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Risk Control

Storage and use of highly flammable and flammable liquids in external fixed tanks

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SCOPE

These recommendations present measures relevant to fire safety in the storage of highly flammable and flammable liquids when stored in external fixed tanks. In many cases, these will be fuels, but may also include solvents, adhesives, resins and other feedstocks. Some of these liquids may present other types of hazards, for example, to health, but these are not discussed in this document.

The following are outside the scope of these recommendations:

- petroleum stored in fixed tanks at petrol filling stations;
- temporary storage facilities (such as in vehicles at lorry parks or on board ships);
- the storage of highly reactive flammable liquids such as oxidising agents and chemicals which may decompose, polymerise or spontaneously combust if specific storage conditions are not observed;
- substances which are gases at ambient temperature and pressure but are stored as liquids under pressure or refrigeration (for example LPG);
- reaction vessels that are integral parts of process plant;
- the construction of 'large' storage tanks (that is, tanks with a diameter greater than 10m) and those with floating covers; and
- the layout of petroleum refineries, tank farms and distribution depots.

In addition, these Recommendations are not applicable to sites where operations are of a scale that The Control of Major Accidents Hazard Regulations 1999 (COMAH) (as amended) apply (ref. 1).

Legislation may impose requirements additional to the provisions contained in this document. Due regard should also be given to considerations of environmental protection. (See refs. 2 to 6.)

These Recommendations are part of a suite of documents and should be read in conjunction with RC20 Parts 1 and 2 (refs. 7 and 8).

The guidance set out here should be taken into consideration when risk assessments are carried out in compliance with the Regulatory Reform (Fire Safety) Order 2005 and equivalent legislation in Scotland and Northern Ireland (refs. 9 to 12) and the Dangerous Substances and Explosive Atmospheres Regulations (DSEAR) 2002 (ref. 13).

SYNOPSIS

These Recommendations give advice on the storage of flammable and highly flammable liquids in tanks above or below ground level.

Guidance is presented on the layout of the installations, fire prevention and protection measures and the fire safety management of the facilities. The information is provided in a manner that follows the criteria set out in DSEAR.

DEFINITIONS

Auto-ignition temperature

The minimum temperature at which a material will ignite spontaneously under specified test conditions.

Classification of hazardous areas (BS EN 60079-10: 2003) *(ref. 14)*

(This classification refers to areas in which open processes are carried out, areas in which closed processes are undertaken should be subject to a risk assessment.)

Zone 0: An area in which an explosive gas atmosphere is present continuously or for long periods.

Zone 1: An area in which an explosive gas atmosphere is likely to occur in normal operation.

Zone 2: An area in which an explosive gas atmosphere is not likely to occur in normal operation and, if it does occur, is likely to do so only infrequently and will exist for a short period only.

Explosive limits (BS EN 60079-10: 2003)

Lower explosive limit (LEL): The concentration of flammable gas or vapour in air, below which the gas atmosphere is not explosive.

Upper explosive limit (UEL): The concentration of flammable gas or vapour in air, above which the gas atmosphere is not explosive.

Flammable liquid

A liquid as defined for highly flammable liquid (see below) but with a flashpoint up to 55°C.

Flashpoint (BS EN 60079-10:2003)

The lowest liquid temperature at which, under certain standardised conditions, a liquid gives off vapours in a quantity such as to be capable of forming an ignitable vapour/air mixture.

Highly flammable liquid

The definition of a 'highly flammable liquid' in the Fire Certificates (Special Premises) Regulations 1976 has been amended in the Dangerous Substances and Explosive Atmospheres Regulations (DSEAR) 2002 (ref. 13) as follows:

'Highly Flammable Liquid' means any liquid, liquid solution, emulsion or suspension, other than aqueous ammonia, liquefied flammable gas, and liquefied petroleum gas which:

(a) when tested in accordance with Part A.9 of the Annex to the Directive has a flashpoint of less than 32°C;

(b) when tested at 50°C using the procedure referred to in Appendix B to the 'Approved requirements and test methods for the classification and packaging of dangerous goods for carriage' (ref. 15) with a heating time of 60 seconds supports combustion.

INTRODUCTION

Flammable and highly flammable liquids fall within the definition of 'dangerous substance' as referred to in the Dangerous Substances and Explosive Atmospheres Regulations 2002 (DSEAR) (ref. 13).

As a result of this legislation, where a dangerous substance is either present or liable to be present at the workplace, a suitable assessment of the risks likely to arise should be conducted and action taken to eliminate or reduce the hazard. Where an explosive atmosphere may occur, the workplace must be classified into zones based on the frequency and duration of the explosive atmosphere and the zones checked by a competent person.

The flashpoint is the property that is conventionally used to classify and indicate the flammability of liquids. Those with

flashpoints close to ambient temperatures are obviously more hazardous than those with flashpoints at temperatures unlikely to be reached in the workplace.

Two main dangers need to be recognised:

- the danger of explosion, when flammable vapour/air mixtures fall within their explosive limits; and
- the danger of fire, which may involve the flow of burning liquid over a wide area, or the rupture or explosion of unvented or inadequately vented containers.

All flammable liquids, regardless of flashpoint, will contribute greatly to the severity and spread of fire. Physical properties, the auto-ignition temperature, explosive limits, specific gravity, vapour density and oxygen enrichment or depletion of the atmosphere will need to be considered when specifying risk control measures. In the case of external fixed tanks, the vapour density of the stored liquid will be of particular significance and the effect of gravity inducing a flow of liquids and vapours also require serious consideration.

The intensity of a fire or its rate of growth may be increased if incompatible materials, such as organic peroxides, are stored adjacent to flammable liquids. In addition, a fire may grow and involve dangerous substances, which are themselves not combustible (see Health and Safety booklet HS(G) 71, **Storage of packaged dangerous substances** (ref. 16)).

These recommendations apply to all flammable and highly flammable liquids. Under certain conditions some of these requirements, where liquids with higher flashpoints are concerned, may be relaxed. The extent of hazard reduction and management will be one of the outcomes of the specific risk assessment conducted in terms of DSEAR (ref. 13) and the general fire risk assessment carried out in compliance with the Regulatory Reform (Fire Safety) Order 2005 and associated legislation (refs. 9-12).

To comply with the requirements of DSEAR, the management of flammable and highly flammable liquids should be subject to a risk assessment undertaken by a competent person. When considering such an assessment it should be remembered that the control measures that may be appropriate in the case of an open process, where flammable vapours are exposed to the atmosphere, may be very different from those which should be observed in an area where a process in which such substances are handled in pipelines and closed containers is undertaken.

The risk assessment is not a once in a lifetime approach. It should be reviewed periodically, following an incident or near miss, and when there are changes in the:

- equipment being used;
- materials being used in the process;
- operating procedures and parameters;
- control measures that are observed;
- management of the process;
- size of the operation; or
- process times involved.

Specialist advice should be sought where materials, such as organic peroxides and monomers, are in use on site that present not only flammability, but also other special hazards.

The main causes of fire involving flammable liquids, which should be borne in mind when carrying out the risk assessment, include:

- lack of awareness: incorrect/improper installation or use of equipment; hazardous situations not being recognised; or people being ignorant of the hazards associated with flammable liquids;
- lack of training in the handling of flammable liquids;
- lack of maintenance: where no problem areas are apparent (such as in the case of a closed process) and it is felt that the cost of regular maintenance is not justified;
- blatant misuse: poor management procedures where a person engages in an unsuitable or prohibited practice (for example, smoking) with total disregard for safety regulations;
- carelessness: where an existing problem is recognised but ignored;
- improper design: possibly by a person not qualified to do so and ignoring relevant legislation and/or standards;
- static electricity: where movement of flammable liquid in the handling process may lead to a build up of charge;
- absence of good housekeeping: where areas are not kept free from other combustible materials; and
- lack of appropriate waste management (for example, of nominally empty tanks): where tanks used in large scale operations have been decommissioned but subsequently inadvertent steam injection has raised the temperature inside high enough to reach the auto-ignition temperature of the residual deposits.

In addition to DSEAR, the requirements of the Control of Pollution (Oil Storage) (England) Regulations 2001 or other relevant national legislation and regulatory body guidance, should be observed, particularly those relating to the provision of bunds (ref. 6).

RECOMMENDATIONS

1. General considerations

1.1 At the outset, attention should always be given to eliminating flammable and highly flammable liquids from the workplace wherever possible. Serious consideration should be given to the need for the use of such liquids in the process and the possibility of replacing them with non-flammable liquids as alternatives – or at least with those having a flashpoint above 55°C.

1.2 The HSE guidance in booklet HS(G) 51 (ref. 17) suggests the use of the acronym VICES to help apply five basic principles which ensure that any flammable or highly flammable liquid that is irreplaceable is used and stored with appropriate care.

The acronym may be explained as follows:

V **Ventilation** (see section 2)

- Is there sufficient ventilation to keep the concentration of the liquid's vapour below its lower explosive limit?

I **Ignition**

- Have all possible ignition sources been removed?

- Is the electrical and heating equipment used in this area suited to the risk category?

C **Containment** (see section 4)

- Are the liquids stored in suitable tanks?
- In the event of a spill will they be contained?
- Is it possible to prevent spillages from spreading?
- Are bunds present where required?
- Are 'empty' tanks properly managed?

E **Exchange** (see section 5)

- Can flammable substances be eliminated?
- Can the substance be replaced by a less flammable one?

S **Separation** (see section 6)

- Is the storage of liquids separated from other stored materials?
- Are incompatible materials suitably separated?
- Are physical barriers (such as fire walls) present as required?

1.3 Suitable staff training should be in place to ensure all personnel are aware of the hazards in the workplace and apply VICES to ensure a safer working environment for all.

2. Ventilation

2.1 Tanks may be located below ground, above ground or in mounds. Storage in the open air at ground level has the advantage that any vapours produced will normally be dissipated by natural ventilation. Further advantages are that a leak may readily be detected and the condition of the tank may easily be monitored.

2.2 To enable adequate ventilation in the open air, sites selected for locating storage tanks should not be in hollows or other areas below surrounding ground level where released flammable vapours may accumulate.

2.3 Open air tank storage areas should be away from buildings and structures that may prevent an adequate flow of air for ventilation.

2.4 Care should be taken when siting new tanks, or structures in the vicinity of existing tanks, that conditions are not created that may be conducive to the accumulation of any released flammable vapours. (See also paragraph 4.1.)

2.5 Consideration should be given to the possible release of flammable vapours from vent and fill lines and dip tube connections (where these have to be employed). Tanks containing flammable liquids should be fitted with safety valves or vents for protection against pressure or vacuum in excess of their design criteria.

2.6 Vents must not be less than the diameter of the filling or discharge line and not less than 25mm. Where liquid is pumped into a tank the vent size must be based on a calculation of the flow rates.

2.7 Vent outlets should be located at least 3m, but not more than 6m, above ground level, or 1m above the top of the tank, whichever is the higher and should discharge to a safe location in the open air at least 3m clear of window and door openings.

2.8 The vent discharge point should always be at least 1m higher than the top of the delivery tanker in the case of gravity delivery.

2.9 If delivery is by pump, high level alarms should be fitted to the tank or pre-set pump metering used (see paragraph 4.37).

2.10 Ventilation pipes should be adequately secured.

2.11 A flame arrester should normally be installed at the vent outlet of any tank containing a liquid with a flashpoint of 21°C or less. A flame arrester should not be fitted where a pressure-vacuum vent valve is provided.

2.12 Flame arresters should be inspected regularly to ensure that they have not been obscured by paint or become obstructed (for example, by polymerised materials). Flame arresters should thus be included on the planned preventive maintenance programme.

2.13 In addition to vents designed to cope with pressure fluctuations during normal operations, additional measures should be provided to relieve excess pressure resulting from fire engulfment. This may be provided by:

- oversize or additional vents;
- manholes or hatch covers which raise under excessive internal pressure;
- weakened roof to wall joints; or
- purpose-made devices.

Specialist advice should be sought in the provision of emergency pressure relief.

3. Ignition

3.1 One of the major objectives of any fire risk assessment is to identify potential sources of ignition in the vicinity of the tanks. These will include flames, hot surfaces and areas of movement that may lead to the generation of heat by friction or the build up of static charges. All sources of ignition should be eliminated and temperatures of surfaces maintained well below the auto-ignition temperature of the liquid. (See also RC20-1, ref. 7.)

3.2 Smoking must be prohibited in all external areas where flammable liquids are used or stored and appropriate notices prominently displayed.

3.3 The risk assessments undertaken for open air tank storage areas should also seek to mitigate the hazards associated with motor vehicles being introduced into the proximity.

Electrical equipment

3.4 Electrical equipment and wiring should be certified as suitable for use within the zone in which the flammable liquid is being stored or processed (see ref. 14) as determined by a risk assessment undertaken by a competent person. They should also comply with the provisions of the Electricity at Work Regulations 1989 (ref. 18). All electrical installations and maintenance thereof should comply with BS EN 60079-14 (ref. 19). (Hazard zones should be identified in the risk assessment undertaken in compliance with DSEAR.)

3.5 There should be adequate level of lighting (at least 50 lux) for safe working at all times; a higher level may be needed in areas where level gauges have to be read.

Static electricity

3.6 The potential hazard of ignition due to a build-up of static electricity during movement or transfer of flammable liquids should be assessed and precautions taken to eliminate it (see ref. 20).

3.7 All metal tanks and associated extraneous pipework and fittings used for handling highly flammable liquids must be electrically bonded and earthed (see ref. 20); non-static tools should be used when working in bunds and consideration should be given to any additional measures necessary to prevent the build up and uncontrolled discharge of static electricity.

3.8 The tank filling line should extend below the lowest normal operating level of the tank to minimise the generation of static electricity during filling operations. To prevent siphoning, the line should be self-draining (suitable arrangements have to be made where a single pipe is used for both filling and emptying a tank).

3.9 Bonding and earthing should be subject to an annual continuity test; suitable records should be kept.

3.10 Care should be taken to ensure satisfactory electrical bonding between flexible hoses and adjacent conventional pipework. Where necessary, bridging cables should be used to link the adjacent pipes directly.

3.11 An earth lead for connection to the tanker should be provided for attachment before filling operations commence. Dip rods and tubes should also be earthed.

Tank heating

3.12 Heated tanks and their equipment should be constructed to an appropriate standard, such BS 799-5 (ref. 21).

3.13 Tank heating equipment should incorporate duplicate temperature sensors and thermostats and a high temperature limit device. The high temperature limit device should prevent the temperature of the liquid exceeding a temperature 10°C below its boiling point and should not be fitted with an automatic reset.

3.14 For economy as well as safety, heating of tanks should be kept to a minimum compatible with effective working practices. The flashpoint of the liquid should not be exceeded and heating rates should be low to allow ease of control of the system.

3.15 Any vessel containing internal heating elements should be fitted with duplicate low liquid level alarms and cut-outs to prevent its elements being exposed to the atmosphere. In addition, the outlet pipe should be located above the heating coil or element.

3.16 Temperature probes, thermostats and associated control equipment should be tested as part of the periodic maintenance programme for the installation. The results should be recorded.

3.17 If a drain pipe is fitted at a level lower than the heating coil or element, it should be fitted with a closed valve and a blanking plate to deny its use during normal operations.

3.18 Tanks should only be drained following cooling of the contents to ambient temperature.

3.19 Where a water layer cannot be avoided, the heating medium should be incapable of raising the temperature above 100°C.

3.20 Any insulation of tanks or pipes should be of non-combustible material.

3.21 Trace heating of pipework may be necessary and vent pipes and flame arresters may also need to be heated.

Vehicles

3.22 Where trucks have to be used in a zone in which a flammable vapour may be present, only trucks certified to the appropriate electrical zoning standard should be used (see HSE Guidance HS(G) 113, ref. 22). This should be identified in the risk assessment undertaken in compliance with DSEAR (ref. 13).

3.23 Roadways should be sufficiently wide to permit safe manoeuvring of any vehicle requiring access to areas in the vicinity of storage tanks.

3.24 Suitably positioned barrier rails should be considered to minimise the risk of impact damage to bunds, pipework and associated fittings.

3.25 Battery powered trucks should not be charged within a zone in which a hazardous atmosphere may be present.

3.26 The gas cylinders of LPG fuelled vehicles should not be changed in the vicinity of storage tanks or in other areas where highly flammable or flammable liquids are stored or used.

Arson prevention

3.27 When planning the site for positioning a flammable liquid storage tank, the possibility of deliberate fire raising should be considered as part of the fire risk assessment and a check made to ensure that there are adequate security precautions against arson and vandalism. Precautionary measures which should be considered depend upon the character of the neighbourhood and the quantity and nature of the flammable liquids stored. (See the FPA book **The prevention and control of arson**, ref. 23.)

3.28 The area immediately surrounding a flammable liquid storage tank should be kept free from combustible materials, including waste, weeds and dried vegetation.

4. Containment

Tank construction

4.1 Tanks should be constructed in compliance with a recognised standard (for example, refs. 24 to 26) and the materials used should be compatible with the highly flammable or flammable liquids being stored.

4.2 Particular care needs to be paid to the protection of tanks constructed of glass reinforced plastic or similar materials to ensure that they maintain their integrity in the event of a fire.

4.3 Where access is provided for personnel wearing protective clothing and breathing apparatus, the inside diameter of the manhole should be at least 600mm.

4.4 Where tanks are compartmented, incompatible materials must not be stored in the same tank.

4.5 To prevent corrosion, coating should be provided by paints or other coatings selected and applied in compliance with a recognised standard (see refs. 27 and 28).

4.6 Internal corrosion may result from water accumulating in the tank. There should be provision for the removal of this with drainage being protected by two in-line valves.

4.7 Tanks should be installed on foundations designed to support the weight of the tank together with a full capacity of the most dense material that is likely to be stored within it.

4.8 Tanks should be secured to their supports or weighted to avoid floatation in the event of flooding or spillage of liquid into the bund.

4.9 Where tanks are raised above ground level in bunds, their supports should be fire resistant to a 2-hour standard.

4.10 In an similar manner to tanks above ground level, those that are below ground require adequate foundations and supports, secure anchorage and appropriate corrosion prevention.

4.11 The space around tanks below ground should be backfilled with pea gravel or similar inert material with small particles, to avoid damaging the coating of the tank.

4.12 Underground tanks should be marked prominently to prevent damage by traffic above. Where necessary, protection may have to be provided by a reinforced concrete slab.

Bunding

4.13 Safe catchment areas need to be provided to contain a possible flowing liquid fire and to guard against the risk of pollution. These catchment areas, or bunds, should:

- incorporate an impervious sill or low bund, at least 150mm high, and must have a capacity of not less than 110% of the contents of the largest container in the bund or 25% of their aggregate storage capacity, whichever is greater;
- the base and walls of the bund must be impermeable to oil and water and be treated with a proprietary sealing product where necessary to maintain this;
- wherever possible, the base and walls must not be penetrated by any drain pipe, valve or opening;
- if any fill or draw-off pipe passes through the base or wall of the bund, the junction between the pipe and the base or wall must be adequately sealed to prevent the escape of flammable liquid or water;
- provision needs to be made for the drainage of rainwater from the bund area. To avoid pollution, rain water should not be allowed to enter surface water drains.
- When designing a bund, consideration should be given to minimising the surface area of any spillage while at the same time maintaining the height of the bund walls at a level at which access can be gained for firefighting. Where the bund is deeper than 300mm, mechanical ventilation should be provided;
- tanks and bunds must be positioned so as to minimise the risk of damage by impact as far as practicable.

4.14 Where there are multiple tanks in bunds, these should be separated by suitable distances (see paragraph 6.4) and low intermediate walls, typically half the height of the bund, should be provided.

4.15 All parts of the tanks should be readily accessible to enable leakages to be easily identified.

4.16 Tanks should not be located one above another.

4.17 Double skin storage tanks may be considered to be a tank within a tank and thus not require a bund providing that an intrinsically safe monitoring system is incorporated into the design.

4.18 Pumps should be inside bunds and be located on concrete bases in the open air, so as to be above the level of the bund walls.

Pipework

4.19 Pipework should preferably be installed above ground level where it can easily be inspected and maintained. It also has the advantage that any leaking vapour is dissipated by natural ventilation.

4.20 Suitable precautions should be taken to route the pipework in order to minimise accidental damage, especially from passing vehicles. The use of barriers, bollards and kerbs may also have to be considered.

4.21 Pipework should be marked prominently in accordance with BS 1710 (ref. 29) to indicate the contents and direction of flow.

4.22 The pipework should normally be constructed of metal. All elements of the pipework, including valves, seals and flange gaskets should be compatible with the contents of the tank to ensure the integrity of the system.

4.23 As every pipe entering a tank is a potential source of leakage, each pipe should be provided with a suitable valve to allow it to be isolated. These valves should be located inside the bund and close to the tank. Consideration should be given to the fitting of remotely operated shut-off valves to pipes that may need to be closed in an emergency without delay. Where these are fitted, manual controls should remain accessible in the event of power failure.

4.24 Valves should also be provided, where necessary, to prevent the backflow of products or process materials into the tank.

4.25 Valves should be labelled as to their function and, where necessary, their method of operation.

4.26 All valves should be exercised (by opening them fully) and tested periodically to ensure that they will work correctly and effectively in an emergency.

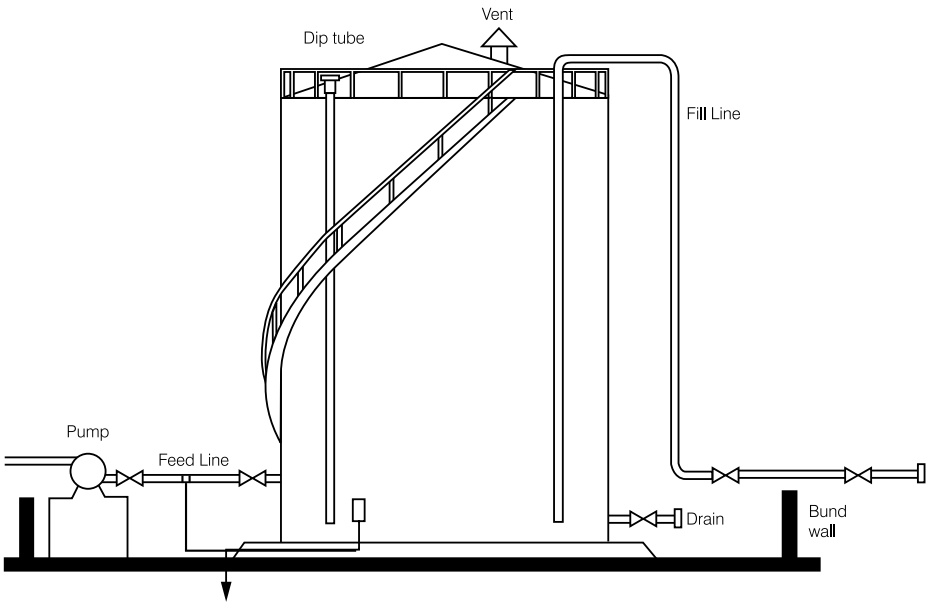
4.27 Measures should be installed to prevent excessive pressure building up as a result of the thermal expansion of liquid trapped in pipework or between shut-off valves. This may take the form of hydrostatic relief valves designed to discharge back to the tank or to a safe area such as a sump or collection vessel.

4.28 Appropriate measures should also be provided for movement between tanks and supports.

4.29 Minimising the diameter and length of the pipes reduces the potential for spillage in case of an accident.

4.30 Where it is necessary to lay pipework beneath ground, it should be laid in a masonry- or concrete-lined trench and be protected by load-bearing covers. Provision should be made to prevent water from accumulating in the trench,

Figure 1: Typical vertical storage tank (modified from HSG176 (ref. 30)



which should not be used for carrying other services such as electrical wiring, compressed gases, corrosive or incompatible materials.

4.31 The pipework should be inspected, especially in the region of joints, and access should be available for any valves below ground level.

4.32 Flexible hoses should only be used where vibration is a problem. They should be installed, supported and maintained as directed by the manufacturer. Flexible hoses should only be installed above ground.

Tank filling

4.33 Tank filling should only be undertaken by an authorised person.

4.34 Tank filling connections, together with those for emptying, dipping and venting, should be located at least 4m from any source of ignition, building opening, trench or depression. Any drain in the vicinity should be fitted with an interceptor and be routed to a waste collection and treatment facility.

4.35 Filling points should be accessible by road tankers without the need for reversing the vehicles. They should be dedicated to tanker use only and not normally be accessible to other road vehicles or pedestrians. A facility should be available to avoid waiting tankers being parked on public or internal roads.

4.36 Fill lines should enter the tank at the top.

4.37 Tanks containing highly flammable and flammable liquids must be fitted with a proprietary overfill prevention system incorporating a means of shutting off the flow and raising an alarm at a remote area that is permanently manned when refilling operations are taking place.

4.38 The connection point for filling or discharge should be outside the bund wall and close to the tanker stand to minimise the length of the connections.

4.39 At all times, the filling operations should be under the control of the receiving organisation.

4.40 Filling should be undertaken using a fixed pump on site rather than a vehicle-mounted pump to allow all equipment on the vehicle to be switched off during the operation and so as to avoid subjecting the vehicle flexible hose and coupling to pump discharge pressures.

4.41 Filling points should be equipped with non-return valves located close to the shut-off valve to minimise any spillage if the shut-off valve fails to seal.

4.42 Spillage from making and breaking connections should be collected in a drip tray and be disposed of safely, for example by draining to a safe place (see 4.29).

4.43 Filling lines should be capped when not in use; consideration should be given to fitting locking caps.

4.44 Each tank should be fitted with a liquid level device. Dial gauges are preferable to sight gauges. Where, however, sight gauges are fitted, they should be protected against damage and fitted with a stop valve or self-closing valve. Because of the potential for large liquid leakage if a sight gauge is damaged, it is important that such valves are closed after readings are taken. Overfill alarms on tanks should be totally independent from the sight gauges.

4.45 Dial or electronic gauges should be calibrated on installation and periodically thereafter as part of the tank inspection programme.

4.46 Physical dipping of tanks should be avoided if possible, in order to minimise the risk of ignition by static electricity and to reduce the likelihood of insecure replacement of the dip cap.

Spillage

4.47 Appropriate quantities of suitable materials should be available to retain and absorb spillages. Staff should be trained in the safe use and disposal of these materials.

5 Exchange

5.1 Although it is the fourth letter of the acronym 'VICES', exchange refers to the primary need to ensure that highly flammable and flammable liquids are eliminated from

the workplace if at all possible. Each such liquid should be considered in turn and possible non-flammable or aqueous alternatives be considered. (A successful example of the practical application of this principle is to be found in several industries where flammable white spirit-based paints and inks have been replaced with water-based alternatives.)

6. Separation

6.1 Tanks should not be installed on roofs of buildings.

6.2 Tanks above ground level should be located in a well-ventilated position, separated from buildings and structures, process areas and the site boundary but in a position with easy accessibility by the emergency services.

6.3 Separation distances will be mainly dependent and on the capacity of the tank; 'small' tanks being those associated with industrial processes with diameters of less than 10m, while 'large' tanks, as the terminology suggests, being those most commonly encountered in refinery and large-scale storage facilities. (The protection of 'large' tanks is outside the scope of this document.)

6.4 Minimum recommended separation distances for 'small' tanks are set out in Table 1. Small tanks may be grouped together provided that the aggregate capacity of the group is not in excess of 8000m^3 and the tanks are all accessible for firefighting purposes. (It should be noted that if a serious fire were to develop, the separation distances are not sufficient to prevent damage or fire spread to adjacent tanks but a sufficient time should be available for evacuation of personnel from the area and emergency plans to be implemented.)

6.5 The insurer should be consulted regarding the separation of groups of 'small' tanks and 'large' tanks from site boundaries, buildings, process areas, fixed sources of ignition and other hazardous materials.

Tank Capacity (m^3)	Separation distance (m)
Less than or equal to 1	1*
Greater than 1 and less than or equal to 5	4
Greater than 5 and less than or equal to 33	6
Greater than 33 and less than or equal to 100	8
Greater than 100 and less than or equal to 250	10
Greater than 250	15

* But at least 2m from doors, plain glazed windows or other openings or means of escape. Also not below any opening (including building eaves and means of escape) from an upper floor, regardless of vertical distance.

Table 1: Minimum separation distances for single 'small' tanks from site boundaries, buildings, process areas and fixed sources of ignition. (From HSE Guidance HSG176 (ref. 30).)

6.6 The separation distances between 'small' tanks arranged in groups are set out in Table 2. For the purpose of determining the separation distances from site boundaries, buildings, process areas and fixed sources of ignition a group of small tanks may be considered to be a single tank.

Tank Capacity (m^3)	Separation distance (m)
Less than 100	The minimum required for safe construction and operation
Greater than 100 but less than 10m in diameter	Equal to or greater than 2m

Table 2: Minimum between tank separation distances groups of 'small' tanks (from HSE Guidance HSG176 (ref. 30))

Underground tanks

6.7 Where it is necessary to site tanks underground, they should be outside the building line. The distance from any part of the tank to the building line should not be less than 2m. If a building has a basement or pit the distance should be 6m.

6.8 Where underground tanks are sited in a position where they are likely to be subjected to undue loadings from any cause (for example, vehicular traffic), either the area should be fenced off or the tanks located in a pit constructed of reinforced concrete with a reinforced concrete slab cover. The pit should be ventilated and may need to be monitored for the presence of flammable vapours.

6.9 The installation of tanks in areas with a high water table should be avoided.

Maintenance

6.10 Bunds, interceptors, loading and unloading facilities, as well as the tanks and associated valves and pipework should be regularly inspected and maintained, on a risk assessed basis, by a competent person. Suitable records should be made of the inspections and other work undertaken.

Decommissioning

6.11 Empty tanks may still contain significant traces of liquid and/or flammable vapours and thus be extremely hazardous.

6.12 A decision has to be taken at the planning stage as to whether a tank is to be taken out of service permanently and hence be demolished, or be cleaned and maintained for possible future use. When a decision has been made, a risk assessment should be undertaken to identify hazards associated with the intended course of action.

6.13 When decommissioning and/or demolishing a tank, the vessel should be physically isolated from any plant, process or other storage vessel. The use of valves to isolate tanks in these circumstances is not acceptable.

6.14 Following isolation, the tank should be emptied as much as possible, vented, cleaned and gas freed. The procedures set out in the HSE Guidance note CS15 (ref. 31) should be followed.

6.15 Tanks to be decommissioned for possible future use should be cleaned as indicated above or filled with water or an inert gas such as nitrogen. If an inert gas is used, the tank should be prominently labelled to prevent unauthorised entry into an atmosphere that will not support life.

6.16 All work undertaken on decommissioning tanks should be carried out under a permit to work system.

6.17 The decommissioning of underground storage tanks should follow the guidance set out by the Energy Institute (ref. 32).

7. Fire safety management

7.1 For quantities greater than 25 tonnes, signs should be in accordance with the Health and Safety (Safety Signs and Signals) Regulations 1996 (ref. 5). On certain sites where dangerous substances are stored, signs in accordance with the Dangerous Substances (Notification and Marking of Sites) Regulations 1990 (ref. 33) should be displayed.

7.2 Where appropriate, competent authorities should be notified and emergency action plans prepared in compliance with the Control of Major Accident Hazards (COMAH) Regulations 1999 (as amended) (ref. 1).

7.3 All tanks and filling points should be marked with the name of the liquid in the tank. This is especially important where several different liquids may be loaded or unloaded from a common location. Additional precautions may be necessary where incompatible liquids are being handled.

7.4 The method of operating isolation and control valves should be indicated by signs or labels where necessary.

7.5 All staff members should be trained in:

- the hazards associated with the storage of highly flammable and flammable liquids on the premises;
- precautions in the filling and discharging of the tanks;
- action in the event of a spillage or fire; and
- emergency procedures as required by the Regulatory Reform (Fire Safety) Order 2005 or the equivalent legislation in Scotland and Northern Ireland (refs. 9-12).

7.6 No hot work should be performed on or near a tank unless a competent person has issued a permit to work under a hot work permit scheme.

7.7 The security of tanks of highly flammable and flammable liquids is of the utmost importance. All storage tanks should be within a secure area protected by welded mesh, palisade or similar perimeter protection complying with a recognised standard (such as BS 1722-12 (ref. 34)). If the site is enclosed and there is a security access control system in place, there is no requirement for an additional fence around the tank or bund.

7.8 Where tanks are enclosed individually or in groups, no less than two gates should be provided for access and escape. These gates should be positioned so that the travel distance does not exceed 24m. The gates should remain locked and the keys controlled when the area is unoccupied.

8. Fire protection

8.1 All storage facilities, including external areas in the immediate vicinity of storage tanks, should be fitted with a manually operated fire alarm system that will sound and be audible in all areas of the storage facility above the background noises (assuming a minimum noise of 65dB(A)), in accordance with BS 5839-1 (ref. 35).

8.2 In zoned hazardous areas, it may be necessary for fire alarm systems and communications systems to be intrinsically safe and appropriate for the zone in which they are installed.

8.3 Consideration should be given to protecting storage tanks with a suitably designed fixed foam or water spray fire protection system. Such a system should be provided where so indicated by a risk assessment, but should only be installed after consultation with the fire and rescue authority and the insurer of the facility.

8.4 Sufficient water supplies for cooling tanks should be available. A flow rate to provide 10litres/min/m^2 for 30 minutes is recommended for a water spray system to keep a tank affected by flame impingement cool (see ref. 30).

8.5 Effective liaison should be maintained with the fire and rescue authority with regard to:

- access to the facilities;
- the layout of the site;
- the planned actions of any on-site firefighting or emergency action team and the equipment at their disposal;
- the adequacy of water supplies, both on site and in the neighbourhood, for fire brigade use for cooling tanks or fighting fires; and
- the availability of foam concentrates and other firefighting media.

8.6 Suitable firewater run-off and retention facilities should be provided and the adequacy of these should also be discussed with the fire and rescue service. Interceptor tanks or special drainage facilities may be necessary to minimise the risk of pollution to water courses. On large sites liaison should also be maintained with the water supply company and the Environment Agency.

8.7 A suitable number of appropriate portable fire extinguishers, approved and certificated by an independent, third-party certification body, should be provided in accordance with BS 5306-8 (ref. 36).

8.8 Consideration should be given to the provision of access for fire brigade personnel and their equipment. Unobstructed access should also be available to hydrants, monitors or fixed installations relevant to the site.

9. Environmental considerations

9.1 The storage of highly flammable liquids – such as oils, petrol and other solvents – is addressed by a number of items of environmental legislation and guidance that varies according to the region of the UK and the regulatory agency involved. It is all aimed at preventing the release of such materials into the environment, that is into water courses, the air or onto land.

Best practice guidance for environmental protection from above ground oil tanks is set out in **Pollution Prevention Guidelines: PPG 2: Above Ground Oil Storage Tanks** (ref. 37). This is published jointly by the Environment Agency for England and Wales, the Scottish Environment Protection Agency and the Environment and Heritage Protection Service in Northern Ireland.

9.2 The earliest possible detection of leakage from tanks and pipework is necessary to minimise the risk of fire/explosion and to prevent contamination of ground and water sources. Quantities of highly flammable and flammable liquids used should be monitored and compared with those delivered; any variations should be investigated.

9.3 The design, installation and maintenance of underground storage tanks require specialist advice to minimise the likelihood of underground pollution. DEFRA and SEPA have both published guidance (refs. 38 and 39) to meet the requirements of the Groundwater Regulations 1998.

9.4 Legislation restricts the discharge of vapour to the atmosphere. Vapour balancing systems will be necessary for most new installations and may need to be retrofitted. Specialist advice should be sought.

10. Checklist

10.1	General	Yes	No	N/A	Action required	Due date	Sign on completion
10.1.1	Have suitable and sufficient risk assessments been undertaken in compliance with the Regulatory Reform (Fire Safety) Order 2005 or the equivalent legislation in Scotland and Northern Ireland? (Intro)						
10.1.2	Has an assessment been undertaken in compliance with the Dangerous Substances and Explosive Atmospheres Regulations (DSEAR) 2002? (Intro)						
10.1.3	Is there a policy for these assessments to be reviewed periodically? (Intro)						
10.1.4	Has attention been given to eliminating flammable and highly flammable liquids from the workplace wherever possible and the possibility of replacing them with non-combustible liquids as alternatives been considered? (1.1)						
10.2	**Ventilation**						
10.2.1	To enable adequate ventilation in the open air, are the sites selected for storage tanks located away from hollows or other areas below surrounding ground level where released flammable vapours may accumulate? (2.2)						
10.2.2	Are open air tank storage areas away from buildings and structures that may prevent an adequate flow of air for ventilation? (2.3)						
10.2.3	Is care taken when siting new tanks, or structures in the vicinity of existing tanks, that conditions are not created that may be conducive to the accumulation of any released flammable vapours? (2.4)						
10.2.4	Has consideration been given to the possible release of flammable vapours from vent and fill lines and dip tube connections? (2.5)						
10.2.5	Are vents not less than the diameter of the filling or discharge line and not less than 25mm? (2.6)						
10.2.6	Are vent outlets located at least 3m, but not more than 6m, above ground level, or 1m above the top of the tank, whichever is the higher, and do they discharge to a safe position in the open air at least 3m clear of window and door openings? (2.7)						
10.2.7	Is the vent discharge point at least 1m higher than the top of the delivery tanker in the case of gravity delivery? (2.8)						
10.2.8	If delivery is by pump, are high level alarms fitted to the tank or is pre-set pump metering used? (2.9)						
10.2.9	Are ventilation pipes adequately secured? (2.10)						
10.2.10	Has a flame arrester been installed at the vent outlet of any tank containing a liquid with a flashpoint of 21°C or less? (2.11)						

		Yes	No	N/A	Action required	Due date	Sign on completion
10.2.11	Are flame arresters inspected regularly to ensure that they have not been obscured by paint or become obstructed, for example, by polymerised materials? (2.12)						
10.2.12	Have additional measures been provided to relieve excess pressure resulting from fire engulfment? (2.13)						
10.3	**Ignition**						
10.3.1	Have all potential ignition sources in the vicinity of the tanks been identified and elmininated?						
10.3.2	Is smoking prohibited in all external areas where flammable liquids are used or stored and appropriate notices prominently displayed? (3.2)						
10.3.3	Do the risk assessments undertaken for open air tank storage areas also seek to mitigate the hazards associated with motor vehicles being introduced into the proximity? (3.3)						
10.3.4	Is the electrical equipment and wiring certified as suitable for use within the zone in which the flammable liquid is being stored or processed as determined by a risk assessment undertaken by a competent person? Are the hazard zones identified in the risk assessment undertaken in compliance with DSEAR? (3.4)						
10.3.5	Is there an adequate level of lighting for safe working at all times, especially where level gauges have to be read? (3.5)						
10.3.6	Has the potential hazard of ignition due to a build-up of static electricity been assessed and precautions taken to eliminate it? (3.6)						
10.3.7	Are all metal tanks and associated extraneous pipework and fittings used for handling highly flammable liquids electrically bonded and earthed? (3.7)						
10.3.8	Does the tank filling line extend below the lowest normal operating level of the tank to minimise the generation of static electricity during filling operations? (3.8)						
10.3.9	Is bonding and earthing subject to an annual continuity test with suitable records being kept? (3.9)						
10.3.10	Is care taken to ensure satisfactory electrical bonding between flexible hoses and adjacent conventional pipework? (3.10)						
10.3.11	Is an earth lead for connection to the tanker provided for use during filling? Are dip rods and tubes also earthed? (3.11)						
10.3.12	Are heated tanks and their equipment constructed to an appropriate standard, such as BS 799-5? (3.12)						

		Yes	No	N/A	Action required	Due date	Sign on completion
10.3.13	Does tank heating equipment incorporate duplicate temperature sensors and thermostats and a high temperature limit device? (3.13)						
10.3.14	For economy as well as safety, is the heating of tanks kept to a minimum compatible with effective working practices? (3.14)						
10.3.15	Is any vessel containing internal heating elements fitted with duplicate low liquid level alarms and cut-outs to prevent its elements being exposed to the atmosphere? In addition, is the outlet pipe located above the heating coil or element? (3.15)						
10.3.16	Are temperature probes, thermostats and associated control equipment tested as part of the periodic maintenance programme for the installation? (3.16)						
10.3.17	If a drain pipe is fitted at a level lower than the heating coil or element, has it been fitted with a closed valve and a blanking plate to deny its use during normal operations? (3.17)						
10.3.18	Are tanks only drained following cooling of the contents to ambient temperature? (3.18)						
10.3.19	Where a water layer cannot be avoided is the heating medium incapable of raising the temperature above 100°C? (3.19)						
10.3.20	Is any insulation of tanks or pipes of non-combustible material? (3.20)						
10.3.21	Is trace heating of pipework necessary and do vent pipes and flame arresters also need heating? (3.21)						
10.3.22	Where trucks have to be used in a zone in which a flammable vapour may be present, are only trucks certified to the appropriate electrical zoning standard used? Has this been identified in the risk assessment undertaken in compliance with DSEAR? (3.22)						
10.3.23	Are roadways sufficiently wide to permit safe manoeuvring of any vehicle requiring access to areas in the vicinity of storage tanks? (3.23)						
10.3.24	Have suitably positioned barrier rails been considered to minimise the risk of impact damage to bunds, pipework and associated fittings? (3.24)						
10.3.25	Are battery powered trucks charged away from any zone in which a hazardous atmosphere may be present? (3.25)						
10.3.26	Are the gas cylinders of LPG-fuelled vehicles changed away from the vicinity of storage tanks? (3.26)						

		Yes	No	N/A	Action required	Due date	Sign on completion
10.3.27	When planning the site for positioning a flammable liquid storage tank, is the possibility of deliberate fire raising considered as part of the fire risk assessment? (3.27)						
10.3.28	Is the area immediately surrounding the flammable liquid storage tanks kept free from combustible materials, including waste, weeds and dried vegetation? (3.28)						
10.4	**Containment**						
10.4.1	Are tanks constructed in compliance with a recognised standard and are the materials used compatible with the highly flammable or flammable liquids being stored? (4.1)						
10.4.2	Is particular care paid to the protection of tanks constructed of glass reinforced plastic or similar materials to ensure that they maintain their integrity in the event of a fire? (4.2)						
10.4.3	Where access is provided for personnel wearing protective clothing and breathing apparatus is the inside diameter of the manhole at least 600mm? (4.3)						
10.4.4	Where tanks are compartmented, are the materials being stored in the same tank compatible? (4.4)						
10.4.5	To prevent corrosion, is the coating provided by paints or other coatings selected and applied in compliance with a recognised standard? (4.5)						
10.4.6	Internal corrosion may result from water accumulating in the tank. Is there provision for the removal of this with drainage being protected by two in-line valves? (4.6)						
10.4.7	Are tanks installed on foundations designed to support the weight of the tank together with a full capacity of the most dense material that is likely to be stored within it? (4.7)						
10.4.8	Are tanks secured to their supports or weighted to avoid floatation in the event of flooding or spillage of liquid into the bund? (4.8)						
10.4.9	Where tanks are raised above ground level in bunds, are their supports fire resistant to a 2-hour standard? (4.9)						
10.4.10	Are tanks that are below ground constructed with adequate foundations and supports, secure anchorage and appropriate corrosion prevention? (4.10)						
10.4.11	Is the space around tanks below ground backfilled with pea gravel or similar inert material with small particles, to avoid damaging the coating of the tank? (4.11)						
10.4.12	Are underground tanks marked prominently to prevent damage by traffic above? (4.12)						

		Yes	No	N/A	Action required	Due date	Sign on completion
10.4.13	Are safe catchment areas (bunds) provided to contain a possible flowing liquid fire and to guard against the risk of pollution? (4.13)						
10.4.14	Where there are multiple tanks in bunds, are these separated by suitable distances and are low intermediate walls, typically half the height of the bund, provided? (4.14)						
10.4.15	Are all parts of the tanks readily accessible to enable leakages to be easily identified? (4.15)						
10.4.16	Are tanks arranged so as not to be located one above another? (4.16)						
10.4.17	Double skin storage tanks may be considered to be a tank within a tank and thus not require a bund. Where these are on site, is an intrinsically safe monitoring system incorporated into the design? (4.17)						
10.4.18	Are pumps located in the open air inside the bunds on concrete bases so as to be above the level of the bund walls? (4.18)						
10.4.19	Is pipework installed above ground level where it can easily be inspected and maintained? (4.19)						
10.4.20	Are suitable precautions taken to route the pipework in order to minimise accidental damage, especially from passing vehicles? (4.20)						
10.4.21	Is pipework marked prominently in accordance with BS 1710 to indicate the contents and direction of flow? (4.21)						
10.4.22	Is the pipework constructed of metal? Are all elements of the pipework, including valves, seals and flange gaskets compatible with the contents of the tank to ensure the integrity of the system? (4.22)						
10.4.23	Is every pipe entering a tank provided with a suitable valve to allow it to be isolated? (4.23)						
10.4.24	Are valves provided, where necessary, to prevent the backflow of products or process materials into the tank? (4.24)						
10.4.25	Are valves labelled as to their function and, where necessary, their method of operation? (4.25)						
10.4.26	Are all valves exercised and tested periodically to ensure that they will work correctly and effectively in an emergency? (4.26)						
10.4.27	Are measures installed to prevent excessive pressure building up as a result of the thermal expansion of liquid trapped in pipework or between shut-off valves? (4.27)						

		Yes	No	N/A	Action required	Due date	Sign on completion
10.4.28	Are appropriate measures provided for movement between tanks and supports? (4.28)						
10.4.29	Are the diameters and lengths of pipes reduced as far as possible to minimise potential for spillage in case of an accident? (4.29)						
10.4.30	Where it is necessary to lay pipework beneath ground, is it laid in a masonry- or concrete-lined trench protected by load-bearing covers? (4.30)						
10.4.31	Is the pipework inspected, especially in the region of joints, and is access available for any valves below ground level? (4.31)						
10.4.32	Are flexible hoses only used where vibration is a problem? And are they only installed above ground? (4.32)						
10.4.33	Is tank filling only undertaken by an authorised person? (4.33)						
10.4.34	Are tank filling connections located at least 4m from any source of ignition, building opening, trench or depression? And is any drain in the vicinity fitted with an interceptor or routed to a waste collection and treatment facility? (4.34)						
10.4.35	Are filling points accessible by road tankers without the need for reversing the vehicles? (4.35)						
10.4.36	Do fill lines enter the tank at the top? (4.36)						
10.4.37	Are tanks containing highly flammable and flammable liquids fitted with a proprietary overfill prevention system incorporating a means of shutting off the flow and raising an alarm at a remote area that is permanently manned when refilling operations are taking place? (4.37)						
10.4.38	Is the connection point for filling or discharge outside the bund wall and close to the tanker stand to minimise the length of the connections? (4.38)						
10.4.39	Are the filling operations at all times under the control of the receiving organisation? (4.39)						
10.4.40	Is filling undertaken using a fixed pump on site rather than a vehicle mounted pump? (4.40)						
10.4.41	Are filling points equipped with non-return valves located close to the shut-off valve to minimise any spillage if the shut-off valve fails to seal? (4.41)						
10.4.42	Is spillage from making and breaking connections collected in a drip tray and disposed of safely? (4.42)						
10.4.43	Are filling lines capped when not in use? (4.43)						

		Yes	No	N/A	Action required	Due date	Sign on completion
10.4.44	Is each tank fitted with a liquid level device? (4.44)						
10.4.45	Are dial or electronic gauges calibrated on installation and periodically thereafter as part of the tank inspection programme? (4.45)						
10.4.46	Is physical dipping of tanks avoided if possible? (4.46)						
10.4.47	Are appropriate quantities of suitable materials available to retain and absorb spillages? Are staff trained in the safe use and disposal of these materials? (4.47)						
10.5	**Exchange**						
10.5.1	Has every effort been made to eliminate highly flammable and flammable liquids from the workplace as far as possible? (5.1)						
10.6	**Separate**						
10.6.1	Are all tanks located at ground level? (6.1)						
10.6.2	Are tanks above ground level located in well ventilated positions, separated from buildings and structures, process areas and the site boundary but in a position with easy accessibility by the emergency services? (6.2)						
10.6.3	Have separation distances between tanks been considered, depending on the capacity of the tank? (6.3 and 6.4)						
10.6.4	Has the insurer been consulted regarding the separation of groups of ‘small’ tanks and ‘large’ tanks from site boundaries, buildings, process areas, fixed sources of ignition and other hazardous materials? (6.5)						
10.6.5	Are the separation distances between ‘small’ tanks arranged in groups as set out in Table 2? (6.6)						
10.6.6	Where it is necessary to site tanks underground, are they outside the building line with the distance from any part of the tank to the building line being not less than 2m? (6.7)						
10.6.7	Where underground tanks are sited in a position where they are likely to be subjected to undue loadings, is either the area fenced off or the tanks located in a pit constructed of reinforced concrete with a reinforced concrete slab cover? (6.8)						
10.6.8	Has the installation of tanks been avoided in areas with a high water table? (6.9)						
10.6.9	Are bunds, interceptors, loading and unloading facilities, as well as the tanks and associated valves and pipework, regularly inspected and maintained, on a risk-assessed basis, by a competent person? (6.10)						

		Yes	No	N/A	Action required	Due date	Sign on completion
10.6.10	Are staff aware that empty tanks may still contain significant traces of liquid and/or flammable vapours and thus be extremely hazardous? (6.11)						
10.6.11	When a decision has to be taken at the planning stage as to whether a tank is to be taken out of service permanently and hence be demolished, or be cleaned and maintained for possible future use, is a risk assessment undertaken to identify hazards associated with the intended course of action? (6.12)						
10.6.12	When decommissioning and/or demolishing a tank, is the vessel physically isolated from any plant, process or other storage vessel? (6.13)						
10.6.13	Following isolation, is the tank emptied as much as possible, vented, cleaned and gas freed? (6.14)						
10.6.14	Are tanks to be decommissioned for possible future use cleaned as indicated or filled with water or an inert gas such as nitrogen? If an inert gas is used, is the tank prominently labelled to prevent unauthorised entry into an atmosphere that will not support life? (6.15)						
10.6.15	Is all work undertaken on decommissioning tanks carried out under a permit to work system? (6.16)						
10.6.16	Does the decommissioning of underground storage tanks follow the guidance set out by the Energy Institute? (6.17)						
10.7	**Fire safety management**						
10.7.1	Where quantities greater than 25 tonnes are stored, are signs displayed in accordance with the Health and Safety (Safety Signs and Signals) Regulations 1996 or in accordance with the Dangerous Substances (Notification and Marking of Sites) Regulations 1990 as appropriate? (7.1)						
10.7.2	Have competent authorities been notified where appropriate and emergency action plans prepared in compliance with the Control of Major Accident Hazards (COMAH) Regulations 1999 (as amended)? (7.2)						
10.7.3	Are all tanks and filling points marked with the name of the liquid in the tank? (7.3)						
10.7.4	Is the method of operating isolation and control valves indicated by signs or labels where necessary? (7.4)						
10.7.5	Have all staff members been suitably trained? (7.5)						
10.7.6	Is hot work on or near a tank prohibited unless a competent person has issued a permit to work under a hot work permit scheme? (7.6)						

		Yes	No	N/A	Action required	Due date	Sign on completion
10.7.7	Are all storage tanks within a secure area protected by welded mesh, palisade or similar perimeter protection complying with a recognised standard? (7.7)						
10.7.8	Where tanks are enclosed individually or in groups, are there no less than two gates provided for access and escape? (7.8)						
10.8	**Fire protection**						
10.8.1	Are all storage facilities, including external areas in the immediate vicinity of storage tanks, fitted with a manually operated fire alarm system? (8.1)						
10.8.2	In zoned hazardous areas, are fire alarm systems and communications systems intrinsically safe and appropriate for the zone in which they are installed? (8.2)						
10.8.3	Has consideration been given to protecting storage tanks with a suitably designed fixed foam or water spray fire protection system? (8.3)						
10.8.4	Are sufficient water supplies available for cooling tanks? (8.4)						
10.8.5	Is effective liaison maintained with the fire and rescue authority? (8.5)						
10.8.6	Are suitable fire water run-off and retention facilities provided with the adequacy of these having been discussed with the fire and rescue service? (8.6)						
10.8.7	Has an appropriate number of suitable portable fire extinguishers, approved and certificated by an independent, third-party certification body, been provided? (8.7)						
10.8.8	Has consideration been given to the provision of access for fire brigade personnel and their equipment? (8.8)						
10.9	**Environmental considerations**						
10.9.1	Has consideration been given to the earliest possible detection of leakage from tanks and pipework to minimise the risk of fire/explosion and to prevent contamination of ground and water courses? (9.1)						
10.9.2	Has specialist advice been sought regarding the design, installation and maintenance of underground storage tanks to minimise the likelihood of underground pollution? (9.2)						
10.9.3	Have vapour balancing systems been retrofitted where necessary? (9.3)						

REFERENCES

1. The Control of Major Accident Hazard Regulations 1999 (COMAH), SI 1999 No 743, as amended by the Control of Major Accident Hazard Amendment Regulations 2005, SI 2005 No 1088, The Stationery Office.
2. The Petroleum (Consolidation) Act, 1928.
3. The Control of Substances Hazardous to Health Regulations 2002, SI 2002/2677 (as amended), The Stationery Office.
4. Chemicals (Hazard Information and Packaging for Supply) Regulations 2002, (CHIPS 3), SI 2002/1689, as amended by the Chemicals (Hazard Information and Packaging for Supply) (Amendment) Regulations 2005, SI 2005/2571. The Stationery Office.
5. The Health and Safety (Safety Signs and Signals) Regulations 1996, SI 1996/341, The Stationery Office.
6. The Oil Pollution (Oil Storage) (England) Regulations 2001, SI 2001/2954, The Stationery Office.
7. RC20: **Recommendations for fire safety in the storage and use of highly flammable and flammable liquids: Part 1: General principles**, 2005, Fire Protection Association.
8. RC20: **Recommendations for fire safety in the storage and use of highly flammable and flammable liquids: Part 2: Storage in drums, cans and containers other than external fixed tanks**, 2007, Fire Protection Association.
9. Regulatory Reform (Fire Safety) Order 2005, SI 2005 No 1541, The Stationery Office.
10. The Fire (Scotland) Act 2005, asp 5, The Stationery Office.
11. Fire Safety (Scotland) Regulations 2006, Scottish SI 2006 No 456, The Stationery Office.
12. Fire and Rescue Services (Northern Ireland) Order 2006, SI 2006 No 1254 (NI9), The Stationery Office.
13. Dangerous Substances and Explosive Atmospheres Regulations (DSEAR) 2002, SI 2002/2776, The Stationery Office.
14. BS EN 60079-10: 2003: **Electrical apparatus for explosive gas atmospheres. Classification of hazardous areas**, British Standards Institution.
15. L88, **Approved Requirements and Test Methods for the Classification and Packaging of Dangerous Goods for Carriage**, 1996, Health and Safety Executive.
16. Health And Safety Booklet HS(G) 71: **Storage of packaged dangerous substances**, 1998, Health and Safety Executive.
17. Health And Safety Booklet HS(G) 51: **Storage of flammable liquids in containers**, 1998, Health and Safety Executive.
18. Electricity at Work Regulations 1989, SI 1989/635, The Stationery Office.
19. BS EN 60079-14: 2003: **Electrical apparatus for explosive gas atmospheres. Electrical installations in hazardous areas (other than mines)**, British Standards Institution.
20. BS 7430: 1998: **Code of practice for earthing**, British Standards Institution.
21. BS 799-5: 1987: **Oil burning equipment. Specification for oil storage tanks**, British Standards Institution.
22. **Lift trucks in potentially flammable atmospheres**, HS(G) 113, 1996, Health and Safety Executive.
23. **The Prevention and Control of Arson**, Second Edition, Adair Lewis, 2008, Fire Protection Association.
24. BS EN 12285-2: 2005: **Workshop fabricated steel tanks. Horizontal cylindrical single skin and double skin tanks for the above ground storage of flammable and non-flammable water polluting liquids**, British Standards Institution.
25. BS EN 14015: 2004: **Specification for the design and manufacture of site built, vertical, cylindrical, flat-bottomed, above ground, welded, steel tanks for the storage of liquids at ambient temperature and above**, British Standards Institution.
26. BS EN 13923: 2005: **Filament-wound FRP pressure vessels. Materials, design, manufacturing and testing**, British Standards Institution.
27. BS EN ISO 12944 (various parts): **Paints and varnishes. Corrosion protection of steel structures by protective paint systems**, British Standards Institution.
28. BS EN ISO 14713: 1999: **Protection against corrosion of iron and steel in structures. Zinc and aluminium coatings**. Guidelines, British Standards Institution.
29. BS 1710: 1984: **Specification for identification of pipelines and services**, British Standards Institution.
30. HSG176: **The storage of flammable liquids in tanks**, 1998, Health and Safety Executive.
31. CS15: **The cleaning and gas freeing of tanks containing flammable residues**, Health and Safety Executive.
32. **Design, Construction, Modification, Maintenance and Decommissioning of Filling Stations – Second Edition**, 2005, Energy Institute.
33. Dangerous Substances (Notification and Marking of Sites) Regulations 1990, SI 1990, No. 304 (as amended), The Stationery Office.
34. BS 1722-12: 2006: **Fences. Specification for steel palisade fences**, British Standards Institution.
35. BS 5839-1: 2002: **Fire detection and fire alarm systems for buildings. Code of practice for system design, installation, commissioning and maintenance**, British Standards Institution.
36. BS 5306-8: 2000: **Fire extinguishing installations and equipment on premises. Selection and installation of portable fire extinguishers – Code of practice**. British Standards Institution.
37. **Pollution prevention guideline: PPG 2: Above ground oil storage tanks**, 2004, published jointly by the Environment Agency for England and Wales, the Scottish Environment Protection Agency and the Environment and Heritage Protection Service in Northern Ireland.
38. **Guidance on the Groundwater Regulations 1998**, 2001, Department of the Environment, Transport and the Regions (now the Department for Environment, Food and Rural Affairs).
39. **The Water Environment (Controlled Activities) (Scotland) Regulations 2005: A Practical Guide**, Version 5, 2008, Scottish Environmental Protection Agency.

FURTHER READING

1. RC30: **Recommendations for the selection of electrical and non-electrical equipment for use in atmospheres containing flammable and explosive gases and vapours**, Fire Protection Association, 2005.
2. Heath and safety booklet HS(G) 140, **Safe handling of flammable liquids**, Health and Safety Executive.
3. Chemical Safety Guidance Note CS24: **The interpretation and use of flashpoint information**, 1999, Health and Safety Executive.
4. **Unloading petrol from road tankers. Dangerous Substances and Explosive Atmospheres Regulations 2002. Approved code of practice and guidance, L133**, 2003, Health and Safety Executive.
5. **Design of plant, equipment and workplaces. Dangerous Substances and Explosive Atmospheres Regulations 2002. Approved code of practice and guidance**, L134, 2003, Health and Safety Executive.
6. **Storage of dangerous substances. Dangerous Substances and Explosive Atmospheres Regulations 2002. Approved code of practice and guidance**, L135, 2003, Health and Safety Executive.
7. **Control and mitigation measures. Dangerous Substances and Explosive Atmospheres Regulations 2002. Approved code of practice and guidance**, L136, 2003, Health and Safety Executive.
8. **Safe maintenance, repair and cleaning procedures. Dangerous Substances and Explosive Atmospheres Regulations 2002. Approved code of practice and guidance**, L137, 2003, Health and Safety Executive.
9. **Dangerous Substances and Explosive Atmospheres. Dangerous Substances and Explosive Atmospheres Regulations 2002. Approved code of practice and guidance**, L138, 2003, Health and Safety Executive.

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