

Breakaway couplings/emergency-release couplings

114 Further safeguards against spillage can be provided by emergency-release or breakaway couplings with automatic shut-off valves installed at the berth.

115 Their use is particularly recommended when the cargo consists of liquefied gases, or when there is a significant risk of drift-off due to the location of the berth. Such situations may arise when the berth is subject to particularly extreme weather conditions and strong currents, or when there are problems with excessive displacement.

Pressure relief

116 Pressure developed from the thermal expansion of liquids, particularly liquefied gases, can build up in the pipework. Over-pressurisation can cause damage to the pipework resulting in the release of the liquid.

117 An assessment of the likelihood and consequences of thermal expansion should be made, and the system can either be designed to withstand the pressure rises, or be fitted with a pre-set hydrostatic relief valve. The liquids should normally discharge back to the storage vessel, or discharge via lines to safe places, such as slop tanks, sumps, flare stacks or other vessels suitably designed for the recovery or disposal of the substance.

Fire engulfment relief

118 To prevent catastrophic failure of pipelines, particularly those containing large capacities (ie greater than 10 m^3) of liquefied flammable gases, the installation of fire engulfment relief is recommended. Such relief needs to be designed and sized according to an appropriate standard, for example API Standard 2000.[48] You need to ensure that the relief vents discharge to a safe place.

Pressure surge

119 Pipelines, especially vulnerable parts such as hoses and flanges, can be ruptured or damaged by a pressure surge in the line. This can be caused by rapid closure of the valves, setting up a pressure wave in the enclosed liquid as it is brought to a sudden halt. Factors which affect the pressure generated include:

- the density of the liquid;
- the number and type of valves in the system;
- valve closing times;
- pipeline length; and
- the overall pipeline geometry.

120 An assessment of the pressure surge which might occur in the pipeline should be made using, for example, the procedures given in the ISGOTT[49] or the SIGTTO[50] guides. If the assessment results in a requirement to reduce the pressure surge, you can take the following measures:

- reduce the pumping rate, and hence the flow rate of the liquid in the pipeline;
- increase the valve closure time. Slow closure over the last quarter of the valve port area is particularly important;
- use surge tanks or other pressure relief devices.

Pipework

121 To ensure its mechanical integrity, the pipework should be constructed in accordance with an appropriate standard, for example ANSI/ASME B31.3 Chemical plant and petroleum refinery piping.[51] Welded joints are preferred to flanges for minimising leakage, and for keeping the number of joints and connections to a minimum.

122 All parts of the piping system, including valve seals and flange gaskets, need to be manufactured from materials compatible with the substances being handled.

123 Pipework should be sized and routed to restrict the contents to a minimum (consistent with pressure-drop requirements). It needs to be positioned or protected to minimise the risk of impact damage, particularly from vehicles. You may need to provide barriers or bollards.

124 You need to ensure that any pipework supports are designed to suit the piping layout and to withstand any anticipated vibration and other stresses. BS 3974,[52] or equivalent, gives guidance on this matter.

125 BS 1710[53] recommends the use of a suitable marking system to identify the contents of individual pipe runs. Marking of pipework is particularly important at filling and discharge points, or where there is likely to be confusion with other piping systems. This is a requirement of the Health and Safety (Safety Signs and Signals) Regulations 1996.[33]

Ancillary equipment

126 Pumps, motors and other equipment forming part of a piping system need to be located in a well-ventilated area, preferably in the open air, with weather protection where necessary. Any small leaks from pumps need to be contained by a low sill or drained to a safe place. Where pumps are controlled remotely, local stop buttons should be provided at the pump itself, as well as at the control point.

Vapour emission controls

127 Many cargo transfers now take place at jetties which have vapour emission control systems installed. During loading, the displaced vapours are collected and transferred ashore for treatment or disposal, rather than being vented direct to the atmosphere from the ship's venting arrangements.

128 Although such systems reduce emissions to the atmosphere, the ship and shore become connected by a common stream of vapours, which introduces into the operation a number of additional hazards which must be effectively controlled.

129 Detailed guidance on the technical issues associated with vapour emission control and treatment systems are available from a number of sources.[54,55]

130 The primary hazards associated with the use of vapour emission control (VEC) systems are:

- misconnection of liquid and vapour lines;
- under and over-pressurisation;
- introduction of air into the system during the making and breaking of connections;
- cargo tank overfill;
- sampling and gauging;
- fire, explosion or detonation of flammable vapours;
- liquid condensate in the vapour lines;
- electrostatic discharge.

131 If flammable vapours are present, the design of the jetty vapour collection and treatment system should have the necessary precautionary controls to ensure safe operation. But unless adequate protective devices are installed and operational procedures adhered to, a fire or explosion occurring in the vapour space of a cargo tank onboard ship could transfer rapidly to the shore, and vice versa.

132 Precautions may include provisions either for making the vapour stream inert, or for enriching or diluting it, and continuously monitoring its composition.

133 The installation of a flame or detonation arrestor, fitted in close proximity to the jetty vapour connection, can protect against the transfer or propagation of a flame from ship to shore, or shore to ship. Further guidance on flame and detonation arrestors is available.[56,57,58]

134 The introduction of VEC reinforces the importance of good communication between ship and shore. Before commencing operations, details must be agreed on, for example, the maximum transfer rates, maximum allowable pressure drops in the vapour collection system, alarm and shutdown conditions, and procedures.

Overfill protection

135 Preventing tanks from overfilling is essential. The simplest means of preventing tanks and tank compartments from being overfilled is to ensure that there is adequate ullage to receive the quantity of cargo being transferred. This is best achieved by having a way of monitoring the contents of the tanks or compartments. The method chosen depends on many factors, in particular the properties and hazards of the liquid or gas.

136 Automatic gauging allows the quantity of the liquid to be determined without the need to open the tank and take manual dip readings.

137 During transfer, the tank levels need to be monitored to prevent overfilling. High-level alarms and pump cut-off devices can be used, with any alarms able to sound at a staffed control point. All alarms, gauges and cut-outs should be regularly tested, and where necessary, recalibrated to ensure accurate operation.

138 Where topping-off of a tank is required, the flow rate to the tank should be reduced to allow adequate control of the flow.

Line draining/purging

139 To prevent spillage when transfer is completed, the cargo arms or hoses need to be drained or purged clear before disconnection. Blowing through with air is not recommended when the arm or hose has contained flammable materials. Means for the safe collection and disposal of residual product (eg sills, drip trays, drainage gullies, slop tanks) should be provided. For this, closed systems are preferable.

140 When cargo transfer is completed, the pipelines on the shore side of the berth shut-off valves may remain full of material. It may be necessary to clear these lines by water washing, by use of a pig or by blowing through. If a closed system is not employed, a drain valve is needed at an appropriate point in the system, with suitable arrangements to collect the drainings.

Pigging operations

141 One of the most hazardous activities associated with operational pipelines involves pigging and in particular, pig trap isolation and opening the closure door to insert or remove a pig. There are a wide range of existing pig traps. The following guidance gives advice on the minimum standards considered as acceptable.

142 The design, operation and maintenance of the pig trap, and any associated equipment, should meet the standards consistent with those for the pipeline system as a whole.

143 The pig trap needs to be adequately supported to withstand the imposed loads due to pigging operations with heavy or fast moving pigs or when large quantities of liquids are being moved along the pipeline.

144 To prevent the build up of static electricity, the pig trap requires bonding to earth. This is particularly important where there is an insulation joint and the pig trap is mounted on sliding supports with, for example, PTFE pads.

145 You need to consider the means of isolating the pig trap. Guidance on the safe isolation of plant and equipment is available in an HSE publication.[59] One acceptable method is to use ‘double block and bleed’ valving arrangements. Alternatively, single pig trap isolation valves may be used if the valves are of the type with double seats which have a vent or drain point between the seal faces.

146 Pig trap isolation valves should not be capable of accidental operation. You could label the valves and ensure that the state of the valve, ie open or shut, is clearly indicated. Closure safety devices can be installed to prevent the opening of the closure door until the pig trap has been properly isolated and the internal fluid pressure is reduced to ambient conditions in all parts of the trap.

147 You need to produce written procedures for the operation and maintenance of the pig trap. Certain operations may be carried out by specialist contractors, and the systems of work of both the operator and the contractor should be integrated before and during the operations. You need to consider methods for dealing with any potentially hazardous events, for example, pigs stuck in a pipeline.

148 You need to consider the means of purging or flushing the pig trap of hazardous fluids, for example, flammable or toxic fluids. Even after the bulk of these fluids have been cleared from the pig trap, there may still be flammable or toxic vapours given off from wetted surfaces. An assessment is needed of the personal protective equipment required, which depends on the nature of the materials involved.

149 All pig traps and associated equipment should be subject to a scheme of inspection and maintenance. If an onshore pipeline is conveying a 'relevant fluid', as defined in the Pressure Systems and Transportable Gas Containers Regulations 1989,[47] then there is a requirement for a written scheme of examination. This has to define the scope, and specify the nature and frequency, of the examination of the equipment and pipework. The scheme has to be drawn up, or certified as suitable, by a competent person. For offshore pipelines, there are similar requirements under the Submarine Pipe-lines Safety Regulations 1982.[60]

150 Any scheme should periodically call for the inspection of the pig trap closure. You need to pay special attention to potential defects in bolts, nuts, nut housings and their method of attachment, etc. The scheme should include guidance on the frequency of inspection, which may depend on pig trap usage and on when worn parts should be replaced. You need to take due account of manufacturers' instructions and recommendations.

151 All personnel involved with pigging operations and maintenance need to be adequately trained so they are competent to carry out their duties safely. The training needs to be designed to ensure that the personnel are familiar with the pipeline system, pig trap and pigging equipment and associated hazards, as well as with procedures and instructions.

152 You need to remember to ensure the training includes the proper use of permits-to-work, protective clothing and equipment, emergency procedures, fire fighting (if necessary) and first aid.

Control of spillage

Emergency shutdown (ESD) and remotely operated shut-off (ROSOV) valves

153 The berth pipeline system should be designed and installed to good engineering and process design practices. The design should be subject to a structured hazard and operability[41] review as part of the overall risk assessment.

154 Any valving installed in the pipework needs to be capable of being quickly and safely shut down in an emergency, so that spillage on the berth or ship is minimised.

155 Good practice dictates that shut-off valves are fitted at the end of each pipeline at the berth. With pipelines used only for ship discharge, a non-return valve should also be fitted. If necessary, a manual override can be provided to allow back-flushing through the non-return valve, but you need to ensure that this valve is reset afterwards.

156 In the case of long pipelines on a jetty or on shore, the installation of at least shut-off valves at the jetty foot should be considered, to minimise spillage if a pipeline fails.

157 There may be a risk of gravity discharge of the contents onto the berth from long pipelines or from shore storage tanks during an emergency (for example, in the event of manual shut-off valves becoming inaccessible as a result of a fire or major spillage). Additional shut-off valves in safe positions are recommended in these situations.

158 Remotely operated shut-off valves (ROSOV) can be installed for shutting down transfer operations and isolating the berth from the ship, shore tanks and associated equipment. Due attention should be paid to the effects of a pressure surge (see paragraphs 119-120). Any ROSOVs need to be capable of being operated from a place of safety.

159 You should consider the use of a 'single-button' system to operate the various emergency systems, ie shutting down cargo transfer and, where flammable gases and liquids are involved, operating the fire alarm and starting the fire pumps.

160 It may be desirable, particularly for liquefied gases and large cargoes of flammable liquids, to provide a way of shutting down shore pumps from the ship. This can be achieved by placing pendant ESD controls onboard ships, or via the installation of removable electrical, pneumatic or fibre-optic connections. The results of your risk assessment will help in determining the requirements of the emergency shutdown systems.

161 With pipelines used for loading and unloading liquefied gases, good practice would also require:

- a non-return valve, an excess flow valve or a ROSOV at or near the shore tanks, so that in the event of an emergency, the line can be isolated;
- a ROSOV at the jetty foot; and
- a ROSOV on the berth, at or near the point where connections are made.

162 For large capacity jetty pipelines (more than 10 m^3) conveying liquefied gases, good practice would require the fitting of intermediate automatic or remotely operated shut-off valves for limiting the quantity of material released during an incident.

163 All ROSOVs should have fusible links or other means of closing the valves in the event of fire. They should be fail-safe and be capable of being closed manually.

Gas detection systems

164 Automatic detection of leaks and spillages, particularly if the hazardous material is flammable or toxic, can have the advantage of allowing fast remedial action to take place.

165 The siting of gas detectors in the following locations may be appropriate bearing in mind the physical properties of the gas, but you should seek the guidance of the suppliers/manufacturers of the equipment:

- remote or inadequately patrolled areas where leakage would remain undetected for long periods;
- for flammable materials, areas near to sources of ignition;
- for toxic materials, those areas most likely to give rise to concentrations above the occupational exposure limits (OEL).

Dispersion

166 If a loss of containment occurs which results in a large spillage of flammable or toxic vapour, there needs to be precautions to prevent the gas cloud either:

- reaching a source of ignition which would result in a flashback; or
- endangering employees or other people in the vicinity.

167 The greatest risk in such incidents results from leaks of liquefied gases. Generally in such incidents, when the liquid is spilt, the following occurs:

- some of the liquid evaporates, which cools the rest to the boiling point at atmospheric pressure and then chills the ground; during this initial period gas is formed rapidly;
- after the first few minutes, the gas evolution rate is reduced, depending on the heat that can be drawn from the surroundings;
- the gas cloud formed spreads according to the wind direction and other local factors.

168 There are a number of methods available which may be used to control the evaporation of spilt liquid.[61] Clearly the properties of the substance will determine the method chosen. You should take advice from the suppliers/manufacturers of the material.

169 All the methods require effective containment so that the liquid can be covered. The use of booms, sandbags, etc, can help to contain the spilt liquid. Covering of spilt liquid can be achieved by:

- applying high-expansion foam when, for example, dealing with spillages of vinyl chloride;
- using plastic sheeting to cover the spilt liquid when, for example, dealing with spillages of chlorine;
- applying a very fine water fog when, for example, dealing with spillages of ammonia or other water miscible liquids. The fine water fog has the effect of creating an ice crust over the surface of the spilt liquid.

170 Sheeting can also be used to cover leaks of liquefied gas from flanges, etc, which causes the knock-down of the liquid, hence reducing the evaporation rate.

171 Although the application of a wet foam or fog reduces the rate of gas evolution, water alone should never be poured onto a spillage as this merely provides the heat to evaporate the liquid more quickly.

172 Use of a very fine water fog can also help to disperse gas clouds.

173 The method chosen, if any, should result from an assessment that takes into account the hazards of the material and the likely consequences. Any actions, determined as a result of the assessment, should be developed in the emergency plan.

Pollution controls

174 Regulations made under the Prevention of Oil Pollution Act 1971,[62] eg the Merchant Shipping (Prevention of Oil Pollution) Regulations 1983,[63] implement the MARPOL[64] Convention and essentially require oil carrying ships to have oil pollution emergency plans.

175 The International Convention on Oil Pollution Preparedness Response and Co-operation 1990[65] lays down the principles of prompt and effective action to be taken in the event of an oil spill. Ships, offshore installations, ports and other facilities which handle oil are required to establish emergency plans, and report all pollution incidents. It would be good practice for similar anti-pollution plans to be drawn up for other bulk liquids.

176 You can avoid pollution during transfer operations by good engineering design and operating procedures. Since many of the precautions discussed in this book are concerned with avoiding the loss of containment, they will also be applicable to avoiding pollution incidents.

177 Additional safety precautions can be taken, and it is useful to include these in a pollution checklist. Many of the items necessary are contained in the ISGOTT[49] ship-to-shore checklist. The checklist would contain checks on:

- ensuring, via written agreement, the quantities of cargo for transfer and their destination;
- ensuring ballast water, that contains dangerous or polluting materials, cannot be discharged;
- ensuring loading arms and hoses are drained before disconnection;
- ensuring drip trays, etc, are placed under flanged connections;
- when topping off, ensuring the tank valves on the next tank to be filled are cracked open in good time;
- ensuring all flanged joints and reducing spools, including manifolds not in use, etc, are bolted correctly with the full number of correctly sized bolts.

You need to develop the necessary response should a pollution incident occur. This will need communicating to all the parties involved, and training and periodic drills will be necessary.

Precautions against fire or toxic gas release

Introduction

178 Much can be done to prevent fire or the release of toxic materials. Following the advice in this book should greatly reduce the chances of this occurring. Unfortunately, the possibility of a fire or a release always remains. It is therefore important to have in place a pre-planned response to such emergencies, including the appropriate actions to take in the event of a fire and efficient arrangements for calling the emergency services.

179 At jetties handling dangerous liquids and gases, you need to assess the possibility of a fire or a toxic release and its uncontrolled escalation. The incident can be minimised by:

- good berth design and location;
- good engineering design of transfer systems;
- good operating and management practices; and
- proper instruction of workers in routine operations and in the actions to take in an emergency.

Emergency and fire-fighting equipment

180 One of the main purposes of emergency equipment is to protect the means of escape for shore staff and ships' crews. Another purpose is to contain an incident, and prevent it from escalating into one which threatens neighbouring people or property. You need to consider the manner and speed with which an incident can develop when determining the type, number and location of the emergency and fire-fighting equipment required.

181 Fire-fighting equipment should be provided:

- to contain and possibly extinguish a fire;
- to safeguard people while they make their escape or await evacuation, pending the arrival of the fire brigade;
- to limit damage to the facility, neighbouring property and the environment; and
- to protect means of access for fire and emergency services.

182 Similarly other emergency equipment should be provided to:

- contain spillages; and
- help disperse and dilute gas and vapour releases.

183 You need to carry out an assessment to determine the level of capability required for these two situations. The equipment necessary depends on a number of factors. The scale of the provisions should be discussed with the fire authority and the environmental agencies.

184 The Dangerous Substances in Harbour Areas Regulations 1987[6] require precautions to be taken against fire or explosion. These matters, which include the process fire precautions and the general fire precautions (see the glossary), are enforced at present by HSE. The Fire Precautions (Workplace) Regulations 1997,[2] which came into force on 1 December 1997, also deal with the general fire precautions at jetties, etc. These regulations are enforced by the fire authorities, and it is therefore important that you also consult with the fire authorities when carrying out a risk assessment concerning fire precautions.

185 The main requirements of the Fire Precautions (Workplace) Regulations 1997 are for an employer to carry out a risk assessment to determine the necessary general fire precautions for safeguarding people within the workplace in the event of fire, and to implement and maintain these precautions. The matters you need to consider as the berth operator when undertaking the risk assessment should include:

- the escape routes for shore staff and ships' crews;
- the size, nature and frequency of cargoes;
- the size of the berths and of the ships, and their distances from other industrial hazards and population centres;
- the availability of off-site emergency services, including fire tugs; and
- the time needed for the local fire authority to turn out, and for reinforcements to arrive from a distance.

186 It is good practice to have on permanent display at the berth, a plan showing the location and type of all fire-fighting and emergency equipment on or adjacent to the berth, along with instructions on fire and emergency procedures. The ship's emergency and fire-fighting plans should also be given to the shore terminal.

187 An adequate number of portable fire extinguishers should be provided at the berth. Their primary purpose is to tackle fires that have just begun, thereby reducing the risk to people and enabling them to make their escape. Similarly, there should be suitable fire extinguishers to deal with fires which may affect the berth, for example in control rooms or jetty shelters.

188 They need to be positioned in conspicuous locations along the escape routes. Unless the location of an extinguisher is self-evident, you need to identify its location by appropriate safety signs. Such signs should comply with the Health and Safety (Safety Signs and Signals) Regulations 1996.[33]

189 To reduce the risk of corrosion, it is sensible to keep extinguishers off the ground and to protect them from the weather.

190 Extinguishers should be to a recognised standard such as BS EN 3[66] and be suitable for tackling fires involving the dangerous substances. Anyone expected to use a fire extinguisher should receive proper training.

Provision of water

191 Water is essential for cooling purposes, and it can be used in fog or spray form for fighting oil fires and for screening fire brigade personnel. It can help disperse vapour clouds and clear away spilled liquid.

192 A fire main, which extends to the jetty head or berth, is an appropriate source of water in this situation. The pipeline may be dry or charged, but should be capable of being pressurised at short notice. Where necessary, it needs to be protected against impact and freezing.

193 Your risk assessment should determine the capacity of the fire main. The factors for determining the required flow rate of water include:

- the size of the hazard at the berth (eg ship size and storage capacity);
- the need to supply fire brigade appliances; and
- the capacity of any installed emergency equipment.

The diameter of the fire main needed depends upon the pump rating and frictional losses in the system.

194 Water take-off points (hydrants) need to be positioned along the fire main at regular intervals. They should be suitable for couplings used by the fire authority, and need to be readily accessible. Isolation valves should be fitted to maintain the efficiency of the system in the event of a fracture.

195 Your risk assessment should consider the means of supplying water to the fire main. This depends on the size, nature and frequency of the cargoes handled and on the time for mobile fire appliances to arrive. In some cases, it may be sufficient for the local water company supply or a fixed fire pump to feed the main.

196 Larger installations may require a number of pumps, suitably backed up so that the main can be supplied effectively at all relevant times. If the fire main is pressurised from the local water company, there needs to be sufficient supply to operate the equipment and it should be secure against loss of pressure. If the sea provides the water, the fire pumps should be capable of providing sufficient suction at all states of the tide.

197 You need to consider where to locate the operating points for the pumps. An obvious solution is a staffed control point, either on the berth or in the control room. It is also preferable to have another at the jetty foot. You can further improve the situation by setting the pumps to operate automatically if the fire alarm is set off from one of the call points.

198 At berths used for vessels of 500 tons gross tonnage and over, an international shore fire connection should be provided to supply water to a ship's fire main from the shore or vice versa. Details of this connection are given in the ISGOTT guide.[49]

Application of water

199 Your risk assessment should consider the means of applying water from a fire main. This is normally achieved by providing at least two water monitors at each berth so that, in the event of a fire, equipment may be cooled and a protective water curtain provided between ship and shore. In deciding the number of monitors needed, you need to consider:

- the maximum size of ships using the berth;
- the area to be covered; and
- the nature of the cargoes.

200 The monitors should preferably be permanently mounted and fitted with jet/fog nozzles. The minimum capacity of each monitor is considered to be approximately 108 m^3/hr (400 gallons/minute). The monitors need to cover the vulnerable locations, ie ship and shore manifold areas, connection points and the full length of any hoses used. You should remember to consider foreseeable weather conditions when assessing the effectiveness of any monitors.

201 You must be able to operate the monitors from a safe location. The separation distances of monitors and the positions of remote controls need to take account of the possibility of vision being obscured by smoke and of the control points being enveloped in a toxic gas cloud.

202 Remote controls should be standard for all elevated monitors so that people do not have to remain on elevated platforms to operate them. Oscillating monitors and those with remote control of both water and movement are an advantage. The heights of tower installations for water monitors are determined by:

- their location;
- wind effects;
- monitor capacity;
- the size of ships handled;
- the maximum freeboard in laden and unladen conditions; and
- local tidal variations.

203 You need to consider the effect of a loss of power to the monitors. Preferably, the power supply for the monitors should be independent of the normal electrical supplies (eg by using separate protected cabling, water-powered motors, or for hydraulic pumps, a back-up hand pump).

204 In some circumstances, mobile monitors may be adequate. However, monitors should always be connected to the water or foam supply during cargo transfer, other than in exceptional cases and only with the formal agreement of the fire authority. For monitors that require the position of the nozzle to be set manually, this should be carried out before any cargo operations start.

205 It may be necessary, particularly at terminals regularly handling vessels with high freeboards or carrying liquefied gases, to provide additional means of applying cooling water. One solution is to mount a third water monitor in an elevated position.

206 For refrigerated LPG (liquefied petroleum gas) or LNG (liquefied natural gas), the insulation around the tanks, pipelines, etc, may provide some protection against overheating, but cooling water is still necessary, particularly for the protection of pipework and fittings. You should not apply water directly to pools of LPG or LNG as it increases vapourisation of the liquid. For the same reason, water should not be allowed to enter any tank containing refrigerated liquid.

Use of fire-fighting foam

207 Foam is of considerable value in extinguishing liquid spill fires provided that the liquid spill can be contained and prevented from spreading. For cargoes of crude oil and other flammable liquids, where the risk of spill fires is greatest, consideration should be given to using suitable foam (or dual-purpose water/foam) monitors. Aspirated low-expansion foam is the most useful for maximum protection against re-ignition.

208 However, where the maximum throw from a monitor is essential, you may prefer to use film-forming foams, which can be used unaspirated. The use of an alcohol-resistant foam may be necessary when handling cargoes of alcohols or similar compounds.

209 Foam has a limited heat absorbing capacity and is largely ineffective for cooling purposes. It is not generally used where cargoes are limited to liquefied gases, apart from bunded areas. Fixed foam equipment is also not normally required at berths handling only high flashpoint liquids.

210 If fire-fighting facilities using foam are present, you need to consider how much foam concentrate to store on site. This depends on a variety of factors. These include:

- the availability of back-up supplies;
- the ease of access to the berth; and
- the cost.

Sufficient foam should be stored on site to supply all the monitors covering one berth for enough time to carry out the evacuation of the vicinity.

Emergency/fire training

211 All terminal staff should receive instruction in fire prevention, the action to take in case of a fire or release, and using the emergency/fire-fighting equipment provided.

212 Staff should be aware of the hazards of the substances being handled.

213 The training should include the means of raising the alarm, and the evacuation procedure. Staff should receive periodic refresher training at least annually, and take part in regular drills. Records should be kept of any training given and drills held.

Operations at installations

Precautions before cargo transfer

Requirements for entering harbour

214 The Dangerous Substances in Harbour Areas Regulations 1987[6] require the master or agent of a ship carrying dangerous substances (or an operator of a ship coming from inland) to give advance notice to the harbour authority. This notification has to include details of the dangerous substance being carried, and in the case of ships entering from the sea, about the ship itself. The information may be used to determine the navigation, etc, of the vessel into the harbour area and to berth.

215 In some instances, navigating the vessel into and within the harbour may require pilotage. Pilots are usually licensed to the harbour authority, and generally must be ordered by the ship's agent for both inward and outward journeys. Some harbour authorities operate a pilot exemption scheme, which allows masters to berth their ships without the advice of a pilot, although masters need to meet a stringent set of criteria in order to qualify.

216 You should note that under the Dangerous Substances in Harbour Areas Regulations 1987,[6] the harbour master has powers to regulate or prohibit entry of vessels into the harbour where the condition of the ship may create a risk to the health or safety of any person from the dangerous substance being carried.

217 Clearly communication is also necessary between the ship and the berth operator. For example, you may need to know the positioning of the ship's manifolds, the state of the cargo holds, or the temperature of any refrigerated product, etc.

218 You may also wish to stop the vessel berthing if, for example, the cargo holds are not satisfactorily inerted, or the temperature of a refrigerated product is not adequate.

Mooring

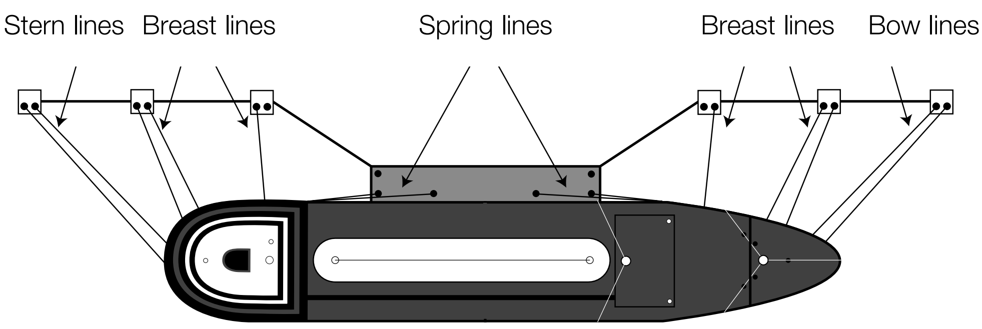


Figure 5 Typical mooring arrangement

219 Assuming that everything is satisfactory, and that the ship can be safely navigated to the berth, the first precaution for preventing an incident is the correct mooring of the ship (see Figure 5).

220 The berth owner or operator is responsible for providing adequate facilities for safe, secured mooring. The necessary facilities are dependent on:

- the size and type of ship;
- local tidal conditions;
- foreseeable weather conditions; and
- the nature of the cargo and ballasting operations.

221 The ship's master and the harbour master should control the actual mooring operations. For large ships, a mooring plan should be supplied, with calculations of the mooring system's performance for specified weather conditions. However, the master is responsible for the safe mooring of the ship, regardless of who supplies the mooring pattern. They also take responsibility for supplying suitable mooring lines and ensuring that the ship remains safely berthed. At many harbours, contractors managed by the harbour authority carry out the running of mooring lines, and the release of mooring lines, except in an emergency.

222 While the ship is alongside, the crew of the ship should keep an adequate watch on the moorings, particularly during cargo transfer.

223 Some berths may have small under-keel clearances for moored ships at certain states of the tide or when ships are fully or almost fully laden. Passing ships can then cause problems of ranging and place increased stress on the mooring lines.

224 The risk of ranging can be reduced by ensuring that the mooring lines are properly tended, and if necessary, by the ship increasing the number of mooring lines and by the harbour authority limiting the speed of passing ships. Ranging and drift alarms may be appropriate.

225 More detailed advice on mooring is given in other publications.[67,68]

Mobility of vessels

226 While berthed, the ship should be prepared to move away at short notice, tidal conditions permitted. This normally means that the engines, steering gear and other manoeuvring equipment should be kept ready for use.

227 For some ships, including those carrying flammable liquids and liquefied gases as defined in paragraphs 19-22, the Dangerous Substances in Harbour Areas Regulations 1987[6] require that the ship can be moved away from berth, tidal conditions permitted.

228 At some locations, tidal movement may leave a ship isolated in a dredged pool, or completely grounded. At others, the dock is closed off from the open water by gates. It may not be reasonably practicable to carry out cargo transfers only when the vessel is afloat and able to move into open water. If this is the case, your risk assessment will have considered these restrictions and determined whether you require any additional precautions or control measures, for example a higher standard of means of escape and emergency equipment.

229 Any maintenance work or repair work, which may immobilise a ship that is otherwise able to move, should only be carried out with the agreement of the harbour master, and should not take place during cargo transfer unless adequate provisions are made.

230 In some cases, it may be undesirable for a ship to cast off in an emergency. Examples include harbours with restricted channels to open water and those with many ships using the waterway. Casting off will also mean losing the benefit of the berth emergency control measures, such as fire-fighting equipment, and there may be a risk of injury to people and damage to equipment during hasty disconnection of hoses and moorings.

231 You and the ship's master should agree the procedure in the event of an emergency before cargo transfer starts. Where ships are subject to the legal requirement in paragraph 227, the harbour master can give an exemption certificate provided they are satisfied that no one's health and safety is prejudiced. The harbour authority also control the movements of other ships in the vicinity to ensure that cargo transfer operations are not put at risk.

Ship to berth access

232 Once the vessel is safely and effectively moored, there needs to be good means of access between the ship and the berth.

233 In some cases, for example with barges on inland waters, a combination of low freeboard and no tidal movement may mean you can easily access all parts of the vessel at all times. In other cases, however, you may require additional access. A correctly rigged and secured ship's accommodation ladder or gangway, set at a safe angle, can achieve this. Alternatively, you may provide similar gangways.

234 In all cases, the means of access should begin and end at a safe place, or lead onto other safe access. It is important that the means of access between ship and berth is considered together with the means of escape in case of emergency or fire.

Means of escape from the ship

235 For the same reasons as quoted in paragraph 72, there should be two separate routes off the ship where reasonably practicable. Since the manifold area is the most likely point of an incident, means of escape are recommended from either side of the ship's manifold area to the berth and at a remote distance from the manifold.

236 For large vessels it may only be feasible to provide one route. In this case it needs to be as close as possible to the ship's accommodation, since this is where the majority of the crew will be located.

237 In all cases, lifeboats should be kept available as an alternative means of escape for the ship's crew.

Communications

238 As mentioned in paragraph 53, effective communication between the ship's deck watch and the berth personnel should be maintained throughout operations at the berth.[69,70]

239 You should provide the means of communication, and there needs to be continuous contact between the ship's duty officer and the responsible person ashore. Two-way portable radios or a ship-to-shore telephone system are normally necessary. You need to consider the use of back-up systems if the normal means of communication fails. This may mean having sufficient numbers of fully charged batteries on standby for the radios. In some cases, the portable radio supplied by you can be supplemented by another portable radio, provided by the ship. This radio should preferably operate on a different frequency.

240 When the cargo being handled is flammable, the communication system used should be suitable for operation in potentially flammable atmospheres.

241 In some cases, radios or telephones may not be necessary. The factors to be considered include:

- the distance over which communication is needed;
- whether the crew members on deck watch and the personnel on shore can see and hear each other easily;
- weather conditions;
- noise levels.

242 Whichever method is used, there needs to be a clear understanding between the ship's crew and the shore personnel regarding who is in charge of each group, and who is in overall command. Where there are language problems with non-English speaking crews, a responsible person with sufficient technical knowledge and wherever possible an adequate command of a language understood by the ship's personnel, should be on board to liaise between ship and shore.

Information exchange

243 Before establishing the connection for cargo transfer, safety precautions should be drawn up to cover the periods before, during and after cargo transfer.

244 A ship-to-shore checklist usually fulfils this function. The checklist is completed jointly by the berth operator and ship's master, or people designated by them. In some cases, this is carried out as part of a more detailed survey of the ship and cargo by independent ship surveyors. The Dangerous Substances in Harbour Areas Regulations 1987[6] actually prohibit the transfer of bulk dangerous substances unless a ship-to-shore checklist has been completed. A suitable ship-to-shore checklist is included in the Approved Code of Practice to the Dangerous Substances in Harbour Areas Regulations 1987[38] or in the ISGOTT guide.[49]

245 Any faults found during the completion of the ship-to-shore checklist should be corrected before beginning cargo transfer. However, in some minor cases, cargo transfer may still go ahead provided an assessment of the risk has been carried out and a decision made between the ship's master and senior shore personnel on how to proceed.

246 If a major infringement of the ship-to-shore checklist is discovered, you or the harbour master can decide to refuse cargo transfer, and even require removal of the ship from the berth.

247 Additional information which needs to be discussed between you and the ship's master before cargo transfer includes:

- shipboard/shore emergency procedures;
- mooring;
- tidal range;
- ballasting arrangements;
- procedural arrangements;
- check of agreed loading rates;
- topping-off procedure;
- loading plan sequence;
- agreed maximum loading rate (dictated by emergency shutdown valve closure times - if fitted);
- emergency shutdown systems;
- condition of ship's inerting system, if required;
- actual or pending weather conditions and operational limits.

Ship-to-shore electrical continuity

248 Many berths are protected from corrosion by cathodic protection systems. Such systems are capable of producing electrical currents or voltages. Consequently, precautions need to be taken to prevent any sparking during the making and breaking of connections between ship and shore. Static electricity can also be generated during the cargo transfer due to the flow of liquid along a pipeline.

249 The build-up of electricity can be prevented by switching off the protection system and ensuring that the hoses and pipelines are electrically continuous, except for an insulating flange or one short section of non-conducting hose. Further guidance on such systems is contained in BS 7361, Part 1.[71] It is generally not feasible to switch off cathodic protection systems, particularly at berths frequently handling flammable liquids or gases.

250 If an insulating flange is used, you need to position it at the jetty end of any flexible hose where it is less likely to be disturbed. An ISGOTT[49] guide provides details of a suitable flange connection. You should take precautions against short-circuiting the flange, for example, by using insulated hooks for handling hose saddles.

251 The risk of electrostatic sparking can be minimised. On the shore side of the insulating flange or hose section, the piping and other metalwork should be suitably bonded to the berth earthing system. On the seaward side, the bonding should be to the ship.

252 The earthing system should be checked periodically, and any other metallic connections to the ship or berth should be bonded, as appropriate. The use of a separate bonding cable between ship and shore is ineffective and can introduce its own hazard (see ISGOTT[49]).

Precautions during cargo transfer

253 The operations which offer the greatest risk of loss of containment are: connecting the transfer systems between ship and shore; transferring the cargo; and disconnecting the systems following cargo transfer.

Monitoring of cargo transfer

254 Continuous monitoring should take place during cargo handling. A competent representative of the berth operator and a competent ship's officer should be present, with sufficient crew on board to deal with the operation and safety of the ship.

255 The representative of the berth operator should ideally remain close to the ship-to-shore connections, for carrying out any duties effectively. These duties may include:

- supervising the cargo transfer (including flow rates and pressures);
- ensuring the cargo hoses or articulated cargo arms are kept properly adjusted;
- preventing unauthorised access to the jetty by other people;
- controlling the activities of personnel on the jetty including off-duty members of the ship's crew;
- assisting in preventing unauthorised approach by other ships;
- ensuring the immediate raising of the alarm and shutdown of shore-based cargo handling equipment in the event of an incident;
- preventing minor incidents escalating into major ones;
- monitoring the ship's position in relation to the jetty and moorings.

256 It may be possible for one representative to supervise the cargo handling for two ships simultaneously. This may be acceptable, for example, where a 'finger-pier' jetty is being used by two ships, one either side of the jetty. The person concerned should be positioned between the land and the ship-to-shore connections so that their means of escape are not prejudiced.

257 In some cases, particularly at large jetty complexes, monitoring by closed-circuit television and control of the cargo transfer is carried out remotely from a control room. This has the advantage that no shore-based person is present at the site of any incident. On the other hand, someone in the vicinity can often detect problems at an early stage, by noticing unusual movements or noises, etc.

258 The option chosen should depend on the results of an appropriate risk assessment. The information that needs to be fed into the risk assessment includes:

- the level of automatic control present;
- the management systems in place;
- the emergency systems in place;
- prior knowledge of the capabilities of the ship and its crew, etc.

Emergency procedures

259 Initiating emergency procedures at the earliest stage of an incident can significantly reduce the impact of an incident on people and premises. You therefore need a written procedure for dealing with fires, spills or leaks. It should cover:

- raising the alarm;
- calling the emergency services;
- evacuating the area and providing safe havens; and
- tackling the fire or controlling the spill or leak (when it is safe to do so).

260 You need to consider the range of possible events which take into account the following:

- the nature and quantities of the cargoes involved;
- the location of the berth and its design; and
- the people, both on site and off site, who may be affected.

261 When they arrive, the fire brigade will assume responsibility for fire fighting and rescue operations. At the discretion of the fire brigade incident commander, they may undertake other appropriate emergency operations to prevent or limit any environmental damage the spillage might cause. It is therefore important that they are aware of the facilities and capabilities at the berth.

262 Where large numbers of employees on site or people off site may be at risk, one person should be nominated to carry out a risk assessment and, in consultation with the emergency services, prepare an emergency action plan.

263 For those sites subject to the Dangerous Substances in Harbour Areas Regulations 1987,[6] the harbour authority must develop an emergency plan for dealing with incidents involving dangerous substances. An associated Approved Code of Practice[38] gives advice on the requirements for emergency arrangements.

264 Formal on-site and off-site emergency plans are required at sites subject to regulations 7 to 12 of the Control of Industrial Major Accident Hazard Regulations 1984[8] (CIMAH) - see guidance booklets HSG25[72] and HSR21.[9]

Appendix 1: Legal requirements

Introduction

1 It is a legal requirement under health and safety law that those responsible for work activities ensure that:

- hazards are adequately identified;
- risks are assessed; and
- suitable control measures are put into practice.

2 Measures must be taken to eliminate or control the risks unless doing so involves a sacrifice (time, trouble or cost) which is grossly disproportionate to the level of risk. However, the ability to pay for additional control measures is not a deciding factor in whether they are necessary.

3 Where it is not possible to remove the risk then the arrangements for managing the activity safely are particularly important.

4 The following paragraphs outline the various health and safety legislation applicable to the bulk transfer of hazardous liquids and gases between ship and shore.

Confined Spaces Regulations 1997[25]

5 These Regulations apply when hazards exist because of the confined nature of certain work activities, and the possible presence of substances or conditions which, if taken together, could increase the risk to people's safety or health.

6 Guidance[26] on the Regulations and a leaflet[27] are available.

Control of Industrial Major Accident Hazards Regulations 1984[8] (as amended 1989/90)

7 These Regulations apply at two levels to certain premises where specified quantities of particular substances are stored or used. The main aim of the Regulations is to prevent major accidents occurring; a secondary objective is to limit the effects of any which do happen. A major accident is a major emission, fire or explosion resulting from uncontrolled developments which leads to serious danger to people or the environment.

8 The general requirements apply at both levels and require the person in control of the industrial activity to demonstrate that the major accident hazards have been identified and that the activity is being operated safely. The additional requirements that apply at the second level include the submission of a written safety report, preparation of an on-site emergency plan and provision of certain information for the public. The HSE publication HSR21[9] provides guidance on the Regulations.

9 The CIMAH Regulations will be replaced in early 1999 by regulations implementing a new European Directive, the Seveso II Directive. The new regulations will have much in common with the existing CIMAH Regulations.

Control of Substances Hazardous to Health Regulations 1994[22]

10 These Regulations require employers to assess the risks arising from substances hazardous to health at work and to decide on the measures needed to protect the health of employees. The employer is also required to take appropriate action to prevent or adequately control exposure to substances hazardous to health.

11 Substances covered by the Regulations include carcinogenic substances and those which, under the Chemicals (Hazard Information and Packaging for Supply) Regulations 1994,[13] are labelled as very toxic, toxic, harmful, corrosive or irritant. The Regulations also cover those substances assigned occupational exposure limits.

The Dangerous Substances in Harbour Areas Regulations 1987[6]

12 These Regulations are concerned with the safe handling and storage of dangerous substances in harbours and harbour areas. The Regulations also give harbour authorities the powers to make bye-laws relating to the dangerous substance, subject to certain conditions.

13 A guide[73] and an Approved Code of Practice[38] accompany the Regulations.

Department of the Environment, Transport and the Regions legislation, and Merchant Shipping Acts[18]

14 Control over the normal shipboard activities of the crew of a ship, under the direction of the master of the ship, is regulated by the Department of the Environment, Transport and the Regions under various Merchant Shipping Acts.

15 Because of this, certain duties under the Dangerous Substances in Harbour Areas Regulations 1987[6] do not extend to the master or crew of a seagoing ship or to the employer of such people in relation to their normal shipboard activities. These activities are covered by, for example, the Merchant Shipping (Dangerous Substances and Marine Pollutants) Regulations 1997.[20]

The Docks Regulations 1988[5]

16 These Regulations contain safety requirements for general dock work. They impose duties on employers and employees on the shore and also on a ship's owners, master and crew. The duties include requirements for lighting, access, maintenance, and rescue from the water.

17 An Approved Code of Practice[74] accompanies the Regulations.

Electricity at Work Regulations 1989[34]

18 These Regulations require precautions to be taken against the risk of death or injury from electricity in work activities. They require electrical installations and equipment to be properly constructed, maintained and fit for the purpose and environment in which they are to be used.

19 Advice is available in guidance booklet HSR25.[75]

Equipment and Protective Systems Intended for Use in Potentially Explosive Atmospheres Regulations 1996[37]

20 These Regulations are aimed at manufacturers and suppliers. They apply to equipment, protective systems, safety devices, controlling devices, regulating devices and components for use in potentially explosive atmospheres.

21 They require the equipment to be safe, to meet the essential health and safety requirements, to have undergone an appropriate conformity assessment and to be affixed with CE marking. There is a transitional period until 30 June 2003. Manufacturers can, in the meantime, continue to ensure their equipment is safe by other means.

Fire Precautions (Workplace) Regulations 1997[2]

22 These Regulations control what have become known as the 'general fire precautions', covering:

- the means of escape in case of fire;
- the means for ensuring the escape routes can be used safely and effectively;
- the means for fighting fires;
- the means for giving warning in the case of fire; and
- the training of staff in fire safety.

Health and Safety at Work etc Act 1974[3]

23 This Act is concerned with securing the health, safety and welfare of people at work, and with protecting those who are not at work, from risks to their health and safety arising from work activities.

24 The Act and its relevant statutory provisions also deal with controlling the storage and use of explosives and highly flammable or otherwise dangerous substances. The general duties in sections 2 to 4 and 6 to 8 of the Act apply to all work activities covered in this book.

Highly Flammable Liquids and Liquefied Petroleum Gases Regulations 1972[4]

25 These Regulations apply when liquids, which have a flashpoint of less than 32°C and which support combustion (when tested in the prescribed manner), are present at premises subject to the Factories Act 1961.[76] The Regulations include provisions for these highly flammable liquids relating to:

- precautions during storage;
- precautions against spills and leaks;
- controls for sources of ignition in areas where vapours may accumulate;
- means to prevent the escape of vapours;
- dispersal of dangerous concentrations of vapours; and
- controls on smoking.

Management of Health and Safety at Work Regulations 1992[1]

26 These Regulations require all employers and self-employed people to assess the risks to workers and others who may be affected by their undertakings, so that they can decide which measures they need to take to comply with health and safety law. The Regulations go on to require employers and self-employed people to implement appropriate arrangements for managing health and safety. Health surveillance (where appropriate), emergency planning, and the provision of information and training are also included.

27 An Approved Code of Practice[30] gives guidance on the Regulations.

Manual Handling Operations Regulations 1992[44]

28 These Regulations implement the directive on the minimum safety and health requirements for the manual handling of loads where there is a risk to employees.

29 They require employers to first consider alternatives to manual handling. If the alternatives are not practicable, employers must assess the manual handling operations and, where there is a risk of injury, take appropriate steps to reduce the risk so far as is reasonably practicable.

30 HSE has produced guidance on the Regulations[77] and a leaflet.[78]

Notification of Installations Handling Hazardous Substances Regulations (NIHHS) 1982[79]

31 These Regulations require premises with specified quantities of particular substances to be notified to HSE.

32 Following the Planning (Hazardous Substances) Act 1990[80] and Regulations 1992,[81] the presence of NIHHS Schedule 1 substances and quantities, together with some from CIMAH Schedule 3,[8] on, over or under land requires consent from the hazardous substances authorities. Similar provisions also apply in Scotland.

The Personal Protective Equipment at Work Regulations 1992[21]

33 These Regulations aim to ensure the safe use and the free provision of personal protective equipment (PPE) where the risk has not been controlled by other means. They include general duties covering the selection of suitable PPE, maintenance, information, instructions and training.

34 Guidance on the Regulations[82] is available.

The Pressure Systems and Transportable Gas Containers Regulations 1989[47]

35 These Regulations require the users of installed systems and owners of mobile systems to know the safe operating limits of their pressure systems before the systems are used. They also need to ensure that a suitable written scheme of examination is in place.

36 A written scheme of examination is a document containing information about selected items of plant or equipment which form a pressure system, operate under pressure and contain a ‘relevant fluid’.

37 The term ‘relevant fluid’ is defined in the Regulations and covers compressed or liquefied gases above 0.5 bar pressure, pressurised hot water above 110 °C and steam at any pressure.

38 A guide[83] and an Approved Code of Practice[84] accompany the Regulations.

Provision and Use of Work Equipment Regulations 1998[85]

39 These Regulations aim to ensure the provision of safe work equipment and its safe use. They include general duties covering the selection of suitable equipment, maintenance, information, instruction and training, and they also address the need for equipment to control selected hazards.

Appendix 2: Hazardous area classification

1 The first approach should always be to control the storage and use of flammable materials to minimise the extent of any hazardous area.

2 The concept of hazardous area classification has, in the past, been used solely as the basis for selecting fixed electrical apparatus. However, it also can be used to help eliminate potential ignition sources, including portable electrical equipment, vehicles, hot surfaces, etc, from flammable atmospheres.

3 Advice on classifying hazardous areas can be found in BS EN 60079-10: 1996.[86]

4 Hazardous areas are classified into three types of zone: Zone 0, Zone 1 and Zone 2, which are three-dimensional spaces in which flammable concentrations of vapours may be present.

5 The higher the zone number the lower the likelihood that a flammable vapour will exist within the zone.

6 Electrical equipment suitable for use in Zone 0 is produced to a higher specification (that is, it is less likely to produce an incendive spark on failure) than that suitable for use in Zone 1, which in turn is produced to a higher standard than that for use in Zone 2.

7 The aim is to reduce to an acceptable minimum level the probability of a flammable atmosphere coinciding with an electrical or other source of ignition. The three zones are defined as follows:

- **Zone 0**
  An area in which an explosive gas atmosphere is present, either continuously or for long periods.
  A Zone 0 classification is probably appropriate for enclosed spaces that are likely to contain a flammable vapour continuously or for long periods. Examples include the inside of vapour emission control equipment and storage containers. It may also apply in the immediate vicinity of exposed liquid surfaces and during continuous releases of flammable material.

- **Zone 1**
  An area in which an explosive gas atmosphere is likely to occur in normal operation.
  A Zone 1 classification is likely to be appropriate if either of the following apply:
  - The area contains plant which may, as part of normal operation, release sufficient flammable material to create a hazard.
  - The area fulfils the requirements for Zone 2 but the ventilation or drainage is inadequate to ensure a flammable atmosphere is quickly dispersed. This is likely to apply to pits, trenches and similar depressions in the case of heavier-than-air vapours and to enclosed roof spaces for lighter-than-air vapours.

- **Zone 2**
  An area in which an explosive gas atmosphere is not likely to occur in normal operation and, if it does occur, is likely to do so infrequently and to exist for a short period only.
  A Zone 2 classification can be applied if all of the following are satisfied:
  - In normal operation, there is no flammable liquid or vapour in direct contact with the surrounding atmosphere.
  - The plant concerned is constructed, installed and maintained to prevent, in normal operation, the release of sufficient flammable material to create a hazard.
  - The area is ventilated and drained well enough to disperse any flammable atmosphere quickly in the event of a release, so that any contact with electrical apparatus is only for a brief period.
- Areas outside these zones are defined as non-hazardous.

8 It is good practice to draw up a plan which shows the extent of each zone. This will vary on the layout, the design of the plant, ventilation and the type of materials handled.

9 Further advice is available in industry codes BS EN 60079-10 Part 10: 1996[86] and the Institute of Petroleum's model code of safe practice part 15 Area classification code for petroleum installations.[87]

References and further reading

1 *Management of Health and Safety at Work Regulations 1992* SI 1992/2051 HMSO 1992 ISBN 0 11 025051 6

2 *Fire Precautions (Workplace) Regulations 1997* SI 1997/1840 The Stationery Office 1997 ISBN 0 11 064738 6

3 *Health and Safety at Work etc Act 1974* Ch 37 HMSO 1974 ISBN 0 10 543774 3

4 *Highly Flammable Liquids and Liquefied Petroleum Gases Regulations 1972* SI 1972/917 HMSO 1972 ISBN 0 11 020917 6

5 *The Docks Regulations 1988* SI 1988/1655 HMSO 1988 ISBN 0 11 087655 5

6 *The Dangerous Substances in Harbour Areas Regulations 1987* SI 1987/37 HMSO 1987 ISBN 0 11 076037 9

7 *Five steps to risk assessment* Leaflet INDG163(rev1) HSE Books 1998 (single copy free or priced packs of 10 ISBN 0 7176 1565 0 Web version available at www.hse.gov.uk/pubns/indg163.pdf)

8 *Control of Industrial Major Accident Hazards Regulations 1984* SI 1984/1902 HMSO ISBN 0 11 047902 5 (as amended) (Out of print)

9 *A guide to the Control of Industrial Major Accident Hazards Regulations 1984* HSR21 HSE Books 1990 ISBN 0 11 885579 4

10 *International maritime dangerous goods code* International Maritime Organisation 1994 ISBN 92 801 1314 3

11 *International code for the construction and equipment of ships carrying dangerous chemicals in bulk* (IBC Code) International Maritime Organisation 1994 ISBN 92 801 1315 1

12 *Code for the construction and equipment of ships carrying dangerous chemicals in bulk* (BCH Code) International Maritime Organisation 1993 ISBN 92 801 1302 X

13 *The Chemicals (Hazard Information and Packaging for Supply) Regulations 1994* SI 1994/3247 HMSO 1994 ISBN 0 11 043877 9 as amended by *The Chemicals (Hazard Information and Packaging for Supply) (Amendment) Regulations 1996* SI 1996/1092 HMSO 1996 ISBN 0 11 054570 2 and *The Chemicals (Hazard Information and Packaging for Supply) (Amendment) Regulations 1997* SI 1997/1460 The Stationery Office 1997 ISBN 0 11 063750 X

14 *International code for the construction and equipment of ships carrying liquefied gases in bulk* (IGC Code) International Maritime Organisation 1993 ISBN 92 801 1277 5

15 *Code for the construction and equipment of ships carrying liquefied gases in bulk* International Maritime Organization 1983 ISBN 92 801 1165 5

16 *Code for existing ships carrying liquefied gases in bulk International Maritime Organisation* ISBN 92 801 1051 9 plus supplement ISBN 92 801 1101 9

17 *Environmental Protection Act 1990* HMSO 1990 ISBN 0 10 544390 5

18 The Department of the Environment, Transport and the Regions has issued an amendment to the Merchant Shipping (Dangerous Goods) Regulations 1981, and prepared as an Annex to the associated Merchant Shipping Notice, a Code of Practice to provide guidance on those aspects of the handling of dangerous substances in harbour areas which are the responsibility of the master of a ship. This Code of Practice complements the Approved Code of Practice to the Dangerous Substances in Harbour Areas Regulations 1987.[38]

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Glossary

Auto-ignition	The minimum temperature at which a material will ignite spontaneously under specified test conditions. Also referred to as the minimum ignition temperature.
Bonding	The connecting together of metal parts to ensure electrical continuity.
Cathodic protection	The prevention of corrosion by electrochemical techniques.
Combustible	Capable of burning in air when ignited.
Corrosive	Capable of destroying human tissue and causing normal construction materials to corrode at an excessive rate.
Enforcing authority	The authority with responsibility for enforcing the Health and Safety at Work etc Act 1974[3] and its relevant statutory provisions.
Flame arrester	A device fitted in gas vent pipelines which is used to prevent the passage of flames. Most flame arresters consist of a permeable matrix of metal, ceramic or other heat-resisting material which can cool a flame and any other combustion products below the temperature required for the ignition of the unreacted flammable gas or vapour on the other side of the flame arrester.
Flammable	Capable of burning with a flame.
Flashpoint	The minimum temperature at which a liquid, under specific test conditions, gives off sufficient flammable vapour to ignite momentarily on the application of an ignition source.
Freeboard	The vertical distance from the waterline to the uppermost continuous deck of the ship where there are permanent means of closing all deck openings.

General fire precautions	Those precautions taken to safeguard people the event of fire, ie: ■ the means of escape; ■ the means for ensuring that escape routes can be used safely and effectively, at all material times; ■ the means for people in the workplace to fight fire; and ■ the means for giving warning within the workplace in case of fire.
Hazard	The disposition of a thing, a condition or a situation to cause injury. The 'injury' of concern is physical injury and/or ill health to people, though this may be accompanied by harm to property and the environment.
Hazardous area	An area where flammable or explosive gas or vapour-air mixtures (often referred to as explosive gas-air mixtures) are, or may be expected to be, present in quantities which require special precautions to be taken against the risk of ignition (see Appendix 2).
Incendive	Having sufficient energy to ignite a flammable mixture.
Lower explosion limit (LEL)	The minimum concentration of vapour in air below which propagation of a flame will not occur in the presence of an ignition source. Also referred to as the lower flammable limit or lower explosive limit.
Occupational exposure limit (OEL)	The limit of concentration in the air of a substance hazardous to health, averaged over a specified time period.
Pressure surge	A sudden increase in the pressure of a liquid in a pipeline brought about by an abrupt change in flow velocity.
Process fire precautions	Those precautions taken in a workplace to precautions reduce the likelihood of an outbreak of fire and its escalation should it occur. The terms 'general fire precautions' and 'process fire precautions' overlap and may affect each other in practice. For example, the means for fighting fire required in connection with the handling of flammable liquids and gases will also form part of the general fire precautions. Similarly, the general fire precautions may be affected by the presence of the flammable substances and, for example, improved means of escape in case of fire may be necessary.

Reasonably practicable	The degree of risk in a particular job or practicable workplace needs to be balanced against the time, trouble, cost and physical difficulty of taking measures to avoid or reduce the risk. Measures must be taken to eliminate or control the risks unless it is clear that the cost of doing so is grossly disproportionate to the level of the risk. However, the ability to pay for additional control measures is not a deciding factor as to whether they are necessary.
Risk	The chance of something adverse happening where 'something' refers to a particular consequence of the manifestation of a hazard. Risk reflects the likelihood that harm will occur and its severity in relation to the numbers of people who might be affected, and also reflects the consequences to such people.
Risk assessment	The process of identifying the hazards present in any undertaking (whether arising from work activities or other factors) and those likely to be affected by them, and of evaluating the extent of the risks involved, bearing in mind whatever precautions are already being taken.
Topping off	The operation of completing the loading of a tank to a required ullage.
Toxic	Poisonous.
Upper explosion limit (UEL)	The maximum concentration of vapour in air above which the propagation of a flame will not occur. Also referred to as the upper flammable limit or upper explosive limit.
Vapour	The gaseous phase released by evaporation from a material that is a liquid at normal temperatures and pressure.
Zone	The classified part of a hazardous area, representing the probability of a flammable vapour (or gas) and air mixture being present (see Appendix 2).

Further information

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