CONTAINMENT OF BULK HAZARDOUS LIQUIDS AT COMAH ESTABLISHMENTS CONTAINMENT POLICY

SUPPORTING GUIDANCE FOR SECONDARY AND TERTIARY CONTAINMENT

Introduction

The Containment policy will be applied to industry sectors and processes according to the level of risk. It will be implemented on the basis of the hazards of the substances present, taking account of the situation, community and environment where the installations are located. The highest standards will be expected where the risks to people and environment are greatest. Elsewhere the measures will be implemented according to the hazard and risk.

The policy provides a framework for good practice and this document consolidates the various sources of standards and guidance which apply to secondary and tertiary containment. It takes each policy statement, the risk control measures expressed and links it to the appropriate standard or guidance.

New guidance is presented in *italic text*.

The policy measures apply immediately to new establishments and, following discussions between the operator and the Competent Authority, to any existing establishments where significant changes in inventory or operation are proposed. Existing establishments will also be upgraded in line with the measures, as far as it is reasonably practicable to do so.

The risk control measures are the good practice which constitute the minimum level of compliance in relation to application of **all measures necessary,** required by COMAH regulation 4.

There are a number of risk assessment methodologies that may be used to establish the risk presented by the current circumstances and which can be used to develop a timetable for improvements required. These will have been used in Major Accident Prevention Policy, Safety Management Systems and safety reports [for upper tier COMAH sites]. The Energy Institute [EI] is developing an “Environmental Risk Assessment of Bulk Liquid Storage Facilities – Screening tool” which will be a further risk assessment tool.

Contain-ment policy statement Ref.	Policy Risk Control Measure	Page
Bunding of above – ground storage tanks (ASTs) (section 6)		
	ASTs shall be bunded to provide secondary containment.	3
	Bunds shall be impermeable	4
	Bunds shall have adequate corrosion resistance.	5
	Bunds shall have adequate strength and durability.	6
	Bunds shall have the minimum number of tanks within each bund in line with good practice	7
	Bunds shall have incompatible materials stored in separate bunds	7
	Bunds shall have sufficient capacity to allow for tank failure and firewater management. This will normally be a minimum capacity of either 110% of the capacity of the largest tank or 25% of the total capacity of all the tanks within the bund whichever is the greater.	7
	Bunds shall have either no rainwater drain or the drain is into a contained and enclosed system requiring positive action for operation	9
	Bunds shall have no pipework that penetrates through the bund floor	10
	Bunds shall have no pipework that penetrates through the bund walls as far as reasonably practicable otherwise it shall be with adequate sealing and support.	10
	Bunds shall be subject to periodic inspection and certification by a competent person regarding their condition and performance.	11
Bunding and fire controls (section 7)		
	Bunds shall have adequate capacity and design to allow fire prevention and control measures to be taken.	11
	Bunds shall have fire resistant structural integrity, joints and pipework penetrations.	13
	Bunds shall have a means of removing fire water from below the surface of the liquid in the bund (for dangerous substances which are not miscible with water and have a lower density than water).	14
Tertiary containment (section 10)		
	Tertiary containment plans for establishments storing or using liquid dangerous substances or that may have firewater containing dangerous substances shall be prepared, having regard to the ground and location characteristics of the site	15
	Tertiary containment measures shall minimise the consequences of a loss of primary containment from equipment that is not provided with secondary containment	16
	Tertiary containment measures shall minimise the consequences of a major incident that causes the failure of or exceeds the storage capacity of secondary containment	17
	Tertiary containment measures shall enable additional measures to be deployed in time if an incident escalates	18

This document does not address other sections of the CA Containment Policy.

Any sites subject to the Control of Pollution (Oil Storage) (England) Regulations 2001 No. 2954 must comply with the requirements of these regulations.

Policy Statement Reference 6 – Bunding of above – ground storage tanks (ASTs)

Policy Risk Control Measure

> Above-ground Storage Tanks ASTs shall be bunded to provide secondary containment.

Current recognised good practice standards

See risk control measure

Further information

A bund is a facility (including walls and a base) built around an area where potentially polluting materials are handled, processed or stored, for the purposes of containing any unintended escape of material from that area until such time as remedial action can be taken.

Reference: CIRIA report 164[7] Section 10.2

The purpose of a bund also includes providing a delineated zone around a tank or tanks which provides protection against vehicle strikes.

Secondary containment in the form of cavity wall and base construction (i.e. double-skin) is sometimes built into primary containment steel tanks and vessels (e.g. to BS 5500 (BSI,1996)) to control leakage, and for safety reasons. The false bottom of such tanks is fitted with leakproof inspection hatches enabling access for maintenance purposes. Each skin of a double-skin tank should be designed to withstand the same loading as a single-skin tank, with consideration given to additional pressures which may arise from a sudden rupture of the internal skin. Other construction systems include specially designed impermeable foundations which provide for leakage monitoring, interception and collection.

Reference: CIRIA report 164 Section 12.1

Associated risk management measures for double-skin tanks include quick response inventory management techniques to detect loss of containment – given that the leak collection layer will not have the same capacity as a bund. Measures are also required to remove any liquid from the collection layer [which may involve significant risk if flammable or toxic substances are involved], to monitor the condition of the lower floor and to provide ancillary secondary containment.

While priority should be given to preventing a loss of primary containment, adequate secondary and tertiary containment remains necessary for environmental protection in the event of a loss of primary containment of hazardous substances. The failure of secondary and tertiary containment at Buncefield contributed significantly to the failure to prevent a major accident to the environment (MATTE).

Reference: BSTG Final Report paragraph 158

Policy Risk Control Measure

Bunds shall be impermeable

Current recognised good practice standards

Bund wall and floor construction and penetration joints should be leak-tight. Surfaces should be free from any cracks, discontinuities and joint failures that may allow relatively unhindered liquid trans-boundary migration. As a priority, existing bunds should be checked and any damage or disrepair, which may render the structure less than leak-tight, should be remedied.

Reference: BSTG Final Report paragraph 159

A bund should be 'liquid-tight'.

Reference: HSG 176 clause 146

The floor of the bund should be of concrete or other material substantially impervious to the liquid being stored.

Reference: HSG 176 clause 147

The current good practice standard for the construction of reinforced concrete bunds is BS 8007:1987 *Code of practice for design of concrete structures for retaining aqueous liquids*. Bund joints are currently required to be rendered leak-tight by the adoption of flexible barriers such as water stops and sealants, bonded into or onto the concrete joint surface.

Reference: BSTG Final Report paragraph 163

The following documents contain important information relating to the design and installation of tanks and containment systems:

- BS EN 14015:2004 Specification for the design and manufacture of steel tanks for the storage of liquids at ambient temperature and above;
- EEMUA publication no. 183 Guide for the Prevention of Bottom Leakage from Vertical, Cylindrical, Steel Storage Tanks;
- API 650 Welded steel tanks for oil storage.

*BS 8007 is concerned with structures retaining aqueous liquids and does not specify the use of hydrocarbon-resistant and/or fire-resistant expansion or movement joints. Therefore reference should also be made to the reinforced concrete standard **BS 8110** with the fitting of stainless steel folded water stop sections for expansion joints (as in BSTG 180) or the fitting of stainless steel plates against joints to improve fire resistance and fire-resistant sealants complying with **BS 476**.*

Where possible the bund joint sealants should also have resistance to hydrocarbon attack.

For manufactured or fabricated bunds if the design and construction was in accordance with the relevant Standards and/or Codes of Practice, the bund design can be considered to be leak-tight.

For **earth bunds** the floor permeability should not be greater than the equivalent of a 1m depth of soil with a permeability coefficient of 10^{-9} $m.s^{-1}$.

References: CIRIA Report 164 s10.3.1; s10.3.9; Box 10.1 page 139
PPG 2
PPC S1.02

In addition to concrete and earth, the use of liners and lining systems can be used to make bunds leak-tight. Some information is provided in CIRIA 164. A key issue is how to incorporate a lining system with existing tanks. Lining a bund floor up to the tank annulus does not provide leak protection under the tank base and under the tank base presents a weak point. Tanks can be lifted and a lining system installed under the tank. Lifting tanks presents additional risks both in terms of safety during the actual operation and introducing stresses to the tank infrastructure.

Reference: CIRIA 164 page 183 section 11.8.1 Types of liner and lining systems

Further information

When an operator may have to replace a tank or a tank floor, this should be an opportunity to replace or undertake remedial work on the foundations and incorporate an impervious membrane under the whole of the tank.

Permeability criteria are only fully relevant to floors, and walls to the extent that they are in permanent contact with the ground and leaks could potentially continue undetected for extended periods. For walls generally (except for excavated bunds), leak-tightness is the most relevant criterion. A maximum permeability 1 x 10^{-7} m per second may be acceptable for earth bund walls and bund floors with a maximum permeability 1 x 10^{-9} m per second required for bund floors underneath tanks.

BS8110 will shortly be replaced by EN1992 Eurocode 2 Part 1-1. For the purpose of enhanced fire resistance of bund joints [see policy statement section 7] Eurocode 2 should be used in conjunction with BSTG Final Report paragraphs 161 - 181.

Eurocode 2 does facilitate a structural design that is fire resistant for a duration of 4 hours maximum and that can eliminate expansion joints. Detail on joint design is weak and no guidance is given on fire resistance.

Policy Risk Control Measure

Bunds shall have adequate corrosion resistance.

Current recognised good practice standards

Bunds and bund joints should be resistant to corrosion by water and contained liquids.

Further information

None

Policy Risk Control Measure

Bunds shall have adequate strength and durability.

Current recognised good practice standards

Design durability life of 50 years or more unless otherwise specified.

Reference: CIRIA Report 164 s10.3.1

Bund should be capable of withstanding the static and hydrodynamic loads associated with;

- release of liquid from primary storage tanks
- release of water from hoses during fire fighting operations
- wind (50-year design life)
- potential impact by site vehicles (if not protected by barriers).

Reference: Chemical storage tank systems – checklists (CIRIA publication W003)

Construction of reinforced concrete bunds should be to an appropriate standard e.g. **BS8007 or BS 8110.** (See references to Eurocode 2 and 6)

References: BS476
CIRIA 164 s10.3 p 139, p154

Further information

Note: BS 8007 is not directly intended for design of bunds to contain substances other than water. Enhanced fire resistance to be specified for bunds containing flammable liquids.

*BS 8007 is concerned with structures retaining aqueous liquids and does not specify the use of hydrocarbon-resistant and/or fire-resistant expansion or movement joints. Therefore reference should also be made to the reinforced concrete standard **BS 8110** with the fitting of stainless steel folded water stop sections for expansion joints (as in BSTG 180) or the fitting of stainless steel plates against joints to improve fire resistance and fire-resistant sealants complying with **BS 476**.*

Earth/clay bunds are often standard practice for older and/or larger installations, and range in construction from simply profiled walls (constructed from soil removed for tank foundation works) and floors of existing subsoil, to engineered clay-lined earth structures to an appropriate standard.

References: BS5628
CIRIA Report 164 s4.3.3, s11.2, s11.2.4

Masonry:
The use of masonry bunds on older installations may have un-reinforced or reinforced masonry bund walls.

Reference: CIRIA Report R164 s10.5

Policy Risk Control Measure

Bunds shall have the minimum number of tanks within each bund

Current recognised good practice standards

The number of tanks within a bund should comply with relevant HSE and industry guides with respect to separation distances.

References: HSG 176 The storage of flammable liquids in tanks
IP Fire precautions at petroleum refineries and bulk storage installations: model code of safe practice part 19

Further information

None

Policy Risk Control Measure

Bunds shall have incompatible materials stored in separate bunds

Current recognised good practice standards

It is important that multiple tank storage systems containing different chemical types or adjacent separate systems that store chemicals that may react with each other, are not located within the same bund [It is also good practice not to store toxic and flammable chemicals in the same bund]. The extent of the separation required should be determined by risk assessment.

Reference: CIRIA C598 Section 3.4.1

Further information

None

Policy Risk Control Measure

Bunds shall have sufficient capacity to allow for tank failure and firewater management. This will normally be a minimum capacity of either 110% of the capacity of the largest tank or 25% of the total capacity of all the tanks within the bund whichever is the greater.

Current recognised good practice standards

The core principles are that secondary containment should be capable of containing:

- the total volume of substance that could be released during an incident;
- the maximum rainfall that would be likely to accumulate in the secondary containment either before or after an incident;
- fire fighting agents (water and/or foam), including cooling water;

where bunds are used they should have sufficient freeboard to minimise the risk of substance escaping as a result of dynamic factors such as surge and wave action.

Reference: CIRIA 164

The minimum capacity for bunds containing tanks in scope at existing installations is 110% of the largest tank.

Reference: BSTG Final Report paragraph 182

Where a single bulk liquid tank is bunded, the recommended minimum bund capacity is 110% of the capacity of the tank.

Reference: CIRIA 164

110% does not always provide provision for fire scenarios which may affect several tanks and involving the application of firewater and other agents.

Reference: CIRIA 164

The factors to be taken into account when sizing bunds to deal with multi-tank failure scenarios and fire water management, plus the capacity for remote [tertiary] containment systems, are:

a) Primary capacity - 100% of primary capacity. Consider the possible failure modes and where appropriate, include the capacity of all primary tanks in multi-tank installations, incidence of multiple tanks in one bund and where tanks are hydraulically linked in which case they should be treated as if they were a single tank.
b) Rainfall - subject to operational procedures, in order to calculate the volume to be contained, allow for a 10 year return, 8 days rainfall prior to the incident, and a 10 year return, 24 hour rainfall, plus an allowance for rain falling directly on to remote containment and areas of the site draining into it, immediately after the incident. The post-incident component and the allowance for dynamic effects (see e) are not additive.
c) Fire fighting and cooling water - Allow for the volume of extinguishing and cooling water delivered through fixed and non-fixed installations based on BS5306, VCI, CEA, ICI and Institute of Petroleum methodologies, with appropriate adjustments in the light of the particular circumstances. Consultation with the regulators and the fire service is essential.
d) Foam - Allow a freeboard of not less than 100 mm.
e) Dynamic effects - this is to allow for the initial surge of liquid and for wind-blown waves.

f) In the absence of detailed analysis, allow 250mm (750 mm for earth walled bunds).

Reference: PPG 18

Other references: PPG2 [Appendix B]
Control of Pollution (Oil Storage) (England and Wales) Regulations 2001
Energy Institute IP Model Code of Safe Practice Part 19
HSG 176
PPC 1.02

Further information

Improved measures in terms of overfill protection and tank integrity will reduce the risk from loss of containment. Provision of secondary containment is a good practice measure. However, demonstration of a lower risk associated with primary containment cannot remove the requirement for secondary containment. The starting point for sizing secondary containment provision are the core principles referred to above. The minimum requirement is for secondary containment to provide 110% of the primary containment.

The 25% rule is an indicative value based on the assumption that, although the probability of more than one tank will fail at any one time is relatively low, there should be provision to mitigate the consequences of a major fire that could affect all of the tanks within a bunded area. It addresses the issue of a bund having sufficient capacity to allow for tank failure and firewater management. This provides a buffer to deal with the incident and informs risk assessment as to the degree of tertiary containment that may be required to deal with subsequent failure of secondary containment in a severe and prolonged event. The actual sizing for multi-tank bunds will be determined by the hazard and the risk.

It is recognised that for some multi-tank bunds applying the 25% capacity criterion results in a much larger bund size which may not be required. For example a bund containing 60 000 m^3 of tankage in 12 tanks would require 15 000 m^3 of bund capacity under the 25% rule and 5 500 m^3 under the 110% rule.

Where modification to the bund either by enlargement or partition is not practical, greater emphasis is placed on provision for tertiary containment.

The risk of increasing the potential pool area for a spillage should be considered in bund capacity calculations. For flammable substances this may increase potential radiative effects resulting from a pool fire and for toxic substances the distances downwind to safe concentrations.

Policy Risk Control Measure

Bunds shall have either no rainwater drain or the drain is into a contained and enclosed system requiring positive action for operation

Current recognised good practice standards

See risk control measure

Further information

Many older bunds have rainwater drains, usually to oil interceptors with manually operated valves. Modern installations have blind sumps.

Reference: CIRIA 164 s10.3.5 p145 et seq

Policy Risk Control Measure

Bunds shall have no pipework that penetrates through the bund floor

Current recognised good practice standards

Existing [see stated CIRIA 164 reference] guidance recommends avoiding pipework penetrations. Most installations limit floor penetrations to drainage pipework but some have process and services penetrations.

Reference: CIRIA 164 p145

Bund floor penetration joints are points of inherent weakness where any failure of integrity is very difficult to detect and may continue unnoticed for some time. Consequently, existing bund floor penetrations should be eliminated wherever practicable. Where flexible sealants are used in floor penetration joints, these should be removed and replaced with fire-resistant sealants.

Reference: BSTG Final Report paragraph 177

Policy Risk Control Measure

Bunds shall have no pipework that penetrates through the bund walls as far as reasonably practicable otherwise it shall be with adequate sealing and support.

Current recognised good practice standards

For penetrations of concrete and masonry, the first option should be to consider re-routing the pipework or other penetrating structures to eliminate the need for the joint. Where this is not practicable, or a planned removal is significantly delayed for operational reasons, the fire-resistance of the joint must be improved. The fitting of steel collars, bellows or similar to improve fire resistance at pipework penetrations may introduce local corrosion initiation points in the pipework, and is therefore not recommended where this may be likely. In such cases joints should be improved by replacing existing sealants with fire-resistant sealants. For penetration of earth bund walls, these joints may be inherently less vulnerable because of the greater joint thickness. However, insufficient information has been considered to allow reliable guidance to be produced for this case. Joints should be assessed on a site-specific basis.

Reference: BSTG Final Report paragraph 175

Existing guidance recommends avoiding pipework penetrations but most installations have many example of it.

Reference: CIRIA 164 s10.3.5 p145

There can be a trade-off as lower routing allows for possible protection by water layer.

Further information

None

Policy Risk Control Measure

> The bunds shall be subject to periodic inspection and certification by a competent person regarding their condition and performance.

Current recognised good practice standards

Repaired cracks in existing concrete and masonry bund surfaces must be assessed for their significance with regard to the potential to fail in a fire scenario, resulting in loss of secondary containment. Where cracks are superficial, improvement may not be required, but where cracks are significant, the flexible sealant used must be replaced by fire-resistant sealants.

Reference: BSTG Final Report paragraph 178

Further information

Regular "housekeeping walk-around" inspections are common, although the results are usually not recorded. This should be against specific criteria and a system which will require significant defects to be recorded, assessed further and if necessary improved.

Routine inspection should be supported by more detailed and documented inspection to an adequate methodology by a competent person who has been adequately trained. For more complex and/or critical assessments, this may increase the need for inspection by suitably trained personnel and certification by a chartered civil engineer.

Hydrostatic testing is referred to in CIRIA 164 [s10.3.9]. There are risks with hydrostatic testing that should be considered. Immersion of the tank floor may result in instability and could force water under the tank floor leading to corrosion.

Policy Statement Reference 7 Bunding and fire controls

ASTs containing substances that are flammable, highly flammable or extremely flammable shall be bunded to provide secondary containment of the dangerous substance as stated in policy statement references 6 and 7 above and in addition shall have the following the risk control measures.

Policy Risk Control Measure

> Bunds shall have adequate capacity and design to allow fire prevention and control measures to be taken.

Current recognised good practice standards

Well-planned and organised emergency response measures are likely to significantly reduce the potential duration and extent of fire scenarios, and so reduce firewater volumes requiring containment and management. Site-specific planning of firewater management and control measures should be undertaken with active participation of the local Fire and Rescue Service, and should include consideration of:

- bund design factors such as firewater removal pipework, aqueous layer controlled overflow to remote secondary or tertiary containment (for immiscible flammable hydrocarbons);
- recommended firewater/foam additive application rates and firewater flows and volumes at worst-case credible scenarios; and
- controlled-burn options appraisal, and pre-planning/media implications.

Reference: BSTG Final Report paragraph 183
CIRIA R164 page 121 section 9.6.1
PPG 28

Detailed guidance on methodologies to determine required overall capacity including firewater from typical application rates of water, foam and other agents can be found in the **Energy Institute IP Model Code of Safe Practice Part 19: Fire Precautions at Petroleum Refineries and Bulk Storage Installations Annex D**

Risk assessment should consider the worst-case scenario for the fire event. For fuel depots this is considered to be either the largest tank in a single bund or the largest group of tanks in a single bund.

Reference: BSTG Final report paragraph 305 page 60

Risk assessments should include the typical magnitude of fire-fighting media application rates.

Reference: Model code of safe practice Part 19
HSG176

Reference can also be made to Verband der Chemischen [VCI Germany] European Insurance Commission guidelines for calculating capacity of fire fighting water retention. in

Reference: CIRIA Report No. 164

Further information

HSG 176 [para 131] quotes the requirement of 10 l/min/m^2 for a pool fire at the tank base, fire engulfment. The application rate of 2 l/min/m^2 is the minimum application rate for a tank exposed to radiation from a non-impinging fire.

Reference: HSG176

Like Eurocode 2, Eurocode 6 does not cover fire resistance in bunds and requires supplementary reference to BSTG report.

Policy Risk Control Measure

Bunds shall have fire resistant structural integrity, joints and pipework penetrations.

Current recognised good practice standards

Improvements should be made to the fire-resistance of bund joints by suitable protection (e.g. metal plate covering) and/or by the use of fire-resistant sealants.

Reference: BSTG Final Report paragraph 175

Bund floor construction joints: For concrete bund floors, vulnerability to fire should be capable of being reduced by managed emergency response measures such as maintaining an insulating water layer on the bund floor. Removal of existing flexible sealant for replacement with fire-resistant alternatives may result in reduced performance with regard to water tightness. Floor joints nevertheless remain a potential weakness for loss of integrity in a severe pool fire. A case-by-case assessment of floor joint fire-resistance improvement options should be made.

Reference: BSTG Final Report paragraph 176

For new bunds, to achieve the maximum practicable fire resistance for bund joints the following additional measures should be taken:

- **Bund wall and floor construction joints:** Joints should be designed to be fire resistant. Consideration should be given to incorporating stainless steel waterstops and expansion joints bonded into the structure, or stainless steel plates against bund joints in combination with fire-resistant sealant.
- **Bund wall penetration joints:** Wall penetrations should not be incorporated into new bunds unless alternative over-wall routing is impracticable. Where wall penetrations are unavoidable, joints should be designed to be fire resistant. Consideration should be given to incorporating puddle flanges cast into the concrete structure.
- **Bund floor penetration joints:** Floor penetrations should not be incorporated into new bunds.

Reference: BSTG Final Report paragraph 179
Reference: BSTG Final report paragraphs 161 - 181

Sealant should be both chemically resistant and fire-resistant. Consideration should be given to the chemical resistance of sealants to gasolines in floor joints, otherwise the joint may be compromised by drips/spillages.

New designs are available incorporating stainless steel water stops into bund walls.

Reference: BSTG Final Report paragraph 180

Further information

A preventative measure would be to reduce the number of joints within a bund.

The BSTG Final Report makes reference to the following standards:

- BS 8110 Structural use of concrete
- BS 476 Fire tests on building materials and structures

Reference: BSTG Final Report paragraph 323

Policy Risk Control Measure

Bunds shall have a means of removing fire water from below the surface of the liquid in the bund (for dangerous substances which are not miscible with water and have a lower density than water).

Current recognised good practice standards

Where bunds may be required to retain flammable liquids which are less dense than water, they should incorporate overflow arrangements which, in the event of the bund capacity being exceeded (e.g. by fire fighting water) will prevent burning liquid spilling over and thereby spreading the fire to other parts of the site. In this situation it is recommended that the overflow pipework does pierce the bid but only in the freeboard zone which would normally be above the level of liquid.

Reference: CIRIA 164 section 10.3.5 page 145

Further information

Bunds could have either: -

(a) installed provision of pipework systems that enable liquid removal by suction or pumping of accumulated firewater, and/or
(b) pre-planned arrangements with the Fire Service to provide suitable facilities to empty the bund.
(c) Gravity drainage system with lockable valves that is connected to properly designed combined drainage system.

Provision must be made to empty rainwater and other liquids from bunds using mobile or fixed pumps. It is recommended that these are switched manually. It is recommended that bunds should not be equipped with means for gravity discharge, even if lockable valves are provided, unless the bund is part of a properly designed combined system.

Reference: CIRIA 164 section 10.3.4 page 145

Gravity drainage has the advantage in that it is relatively simple, requires no pumping - therefore reducing complexity in an emergency, can be easily monitored and should be drained to a safe area for collection. It also requires bund penetration and for any existing systems the risks associated with any penetration must be weighed against the potential environmental impact.

With controlled bund overflows there are practical considerations that require consideration:

- *what flow rate will the overflow be designed for?*
- *if a pipe is used what head is required to achieve the flow?*
- *where will the overflow be routed?*

For larger bunds this may require 8" or even 10" diameter for larger bunds. This may present difficulties in arranging a line of this size towards the top of a bund wall (almost the height of the free board). One option is to install a valved emergency emptying line which would enable drainage by gravity (or pump if available) from the bund without endangering personnel. For practical pump priming/drainage reasons there is no reason why this line cannot be correctly designed to run through the bund wall at a lower level. The risks of any additional penetration of the bund wall must be taken into account.

Large volume transfer of liquids is typically more practical for general tank storage sites that tend to have common pipework systems – compared with fuel storage sites that are more reliant on high volume pumps provided by fire service in the event of an incident. These arrangements should be included in on-site emergency plans.

Policy Statement Reference 10 – Tertiary Containment

Tertiary containment plans for establishments storing or using liquid dangerous substances or that may have firewater containing dangerous substances shall be prepared, having regard to the ground and location characteristics of the site.

The term ‘tertiary containment’ is used to describe containment systems and measures to contain potentially polluting liquids which may escape as a result of loss of secondary containment, and would otherwise be released into the environment causing pollution.

Reference: BSTG Final Report paragraph 185

Policy Risk Control Measure

> Tertiary containment plans for establishments storing or using liquid dangerous substances or that may have firewater containing dangerous substances shall be prepared, having regard to the ground and location characteristics of the site

Current recognised good practice standards

- a risk assessment should be undertaken to determine the extent of the requirement for tertiary containment, taking into account:
    - foreseeable bund failure modes;
    - firewater volumes including firefighting agents;
    - environmental setting;
    - known pathways and potential pathways to environmental receptors in the event of failure of secondary containment;

    - likely environmental impact consequences, in terms of extent and severity, of the pollutant and/or firewater quantities and flows resulting from foreseeable bund failure scenarios.

- The size, type and location of tertiary containment should be based on the scope and capacity determined by the site-specific risk assessment,

Reference: BSTG Final report paragraphs 184 - 200

Further information

*Tertiary containment is informed by risk assessment taking into account the configuration of primary and secondary containment and the environmental setting of the site. Further information on environmental risk assessment can be found in the COMAH Competent Authority "**Guidance on the Environmental Risk Assessment Aspects of COMAH Safety Reports"** December 1999 http://www.environment-agency.gov.uk/business/1745440/444663/comah/1769899/?version=1&lang=_e*

Policy Risk Control Measure

Tertiary containment measures shall minimise the consequences of a loss of primary containment from equipment that is not provided with secondary containment

Current recognised good practice standards

Assessment of tertiary containment requirements, i.e. type and capacity should start with an initial worst-case assumption that available secondary containment will fail or capacity will be exceeded, and the consequent firewater flows and directions should be identified and estimated.

Reference: BSTG Final Report paragraph 194

Based on the scope and capacity determined by the site-specific risk assessment, tertiary containment should be designed to:

- be independent of secondary containment and any associated risks of catastrophic failure in a worst-case major accident scenario;
- be capable of fully containing foreseeable firewater and liquid pollutant volumes resulting from the failure of secondary containment;
- be impermeable to water and foreseeably entrained or dissolved pollutants;
- use cellular configuration, to allow segregation of 'sub-areas' so as to limit the extent of the spread of fire and/or polluted liquids;
- operate robustly under emergency conditions, for example in the event of loss of the normal electrical power supply;
- avoid adverse impacts on fire fighting and other emergency action requirements;
- allow the controlled movement of contained liquids within the site under normal and emergency conditions;
- facilitate the use of measures for the physical separation of water from entrained pollutants;

- incorporate practical measures for the management of rainwater and surface waters as required by the configuration;

and

- facilitate clean up and restoration activities.

Reference: BSTG Final Report paragraph 187

Further information

None

Policy Risk Control Measure

Tertiary containment measures shall minimise the consequences of a major incident that causes the failure of or exceeds the storage capacity of secondary containment

Current recognised good practice standards

General guidance on the design of remote containment systems (including lagoons, tanks and temporary systems such as sewerage storm tanks and sacrificial areas such as car parks, sports field and other landscape areas) is available in numerous documents including CIRIA report 164 and PPG18.

Reference: BSTG Final Report paragraph 196

A wide variety of products are available to deal with spillages or to contain spills in emergency containment areas, for example drain seals.

Reference: PPG 18

A risk assessment should be undertaken to determine the extent of the requirement for tertiary containment, taking into account:

- foreseeable bund failure modes, including:
    - the amount of spilled substances, including hydrodynamic effects of catastrophic tank failure and emergency response actions such as fire fighting;
    - the potential impact of fire on bund integrity including joints in walls and floors;
    - worst-case foreseeable delivered firewater volumes including fire fighting agents;

    and

    - passive and active firewater management measures.
- environmental setting, including:
    - all relevant categories of receptors as specified in *Guidance on the interpretation of Major Accident to the Environment;*
    - proximity of receptor, e.g. groundwaters under the site;
    - site and surrounding topography;
    - geological factors affecting the permeability of surrounding land and environmental pollution pathways;

    and

  - o hydrogeological factors affecting liquid pollutant flows and receptor vulnerabilities;
- known pathways and potential pathways to environmental receptors in the event of failure of secondary containment;
- likely environmental impact consequences, in terms of extent and severity, of the pollutant and/or firewater quantities and flows resulting from foreseeable bund failure scenarios.

Reference: BSTG Final Report paragraph 186

Site-specific planning of firewater management and control measures should be undertaken with active participation of the local Fire and Rescue Service, and should include consideration of bund design factors, such as firewater removal pipework, aqueous layer controlled overflow to remote secondary or tertiary containment (for immiscible flammable hydrocarbons);

Reference: BSTG Final Report paragraph 46

Plan with the Fire and Rescue Service suitable fire fighting strategies, such as:

- reducing the amount of firewater generated: using sprays rather then jets
- recycling firewater where this is not hazardous
- a controlled burn where it is safe to do so. In cases where action is required to prevent the fire spreading, for example the application of cooling water to the areas around the storage tanks, care should be taken to ensure 1) this water does not become a pollutant or 2) the cooling process does not cause significant increases in air pollution

Reference: PPG 28

Further information

Many installations do not have tertiary containment designed to mitigate the effects of a loss of secondary containment.

Reference: BSTG Final Report

Tertiary containment is as much about assessment as it is containment. It is using environmental risk assessment techniques to assess what would happen to product and fire water in the event of an incident. Once this has been established relatively simple measures such as curbing to divert flows away from sensitive areas can be implemented.

Policy Risk Control Measure

Tertiary containment measures shall enable additional measures to be deployed in time if an incident escalates

Current recognised good practice standards

On-site effluent treatment facilities, sized to allow collection and treatment of polluted firewater, are a desirable design feature, but may only be justifiable at larger establishments.

Reference: BSTG Final Report paragraph 185

To limit fire spread, low walls or kerbs should be provided and each should be connected to a drainage system (but not any storm water system).

Reference: Section 4.8.4 Model code of safe practice Part 19

Further information

Provision could be made for site-dedicated or mutual aid provision to accommodate product and firewater.

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