US 947-2

UGANDA STANDARD

First Edition
2017-mm-dd

Petroleum Industry — Above ground storage tanks of petroleum products — Part 2: Siting, design and construction of large consumer Installations and Handling of petroleum products and their derivatives

Reference number
US nnnn-n: yyyy

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The **table of contents** is an optional preliminary element, but is necessary if it makes the document easier to consult. The table of contents shall be entitled "Contents" and shall list clauses and, if appropriate, subclauses with titles, annexes together with their status in parentheses, the bibliography, indexes, figures and tables. The order shall be as follows: clauses and subclauses with titles; annexes (including clauses and subclauses with titles if appropriate); the bibliography; indexes; figures; tables. All the elements listed shall be cited with their full titles. Terms in the "Terms and definitions" clause shall not be listed in the table of contents.

The table of contents shall be inserted for a document of 15 or more pages.

Foreword

Uganda National Bureau of Standards (UNBS) is a parastatal under the Ministry of Trade, Industry and Cooperatives established under Cap 327, of the Laws of Uganda, as amended. UNBS is mandated to co-ordinate the elaboration of standards and is

(a) a member of International Organisation for Standardisation (ISO) and

(b) a contact point for the WHO/FAO Codex Alimentarius Commission on Food Standards, and

(c) the National Enquiry Point on TBT Agreement of the World Trade Organisation (WTO).

The work of preparing Uganda Standards is carried out through Technical Committees. A Technical Committee is established to deliberate on standards in a given field or area and consists of key stakeholders including government, academia, consumer groups, private sector and other interested parties.

Draft Uganda Standards adopted by the Technical Committee are widely circulated to stakeholders and the general public for comments. The committee reviews the comments before recommending the draft standards for approval and declaration as Uganda Standards by the National Standards Council.

The committee responsible for this document is Technical Committee UNBS/TC ###, *[name of committee]*, Subcommittee SC ##, *[name of subcommittee]*.

This second/third/… edition cancels and replaces the first/second/… edition (US nnn-n:yyyy), which has been technically revised.

US 947 consists of the following parts, under the general title The petroleum industry.

- —*Part 1: Sitting, design and construction of service station*
- —*Part 2: Storage and distribution of petroleum products in above-ground bulk installations*

This Part of DUS 947 was based on

Petroleum Industry — above ground storage tanks of petroleum products — Part 2: siting, design and construction of large consumer Installations and Handling of petroleum products and their derivatives

1 Scope

1.1 This part of DUS 947 covers the layout and design of petroleum bulk depots, and the installation of

equipment of the types normally used for the handling, storage and distribution of petroleum products and their derivatives, other than equipment that is used for storage and dispensing on consumer premises (including service stations) and for which relevant standards exist.

1.2 A design will meet the requirements of this part of DUS 947 if it complies with any one of the approved standards listed (see 2.1). However, such a standard shall be applied in its entirety (where applicable). For example, the product classification of one standard cannot be used in combination with the design of another standard.

NOTES

1. Examples of permits to be issued in relation to construction or repair work are given in appendix C.

2. Recommendations specific to the handling and storage of liquefied petroleum gas (LPG) are given in DUS ISO 11625:2007 The recommended safety distances for the installation of LPG facilities are given in appendix D.

3. The design of an interceptor (gravity separator) that has at least three chambers is described in appendix B.

2 Normative references

The following normative documents contain provisions, which, through reference in this text, constitute provisions of this part of DUS 947. All documents are subject to revision and, since any reference to a normative document is deemed to be a reference to the latest edition of that document, parties to agreements based on this part of ZS 385 are encouraged to take steps to ensure the use of the most recent editions of the documents indicated below. Information on currently valid national and international standards ran be obtained from the South African Bureau of Standards.

US 947-1:2011, Handling of petroleum products and their derivatives — Part 1: Sitting, design and construction of service station

US ISO 3183:, Petroleum and natural gas industries — Steel pipe for pipeline transportation systems

API 620 Rules for design and construction of large, welded, low-pressure storage tanks.

API 650 Welded steel tanks for oil storage.

AP RP 2003, Protection Against Ignitions Arising Out of Static, Lightning, and Stray Currents

API Std 2000 — Venting Atmospheric and Low-Pressure Storage Tanks

ASTM D 86 — Standard Test Method for An American National Standard Distillation of Petroleum Products at Atmospheric Pressure

Occupational Safety and Health Act, 2006

The electricity act, 1999

IEC 60079-1 0 — Explosive atmospheres - Part 1: Equipment protection by flameproof enclosures "d"

ISO 15589-1:2015 — Petroleum, petrochemical and natural gas industries -- Cathodic protection of pipeline systems -- Part 1: On-land pipelines

ISO 13623:2017 —Petroleum and natural gas industries -- Pipeline transportation systems

ISO 15589-2:2012 — Petroleum, petrochemical and natural gas industries -- Cathodic protection of pipeline transportation systems -- Part 2: Offshore pipelines

ISO 13702:2015(en) — Petroleum and natural gas industries — Control and mitigation of fires and explosions on offshore production installations — Requirements and guidelines

ISO 7203 —Fire extinguishing media -- Foam concentrates

ISO 7076 — Fire protection - Foam fire extinguishing systems

ISO 6182 — Fire protection -- Automatic sprinkler systems

ISO 1825:2017 — Rubber hoses and hose assemblies for aircraft ground fuelling and defuelling – Specification

ISO 6942:2002 — Protective clothing -- Protection against heat and fire -- Method of test: Evaluation of materials and material assemblies when exposed to a source of radiant heat

ISO 834-1:1999 — Fire-resistance tests -- Elements of building construction -- Part 1: General requirements

ISO 16106 —. Packaging -- Transport packages for dangerous

ISO 7165:2017 — Fire fighting -- Portable fire extinguishers -- Performance and construction

Fire fighting -- Portable fire extinguishers -- Performance and construction

ISO 16104:2003Packaging --— Transport packaging for dangerous goods -- Test methods

Goods

ISO 14557— Fire-fighting hoses -- Rubber and plastics suction hoses and hose assemblies

ISO 4497:1983 — Metallic powders -- Determination of particle size by dry sieving

3 Definitions

For the purposes of this part of DUS 947-2, the following definitions apply:

3.1 acceptable: Acceptable to the appropriate approving authority.

3.2 accredited person: a person registered in terms of Uganda Institution of Professional Engineers (UIPE) Engineers Registration ACT (ERA) as an electrical tester for single phase, an installation electrician or a master installation electrician.

3.3 approved: Approved by the appropriate approving authority.

3.4 approved apparatus: Explosion-protected equipment that has been submitted to the appropriate approving authority for examination and testing and for which a certificate of approval for a prescribed application has been issued.

3.5 approving authority: The appropriate of the following:

a) in terms of the Factories Act Cap 220, Laws of Uganda , the Chief Inspector of

b) Factories;

c) in terms of the Mining Act, 20033 of the Laws of Uganda, the Director of

d) Mine Safety;

e) in terms of the Weights and Measures Act, Cap 103 of the Laws of Uganda, the

f) Superintendent Assizer;

g) in terms of the Water Act, 1997 of the Laws of Uganda, the Director and

h) the local authority concerned.

3.6 boiling point: The temperature at which a liquid exerts a vapour pressure of 101.3 kPa. Where an accurate boiling point is not available for the material in question, or in the case of mixtures that do not have a constant boiling point, for the purposes of this part of DUS 947, the 10 % point of distillation determined in accordance with ASTM D 86 can be taken as the boiling point of the liquid.

3.7 breathing apparatus: An apparatus that allows the wearer to breathe independently of the ambient atmosphere.

3.8 buildings: As defined in the laws and Building regulations and Public Health Act 1935 of Uganda.

3.9 bulk depot: Premises (sometimes referred to as marketing installations or terminals) on which the capacity for the storage of flammable goods or combustible goods (or both) exceeds 200 m3 if above-ground tanks, on which goods are normally received from a refinery or other bulk depot by road rail, sea or pipeline (or a combination of these), and from which such flammable goods or combustible goods (or both) are delivered.

NOTE -For aboveground storage of less than 200 m3 for petroleum products, see US 947-1

3.10 bunded area: An area bounded by ground contours that confine spillage, or an area surrounded by bund walls.

3.11 bund (wall): A wall designed to confine product spillage to the bunded area.

3.12 class: The class of petroleum product, based on the following classification: is

a) class 0: liquefied petroleum gases

b) class 1: liquids, which shall be subdivided as follows:

1) class IA: liquids that have a closed-cup flash point of below 23 C and a boiling point of below 35 C

2) class IB: liquids that have a closed-cup flash point of below 23 C and a boiling point of 35 C or above

3) class IC: liquids that have a closed-cup flash point of 23 C or above, but below 38 C

c) class II: liquids that have a closed-cup flash point of 38 C or above, but below 60.5 C

d) class IIIA: liquids that have a closed-cup flash point of 60.5 C or above, but below 93 C

e) class IIIB: liquids that have a closed-cup flash point of 93 C or above

NOTES

1. Product classifications vary among different standards.

2. Classes II and III constitute the following:

If a class II or a class III combustible liquid should be stored or handled at temperatures above its flash point and at or above its boiling point, special precautions should be taken in both the layout and the operation for such a liquid.

3.13 combustible-gas detector: An instrument used to measure the concentration of flammable vapours in air, up to the lower explosive limits (for example, an explosimeter).

3.14 combustible liquid: A liquid that has a closed-cup flash point of 38 C or above.

3.15 competent person: A person who has the necessary knowledge of and ability with regard to that particular process or type of plant and equipment to which this part of DUS 947-2 refers, to render him capable of the work involved.

3.16 designated person: A person designated by his employer in terms of this standard.

3.17 effluent: Residual water or any other liquid resulting from the use of water for industrial purposes, including any substance suspended therein and any storm water flowing or seeping or being pumped from a site, while such a site is in production or after its temporary closure or permanent abandonment.

3.18 explosion-proof: Apparatus enclosed in a case that

a) is capable of withstanding an internal explosion of a specific gas or vapour,

b) is capable of preventing the ignition, by arcs, sparks or explosions that occur inside the case, of

c) specific gas or vapour surrounding the case, and

d) has, when the apparatus is operating, an external temperature such that the surrounding flammable atmosphere cannot be ignited thereby.

NOTE -The German term 'explosion geschutz' (frequently translated as "explosion-proof) is used to denote apparatus protected by means other than an explosion-proof case. Such other means include those described as type C- apparatus, intrinsically safe apparatus and pressurized apparatus.

3.19 fire stop: A barrier across pipeline trenches to prevent the spread of fire.

3.20 fire wall: A wall intended to prevent the spread of fire or the passage of flammable liquids or gases.

3.21 flame arrestor; flame trap: A device used to prevent the passage of flame into or out of an

3.22 flame trap: See 3.21.

3.23 flammable: Descriptive of a material that is capable of ignition.

NOTES

1. The term "inflammable" is not acceptable as a synonym for "flammable".

2. A flammable liquid is a liquid that has a flash point of below 38 C. (See also 3.14.)

3.24 flash point; closed-cup flash point: The lowest temperature at which the application of a small flame causes the vapour above a liquid to ignite when the product is heated under prescribed conditions, in a "closed" container (IP 34 and IP 170).

3.25 freeboard: The height of a bund wall above the calculated liquid surface.

3.26 gas free. Descriptive of a vessel, a container or an area that contains an atmosphere in which the concentration(s) of flammable gases or toxic gases (or both) have been certified as being within the prescribed safe limits. (See also 9. 1 0.6 and table 5.)

3.27 gas-free certificate: A certificate, issued by a competent person, that certifies that tests have proved that the concentrations of flammable gases or toxic gases (or both) in the relevant atmosphere are within the prescribed limits (see clause C.1).

3.28 hazardous area: An area in which flammable gases or vapours are or might be present in the air in quantities sufficient to become hazardous.

NOTE - Hazardous areas are classified as follows (see IEC 60079-1 0):

1) zone 0: An area in which a flammable gas or vapour is continuously present in a concentration within its lower and

2) upper limits of flammability,

3) zone 1: an area in which

   a) a hazardous concentration of a flammable gas or vapour occurs intermittently or periodically under normal operating conditions, or

   b) a hazardous concentration of a flammable gas or vapour might occur frequently because of repair operations, or maintenance operations, or leakage, or

   c) breakdown or faulty operation of equipment or processes that might release a hazardous concentration of a flammable gas or vapour, might also cause simultaneous failure of electrical equipment;

c) zone 2. an area in which operations that involve flammable or explosive substances, gases or vapours, or volatile liquids, are so well controlled that an explosive or ignitable concentration is likely to occur only under abnormal conditions.

3.29 hazardous atmosphere: An atmosphere that presents a threat to human life because

a) it contains a flammable gas or vapour in a concentration capable of ignition, or

b) it contains toxic components or

c) it does not contain sufficient oxygen for breathing.

NOTE - The term refers exclusively to danger that arises from ignition, but it should be remembered that a hazardous condition also exists where there is a lack of oxygen or where the atmosphere contains toxic gas or vapour, or an inert gas (such as is sometimes used to purge a tank), in such a concentration as to endanger life. apparatus or equipment.

3.30 interceptor; gravity separator: An approved chamber or chambers included in a drainage system and so designed as to permit the passage of effluent but to retain any hydrocarbons that arenot miscible in water and that could be carried by the effluent stream.

NOTE - Design details for interceptors are given in appendix B.

3.31 manifold: One or more header pipes, With branch connections, used for collecting or distributing the products carried in pipelines, pumps or vessels.

3.32 maximum allowable working pressure: The maximum pressure, steady state or static, that is permitted anywhere in a tank during normal service.

3.33 mobile plant; mobile equipment: Plant (or equipment) that is mounted on its own wheels or on tracks that has other facilities that give it mobility.

3.34 mounded tank: A tank that is above the ground and completely covered by earth, sand or other such suitable material.

3.35 packed-product facility: A depot for the storage of one or more grades of flammable or combustible products in packages, i.e. a depot in which no product is stored in above-ground or in semi-buried tanks.

3.36 Permit: A document that is issued by a designated person, or persons, and that permits specific work to be carried out in one or more defined areas.

3.37 protection for exposure. Fire protection for structures property adjacent to a liquid petroleum storage site.

NOTE - Fire Protection for such structures should be approved when the structures are located either within the jurisdiction of any public fire department or adjacent to plants that have private fire services capable of providing cooling water streams on the structures.

3.38 respirator. An apparatus that allows the wearer to breathe filtered respirable air. (See also 3.7.)

NOTE - An atmosphere that is not ignitable is not necessarily respirable.

3.39 Registered engineer- An engineer who is registered in terms of the Uganda Institution of Professional Engineers (UIPE) Engineers Registration ACT (ERA)

3.40 safety gauze: A non-corrodible wire gauze, of nominal aperture size not exceeding 0,5 mm, that is used to prevent the passage of flames into or out of an apparatus, equipment or a building.

3.41 safety zone: An area around above-ground tanks and around semi-buried tanks that does not necessarily fall within the premises of the company that operates the site, but over which such company can ensure control and enforcement of safety requirements by a legally binding agreement.

3.42 safe atmosphere: An atmosphere that is life supporting, non-toxic and incapable of being ignited.

(See 9.10.6 and table 5.)

3.43 semi-buried tank: A tank that is partly in the ground and completely covered by earth, sand or other suitable material.

3.44 source of ignition: Any means of supplying sufficient energy to ignite a flammable atmosphere.

3.45 spark arrestor: A device that is capable of preventing the emission of incandescent particles from the exhaust systems of internal combustion engines into the atmosphere.

NOTE - A spark arrestor is not necessarily a flame trap (flame arrestor).

3.46 tank types: One of the following types of tank that are commonly used to store liquid petroleum products:

3.46.1 Atmospheric tank: A fixed-roof tank, that has a weak roof-to-shell seam, and that is designed to withstand an internal vapour pressure not exceeding (measured at the top of the tank) 3,5 kPa, and that is generally free-venting. (A tank with a vertical cone roof is a typical example.)

NOTE - Atmospheric tanks are not designed for storing a liquid at a temperature at or equal to its boiling point

3.46.2 Floating roof tanks: A type of tank that can be of two designs

3.46.2.1 open-top floating-roof tank: A tank that is designed to an approved standard (API 650 or equivalent), with a pontoon (double-deck metal floating roof that meets the requirements of the design standard; or

3.46.2.2 internal floating-roof tank: A cone-roof tank with an internal floating roof or a lightweight metal pan, and with roof and eaves ventilation designed in accordance with an approved standard (API 650/620 or equivalent).

3.46.3 low pressure tank: A fixed-roof tank, that has a strong roof-to-shell seam, and that is designed to withstand an internal pressure above 3.5 kPa. but not exceeding 103.4 kPa, measured at the top of the tank. (A tank with a hemispheroid top is a typical example.)

3.47 working area: In regard to railway sidings, only that area on each side of the actual staging length of the rail tank car.

3.48 unrestricted area: An area of which no part is classified as a hazardous area.

3.49 unstable liquid: A liquid that, in the pure state or as commercially produced or transported, will vigorously polymerise, decompose, undergo condensation reaction, or become self-reactive under conditions of shock, pressure or temperature.

4. Planning of bulk depots

4.1 Design and construction of bulk storage tanks

4.1.1 General

Plans submitted for approval to the approving authority concerned shall be signed by a Professional or responsible engineer who thereby certifies that such plans comply with the provisions of this part of DUS 947.

All tanks shall be designed and built in accordance with an approved standard (for example, /API 650).

4.1.2 Elevated tanks

An elevated tank shall be so designed that it is supported on a structure with a 4 h fire rating.

4.1.3 Vertical tanks

A vertical tank shall consist of not more than one compartment.

4.2 Topography

4.2.1 Safety distances

Hydrocarbons are volatile under certain conditions and their vapours in specific concentrations are flammable. Precautions shall be taken to prevent their ignition and, in the event of fire, to prevent further spread. One facet of a total fire protection package is to reduce the likelihood of a fire by siting facilities at what is considered to be a safe distance from one another. Safety distances do not guarantee protection from fire hazard, but they help to prevent the start of a fire by ensuring that any flammable vapour generated by one facility will diffuse to a concentration well below the lower explosive level (LEL) before it reaches any other facility or area where a source of ignition might exist.

4.2.2 Bulk depot siting

The siting of a bulk depot is of paramount importance, not only from a marketing point of view but also from a fire and security point of view. Cognisance shall be taken of the following:

a) the fall of the ground in relation to residential areas and other risk areas that could be exposed in the event of accidental large-scale spillages;

b) access facilities to and around the site;

c) drainage systems, especially where these link up with the drainage system of the local authority;

d) available water supplies;

e) fire protection, security, and general service facilities in the area, including the fire services' response time;

f) population densities around the premises;

g) future expansion.

TABLE 1 Minimum Shell to Shell Spacing for tanks in the same bund

1	2	3	4

Impounding	Floating roof tanks	Horizontal tanks	
		Class I or II liquids Class III A liquids	**Class I or II liquids Class III A liquids**
Tanks of diameter not exceeding 45 m			
Remote or in the bund	One sixth of the sum of adjacent tank diameters but not less than 1m	One-sixth of the sum of adjacent tank diameters but not less than 1 m	One-sixth of the sum of adjacent tank diameters but not less than 1m
Tanks of diameter exceeding 45 m			
In the In the tank bund	One-quarter of the sum of adjacent tank diameters	One-third of the sum of adjacent tank diameters	One-quarter of the sum of adjacent tank diameters
Remote	One-sixth of the sum of adjacent tank diameters	One quarter of the sum of adjacent tank diameters	One sixth of the sum of adjacent tank diameters

1. Tanks used for storing stable liquids of class I, II or IIIA shall be separated in accordance with table 1.
2. If a class II liquid is stored adjacent to a class I or class II liquid, the larger of the class spacings shall be used.
3. Where tanks are in a bunded area that contains class I or Class II liquids, or that are in the drainage path of class I or Class II liquids, and that are compacted in three or more rows, or in an irregular pattern, the approving authority shall be permitted to require greater spacing or other means of separation to make tanks in the interior of the pattern accessible for fire-fighting.
4. The minimum horizontal separation between an LPG container and a Class I, II or IIIA liquid storage tank shall be at least 6m, except in the case of a class I, II or IIIA liquid tank that operates at a pressure exceeding 17.2 kPa or that is equipped with emergency venting that permits pressures to exceed 17.2 kPa, in which case the provisions of notes 1 and 2 will apply.
5. Tanks should be so arranged and disposed that, irrespective of whether the tanks are erected within one or several bunded areas, any fires in nearby tanks in the same or adjacent bunded areas, or in equipment or buildings nearby will have minimal effect. As an additional safety factor, consideration can be given to ensuring the further protection of tanks from fire by mobile or stationary firefighting equipment.
6. Tanks should be arranged so that if a fire breaks out, fire-fighting can be carried out effectively with mobile and stationary fire-fighting equipment. Access for and operating availability of such equipment is therefore of prime importance. Tanks should be so sited that each tank is adjacent to a (fire) road or accessible to mobile firefighting equipment.

In the case of tanks that contain a stable liquid of class I, II or IIIA, at an operating pressure of 17,2 kPa or less the distance between the tank and any property boundary, public road or building shall be as given in Table 2.

Table 2 Stable liquids

(at an operating pressure of 17.2kPa or less)

1	2	3	4
Type of tank	**Level of protection**	Minimum distance from boundary of a property that is or can be built on,	Minimum distance from the near side of a public road, or

		including the far side of a public road, but not less than 2 m	nearest important building on the same property, but not less than 2m
Floating-roof (all types)	Protection in case of exposure	Half of the diameter of the tank	One-sixth of the diameter of the tank
	None	Diameter of the tank, but need not exceed 53 m	One-sixth of the diameter of the tank
Vertical with weak roof-to-shell seam	Tanks of diameter 45 or less, with approved foam or inerting systems	Half of the diameter of the tank	One-sixth of the diameter of the tank
	Protection in case of exposure	Diameter of the tank	One-third of the diameter of the tank
	None	Double the diameter of the tank but need not exceed 106 m	One-third of the diameter of the tank
Horizontal or vertical with emergency relief venting to limit pressure to 17.2kPa	Approved inerting system on the tank or approved foam system on vertical tanks	Half values given in column 2 of table 4	Half the values given in column 3 of table 4
	Protection in case of exposure	Value given in column 2 of table 4	Value given in column 3 of table 4
	None	Double the value given in column 2 of table 4	Value given in column 3 of table 4

Table 3 Stable liquid

(at an operating pressure exceeding 17.2 kPa)

1	2	3	4
Type of tank	Level of protection	Minimum distance from boundary of a property that is or can be built on , including the far side of a public road	Minimum distance from the near side of a public road, or the nearest important building on the same property
Any type	Protection in case of exposure	One-fifth of the values given in column 2 of table 4 but not less than 15 m	One-fifth of the values given in column 3 of table 4, but not less than 7.5 m
	None	Three times the values given in column 2 of table 4, but not less than 15 m	One-fifth of the values given in column 3 of table 4, but not less than 7.5 m

Tankage: Class I, II and IIIA liquids		
Dimensions		Level of protection
A1	1/2 diameter of tank	Protection in case of exposure
	1 × diameter of tank	None
A2	1/6 diameter of tank	Protection in case of exposure
B1	1/2 diameter of tank	Approved foam or inerting system
	1 × diameter of tank	Protection in case of exposure
	2 × diameter of tank	None
B2	1/6 diameter of tank	Approved foam or inerting system
	1/3 diameter of tank	Protection in case of exposure
C1	1/2 of values given in column 2 of table 4	Approved inerting system on the tank, or approved foam system on vertical tanks
	Table 3	Protection in case of exposure
	2 × values in column 2 of table 4	None
	1/2 of values in column 2 of table 4	Approved inerting system on the tank, or approved foam system on vertical tanks
C2	Table 3	Protection in case of exposure
NOTES 1 Applies only to tanks that are less than 45 m in diameter and that operate at pressures of less than 17,2 kPa, in the case of stable liquids. In the case of tanks that operate at pressures exceeding 17,2 kPa, see table 3. 2 The minimum distance between a tank and the toe of a bund wall shall be 1,5 m, and that between a bund wall and a property boundary shall be 3 m. 3 The minimum spacing between tanks shall be at least 1 m.		
Tankage: Class IIIB liquids		
NOTES 1 In the case of class IIIB liquids, see table 5. 2 The minimum distance between tanks shall be at least 1 m. 3 The minimum distance between a tank and the toe of a bund wall shall be 1,5 m, and that between a bund wall and a property boundary shall be 3 m.		
General safety distances		
Dimensions	Classification	Description
D	15 m	Class I	If boundary is open-type fencing
	6 m	Class I	If boundary is a solid wall
	6 m	Class II	If boundary is open-type fencing
	3 m	Class II	If boundary is a solid wall
		Class IIIA	No restriction
E	15 m	Class I	
	6 m	Classes II and IIIA	
F	15 m	Classes I, II and IIIA	

Tankage: Class I, II and IIIA liquids		
Dimensions		Level of protection
A1	1/2 diameter of tank	Protection in case of exposure
	1 × diameter of tank	None
A2	1/6 diameter of tank	Protection in case of exposure
B1	1/2 diameter of tank	Approved foam or inerting system
	1 × diameter of tank	Protection in case of exposure
	2 × diameter of tank	None
B2	1/6 diameter of tank	Approved foam or inerting system
	1/3 diameter of tank	Protection in case of exposure
C1	1/2 of values given in column 2 of table 4	Approved inerting system on the tank, or approved foam system on vertical tanks
	Table 3	Protection in case of exposure
	2 × values in column 2 of table 4	None
	1/2 of values in column 2 of table 4	Approved inerting system on the tank, or approved foam system on vertical tanks
C2	Table 3	Protection in case of exposure
NOTES 1 Applies only to tanks that are less than 45 m in diameter and that operate at pressures of less than 17,2 kPa, in the case of stable liquids. In the case of tanks that operate at pressures exceeding 17,2 kPa, see table 3. 2 The minimum distance between a tank and the toe of a bund wall shall be 1,5 m, and that between a bund wall and a property boundary shall be 3 m. 3 The minimum spacing between tanks shall be at least 1 m.		
Tankage: Class IIIB liquids		
NOTES 1 In the case of class IIIB liquids, see table 5. 2 The minimum distance between tanks shall be at least 1 m. 3 The minimum distance between a tank and the toe of a bund wall shall be 1,5 m, and that between a bund wall and a property boundary shall be 3 m.		
General safety distances		
Dimensions	Classification	Description
D 15 m	Class I	If boundary is open-type fencing
6 m	Class I	If boundary is a solid wall
6 m	Class II	If boundary is open-type fencing
3 m	Class II	If boundary is a solid wall
	Class IIIA	No restriction
E 15 m	Class I	
6 m	Classes II and IIIA	
F 15 m	Classes I, II and IIIA	

Figure 1 Typical bulk storage installation showing safety distances

Table 4 Reference table

(to be used in conjunction with table 2 and 3)

1	2	3
Tank capacity m³	Minimum distance from boundary of a property that is or can be built on, including the far side of a public road m	Minimum distance from the near side of a public road, or from the nearest important building on the same property m
Less than 1	1,5	1,5
1.0 -2.2	3,0	1,5
2,201 -45,0	4.5	1,5
45,001 -82,0	6,0	1,5
82,001 -200,0	9,0	3,0
200,001 -378,0	15,0	4,5
378,001—1892,5	25,0	7,6
1892,501 –3785,0	30,0	11,0
3785,001 –7570,0	41,0	13,7
7570,001 –11355,0	50,0	17,0
11 355,001 or more	53,0	18,0

Table 5 Class IIIB liquids

1	2	3
Tank capacity m³	Minimum distance from boundary of a property that is or can be built on, including the far side of a public road m	Minimum distance from near side of a public road, combustible structure or important building on the same property M
Less than or equal to 48	1.5	1.5
> 48 - 112	3.0	1.5
> 112 - 1 92	3.0	3.0
> 192 - 384	4.5	3.0
> 384	4.5	4.5

The minimum distance between a tank and the toe of the inside of a bund wall shall be at least 1.5 m.

4.4.3 Normal venting for above-ground tanks

4.4.3.1 General

All atmospheric storage tanks shall be adequately vented to prevent in the case of a cone-roof tank, the development of a vacuum or pressure that could distort the roof, or in the case of other atmospheric tanks, the design pressure from being exceeded as a result of filling, emptying, and temperature changes.

Protection shall be provided to prevent the overpressure in any pump from being discharged into the tank or vessel where the pump discharge pressure can exceed the design pressure of the tank.

4.4.3.2 Normal venting

Normal vents shall comply with the requirements of an approved standard, such as API Std 2000, or another acceptable standard, and shall be of size at least the same as that of the filling or withdrawal connection (whichever is the larger), but in no case shall the nominal inside diameter be less than 30 mm.

4.4.3.3 Vent flow

In the case of a tank or pressure vessel that has more than one fill or withdrawal connection, and where simultaneous filling and withdrawal can take place, the vent size shall be based on the maximum anticipated simultaneous flow.

4.4.3.4 Vent outlets

The outlets of all vents and vent drains on tanks that are equipped with venting to permit pressures from exceeding 17.2 kPa shall be arranged to discharge in such a way as to prevent localized over-heating of, or flame impingement on any part of the tank, should vapours from such vents ignite.

4.4.3.5 Venting of tanks

Tanks and Pressure vessels for storing class I liquids could be equipped with venting devices that are normally closed except when venting to pressure or vacuum conditions. Tanks and pressure vessels for storing class IA, IB and IC liquids shall be equipped with venting devices that are normally closed except when venting under pressure or vacuum conditions, or with listed flame arrestors. Tanks for storing class I liquids equipped with blankets shall be free venting.

Tanks for storing class II or class III petroleum products could be fitted with open vents.

Pressure and vacuum vents or open vents should not be fitted with fine mesh gauze (less than 6 mm) that is liable to become clogged with dust, dirt or ice and impair venting capacity. However, where such vents are equipped with screens to prevent the entry of foreign matter, the screen shall be of aperture size at least 6 mm.

4.4.4 Emergency venting

4.4.4.1 Every above-ground tank shall have some form of approved emergency venting that will relieve excessive internal pressure in the event of exposure to fire.

4.4.4.2 In the case of vertical tanks, emergency venting could be provided by a floating or if the tank has a fixed roof, by a weak roof-to-shell seam that will fail before any other seam or plate of the tank shell or bottom.

4.4.4.3 If emergency venting is provided by means of pressure relieving vents, the venting capacity of normal vents together with emergency vents should be sufficient to prevent failure of, in the case of a vertical tank, the shell or bottom or, in the case of a horizontal tank, of the shell or ends.

4.4.4.4 The emergency capacity provided shall be in accordance with an approved standard, such as API Std 2000.

4.5 Tank farms and bunding

4.5.1 General

Spillages and fires that involve bulk storage tanks could pose a risk to the depot, adjoining property, thecommunity and the environment. The general purpose of tank farms and bunding is to limit, contain, divert, minimize and manage the impact of spillages and fires.

The design should consider the optimization of tank farm and bunding sizes in conjunction with firefighting requirements of the tank farm and its limitations. The design should also consider the risk of pollution to surface and ground water, soil and environment.

NOTE - In certain situations, the equipment required to extinguish a fire cannot be justified by the economic consequences of the fire alone. If by allowing the fire to bum, the risk to people, the environment and property lying outside the restricted area is not increased, the approving authority need not consider the capability to extinguish a fire to be a requirement.

4.5.2 Spillage control

Spillage control can be provided by remote impounding, impounding around tanks, bunding or by a combination of all three.

In both types of impounding, the impoundment area shall be protected by adequately designed systems to prevent the contamination of ground water if such a risk exists.

4.5.1.1 Impounding around tanks by bunding

Where protection of adjoining property and waterways is by means of impounding by building bund walls around tanks, such bunding shall comply with the following:

a) A slope of at least 1:100 away from the tank shall be provided for at least 15 m or the distance to the bund wall toe, whichever is less.

b) The volumetric capacity of the bunded area shall be not less than the greatest amount of product that can be released from the largest tank in the bunded area, assuming a full tank. To allow for the volume occupied by the tanks, the capacity of the bunded area that encloses more than one tank shall be calculated after the volume of all the tanks, other than the largest tank, below the height of the bund wall has been deducted.

c) To permit access, the outside toe of the bund wall at ground level shall be no closer than 3 m to any property boundary that is or can be built upon.

d) Walls of the bunded area shall be of earth or concrete, and shall be designed to be liquid-tight and to withstand a full hydrostatic head of water. Earthen walls of height 1 m or more shall have a flat section not less than 0.6 m wide at the top. The slope of an earthen wall shall not exceed the angle of repose of the material of which the wall is constructed.

In the case of tanks that contain liquids of class I, II or III, and that are situated in porous soils, bunded areas shall receive special treatment to prevent the seepage of spilled hazardous liquids to low-lying areas or waterways. (See also 4.9 and 5.9.)

e) Except as provided for in f) below, the wall height of the bunded area shall be restricted to 1.8 m.

f) Bund walls shall be permitted to be higher than the general maximum of 1.8 m where adequate provisions are made for normal access and for the necessary emergency access to tanks, valves and other-equipment. A safe exit from the bunded area shall also be provided.

NOTES

1. Where the average height measured from the interior grade, of a bund that contains class I liquids exceeds 3.6 m

or when the distance between any tank and the top inside edge of a bund wall is less than the height of the bund wall, provision shall be made for normal operation of valves and for access to the tank roof without entry below the top the bund. It should be possible to meet these provisions through the use of remote operated valves, elevated walkways, or similar arrangements.

2. Piping that passes through bund walls should be designed to prevent excessive stress as a result of settlement of the soil or exposure to fire.

g) The minimum distance between a tank and the toe of an interior bund wall shall be at least 1,5 m.

h) Each bunded area that contains two or more vertical tanks shall be subdivided at least by intermediate

bund walls or by drainage channels, to prevent spills from one tank from endangering adjacent tanks within that bunded area

.NOTES

1. Whenever two or more tanks that contain class I liquids, and of which one is of diameter exceeding 45 m, are located in a common bunded area, intermediate bund walls should be provided between adjacent tanks to hold at least 10% of the capacity bf the tank so enclosed, and not including the volume displaced by the tank.

2. Intermediate bund walls or drainage channels (or both) should be so located between tanks as to take full advantage of the available space with due regard for the capacity of each individual tank. Intermediate bund walls should be of height at least 0.5m.

i) Where provision is made for draining water from bunded areas, such drains shall be so controlled as to prevent flammable or combustible products from entering natural water courses, public sewers or public drains. Under fire conditions, the controls of such drainage shall be accessible from outside the bunded area.

j) No storage of combustible materials shall be permitted in any bunded area.

4.5.1.2 Remote impounding

Where protection of adjoining property or waterways is by means of drainage to a remote impounding to area, such systems shall comply with the following:

a) A slope of at least 1:100 away from the tank and toward the impounding area, shall be provided for at least 15 m.

b) The impounding area shall have a capacity of at least that of the largest tank. Where this is impractical because of area restrictions, partial remote impounding for a percentage of the tank capacity shall be permitted, remote from any tank or adjoining property. Bunding that meets the provisions of 4.5.2.1 shall be provided for the volume that was not provided for by the partial remote impoundment.

c) The route to and from the remote impounding system shall be so designed that, in the event of a fire, the tank or the adjoining property is not seriously exposed.

d) The confines of the impounding area shall be so designed that, when the area is filled to capacity, the liquid level is not closer than 15 m to any property boundary that is or can be built on, or to any tank. Where partial remote impounding is used, the level in the partial impoundment shall meet the provisions of this subclause. Any excess volume shall meet the provisions for impounding by bunding as provided for in 4.5.2. 1, and the tank spacing shall be determined as for tanks impounded in accordance with 4.5.2. 1.

4.5.2 Packed-product facilities (warehouses) and pump slabs

Bund walls are not required around packed-product storage areas, storage buildings, filling sheds or pump slabs. Spillage control shall be provided where product is decanted or pumped. The floors of packed-product facilities shall not be sunken, since petroleum vapours are difficult to disperse from such locations and can accumulate and cause toxic and fire hazards.

4.5.3 Lighting

To facilitate night operations, tank farms shall be provided with adequate artificial lighting facilities that comply with the recommendations given in this DUS 947 Part 2

4.6 Location and spacing of buildings

4.6.1 General

All buildings shall comply with the Traffic Road safety laws and Building regulations and Public Health Act 1935 of Uganda.

4.6.2 Administrative buildings

Where possible, administrative buildings should be located in a safe area (preferably near the main gates), with access from the roadway so that visitors to the offices do not have to enter the working area of the depot. The walls of these buildings may form part of the outer boundary of the depot.

4.6.3 Operational facilities

Operational buildings (such as filling sheds and pump slabs) shall be spaced as follows:

a) No filling shed or pump slab that contains class I liquids shall be sited less than 15 m from any part of the outer boundary of the depot if the boundary is constructed of open-type fencing. At points where the open-type fencing is replaced by a solid wall, or if the depot is bounded by a solid wall, this distance may be reduced, but shall be at least 6 m. (See also 5.9.5.) In the case of filling sheds for class II petroleum products, the above distances could be reduced to 6m and 3 m respectively. In the case of class III liquids, no limit need be imposed.

b) Filling sheds and pump slabs where class I petroleum products are handled shall be sited at least 15m from any building in which work that involves heat is done or where open fires are used (for example, reconditioning shops, tin factories, and soldering sheds). In the case of class II and class III petroleum products, this distance may be reduced to 6 m.

NOTE - If the safety distances given in (a) or (b) above cannot be attained, fire walls may be used, subject to approval by the appropriate approving authority.

4.6.4 Service buildings

Service buildings do not constitute an inherent petroleum-fire hazard but might include open fires or other similar fire hazards. Service buildings shall be sited in safe areas away from places where products are stored and handled and out of the line of possible vapour travel (at least 15 m away in the case of class I products and at least 6 m away in the case of class II products).

4.6.5 Boiler houses, power plants and fire pump slabs

These buildings shall be so located (in safe areas) that their equipment can be safely operated in the event of a fire.

4.6.6 Buildings on boundaries

The walls of buildings other than buildings for which safety distances are given in 4.6.2, may farm part of the boundary of a depot. Any openings in such walls shall have some suitable form of security.

4.7 Roadways

4.7.1 Traffic arrangements

On-site roads shall not be used for parking. Special parking areas shall be allocated for petroleum-carrying vehicles. Parking areas for bulk tankers shall be so designed that a large spill will not endanger the tank farm, buildings or any other structures. If possible, allocate a parking area for private cars, preferably on a part of the site that is remote and separated from operational areas.

Vehicles (other than those normally employed on the premises) shall not be used on on-site roads without the prior approval of the manager or his authorized representative. Suitable lighting is essential for night operations. (see Table 4, column 2)

Where pipelines or cables are routed adjacent to roads, protective kerbing shall be provided. If kerbing cannot be provided, warning posts or fencing shall be provided to prevent accidental damage.

Symbolic safety signs and warning signs shall be provided where necessary. In large depots, the numbering or naming of roads is desirable.

4.7.2 Access for fire-fighting equipment

The effectiveness with which fire-fighting equipment can be used, particularly in the early stages of a petroleum-product fire, depends primarily on the speed with which such equipment can be brought I into active use. (See also clause 7.)

4.7.3 Layout

The layout of a depot should embody roadways or all-weather hard-surfaced tracks that give mobile equipment and persons access to hydrants and permit effective and safe use of the equipment, irrespective of the location of the outbreak of the fire or the direction of the wind. All such roads and tracks, exits and entrances to buildings, and access to fire-fighting equipment shall be unobstructed.

Hydrants and fire-fighting equipment shall be so located that they can be approached from different directions, and distinctly marked that they can be easily seen (reflective material is recommended to facilitate visibility at night). Hydrants shall be provided at positions that would enable any fire to be combated, irrespective of the wind direction.

4.7.4 Planning

When the layout of a bulk storage depot is being planned,

a) the roads shall be so aligned in relation to the siting of the tanks, plant and buildings that operational requirements are complied with, and ease of access is provided for fire-fighting purposes;

b) there shall be a street or passage closed at one end;

c) in large bulk depots (i.e. of storage capacity exceeding 150 000 m3), a perimeter road with subsidiary

intersecting roads that divide tank compounds or other operational areas or both shall be provided (see also 4.5.2.1 (c));

d) a uniform grid plan shall be used when the roadways are being designed;

e) where the approach of vehicles to and from a public highway is controlled by gates, the gates shall be set far enough back from the frontage to enable a vehicle to be halted clear of the highway;

f) adequate turning room shall be provided at junctions and care taken to avoid obstructing the vision of drivers, taking into account that there must be a minimum turning radius of 13.1m for vehicles;

g) roadways shall be constructed suitably and with due regard to the traffic and layout of the plant, and the roadways shall be properly maintained;

h) well-surfaced and well-drained main roads that are capable of accommodating two lines of traffic are recommended;

NOTE-Subsidiary roads may be of single-track width with adequate passing bays, and a lower standard of surfacing and drainage is acceptable.

i) a perimeter road may be sited within the safety distances between tanks and boundaries.

4.8 Railway sidings

The Provision and construction of private sidings shall be in accordance with the relevant regulations of Ministry of works and Transport (See 4.10.). Sidings shall be so sited that they cannot be cut off by a fire in another area and that they are accessible for fire-fighting purposes.

The position of the railway track relative to plant and to loading gantries of platforms shall be in accordance with the Regulations of Uganda Railways.

Loading sidings shall be located at least 15 m from the running line used by locomotives (electric or other), and rail tank vehicle staging points shall be located at least 15 rn from tank shells, buildings in which work that involves heat is done, important buildings (for example, offices), bulk truck loading racks that handle class I products, package warehouses and filling sheds that contain class I products and possible fire areas.

In the case of package warehouses, filling sheds and bulk loading racks that handle class II and III products only, this distance may be reduced to 6 m (see 4.6 and figure 1).

4.9 Drainage and interceptors (see also Appendix B)

4.9.1 Surface water: general

Drainage shall be planned in accordance with statutory regulations. Every advantage of natural seepage for disposal of surface water shall be utilized. Existing storm-water drains, rivers and streams shall be used to cope with the outflow, although it might be necessary to provide special catchment basins or seepage areas in large plants where heavy precipitation rates (that might temporarily be beyond the capacity of the local system) can be expected.

4.9.2 Surface water (tank farm areas)

Suitable drainage facilities shall be provided to deal with surface water and to dispose of fire-fighting water. The water used to control a fire shall be of an acceptable quality (free from hydrocarbons, solvents, alcohols and any additives) before the water is passed into drain.

Outlets from tank farm areas shall be controlled by means of valves situated outside the bunded areas because access to these valves might be needed during fire-fighting to release excess cooling water. The valves shall be kept locked in the closed position at all times unless drainage is taking place under the control of a designated person. The valves shall be clearly identified and marked with the direction of opening.

4.9.3 Containment separation

The local authority bylaws shall be consulted and the collecting system shall be so designed as to minimize the amount of surface water that results from precipitation and normal drainage and that has to be routed through the interceptors (thus avoiding the need for inordinately large interceptors). This is best achieved by providing, where possible, separate systems for surface water and for water from contaminated sources such as tank farms and loading and filling areas. (For design details of an interceptor, see appendix B.)

4.9.4 Sewage

Where a local system for the disposal of sewage exists, it is obviously desirable that the drainage system be connected to it, but where this is impracticable, septic tanks or other suitable disposal units should be installed. Consult the regulations of the local authority and investigate the suitability of the ground with a view to the installation of disposal beds. Contamination with product in such systems shall be avoided. Conversely, sewage systems shall not be connected to interceptors.

4.9.5 Washing of vehicles

4.9.5 .1 washing of vehicles should be discouraged and where it is done the Uganda standard shall apply.

4.9.5.2 All wash-bays shall be so designed that effluent, detergents and contaminated water are contained. Run-off water that contains effluent shall be of such quality that it complies with the relevant regulations of the NEMA and with the bylaws of the local authority before the water passes into the relevant drains. Specially designed wetlands can also be considered for this purpose.

4.10 Loading and discharging facilities

4.10.1 Planning

In planning the layout of road and rail facilities, safety, the environment and efficiency shall be regarded as the basic considerations. The location of these facilities will be determined by the topography and by the proximity of risks from outside the property.

4.10.2 Safety of personnel

All access ladders and operating platforms to facilitate the handling of hoses, the dipping of tanks and the manipulation of valves shall comply with the Factories Act Cap 220, Laws of Uganda

5. Design and construction of plant, equipment, and buildings

5.1 Above-ground tankage

Because of the various types of above-ground tankage that can be constructed, close consideration (based on sound engineering principles and common sense, but within the framework of an approved standard (for example , BS 2654,

ANSI/API 620, ANSI/API 650, or equivalent)), shall be given to tankage, especially with regard to foundations, venting (see API Std 2000). earthing (pipe connections, manholes, stairways, ladders, handrails, gauging equipment, floating roofs, diaphragm roofs, cathodic protection systems and maintenance facilities. (See also the current regulations framed under the OHS Act, the electricity act, 1999 with regard to statutory requirements for earthing, stairways, gangways and ladders.)

All new vertical tanks shall consist of not more than one compartment and shall incorporate a system that will give early warning of a floor-plate leak.

Elevated tanks shall be supported on structures with a fire rating of at least 4 h.

5.2 Pipelines

Underground water mains need not be constructed of steel but shall be designed to withstand a minimum test pressure of 1.5 times the working pressure.

5.2.1 Design of equipment and construction

All pipes, valves and pipe fittings used shall have been fabricated to an approved code (or equivalent) and shall have a safety factor based on engineering judgment for the conditions of service.

5.2.2 Valves

Inside bunded areas, only valves that are of steel, are fire safe, and that comply with an approved standard shall be used (see also 5.2.1). Elsewhere in the depot, approved cast-iron valves may be used.

Valves shall be designed with a suitable factor of safety relative to the pressures and stresses likely to be met in service, and glands shall be such that they can be repacked without the removal of the valves from service.

Valves of other than the rising spindle type shall incorporate an indicator that shows clearly when they are in the open and the closed positions. Valves used in locations where frost damage can be expected, should be provided with means for draining valve bodies or shall be constructed of mild steel.

Where unidirectional fire-safe valves are installed, they shall be so installed that the contents of the tank are held back.

5.2.3 Pipe run

5.2.3.1 above ground

Pipelines over pathways, roadways and platforms shall be supported by gantries, bridges or other approved structures. Provision shall be made to ensure that personnel do not come into contact with hot product lines and steam lines.

Where vehicular traffic could damage pipelines, provision shall be made to protect such pipelines (by means of guardrails, safety barriers or other suitable means).

Drains designed and intended for storm water control or effluent control (or both) shall not be used to house pipelines.

5.2.4 Protection against corrosion

Where necessary, the outer surfaces of above-ground pipelines shall be protected by a suitable coating. All below-ground pipelines shall be protected in an acceptable way with suitable corrosion-resistant materials. If a cathodic protection system is used, it shall comply with ISO 15589-2.

A cathodic protection system shall

a) be designed in accordance with ISO 15589-1 , and

b) follow the electrical safety requirements of the OSH Act

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5.2.5 Line identification

Colour markings or other acceptable means shall be used to identify the product or service for which pipelines and valves are intended (see API/IP 1542, ISO 9095:1990), and the relevant oil-marketing company's colour coding of product pipework). It is recommended that the lines be stencilled at strategic points, for likely example, FRESH WATER MAIN, FOAM, BASE INJECTION, etc. Letters that are clearly legible and of contrasting colour to the colour coding of the pipeline itself shall be used.

5.2.6 Testing

Before each completed pipeline is commissioned and, where applicable, before the closing of the trench(es) in which a product pipeline is laid, ensure that the pipeline is properly fabricated and free from leaks by testing it in accordance with the design code employed. It is recommended that all buried pipelines be pressure-tested annually throughout their service life, and provision should be made for this

The tests shall be witnessed and verified by UNBS.

Pipelines shall be fitted with adequate vent connections, drain connections and fittings to facilitate testing.

Thermal pressure relief shall be provided on all product pipelines.

5.2.7 Flow direction

Pipeline systems shall be so designed, through use of L-port, T-port and non-return valves that the possibility of flow in unintended directions is minimized.

5.3 Hoses (for product)

5.3.1 Hoses shall be used that comply with the requirements of ISO 1825:2017, ISO 6942:2002 (as relevant), or with an approved specification, and that are designed for a working pressure at least equal to the maximum working pressure likely to be met in the pipeline system to which the hoses might be connected.

5.3.2 Materials used for the outer covering of hoses shall be resistant to abrasion and to deterioration arising from contact with petroleum products. Hoses shall be pressure-tested at least once a year at which a test pressure of 1.5 times the maximum working pressure, and records of such pressure tests shall be kept and made available for inspections.

5.4 Pumping plant (for product)

5.4.1 General

All pumps for application and intended service in the petroleum industry shall be designed to an approved standard.

5.4.2 Pumps

The type of pump to be used will be determined by the product characteristics and pumping requirements.

Preferably use centrifugal pumps of single-stage or multi-stage design for all products except viscous fuel

oils. Where positive-displacement pumps can have significant advantages, they may be used. Screw pumps and piston-type pumps are particularly suitable for handling heavy, heated products. Pumps shall be adequately supported. Spill containment shall be provided for all pumps, and shall include suitable drainage.

5.4.3 Pipe manifolds and pumps

Pipe manifolds and pumps shall be protected in an acceptable way from stress induced by the expansion and contraction of pipelines. Hose connections from manifolds are regarded as a fire risk and shall not be used indiscriminately. Pumps and pump manifolds should preferably not be located inside a bunded area where class I liquids are stored or pumped.

5.4.4 Electrical equipment

Electric motors that are used to drive pumps shall be rated for continuous operation at the maximum power output likely to be required in service. Electric motors and associated equipment located within a hazardous area shall conform to, and be installed in accordance with, the requirements of ISO 13702

5.5 Loading and unloading of bulk road vehicles and bulk rail vehicles

5.5.1 Loading arrangements

Arrangements for either open or closed loading can be adopted to prevent splash loading. Where top loading arrangements are used, the point of discharge from the loading arm shall be positioned close to the bottom of the tank.

Where bottom loading arrangements are used, an overfill protection method shall be installed to provide control of the quantity delivered to vehicle tanks.

5.5.2 Layout

In the layout of road-vehicle loading facilities and rail tank-vehicle loading facilities that handle class I (or class I combined with class II and class III) products, the safety distance shall be at least 15 m. If only class

II and class III products are handled, this distance may be reduced to 6 m. (See also 4.8.)

Allow for ease of vehicle access and exit, preferably without the need for reversing. It is preferable to group road-vehicle loading points on islands that are parallel to one another. Such islands shall have suitable protection for the loading equipment.

The area adjacent to a railway siding where petroleum products are loaded or unloaded shall be so graded that a major product spillage will be contained.

Where practicable, adequate earth dikes, channels, etc., to control such a spillage shall be provided.

Rail vehicle loading points shall be located alongside the track at intervals that suit the vehicle dimensions.

Wherever possible, the section of track that serves the rail-vehicle loading facilities shall be reserved for this purpose only. The track and pipelines shall be properly bonded and earthed in accordance with the relevant regulations of Uganda Railways.

5.5.3 Road-vehicle loading areas

The loading areas shall be surfaced with materials that are resistant to damage by the product(s) and by fire.

The surface shall be so graded that spillage occurring at any one point will not flow under vehicles at any other point. An acceptable method of spillage control shall be provided at all filling points, including spillage containment with sufficient capacity to hold a minimum of two minutes flow from the loading point with the largest capacity. The drainage system that is used shall be so connected that it drains the area to an interceptor.

5.5.4 Rail-vehicle loading and unloading areas

These areas shall have permeation values of less than 10-6 cm/s. Any spillage that occurs, shall be contained and passed through an interceptor for recovery.

At loading facilities, spillage containment shall be provided, with sufficient capacity to hold a minimum of two minutes' flow from the loading point with the largest capacity. At unloading facilities, spillage containment shall be provided to hold the capacity of the single largest rail vehicle that can be accommodated at the siding.

5.5.5 Loading equipment

Loading equipment can be located at ground level or on a platform of a height that suits the transport fleet.

Loading equipment shall be so installed that the strain on any metering unit does not exceed the design limit of the unit.

When automatic loading equipment is used, a manually operated shut-off valve for use in an emergency shall be provided away from the risk area.

Where gravity loading methods are used and also where gravity flow to the equipment is possible, each supply line shall be fitted to the loading points with a quick-acting emergency stop-valve located at a safe distance from the loading area.

5.5.6 Platforms

All platforms shall comply with the requirements of the Factories Act, Cap 220 of the Laws and regulations of Uganda.

5.5.7 Construction materials

Materials that are of adequate strength and that are non-combustible shall be used in the construction of loading structures.

5.5.8 Earthing

Before any connections are made to trucks or rail vehicles and before any flow of the product commences, an electrically continuous path (bond) shall be in place.

The accumulation of static electricity shall be reduced by earthing and bonding the loading or the unloading equipment (or both) in accordance with the recommendations given in the electricity act, 1999 laws of Uganda.

5.5.9 Lighting

All lighting shall comply with the requirements in the Factories Act Cap 220, Laws of Uganda.

Electrical installations shall be in accordance with the recommendations given in Uganda regulation for electrical installations.

5.6 Ship loading and discharging equipment

Ship loading and discharging facilities shall be designed in accordance with the Uganda regulations and the recommendations given in the Design, Construction and Operation of Distribution Installations (See also 6. 1.)

5.7 Package filling and packaged-oil warehouse buildings

5.7.1 General construction

All buildings shall comply with the Building Regulations of Uganda. Use fire-resistant materials in the construction of buildings and equipment. (See ISO 834-1:1999)

5.7.2 Spillage

Separator facilities shall be provided to contain any possible spillage and to prevent the spillage from leaking into sewage drains. (See also appendix B.)

5.7.3 Ventilation

All ventilation in buildings shall comply with the requirements of the Petroleum Act. Unless the buildings have open sides, they shall have ventilation openings in opposite sides near the floor and near the roof.

5.7.4 Service doors, windows and skylights

Where so required by the OSHA of Uganda, in the event of a fire shall be specified.

5.8 Packed-product storage areas

Packed-product storage areas shall be provided with suitable drainage and measures against flooding.

The base of these storage areas shall be constructed from any suitable material that will provide support for the loads to be carried (including those imposed by any mechanical handling equipment to be used).

5.9 General site works

5.9.1 Design and construction of bund walls (see also 4.5)

Bund walls shall be constructed of earth or concrete, and shall be liquid tight. Bunds shall not be covered with any material that will deteriorate under the effects of any petroleum product. A person qualified in terms of Uganda Institution of Professional Engineers (UIPE) Engineers Registration ACT (ERA) , shall design all bunds.

Because of the behaviour of other materials in the event of a fire, earthen bund walls or earthen bund walls contained within masonry are preferred. Ensure that earthen bund walls have a flat crown of at least 0.6 m wide and suitable foundations that prevent oil from seeping underneath them and polluting the environment, or from escaping from the bund. If the earth is permeable, and a high risk of contamination of ground water exists, an approved method of sealing shall be provided (e.g. high density polyethylene (HDPE) plastic sheeting).

Whenever a bund wall has been breached, the gap shall be made good as soon as possible, and not left open overnight while any tank it encloses has product in it. Pipelines that pass through bund walls shall be wrapped to protect them from corrosion and sealed to prevent leakage of product.

Main bund walls shall be strong enough to withstand the hydrostatic pressure to which they will be subjected if the space within the bund is filled with water. Cognisance shall be taken of the effect of heat exposure under fire conditions.

5.9.2 Bund floors

Permeable bund floors shall be restricted to a coefficient of permeability not exceeding 10-6 cm/s (in situ).

5.9.3 Railway sidings

Railway sidings shall be constructed, operated and maintained in terms of the operating rules of

Uganda Railways. Gates equipped with efficient matches to hold them open when required, shall be provided across railway lines. Prevent gates and fences from picking up electric charges from the rails by so constructing the gates that they cannot touch either running rails or check rails.

Electrical installations and earthing arrangements and provisions for the electrical isolation of private sidings from main line electrified services shall conform to the regulations of Uganda Railways. No overhead cable shall cross a siding where rail vehicles are loaded or unloaded.

The working area, if it has an impermeable surface, shall have surface drainage on each side of the track or, alternatively, filter drains shall be installed to act as collectors. The drains shall be led to an interceptor via a valved system. Adequate means and procedures for catching and disposing of product from leaks and spills shall be provided.

5.9.4 Drainage interceptors

Drainage interceptors shall be provided on all drainage systems where a spillage could occur. Drainage interceptors shall comply with the requirements of 4.9. For design criteria of an interceptor, see appendix B.

5.9.5 Boundaries

Boundary fencing with a total vertical height (from ground level to the top of the fence line, including barbed wire) of at least 2.5 m is required. It shall be of an approved type of unclimbable fencing or walling, and may be of chain-link fencing, steel paling, brick or mass concrete walling, or of the slab- and-post concrete type. It will often be found that more than one type of boundary fencing can be usefully employed at the same depot, for example, chain-link or other open-type fencing for tank compounds, and brick or concrete walling for busy operational areas, particularly where these adjoin a public thoroughfare.

NOTE - Where a number of bulk depots that belong to different companies adjoin or are situated within a controlled and fenced area such as a dock, the above stipulations may be relaxed, subject to agreement by the approving authority.

6. Operations

6.1 Receiving bulk cargoes from and delivering bulk cargoes to tank vehicles

6.1.2 Regulations

All regulations contained in the Design, Construction and Operation of Distribution Installations: Model

Code of Safe Practice Part 2, the fire authorities and the operating company shall be strictly adhered to. It is recommended that an extract of relevant port and depot regulations be handed to the master of a truck on arrival.

6.1.3 Communications

An efficient communication system shall be set up between all persons involved in operations, to ensure that cargo-handling operations are safe and efficient, and that immediate action can be taken in the event of an emergency. Where class I and class II products are handled, communication equipment shall be acceptable explosion-proof equipment, and shall comply with the requirements of IEC 60079.

6.1.4 Earthing, bonding and insulation

All earthing, bonding and insulation shall comply with the requirements as laid down in electricity (safety code) regulations, 2003 .

6.2 Loading and unloading of rail tank vehicles

It is recommended that the entry of rail tank vehicles into a siding and the loading and unloading operations be controlled by a designated person, who shall adhere to the relevant regulations contained in the Spoornet manual on dangerous goods as in clause 2.2 In addition, the following shall be noted:

a) movement of rolling stock within 15 m of a rail tank vehicle that is being loaded or unloaded shall not be permitted, and locomotives that are not approved for use in hazardous areas shall not be permitted to approach closer than 5 m to a loading or unloading point during operations that involve class 0, class I, class II or class III products;

b) a warning notice (symbolic sign) shall be placed near both the loading and the unloading points and shall state the point beyond which locomotives shall not pass:

c) suitable warning notices (symbolic signs) shall be displayed during each loading or unloading operation;

d) a recognized distinctive code of sound signals and lights shall be used during shunting operations;

e) during loading and unloading operations, suitable warning notices shall be conspicuously displayed at

the approach to internal sidings. Should the sidings fall outside the depot, the warning notices shall be

displayed at both ends of the train;

f) smoking shall only be permitted in designated areas; and

g) splash filling or splash loading shall not be allowed (see electricity (safety code) regulations, 2003.

6.3 Loading and unloading of road vehicles

The following general safety rules shall apply during loading and unloading of road vehicles:

a) no vehicle shall be left unattended while loading or unloading is in progress;

b) accidental movement of the vehicle shall be prevented, and it shall be left in a gear that prevents movement;

c) all vehicle engines shall be switched off before loading, and shall not be restarted until all caps, cocks, valves and covers have been closed and secured;

d) no internal combustion engine (other than that of a vehicle specially equipped for transporting, handling,

or pumping flammable liquids) shall be closer than 15 m to an area in which class I or class II products

are being loaded or unloaded;

e) vehicles awaiting loading shall remain at a safe distance from the loading point;

f) smoking shall only be permitted in designated areas;

g) heated products shall be handled with great care;

h) all personnel shall be provided with protective clothing for loading or unloading operations as ISO 1696

i) where operations involve switch loading, safety procedures shall be implemented (see AP RP 2003); and

j) splash filling or splash loading shall not be allowed .

6.4 Containers

Containers used in the petroleum industry vary considerably in type and size. In order to select the type of pack that will be acceptable, it is necessary to consult the publications of the appropriate transportation authority. The publications available at present are:

a) SARU manual on dangerous goods - Requirements concerning the packing, acceptance, transportation

and delivery of dangerous goods;

b) IATA regulations, relating to the carriage of restricted articles by air; and

c) International Maritime Dangerous Goods Code of the Intergovernmental Maritime Consultative Organization (IMCO).

However, the publications listed above do not always give details of the components of the pack or of its minimum performance level and, in such cases, containers and packs that comply with the requirements of ISO 16104, 16106 or Pesticides and Toxic Substances Regulations of the NEMA Act Cap 153 of the Laws of Uganda shall be used.

7. Fire precautions and fire control in bulk depots

7.1 General

The protection facilities against fire hazards in bulk depots shall be achieved by good engineering design and construction standards. Safe operational procedures and efficient plant and equipment maintenance shall be such that it is highly improbable that fire will break out.

7.2 Ignition sources

7.2.1 Any device or action that could cause a flame or spark shall not be permitted in restricted areas, unless authorized by an appropriate permit, the stipulations of which shall be strictly adhered to. (See also 7.2.3.)

7.2.2 Sources of ignition include but are not limited to the following: cutting and welding, electrical sparks, frictional heat of sparks, furnaces, heating equipment, hot surfaces, lightning, open flames, ovens, radiant heat, smoking, static electricity, stray currents and spontaneous ignition.

7.2.3 Welding, cutting and similar spark-producing operations shall not be permitted within the depot premises without an authorized hot-work permit (see 9.1.2 and 9.8).

7.3 Access control

7.3.1 Persons

All points of entry to depots shall be so planned that persons or passenger vehicles that enter or leave the depot can be observed. Unauthorized persons shall not be permitted access to the depots.

7.3.2 Locomotives and rolling stock

7.3.2.1 Locomotives shall not be permitted to enter hazardous areas, unless they comply with ISO 1825.

7.3.2.2 Trucks shall not be shunted onto or off shuntings during loading, and unloading operations. Warning notices in accordance with clause 7.15 against such shunting shall be displayed near the entrances to sidings during loading or unloading operations.

7.3.2.3 Fly shunting shall be prohibited.

7.4 Housekeeping and vegetation

The site shall be kept free from obstructions and combustible rubbish. Vegetation that is liable to dry out and become a fire hazard shall be kept short and cuttings shall be removed.

7.5 Absorbents

Absorbents are basically recommended for containing spillages. Adequate supplies of absorbents shall be available at all times.

7.6 Work permits

Before any construction, repair or maintenance work is carried out, the appropriate certificates of work permits (or both) shall be issued in terms of 9.8. (For examples see appendix C.)

7.7 Training (safety organization)

Each facility shall have a safety organization the size of which will depend upon the complexity of the operation.

The safety organisation shall advise the management on the technical and legal aspects of safety and shall provide a programme for the improvement of safety performance (training programmes).

As many persons as practicable at each work site shall be given training in the use of the appropriate firefighting equipment.

7.8.7 Fire hoses

Fire hoses shall have fittings that are compatible with all the hydrant connections and shall be maintained for the worst-case fire scenario.

7.8.8 Foam applications

Normal finished foam is produced by introducing foam compound into water (usually at a rate of 3% to 6%) and then expanding the mixture with air for the type of low-expansion foam compound used (The expansion factor is about 8 to 1.)

The foam may be applied by monitors that deliver it to the seat of the fire or, in the case of tanks, by dry risers or subsurface injection.

In the case of fixed-roof tanks, the application rate of the available mixture (solution) of foam compound and water for fire-fighting with low-expansion foam, can be calculated in litres per minute per square metre of total fire area. As a general rule 6.5 l/min/m2 of fire area will result in the fire being extinguished (see ISO 7203, 7076 & 6182).

Depending on the design of the tank, foam may be applied either by direct projection or by means of dry risers. In the case of floating-roof tanks, it is usual to design fire-fighting facilities that cater for rim seal fires only.

This is most commonly done by applying low expansion foam to the seal area. Vaporizing liquid systems are also used, especially in the case of crude-oil tanks. When foam is used, dry risers and foam dams shall be provided for.

An alternative method of applying foam is by injection via the base of a storage tank through product lines or special inlets (see ISO 7203, 7076 & 6182). To avoid foam dilution, it is important to ensure that any injection point is above the water level of the tank bottom. Foams suitable and approved for base injection should be used.

7.8.9 Foam stocks

Sufficient foam compound should be stocked to cater for the largest extinguishable fire in the greater area of a fixed-roof tank and the largest possible spill area for 1 h, plus a complete reserve charge to cover the possibility of a second fire. Furthermore, it is recommended that some of the calculated requirements be held in terms of the mutual aid arrangements between local authorities and industry.

7.8.10 Extinguishers

Conveniently placed hand-held fire extinguishers or large mobile fire extinguishers, or a combination of these, shall be provided, which shall comply with Building Regulations of Uganda.

The servicing of portable fire extinguishers shall comply with the requirements of ISO 7165.

7.9 Location and marking of equipment

7.9.1 Location plan

For ready reference in an emergency, a layout plan of the site shall be displayed in an easily accessible location so that authorized persons can have easy access to it. The plan shall indicate the position and the nature of the contents of all product tanks, product pipe lines and valves, as well a- the positions of water pipelines, hydrants, fire appliances, the fire control Centre, emergency stop buttons, and access routes for fire-fighting equipment to reach all parts of the plant.

The plan shall also indicate the location of fire-fighting equipment and foam storage, including the quality and type of foam stored.

7.9.2 Emergency numbers

A notice on which the telephone numbers of the fire service and other emergency services are clearly recorded, shall be displayed near every telephone, at the control centre and at the gate of the site.

7.9.3 Tank identification

All tanks shall have their numbers painted on in two positions, one that is visible from the fire-service access route and the other opposite it, as follows:

a) numerals and letters shall be in colours that contrast with that of the tank shell; and

b) characters shall be of such size as to be clearly visible and identifiable, of minimum height 290 mm and of minimum width 25 mm.

7.9.4 Equipment and hydrant points

All fire points (equipment and hydrant points) shall be clearly identified by the appropriate signs in accordance with an approved international standard. It is recommended that retro-reflective materials be used for this purpose. (See also 7.11.)

7.10 Fire-fighting equipment

7.10.1 Water Supply

7.10.2 Portable and mobile fire-extinguishers

7.10.2.1 Portable and mobile fire-extinguishers shall comply with an approved standard (for example, ISO 7165.

7.10.2.2Dry-chemical powders shall be of a type that complies with ISO 4497:1983 and is compatible with the intended application.

7.10.2.3 All fire-extinguishers shall be protected from the weather.

7.10.3 Fire hoses

7.10.3.1Fire-fighting hoses shall comply with an approved standard (for example, ISO 14557).

7.10.3.2Hoses shall be inspected at least once every calendar year by a designated person. Hoses found to be defective on inspection shall be replaced or repaired immediately.

NOTE - A record should be kept that shows the date of each inspection and is signed by an appointed responsible person. (See also 7.16.4.)

7.10.3.3Fire-fighting hoses shall be housed or stored in weatherproof containers when not in use.

7.10.4 Couplings

7.10.4.1Couplings for hoses, branch pipes, nozzles and connectors shall comply with ISO 14557).

7.10.4.2All couplings shall be compatible with the local authority's fire-fighting equipment.

7.10.5 Hydrants

All hydrants shall comply with ISO 3600 and shall be provided with rubber or plastic protective caps.

7.10.6 Fire alarms

7.10.6.1Fire alarms shall be of such volume and tone that they are clearly distinguishable from background noise and are audible, under prevailing wind conditions, anywhere along the perimeter of the site.

7.10.6.2Where an alarm is electrically powered, an independent source of power shall also be available.

NOTE - Hand-cranked or compressed gas units may also be used.

7.10.6.3An approved means of direct emergency communication with local emergency services shall be available.

7.10.7 Foam concentrates

7.10.7.1Foam compound shall comply with an approved standard. A knowledge of the compatibility of different foam compounds with one another and with dry chemicals, when used simultaneously in fire-fighting, is essential, since outside bodies, such as the local authority, might use different compounds. Regular quality tests shall be carried out in accordance with the manufacturers recommendations.

NOTE - It is recommended that low expansion foam is used.

7.10.7.2Foam compound types shall be suitable for the risk presented by the product on hand. All foam compound containers shall be clearly marked, appropriate to the type of compound. In this regard, expert advice shall be obtained from approved standards or from the manufacturer (or from both) (see ISO 7203, 7076 & 6182).

7.10.7.3Foam compound that is corrosive shall be stored in suitable containers.

7.11 Colour identification of fire-fighting equipment

All fire-fighting equipment shall be painted a distinctive red (A11 signal red or Al4 poppy red.). Notices shall be displayed and the location of equipment that is not visible shall be clearly indicated. (See also 7.9.4.)

7.12 Employees for fire-fighting

All selected key employees shall be trained and remain competent to deal with all possible emergencies and shall be conversant with the principles of fire-fighting and the operation of the fire-fighting equipment provided in their work environment.

An adequate number of employees shall be trained to stand in for absent trained key employees during periods of leave (including absences due to sickness) and on public holidays.

Records shall be kept of all training. (See also 7.16.4.)

7.13 Fire drills

After key personnel have been trained, fire drills shall be conducted regularly to maintain a competence level. Records shall be kept of all fire drills. (See also 7.12).

7.14 Co-operation with the local fire authorities

It is essential to co-operate closely with the local fire authorities and to ensure that the fire brigade knows in advance the layout of the depot, what equipment and facilities are available, where they are located, and how they are used.

It is essential that an adequate joint plan of action in the event of a fire or other emergency be agreed upon in advance with the fire authority concerned, taking into account aspects such as the nature of the product stored and special risks (if any) that exist in the depot. (See also 7.16.3.)

7.15 Warning notices and signs

Warning notices or symbolic safety signs (or both) shall be displayed at all entrances to hazardous areas in accordance with the requirements of OSHA.

7.16 Testing and records

7.16.1 All portable and mobile fire extinguishers shall be examined and tested periodically in accordance with ISO 7165or the manufacturers instructions.

7.16.2 All fire-fighting equipment and systems shall be inspected once every calendar year by a competent person.

7.16.3 A fire practice shall be carried out once every calendar year, and shall include the local fire department's personnel and appliances. (See also 7.14.)

7.16.4 Records of all inspections, tests and practices shall be kept by the designated person, and any shortcomings shall be rectified as soon as possible. These records shall be made available for inspection at any time during normal working hours. (See also 7.10.2.)

8. Protection and welfare of personnel

8.1 General

It is assumed that the layout of the depot, the type of plant and equipment installed, and the methods of

operation are fully in accordance with the relevant recommendations given in this part of DUS 947, and that familiarity and general compliance with ordinances and any other applicable regulations are ensured.

All accidents and dangerous occurrences shall be reported to the designated person or safety representative, who shall arrange for medical attention for the injured and for the elimination of unsafe conditions or unsafe actions, or both. accidents recording board shall be put in place and it should be visible inspection by an authorized inspector or by a designated officer

8.2 Safety and protection measures

8.2.1 The following specific safety and protection measures shall be provided for:

a. first-aid treatment;

b. medical assistance;

c.emergency treatment;

d. prevention of inhalation of fumes;

e. protective clothing;

f. protective footwear;

g. protective equipment,

h. breathing apparatus;

i. safety belts; and

j. safety goggles or eye shields.

8.2.2 Contact with petroleum products

Contact with petroleum products and the associated dangers require that the following points be attended to: prevention and treatment of contamination; prevention and treatment of occupational diseases; prevention of contamination by leaded petrol, provision of safe access to confined spaces; correct handling of materials and packages by hand; accident reports; good housekeeping; welfare facilities; and material safety data sheet.

9. Maintenance of and extensions to depots

9.1 Risk assessment procedure

9.1.1 General

Before any extensions can be made to an existing depot, a full risk analysis shall be made. Any maintenance of or extensions or repair work to a petroleum depot shall follow but not be limited to the following procedure:

a) lay down clearly defined responsibilities;

b) adopt specific and explicit rules and regulations;

c) ensure that instructions and orders given are simple and clear, and

d) ensure that the cathodic protection system is turned off before the start of any work on pipelines, pumps,

e) valves, etc,

The utmost vigilance is required to ensure that deviation from regulations is avoided, particularly when personnel are engaged in work in hazardous areas or when the staff of an outside contractor are employed.

During such operations, tanks and plants that have been used for a class II petroleum product shall be treated as if they had been used for a class I product.

Tanks and items of plant that have been used for a class III petroleum product present a reduced risk, and do not require the same precautions as in the case of a class I or a class II petroleum product. Nevertheless, care is still necessary, and in the case of repairs and maintenance proceed with caution, bearing the proximity of any class I or class II plant in mind.

9.1.2 Hot work

When any hot work is to be carried out in a hazardous area that contains a petroleum product, a high degree of control and supervision shall be maintained. A permit that authorizes the work shall be issued in writing in accordance with 9.8. (See also appendix C.)

NOTE - All petroleum products become flammable when heated to their flash points.

9.2 Repairs and alterations

9.2.1 General

Repairs or alterations shall not be permitted on any plant or equipment while such plant or equipment is in use (for example, when a tank or vessel is being loaded or unloaded). The local fire-fighting services shall be informed when water is not available or when any work is being carried out on major fire-fighting installations.

9.2.2 Equipment

When repairs or alterations necessitate the dismantling of essential items of plant such as valves, pumps and pipelines, a specific notice shall be issued to all concerned. The work shall not be started until acknowledgement of the notification has been received.

9.2.3 Tanks and vessels

No hot or other hazardous work shall be started inside a tank or vessel in which a class I, a class II, or a class III petroleum product has been stored until such time as the tank or vessel has been inspected, a gas-free certificate has been issued (see 9.8), all pipelines have been disconnected and all relevant authorities have been notified.

No untrained person shall be allowed to enter a tank or vessel that has not been declared gas-free unless such person is equipped with suitable breathing apparatus. An observer shall be stationed at the manhole whenever work is to be done on such tank or vessel. Observers shall be instructed to watch the workers carefully and to take immediate action or summon assistance if any person(s) collapses (collapse) inside the tank or vessel.

A trained observers and other rescue personnel shall be equipped with the proper safety gear so that they them- selves will not succumb during rescue operations. Special attention shall be given to the manholes, scaffolding) and digging, to ensure safe entry and exit. When tank cleaning, repairs or alterations are involved, the special -instructions applicable to this type of work shall be rigorously observed. (See also 9.9 and appendix C.)

9.2.4 Pipelines, pumps and valves

In the event of a broken connection, no reliance shall be placed on closed valves. Complete drainage shall be effected and openings shall be closed property by means of blank flanges or line blinds. Any spillage of product shall be collected and disposed of in an acceptable way. When continuity in a pipe- line is broken, the work area shall be bridged with a heavy electrical jumper Gable to reduce the risk of sparks from stray or induced currents.

9.2.5 Electrical equipment

An accredited person shall certify that the electrical equipment has been isolated and locked out safely before any repair, adjustment or test is commenced. Warning notices (symbolic signs) shall be hung onto or affixed to main switches or circuit-breakers, to prevent accidental switching-on while repairs are in progress.

After repairs have been completed, an accredited person shall certify that the apparatus is in order, both mechanically and electrically, before it is brought back into use. .

9.2.6 Lock-out requirements

Only authorized personnel shall be able to lock out equipment.

9.2.7 Records

For certain types of plant and equipment such as pressure vessels, cranes, and electrical apparatus, an adequate system of keeping permanent records shall be maintained for all repairs, inspections and tests, in compliance with the Factories Act, Cap 220 of the Laws of Uganda.

9.3 Personnel

9.3.1 Safety

All staff engaged in operational maintenance duties shall be certified and be fully acquainted with the safety regulations in terms of the .Factories Act, Cap 220 of the Laws of Uganda.

9.3.2 Supervision

Maintenance and inspection work shall be planned and supervised by responsible members of staff, who shall ensure that all relevant precautions are observed.

9.3.3 Use of casual and contractors' labour

When casual and contractors' labourers are employed, they shall be trained and familiarized with all the relevant precautions adopted by the depot. The necessary precautions to be taken shall have been thoroughly explained to them before any work is commenced.

When such labourers are employed in or adjacent to a hazardous area, strict supervision shall be arranged to ensure that all relevant precautions are observed.

9.4 Plant

When mobile plant is temporarily stationed in a hazardous area for maintenance, repair or other purposes, care shall be taken to ensure that the plant is of such construction that it is not likely to cause a fire by the emission of sparks or flames, or by any other source of ignition.

No plant belonging to a contractor shall be used on the premises without the written permission of the depot manager or his authorized representative.

9.5 Access to site

The use of vehicles and plant on the site, particularly in hazardous areas, shall be defined and controlled and the routes to and from such areas shall be clearly indicated.

9.6 Temporary fencing

Personnel or contractors shall be prevented from gaining unauthorized access to a hazardous area and, when necessary, temporary fencing, portable barriers or screens shall be provided.

9.7 Notices

Warning notices shall be prominently displayed where necessary (see also 7.15 and 9.2.5).

9.8 Permits

9.8.1 General

To ensure safety, construction and repair work shall only be performed in a depot if written permission has been granted by the manager or his authorized representative. All permits issued shall be specific with regard to their purpose. A permit can be cancelled at any time if conditions are considered to have become unsafe. (See examples in appendix C.)

9.8.2 General or cold-work permits

General or cold-work permits shall be issued by the designated person to allow any work within the depot that does not involve hot work (which could cause ignition) or entry into confined spaces. (See examples in appendix C.)

9.8.3 Gas-free certificates

Gas-free certificates shall be issued by a person who has received formal training in the properties of flammable liquids and in the operation, calibration, maintenance and use of the type and model of gas testing device employed to determine the presence of hazardous vapours in the workplace, and who has been vested

38 (in writing, by the employer) with authority to issue gas-free certificates (see 9.10.2). (See examples in appendix C.)

9.8.4 Hot-work permits

Hot-work permits shall be required wherever hot work is to be done in an area in which flammable vapours might exist. A hot-work permit is issued on the condition that a normally safe area remains safe for the duration of the work, or that an area which is normally hazardous be converted into a temporary safe area for the duration, of the work. Hot-work permits shall be issued by a person who has been vested (in writing, by the employer) with authority to issue hot-work permits. (See examples in Appendix C.)

9.8.5 Confined-space entry permits

Confined-space entry permits shall be required whenever it is necessary to enter a confined space that contains, or has contained, a flammable or toxic atmosphere and from which easy and ready escape is hampered. A gas-free certificate shall also be required. Confined-space entry permits shall be issued by a person who has been vested (in writing, by the employer) with authority to issue confined-space entry permits. (See examples in appendix C.)

The designated person may sub delegate the extension of the period of validity of permits that he has issued to a responsible person, provided that conditions do not change in a way that would constitute an increased hazard.

9.9 Safety

9.9.1 Safety conditions

It is difficult to recommend hard and fast safety rules that should be observed during maintenance work in operating plants, and the recommendations given in this part of DUS 947might have to be modified or adapted. Pay due regard to the petroleum operations

being carried out at the time, and to the weather, humidity, wind direction, topographical features of the site, and the availability of assistance from outside should emergencies arise during the work.

9.9.2 Safety distances

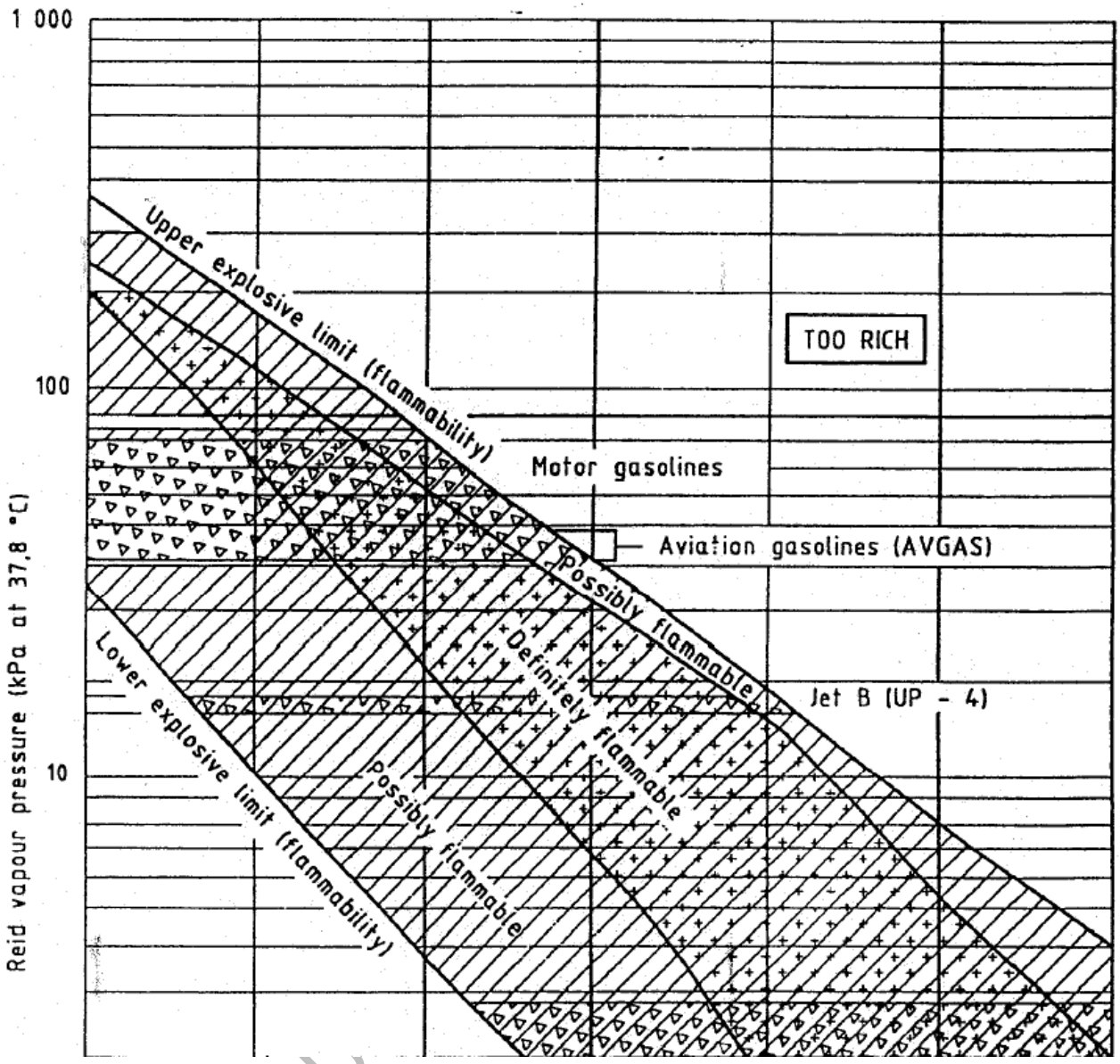
Unless it is unavoidable, no hot work, riveting or welding shall be permitted within 15 m of a tank or vessel that contains class I or class II petroleum products, or within 6 m of one that contains class III petroleum products.

These distances are minimum distances that might have to be increased because of local conditions or specific circumstances. Bear in mind also that an area that has been classed as safe could become hazardous owing to a change in wind direction. In addition to professional judgement, use a gas detector to assess the conditions in each situation.

Ensure that any working tank of which any part is within these distances, is emptied, and that a gas-free certificate is issued by a qualified person. Where these distances cannot be adhered to, a qualified person shall supervise the work (throughout its duration) and such person shall strictly enforce the necessary precautions.

9.9.3 Fire danger

In hazardous areas, special precautions shall be taken, such as the temporary resitting or supplementing of fire equipment to cover an emergency or, when it is deemed expedient, the provision of fire watchers to detect incipient fire and to bring first-aid and fire-fighting equipment into immediate use. Brief but explicit instructions shall be given to any contractor regarding the action to be taken in the event of a fire. (See also clause 6.)



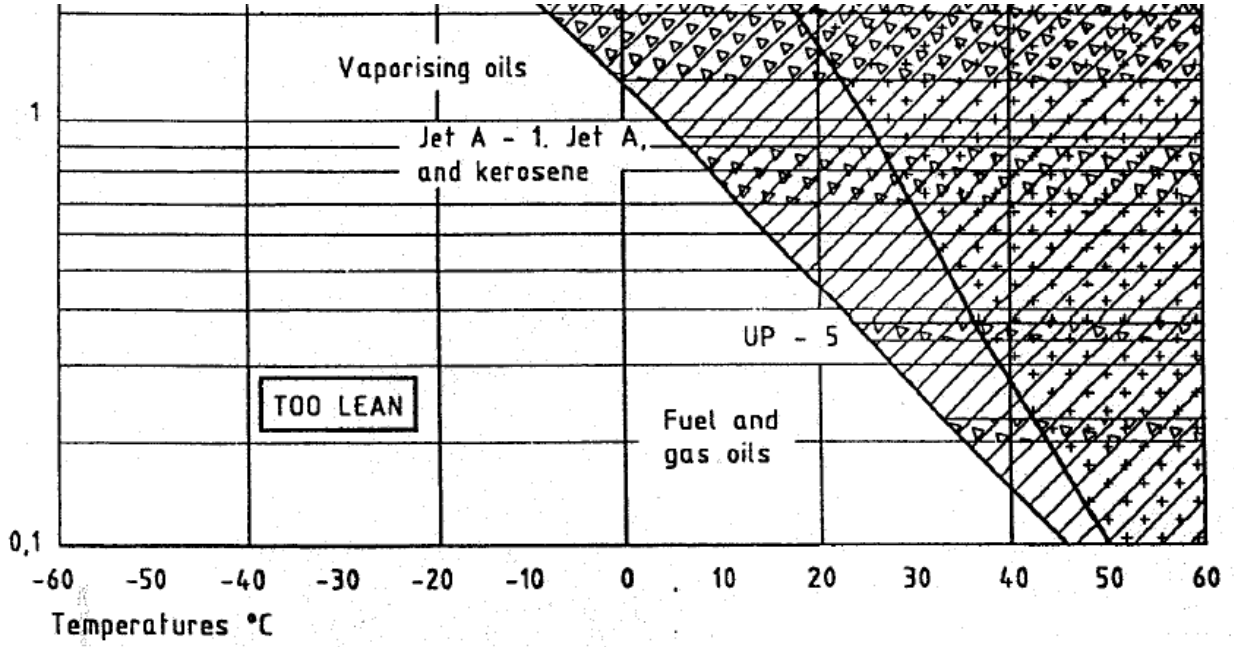


Figure 2 Approximate relationship between temperature, Reid vapour pressure and

explosive limits of petroleum products

9.10 Gas-freeing of tanks

9.10.1 General

A tank that has contained a volatile hydrocarbon might have to be gas-freed before the tank can be cleaned or repaired. (This is done to protect persons from the toxic and asphyxia effects of the hydrocarbon, and to make the repair operation safe from the hazard of fire.)When a combustible-gas indicator (gas detector) has been used to confirm freedom from flammable vapours, the atmosphere within the tank could still be deficient in oxygen or could contain toxic components. In all cases of doubt, appropriate chemical tests shall be carried out. (For more detailed information regarding the cleaning of leaded gasoline tanks and the disposal of sludge, refer to OCTEL directive Lead alkyl antiknock compounds (see 2.2).)

9.10.2 Gas-free certificate

A gas-free certificate is required when:

a) any hot work is to be done in a restricted area; or

b) when entry into any confined space is required, i.e. in addition to the confined-space entry permit. In the latter case, special attention shall be given to the oxygen content.

9.10.3 Vapour travel

Hydrocarbon vapours are denser than air and, although they can be dispersed easily and safely by a light

breeze, a dangerous concentration can travel a considerable distance in a still atmosphere. The large volume

of an air and hydrocarbon vapour mixture that could be released during a gas-freeing operation can travel beyond the limits of the usual safety distances, and it is therefore recommended that all possible sources of ignition in the entire area be eliminated at all times during gas-freeing. Persons shall be kept clear of the bunded area and the down-wind area as far as possible, especially where gas and air from the tank cannot be discharged at a high level.

9.10.4 Lower explosive limit (LEL) and upper explosive limit (UEL)

Mixtures that contain about 1 % to 10 % (by volume) of petroleum vapours in air are flammable. If there is less than 1 % or more than 10 % of vapour, the mixture will be too lean or too rich to burn. The limiting values of 1 % and 10 % are known as the lower explosive limit (LEL), and the upper explosive limit (UEL) respectively.

NOTE - The approximate relationship between temperature, Reid vapour pressure, and explosive limits of petroleum products is given in figure 2.

9.10.5 Measurement of vapour concentration

The quantity of vapour in an air-and-vapour mixture can be measured by means of a gas detector.

NOTE - Gas detector scales are graduated from 0 to 1 00, their graduation being based on the lower limit of flammability of 1 %. A reading of 50 indicates 50 % of the lower limit of flammability (i.e. the mixture contains 0.5 % of vapour), and a reading of 20 an that scale indicates 0.2 % of vapour.

The instrument used for recording the concentration of this vapour shall be of approved design and shall be regularly calibrated and tested for accuracy.

9.10.6 Permissible petroleum vapour concentration

Vapour concentrations and the corresponding safeness of working conditions are given in table 6.

9.10.7 Methods of gas-freeing and their applicability

The methods of gas-freeing in 9.10.7.1 to 9.10.7.4 can be used, either singly or in combination.

9.10.7.1Ventilation by forced or natural draught

This method is recommended in the case of storage tanks where the use of steam or water is impracticable or undesirable.

9.10.7.2Flooding with water

Gas-freeing by flooding with water has the disadvantage that it cannot be relied on to remove all petroleum vapour, liquid, and solid residues. Furthermore, before the method is adopted, the tank and its foundations have to be verified as being capable of sustaining the mass of the vessel filled with water. To avoid the build-up of a. static charge when this method is used, the flooding water shall be introduced at the base of a tank and, if a hose pipe is used, the flow rate shall be kept low and the nozzle shall be electrically earthed.

9.10.7.3Steaming

This method can be used in the case of small storage tanks and medium-sized insulated tanks. In the case of certain products, complete removal by steam is not always possible, and a residue might remain that could be ignited during welding. Only low-pressure steam shall be used, and steam hoses shall be electrically bonded to the tank shell.

NOTE - Steam degassing can present the danger of tank implosion should rapid steam condensation occur.

Figure 2 - Approximate relationship between temperature, Reid vapour pressure and explosive limits of

petroleum products

9.10.7.4Purging by inert gas or flue gas

This method can be used where it is impossible to displace flammable gases or liquids with steam, water or air because of their effect on the contents of the tank. This method involves a danger that, when air later displaces the inert gas, any pyrophoric deposits that are present could burst into flame. In addition, the tank atmosphere will not be fit to breathe after purging and the inert gas will have to be swept out with air and a test for sufficiency of oxygen will have to be carried out before anyone can enter without breathing apparatus.

9.10.8 Procedure for gas-freeing

The procedure for the gas-freeing of tanks varies according to the type of tank.

Gas-freeing does not ensure the safety of persons who enter tanks that have contained hydrocarbons unless appropriate protective clothing is worn. Conduct gas-freeing operations only under the direct supervision of a designated person, and use the appropriate procedure described in 9.10.8.1 to 9.10.8.4.

9.10.8.1Above-ground fixed-roof vertical storage tanks (conventional types)

Carry out the following procedure:

a) Empty the tank of product

b) Disconnect all pipelines at the tank valves, blank off open ends of pipes and, if there is any possibility that tubular housings and conduits connected to the tank for gauging or other instrumentation purposes might contain product, disconnect them.

c) Open all tank valves that lead to the atmosphere and all manhole covers in the roof of the tank.

d) Open shell manhole covers. Do this carefully and, by opening the covers only partially at first, prevent

the escape of an excessive initial volume of gas.

e) Thoroughly ventilate the tank. Ventilation is normally assisted by the use of wind-sails at roof manholes, and by the use of a fan or an educator if compressed air, steam or electric power is available.

As petroleum vapours are denser than air, it is preferable that fresh air be drawn into the tank at a high level and that the effluent vapour be extracted, via flexible trunking from a top manhole, at a low level (about 2 m above the tank floor).

If possible, do not expel air from a low level (for example from a manhole at the bottom or side), since vapour will concentrate in the bund area and create a hazard.

Continue ventilation until gas detector tests show either a safe concentration of, or freedom from petroleum vapour. A tank can be considered free from gas when a series of gas detector tests are carried out at 5 min intervals over a 30 min period at several places in the tank and all gas detector readings are below 4. Before anyone starts working in the tank, provide maximum dilution of the atmosphere in the working area by moving the air inlet to a low level. To prevent any build-up of flammable vapour when sludge is disturbed, continuous ventilation is necessary throughout a tank-cleaning operation. Discontinue forced ventilation and tank cleaning during an electrical storm.

Use a gas detector, as and when required, to check that tanks that have been freed from gas remain gas free throughout the period during which maintenance work is being carried out.

9.10.8.2Floating-roof tanks

Follow the same general procedure as detailed in 9.10.8.1. Facilitate entry by supporting the floating roof by its extended vertical columns (or other means), and open roof fittings, manhole covers, and dip hatches to facilitate ventilation. The use of wind-sails on this type of tank is often not practicable, but ventilation can be accelerated mechanically by the use of wind-scoops made of suitable material and located in the side manholes, or by the use of fans or educators. When testing for vapour concentration, include the space in the tank that is above the roof and inside the pontoons. Open and ventilate pontoons and double decks, and use a gas detector to check each such space individually.

Ensure that water-drainage systems are clear of product, by opening and flushing them.

9.10.8.3 Above-ground horizontal tanks

After draining the horizontal tank as completely as possible of its contents, remove the manhole covers and use water as a flushing medium. Before flushing the tank, ensure that all pipelines are disconnected and blanked off and all apertures fully opened. Ventilation can be accelerated by means of a wind-sail or by mechanical means.

9.10.8.4Below-ground and mounded tanks

Follow the same general procedure as in the case of fixed-roof tanks (see 9.10.8.1), but remember that it is essential to ventilate access chambers, valve chambers, and tunnels ancillary to the tank as well, and to include these places in the testing procedure.

9.11 Cleaning of tanks

9.11.2 Tanks used for the storage of unleaded class I and class II petroleum product

9.11.2.1 Cleaning under other than gas-free conditions

When the cleaning of a tank involves the entry of persons and the tank cannot be completely gas-freed and maintained in that condition throughout the entire operation, the following precautions shall be observed:

a) Ensure that cleaning is carded out under the direct supervision of a qualified person.

b) Remove as much highly flammable liquid and sludge as possible from the tank through a closed pumping system, then drain out the remaining contents of the tank via the main and drain lines and disconnect these and any other lines that are connected to the tank. Blank off all tank valves and disconnect pipelines. Reduce hand bailing and mopping out to a minimum.

c) Keep the tank as well ventilated as possible during cleaning operations.

d) All persons who enter the tank shall be equipped with safety equipment. While work is in progress, ensure constant supervision by a qualified person stationed outside the tank and equipped with suitable breathing apparatus that enables him to enter immediately, should the need arise. A safety line shall also be immediately available.

e) The period for which persons may be allowed to remain in the tank continuously will vary with site conditions, but it is recommended that this period in no case exceeds 1 h 30 min and that there be a break of at least 30 min before such persons return to the tank.

f) Ensure that all clothing, any part of which has become saturated, is removed immediately and washed and dried before being worn again. (See also 9.9.1.)

g) Examine, test, clean, and sterilize breathing apparatus on each occasion before use.

h) Ensure that the breathing apparatus correctly fits the person who is to wear it, and is maintained in sound working order.

i) During cleaning, use compressed air operated lights and equipment inside the tank. Alternatively, battery-operated or mains-operated equipment and lighting may be used, provided that they are of flameproof, intrinsically safe, or approved construction. Connect electrical equipment to the power supply by means of a flexible lead of an approved type . Pass cables for lighting through the roof manhole. Do not use side manholes for this purpose, and do not allow the mass of suspended lighting to be carried by its cable.

j) Ensure that the accumulation of sludge and corrosion scale from the cleaning operation is handled in a wet state only, both in the tank and after removal. Disposal of this sludge and scale should be carried out by burning or by chemical treatment.

k) In the case of hard deposits that necessitate the use of chipping tools, ensure that the surface being chipped is kept thoroughly wetted during the operation.

l) Ensure that water hoses, fire extinguishers and sand are available in the immediate vicinity throughout tank-cleaning operations.

9.11.2.2 Cleaning under gas-free conditions

In the case of a tank that is free from gas and can be maintained in that condition throughout the entire operation, only the precautions given in 9.11.2.1 (a), 9.11.2.1 (f) and 9.11.2.1(j) have to be observed, while workers should still be provided with suitable clothing.

Tanks that are being cleaned under gas-free conditions may be illuminated as in 9.11.2.1 (i), or by low voltage a.c. (below 50 V) portable lighting equipment. The supply cable to the flameproof transformers for low-voltage lighting equipment shall always be so supported that the cable is held clear of the ground, and a transformer shall never be taken inside a tank.

10. Transportation of petroleum products (other than LPG) by road and by Rail in accordance with US ISO 3183

11. Pollution control

The design and operation of the installation shall be such that the storage and handling facilities will not cause contravention of the NEMA ACT of Uganda

In particular, all reasonable steps shall be taken to prevent pollution of both underground water and surface water. This would be best done by the installation of a suitable oil interceptor or gravity separator.

All waste shall be disposed of in an approved manner. (See also 4.9.)

Appendix A

(Informative)

Determination of water requirements for the highest fire risk area

A.1 Introduction

Water requirements for fire-fighting purposes should be determined for the highest fire risk with the largest fire surface area in a depot.

The fire risks in a depot should be determined by means of a risk assessment.

A.2 References

The definitions in A.3 and research for this appendix have been collected from the various publications as

listed below:

AICE, Guidelines for chemical process quantitative risk analysis.

AICE, Guidelines for hazard evaluation procedures.

API Publication 2030, Application of fixed water spray systems for fire protection in the petroleum industry.

NFPA 11, Low-expansion foam.

NFPA 15, Water spray fixed systems for fire protection.

UNEP IE/PAC Technical Report No. 12, Hazard identification and evaluation in a local community.

A.3 Definitions

For the purpose of this appendix, the following definitions apply.

A.3.1 accident: An unplanned event or sequence of events that results in undesirable consequences. An incident with specific safety consequences or impacts.

A.3.2 credible event: An event that has a degree of probability (likelihood) of occurring, or for reasonably practical mitigating actions can be taken by the owner of the depot to minimize the consequences (or both).

A.3.3 consequence: The direct, undesirable result of an accident, usually involving a fire, an explosion, or the release of toxic material. Consequences may be expressed as either quantitative or qualitative estimates of the effects of an accident in terms of factors such as health impact, economic loss, and environmental damage.

NOTE - Severity is very often used as a synonym or to express the degree of consequence.

A.3.4 event: An occurrence related to equipment performance or human action external to the system that

causes a system upset. An event is either the cause of or a contributor to an incident or accident, or is a response to the event that initiated an accident. Fire, explosion, and toxic release are typical events.

A.3.5 external event: Any event that occurs external to the system considered.

NOTE - Examples are: lightning, extremely unusual weather conditions, earthquake, landslides, flooding, actions of third parties or failure of their equipment outside of the property of the depot but impacting on the depot.

A.3.6 hazard: A chemical or physical condition that has the potential to cause damage to people, property,

or the environment.

NOTE - A common synonym is "risk source".

A.3.7 hazard evaluation / analysis: The analysis of the significance of hazardous situations, or other processes or activity. It uses Qualitative techniques to pinpoint weaknesses in the design and operation of facilities that could lead to accidents.

A.3.8 hazard identification: The pinpointing of material, system, process, and plant characteristics that produce undesirable consequences through the occurrence of an accident.

A.3.9 incident: The loss of hazardous material from containment or the release of hazardous forms of energy (for example, in a "near miss').

A.3.10 incredible event: An event that is extremely improbable (with, for example, a likelihood of less than 1 in 1000), or for which 'reasonably practical' measures to minimize the consequences are beyond the capabilities of the owner of the depot, or both.

A.3.11 likelihood: A measure of the probability or expected frequency of an events occurrence.

A.3.12 probability: An expected chance for certain events to happen within a certain period of time.

A.3.13 risk: The combination of the expected probability of an event and the consequence of that event. It is a measure of economic loss or human injury in terms of both incident likelihood and the magnitude

of loss or injury. (Risk = Severity x Probability.)

A.3.14 risk analysis: The development of a quantitative estimate of risk based on engineering evaluation and mathematical techniques for combining estimates of incident consequences and frequencies. It is the systematic identification and evaluation of risk objects and hazards.

A.3.15 risk assessment: The process by which the results of a risk analysis (i.e. risk estimates) are used to make decisions, either through relative ranking of risk reduction strategies or through comparison with risk targets.

A.3.16 risk estimation: The process of combining the estimated consequences and likelihood of all incident outcomes from all selected incidents to provide a measure of risk.

A.3.17 risk object: Any object that could institute a risk within the perimeter of a bulk storage depot (for example, tanks, tank bund, loading racks, rail sidings, warehouses, workshops, etc.).

A.3.18 risk targets: Objective-based risk criteria established as goals or guidelines for performance.

A.3.19 worst case: The possible event with the worst consequences. There are three types of worst case :

a) the consequences are so limited that the risk is unimportant, whatever the probability of the event;

b) the consequences are so serious that the-probability of the event must be very small (low) if there is to

be a tolerable level of risk; and

c) the worst possible consequences are irrelevant since the probability is so low that the risk is negligible.

(See also UNEP IEIPAC Technical Report No. 12.)

A.4 Hazard evaluation and risk assessment

There are numerous hazard evaluation techniques. Each technique has a specific purpose, benefits, costs and limitations. Some are qualitative techniques whilst others are quantitative methods, and a few are a combination of qualitative and quantitative methods.

A.4.1 The most common hazard evaluation techniques are:

a) Safety review

b) Checklist analysis

c) Relative risk ranking

d) Preliminary hazard analysis (PHA)

e) What if analysis

f) Hazard and operability analysis (HAZOPS)

g) Failure modes and effects analysis

h) Event tree analysis

i) Fault tree analysis

j) Cause-consequence analysis

k) What-if/checklist analysis

l) Human reliability analysis

A.4.2 The most suitable and practicable techniques for a petroleum bulk depot are any of the following:

a) Safety review

b) Checklist analysis

c) Relative risk ranking

d) PHA or HAZOPS

e) What-if analysis

The technique(s) used for the hazard evaluation shall be at the discretion of the responsible engineer.

NOTE - It has been found that the applications of simple qualitative assessment techniques for depot assessments give results that are very similar to those of the more complicated in-depth techniques.

A.5 Consequence analysis

In addition to the hazard evaluation listed in A.4, there is another method, called quantitative consequence analysis (QCA). In most cases it is sufficient to estimate the order of magnitude of the consequences. It is not always necessary to estimate in great detail. In a few cases it may be necessary to conduct QCA for a depot, for example when modelling the spread of gases (toxic or LPG) and their effects.

A.6 Example of a risk analysis

NOTE - This example only gives the key features of a full analysis.

The following details deal with PHA, one of the techniques listed in A.4, to serve as a typical illustration of

a major risk analysis approach. The primary components of a PHA are:

a) hazard identification, which may be extended to hazard evaluation and, still further, to a quantitative risk analysis depending on the depth of analysis required to obtain more information;

b) risk index evaluation; and

c) risk mitigation.

In A.6.1, the specific example of a PHA for a fuel depot is outlined.

A.6.1 Hazard identification, hazard evaluation and quantitative risk assessment

A.6.1.1 List the various hazardous events.

A.6.1.2 Follow each event through to its conclusion (without any controls applied) and record the consequences.

A.6.1.3 Identify and record existing active and passive controls which would limit the probability of the event or the severity of the consequences.

NOTE

1 Examples of passive controls are: preventative safety measures such as engineering design and layout, equipment specifications, control of ignition sources, standard safe operating procedures, training of personnel in procedures, selection of fire-resistant materials, specialized electrical equipment, inspection and maintenance of facility.

2 Examples of active controls are: emergency shut-off equipment, emergency shut-off and response procedures and training,provision of fire fighting equipment and checks on the reliability of fire-fighting equipment.

A.6.1.4 Review the critical factors such as operating procedures, training, fire protection systems and emergency shutdown devices which could influence the likelihood of an event occurring,, or the severity of the incident. The information obtained from such a review is then considered when determining a risk index value for the event.

A.6.2 Risk matrix

A.6.2.1 Once the definition and ranking of likelihood and consequence are determined and tabulated, a corresponding 5 x 5 matrix ran be constructed (see the example in figure A.1).

The risk index (RI) for any event is calculated as the product of its likelihood and its consequence value in the risk matrix.

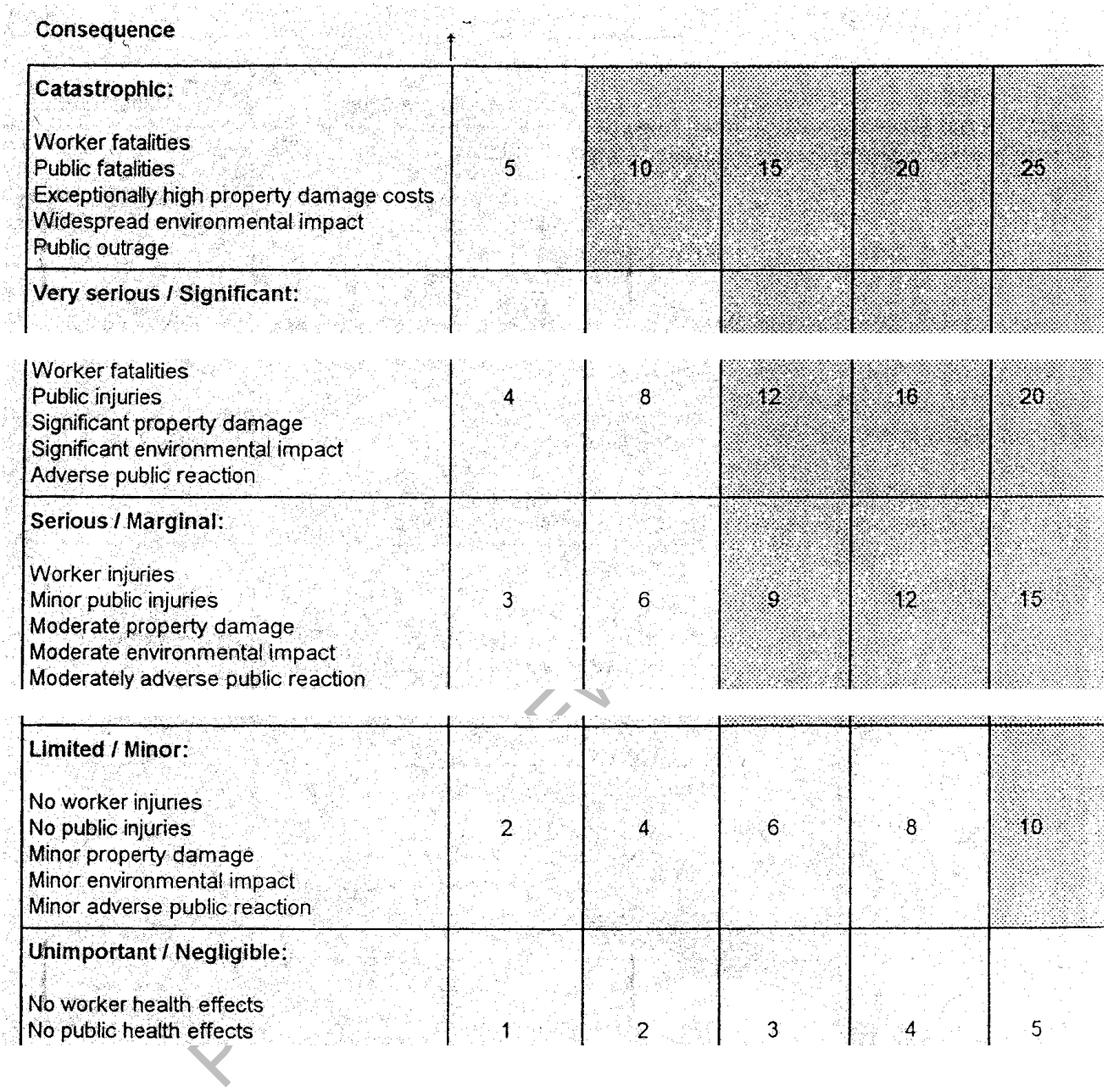


Figure A.1 Typical (5 x 5) risk matrix

A.6.2.2 The first steps in drawing up a risk matrix are to define the ranking of likelihood and ranking of consequence (or severity) of events.

Both the likelihood and consequence (or severity) of various events are given a ranking value subjective scale, as in the example of a five-point ranking given in table A.I.

Table A.1 — Universal system of ranking severity and likelihood

1	2	3
Ranking	**Consequence or severity**	**Likelihood**
1	Unimportant / Negligible: • No worker health effects • No public health effects • No property damage • No environmental impact • No adverse public reaction	Highly improbable < once per 1 000 years
2	Limited / Minor: • No worker injuries • No public injuries • Minor property damage • Minor environmental impact • Minor adverse public reaction	Improbable Once per 100 - 1 000 years
3	Serious / Marginal: • Worker injuries • Minor public injuries • Moderate property damage • Moderate environmental impact • Moderately adverse public reaction	Infrequent Once per 10 -100 years
4	Very serious / Significant: • Worker fatalities • Public injuries • Significant property damage • Significant environmental impact • Adverse public reaction	Frequent Once per 1 - 10 years
5	Catastrophic: • Worker fatalities • Public fatalities • Exceptionally high property damage costs • Widespread environmental impacts • Public outrage	Very probable More than once per year

A.6.2.3 The standard definitions of likelihood and severity may be modified to accommodate local factors relevant to the installation being evaluated and 3 x 3 or 4 x 4 risk matrices may be used. Examples that illustrate the use of likelihood and consequence definitions and ranking for a particular case

study are given in tables A.2 and A.3.

Table A.2 — Example of likelihood definitions and ranking

1	2	3
Likelihood designation	**Likelihood ranking**	**Description/Definition**
Frequently	5	This type of event has occurred at this facility one or more times during the life o this type of process OR piece of equipment.
Probable	4	It is expected that this event will occur at this facility at least once during the life of this type of process or piece of equipment.
Possible	3	This event may occur at this facility at least once during the life of this type of process or piece of equipment.
Seldom	2	This event is unlikely to occur at this facility, but it has occurred at least once somewhere else for this type of process or piece of equipment.
Unlikely	1	This event will not occur at any of the company's depots, and the company is unaware of any other facility where it has occurred under similar circumstances.

Table A.3 — Example of severity definitions and ranking

1	2	3
Severity designation	**Severity ranking**	**Characteristics of the event**
Catastrophic	5	a) Closure of a major area[1)] in the depot for more than 5 days b) Significant impact on the community outside of the depot's property lines c) Numerous fatalities or severe injuries (inside or outside the depot) d) If two or more adjacent tanks could be exposed (and endangered) simultaneously, regardless of the wind direction
Significant	4	a) Closure of a major area in the depot for 2 days to 5 days b) Minor damage outside the depot (cracked windows, etc.) c) Fatalities and severe injuries (only in the depot), minor injuries (outside the depot) d) If a single adjacent tank could be exposed (and endangered), regardless of the wind direction e) A fire in a strategic product tank, regardless of the number of additional tanks exposed containing, e.g., jet fuel for an aviation depot
Marginal	3	a) Closure of operations at a major area of the depot for 2 d to 5 d b) Multiple severe injuries (in the depot)

		c) A full surface fire in any tank containing products such as illuminating paraffin slops or additive, provided it does not present a hazard to adjacent tanks regardless of the wind direction
Minor	2	a) Two days or less downtime b) Damages limited to equipment in the immediate area c) Minor injuries only
Negligible	1	No loss of production, no injuries, or minor equipment loss.
1) For this example a "major area" is defined as a single tank, a pump manifold, a bulk truck loading rack, a switchgear building, or an office/control building.		

A.6.2.4 The severity values used for a risk assessment study should be based on factors that are mutually agreed upon with the respective company management before use. Some critical aspects (in the above example) are:

a) The tank spacing between the tank on fire and the adjacent threatened tanks. If the tank spacing is less than one tank diameter of the tank on fire, it can be assumed that the adjacent tank would be exposed to excessive radiant heat loads, regardless of wind direction. If one adjacent tank is exposed, a severity value of 4 is assigned. If two adjacent tanks could simultaneously be exposed to the fire, a severity value of 5 is assigned.

b) The criticality of the tank on fire is a function of the product stored and whether alternate storage arrangements could be made if a tank fire occurred. If there are difficulties regarding alternate storage arrangements for a strategically important product, a minimum severity value of 4 is assigned regardless of the number of additional tanks exposed to the fire.

A.6.3 Risk mitigation

Risk mitigation involves the implementation of measures that reduce the risk index (RI) to an acceptable value. Such measures could be either passive or active controls (see A.6.1.4) or both. If the RI for an event can be reduced to an acceptable level by passive control alone, and it is cost effective, then there is obviously no justification for additional fire protection systems.

The example in A.6.1 and A.6.2 is only one typical example of one of the risk assessment techniques.

NOTE - Generally, the oil industry worldwide tends to consider only those recommendations that would be necessary to reduce the risk index for an event to below 9. Additional mitigation measures could be taken to reduce the RI further, but might not be costjustified. Risks of 8 and below are considered acceptable risks that the oil industry is prepared to take.

A.7 Water requirements for some typical events

Water requirements in the management of fire effects (see note) are expressed as total flow in litres per minute and calculated pressure.

NOTE - The management of fire effects is the fire-fighting strategy that involves any one or a combination of the following, often in the priority order given.

a) safeguard exposures against fire;

b) control or contain fire; and

c) extnguish fire.

The water is applied together with foaming agents for extinguishing and, if required, for control of a petroleum fire. (Foaming agents are not necessarily required for safeguarding exposures and for control or isolation purposes.) Some typical events, which are generally included in risk assessments, are given in A.7.1 to A.7.4. The results of a risk assessment for a depot will identify the highest risk with fire area that has the largest horizontal surface area.

A.7.1 Tank fire in the tank with the largest fire surface area

A.7.1.1 Calculation of water requirement for foam application to the tank on fire

The determination of water requirements is dealt with in the latest edition of ISO 7203, 7076 & 6182 or in the information service of the supplier of foam and equipment. The following shall be taken into account when determining water requirements:

a) the tank dimensions;

b) the liquid surface area, in square metres;

c) the type of product;

d) the type of foam specified for the product;

e) the method of foam application;

f) the foam type specified for the product;

g) the application rate for the foam, in litres per minute per square metre;

h) the minimum application time, in minutes; and

i) the minimum operating pressure required by the foam appliances being used.

A.7.2.2 Allowances

An allowance should be made for the application of foam into the failed tank if it has not totally collapsed. Calculate the water flow for foam application as in A.7.1.1.

A.7.2.3 Remote bunding

If remote bunding was provided as additional containment for the spill, then follow the same calculation as in A.7.2.1. Generally, the principle of remote bunding is to contain a spill in a safe location where there is no

threat to adjacent facilities. If so, foam application need only commence in the remote bund once the fire in

the main bund has been extinguished.

A.7.2.4 Water requirements

The required total water flow is equal to the requirement as determined in A7.2.1 or A.7.2.3, whichever is

the greater, based on the principle of fighting one bund fire at a time.

A.7.2.5 Water flow availability

The total water flow shall be available from the fire main for, at least 1 h. The total flow as given in A.7.2.4 should be guaranteed for the minimum application time for the type of application and for the type ofproduct as defined in A.7.2, based on the principle of fighting the ground and bund fire first before fighting the tank fire.

A.7.3 Loading rack operational spill fire

The considerations in A.7.3.1 to A.7.3.5 are applicable to both bulk truck loading racks and rail sidings.

A.7.3.1 Distinguish clearly between the various types of event.

A.7.3.1.1 One event is the release of the total contents of a truck or tank car into the containment area and oil/water separator(s) or remote impounding area if provided, or both.

A.7.3.1.2 Another event could be the release of only a quantity of product that depends on the effectiveness of the emergency shut-off response.

NOTE - The maximum allowable emergency shut-off response time should not be more than 2 minutes. The maximum anticipated

spill in litres is then equal to the product of this response time (in minutes) and the spill release rate (in litres per minute).

A.7.3.1.3 Yet another event could be an explosion due to switch loading and the release of the contents of the tanker.

NOTE - A bulk truck has a far greater likelihood of releasing the contents of at least one compartment (or more) than a tank car, because a bulk truck is constructed of aluminium and is loaded with closed domes for bottom loading, and emergency venting is generally not provided for. Tank cars are constructed of steel and loaded with open domes, thus providing adequate emergency venting. All of this should be considered in the risk assessment.

A.7.3.1.4 Yet another event is the derailment of a tank car that could result in the total contents of the tank car being released as in A.7.3.1.1, or a portion of the tank car contents being released.

A.7.3.2 Design for the highest risk, as determined by a risk assessment of the various events.

A.7.3.3 Determine the spill fire area for the highest risk

A.7.3.4 Refer to the latest edition of ISO 7203, 7076 & 6182 and to suppliers of the foam and equipment to determine foam water requirements.

Calculate the foam water flow required in litres per minute.

The calculation of the water requirement should take into account the following:

a) the spill fire surface area at the loading rack or siding, in square metres (determined from volume of

product released and the topography of the containment area);

b) the type of product released (assume worst case type of product);

c) the method of foam application (foam/water sprinklers, fixed monitors, or portable equipment)

d) the type of foam,

e) the foam application rate in litres per minute per square metre; and

f) the minimum foam application time, in minutes.

Calculate the foam water required in litres per minute.

A.7.3.5 Ensure that cooling water for pressure fires (minimum 2 hoses, streams of 125 to 250 litres per minute) is provided if no fixed foam/water sprinklers or fixed monitors exist or only portable foam equipment is provided. Generally, closing remote valves and switching off pumps would extinguish pressure fires in depots, and a dry chemical powder extinguisher could extinguish a pressure fire on a tanker. Additional water requirements for fire fighters might be required for isolation remote isolation is not provided (determine the number of hose, streams of 250 to 450 litres per minute).

Hence calculate the total water flow requirements.

A.7.3.6 The total water flow requirements should be available for at least 1 h.

A.7.4 Operational spill fire in the bund due to a tank overfill

A.7.4.1 Refer to ISO 7203, 7076 & 6182and the suppliers of foam and equipment to determine the total water flow requirements. The calculation of the water requirement should take into account the following:

a) the anticipated spill volume (the product of the flow rate and the response time for emergency shut off in litres;

b) the spill fire area (determined from the volume of product released and the topography

of the containment area), in square metres;

c) the method of foam application (fixed monitors or portable equipment);

d) the type of foam;

e) the foam application rate for type of foam and method of application, in litres per minute per square metre; and

f) the minimum foam application time, in minutes.

Calculate the total water flow requirements.

Appendix B

(Informative)

Design Criteria for Interceptors (Gravity Separators)

B.1. General

From the results of experiments and from plant operating data, it has been determined that the design of waste water separators should be based on the rate of rise of oil globules that have an average diameter of 150 m. This globule size, although somewhat arbitrary, has been adopted for design purposes because satisfactory oil removals are achieved when a particle of 150 m diameter is used as a basis for design and investigation.

B.2. Design Procedure

The vertical rate of rise , V t, of an oil droplet in water is given by the formula

$$V_t = 1.962 \times 10^{-9} \times \Delta\partial \times \frac{D^2}{\eta}$$

Where

V_t is the vertical rate of rise, in metres per hour;is the difference in densities between water and oil, in kilograms per cubic metre; D is the diameter of the oil droplet, in micrometres; and is the dynamic viscosity of water, in pascal-seconds.

Therefore for water at 10 C with a density of 997 kg/m3 and a dynamic viscosity of 1.348 x 10-3 Pa.s, diesel oil with a density of 860 kg/m3 and an oil droplet size of 150 m,

$$V_t = 1.962 \times 10^{-9} \times (997 - 860) \times \frac{150^2}{1.348 \times 10^{=3}}$$

= 4.487 m/h

= 0.748 m/min

The interceptor should be so designed for a given flow rate q that there is sufficient time for the oil globules to rise all the 2way from the bottom of the interceptor to the under-surface.

The design of the retention system around the spill origin and outlets should be able to cope even with the worst rainfall conditions and should therefore take into account the maximum rain intensity (this figure can be obtained from the Meteorological Department), viz, mm/h for Lusaka. Assuming that the rain water runs off as fast as it is deposited, the maximum runoff becomes

$$q = \frac{C \times I \times A}{60{,}000}$$

Where

q is the runoff flow capacity, in cubic metres per minute;

C is the runoff co-efficient (e.g. 0.9 for concrete);

I is the rain intensity, in millimetres per hour; and

A is the catchment area; in square metres.

The horizontal velocity, Vh, is given by

$$V_h = \frac{q}{A_c}$$

Where

V_h is the horizontal velocity, in metres per minute;

q is the runoff flow capacity, in cubic metres per minute; and

A_c is the cross-sectional area of the separator, in square metres.

An acceptable maximum horizontal velocity,V_h for the flow through an interceptor would be less than 0,91m/min (3ft/min or 55m/h)or $15V_t$ whichever is smaller.

The length of the separator, *L*, in metres, is given by

$$L = F\,(V_h/V_t) \times d$$

where

F is a design factor (dimensionless); and

d is the depth of the separator, in metres.

The design factor *F* is the product of the short-circuiting factor, F_{sc}, which can be taken as 1,2, and the turbulence factor, F_t, which is a function of the ratio of V_h to V_t:

$$F = F_{SC} \times F_t$$

The American Petroleum Institute gives the following recommended values of turbulence factors:

V_h / V_t	Turbulence factor, F_t
20	145
15	137
10	127
6	114
6	107

Furthermore, a separator should be designed within the following limits:

a) a depth d of between 1 m (3ft) and 2,4 m (8ft);

b) a recommended depth-to-width ratio greater than 0,3 and less than 0,5 i.e. d = 0,3 W to 0,5 W, where W is the width of the separator; and

c) a width W of between 2 m (6 ft) and 20 m (6 m).

B.3 Example

A separator is to be designed to cater for runoff from a concrete area 50 m × 45 m = 2 250 m², assuming a maximum rain intensity of 40 mm/h. The design temperature is 10 °C, and waste water through the separator contains diesel with a density of 860 kg/m³ at 10 °C.

q = $C.I.A./60000$

= 0,9 × 40 × 2 250/60000

= 1,35 m³/min

V_t = 1,962

= $1{,}962 \times 10^{-9} \times (997\text{-}860) \times 150^2/1{,}348 \times 10^{-3}$

= 4,487 m/h

= 0,0748 m/min

V_h = 15 V_t

= 1,122 m/min

which is greater than 0,91 m/min, therefore use V_h = 0,91 m/min as a maximum.

To avoid excessively long separators, V_h should, in practice, be kept to a minimum. This can be done by increasing (within reason) the cross sectional area of the separator.

Therefore assume $d = 1,3$ m

From $d = 0,5 \times W$

$W = 2,6$ m

Then $A_c = d.W$

$= 1,3 \times 2,6$

$= 3,38$ m^2

and $V_n = q / A_c$

$= 1,35/3,38$

$= 0,4$ m/min

Hence $V_n/V_t = 0,4/0,0748$

$= 5,34$

By interpolation between the listed turbulence factors,

$F_t = 1,125$

So that $F = F_{sc} \times F_t$

$= 1,2 \times 1,125$

$= 1,35$

This gives $L = F (V_n/V_t) \times d$

$= 1,35 \times 5,34 \times 1,3$

$= 9,37$ m

Therefore, the final dimensions of the separator would be:

length = 9,4 m;

width = 2,6 m; and

depth = 1,3 m.

Appendix D
(Informative)

C.1 Gas free certificate

NOTE – This certificate does not authorize any work to be carried out, or entry by a person into a confined space.

Separate permits shall be issued for these purposes.

GAS-FREE CERTIFICATE

(TO BE ISSUED IN CONJUNCTION WITH A PERMIT)

CERTIFICATE No. 000

NOTE: GAS-FREE DOES NOT MEAN **LEAD-FREE**. IF IN DOUBT, CONTACT REGIONAL ENGINEER

Exact location of work area: _____

GAS TESTING:

Meter make/Model: .....

Serial No. .....

Calibration date: .....

Date of test: .....

Time of test: .....

Results of test

% LEL ..... % 0_2 .....

Signature of issuing officer

.....

Date: .....

Time of issue: .....

NOTES

1) This certificate is valid on the day of issue only (unless re-endorsement has been authorized).

2) This certificate shall be held at the work site (blue copy) with contractor/employer performing work. Pink copy to be held by site office and yellow copy by issuing officer.

3) Upon completion of work and acceptance, the performing authority shall hand back the certificate to the operating authority.

I have **personally** tested the work area specified above, and certify it safe for the purpose of

• *HOT WORK* / • *COLD WORK* (• *delete as applicable*)

THIS CERTIFICATE IS TO BE ATTACHED TO: WORK PERMIT No. .....

AUTHORIZATION TO RE-ENDORSE

Name of person authorized to re-endorse: .....

Certificate to be re-endorsed: ..... (Daily/Hourly

Signature of issuing officer: .....

Date : ...../...../.....

Name of person authorized to re-endorse: .....

Certificate to be re-endorsed: ..... (Daily/Hourly

Signature of issuing officer: .....

Date : ...../...../.....

C.2 Example of permit for entry into a confined space

NOTE – This permit does not authorize any work to be carried out. A separate work permit shall be issued

PERMIT FOR ENTRY INTO A CONFINED SPACE

THIS PERMIT IS VALID FOR A MAXIMUM OF 12 HOURS AND SHALL BE CANCELLED ON COMPLETION OF THE WORK

Work site:	Date and time of issue	Permit No. 000X
Contractor's name	Address	
Contractor's responsible person	For performing the work specified for duration of this permit	
Description of work	Sketch of exact location	
Special instructions	GENERAL WORK PERMIT ISSUED	HOT-WORK PERMIT ISSUED
	Number	Number

Any substances hazardous to health?	Personal safety requirements met?	Is a gas-free certificate required?	Is safety induction required?
NO YES	NO YES	NO YES	NO YES
		Number:	

PERSONAL PROTECTION REQUIRED

EYES	HANDS	EARS	BREATHING	BODY / OTHER
☐ Goggles	☐ PVC gloves	☐ Ear protection	☐ Canister mask	☐ Safety
☐ Shield	☐ Ord. gloves		☐ Air- supplied respirator	☐ Rubber boots
				☐ PVC suit

I hereby certify that it is safe to do the specified work in the specified location, provided that the indicated protective clothing and equipment are worn by all persons entering the tank, confined space or other work area specified.

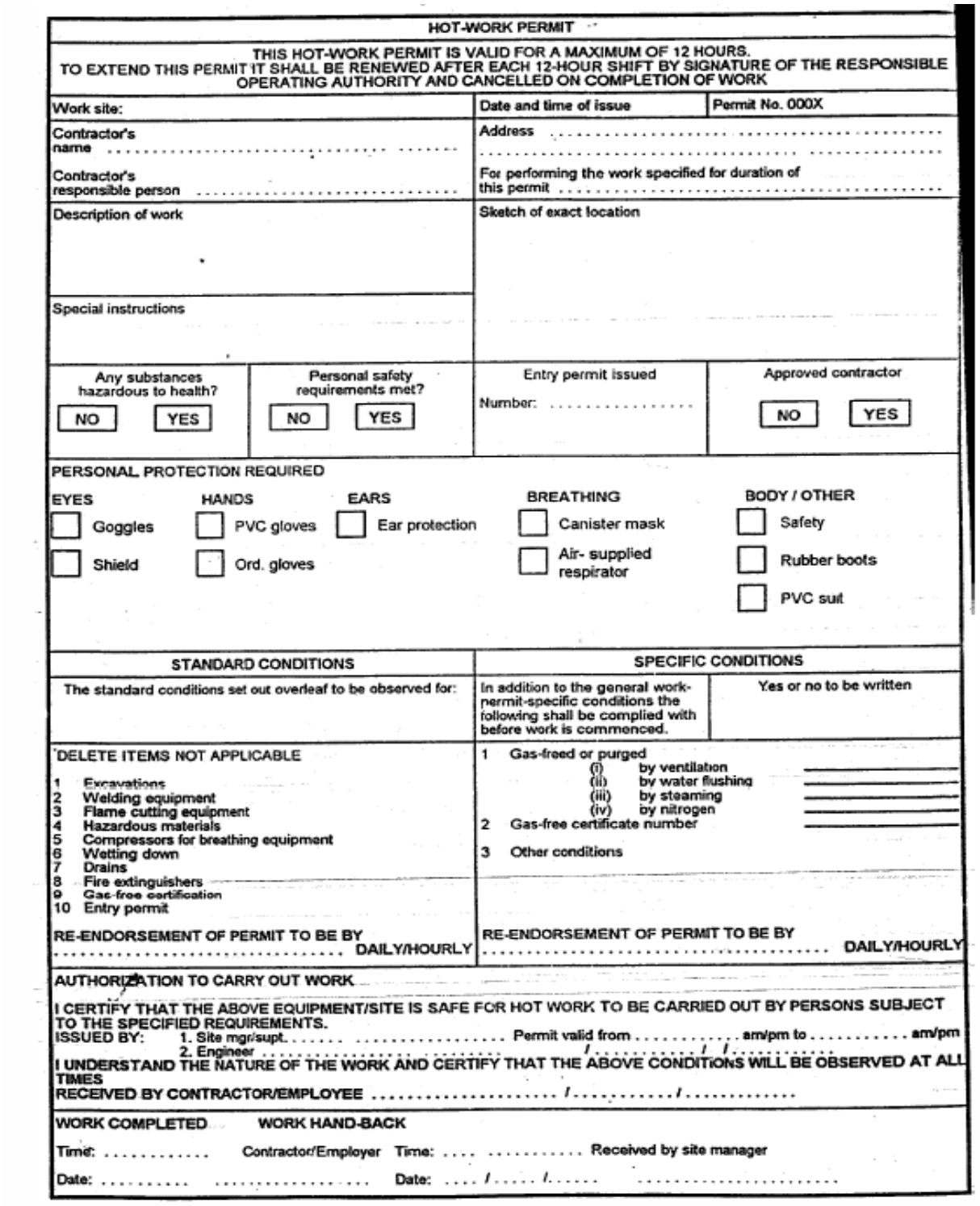
Signed ..... at ..... hours on .....

Print name: ..... Company: .....

I confirm that I will comply with the requirements set out in this permit.	Permission is hereby granted to enter the above tank, confined space, or work area, as specified. This permit is valid until XX hours on dd - mm - ccyy
Signed: ..... Performing Authority	Signed: ..... Operating Authority
Print name: ..... Date dd - mm - ccyy	Print name: ..... Date dd - mm - ccyy

COMPLETION OF WORK	CANCELLATION OF PERMIT
I certify that the work for which this permit was issued has been completed and that all personnel and equipment have been removed from the hazardous area. Personnel have been warned that re-entry is no longer safe.	This permit is now cancelled.
Signed: ..... Time ..... Performing Authority	Signed: ..... Time ..... Operating Authority
Print name: ..... Date dd - mm - ccyy	Print name: ..... Date dd - mm - ccyy

C.3 Example of a hot work permit



HOT-WORK PERMIT

THIS HOT-WORK PERMIT IS VALID FOR A MAXIMUM OF 12 HOURS.
TO EXTEND THIS PERMIT IT SHALL BE RENEWED AFTER EACH 12-HOUR SHIFT BY SIGNATURE OF THE RESPONSIBLE OPERATING AUTHORITY AND CANCELLED ON COMPLETION OF WORK

Work site:	Date and time of issue / Permit No. 000X
Contractor's name	Address .....
Contractor's responsible person	For performing the work specified for duration of this permit .....
Description of work	Sketch of exact location
Special instructions	

Any substances hazardous to health?	Personal safety requirements met?	Entry permit issued	Approved contractor
NO YES	NO YES	Number:	NO YES

PERSONAL PROTECTION REQUIRED

EYES	HANDS	EARS	BREATHING	BODY / OTHER
☐ Goggles	☐ PVC gloves	☐ Ear protection	☐ Canister mask	☐ Safety
☐ Shield	☐ Ord. gloves		☐ Air- supplied respirator	☐ Rubber boots
				☐ PVC suit

STANDARD CONDITIONS	SPECIFIC CONDITIONS	
The standard conditions set out overleaf to be observed for:	In addition to the general work-permit-specific conditions the following shall be complied with before work is commenced.	Yes or no to be written

DELETE ITEMS NOT APPLICABLE

1 Excavations
2 Welding equipment
3 Flame cutting equipment
4 Hazardous materials
5 Compressors for breathing equipment
6 Wetting down
7 Drains
8 Fire extinguishers
9 Gas-free certification
10 Entry permit

RE-ENDORSEMENT OF PERMIT TO BE BY ..... DAILY/HOURLY

1 Gas-freed or purged
(i) by ventilation
(ii) by water flushing
(iii) by steaming
(iv) by nitrogen
2 Gas-free certificate number
3 Other conditions

RE-ENDORSEMENT OF PERMIT TO BE BY ..... DAILY/HOURLY

AUTHORIZATION TO CARRY OUT WORK

I CERTIFY THAT THE ABOVE EQUIPMENT/SITE IS SAFE FOR HOT WORK TO BE CARRIED OUT BY PERSONS SUBJECT TO THE SPECIFIED REQUIREMENTS.
ISSUED BY: 1. Site mgr/supt. ..... Permit valid from ..... am/pm to ..... am/pm
2. Engineer ..... / ..... / ..... / .....
I UNDERSTAND THE NATURE OF THE WORK AND CERTIFY THAT THE ABOVE CONDITIONS WILL BE OBSERVED AT ALL TIMES
RECEIVED BY CONTRACTOR/EMPLOYEE ..... / ..... / .....

WORK COMPLETED		WORK HAND-BACK	
Time:	Contractor/Employer	Time:	Received by site manager
Date:	.....	Date: ..... / ..... /	.....

C.3 Example of a hot work permit (concluded)

THIS PERMIT IS RENEWED

FROM		TO		I HAVE PERSONALLY CHECKED THAT THE CONDITIONS LISTED OVERLEAF HAVE NOT CHANGED AND I CONSIDER IT SAFE FOR WORK TO COMMENCE.
HOURS	ON	HOURS	ON	SIGNATURE (Operating authority)

DISPLAY OF PERMIT

THIS PERMIT SHALL BE CLEARLY DISPLAYED AT THE WORK SITE (WHITE COPY) WITH CONTRACTOR/EMPLOYEE PERFORMING THE WORK.

Pink copy to be given by hand to the site manager and the yellow copy to be kept by the person issuing the permit.

Upon completion of work and acceptance, the contractor/employee shall sign permit and hand it back to the site manager for close-out.

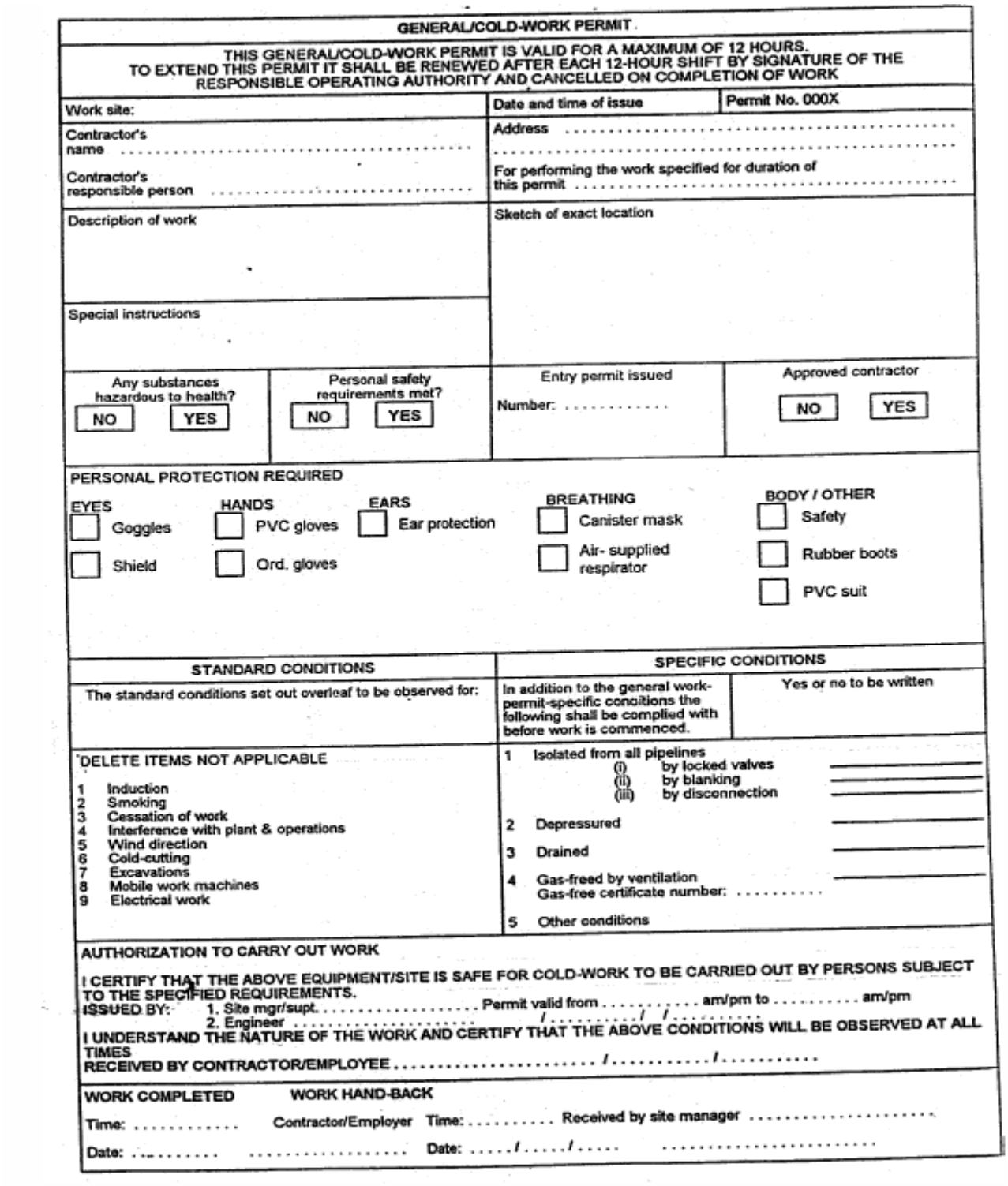
PERMIT ISSUE

Permits are to be issued by a site manager. They may be issued by the engineer, in which case they shall be countersigned the site manager.

STANDARD CONDITIONS

			YES	NO
1	EXCAVATIONS:	If more than 1.5 m deep, the following conditions SHALL apply before entry is permitted: (i) an ENTRY permit shall be obtained; (ii) the sides of the excavations shall be suitably shored and graded back.		
2	WELDING EQUIPMENT:	(i) Is the equipment sited in an approved safe area? (ii) Are welding cables in good condition? (iii) Is there an insulating bridge in place where cables cross pipelines? (iv) Is the welding-circuit return cable positioned within 2 m of the job? (NOTE: Earth routing via installed plant is prohibited.)		
3	FLAME CUTTING EQUIPMENT:	(i) Is the equipment sited in a safe area? (ii) Are oxyacetylene cylinders secured upright in a special trolley or rack? (iii) Confirm flashback arrestors fitted. Gas cylinders SHALL NOT be taken inside tanks or confined spaces and when not in use SHALL be turned off at the main cylinder valve.		
4	HAZARDOUS MATERIALS:	(i) Hot-work areas shall be kept free of loose flammable and combustible materials and empty drums. Confirm appropriate action taken. (ii) Where asbestos, lead or other critical materials are present in the work area, the appropriate statutory regulations and codes of practice shall be strictly observed. Confirm appropriate action has been taken		
5	COMPRESSORS FOR BREATHING EQUIPMENT:	The compressor should be sited upwind of the job in an approved safe area free from flammable or toxic vapours. Confirm wind sock is in place.		
6	WETTING DOWN:	During hot work, chipping, caulking or grinding and disk-cutting of materials, concrete or other materials likely to cause a hazardous build-up of temperature, provision shall be made for thoroughly wetting the work being carried out. Is coolant available?		
7	DRAINS:	All drains within 15 m of hot work shall be covered with tarpaulin or heavy gauge plastic and sand. Confirm drains are sealed.		
8	FIRE EXTINGUISHERS:	At least 2 fire extinguishers suitable for the job shall be available at the work site. Confirm extinguishers are available. A fire guard shall be stationed at the work area to take appropriate action in the event of a fire and to warn personnel and fire control. Is fire guard available?		
9	GAS-FREE CERTIFICATION:	Before hot work may commence the work site shall be certified gas-free. Confirm certificate has been issued.		
10	ENTRY PERMIT:	An entry permit shall be obtained before entry is permitted into a confined space. Confirm entry permit has been issued.		

C.4 Example of a general or cold work permit



GENERAL/COLD-WORK PERMIT

THIS GENERAL/COLD-WORK PERMIT IS VALID FOR A MAXIMUM OF 12 HOURS.
TO EXTEND THIS PERMIT IT SHALL BE RENEWED AFTER EACH 12-HOUR SHIFT BY SIGNATURE OF THE RESPONSIBLE OPERATING AUTHORITY AND CANCELLED ON COMPLETION OF WORK

Work site:	Date and time of issue	Permit No. 000X
Contractor's name ..... Contractor's responsible person	Address ..... For performing the work specified for duration of this permit	
Description of work	Sketch of exact location	
Special instructions		

Any substances hazardous to health?	Personal safety requirements met?	Entry permit issued	Approved contractor
NO YES	NO YES	Number:	NO YES

PERSONAL PROTECTION REQUIRED

EYES	HANDS	EARS	BREATHING	BODY / OTHER
☐ Goggles	☐ PVC gloves	☐ Ear protection	☐ Canister mask	☐ Safety
☐ Shield	☐ Ord. gloves		☐ Air- supplied respirator	☐ Rubber boots
				☐ PVC suit

STANDARD CONDITIONS	SPECIFIC CONDITIONS	
The standard conditions set out overleaf to be observed for:	In addition to the general work-permit-specific conditions the following shall be complied with before work is commenced.	Yes or no to be written

DELETE ITEMS NOT APPLICABLE

1 Induction
2 Smoking
3 Cessation of work
4 Interference with plant & operations
5 Wind direction
6 Cold-cutting
7 Excavations
8 Mobile work machines
9 Electrical work

1 Isolated from all pipelines
(i) by locked valves
(ii) by blanking
(iii) by disconnection
2 Depressured
3 Drained
4 Gas-freed by ventilation
Gas-free certificate number: .....
5 Other conditions

AUTHORIZATION TO CARRY OUT WORK

I CERTIFY THAT THE ABOVE EQUIPMENT/SITE IS SAFE FOR COLD-WORK TO BE CARRIED OUT BY PERSONS SUBJECT TO THE SPECIFIED REQUIREMENTS.
ISSUED BY: 1. Site mgr/supt. ..... Permit valid from ..... am/pm to ..... am/pm
2. Engineer ..... / ..... / .....
I UNDERSTAND THE NATURE OF THE WORK AND CERTIFY THAT THE ABOVE CONDITIONS WILL BE OBSERVED AT ALL TIMES
RECEIVED BY CONTRACTOR/EMPLOYEE ..... / ..... / .....

WORK COMPLETED		WORK HAND-BACK	
Time:	Contractor/Employer	Time:	Received by site manager .....
Date:	.....	Date: ..... / ..... /	.....

C.4 Example of a general or cold work permit (concluded)

THIS PERMIT IS RENEWED				I HAVE PERSONALLY CHECKED THAT THE CONDITIONS LISTED OVERLEAF HAVE NOT CHANGED AND I CONSIDER IT SAFE FOR WORK TO COMMENCE.
FROM		TO		
HOURS	ON	HOURS	ON	SIGNATURE (Operating authority)

DISPLAY OF PERMIT

THIS PERMIT SHALL BE CLEARLY DISPLAYED AT THE WORK SITE (WHITE COPY) WITH CONTRACTOR/EMPLOYEE PERFORMING THE WORK.

Pink copy to be given by hand to the site manager and the yellow copy to be kept by the person issuing the permit.

Upon completion of work and acceptance, the contractor/employee shall sign permit and hand it back to the site manager for close-out.

PERMIT ISSUE

Permits are to be issued by a site manager. They may be issued by the engineer, in which case they shall be countersigned by the site manager.

STANDARD CONDITIONS

			YES	NO
1	INDUCTION	Has the performing authority and associated work force attended the terminal/depot induction briefing?		
2	SMOKING:	Smoking is PROHIBITED within the terminal/depot except in those locations specifically designated. No matches or lighters shall be carried within the terminal/depot operations area. Confirm the performing authority has been advised.		
3	CESSATION OF WORK:	All work SHALL cease immediately whenever, (i) requested by the terminal/depot manager, (ii) sounding of the FIRE/EMERGENCY evacuation alarm, (iii) discovery of any potentially hazardous circumstances, and (iv) when flammable or toxic vapours enter the work area.		
4	INTERFERENCE WITH PLANT AND OPERATIONS:	Within the conditions of this permit, contractor personnel to whom this permit is issued SHALL not interfere with terminal/depot operations nor any plant or equipment which is not part of the work for which this permit is issued.		
5	WIND DIRECTION:	Has the performing authority arranged a regular frequency for checking and recording the wind direction during the work period? Confirm wind sock is in place.		
6	COLD-CUTTING:	All cutting edges SHALL be continually wetted with lubricant or water. Provision in place?		
7	EXCAVATIONS:	Machine excavations shall not be allowed in areas where there are underground services, e.g. pipework, electric cables, drains and sewers. Hand excavations? Machine excavations?		
		The sides of excavations that are not self-supporting, shall be suitably shored or graded back. All excavations SHALL be surrounded and secured with safety barriers. Entry permit SHALL be obtained before entering an excavation more than 1,5 m deep.		
8	MOBILE WORK MACHINES:	THEY SHALL comply with the following conditions: (i) a spark-arrestor on each exhaust system, (ii) overspeed shutdown device on air inlet, and (iii) a shroud over each spark plug (where applicable). Machines SHALL be refuelled while running. Machines SHALL NOT be left unattended while running.		
9	ELECTRICAL WORK:	(If the answer to any of these questions is NO, please state reason briefly.) Electrical work shall only be carried out on a general/cold-work permit after the live supply has been isolated. Has an electrical isolation (lock-out) been made?		

C.5 Example of an electrical work permit

As it is possible that work of an electrical nature in a most hazardous area will be carried out by technicians other than registered electricians (i.e. meter technicians, computer technicians, electronic technicians, etc.) electrical permits shall comply with the following requirements:

a) Name of electrical contractor and *ECB* registration number, or the name of the company if work is only electrically related.

b) Name of accredited person (electrician) and his qualification, i.e. master installation electrician or installation electrician, or name and qualification of technician if work is only electrically related.

c) Accredited person's registration number.

d) Name(s) of personnel working under the accredited person or approved technician.

e) Safety lock-out requirements. (This shall be attended to and signed by the responsible person issuing the permit.)

f) Full details of the equipment to be worked on.

g) Detailed description of the nature of the work involved.

h) Details of all instrumentation and equipment intended for use in the hazardous locations. (This shall be acceptable explosion protected equipment.)

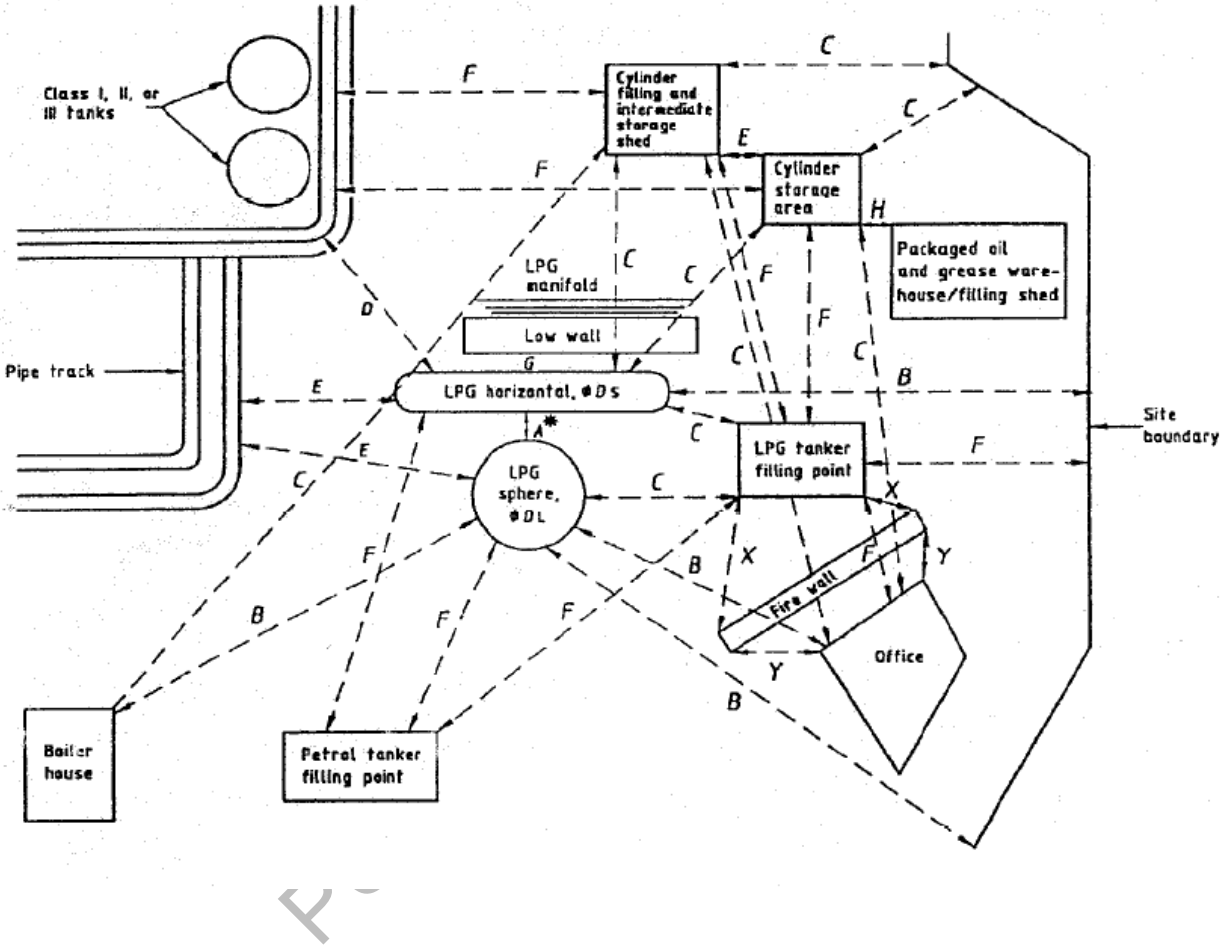
i) A section shall be provided in which the responsible electrician or technician shall sign a statement that the work has been completed in accordance with all safety regulations, that the equipment has been closed according to all explosion protection requirements, and that the plant has been rendered safe for re-use in a hazardous location. Where applicable, a certificate of electrical compliance shall accompany this statement.

NOTE – An illegible signature is not acceptable. The person concerned shall sign where necessary, and shall also print his name in block letters.

Appendix D
(Informative)

Safety distances for LPG facilities

LPG tank installation



	A*	B	C	D	E	F	G	H	X + Y*
a) Vessel capacity, ℓ									
67 500 up to and including 135 000	$\frac{D_L + D_s}{4}$	15	15	15	–	15	5	–	≥ F
Over 135 000 up to and including 265 000		22,5	15	15	–	15	5	–	≤ F
Over 265 000	D_L	30	15	15	10	15	5	–	≤ F
b) Cylinder filling and storage shed	–	–	15	–	10	15	–	–	≤ F
c) Cylinder storage area	–	–	15	–	10	15	–	3	≤ F
d) Intermediate LP gas vessel filling point	–	–	–	–	–	15	–	–	≤ F

* May be reduced to 8 m if site boundary is a solid wall.
* X + Y may not be less than 5 m in any case.

Figure D.1 Recommended safety distances for LPG facilities

Bibliography

[1] ZS 385 —The Petroleum Industry— Code of Practice — Part 1: Storage and distribution of petroleum products in aboveground bulk installations

[2] SANS 10089-1:2008, —The petroleum industry Part 1: Storage and distribution of petroleum products in above-ground bulk installations

Certification marking

Products that conform to Uganda standards may be marked with Uganda National Bureau of Standards (UNBS) Certification Mark shown in the figure below.

The use of the UNBS Certification Mark is governed by the Standards Act, and the Regulations made thereunder. This mark can be used only by those licensed under the certification mark scheme operated by the Uganda National Bureau of Standards and in conjunction with the relevant Uganda Standard. The presence of this mark on a product or in relation to a product is an assurance that the goods comply with the requirements of that standard under a system of supervision, control and testing in accordance with the certification mark scheme of the Uganda National Bureau of Standards. UNBS marked products are continually checked by UNBS for conformity to that standard.

Further particulars of the terms and conditions of licensing may be obtained from the Director, Uganda National Bureau of Standards.

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