ICHCA International Limited

INTERNATIONAL SAFETY PANEL

SAFETY BRIEFING PAMPHLET SERIES #26

The Safe Handling of Dangerous Bulk Liquids and Gases at the Ship/Shore Interface

By

Jeff Hurst

ICHCA International Limited

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No. 4 Classification Societies (*Revised*)
No. 5 Container Terminal Safety
No. 6 Guidance on the Preparation of Emergency Plans (*under revision)*
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This publication is one of a series developed by the International Safety Panel ("Safety Panel") of ICHCA International Limited ("ICHCA"). The series is designed to inform those involved in the cargo-handling field of various practical health and safety issues. ICHCA aims to encourage port safety, the reduction of accidents in port work and the protection of port workers' health.

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THE SAFE HANDLING OF DANGEROUS BULK LIQUIDS AND GASES AT THE SHIP/SHORE INTERFACE

PART A - GENERAL

1. Introduction

Statistics for incidents involving bulk liquid and gases in tankers show that these occur more frequently in Port than at sea or in confined waters. This is a very significant statistic for tankers spend only a small proportion of their time in Port. So the risk of an incident occurring whilst a vessel is in Port is greater than at any other time during its operational life.

1.1 The ship/shore interface is therefore worthy of special attention. This encompasses equipment, procedures and personnel, both on ship and shore, each of which can create difficulties and misunderstandings. It is when cargo is being transferred that the greatest risk arises.

1.2 The purpose of this publication is to give a brief introduction to and appreciation of the subject to those who are not otherwise involved in marine transport and storage of bulk liquids and gases .Its scope is intended to cover all bulk liquids. However, because the main hazards occur when there is a release of dangerous cargo, and such loss of containment may lead to the release of a dangerous substance with the potential consequence of fire and explosion, or toxic release to the air, sea or land. it also provides some basic advice on the hazards associated with these types of products, and provides an illustration of the sort of precautions that must be taken. It is not intended to give definitive guidance in what is a vast and complicated subject. This will only be gained from the appropriate publications, associations and institutions world wide.

1.3 This may result in damage to the health of people, to property and to the environment.

1.4 Common causes of such incidents include:

- Inadequate design, installation or maintenance of installations and equipment
- Operator error due to lack of supervision and insufficient training
- Ineffective management of operators
- Lack of awareness of the properties of the dangerous substance
- Arson or vandalism

1.5 Loss of containment can occur in a number of ways including a burst hose or overfilled tank.

1.6 No matter how sophisticated the equipment or refined the operating procedures, safety in the end depends on people. The best and most technically advanced equipment will count for little unless it is properly maintained and properly used. Training can do much to reduce the likelihood of an accident. The avoidance of an incident or, given that the incident has occurred, the terminals ability to bring this incident quickly under control, requires constant vigilance on the part of the berth operator.

1.7 There are a number of publications giving detailed guidance on the handling of hazardous substances. The bibliography attached to this booklet will give guidance as to where to look further. The IAPH/ICS/OCIMF publications '*International Safety Guide for Oil Tankers and Terminals'* and *'International Safety Guide for Chemical Tankers and Terminals',* the ICS/OCIMF publication *'Safety Guide for terminals handling Ships carrying liquefied gases in bulk*' and the SIGTTO publication '*Liquefied gas handling principles on ships and in terminals'* are to be regarded as the definitive guide to the safe operation of vessels and terminals handling these hazardous products.

1.8 Because of the somewhat technical aspects of the subject some of the terms used may be unfamiliar and obscure. The following section gives definitions of the terms that are used in this document and some that are used commonly elsewhere, which may be expanded on later within the text.

1.9 The transport of dangerous goods in packaged form is required to be carried out in accordance with the International Maritime Dangerous Goods Code (IMDG Code) produced by the IMO. Whilst it does not apply to the transport of bulk dangerous goods, it is still the most complete and up to date guide on the chemical properties and hazard classification of dangerous goods. Whilst Chapter 2 of ISGOTT discusses the hazards of petroleum cargoes, the IAPH/ICS/ISGOTT/OCIMF/ SIGTTO publications mentioned in section 1.10 give no guidance on, or reference to the chemical properties of any of the dangerous substances that may be carried by sea in bulk. The IMDG Code will be available in most Port or Harbour organisations world- wide. For the purpose of this document only, therefore, a dangerous substance may be regarded as any liquid or gas that is classified in the IMDG Code as flammable, toxic (poisonous) corrosive or a marine pollutant. Chemical properties of a specific bulk liquid cargo may be obtained from the appropriate Material Safety Data Sheet (MSDS). IMO Resolution MSC 150(77) gives recommendations for MSDS for Marpol Annex 1 cargoes. Further reference may be found in MARPOL 73/78, and specific details of the toxicology of these substances, and their synonyms or 'other names' may be found in Saxs' 'Dangerous Properties of Industrial Materials'.

2. Definitions

Administration – Means the Maritime Administration of the Government of the State whose flag the ship is entitled to fly.

ALARP – As low as reasonably practicable

Approved Equipment – Equipment of a design that has been tested and approved by an appropriate authority such as a government department or classification society. The authority should have certified the equipment as safe for use in a specific hazardous atmosphere.

Auto-Ignition – The ignition of a combustible material without initiation by a spark or flame, when the material has been raised to a temperature at which self sustaining combustion occurs.

Base - A substance which turns litmus paper blue and has the ability to neutralise acids to form salts.

Berth - Any part of a quay, wharf, pier, jetty or dock at which a ship may tie up and load or discharge cargo.

Berth Operator – The person or company who has the day to day responsibility for

the berth.

Bonding – The connecting together of metal parts to ensure electrical continuity.

Cathodic Protection – The prevention of corrosion by electrochemical techniques. On tankers it may be applied either externally to the hull or internally to the surfaces of tanks. At terminals, it is frequently applied to steel piles and fender panels.

Cold Work - Work which cannot create a source of ignition.

Combustible (also referred to as 'Flammable') – Capable of being ignited and of burning. For the purposes of this guide the terms 'combustible' and 'flammable' are synonymous.

Combustible Gas Indicator9also may be referred to as Explosimeter – An instrument for measuring the composition gas/air mixtures, usually giving the result as a percentage of the lower flammable limit (LFL). This is sometimes referred to as the lower explosive limit (LEL).

Dangerous Area –
As area on a tanker or berth which for the purposes of the installation and use of electrical equipment is regarded as dangerous.

Dangerous Substance –. In this publication a dangerous substance is any liquid or gas that is classified as flammable, toxic (poisonous) corrosive or a marine pollutant in the International Maritime Dangerous Goods (IMDG) code. Whilst strictly speaking IMDG does not apply to bulk goods it is considered the most appropriate reference for those working in Ports (see note 1.13 above). The IMO publication "Safe Transport of Dangerous Cargoes and related activities in Port Areas 2007 edition page 4 properly identifies dangerous cargoes .

Dry Chemical Powder – A flame inhibiting powder used in Fire Fighting.

Density – Mass per unit volume.

Earthing (also referred to as 'Grounding') - The electrical connection of equipment to the main body of the ship or other structure to ensure that it is at earth potential. On board ship, the connection is made to the main metallic structure of the ship which is at earth potential because of the conductivity of the sea.

Entry Permit – A document issued by a responsible person permitting entry to a space or compartment during a specific time interval.

Explosimeter – See 'Combustible gas indicator'.

Explosion-protected (sometimes colloquially known as Flame-proof) – Electrical equipment is defined and certified as explosion protected when it is enclosed in a case which is capable of withstanding the explosion within it of a hydrocarbon gas/air mixture or other specified flammable gas mixture without releasing combustion products hot enough to ignite the surrounding atmosphere. It must also prevent the ignition of such a mixture outside the case either by spark or flame from the internal explosion or as a result of the temperature rise of the case following the internal explosion. The equipment must operate at such an external temperature that a surrounding flammable atmosphere will not be ignited. ('T' rating)

Explosive Range – See 'Flammable range'.

Flame Screen – A portable or fitted device incorporating one or more corrosion resistant wire woven fabrics of very small mesh which is used for preventing sparks from entering a tank or vent opening or, for a short time, preventing the passage of flame. (Not to be confused with flame arrester.)

Flammable (also referred to as 'Combustible') – Capable of being ignited and or burning. For the purposes of this guide the terms 'flammable' and 'combustible' are synonymous.

Flammable Range (also referred to as 'Explosive Range') – The range of hydrocarbon gas concentrations in air between the lower and upper flammable (explosive) limits. Mixtures within this range are capable of being ignited and or burning.

Flashpoint – The lowest temperature at which a liquid gives off sufficient gas to form a flammable gas mixture near the surface of the liquid. It is measured in a laboratory in standard apparatus using a prescribed procedure. It represents the change point from safe to risk.

Foam – An aerated solution which is used for fire prevention and fire fighting.

Foam Concentrate (also referred to as 'Foam Compound') – The full strength liquid received from the supplier which is diluted and processed to produce foam.

Foam Solution – The mixture produced by diluting foam concentrate with water before processing to make foam.

Gas Free – A tank, compartment or container is gas free when sufficient fresh air has been introduced into it to lower the level of any flammable, toxic, or inert gas to that required for a specific purpose, e.g. hot work, entry, etc.

Gas Free Certificate – A certificate issued by an authorised responsible person confirming that, at the time of testing, a tank, compartment or container was gas free for a specific purpose.

Grounding – See 'earthing'.

Halon – A halogenated hydrocarbon used in fire fighting which inhibits flame propagation. Its use was banned by the Montreal Convention from 1st January 2004.

Hazardous area – An area on shore which for the purposes of the installation and use of electrical equipment is regarded as dangerous. Such hazardous areas are graded into hazardous zones depending upon the probability of the presence of a flammable gas mixture. (see Dangerous Area).

Hazardous Zone – See 'Hazardous area'.

Hot Work – Work involving sources of ignition or temperatures sufficiently high to cause the ignition of a flammable gas mixture. This includes any work requiring the use of welding, burning or soldering equipment, blow torches, some power driven tools, including pneumatic drills and chisels, both hand and power, portable electrical equipment which is not intrinsically safe or contained within an approved explosion-proof housing, and internal combustion engines.

Hot Work Permit – A document issued by a responsible person permitting specific hot work to be done during a specific time interval in a defined area.

Hydrocarbon Gas – A gas composed entirely of hydrocarbons.

Inert Condition – A condition in which the oxygen content throughout the atmosphere of a tank has been reduced to 8 per cent or less by volume by the addition of inert gas.

Inert Gas – A gas or a mixture of gases, such as flue gas, containing insufficient oxygen to support the combustion of hydrocarbons. For guidance on Inert gas systems in tankers please refer to MSC Circ 353 and IMO Resolutions A 567 (14) and A 473 (XII)

Inerting - The introduction of inert gas into a tank with the object of attaining the inert condition.

Insulating Flange – A Flanged joint incorporating an insulating gasket, sleeves and washers to prevent electrical continuity between pipelines, hose strings or loading arms.

Liquefied Natural Gas (LNG) – A mixture of gaseous hydrocarbons found in their natural state in petroleum bearing regions throughout the world.

Liquefied Petroleum Gas (LPG) – A compressed or liquefied gas obtained as a by product in petroleum refining.

Liquid Relative Density (Specific Gravity) – The relative density of a liquid in comparison to that of water. Its value depends on temperature.

Loading Overall – The loading of cargo or ballast 'over the top' through an open ended pipe or by means of an open ended hose entering a tank through a hatch or other deck opening, resulting in the free fall of liquid.

Lower Flammable Limit (LFL) – The concentration of a flammable gas in air below which there is insufficient gas to support and propagate combustion. Sometimes referred to as lower explosive limit (LEL).

Material Safety Data Sheet (MSDS) – A document which identifies a substance and all its constituents. It provides all necessary information to manage the substance safely.

Naked Lights – Open flames or fires, lighted cigarettes, cigars, pipes or similar smoking materials, any other unconfined sources of ignition, electrical and other equipment liable to cause sparking while in use, and unprotected light bulbs.

Non-Volatile Petroleum – Petroleum having a flash point of 60^{o}C (140^{o}F) or above as determined by the closed cup method of test.

Oxygen Analyser/ Meter – An instrument for determining the percentage of oxygen in a sample of the atmosphere drawn from a tank, pipe or compartment.

Packaged Cargo – Petroleum or other cargo in drums, packages or other containers.

Occupational Exposure Limits (OEL) – The maximum exposure to a toxic

substance that is allowed by appropriate regulatory standards, including those of flag States. OEL's are usually expressed as :

Time Weighted Average (TWA) – the airborne concentrations of a toxic substance averaged over an 8 hour period, usually expressed in parts per million (PPM).

Short Term Exposure Limit (STEL) – the airborne concentration of a toxic substance averaged over any 15 minute period, usually expressed in parts per million (PPM).

Some administrations have introduced a Workplace Exposure Limit which replaces both OELs and MELs (maximum Exposure Limits) with a single limit which may not be exceeded

Petroleum – Crude oil and liquid hydrocarbon products from it.

Petroleum Gas – A gas evolved from petroleum. The main constituents of petroleum gases are hydrocarbons, but they may also contain other substances, such as hydrogen sulphide or lead alkyls, as minor constituents.

Pour Point – The lowest temperature at which petroleum oil will remain fluid.

Pressure Surge – A sudden increase in the pressure of the liquid in a pipeline brought about by an abrupt change in flow velocity.

Pressure/Vacuum Relief Valve (P/V Valve) – A device which provides for the flow of the small volumes of vapour, air or inert gas mixtures caused by thermal variations in a cargo tank. Its purpose is to prevent dangerous overpressure or vacuum conditions from affecting the structural integrity of a tank.

Purging – The introduction of inert gas into a tank already in the inert condition with the object of:

(1) Further reducing the existing oxygen content; and/or
(2) Reducing the existing hydrocarbon gas content to a level below which combustion cannot be supported if air is subsequently introduced into the tank.

Reid Vapour Pressure (RVP) – The vapour pressure of a liquid determined in a standard manner in the Reid apparatus at a temperature of 37.8^{o}C and with a ratio of gas to liquid volume of 4:1. Used for comparison purposes only. See 'True Vapour Pressure'.

Responsible Officer (or person) – A person appointed by the employer or the master of the ship and empowered to take all decisions relating to a specific task, having necessary knowledge and experience for that purpose.

Salts - The substances formed when an acid reacts with a metal or base, e.g. common salt, (sodium chloride).

Safety Management System (SMS) - A formal, documented system required by the ISM Code, compliance with which should ensure that all operations on board ship are carried out in a safe manner

SOLAS – IMO's International Convention for the Safety of Life at Sea.

Spontaneous Combustion – The ignition of material brought about by a heat

producing (Exothermic) chemical reaction within the material itself without exposure to an external source of ignition.

Static Electricity – The electricity produced by dissimilar materials through physical contact and separation.

Stripping – The final operation in pumping bulk liquid from a tank or pipeline.

Tanker – A ship designed to carry liquid cargo in bulk, including a combination carrier when being used for this purpose.

Tank Cleaning – The process or removing cargo vapours, liquid or residue. Usually carried out so that tanks can be entered for inspection or hot work.

Terminal – A place where tankers are berthed or moored for the purpose of loading or discharging cargo.

Terminal Representative – A person designated by the terminal to take responsibility for an operation or duty.

Threshold Limit Value (TLV) – The time-weighted average concentration of a substance to which workers may be repeatedly exposed, for a normal 8-hour work day or 40-hour work week, day after day, without adverse effect. (See also occupational exposure limits).

Topping Off – The operation of completing the loading of a tank to a required ullage.

Toxicity – The degree to which a substance or mixture of substances can harm humans.

'Acute Toxicity' involves harmful effects through a single short- term exposure.

'Chronic Toxicity' is the ability of a substance or mixture of substances to cause harmful effects over an extended period, usually upon repeated or continuous exposure, sometimes lasting for the entire life of the exposed organism.

Ullage – The depth of the space above the liquid in a tank.

Upper flammable limit (UFL) – The concentration of a hydrocarbon gas in air above which there is insufficient oxygen to support and propagate combustion. Sometimes referred to as upper explosive limit (UEL).

Vapour – A gas below its critical temperature.

Vapour Emission Control System – An arrangement of piping and equipment used to control vapour emissions during tanker operations, including ship and shore vapour collection systems, monitoring and control devices and vapour processing arrangements.

Vapour Lock System – Equipment fitted to a tank to enable the measuring and sampling of cargoes without release of vapour/inert gas pressure.

Viscosity – The property of a fluid which tends to prevent one layer moving over another. High viscosity products are difficult to pump at ambient temperature.

Volatile Fluid - A liquid with a tendency to become vapour at specified conditions of temperature and pressure.

Volatile Petroleum – Petroleum, having a flash point below 60^{o}C as determined by the closed cup method of testing.

Water Fog – A suspension in the atmosphere of very fine droplets of water usually delivered at a high pressure through a fog nozzle for use in fire fighting.

Water Spray – A suspension in the atmosphere of water divided into coarse drops by delivery through a special nozzle for use in fire fighting.

Work Permit – A document issued by a responsible person permitting specific work to be done during a specific period in a defined area.

PART B - HAZARDOUS PROPERTIES OF DANGEROUS SUBSTANCES

In the event of a loss of containment during a cargo loading/discharge operation the consequences will depend on a number of factors.

However, the major contributor will be the hazardous characteristics of the substance or substances involved. These may result in:

- Fire and/or Explosion
- Release of Toxic Substance
- Release of a Marine Pollutant
- Frostbite

These are further explained as follows:

3. Fire and Explosion

These are likely to occur when a flammable substance comes into contact with an ignition source. This may be because of a release into an uncontrolled environment, or the introduction of an ignition source into a controlled environment.

3.1 The Fire Triangle

Fire is an example of a fast chemical reaction between a combustible substance and oxygen, accompanied by the evolution of heat. An explosion is an even more spectacular example of the same reaction.

The three requirements for fire are:

- Oxygen (except in very special circumstances)
- A fuel or combustible substance
- A source of energy for ignition

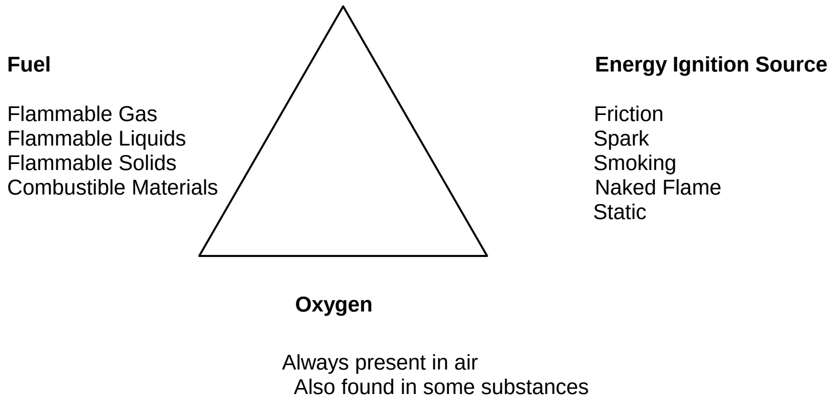
3.1.1 Fire always requires oxygen to occur, or having started, to continue. The chief source of oxygen is air. A number of other substances can be the source of oxygen in a fire. These are substances containing oxygen, readily available under fire conditions. An example is sodium chlorate. A third source of oxygen can be from the combustible substance itself, for example ammonium nitrate.

3.1.2 The second requirement is a combustible substance or fuel, this includes a large

number of organic (wood, paper, gasoline, LNG, and plastics) and inorganic (hydrogen, sulphur, phosphorus and magnesium) materials.

3.1.3 The ignition source can be any source of energy to start the fire, usually it is in the form of heat, but not necessarily so. The heat can be simply contained in the combustible substance, such as hot fuel. It may also be generated by friction such as that of a worn pump bearing. Other sources include smoking, hot work and cold work and mobile telephones and radios. All these should be strictly controlled through a permit system. .Electrical energy such as lightning, sparks from defective or non approved equipment or static generation may also serve as an ignition source.

3.1.4 These three requirements may best be demonstrated by the Fire Triangle.



Remove any of these three elements and fire will not occur.

3.1.5 Effective fire fighting methods include removing or shutting down the fuel source, removing oxygen by smothering the fire or removing the energy by cooling the fire.

3.1.6 Combustion occurs when the gas or vapours released at the surface of the liquid ignite. The extent of any fire or explosion hazard depends on the amount of flammable vapour or gas present. This depends on:

- temperature of the liquid
- volatility of the liquid
- the surface area exposed
- how long the surface is exposed
- the size of the release
- air movement.
-

3.1.7 A knowledge of the physical properties of a substance will give some indication of how flammable mixtures will develop and about potential hazards, these include:

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

In many cases the flammable vapour is heavier than air and it tends to accumulate in low areas, such as drains and pits. Liquid vapour can spread away from a leak or spill and if ignited can 'flash back' to the liquid.

3.2 Overpressure

Gases produced by burning are heated by the reaction and expand. In open spaces this will proceed without undue overpressure developing. If expansion is restricted pressure will rise and flame level will increase, which in its turn gives rise to a more rapid increase in pressure. If confinement is sufficient the combustion can take on the nature of an explosion. This in turn may burst the containment, due solely to the pressure surge.

3.3 The BLEVE

A BLEVE (Boiling Liquid/Expanding Vapour Explosion) is an explosion resulting from the catastrophic failure of a vessel containing a liquid significantly above its boiling point at normal, atmospheric pressure. The container may fail because of mechanical damage, corrosion, excessive internal pressure, flame impingement or metallurgical failure.

3.3.1 The most common cause of a BLEVE is overpressure and reduction in mechanical strength caused by flame impingement. The tank ruptures, the decompression causes a blast and debris is thrown over a wide area. The pressure drop causes the liquid inside to boil off, creating quantities of vapour which are thrown upwards along with liquid droplets. Where the gas/air mixture is within its flammable limits it will ignite from the surrounding fire to create a fireball of gigantic proportions.

3.3.2 However, there have been no incidents of BLEVEs on liquefied gas ships. Under the current construction codes Pressure Relief Valves are sized to cope with the surrounding fire, this helps to limit the risk.

4. Release of a Toxic Substance

Toxic products are those which react with the body to give undesirable results. The degree of the effect depending, of course, on the strength of the dose of poison entering the body.

4.1 All substances can prove fatal if given by an inappropriate route and in inappropriate quantities – even water or sodium chloride (common salt).

4.2 Relative to our ship to shore interface operations therefore, the hazards associated with a given product are related to:

- Its absolute toxicity
- Its physiochemical properties
- Circumstances of use – length or exposure, concentration

Depending on these variables, health effects may be acute or chronic.

4.3 For example, two substances which are commonly encountered within industry are :-

4.3.1 Acrylonitrile - the acute effects of which – severe eye irritation, skin blistering, dizziness asphyxia and death, far outweigh the suspected chronic effect of lung

cancer.

4.3.2 Benzene –from which acute effects are unusual in our industry. The chronic effects of long term exposure lead to delayed effects such as acute myeloblastic leukaemia.

4.4 The most common route of entry for toxic materials is inhalation, although skin absorption and ingestion may be routes depending upon the substance's properties.

4.5 It is possible for a toxic material to produce local effects at the point of contact as well as distant effects during its travels around the body. The most common target organs are the skin, lungs, liver, nervous system, bone marrow and kidneys.

4.6 Because of the many variables applying to toxicity, it is difficult to rate the toxicity of substances. However a frequently quoted measure of acute toxicity is the LD_{50}, that is the dose of the material capable of killing half a population of exposed laboratory animals. Relative values are shown below in Table 1

Toxicity Rating	**Description**	**LD_{50} (wt per kg single oral, dose to a rat)**
1	Extremely toxic	1mg or less
2	Highly toxic	1 – 50 mg
3	Moderately toxic	50 – 500 mg
4	Slightly toxic	0.5 – 5 g
5	Practically non toxic	5 – 15 g
6	Relatively harmless	15 g or more

Table 1

These ratings of course give no guidance as to long term effects, and assume at all times that humans react to these substances in the same way as rats. However, in the absence of any more appropriate system it offers a good guide as to general toxicity.

4.7 In reality whereas solid and liquid poisons are readily seen and identified, and rarely taken by accident, this does not apply to vapours from toxic liquids. They are invisible, strengths are not readily measured, and in some instances undetectable by human senses.

4.8 As much depends upon the degree of exposure, ie. the dose, the line between what is hazardous and tolerable, has to be drawn where possible. In this context a term called the maximum allowable concentration (MAC) is used.

4.9 This is often expressed also as occupational exposure limits or occupational exposure standards which are regulatory limits imposed by the Government concerned. They are expressed as parts per million (PPM) or milligrams per cubic metre of air (mgm^{-3}).

4.10 For many substances two standards are quoted:

- A long term time weighted average (TWA) normally for an eight hour period
- A short term exposure limit (STEL) normally for a 15 minute period

The measurement of these levels cannot be done without sophisticated equipment

4.11 As a general rule you can be reasonably certain that under normal circumstances, as

long as containment is maintained, vapour levels at a berth during discharge/loading operations will not exceed 5 ppm. However, should loss of containment occur then appropriate precautions should be taken when dealing with the spillage.

4.12 Reference to specific OESs or MELs of substances will give a guide therefore to the degree of hazard to be associated with the substance during these types of operations.

5 Release of a Marine Pollutant

The International Convention for the Prevention of Pollution from Ships 1973 (MARPOL 73/78) defines a harmful substance as ‘any substance which if introduced into the sea is liable to create hazards to human health, to harm wrong resources and marine life, to damage amenities or to interfere with other legitimate uses of the sea’.

5.1 In the context of the present need to be environmentally aware almost any fluid, if a large enough volume is spilt, including such innocuous liquids as milk or molasses, may be regarded as a harmful substance.

5.2 Legislation in many parts of the world now requires Port Authorities to have in place suitable and sufficient procedures to deal with marine pollution incidents, be they oil or other substances.

5.3 It is appropriate therefore that readers of this booklet carry out an inventory of products handled on their facility, and have the appropriate resources in place.

6 Frostbite

The extreme coldness of some liquefied gases is a significant hazard. If the skin is exposed to extreme cold, the tissue will freeze.

6.1 This is a significant hazard in gas terminals and on a ship handling fully refrigerated cargoes. Even in ambient temperature (pressurised) storage, liquid leaks will quickly flash to the fully refrigerated temperature.

6.2 The symptoms of frostbite are extreme pain in the affected area whilst being thawed, confusion and agitation. If the affected area is large, severe shock will develop.

PART C – CARGO

With regard to Section 5 above, this booklet will only be concerned with those classified as dangerous substances as defined in Section 2 above. Some common examples of these, which may be carried as bulk cargo, are described below:

7 Liquefied Hydrocarbon and Chemical Gases commonly carried in Bulk

7.1 The most frequently carried of these are tabulated below:-

Name	Alternative Name	Formula	Broad Description
Methane		CH_4	LNG
Ethane		C_2H_6	LNG
Ethane	Ethylene	C_2H_4	LNG
Propane		C_3H_8	LPG
Propane	Propylene	C_3H_6	LPG
Butadiene		C_4H_6	LPG
Butane		C_4H_{10}	LPG
Vinyl Chloride	Chloroethylene	$C_2H_3C_1$	Chemical Gas

Ammonia	Anhydrous Ammonia	NH_3	Chemical Gas
Chlorine		C12	Chemical Gas

Table 2

All these gases except Chlorine are flammable.

7.2 With the exception of methane and ammonia they have a relative vapour density greater than or near 1.

7.3 LNG and LPG are asphyxiants.

7.4 Vinyl Chloride monomer, chlorine and ammonia are toxic.

7.5 As most LPG's have odours which are hardly perceptible, odorisers are sometimes added to aid their detection.

8 Crude Oil

Crude Oil is the naturally occurring rock oil which accumulates in underground oil fields held in many parts of the world.

8.1 The actual constituents vary in proportion from one locality to another. However, the term is restricted to liquid mixtures of hydrocarbons and relative compounds which are capable of flowing up a well pipe.

8.2 Excluded from this definition are natural gases and gas condensates.

8.3 Crude Oil may be classified as a flammable liquid free flowing at or slightly above normal ambient temperatures. Its density is within the range 0.780 to 1.000 kg/dm^3 at 15^oC.

8.4 The Petrochemical industry manufactures from crude oil a wide range of synthetic products by extraction and transformation processes.

8.5 Some of the families of compounds which occur are hydrocarbons, sulphur compounds and nitrogen compounds.

9 Petroleum Fractions and Distillates

Products derived from Crude Oil.

9.1 Their will depend on the characteristics of the individual Crude Oil.

9.2 Each Crude will possess attractive features for the preparation of some products but

be less suitable with respect to other products, including LPG (See 4.1), light gases, napthas, kerosenes and diesel fuels.

9.3 These all share the common characteristics of low relative density and viscosity.

9.4 The lighter fraction (LPG, Naphtha, gasoline's and some kerosenes) are highly volatile and have a flashpoint at or below ambient.

9.5 These properties make them particularly hazardous whilst loading or discharging.

10 Aromatic Hydrocarbons

10.1 These products are all benzene type compounds and constitute a large and important part of the chemical industry and therefore tanker trade.

10.2 They are mostly flammable and comparative hazards are determined by flash point and flammable limits.

10.3 When burning, they can often be identified by unusually smoky flames.

10.4 Many are toxic and have a low occupational exposure limits.

10.5 Short exposure can be dangerous because of their anaesthetic effect.

11. Substituted Hydrocarbons

These form the bulk of industrial chemical products shipped around the world. Their properties vary depending on the chemical characteristics. Some of the most common are:

11.1 Alcohols

11.1.1 All common alcohols have a low flash point and are therefore flammable hazardous materials.

11.1.2 Most are highly toxic, some are water soluble.

11.1.3 They are all fairly volatile and have relative densities less than one.

11.1.4 Alcohols are not compatible with all types of foam used in fire fighting. The foam gets broken down and is limited in its usefulness. Low protein foams tend to have a greater breakdown resistance.

11.1.5 The most common alcohols are methanol (wood alcohol) and ethanol (pure spirits).

11.2 Glycols - These may also be called higher alcohols.

11.2.1 They have high flash points and are not very flammable.

11.2.2 They are all combustible however, but are not toxic unless swallowed.

11.2.3 They are not normally very volatile and have a relative density greater than one,

11.2.4 They are water soluble and can break down certain types of foam.

11.2.5 Typical examples are ethylene glycol (antifreeze) and glycerol (glycerine).

11.3 Amines – All the amines being derivatives of ammonia have the characteristic hazardous properties.

11.3.1 They have a low flash point, a relative density less than one and their vapours are heavier than air.

11.3.2 Some are caustic and in undiluted form are corrosive to human tissue.

11.3.3 Most are easily detectable because of their fish like ammonia like odour. They are toxic by ingestion, inhalation and skin absorption.

11.3.4. Some are also respiratory sensitizers. Examples are ethylamine and aniline.

11.4 Halocarbons – These are halogen substituted hydrocarbons.

11.4.1 They have a low flammability hazard, indeed one, carbon tetrachloride used to be used extensively as an extinguishing agent.

11.4.2 They are insoluble a water and their relative density and vapour density are greater than one.

11.4.3 They are highly toxic and produce toxic combustion products.

11.4.4 They are extremely volatile and are a major atmospheric pollutant and an extreme environmental hazard.

11.4.5 Examples are chloroform and dichloromethane.

11.5 Aldehydes and Ketones – The aldehydes and ketones have similar degrees of flammable hazard because of their low flash point.

11.5.1 In some cases these are below zero Celsius.

11.5.2 Aldehydes are chemically reactive and moderately toxic. Their relative densities and solubilities vary.

11.5.3 Ketones by comparison have low chemical reactivity and low toxicity but can be very volatile.

11.5.4 Both groups are extremely flammable. Alcohol resistant foams should be used for fire fighting. Examples are acetaldehyde and acetone.

11.6 Organic Acids - These are very weak acids and none of their hazards are associated with acidity.

11.6.1 They usually have a high flash point, high chemical reactivity and low corrosive hazard.

11.6.2 Fire fighting procedures are the same as those for alcohols, aldehydes and ketones. An example is propionic acid.

12. Other Organic Compounds

12.1 Esters Organic acids and alcohol's react together with the elimination of water to form an ester. For example Acetic acid reacts with ethanol to form the ester ethyl acetate.

12.1.1 They have pleasant odours (butyl acetate-pear drops) and flavours and are used extensively in the food industry.

12.1.2 They are also used as solvents and plasticisers.

12.1.3 They are highly flammable and non-toxic, although their vapours are narcotic

12.1.4 When fire fighting the same precautions should be taken as with alcohols.

12.2 Amides - These are formed by the reaction between ammonia and organic acids.

12.2.1 They are hazardous primarily because of the formation of toxic combustion products such as hydrogen cyanide.

12.2.2 Some amides are fire retardant.

12.3 Ethers these are formed by the combination of two alcohols.

12.3.1 These are extremely hazardous because of low flashpoint their high flammability, and high volatility.

12.3.2 They have a relative density less that one and a vapour density greater than one.

12.3.3 They also have anaesthetic properties and may be potentially explosive.

13. Corrosive Materials

13.1 Acids the simplest definition of an acid is any class of chemical compound whose solution in water turns blue litmus paper red.

13.1.1 Nitric, hydrochloric and sulphuric acids may be regarded as strong acids, hydrogen sulphide and hydrogen cyanide as 'weak' acids.

13.1.2 Some weak acids are not hazardous because of acid strength but because of toxicity and other reasons.

13.1.3 The properties of acids may be summarised as follows:

- React with metals (liberating hydrogen)
- React with bases (reaction can be dangerously rapid)
- React with body tissue
- Can be toxic
- May react violently with water (concentrated sulphuric acid).
- Corrosive properties may be increased by dilution with water
- Organic acids are flammable.

13.2 Bases ('Alkalis') Once again the simple definition is any class of chemical compound which when dissolved in water turns red litmus paper blue.

13.2.1 The commonly occurring compounds are (in order of strength):

- Amines - Ethylene diamine
- Hydroxides - Sodium hydroxide(Caustic soda)
- Potassium hydroxide (Caustic Potash)
- Carbonates - Sodium Carbonate (Common Soda)

13.2.2 As with the acids, hazardous properties may be determined by factors other than base strength.

13.2.3 Their properties may be summarised as follows:

- React with acids (this reaction can be dangerously rapid)
- React with body tissue
- Can react violently with water

- All amines are toxic

13.2.4 Organic bases (eg. Amines) are flammable.

14. Cargo Reactivity and Compatibility

14.1 Inter Reaction violent reactions may occur between some chemicals when they are mixed in certain proportions, water may also have to be considered in this respect.

14.1.1 The IMO IBC Code and the US Coast Guard Rules specifically prohibit the placement of Inter-reactive cargoes on both side of a bulkhead.

14.1.2 There must be an empty tank, coffer dam or tank with a neutral cargo in between.

14.1.3 There must also be complete separation of piping systems so that one product cannot inadvertently be pumped into another.

14.2 Auto Reaction Certain hydrocarbon compounds have a tendency to polymerise with time, accelerated by heat, light, air or other matters such as rust.

14.2.1 The compound tends to become more viscous and may eventually solidify. Heat is liberated, which accelerates further polymerisation.

14.2.2 The process may become uncontrolled and violent.

14.2.3 Polymerisable products must be kept as cool as possible and should never be placed near heated cargoes. Cargo temperature should be checked at regular intervals.

14.2.4 Polymerisation can be prevented or delayed by the addition of inhibitors to the product.

PART D - DESIGN OF JETTYS AND BERTHS

There are many different designs of facilities for the handling of bulk liquids and gases. They may be jetties, wharves, docks etc. and may even have a role as a solid bulk, general cargo or container berth when not handling liquid bulk products.

However, there are common issues concerning layout design and equipment provisions that affect all these facilities

15. Security.

Physical control of access and egress allow the risks to personnel during operations at

the ship/shore interface to be minimised.

15.1 Security Management both during and outside the working day should be such as to reduce the possibility of trespassing, tampering or arson.

15.2 When security fencing is installed it should take into account the general fire precautions required while the berth is in use. It should not be possible for unauthorised persons to enter the area unchallenged.

15.3 All persons entering the area should be given a safety briefing.

15.4 Facilities must comply with The International Ship and Port Facility Security Code (ISPS Code) The ISPS Code is part of SOLAS so compliance is mandatory for the 148

Contracting Parties to SOLAS – please see the IMO Status of Conventions for complete list of SOLAS Contracting Governments.

16. Means of Access

Access is needed both for normal operations and for emergencies.

16.1 It should be sufficient to allow for the rapid deployment of emergency equipment.

16.2 Passing places may be necessary. Such access needs to be available when vessels are on the berth. Consequently vehicle access and parking must be controlled.

16.3 If vehicles cannot be accommodated, alternative transport (ie. rail mounted) should be provided.

17 Means of Escape

17.1 As important as safe access routes are emergency escape routes.

17.2 These must ensure that people do not get 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.

17.3 If only one route is available then alternatives must be considered. These may include:

- Water sprays to cover means of escape
- Breathing apparatus to allow means of escape to be used
- Additional Walkways
- The provision of escape boats

18. Separation Distances

With flammable cargoes there is a simple means of protection both from the effects of fire and explosion, and from potential ignition sources This is to have separation distances between the cargo transfer facilities and site boundaries, occupied buildings, (except small shelters), storage tanks and fixed sources of ignition.

18.1 The distances quoted in Table 3 below are based on what is considered good practice

and is generally accepted by industry, although they may well not provide complete protection from a major incident, they will help protect the risk of injury by making evacuation easier.

18.2 National legislation or standards may vary. It is advisable therefore always to check with the local Fire or Harbour Authority.

Minimum separation distances before cargo transfer facilities are:	
Occupied buildings, storage faults and fixed ignitions	20 metres
Site boundaries and other ships	30 metres
Passenger sources and their associated assembly areas	75 metres

Table 3

19. Control of Ignition Sources

19.1 The objective during normal product handling operations is to prevent the creation of flammable concentrations of vapours.

19.2 When these do occur, either during normal operation or during accidental spillage there must be controls to prevent ignition by the various sources.

19.3 Hazardous area classification is widely used to determine the extent of hazardous zones created by the use of flammable liquids.

19.4 It has been used in the past purely for selecting fixed electrical apparatus, but it can be used generally to eliminate potential ignition sources.

19.6 Areas are classified into three zones, Zone 0, Zone 1 and Zone 2. These are three dimensional spaces in which flammable concentration of vapours may be present.

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

19.8 Electrical equipment suitable for use in Zone 0 is less likely to produce an incendive spark or failure than that suitable for use in Zone 1, which in turn is less likely to produce such a spark than that suitable for Zone 2.

19.9 The objective is to reduce to an acceptable level the probability of a flammable atmosphere coinciding with an electrical or other source or 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
- Zone 1 – An area in which there is likely to be a flammable gas mixture under normal operating conditions
- Zone 2 - An area in which the presence of a flammable gas mixture is unlikely, but if such a mixture is present, it is likely to persist for only a short period.

19.10 When a tanker is at a berth, it is possible that an area aboard that is normally

regarding as safe whilst at sea may fall within one of the hazardous areas of the Terminal. If such a situation does arise and if the area concerned contains unapproved electrical equipment, or sources of ignition, then both the area and the equipment may need to be isolated or closed down whilst the tanker is alongside.

20. Potential Sources of Ignition

These include:

20.1 Naked lights (flames and lamps) and smoking are obvious ignition sources and should be prohibited, both on ship and shore except in places designated by the berth operator. Smoking areas aboard ship are as designated by the master in accordance with the ship's safety management plan as per the ISM Code.

- Any maintenance work in the cargo handling area should be subject to "permit to work" procedures. Where the work introduces ignition sources into the area such as welding, cutting, grinding or chipping a hot work permit system should be in operation.

20.2 Electrical equipment should be located in non hazardous areas if possible. However such equipment as needs to be operated within a hazardous area and so exposed to flammable substances should be constructed or protected so as to prevent danger.

- This may be achieved by selecting equipment built to explosion protected standards or equipment that is intrinsically safe.

- Further advice on hazardous area classification may be found in BSEN 60079-10 Part 10, 1996, and on the selection installation and maintenance of explosion protected electrical equipment in BSEN 60079-14. Both these publications are available from the British Standards Institution. Reference may also be made to ISGOTT 4.4 and the International Electrical Commission publications on suitable types of electrical equipment and the classification of hazardous zones at marine terminals.

20.3 Vehicles with internal combustion engines or electrical motor drives should not be permitted within a hazardous zone on a berth during cargo transfer. Diesel engined vehicles can be modified in such a way as to be protected and unable to ignite flammable vapour. Specialist companies are licensed to carry out this work. The general view is that petrol or gas driven vehicles cannot be made safe. Where flammable liquids with a flash point above 32ºC only are present, vehicle protection is not required.

20.4 Radio frequencies of 300 kHz – 30 MHz can produce significant amounts of energy. This can, at distances of up to half a kilometre from the transmission antennae induce an electrical potential in unearthed receivers such as derricks, rigging, masts and stays which may produce an incendive discharge. Arcing can also occur on dirty or wet insulations.

- It is therefore recommended that medium and high frequency transmissions are not permitted during periods when there is likely to be a flammable vapour on the area of the transmitting aerial. Radio aerials should be earthed and radar switched off during cargo operations (see ship shore checklist item no 42.

20.5 Portable VHF/UHF communications equipment is generally considered safe provided

that it is used on low power setting and is properly certified use in hazardous areas. Reference may be made to ISGOTT 4.8 Communications Equipment.

21. Earthing, bonding, cathodic protection

Metal hard arms or bonded flexible hoses provide a very low resistance connection between ship and shore. Large currents can flow therefore between ship and shore.

21.1 Because of this there is a real danger of an incendive arc when the large flow of current between ship and shore caused by cathodic protection systems, galvanic potential differences or leakage effects from electrical power source is suddenly interrupted

21.2 In times past it was usual to connect the ship and shore systems by a bonding wire via a flame proof switch, before the cargo connection (hose or hard arm) was made and maintain it until after the cargo connection was broken.

21.3 The use of this bonding wire had no relevance to electrostatic charging, but was an attempt to short circuit the ship/shore electrolytic/cathodic protection systems and to reduce the ship/shore potential difference to such an extent that current flows in hoses or hard arms would be negligible.

For various reasons this method has been found to be quite ineffective and in fact a possible hazard to safety.

21.4 The use of ship to shore bonding wires has therefore been abandoned in favour of the insertion of an insulating flange within the length of the loading arm or at the connection of the hose string to the shore pipeline. An alternative when using hoses is to insert a length of hose in the string with no internal bonding. These flanges are commercially available from cargo handling equipment manufacturers.

21.5 Some national and local regulations may still require a bonding cable to be connected. If a bonding cable is insisted upon, it should be first visually inspected to ensure that it is mechanically sound. It should be connected to the ship well clear of the manifold area. There should always be a switch in series to the cable mounted on the jetty, of a type suitable for the hazardous area. The switch should be in the off position when connecting or disconnecting the cable. Only when it is properly attached should the switch be closed. The cable should be attached before the cargo hoses or arms are connected and removed only after they are disconnected. An insulating flange should also be used. (see IMO's Recommendations on the Safe Transport of Dangerous Cargoes and related Activities in Port Areas)

21.6 Reference should be made to ISGOTT Fifth Edition, Section 17.5 for more information on ship/shore electrical isolation including the construction and testing of insulating flanges.

PART E - EQUIPMENT DESIGN

The equipment used to undertake cargo transfer must be engineered to the appropriate standard to the duty required.

All materials used must be suitable for the cargo to be handled at the appropriate temperatures and pressure.

The subject of material compatibility is extremely complex and beyond the scope of this booklet to discuss, but briefly some considerations will be as follows

22 Pipelines and Valves

22.1 The basic standards for pipework in the industry are those laid down by the American National Standards Institute (ANSI) or the American Petroleum Industry (API) standard codes.

22.2 It is usual for pipelines up to 300mm (twelve inch) diameter to be manufactured of seamless, drawn pipe. Above this size seam welded pipe is used. For hydrocarbon products only carbon steel or alloy steel pipes are used, type depends on temperature and pressure. Some corrosive or fire chemical products may require the use of stainless steel pipework, (ANSI Type 316 is recommended). Cast iron pipework and fittings are not recommended for jetty service.

22.3 All pipelines should be clearly identified as either product or utility.

Depending on product characteristics, pipelines and valves may need to be insulated and/or trace heated. Again regular inspection of insulated pipelines for production or water ingress is essential.

22.4 To prevent the catastrophic failure of pipelines, in particular those containing large capacities of liquefied flammable gases, the installation of fire engulfment relief to API Standard 2000 is recommended.

22.5 Arrangements must also be made for temperature extremes both for expansion and contraction of pipework and pressure relief when the pipelines are full of product.

22.6 Pipelines, especially joints and hoses can be ruptured and damaged by pressure surge. 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.

22.7 An assessment of the pressure surge using industry guidelines as published in the ISGOTT guide should be made. Factors included will be liquid density, number of valves in the system, valve closing times, pipeline length and geometry. If this assessment results in an identified need to reduce the pressure surge, the following measures should be taken

- Reduce the pumping rate
- Increase valve closure time
- Use surge tanks or other pressure relief devices

22.7 Manual or automatic valves may be provided, of the ball, gate or globe pattern. Sealing materials should be of a type compatible with the product carried.
For ease of isolation and maintenance a double block and bleed system may be used. Two valves with a short stool piece and an intermediate drain valve are used.

23. Air Compressors

Compressed air may be used to clear pipelines and hoses of high flashpoint (above 32^{o} Celsius) liquids, as may nitrogen gas in the case of low flashpoint liquids

Air supply is normally from a remote compressor away from the hazardous area delivering about 7 bar (100 psig). Supply should normally be via a cooler and dehumidifier. Nitrogen supply may be from manifolded cylinders or bulk liquid supply

via a vaporiser

24 Electrical Equipment

24.1 Electrical apparatus must be of the approved standard for operation in hazardous area (see section 19). These are based on recommendations by the International Electrotechnical Commission, which for terminals follow a rigid classification based upon the zonal concept outlined in section 19.

24.2 The type of protection required will vary according to the area of operation. The classes of equipment used are defined in the various national and international standards.

24.3 Apparatus installed in a hazardous area may cause ignition if surface temperatures exceed the auto-ignition temperature of the gas or vapour concerned. Equipment is therefore coded according to the maximum surface temperature development during use, and should be selected with reference to the auto-ignition temperature of the gases or vapours involved.

24.5 personnel carrying out maintenance on equipment within hazardous zones should be trained and certified as competent to carry out the work

25 Hoses, Cargo Arms and Associated Equipment

Both hoses and cargo arms must be compatible with products handled. One particular concern with hard arms is that seal mating faces should be stainless steel to prevent corrosion.

If not properly used, engineered and maintained, there is a risk that the equipment may fail and jeopardise the cargo systems integrity.

25.1 <u>Hoses</u>

Can be of flexible metallic, rubber (natural and synthetic) and composite, depending on duty. Their strength depends on the number of layers or 'plys' built into the carcass of the hose.

25.1.1 Synthetic hose is usually much lighter and easier to handle than rubber or metallic hose. It is normally composed of layers of polypropylene fabric strengthened by an external wire and a helix coated or stainless steel internal wire helix. For specific products a PTFE liner may be used.

25.1.2 Hoses made of synthetic rubber should not be used for LNG transfer. Please contact SIGTTO for further information.

25.1.3 During operations, the proper handling of hoses is extremely important. Hoses of all types must be correctly supported in a hose cradle, and not allowed to become overly bent, or allowed to hang between ship and shore.

25.1.4 The bend radius of the hose should however be less than the manufacturer's minimum recommended. Care should also be exercised when rigging or moving hoses to ensure that they are not damaged or laid against sharp edges which could weaken the hose.

25.1.6 Hoses should be inspected before each use and tested at intervals in accordance with

national legislation, but not exceeding six months for composite chemical and petroleum hose and annually for rubber LPG, LNG and petroleum hose. Shorter intervals may be specified for those products which are more aggressive...

25.2 <u>Hard Arms (loading arms)</u>
Loading arms are fitted with swivel joints to provide the required movement between the ship and shore connections. A counter balance is provided, either in the form of springs or a weight, to reduce the deadweight of the arm on the ship's manifold and to reduce the power required to move the arm into position.

25.2.1 The range, or operating envelope, of the hard arm is determined by the tidal variation and changes in ship's freeboard. Whilst loading or discharging an allowance is also provided for the ship to range fore and aft along the jetty or draft off the berth.

25.2.2 The waterline to manifold heights at ballast and laden drafts at the predicted tidal conditions should be checked and the person in charge of operations at a berth should ensure that the tankers manifolds are kept within the operating envelope during all stages of the loading and discharge operations. To achieve this the tanker may be required to ballast or de-ballast.

25.3 Connecting Systems
Connecting systems between hoses or hard arms and ships can be of two types:

- Bolted flanges – standard flange connections to ASA, DIN or BS standards.

- Quick connect/disconnect systems (QCDCS) these are used to speed up the connection and disconnection operation. The coupling has full manual control but most often has hydraulic operation of the clamping/unclamping jaws. During cargo operation, the ship/shore joint is maintained by a positive mechanical lock.

- In addition to the above on hard arms an emergency release system may be fitted for use if the design limits of the operating envelope of the hard arm are approached.

25.4 For more information on the construction, use and maintenance of hoses and hard arms please see ISGOTT 5th Edition Chapter 18, and refer to SIGTTO for information on emergency shutdown systems (ESD) for gas tankers

26. Emergency and Fire Fighting Equipment

26.1 Risk Assessment - when equipping a terminal with the resource to fight fire, much will depend on the number and types of fire risks which the Port environs accommodates. The risk assessment should take into account the following criteria for each berth

- Type of cargo handled
  Bulk liquids – chemicals, oils, fuels
  Bulk gases – LPG, LNG
- Size of ship that can be accommodated

- Location of the terminal and/ or berth

- Potential environmental impact

- Areas to be protected

- Local Authority/National Fire Service – capability, distance and intervention time

- Fire Tugs- Availability capacity

- Level of training and capability of local emergency response teams/Industrial Fire Services – mutual aid agreements

This risk assessment will then allow you to match your resource availability to the type and likelihood of risk.

26.1.1 The main purpose of fire fighting equipment is:

- To protect the means of escape for staff and crews, and the means of access for emergency crews.

- To contain the incident, and prevent it escalating.

- To extinguish the fire.

26.1.2 The manner and speed with which an incident might develop needs to be considered when determining the type number and location of the emergency and fire fighting equipment required. Similarly other emergency equipment may be needed to:

- Contain spillages
- Dispense and dilute gas and vapour releases

26.1.3 The scale of these provisions should always be discussed with the local fire authorities and environmental agencies.

26.1.4 It is recommended that a location plan of all fire fighting equipment and emergency equipment on or adjacent to the berth, along with instructions on fire and emergency procedures should be on permanent display on the berth.

26.1.5 The ship's emergency and fire fighting plans should also be given to the terminal.

26.2 Fire Extinguishers - An adequate number of portable and wheeled extinguishers should be provided at the berth. These can be used to extinguish small fires that have just begun, preventing escalation and allowing people to escape.

26.2.1 Dry powder extinguishers are the most suitable for this use.

26.2.2 Foam extinguishers with a capacity in the order of 100 litres of pre-mix foam solution are suitable for use at berths .They are capable of producing approximately 1,000 litres of foam and provide a typical jet length of about 12 metres .

26.2.3 They should be located so they can be reached without travelling for more that 15 metres (50 ft)

26.2.4 The location of these extinguishers should be highlighted, by using suitable signs.

26.3 Water - is essential for cooling fires, helping to dispense vapour clouds and clearing spilt liquid.

26.3.1 It can be used in spray form for fighting oil fires and for screening firefighters.

26.3.2 A fire main, extending to the berth should be provided. It may be dry or charged, but it should be capable of being pressurised at short notice. If necessary it must be protected against impact or frost.

26.3.2 The capacity of the main (flow rate) will depend on:

- The maximum ship size at the berth
- The number of fire fighting appliances it serves

26.3.2 The diameter of the pipeline will depend on the required capacity.

26.3.3 Readily accessible hydrants should be positioned along the main and should be suitable for the hose couplings used by the fire-fighters. Isolation valves should be fitted periodically along the line, to isolate any damage. Hydrants should be spaced at not more than 45 metres (150ft.) in the berth, and not more than 90 metres (300 ft) along the approach to the berth.

26.3.4 Similarly supply pumps should be sized accordingly. The local water supply may have sufficient flow rate, pressure and capacity to suffice.

26.3.5 If not a number of pumps and backups may need to be provided. If, the sea provides the water, these pumps should be capable of providing suction at all states of the tide. Electric motor, diesel engine or steam turbine driven pumps are acceptable, however when considering steam or electrical power the availability of supplies at the terminal needs to be considered. Normally a combination of electric and diesel powered pumps is preferred

26.3.6 Both primary and backup operating points should be provided for the pumps. It may be preferable in remote locations to set the pumps to operate automatically if the fire alarm is set or from one of the call points.

26.3.7 Where the water supply is provided from static storage such as a tank or reservoir, then the reserve for fire fighting purposes should be at least equivalent to four hours continuous use at the maximum design capacity of the fire fighting system.

26.3.8 If fire fighting tugs are available they may be used to pump water into the terminal fire main. These pump-in points should comprise at least 4 x 63 mm. (2.5 inch) hose inlets or equivalent. They should be fitted with gate type stop, and non-return valves

26.3.9 At berths used for vessels of 500 gross tonnes or over, an international shore fire connection should be provided to supply water to a ships fire main from shore or vice versa. Details are given in Appendix A.

26.4 Fire Fighting Monitors The main purposes of water monitors at a berth is, in the event of a fire, to cool equipment and provide a protective curtain between ship and shore.

26.4.1 At least two monitors should be provided, for each berth. In deciding exactly how many, it will be necessary to consider the size using of ships the berth, the area to cover and the type or cargoes used.

26.4.2 They should be permanently mounted and fitted with jet/fog nozzles. The minimum capacity should be around 100 m^3 hr (400gpm). They need to cover the vulnerable

locations, ie. ship and shore manifold areas, connection points and hoses.

26.4.3 Remote controls should be standard for all monitors, to allow them to be operated safely. Monitors should preferably have their own backup power supply.

26.4.3 Water should never be applied directly to pools of LPG or LNG as it increases vaporisation of the liquids.

26.5 Foam - is only of value when fighting liquid spill fires provided that the fuel for the fires can be contained and prevented from spreading.

26.5.1 Monitors may be used to apply foam. Aspirated low expansion foam is the most useful for maximum protection against re-ignition. If it is essential to obtain the maximum throw from a monitor it may be preferable to use film-forming foams, such as AFFF, which can be used un-aspirated.

26.5.2 If fighting fires where alcohol or a similar chemical is involved the use of an alcohol resistant foam such as Alcoseal will be necessary

26.5.3 Foam is largely ineffective for cooling purposes.

26.5.4 The amount of foam concentrate stored will depend on the availability of backup supplies, access to the berth and cost.

26.5.5 However, sufficient foam at least should be stored to supply all the monitors for enough time to carry out an evacuation of the vicinity.

26.6 More extensive detailed information on fire fighting equipment may be found in Section 19.5 of ISGOTT 5th Edition

PART F- PROCEDURES AND PRECAUTIONS TO BE TAKEN

27. Communications

27.1 Equipment - Telephone and radio equipment should comply with the appropriate safety requirements.

27.1.1 The provision of adequate means of communication, including a back-up system, ship to shore, is the responsibility of the terminal.

27.1.2 The selected means of communication, together with the necessary information on telephone numbers and radio channels, should be recorded on an appropriate form which should be signed by representatives of both parties

27.2 Procedures - to ensure that operations are safely carried out at all times both parties should establish and agree in writing a reliable communication system. A secondary system should also be established before cargo operations commence and both systems should be tested.

27.2.1 They should include signals for:

- Standby
- Start loading or discharging

- Slow down
- Stop
- Emergency Stop

27.2.2 Any other signals required should be agreed and understood.

27.2.3 If different grades or products are to be handled, their names and descriptions must be clearly understood by all concerned.

27.2.4 The use of one radio channel by more than one ship/shore combination should be avoided.

28. Pre-Arrival Exchange of Information – At the terminal there should be an exchange of information as necessary on the following matters.

28.1 Exchange of Security Information - Security protocols must be agreed between the ship and the Port or Terminal Security Officer. Pre-arrival communications should sort out who performs these functions and how they are carried out

28.2 Tanker to the Appropriate Competent Authority Information as required by international, regional and national regulations and recommendations.

28.3 Tanker to Terminal -the information, some of which may be required in the form of a check list, should include at least the following:

- Name and call sign of vessel
- Country of registration
- Overall length, draught and beam of vessel
- Name of designated arrival point and estimated time of arrival
- Ships displacement on arrival, nature of cargo, correct technical name, name in common usage, UN number (if applicable), flashpoint (as appropriate) and quantity
- Distribution of cargo on board, indicating that to be unloaded and that to be left on board
- Whether vessel is fitted with an inert gas system and, if fitted, whether fully operational confirmation that the ship's tanks are in an inert condition (vessels carrying crude oil or petroleum products only).
- Oxygen content of cargo tanks. (. vessels carrying crude oil or petroleum products only).
- Whether vessel has any requirements for tank cleaning or slops disposal.
- Any defect of hull, machinery or equipment which may:
  - Affect the safe manoeuvrability of the tanker.
  - Affect the safety of other vessels.
  - Constitute a hazard to the marine environment.

  - Constitute a hazard to persons or property on land or in the vicinity of the harbour.

- Details of statutory certificates and their period of validity.
- Maximum draught and trim expected during and upon completion of cargo handling.
- Advice from master on tug assistance required.
- Any hull, bulkhead, valve or pipeline leaks which could affect cargo handling or cause pollution.
- Any repairs which could delay commencement of cargo handling.
- Whether crude oil washing is to be employed. (crude carriers only)
- Ship's manifold details, including type, number, size, and material of
- connections to be presented.
- Whether the ship has external impressed cathodic protection.

- Advance information on proposed cargo handling operations or advance information on changes in existing plans for cargo handling operations and distribution of cargo.

- Information as required on quantity and nature of slops and dirty ballast, and of any contamination by chemical additives.

28.4 Terminal to Tanker – the terminal should ensure that the ship has been provide with relevant port information as soon as is practicable, for example

- Depth of water at the berth at chart datum and range of salinity that can be expected at the berth.

- Maximum permissible draft and maximum permissible air draft

- Availability of tugs and mooring craft, when they are required to assist in manoeuvring and mooring.

- Whether the ship's or the tugs' lines are to be used.

- Mooring lines and accessories which the ship is required to have available for all mooring operations.

- Details of any shore moorings which will be provided.

- Which side to be moored alongside.

- Number and size of hose connections/manifolds.

- Inert gas requirements for cargo measurement. (vessels carrying crude oil or petroleum products only).

- Whether a Vapour Emission Control system (VEC) is in place.

- Any particular feature of a jetty berth or buoy mooring which it is considered essential to bring to the prior notice of the master.

- Maximum allowable speed and angle of approach to the jetty.

- Any code of visual or audible signals for use during mooring, including availability of berthing approach velocity indicators.

- For jetty berths, arrangement of gangway landing space or availability of terminal access equipment.

- Closed loading requirements

- Advance information on proposed cargo handling operations or changes in existing plans for cargo handling operations.

- Requirements for crude oil washing procedures and tank cleaning, if applicable. (crude carriers only)

- Whether tanks are to be gas free of hydrocarbon vapours for loading non-volatile static accumulator products.

- Advice on environmental and load restrictions applicable to the berth.
- Arrangements for the reception of slops and/or oily ballast residues.

29. **When Mooring**

When it has been established that the ship can safely proceed to the berth, the first precaution to take is to ensure that the ship is safely moored. Proper engineering and berthing analysis should be performed for the expected range of vessels, proper mooring configurations and any environmental limits (wind, currents etc.)

29.1 The berth owner or operator is responsible for providing adequate facilities for safe, secure mooring. These will depend on size of ship, tidal conditions, weather forecast and the kind of cargo and ballast operations.

29.2 The Master is responsible for the safe mooring of the ship providing suitable lines and ensuring that the ship remains safely moored. This includes ensuring that lines are properly tended.

29.3 Mooring and unmooring operations are dangerous operations. It is vitally important that everybody concerned is fully aware of the hazards, are fully trained and competent for their allotted tasks, and takes the appropriate precautions to prevent accidents. For extensive information on ship mooring including equipment, line tending and the use of tugs please see ISGOTT 5th Edition Chapter 23

30 **Information Exchange After Berthing**

Completion of a safe cargo handling operation is dependant on effective co-operation and co-ordination between all parties involved. This section includes the subjects about which information should be exchanged, and where necessary agreement reached.

30.1 Terminals advice to the tanker - the following information should be made available to

the responsible officer

30.1.1 Information before loading or bunkering

- Cargo specifications and preferred order of loading.
- Whether or not the cargo includes toxic components, for example H_2S, benzene, lead additives, mercaptans etc.
- Tank venting requirements.
- Any other characteristics of the cargo requiring attention, for example high true vapour pressure.
- Flashpoints (where applicable) of products and their estimated loading temperatures, particularly when the cargo is non-volatile.
- Bunker specifications including H_2S content (Crude oil only)
- Nominated quantities of cargo to be loaded.
- Maximum shore loading rates.

- Standby time for normal pump stopping.

- Maximum pressure available at the ship/shore cargo connection.

- Number of sizes of hoses or arms available and manifold connections required for each product or grade of the cargo.

- Proposed bunker loading rate.

- Communication system for loading control, including the signal for emergency stop.

- Limitations on the movement of hoses or arms.

- Operating limits of any cargo vapour return equipment employed by the terminal.

30.1.2 Information in preparation for discharge:

- Order of discharge of cargo acceptable to terminal.

- Nominated quantities of cargo to be discharged.

- Maximum acceptable discharge rates.

- Maximum pressure acceptable at ship/shore cargo connection.

- Any booster pumps that may be on stream.

- Number and sizes of hoses or arms available and manifold connections required for each product or grade of the cargo and whether or not these arms

are common with each other.

- Limitations on the movement of hoses or arms.

- Any other limitations at the terminal.

- Communication system for discharge control including the signal for emergency stop.

- Minimum discharge rates for high pour point cargoes

30.2 Tanker's Advice To The Terminal - Before cargo handling commences the responsible officer should inform the terminal of the general arrangement of the cargo, ballast and bunker tanks, and should have available the information listed below:

30.2.1 Information in Preparation for Loading and Bunkering:

- Details of last cargo carried, method of tank cleaning (if any) and state of the cargo tanks and lines

- Where the vessel has part cargoes on board, grade, volume and tank distribution

- Maximum acceptable loading rates and topping off rates

- Maximum acceptable pressure at the ship/shore cargo connection during loading
- Cargo quantities acceptable from terminal nominations
- Proposed disposition of nominated cargo and preferred order of loading
- Maximum acceptable cargo temperature (where applicable)
- Maximum acceptable true vapour pressure (where applicable)
- Proposed method of venting
- Quantities and specifications of bunkers required
- Disposition, composition and quantities of ballast together with time required for discharge and maximum light freeboard
- Quantity, quality and disposition of slops
- Quality of inert gas (if applicable)

30.2.2 Information in Preparation for Discharge:

- Cargo specifications
- Whether or not the cargo includes toxic components, for example H_2S, benzene, lead additives, mercaptans etc

- Any other characteristics of the cargo requiring special attention, for example, high true vapour pressure (TVP)
- Flashpoint (where applicable) of products and their temperatures upon arrival, particularly when the cargo is non-volatile
- Cargo quantities loaded and disposition of ship's tanks
- Quantity and disposition of slops
- Any unaccountable change of ullage in ship's tanks since loading
- Water dips in cargo tanks (where applicable)
- Preferred order of discharge
- Maximum attainable discharge rates and pressures
- Whether tank cleaning, including crude oil washing, is required
- Approximate time of commencement and duration of ballasting into permanent ballast tanks and cargo tanks

31. Agreed Loading Plan

On the basis of the information exchanged, an operational agreement should be made in writing between the responsible officer and the terminal representative covering the following:

- Ship's name, berth, date and time
- Name and signature of ship and shore representative
- Cargo distribution on arrival and departure
- The following information on each product:
    - Quantity.
    - Ship's tank(s) to be loaded
    - Shore tank(s) to be discharged
    - Lines to be used ship/shore
    - Cargo transfer rate
    - Operating pressure
    - Maximum allowable pressure
    - Temperature limits
    - Venting system.

- Restrictions necessary because of:
    - Electrostatic properties
    - Use of automatic shut-down valves

This agreement should include a loading plan indicating the expected timing and covering the following:

- The sequence in which ship's tanks are to be loaded, taking into account
    - De-ballasting operations
    - Ship and shore tank change over
    - Avoidance of contamination of preloaded cargo
    - Pipeline clearing for loading
    - Other movements of operations which may affect flow rates
    - Trim and draught of the tanker
    - The need to ensure that permitted stresses will not be exceeded
- The initial and maximum loading rates, topping off rates and normal stopping

times, having regard to:

- The nature of the cargo to be loaded
- The arrangement and capacity of the ship's cargo lines and gas venting system
- The maximum allowable pressure and flow rate in the ship/shore hoses or arms-
- Precautions to avoid accumulation of static electricity
- Any other flow control limitations

• The method of tank venting to avoid or reduce gas emissions at deck level, taking into account:

  - The true vapour pressure of the cargo to be loaded
  - The loading rates
  - Atmospheric conditions

• Any bunkering or storing operations

• Emergency stop procedure

32 Inspection of Ship's Cargo Tanks Before Loading

Where possible, inspection of ship's tanks before loading cargo should be made without entering the tanks.

32.1 Methods such as dipping and measuring the heel, or having the stripping line or eductors opened in the tank and listening for suction, may have to be used.

32.2 It may sometimes be necessary to remove tank cleaning opening covers to sight parts of the tank not visible from the ullage ports but this should only be done when the tank is gas free, and the covers must be replaced and secured immediately after the inspection.

32.3 If, because the cargo to be loaded has a critical specification, it is necessary for the inspector to enter a tank, all the precautions for confined space entry.

32.3 Before entering a tank which has been inerted, it must be gas freed for entry and, unless all tanks are gas freed and the IGS completely isolated, each individual tank to be entered for inspection must be isolated from the IGS . oxygen levels must be checked before entry, and the appropriate confined space entry certificate completed

33. Agreed Discharge Plan

33.1 On the basis of the information exchanged, an operation agreement should be made in writing between the responsible officer and the terminal representative covering the following:

• Ship's name, berth, date and time

- Names and signatures of ship and shore representatives

- Cargo distribution on arrival and departure

- The following information on each product:

  - Quantity
  - Shore tank(s) to be filled
  - Ship's tank(s) to be discharged
  - Lines to be used ship/shore
  - Cargo transfer rate
  - Operating pressure
  - Maximum allowable pressure
  - Temperature limits
  - Venting systems

- Restrictions necessary because of:

  - Electrostatic properties

  - Use of automatic shut-down valves

33.2 This agreement should include a discharge plan indicating the expected timing and covering the following:

- The sequence in which the ship's tanks are to be discharged, taking account of:

  - Ship and shore tank change over
  - Avoidance of contamination of cargo
  - Pipeline clearing for discharge
  - Crude oil washing, if employed, or other cleaning
  - Other movements or operations which may affect flow rates
  - Trim and freeboard of the tanker
  - The need to ensure that permitted stresses will not be exceeded
  - Ballasting operations

- The initial and maximum discharge rates, having regard to:

  - The specification of the cargo to be discharged
  - The arrangements and capacity of the ship's cargo lines, shore

- The maximum allowable pressure and flow rate in the ship/shore hoses or arms
- Precautions to avoid accumulation of static electricity
- Any other limitations

- Bunkering or storing operations
- Emergency stop procedures.

PART G- SAFETY MANAGEMENT

34 Climatic Conditions

34.1 Advice of Adverse Weather Conditions – The Terminal should establish limiting criteria for controlling or stopping cargo operations based on the design criteria for the berth, its moorings and equipment. Any limitations should be discussed with the tanker before operations commence and recorded in the ship/ Shore Safety Check List.

34.1.1 The Terminal Representative should alert the Tanker to any forecast adverse weather conditions, which may require operations to be stopped, or loading/discharge rates to be reduced.

34.2 Wind Conditions – If there is little air movement, flammable vapours or LPG gas, may persist on deck in heavy concentrations. If there is wind, eddies can be created on the lee side of the accommodation or deck structures which can carry vented gas or vapour towards the structure. Either of these conditions may cause high local concentrations of gas, and it may be necessary to stop loading, ballasting or tank cleaning operations, whilst these conditions persist.

34.2.1 Electrical Storms (Lightning) - When an electrical storm is expected in the vicinity of the Terminal , the following operations should be stopped, even if the cargo tanks are inerted:-

- The handling of volatile flammable products
- The handling of non-volatile products in non gas free, flammable product tanks.
- Ballasting of tanks no free of flammable vapours
- Purging, tank cleaning, or gas freeing after the discharge of flammable, volatile products

35. Personnel Safety

35.1 Personal Protective equipment - should be worn by all personnel involved in cargo handling operations on board and ashore.

35.1.1 Minimum standard should be an overall (boiler-suit), made of non-synthetic material, safety shoes, safety glasses, PVC gloves, and safety helmet.

35.1.2 The Material Safety Data Sheet (MSDS) for those products being handled will give details of any special protection required, such as chemical suits or breathing apparatus.

35.1.3 Shore personnel should also wear a lifejacket or vest where there is a risk of falling into the water

35.2 Slips, trips and falls – continue to be the major cause of accidents within all industries. This is particularly so on board tankers and on bulk liquid berths.

35.2.1 Precautions such as non-slip - coatings or gratings should be used, and such areas marked to reduce these accidents as low as reasonably practicable.

35.2.2 Good design and construction will also help to prevent accidents, trip hazards should be designed out, and if this is not possible they should be clearly marked.

35.3 Personal hygiene – Many industrial chemicals, especially refined oils can cause industrial dermatitis and skin sensitisation. Even, in some cases, when contact is for a relatively short period of time. Barrier creams are usually ineffectual due to the solvent properties of most products. Direct skin contact must therefore be avoided.

36 The Ship/Shore Safety Check List

The Ship/Shore safety checklist must be completed jointly by the Terminal Representative and a responsible officer.

36.1 All items lying within the responsibility of the tanker should be personally checked by the tankers representative and similarly items which are the terminals responsibility should be personally checked by the terminal representative.

36.2 In carrying out their full responsibilities however, both representatives, by questioning the other, by sighting records and, where felt appropriate by joint visual inspection, should assure themselves that the standards of safety on both sides of the operation are fully acceptable.

36.3 Each item should be verified before it is ticked, some of the items may require one or more physical checks before signing and perhaps continuous supervision during the operation.

36.4 The recommended Ship/Shore check list can be found in Chapter 26 of ISGOTT Fifth Edition and also guidance on its completion.

36.5 An explanatory letter inviting the co-operation understanding of the tankers personnel may be found at Appendix C. This letter must be given to the Master or a responsible ships officer, who should acknowledge receipt of the letter on the Terminal Representatives copy.

37. Checks during Cargo Transfer

As mentioned at the beginning of this guide, 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.

37.1 Continuous monitoring should take place during cargo handling.

37.2 A competent jetty watchman should be present at all times during cargo working and a ships officer should be present, with sufficient crew on board to deal with the operation and safety of the ships.

37.3 The jetty watchman should be positioned close to the ship shore connections, and his duties will include:

- Checking and supervising flow rates and pressures
- Ensuring cargo hoses or hard arms are best properly adjusted
- Prevent unauthorised access to the jetty by other people
- Controlling activities of personnel on the jetty
- In the event of an incident, raising the alarm and shutting down shore based cargo handling equipment
- Monitoring the ships position in relation to the jetty and moorings

In some cases this function can be successfully supplanted by the use of CCTV and automatic closure valves.

38 Emergency procedures

The ICHCA Safety Panel Briefing Pamphlet No. 6 – Guidance on the Preparation of

Emergency Plans, gives guidance on preparing emergency plans in Port areas.

and

In addition, the joint IMO/UNEP publication, APELL for Port Areas, which is concerned with chemical incident preparedness, will be found of great help to those unfamiliar with emergency planning.

It is not considered necessary to reiterate within this document the full content of these publications. What follows is a digest of their contents

38.1 The proactive and reactive elements of emergency management need to be considered, these are:

- Anticipation
- Preparation
- Response
- Recovery

38.2 Having identified existing and potential hazards a priority ladder can be developed and preventative or mitigating measures installed. These should include procedures for credible worst case scenarios.

38.3 Identified hazards should be removed or reduced as far as possible by engineering them out of the system, or introducing physical measures to mitigate their impact.

38.4 Written procedures should then be prepared for dealing with emergency incidents.

Before these are completed, the following must be completed:

- The quantities and types of cargoes likely to be involved
- Their characteristics ie. toxicity, flammability, volatility, density solubility in water
- The location of the berth, and its design
- The distance between the berth and other features ie. buildings, other berths, beaches, other hazardous cargo
- The people, both on and off site who may be affected
- Where particularly hazardous cargoes are involved, predetermined evacuation distances may be included in the plan. These may be found in the Guidebook for First Responders published by the US Department of Transportation.

38.5 Once this has been done procedures can be prepared for:

- Raising the alarm
- Calling the emergency services
- Informing those others likely to be affected by the incident

- Evacuating the area and providing places of safety
- Dealing with the emergency ie. fighting the fire, controlling the spill or leak in a safe manner

38.6 It is normal procedure for the Senior Emergency Services Officer (SESO) to take charge of the incident when he/she arrives. However, as part of the emergency plan Terminal Incident Controllers should be appointed and trained. Their duties will fundamentally consist of:

- Stopping all operations in the area to allow emergency service personnel to proceed with emergency actions
- Contact the SESO on arrival, ensure he is briefed, and provide communications as necessary
- Act as liaison with SESO for equipment etc
- Ensure clear access is provided at all times
- Provide Terminal Management with regular situation reports
- In co-operation with SESO preparing emergency evacuation plans should incident escalate

38.7 Having emergency plans in place and initiating them at the earliest stage of the incident can significantly reduce the impact of an incident on people and premises.

38.8 All aspects of training must be considered in an integrated emergency management structure, and the effectiveness of the plan needs to be subjected to rigorous practical simulation drills and desktop exercises.

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In this section the IMO publication reference numbers apply to English-language versions but versions in other official languages (French and Spanish) are available.

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1.4 International Convention on Standards of Training, Certification and Watchkeeping for Seafarers, 1978. 2001 Edition As amended by the 1995 Convention. IMO Ref 938 E. ISBN 92 801 51088. (revised 2001).

1.5 Recommendations on the Safe Transport of Dangerous Cargoes and Related Activities in Port Areas, 2007. IMO Ref: IB290 E. ISBN 978 92 801 1472-8.

1.6 Medical First Aid Guide for Use in Accidents involving Dangerous Goods (MFAG), 1994. IMO Ref 251 E.

See also **supplement** to the International Maritime Dangerous Goods Code (IMDG Code). 2004 Edition. IMO Ref: 210E. ISBN 92 801 4189 9

The publications listed above are available from International Maritime Organisation, 4 Albert Embankment, London SE1 7SR, United Kingdom, Tel: +440207-735-7611, Fax +44 (0)20 7587-3210.

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2.19 Accident Prevention. The Use of Hoses and Hard Arms at Marine Terminals Handling Liquefied Gas. Information Paper No. 4 (SIGTTO) 1996. ISBN 85609 1147.

2.20 Information Paper No. 15. A Listing of Design Guidelines for Liquefied Gas Terminals (Referencing Ports and Jetties), (SIGTTO) 1997. ISBN 1 85609 1406.

2.21 Information Paper No. 16. Ship/Shore Interface. Safe Working Practice for LPG and Liquefied Chemical Gas Cargoes, (SIGTTO) 1998. ISBN 1 85609 1430.

2.22 The Bulk Transfer of Dangerous Liquids and Gases between Ship and Shore Health and Safety Executive UK 1999 ISBN 07176 1644 4.

2.23 Sax's Dangerous Properties of Industrial Materials 2005 ISBN 0 471 701335 Published by WILEY.

3 Internet Web Sites

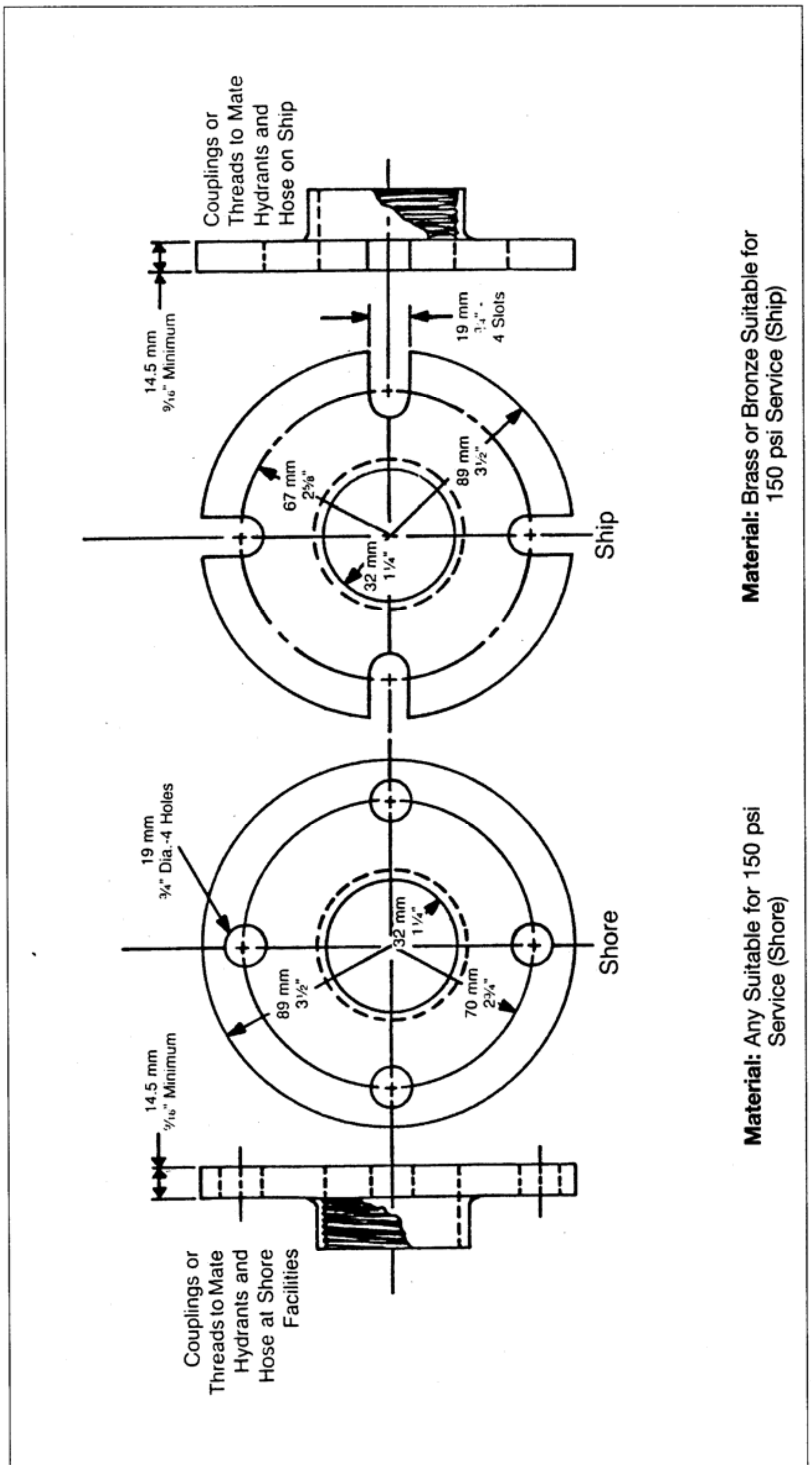
3.1 **www.metalinfo.com** provides an information site and cross references over 150,000 metal standards including API, ASTM, and BS.

3.2 api-ec.api.org/newsplashpage/index CFM is the American Petroleum Institutes home page.

3.3 **www.hse.gov.uk** is the UK Health and Safety Executive home page.

3.4 **www.petroleum.co.uk** is the UK Institute of Petroleum home page.

APPENDIX 1


INTERNATIONAL SHORE FIRE CONNECTION
Couplings or Threads to Mate Hydrants and Hose at Shore Facilities
14.5 mm 9/16" Minimum
19 mm 3/4" Dia.-4 Holes
89 mm 3½"
32 mm 1¼"
70 mm 2¾"
Shore
Couplings or Threads to Mate Hydrants and Hose on Ship
14.5 mm 9/16" Minimum
19 mm 3/4" - 4 Slots
67 mm 2⅝"
89 mm 3½"
32 mm 1¼"
Ship
Material: Any Suitable for 150 psi Service (Shore)
Material: Brass or Bronze Suitable for 150 psi Service (Ship)
For Both
Flange Surface: Flate Face
Gasket Material: Any Suitable for 150 psi Service
Bolts: Four (⅝ inch) Diameter, 50mm (2 inches) long Threaded to within 25mm (1 inch) of the bolt head
Nuts: Four, to Fit Bolts
Washers: Four, to Fit Bolts

Appendix 2

Specimen Letter for Issue to Masters of Tankers at Terminals

Company …………………………….……
Terminal
Date

The Master
SS/MV …………………………………………..

Port: ……………………………………………..

Dear Sir

Responsibility for the safe conduct of operations whilst your ship is at this terminal rests jointly with you, as master of the ship, and with the responsible terminal representative. We wish, therefore, before operations start, to seek your full co-operation and understanding on the safety requirements set out in the Ship/Shore Safety Check List which are based on safe practices widely accepted by the oil and the tanker industries.

We expect you, and all under your command, to adhere strictly to these requirements throughout your stay alongside this terminal and we, for our part, will ensure that our personnel to likewise, and co-operate fully with you in the mutual interest of safe and efficient operations.

Before the start of operations, and from time to time thereafter, for our mutual safety, a member of the terminal staff, where appropriate together with a responsible officer, will make a routine inspection of your ship to ensure that the questions on the Ship/Shore Safety Check List can be answered in the affirmative. Where corrective action is needed we will not agree to operations commencing or, should they have been started, we will require them to be stopped.

Similarly, if you consider safety is endangered by any action on the part of our staff or by any equipment under our control you should demand immediate cessation of operations.

THERE CAN BE NO COMPROMISE WITH SAFETY

Please acknowledge receipt of this letter by countersigning and returning the attached copy.

Signed: ……………………………………..
Terminal Representative

Terminal Representative on Duty is: ……………………………………….

Position or Title: ……………………………………….

Telephone No: ……………………………………….

UHF/VHF Channel: ……………………..……………..

Signed: …………… …………………………..
Master
SS/MV …………… …………………………..

Date: ………………... Time ………………….