Secondary Containment Systems

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1 Purpose and Scope

1.1 Purpose

The controls for hazardous substances that are liquids, or are likely to liquefy in a fire, include a requirement to be able to capture the substances in the event they are released from their primary container. This is achieved by means of a secondary containment system.

A secondary containment system, in relation to a workplace, is a system or systems—

(a) in which pooling substances held in the workplace will be contained if they escape from the container or containers in which they are being held; and

(b) from which they can, subject to unavoidable wastage, be recovered

The purpose of these Guidelines is to provide a practical means of meeting the controls for secondary containment systems. These Guidelines seek to address some of the range of secondary containment options a PCBU is likely to consider when developing a new site or making significant changes to an existing site.

1.2 Scope

Secondary containment is one aspect of wider emergency management provisions for hazardous substances. These Guidelines provide options for meeting the requirements of secondary containment systems for sites having pooling hazardous substances in above-ground containers including bulk tanks, transportable containers, process containers and packages.

These Guidelines provide guidance on compliance with the requirements for secondary containment in the Health and Safety at Work (Hazardous Substances) Regulations 2017 (the Regulations).

PCBUs also need to be aware of the requirements of the Hazardous Substances and New Organisms (HSNO) Act 1996 relating to class 9 (ecotoxic substances). Of particular relevance are the controls on class 9 substances prescribed in the Hazardous Substances (Hazardous Property Controls) Notice 2017.

Compliance with these Guidelines does not remove the requirement to comply with other relevant provisions of the Health and Safety at Work Act 2015 (HSWA) and regulations, or with other legislation such as the Resource Management Act 1991 (RMA) and the Building Act 2004.

These Guidelines provide general guidance about requirements and are not a substitute for PCBUs obtaining specialist advice about the requirements for their sites.

1.3 Exclusions

The following situations are not addressed in these Guidelines:

- Stationary containers with integral secondary containment.
- Below ground stationary containers.
- Small scale use of hazardous substances in research and development or teaching laboratories.
- Containment of explosives.
- Stationary containers covered by a safe work instrument.

The examples provided in these Guidelines are not intended to be used as technical specifications. The design, construction and maintenance of each secondary containment system must be supported by technical documentation.

1.4 Secondary containment systems

Containment of a liquid hazardous substance is provided by the primary container, for example a package, a drum, a bulk tank. It is expected that in everyday storage a substance will be contained in this primary container. To deal with a loss of containment of the primary container, a secondary containment system is required. This must be designed to contain the substance, and enable the safe collection of it. The threshold quantities above which secondary containment is required depend on the hazard classification of the substance and the size of the container.

Secondary containment systems apply to pooling substances, that is, a hazardous substance that is a liquid or is likely to liquefy in a fire. By containing a spill and enabling its recovery, the secondary containment systems can prevent a potential emergency from escalating to a point where the workers at the site, the public, or the environment is at risk.

Fires at tank farms or earthquakes in the area of storage facilities are occurrences that might cause failure of primary containers and therefore an appropriately designed, constructed and maintained secondary containment system is essential. On a smaller scale, spills can result from handling incidents in package stores, failure of operational procedures or overfilling, for example, a valve left open or a package failure during handling.

Secondary containment systems are required for the duration of storage on site. This includes the lifetime of tanks and the period of storage for packages and drums. In the event of deterioration of the secondary containment system, its integrity must be restored as soon as possible.

Secondary containment systems must be designed, constructed and maintained for their intended purpose.

1.5 Terminology

These Guidelines use the term “must” to indicate a legal requirement to do something (for example it is required by an Act or Regulations). The term “should” is used for a recommended practice or approach.

Section 9 of these Guidelines (Interpretation) explains some of the terms used in these Guidelines.

2 HSWA

2.1 Purpose of HSWA

The main purpose of HSWA is to provide for a balanced framework to secure the health and safety of workers and workplaces.

HSWA sets out the principles, duties and rights in relation to workplace health and safety.

2.2 The control framework for hazardous substances in the workplace

HSWA provides for controls on hazardous substances by:

- Regulations
- Safe work instruments.

2.3 Regulations

The Health and Safety at Work (Hazardous Substances) Regulations 2017 (the Regulations) made under HSWA specify generic controls for hazardous substances. Some regulations encompass all hazard classes and some encompass specific hazard classes.

For instance:

Part 10 of the Regulations relates to controls on Class 2, 3 and 4 substances

Part 11 of the Regulations relates to controls relating to adverse effects of unintended ignition of class 2 and 3.1 substances

Part 12 of the Regulations relates to controls on Class 5 substances

Part 13 of the Regulations relates to controls on Class 6 and 8 substances

Part 17 of the Regulations relates to controls on stationary container systems for all hazard classes, including subpart 18 on secondary containment.

2.4 Safe work instruments

WorkSafe develops safe work instruments for approval by the Minister for Workplace Relations and Safety. The purpose of a safe work instrument is to define terms, prescribe matters, or make other provision in relation to any activity or thing, including listing standards, control of substances, and competency requirements. Safe work instruments have been developed to:

- prescribe detailed or technical matters or standards that change relatively frequently and will often be industry-specific
- provide an alternative means of complying with regulations.

An example of a safe work instrument is the *Reduced secondary containment for certain above ground stationary* *tanks – Safe Work Instrument 2017*. This safe work instrument allows for a reduction in the capacity that the secondary containment system for an above-ground stationary tank with integral secondary containment is required to have under the Regulations, if the tank meets certain requirements specified in the safe work instrument.

Safe work instruments can be found on the WorkSafe website.

2.5 Hazardous substance classification

Hazardous substances can be classified under several similar systems. New Zealand uses the HSNO classification system and the Globally Harmonized System of Classification and Labelling of Chemicals (GHS).

The classification of hazardous substances must be listed in the Hazards Identification section of the safety data sheet (SDS); usually Section 2. Section 15 of the SDS may also have other specific regulatory information.

The HSNO classification system is used in the Regulations.

2.5.1 HSNO classification system

Hazardous substances are classified in accordance with their inherent hazardous properties. The Hazardous Substances (Classification) Notice 2017 sets out the following classes of hazardous properties:

- Class 1 – explosiveness
- Class 2 – flammability, gases
- Class 3 – flammability, liquids
- Class 4 - flammability, solids
- Class 5 - capacity to oxidise
- Class 6 - toxicity
- Class 8 - corrosiveness
- Class 9 - ecotoxicity
- (Class 7 is unallocated; radioactivity is subject to separate legislation).

Each class is then split into numbered sub-classes to indicate the type of hazard, and a letter category to indicate the degree of hazard. Each hazardous substance is given a series of hazard classes in accordance with the properties of the substance, for example petrol has hazard classifications 3.1A, 6.1E, 6,3B, 6.7B, 9.1B.

Each hazardous substance is required to have safety data sheets available. The safety data sheets, available from substance suppliers, are required to have the hazard classifications included on them.

Information on the HSNO classification system is available Environmental Protection Authority website.

2.5.2 Globally Harmonized System of Classification and Labelling of Chemicals (GHS)

Products brought into New Zealand from overseas will use the GHS system as the HSNO classification system is unique to New Zealand. The SDS could show either the GHS or the HSNO classification for the substance.

A correlation table for HSNO and GHS classifications is available at the Environmental Protection Authority website.

2.6 Requirement for secondary containment systems

While these Guidelines primarily focus on the requirements of the Regulations, they also provide information on some other requirements such as the controls on class 9 substances.

The thresholds for secondary containment systems for above-ground containers are specified in the Regulations and also the Hazardous Substances (Hazardous Property Controls) Notice 2017 (for class 9 pooling substances).

See Appendix 1 for information on the specific regulations concerned.

Each site must be assessed for secondary containment requirements. Appendix 15 and Appendix 16 of these Guidelines provide template registers for assessing secondary containment system requirements based on the substances held at the site.

2.7 Other regulatory requirements

These Guidelines do not cover obligations that may exist under other legislation. For example, the RMA provides for regional and district resource management plans which set out rules regarding permitted activities. PCBUs need to be familiar with all of their legal obligations.

2.8 Duties of the PCBU

The PCBU with management or control of a place where hazardous substances are present is responsible for ensuring that the specified controls are in place and are being followed. The Regulations set out detailed secondary containment requirements for the different classes of pooling substances.

3 Major principles

The intent of a secondary containment system is to contain any hazardous substance should a loss of containment in a primary container system occur.

Typical containers that require secondary containment systems are stationary tanks, process containers and packages, such as drums and small packs. The secondary containment system around a tank is typically a compound with bund walls.

3.1 Business activity

The requirement for secondary containment systems is based on the nature and quantity of the substances held rather than the nature of the business activities at the place. For example, secondary containment systems are required for commercial premises, retail outlets, industrial factories and distribution centres.

3.2 Threshold quantities

The threshold quantities in the Regulations for substances requiring a secondary containment system are reproduced in Appendix 1 of these Guidelines. Other controls such as those in the Hazardous Substances (Hazardous Property Controls) Notice 2017 may be different. PCBUs need to be familiar with the requirements that apply to them. Storage above these quantities requires a secondary containment system, irrespective of the type of storage, for example, stationary tanks, drums or packages.

When applying Appendix 1, each of the hazard classes assigned to the substances must be individually considered. For example, diesel fuel has hazard classifications 3.1D, 6.1E, 6,3B, 6.7B, 9.1B. It is hazard classification 9.1B that triggers a requirement for secondary containment with a threshold quantity for secondary containment of 1000 litres (see special cases in Section 5.1 below for farm tanks and Section 5.4 below for short-duration storage).

Some substances have had specific variations made to the secondary containment thresholds, for example petrol has hazard classifications 3.1A, 6.1E, 6,3B, 6.7B, 9.1B. The threshold quantity under the Regulations for class 3.1A substances is 100 litres. However, regulation 10.30(6) varies the secondary containment threshold quantity for petrol to 1000 litres (see special cases in Section 5.1 below for farm tanks and Section 5.4 below for short-duration storage).

The Hazardous Substances Calculator can be used to find out whether the quantity of hazardous substances in a workplace requires secondary containment.

The Regulations also prescribe a requirement for preparing response plans. These emergency response plans should provide for recovering hazardous substances from the secondary containment system, and where necessary, for treating the hazardous substance to enable disposal of it.

Workrooms containing flammable liquids require secondary containment at 100% of the total pooling potential. This is irrespective of the hazard class or quantity of substances held in the workroom, that is, there is no minimum threshold quantity.

3.3 Capacity of secondary containment system

The minimum required capacities of secondary containment systems are specified in the Regulations, The following tables are a summary of these.

Table 1 Minimum secondary containment capacity for class 3, 4, 5.1.1 and 5.2 hazardous substances

Container Size Categories	Quantity – Total Pooling Potential (TPP)		
	Less than 5,000 litres	Greater than or equal to 5,000 litres	Relevant Regulations
≤ 60 litres	At least 50% TPP	2,500 litres or 25% TPP whichever is the greater	10.31 (class 3 or 4) 12.14 (class 5.1.1) 12.39 (class 5.2)
> 60 and up to 450 litres	At least 100% TPP	5,000 litres or 50% TPP whichever is the greater	10.32 (class 3 or 4) 12.15 (class 5.1.1) 12.40 (class 5.2)
> 450 litres	At least 100% TPP	5,000 litres or 50% TPP whichever is the greater	10.33 (class 3 or 4) 12.16 (class 5.1.1) 12.41 (class 5.2)
> 450 litres (portable tank)	At least 110% of the capacity of the largest portable tank at the place		
Stationary container systems[1]	At least 110% of the capacity of the largest container		17.100

Workrooms[2] require secondary containment at 100% of the TPP.

[1] As defined in Regulation 3(1) of the Health and Safety at Work (Hazardous Substances) Regulations 2017
[2] Type 1, Type 2 and Type 3 workrooms as defined in Regulation 11.1.

Table 2 Minimum secondary containment capacity for classes 6, 8 and 9 substances that do not have class 1 to 5 hazard classifications.

Container size categories	Quantity – total pooling potential (TPP)		
	Less than 20,000 litres	Greater than or equal to 20,000 litres	Relevant Regulations
≤ 60 litres	At least 25% TPP	5000 litres or 5% TPP whichever is the greater	13.31 (class 6 or 8)
> 60 and up to 450 litres	At least 25% TPP or 110% of the largest container whichever is greater	5,000 litres or 5% TPP whichever is the greater	13.32 (class 6 or 8)
> 450 litres	At least 25% TPP or 110% of the largest container whichever is greater	5,000 litres or 5% TPP whichever is the greater	13.33 (class 6 or 8)
> 450 litres (portable tank)	At least 110% of the capacity of the largest portable tank at the place		
Stationary container systems	At least 110% of the capacity of the largest container		17.100

The following matters apply:

1. The capacity of a container is:
    a. For process vessels – the overflow point capacity.
    b. For vertical stationary tanks - the capacity up to the roof to shell joint (or overflow point if one is provided).
    c. For horizontal tanks - the total enclosed volume.
2. The volume of isolatable piping connecting stationary containers or process containers is not considered when determining the secondary containment system capacity requirement.
3. Where stationary containers are interconnected and a spillage will entail the release of the contents of both or all of the containers, for example by a pipeline that is open, they are considered as one container.
4. In situations that rely on achieving a water bottom in the compound, for example, some clay-lined compounds that require moisture for the clay to form a seal, the volume of water that is necessary to achieve this is in addition to the 110% containment capacity that is required.
5. If 2 or more categories of containers of different capacities (as described in Regulations 10.31, 10.32, and 10.33) are held at 1 place, the PCBU must ensure that the secondary containment system has a capacity of at least the sum of each container category [Regulations 10.30(3), 12.13(3), 12.38(3), 13.30(3)].
6. If a stationary container system comprises above-ground stationary containers, 1 or more of which have a capacity of at least 250 litres, the capacity of the secondary containment system for the stationary container system must be at least 110% of the capacity of the largest container [Regulation 17.100(1)]. A

reduction in the capacity of the secondary containment system for stationary tanks can be approved upon application to WorkSafe or permitted if the secondary containment system is designed in accordance with a relevant safe work instrument. This reduced capacity must not be less than 100% of the capacity of the largest container located within the secondary containment system [Regulation 17.100(5)].

7. The secondary containment system should have a minimum containment volume of 20 minutes fire-fighting water/foam at the design rate of application in addition to containing a spill from the largest container. This calculated volume of water must be available onsite or available from a minimum of 2 fire hydrants within 135m of the site.

3.4 Maximum Capacity of Secondary Containment System - Class 3.1 substances

The aggregate quantity of flammable hazardous substances that may be held in a secondary containment system must not exceed 75,000,000 litres. This may be increased up to a maximum of 120,000,000 litres upon application to WorkSafe.

If the aggregate quantity of flammable liquid which is to be held within a secondary containment system is greater than 25,000,000 litres and the storage is in more than one stationary container, the stationary containers must be divided into groups. This quantity may be increased up to 40,000,000 litres upon application to WorkSafe. Each group must be separated from all other stationary containers within the secondary containment system by an intermediate secondary containment system.

The capacity of the intermediate secondary containment system must be at least 50% of the capacity of the largest stationary container within that group. The walls that form the subdivision of the secondary containment system must be at least 250mm below the top of the lowest wall of the secondary containment system in which it is located.

The intermediate secondary containment system will limit the impact of a minor spill from a single container. These spills are contained around the container that failed, thereby reducing the impact from allowing the spill to spread over a wider containment area. If the spill cannot be stopped and the quantity in the container is greater than the capacity of the intermediate secondary containment system, then the spillage will cascade into the secondary containment system.

The legislation that applies in this Section is:

Secondary containment systems for storage of class 3.1 substances in above-ground stationary tank - Regulation 17.102

Increased capacity of tanks in secondary containment systems - Regulation 17.103

Increased aggregate capacity for groups of stationary tanks - Regulation 17.104

3.5 Design

A PCBU has a duty to ensure, so far as is reasonably practicable, that they provide and maintain safe secondary containment systems [HSWA, s.36(3)(b)].

Factors to consider for secondary containment systems include:

- The secondary containment system is designed, constructed and maintained to hold the substance
- Materials used to construct the secondary containment system are compatible with the substance stored, that is, have adequate chemical, corrosion and flame resistance
- The strength of the secondary containment system is adequate to retain the substance when the secondary containment system is full. The walls of the secondary containment system are able to withstand the hydrostatic pressure from the contained liquids. Consideration should be given to hydraulic forces that may result from sudden container failure together with any waves that may be generated
- Stationary tanks require secondary containment systems for the life of the storage tank. If the initial secondary containment system is not designed for the lifetime of the tank, it must be repaired or replaced prior to its failure
- The system has durability for all foreseeable circumstances (see Section 3.7 of these Guidelines)
- Connections between a compound wall and the floor of the compound must be adequately sealed. This could include (non-exclusive):
  - continuous pour from floor to wall, or
  - inserted leak stop barriers, or
  - a continuous earthen layer. Refer to Appendix 4 for examples.
- Incompatible substances must be prevented from adversely affecting each other. Incompatible substances stored in stationary tanks must have separate secondary containment systems. This does not prevent dilute substances whose only action is to neutralise each other with minimal rise in temperature from being located in the same compound [Regulations 10.5, 13.28, 17.24]
- For secondary containment systems about stationary tanks, the capacity requirements of Section 3.2 of these Guidelines must be complied with
- Drainage from the secondary containment system is to be controlled
- Consideration should be given to implementing means of early detection of a leak of hazardous substances into the secondary containment system, for example, detector at the low point in the secondary containment system
- The secondary containment should be a sufficient to contain the required maximum expected loss of containment of hazardous substance
- Additional secondary containment capacity should be installed to ensure the maximum rainwater accumulation (based on local meteorological data) based on the frequency that the secondary containment will be checked and emptied of rainwater
- Consideration is to be given to avoiding penetrations through the secondary containment walls and floors. Where penetrations are necessary, the provisions of Section 4.13 of these Guidelines are to be complied with
- A plan is to be available to recover the substance released into the secondary containment system. All necessary equipment to achieve this should also be available (part of the emergency response plan)
- Where packages are stored, it may be necessary for the compound to have sloping ramps to allow vehicle

access, such as fork lift trucks.

3.6 Capture of spillage

The secondary containment system is to be located so as to be able to capture a spillage from the primary container for all credible failure modes. Options to achieve this include:

1. Locating the storage container such that the top inside edge of the secondary containment system perimeter is inside the crest locus specified in Appendix 12, unless it can be demonstrated that a reduced distance would be suitable due to viscosity or other factors.
2. While Option 1 is preferred, splash shields could be fitted about the tank in circumstances where:
    - only non-flammable substances are stored in the storage container and in other containers in the same compound, and
    - it is not possible to ensure that a leak will fall into the compound, and
    - there are no circumstances whereby the shielded portion of the tank wall may require water cooling, and
    - the tank is sufficiently distant from the bund wall that a catastrophic failure of the tank will not spill over the bund wall and the bund wall can withstand the hydraulic loads from a catastrophic tank failure, or there is containment capacity outside of this portion of the bund.

    Appendix 13 provides an example of this.

A failure that results in jetting could lead to the contained substance being projected over the secondary containment system wall. Therefore, for sensitive sites, potential jetting should be considered and addressed. Refer to Appendix 12 for a methodology. In this context, sensitive sites are those which will result in consequences, such as environmental damage or human harm, if the contained substance escapes outside the secondary containment system.

In circumstances where maintenance about the tank or water cooling of the tank is required, sufficient clearance needs to be available between the tank and the inside of the secondary containment system perimeter.

3.7 Secondary containment system durability

The potential consequences should a secondary containment system containing hazardous substances fail should be considered in the bund design phase.

The secondary containment system must be designed and constructed to withstand all foreseeable events. This includes seismic activity. The secondary containment system should be designed to withstand a seismic event, that is, it should be able to withstand the seismic event in the unloaded state and be able to retain the contents of the damaged containers subsequent to the seismic event. In the event that liquefaction can result in land movement, this should also be designed for.

Design criteria for the secondary containment system in the unladen state should exceed the stationary tank design criteria, so that it can provide effective containment if the stationary tank fails due to seismic activity. The secondary containment system in the laden state should be able to withstand aftershocks so the secondary containment system in the laden state should be designed to the same criteria as the stationary tank.

New secondary containment systems for stationary tanks should have a statement from a competent person to:

1. demonstrate the design integrity and
2. demonstrate the foundation details

Hydraulic forces arising from the catastrophic failure of a tank can lead to wave action. This can result in significant hydraulic force and also a significant wave height. While some spillage over top of a secondary containment system may be inevitable, the design of the walls and adjacent tertiary containment should provide for mitigation and control of these effects so far as is reasonably practicable.

The secondary containment should be designed to the most up-to-date structural design and construction standards and codes to ensure it is fit for purpose over its design life.

Relevant standards of design and construction include (but are not restricted to):

- NZS 3101 Concrete structures standard
- NZS 3106 Design of concrete structures for the storage of liquids
- NZS 4203 Code of practice for general structural design and design loadings for buildings.

4 Further principles

4.1 Compounds

Compounds are a common form of secondary containment system. Examples of compounds are included in the Appendices to these Guidelines.

The publications CIRIA C598, CIRIA R163 and CIRIA C736 provide further information on compounds.

4.2 Containment below stationary tanks

Consideration needs to be given to the ground and details underneath above-ground tanks to detect leaks and capture any substance that may leak through the bottom of the tank. This is a particular requirement for vertical cylindrical above-ground tanks with flat bottoms.

The standard API 650 in Appendix I – *Underground Leak Detection and Subgrade Protection* provides acceptable construction methods for the detection of leaks through the bottoms of above-ground stationary tanks and Appendix 11 of these Guidelines provides an example.

4.3 Impounding basin

Where site restrictions make it impossible to construct an adequate secondary containment system directly around a stationary tank, the secondary containment system may be connected by piping or ducting to an impounding basin. The impounding basin needs to be constructed with the same degree of integrity as the initial secondary containment. Refer to Appendix 7 of these Guidelines for an example.

4.4 Flammable and oxidising substances

Secondary containment systems for flammable substances should be designed to minimise the surface area of the spill/fire size so far as is reasonably practicable.

A fire in a secondary containment system containing flammable substances is a foreseeable event and the secondary containment system needs to be designed on this basis. The secondary containment system is to be designed to retain its structural integrity and withstand such a fire. Furthermore, the secondary containment system design needs to ensure that a fire occurrence in the secondary containment system, the transfer route or impounding basin does not endanger neighbouring facilities, particularly, protected places.

Flammable substances can create hazardous areas. Such areas can be present in compounds for flammable substances. These areas must be delineated and controls put in place. Refer to AS/NZS 60079.10 for the classification of hazardous areas [Regulation 10.6].

Also PCBUs should ensure that:

- buildings are adequately vented, and
- where possible, spillages in buildings are piped via a trap to an outside sump.

Where there are secondary containment systems for flammable and oxidising substances or organic peroxides, energy sources or incompatible substances capable of igniting the substances or causing them to thermally decompose must be excluded or where it is necessary for such items to be in the secondary containment system they must be suitably rated for the hazardous areas.

It is important that there are no materials in the compound which are incompatible with the substance being stored. As an example, when substances such as peroxides are being stored, the compound must be free of organic material such as wind-blown leaves and debris

[Regulations 10.30(4), 12.13(4), 12.38(4), 17.99(4)].

4.5 Compatibility

4.5.1 Compatibility of substances

Hazardous substances that react with other substances must have separate secondary containment systems so that the substances do not come into contact with each other. Incompatible materials must also be prevented from coming into contact with the hazardous substance. This includes any spillage route within the secondary containment system. The site inventory must identify the incompatible substances on the site.

Refer also to Section 3.5 of these Guidelines.

When substances are classified as incompatible, they must not be stored in the same compound, and segregation distances must be applied. Furthermore, water-reactive substances must be protected from water. This extends to reaction with fire-fighting mediums.

Schedule 9, Table 1 of the Regulations specifies substances that are incompatible with class 2, 3 and 4 substances; Schedule 10, Table 3 has a table of separation distances for substances that are incompatible with substances with 5.1.1A; 5.1.1B; 5.1.1C and 5.1.2A hazard classifications; and Schedule 15 specifies substances that are incompatible with class 6.1A, 6.1B, 6.1C, 8.2A, 8.2B, and 8.2C substances.

AS/NZS 3833:2007 Figure 6.1 has a useful segregation matrix for storage areas.

The legislation that applies in this Section is:

Separation of chemically incompatible substances - Regulation 17.24

Class 2, 3 or 4 substances - Regulations 10.1, 10.5, 10.30

Class 5.1.1 substances - Regulation 12.13(4)

Class 5.2 substances - Regulation 12.38(4)

Class 6 or 8 substances - Regulation 13.30(4)

Inventory - Regulation 3.1

4.5.2 Compatibility of secondary containment system

A PCBU who installs, constructs, or commissions a secondary containment system has a duty to ensure, so far as is reasonably practicable, that the system is without risks to the health and safety of workers or others [HSWA s.43].

This means that the material which the secondary containment system is constructed from must not be adversely affected by the substance stored inside it. It may be necessary to coat the secondary containment system to achieve this, for example, coating it with fibreglass to achieve corrosion resistance for a class 8 substance.

Substances with a 3.1 hazard classification are susceptible to ignition when spilled into a secondary containment system and consideration must be given to the materials of construction to withstand this scenario. This applies particularly to substances with 3.1A, 3.1B or 3.1C flammable classification which, by their very nature, have relatively low flash points. The secondary containment systems for these substances with 3.1A, 3.1B or 3.1C flammable classification must be constructed from materials that maintain their structural integrity in a fire. Metals such as steel, stainless steel and aluminium must not be used to form the secondary containment system where substances with these hazard classes are present. It is recognised however that such materials may be necessary for requirements such as to assist with protection of fire-resistant sealants.

Some hazardous substances are stored at elevated temperatures. In these scenarios consideration must be given to the materials of construction of the secondary containment system to ensure it retains it characteristics at these elevated temperatures.

4.6 Compound access

Secondary containment systems must have safe exit routes. Where access is required into a secondary containment system for maintenance or operational work, there must be uncomplicated access and egress. Where the walls of secondary containment system cannot be stepped over, egress routes needs to be provided, for example by steps or stairs.

For larger storage areas and buildings/warehouses, sufficient safe exit routes need to be provided to ensure that a loss of containment does not prevent egress from the secondary containment system.

4.7 Drainage

4.7.1 Slope away from container.

The floor of a compound around a stationary tank should be sloped away from the storage container. This does not imply that it is sloped away from the container in all directions, for example, other sections of the compound floor may slope towards the tank in question and this may then flow to a lower section of the compound. Tank bases should be constructed at an elevation above the compound floor.

4.7.2 Secondary containment system drains

PCBUs need to ensure that water does not accumulate in a compound. The compounds are to be periodically drained to minimise this accumulation and the compound needs to include a method for draining this water when needed, for example, a normally closed valve at the lowest point.

Secondary containment systems storing a highly toxic substance, that is with 6.1A, 6.1B or 6.1C hazard classifications, must not have drains to open areas unless the PCBU is certain that the discharged water is not contaminated with the hazardous substance. Drains to sump systems must be compatible with the chemical being stored.

The piping should be subjected to an integrity test at the time of construction. Any seals where piping is joined, for example to sumps etc., must also be compatible with the substances involved.

The legislation that applies in this Section is: Class 6 substances – Regulation 13.30(4)

Duty of PCBU who installs, constructs, or commissions plant or structures HSWA s.43

4.7.3 Site drains

PCBUs need to consider drainage systems through the site. This may mean providing separate drainage from the site for:

- areas continuously contaminated
- areas able to be accidentally contaminated
- storm water.

The division of areas of the site and the drainage systems on this basis, can optimise the focus on areas which may be contaminated with the hazardous substance, thereby avoiding having to treat large volumes of rainwater that have become contaminated.

Drainage from secondary containment systems, whether by gravity or pumping, needs to be controlled. The quality of the material being drained should be monitored and only released to public drain systems when it is compliant with the requirements of the territorial authority, otherwise the drained material requires collection for treatment and disposal or re-use. Manual control may be necessary, especially for water-miscible substances, such as alcohols, aldehydes and ketones.

Care should be taken with concentrated acids as they may result in an exothermic reaction when coming into contact with water.

The drainage system, if accessible to unauthorised persons, needs to be kept locked. This requirement can be met by locking the outlet valve in the closed position. Where gravity draining is used, the status of the valve position should be clearly obvious. It is good practice to place a sign at each drain position stating that the valve/s must be kept closed unless under supervision.

Site operation procedures should define disposal routes for contaminated content. Drainage water from the secondary containment system of sites storing hydrocarbons should be passed through an interceptor or separator to ensure the hydrocarbons are trapped.

4.7.4 Rain proofing

Where it is practicable, PCBUs of sites that utilise compounds as a means of secondary containment should consider rain proofing the compound. This will minimise the requirements for draining it.

4.7.5 Water

If it is not possible to establish whether the water in a compound is contaminated by looking at it, the water should be tested prior to being discharged. If the water is polluted it should be disposed of in a manner that does not affect the environment.

4.8 Unavoidable wastage

Where wastage is unavoidable, the disposal of the unrecoverable material must comply with the Hazardous Substances (Disposal) Notice 2017. There may also be a requirement to comply with the RMA and any resource consent.

4.9 Substances that are toxic, corrosive or ecotoxic

Secondary containment systems for substances that are acutely toxic or very ecotoxic must be impermeable, that is Section 4.11, of these Guidelines is not applicable. For the purposes of this Section, acutely toxic substances are those with a 6.1A or 6.1B classification and very ecotoxic are those with a 9.1A classification.

For concrete compounds this may mean the application of a suitable surface coating resistant to the hazardous substance. Consideration should be given to treating the concrete with penetrating synthetic resin or a similar suitable system that is compatible to the final surface coating, before that surface coating is applied.

Where toxic or biologically corrosive substances are to be contained, people must be prevented from being directly exposed to them.

The legislation that applies in this Section is:
Class 6 substances - Regulation 13.30(4)

Controls on class 6 or 8 substances Regulation 17.99(4)(c)

4.10 Use of secondary containment systems for other purposes

The interior of a secondary containment system that is occupied by tanks is to be limited to the tanks and the necessary related equipment, such as piping, valves, dewatering tanks equipment etc. Substances in packages are not to be located in secondary containment systems for stationary tanks. Similarly, the secondary containment system is not to be used for the storage of gas cylinders full or empty.

4.11 Permeability rates for flammable liquids

A secondary containment system for flammable liquids must be impervious to the class 3.1 substance it contains; and must be fire resistant. [Regulation 17.102(2)].

These requirements may be met by having a barrier that is sufficiently thick to:

- prevent the passage of the flammable liquids from passing through the membrane until such time as the substance is removed from the secondary containment system or an alternative action is initiated to inhibit the passage of the substance, for example implementing a water bottom, and
- restrict the seepage rate while under full hydrostatic head. The water seepage rate at full head is to be no greater than 1 mm/hour, (See Section 7.1.2 for information on periodic compound tests), and
- avoid localised seepage. In particular, localised seepage into an earthen compound wall must be avoided as this may fluidise the wall mass and result in sudden rupture.

The water seepage rate may be calculated from the Darcy Equation. See Appendix 6 for details on the Darcy Equation and permeability rates of hydrocarbons through compound floors of high clay index layers

When constructed of low permeability materials (for example, clay) the top of the compound wall should be at least 300mm wide and if the wall height is greater than 750mm, the top width should be more than 600mm. Where earth is placed to form the compound wall, it should not have a slope greater than 1m in 1m.

Sites in use prior to 1 July 2006 are able to have approved compliance plans which may accept seepage rates different from those above. However, where major works are undertaken on the compound, or new tanks are added into the secondary containment system, these compliance plans are typically invalidated. In these circumstances, the secondary containment system (or intermediate secondary containment system) is to be upgraded to the current standard.

Some hazardous substances, for example, cut back bitumen have a viscosity that is sufficiently high that a specifically engineered geotextile membrane is not required.

4.12 Penetrations through compounds

Consideration should be given to avoiding penetrations through compound walls and floors. Where a penetration is necessary, it is to be constructed so that:

- the penetration does not threaten the structural integrity of the compound or its impermeability.
- where pipe work is required to penetrate the compound wall, it is sealed and supported.
- where pipe work is required to penetrate the compound floor, it is sealed.
- where flammable substances are stored, the seals are fire resistant. The seals may need to be protected by a covering such as a metal plate.
- earth rods, pipe sleepers and other support footings are sealed through the compound floor. Setting into a poured bentonite clay mix may suffice for clay compounds.

Examples of penetrations are included in Appendix 5 and Appendix 10 of these Guidelines.

4.12.1 Crevice corrosion

For certain arrangements of bund penetrations there is a higher possibility of crevice corrosion between the pipe and the sleeve packing. Pipe protective coatings and materials should be carefully selected and regular inspections should be carried out to ensure that protective coatings and seal arrangements remain in good condition and corrosion of the pipe is not taking place.

This means that the ability to conduct ongoing maintenance and integrity checks should also be considered in the design phase.

4.13 Substances that degrade with age

Some substances can change their hazard characteristics with age, or can lose their desensitising or inerting characteristics. These require careful documentation and management and the secondary containment system must be compatible with all phases of the substances. This is especially so for desensitised explosives or substances that degrade to oxidisers over time.

4.14 Storage inside buildings

When planning the use of a building for the storage or retail sale of hazardous substances that require a secondary containment system, each substance must be catalogued in an inventory list. The HSWA requirements, including the secondary containment requirements, for the aggregate of the substances in the building is then able to be determined.

4.14.1 Buildings that store hazardous flammable liquid

Particular care must be taken if it is intended to store or use flammable liquids inside buildings; the building must be constructed to a prescribed type, must be sited to comply with prescribed separation distances, must have hazardous areas, and may be required to have secondary containment systems. Stationary tanks used to store flammable liquids should not be located in a building.

Where flammable storage inside a building is required to be vented, this needs to be vented outside the building.

The legislation that applies in this Section is:
Secondary containment for class 3 and 4 pooling substances - Regulations 10.30, 10.31, 10.32, 10.33

Storage of packages holding class 3.1 substance in a store in a building - Regulations 11.13, 11.31

Storage of containers of more than 60 litres of class 3.1A, 3.1B, or 3.1C substances - Regulations 11.14, 11.34

Storage of class 3.1 substances in retail stores - Regulation 11.32

Storage of class 3.1B and 3.1C substances in retail shops - Regulation 11.33

4.14.2 Example of a typical internal store

This store has a surrounding nib wall with entrance ramps and contoured floor. The centre drain slopes to an internal sump where it can be pumped out. The store is attached to a retail shop and has electronic keyed entrance.

4.14.3 Buildings that store incompatible substances

Incompatible substances must be segregated in accordance with the provisions of Section 4.5 of these Guidelines. One form of secondary containment is for incompatible material to be stored on separate racks with "grate-over channel" drains all around the rack. The total volume of the drain is to meet the secondary containment capacity requirement for the maximum amount of stored liquid and substances that liquefy in a fire, for each storage rack. Each drain system must be kept segregated from each other for this type of control.

Another form of secondary containment is to install berms around the segregated storage areas.

4.14.4 Fire-fighting design for buildings

When designing the layout of a secondary containment system within a building, consideration should be given as to how a fire is to be combatted. For example, if using water fog nozzles to push the fire towards a corner is the intended method, an aerosol display stand that would be engulfed should not be located in this area. A competent person[3] should be consulted prior to the design and establishment of hazardous storage areas within buildings.

The US National Fire Protection Association Flammable and Combustible Liquids Code (NFPA 30) provides an extensive guideline for fire-fighting considerations when storing flammable substances inside buildings. It includes drainage through traps to remote secondary containment, containment sills or ramps, as well as guidelines for heights of racks and stacked storage.

Consideration should be given to the management of fire-fighting water. A compound should have the capacity to contain 20 minutes of fire-fighting water/foam at the design rate of application in addition to containing a spill from the largest container. This calculated volume of water must be available onsite or available from a minimum of 2 fire hydrants within 135m of the site.

4.14.5 Buildings holding substances that are required to be kept cool.

Hazardous substances that are required to be kept cool need to be located where that requirement is met.

4.14.6 Rooms where flammable liquids are in open containers or are being used

Rooms where flammable liquids are being used or are held in one or more containers, one or more of which is open must be held in a Type 1, Type 2 and Type 3 workroom or a paint-mixing room that complies with AS/NZS 4114.1:2003.

The secondary containment system capacity for workrooms must be at least 100% of the total pooling potential. This is applicable irrespective of the quantity contained, that is, there is no minimum threshold quantity.

The legislation that applies in this Section is: Workroom requirements - Regulations 11.1, 11.16, 11.36

4.14.7 Harmful or flammable vapours

Where practicable, the drainage from indoor secondary containment systems of substances with flammable or toxic vapours should be piped via traps to holding vessel/s or sump/s in a safe location. The sump may form part of the volume calculation of the required secondary containment capacity. Incompatible substances must not share the same secondary containment system [Regulation 17.24].

[3] In this context a competent person means a person who is skilled and experienced in this activity, such as a fire engineer, or the Fire Engineering Unit of the Fire and Emergency New Zealand.

4.15 Outdoor storage for packages

Outdoor storage buildings for packages of liquid hazardous substances, for example, drums, must meet the requirements for secondary containment where the threshold for secondary containment has been exceeded (refer Appendix 1). If they are flammable, the buildings must also be installed in compliance with the location requirements of Part 11 of the Regulations.

4.15.1 Outdoor storage under shelter

Consideration should be given to covering outdoor package stores, for example by roofing over, to minimise rainfall into the secondary containment system. This has the benefits of

- minimising contamination of rain water from localised spills, thereby reducing the cost and effort to maintain the secondary containment system and the drainage from it, and
- preventing the pooling of rain water and thus maintaining the capacity of the secondary containment system.

4.16 Transportable bulk containers – Including IBCs

These containers are designed for transporting substances in bulk. They may be stored awaiting transport or for the purpose of discharging their contents. The requirements for secondary containment must be complied with at the location of these containers.

Some transportable bulk containers have an integrated secondary containment system, for example, a double skin containment system, which may be utilised while the container is being held and discharged. The design and construction of the integral containment system is required to support the total load of the transportable bulk container and is not to be subject to weakening from being contacted by the hazardous substance that is contained.

4.17 Tertiary containment systems

Catastrophic multiple container failures or the use of water for fire protection purposes may result in overwhelming the secondary containment system. Where this is a possibility, consideration should be given to providing tertiary containment to prevent harm to the public or the environment. This can be provided by raised earthen mounds, depressions, or hard paved areas with nib walls. Portable deployment systems may also be used such as inflatable pools and tubes, or sand bags to create compounds on hard paved areas.

Tertiary containment systems can be used to:

- minimise the consequences of a major incident that overwhelms the secondary containment system
- contain fire-fighting water that is contaminated with hazardous substances. There should be allowance for controlling run-off of fire-fighting water where contamination is likely from oil, chemicals, fire-fighting foams and combustion sediments, etc. In these circumstances the run-off may be contaminated with fire-fighting foam where otherwise immiscible liquids are entrained and solubilised to the point they may flow through an interceptor. The run-off should be controlled until it can be rendered safe for discharge or is recovered
- increase the time available for response. This is particularly useful for remote and/or unmanned locations.

The arrangements of a tertiary containment system must not frustrate access for emergency services to the site. Appendix 14 provides examples of tertiary containment systems.

4.17.1 Types of tertiary containment

Types of tertiary containment include:

- Storage tanks where the size is practical.
- Car parks and similar areas designed with ramps, portable deployment boom or barriers to provide a ponding area.
- Permanent lagoons (Storm Basins).
- Perimeter drainage systems controlled via a shut-off valve – an example of this is depicted in Appendix 19.

Where a site or building has an impermeable mound or ramp built around it for tertiary containment, care should be taken to ensure this does not become a hazard for use of other buildings or equipment.

4.17.2 Tertiary containment as auxiliary fire-fighting water supply

Where tertiary containment is provided to capture fire-fighting water run-off, for example, storm basins, the potential may exist for fire pumps to take water from this containment area thereby reducing the overall volume of liquid to contain.

4.17.3 Fire-fighting run-off pollutants

The polluting effects of fire-fighting water run-off, related to both surface water and groundwater, can be due to one or more of the following (amongst others):

- direct toxicity and ecotoxicity including metals
- a change in Biological Oxygen Demand (BOD)
- a change in Chemical Oxygen Demand (COD)
- suspended solids lowering water quality and disrupting waterway ecology
- a change in pH.

Diluting the fire-fighting water run-off does not remove contamination and the makeup of the contamination may not be able to be treated by standard waste water bio-treatment or interceptors.

PCBUs should consider the amount of contaminated fire-fighting water that will be generated in accordance with the emergency response procedures to the fire, how much containment is required and what can be used as containment.

4.18 Compounds and fire controls

A PCBU who installs, constructs, or commissions a secondary containment system has a duty to ensure, so far as is reasonably practicable, that the system is without risks to the health and safety of workers or others [HSWA s.43].

This means that compounds for flammable substances must:

- have fire-resistant structural integrity, including joints and pipe work penetrations.
- have a plan which specifies the management of fire-fighting water, for example, have a means of removing fire-fighting water from below the surface of the liquid in the compound for substances that are not miscible with water and which have a lower density than water. This may be via a permanent structure (preferable) or the emergency response plan may specify how to form it.
- have traps on below ground drains.

- where flammable substances are stored, have adequate access around the perimeter of the compound for fire appliances.

In addition to these, consideration should be given to the management of fire-fighting water. The compound should have the capacity to contain 20 minutes of fire-fighting water/foam at the design rate of application in addition to containing a spill from the largest container. This calculated volume of water must be available onsite or available from a minimum of 2 fire hydrants within 135m of the site.

4.19 Secondary containment for pipework

Where a hazardous substance is contained in pipework that is installed and operated so as to manage any loss of containment in the pipework, that hazardous substance:

- does not need to be taken into account in determining whether a place is required to have secondary containment, and
- is not required to be located in a secondary containment system. [Regulation 10.30(5)].

4.20 Housekeeping

Secondary containment systems should be maintained in a tidy state. Compounds should be regularly cleared of rubbish and other extraneous material. No combustible or incompatible material, such as vegetation, litter or rubbish, should be allowed to accumulate in the bund.

Spillages of material within the compound should be cleaned up immediately.

After rainfall, the compound should be emptied as soon as possible to maintain full capacity.

Secondary containment systems for tanks must not be used for the storage of packages, gas cylinders (full or empty) or other hazardous substances.

There must be instituted or capable of being instituted in respect of a secondary containment system, controls that—

- if flammable liquids, oxidising substances or organic peroxides must be contained, exclude any energy source capable of igniting them or causing them to decompose thermally; and
- if toxic or biological corrosive substances must be contained, prevent people from being directly exposed to them; and
- ensure there are no incompatible materials in the secondary containment system for example – oxidising substances and peroxides can react with organic material including wood chips and wind-blown debris. Such material must be excluded, and
- prevent the substances retained from being contaminated by incompatible substances and materials.

The legislation that applies in this Section is: class 3 or 4 substances - Regulation 10.30(4), 17.99(4)
Class 5,1,1 substances - Regulation 12.13(4)
Class 5.2 substances - Regulation 12.38(4), 17.99(4)
Class 6 or 8 substances - Regulation 13.30(4), 17.99(4)

5 Specific sites

5.1 Storing less than 1000 litres of fuel

Secondary containment is not required if E10, E85, petrol, aviation gasoline, or racing gasoline is stored in a total quantity of less than 1,000 litres. [Regulations 10.30(6)(a); 17.99(6)(a)]

5.2 Farm tanks

On a farm of not less than 4 ha in area, secondary containment is not required:

- where E10, E85, petrol, aviation gasoline, racing gasoline or kerosene is stored in a total quantity of less than 2500 litres, or
- where diesel that is used for farm work is stored in a total quantity of less than 2500 litres, and it is located so that any spillage will not endanger any building, or flow into, seep into or otherwise reach any water body including streams, lakes, or natural water.

In order to comply with these requirements:

- all containers should be maintained so that valves, hoses and dispensers do not leak, and
- in areas with light, free draining soils, for example pumice or sandy soils, the ground may need to be lined with an additional barrier that will prevent soakage into the soil.

The legislation that applies in this Section is: Secondary containment systems on farms - Regulation 17.99(6)(b), 17.99(6)(d)

5.3 Tanks installed prior to July 2006

Generally, if substances are held in tanks, 1 or more of which have a capacity of at least 250 litres, the capacity of the secondary containment system must be at least 110% of the capacity of the largest container [Regulation 17.100]

However, the requirements for tanks installed before July 2006 have been modified by the *Health and Safety at Work (Hazardous Substances—Management of Pre-2006 Stationary Container Systems up to 60,000 L) Safe Work Instrument 2017*.

See clauses 10, 13, 16, 20, and 23 of the safe work instrument for modifications of the secondary containment requirements for different types of above-ground stationary tanks in stationary container systems installed prior to July 2006.

5.4 Short-duration storage

Where E10, E85, petrol, aviation gasoline, racing gasoline, kerosene or diesel fuel is:

- stored in a total quantity of less than 2000 litres, and
- is contained in a tank wagon or in secure containers, each individual container with a capacity of less than 250 litres, and
- the duration of the storage is for a continuous period of less than 14 days,

secondary containment is not required if the fuel is located so that any spillage will not endanger any building, or flow into, seep into or otherwise reach any water body including streams, lakes, or natural water any natural water body.

In order to comply with this requirement all tanks should be maintained so that valves, hoses and dispensers do not leak, and in areas with light, free draining soils, for example, pumice or sandy soils, the ground may need to be lined with an additional barrier that will prevent soakage into the soil.

The legislation that applies in this Section is: Regulation 10.30(6)(c) and Regulation 17.99(6)(c)

5.5 Movable stationary tanks

Movable stationary tanks that do not have integral secondary containment are required to have suitable secondary containment systems. Where this secondary containment system is not attached to the frame of the stationary tank, a suitable system is a compound, the capacity of which must be at least 110% of the capacity of the largest stationary tank within it and where:

- the material used to form the compound is compatible with the substance being stored.
- where earth is used to form any compound wall, the wall has a minimum top width of 300mm and if the wall height is greater than 750mm, the top width is not less than 600mm. Where earth is placed to form the bund it is to have a slope not greater than 1m in 1m.
- where earth is placed to form a compound or bund, the earth is to be selected and appropriately compacted to form a layer that is impermeable to the substance being stored. It is not suitable to use loose or sandy loam in this circumstance.
- the interior of any compound is occupied only by the stationary tank or tanks, and such settling and measuring tanks, piping, valves and other necessary appliances. These additional facilities are not to be included in the volume calculations of the secondary containment system.
- no person may allow water to accumulate in the compound. Compounds are to be periodically drained to minimise the accumulation of water, for example, by means of an oil stop valve, by means of pumping or by means of a pipe carried through the wall of the compound at the lowest practicable point. For compounds that are manually drained, the pipe needs to be fitted with either a screw-in bung or a lockable valve which is to be kept in the closed position at all times except when draining off accumulated water.
- Where such compounds are in use or planned to be in use for more than 6 months, they are required to comply with the maximum allowable seepage rate specified in Section 4.12.

The legislation that applies in this Section is: Secondary containment for above-ground stationary containers - Reg 17.100

6 Evaluation and operation

6.1 Process safety

Businesses who design, manufacture, supply or install secondary containment systems must, so far as is reasonably practicable, make sure that the system is without risks to the health and safety of any person when they are used for their intended purpose in a workplace.

Risks must be evaluated at all phases of a project. Refer to Appendix 18 for further details.

A PCBU with management or control of a workplace where a secondary containment system is installed must manage the risk associated with the system.

They must also prepare an emergency response plan that describes and applies to all reasonably foreseeable emergencies that may arise from a breach or failure of the system.

7 Certification and Testing

7.1 Compound Testing

7.1.1 New Compounds

The construction of permanent new /upgraded secondary containment systems for above-ground storage should be verified by post-construction integrity testing. For compounds, the preferred method is a hydro test at full head. In this context;

- hydro test means testing with water, and
- full head means 100% of the capacity of the largest stationary tank within the compound,

Where:

- this is not practicable, for example, within a building or a tank in a chamber, or
- there are new/upgraded secondary containment systems for above-ground storage which are not permanent,

these may be assessed by a competent person[4] as an alternative option to this requirement.

In the context of this Section, a permanent facility is one that is intended to be in place for a period greater than 6 months.

Because large primary containers require a full hydro test for foundation compression stability and tank integrity prior to service, the testing of the new compound can often be combined with the primary container hydro test.

The criteria for the test are:

- No measurable loss, except for
- Earthen type compounds for hydrocarbons which should not exceed 1mm / hr level drop at full hydrostatic head.

The testing needs to be done after initial soaking into the membrane has occurred and the system has stabilised. Accordingly, a duration of 24 to 48 hours subsequent to filling and initial ground wetting is a typical test period.

Compound walls that become damp on the external face or toe of the compound during the test must be investigated and the significance of the dampness determined. Where the cause of the dampness may result in structural failure, it must be remedied.

If there is a failure, the compound must be repaired and a hydrostatic test repeated. It is not necessary to repeat the test for the complete compound if the repaired section can be isolated.

One method of undertaking measurements is to:

- use a stilling well arrangement to take height measurements, for example, a pipe with slots at the bottom, to avoid inaccurate measurements from waves and ripples that may occur.
- determine the evaporation loss/rainfall gain through a parallel measurement adjacent to the compound being tested using an open top vessel of known leak free integrity. This loss/gain is subtracted from/added to the

[4] In this context, a competent person is a person who is skilled and experienced in assessing the natural characteristics of the secondary containment system for example, a Chartered Professional Engineer.

liquid seepage loss to provide actual seepage rates.

A water level data logger is a useful instrument for monitoring the levels.

The results of the tests should be recorded and signed by a competent person[5]. A suitable form is included in Appendix 17 of these Guidelines. The full results of the loss rate should be made available to the HSWA compliance certifier.

7.1.2 Periodic compound testing

Flood test compound testing should be undertaken at least every 10 years and a technical inspection[4] should be undertaken at least every 5 years. A suitable process is:

- Flood the compound floor to within 50mm of the floor of the primary container. This can be water retained during heavy rain or water introduced into the compound. (Tank bases should be constructed to an elevation above the compound floor.) Monitor and record the results and scale them to the full compound head. The criteria are the same as in Section 4.11 of these Guidelines for new compounds.
- The technical inspection must include seals and joints.

In some circumstances it may be impractical to undertake a periodic hydro test. In these circumstances an alternative test that is at least equivalent should be undertaken. A risk based inspection (RBI) program may assist.

For large sites with multiple large compounds that have consistent design and construction, it is acceptable to conduct the periodic flood tests in representative compounds with verification checks and inspections in the other compounds. In this context, large compounds are those with a capacity in excess of 1,000,000 litres.

7.2 Compliance certificates

The compliance certification process, which is a requisite of HSWA, encompasses secondary containment systems. A secondary containment system is required to be verified for:

- a location compliance certificate, and
- a stationary container system compliance certificate in circumstances where a location compliance certificate is not required.

A compliance certifier may be located from the WorkSafe register of compliance certifiers: https://compliancecertifiers.worksafe.govt.nz/

7.3 Compound maintenance

7.3.1 Works being undertaken

Any works involving penetration of the permeability barrier must ensure the containment integrity is maintained according to the performance criteria.

Where these are minor works and localised, for example, localised pipe or earthing rod penetrations, the works must use recognised detailing practices. The detail of the works are to be documented and this documentation can be augmented by localised testing.

Where these works are moderate or significant, for example, rebuild of a section of the secondary containment

[5] A Chartered Professional Engineer or equivalent with experience in this activity.

system, re-founding of a tank or reconfiguring the compound, the integrity of the containment needs to be demonstrated upon completion of the works, for example, by undertaking a compound flood test. A test in accordance with Section 7.1.2 of these Guidelines will normally suffice but in circumstances where this will not test the works that have been undertaken, a test in accordance with Section 7.1.1 of these Guidelines may need to be considered. A consideration in determining whether a full head test is required is the impact on both the tanks in the compound and the long term under floor corrosion of tanks in the compound.

7.3.2 Ongoing monitoring of integrity

Secondary containment systems are a passive barrier but their condition still needs to be monitored to ensure their integrity. All operators should implement a periodic condition monitoring / inspection regime for their secondary containment systems. This can include visual inspections, checking bund penetrations for crevice corrosion etc.

Signs of failure of the bund integrity include wildlife burrowing in an earthen bund, cracking in a bund wall, sealant degradation etc.

Where this is undertaken as part of an inspection and test plan, the plan and frequency of future inspections should be adjusted accordingly when issues are noted.

8 References and Further Information

API 650	Welded Tanks for Oil Storage
API RP 2350	Overfill Protection for Storage Tanks in Petroleum Facilities
AS 1940	The Storage and Handling of Flammable and Combustible Liquids
AS 3780	The Storage and Handling of Corrosive Substances
AS 4326	The Storage and Handling of Oxidizing Agents
AS/NZS 3833	The storage and handling of mixed classes of dangerous goods, in packages and intermediate bulk containers
AS/NZS 4452	The Storage and Handling of Toxic Substances
AS/NZS 60079.10	Explosive atmospheres – Classification of areas – Explosive gas atmospheres (IEC 60079-10-1, Ed.1.0(2008))
BS EN 61511	Functional safety. Safety instrumented systems for the process industry sector
CIRIA C598	Chemical Storage Tank Systems – Good Practice https://www.ciria.org//ProductExcerpts/C598.aspx
CIRIA R163	Construction of Compounds for Oil Storage Tanks
CIRIA R164	Design of Containment Systems for the Prevention of Water Pollution from Industrial Incidents
NFPA 30	Flammable and Combustible Liquids Code
Buncefield Recommendations	***Safety and Environmental standards for fuel storage site*** final report by the Process Safety Leadership Group (PSLG): https://www.hse.gov.uk/comah/buncefield/fuel-storage-sites.pdf

9 Interpretation

Bentonite	means an absorbent aluminium phyllosilicate, generally impure clay that's absorbent swelling properties make it an excellent sealant
Compound wall	means an impermeable wall surrounding above-ground (or partially depressed) bulk storage tanks, or containers and which forms the initial boundary of a secondary containment system
Compound	in relation to the storage of a hazardous substance, means a basin, pit, excavation, hollow, or enclosure that is resistant to fire and— (i) is constructed of concrete, brick, clay, earth, or similar incombustible material; and (ii) is of such a nature and construction that it will effectively retain a hazardous substance that is a liquid if the hazardous substance leaks or flows out of its container Regulation 3
Containment	means prevention of a sites hazardous substance endangering the environment, or public outside of a site's boundary
Container	means (a) any receptacle, whether movable or fixed, in which hazardous substances or gases under pressure may be encased, covered, enclosed, contained, or packaged; and (b) includes— (i) a receptacle that forms an integral part of a vehicle (other than part of a vehicle's fuel system, electrical system, control system, or emergency system); and (ii) a stationary tank or a process container; and (iii) a package; and (iv) a supporting structure for a receptacle Regulation 3
HSWA	means the Health and Safety at Work Act 2015
Hydrocarbon fuels	means liquid hydrocarbon fuels, crude oils and bitumens

Intermediate secondary containment system	means a secondary containment system that is part of a larger secondary containment system
LoPA	means layer of protection analysis
Pooling substance	a hazardous substance that is a liquid; or is likely to liquefy in a fire Regulation 3
Primary container	means the container intended to hold the hazardous substance
RMA	means the Resource Management Act 1991
Secondary containment system	in relation to a workplace, means a system or systems— (a) in which pooling substances held in the workplace will be contained if they escape from the container or containers in which they are being held; and (b) from which they can, subject to unavoidable wastage, be recovered. Regulation 3
Regulations	means the Health and Safety at Work (Hazardous Substances) Regulations 2017
SIL	means Safety Integrity Level: a formal risk assessment process.
Tertiary containment	means a system that will prevent leak to the environment in the event of overflowing the secondary containment system
Total pooling potential	in relation to a workplace or a place within a workplace, means the aggregate quantity of all pooling substances present at the workplace or place Regulation 3
Type 1 workroom	Type 1 workroom means a building or room— (a) where hazardous substances are held in open containers or used; and (b)that is constructed in accordance with the following: (i) the floor, walls, and ceiling have a minimum fire-resistance rating of 60/60/60 minutes: (ii) every door opens towards the outside of the building or room, is self-closing, and has a fire-resistance rating of at least -/60/60 minutes: (iii) every window in the building or room complies with NZS 4232.2:1988; and

	(c) that is not occupied either in whole or in part as a dwelling; and (d) that has a secondary containment system with a capacity of at least 100% of the total pooling potential. Regulation 11.1
Type 2 workroom	type 2 workroom means a building or room— (a) where hazardous substances are held in open containers or used; and (b) that is constructed in accordance with the following: (i) the floor, walls, and ceiling have a minimum fire-resistance rating of 120/120/120 minutes: (ii) every door opens towards the outside of the building or room, is self-closing, and has a fire-resistance rating of at least -/120/60 minutes: (iii) every window in the building or room complies with NZS 4232.2:1988; and (c) that is not occupied either in whole or in part as a dwelling; and (d) that has a secondary containment system with a capacity of at least 100% of the total pooling potential Regulation 11.1
Type 3 workroom	type 3 workroom means a building or room— (a) where hazardous substances are held in open containers or used; and (b) that is constructed in accordance with the following: (i) the floor, walls, and ceiling have a minimum fire-resistance rating of 240/240/240 minutes: (ii) every door opens towards the outside of the building or room, is self-closing, and has a fire-resistance rating of at least -/240/60 minutes: (iii) every window in the building or room complies with NZS 4232.2:1988; and (c) that is not occupied either in whole or in part as a dwelling; and (d) that has a secondary containment system with a capacity of at least 100% of the total pooling potential Regulation 11.1

Unavoidable wastage	means the loss of a substance from a spill that a) is unrecoverable, for example, due to evaporation or seepage into the containment system surfaces or sealing membranes, or b) as a result of a spill has become contaminated such as to be unusable.

Appendix 1: Threshold quantities for secondary containment

Reproduced from Schedule 9, Table 9; Schedule 10, Table 5; Schedule 11, Table 7; Schedule 16; of the Health and Safety at Work (Hazardous Substances) Regulations 2017

Hazard Classification	Quantity (Litres)
3.1A	100
E10, E85, petrol, aviation gasoline, or racing gasoline	1000
3.1B	1000
3.1C, 3.1D	10,000
3.2A, 3.2B, 3.2C	100
4.1.2A, 4.1.2B	50
4.1.2C, 4.1.2D	100
4.1.2E, 4.1.2F, 4.1.2G	100
4.1.3A, 4.1.3B, 4.1.3C	100
4.2A	100
4.3A	100
4.3B	1,000
4.3C	10,000
5.1.1A	50
5.1.1B	500
5.1.1C	5,000
5.2A, 5.2B	10
5.2C, 5.2D	25
5.2E, 5.2F	100
6.1A, 6.1B, 6.1C	100
6.1D, 6.5A, 6.5B, 6.7A	1,000
6.6A, 6.7B, 6.8A, 6.9A	10,000
8.2A	100
8.2B	1,000

8.2C, 8.3A	10,000
9.1A	100
9.1B, 9.1C	1,000
9.1D	10,000

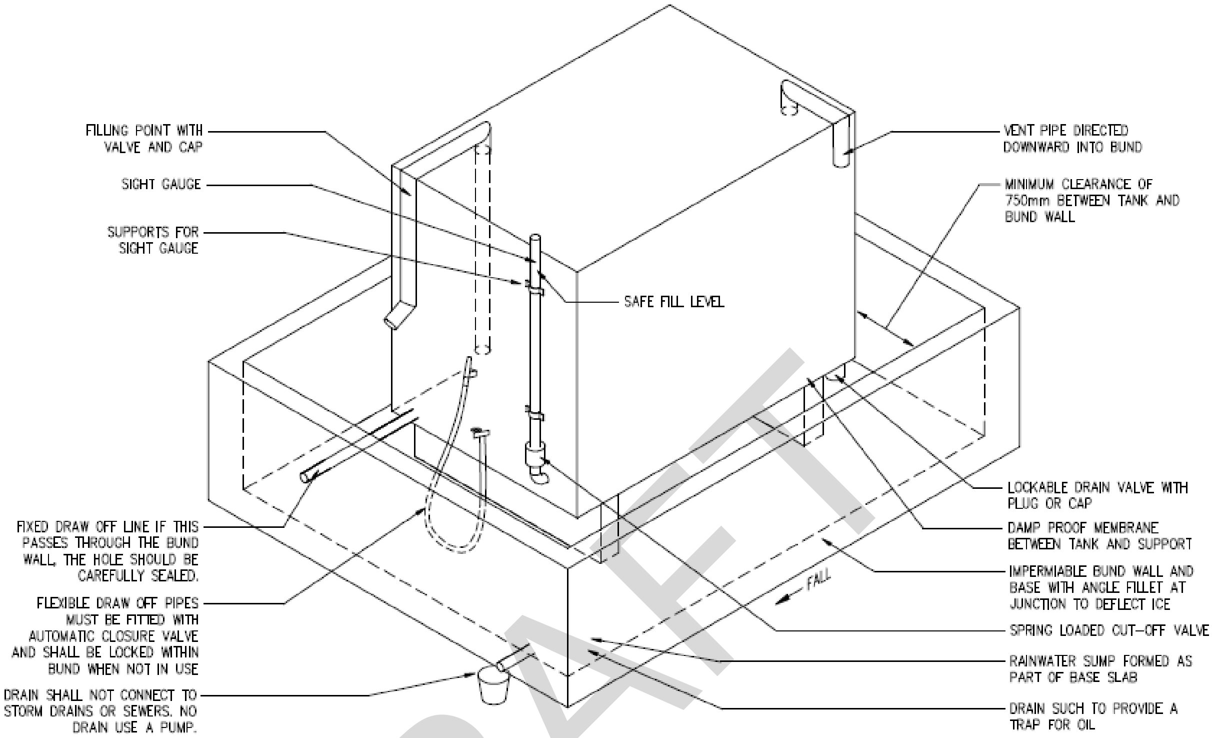
Some substances have variations associated with secondary containment systems as prescribed in:

- Regulation 10.30(6)(b) for E10, E85, petrol, aviation gasoline, racing gasoline, kerosene or diesel fuel stored on a farm, and
- Regulation 10.30(6)(c) for E10, E85 for petrol, aviation gasoline, racing gasoline, kerosene or diesel fuel stored for temporary use, and
- Regulation 10.30(6)(c) for E10, E85, petrol, aviation gasoline, or racing gasoline, setting the threshold quantity as 1000 litres, and
- Regulation 13.31(2) for substances which do not have a class 1 to 5 hazard classification, and
- Regulations 17.102 and 17.103 for the storage of large quantities of flammable substances in bulk. This specifies maximum quantities within a secondary containment system, trigger for intermediate secondary containment and provisions for approval to modify aggregate quantities.

The controls that apply to a specific hazardous substance or multiple substances held at a place can be found by using the online Hazardous Substances Calculator.

Appendix 2: Examples of Secondary containment Systems

Example of Small Tank

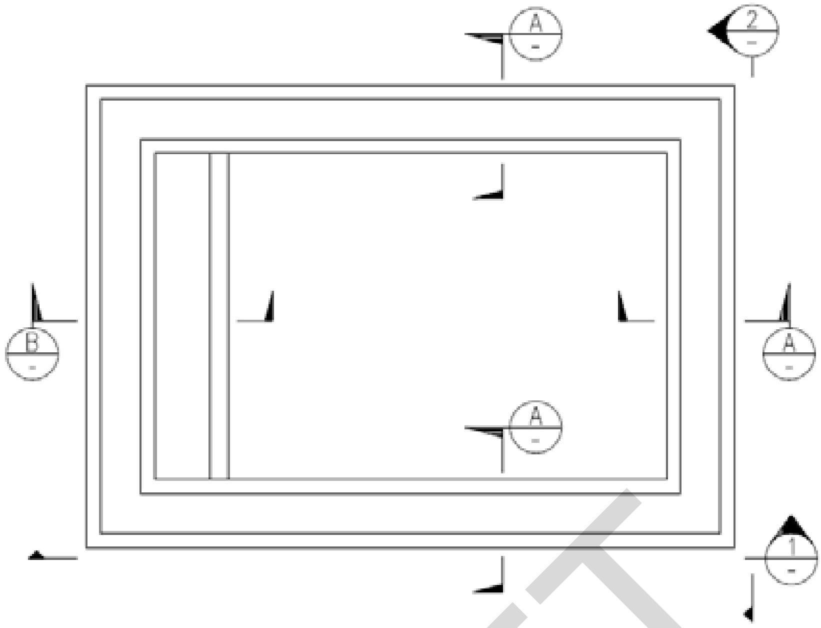


Notes to diagram:

1. Tank side valves that are below flammable product level are to be fire safe.
2. When concrete is used it is to be reinforced to prevent cracking and to withstand loads expected during normal service.

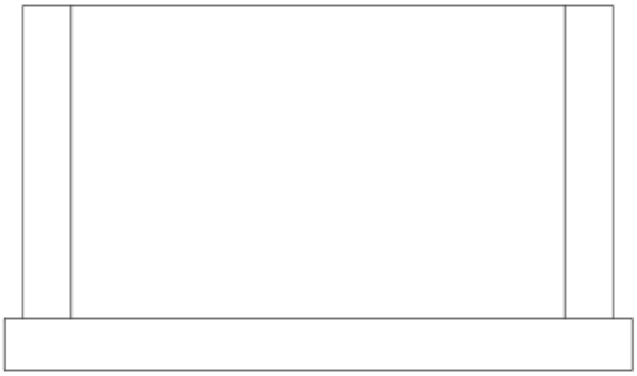
Refer to Appendix 3 for examples of compounds constructed from concrete blocks and cast concrete.

Appendix 3: Examples of concrete compound walls

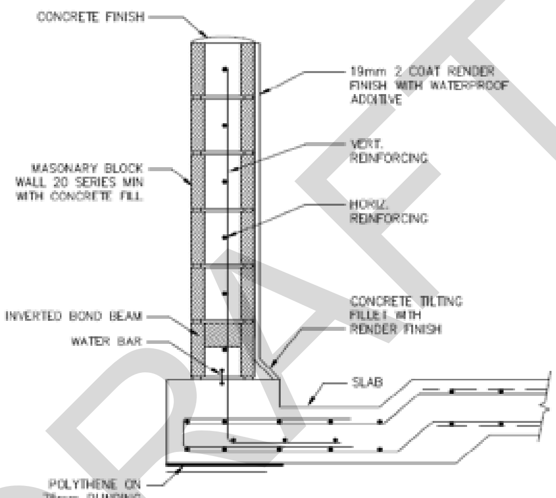


PLAN

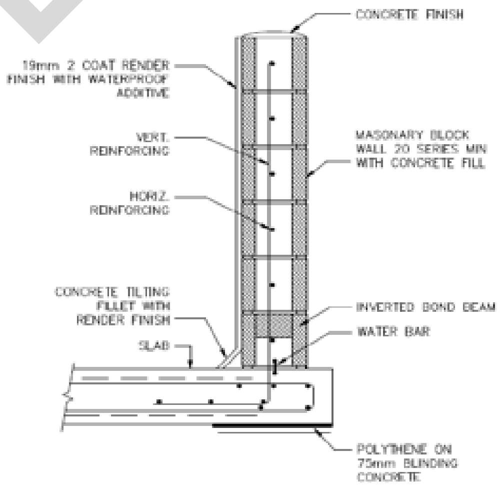
ELEVATION 1



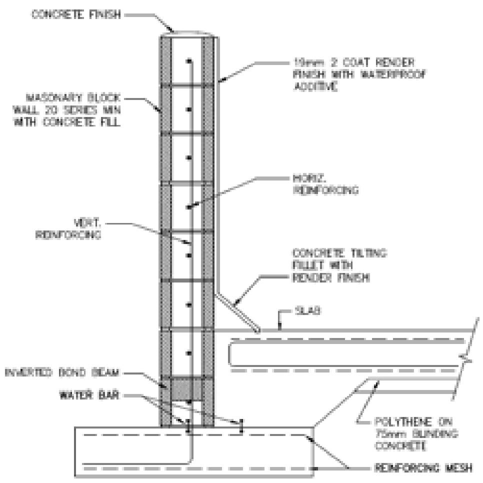
ELEVATION 2



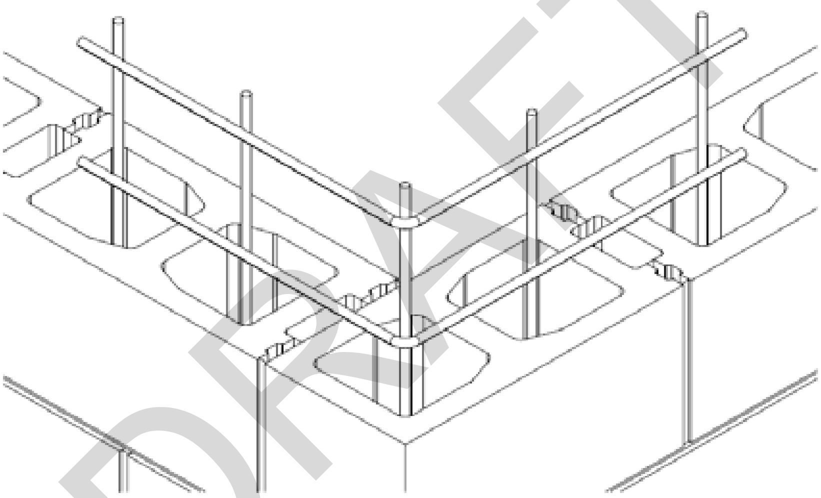
SECTION B



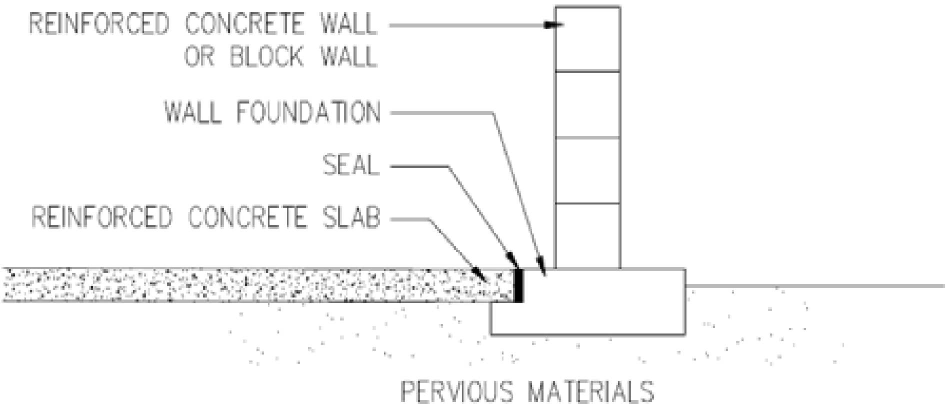
SECTION A



BLOCKWORK BUND WALL BUILT OFF STRIP FOUNDATION

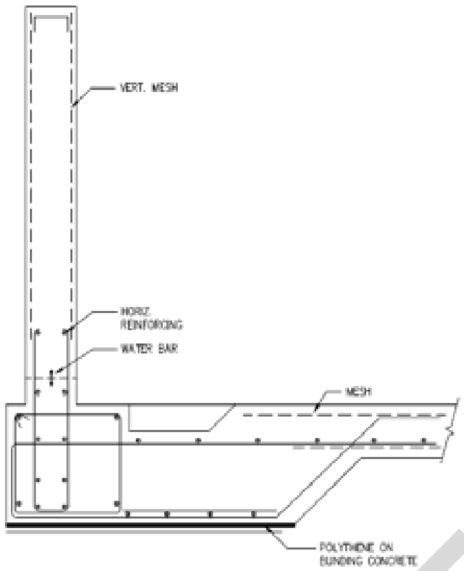


CORNER REINFORCEMENT DETAIL

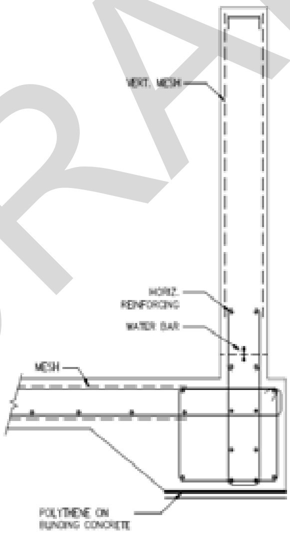


CONCRETE BUND WALL EXAMPLE

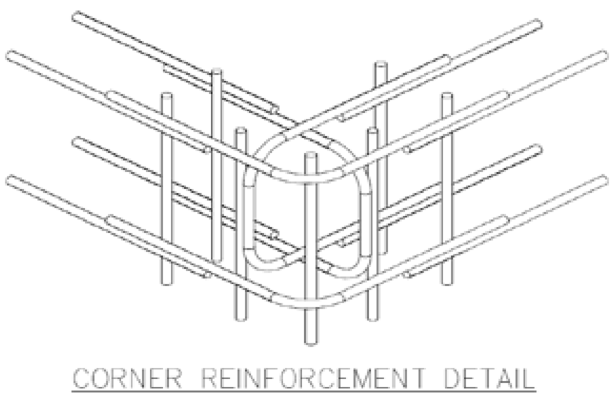
Cast reinforced concrete wall example



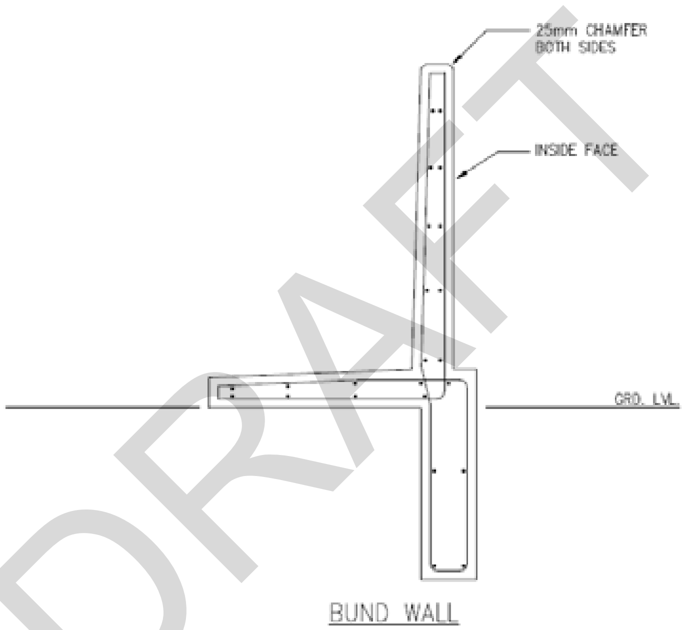
REINFORCED CONCRETE BUND



REINFORCED CONCRETE BUND

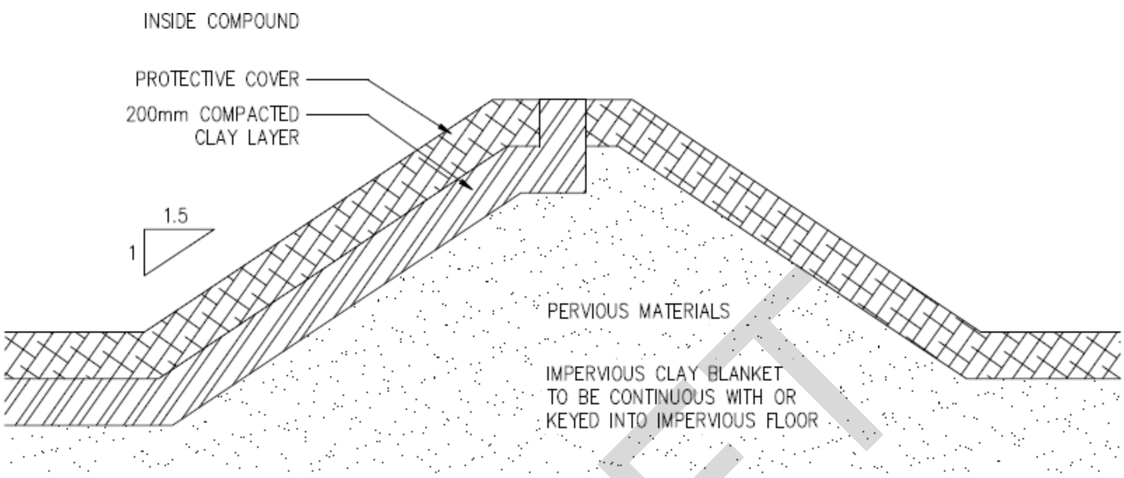


Example of cast concrete wall for larger diameters where lateral loading is increased.

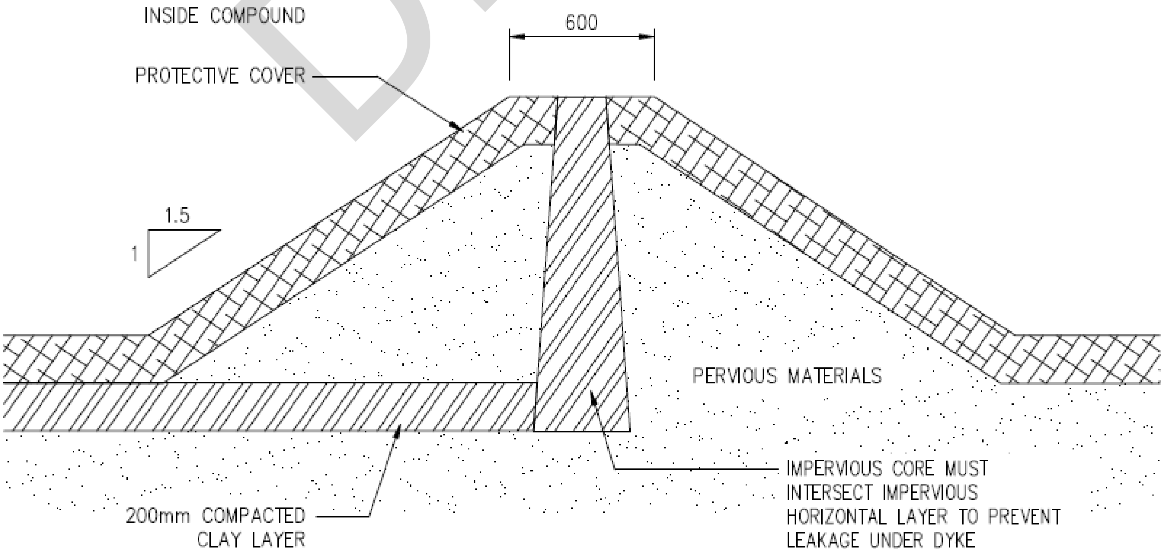


Appendix 4: Examples of compound walls – bulk flammable liquids

Example of Wall Construction Using a Clay Blanket

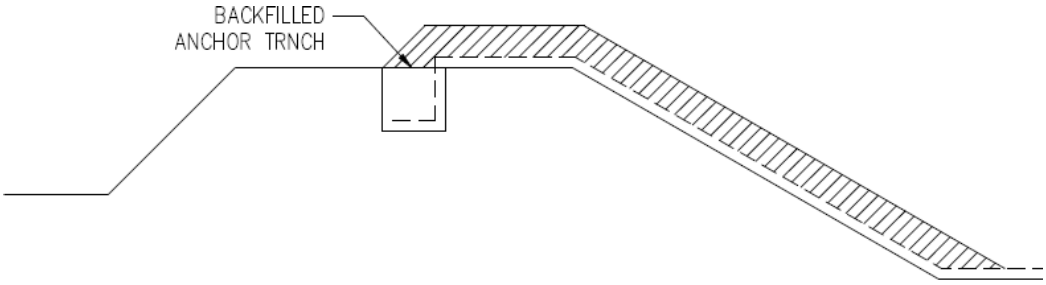


CLAY BLANKET



CLAY CORE

Example of Protecting and Anchoring a Liner

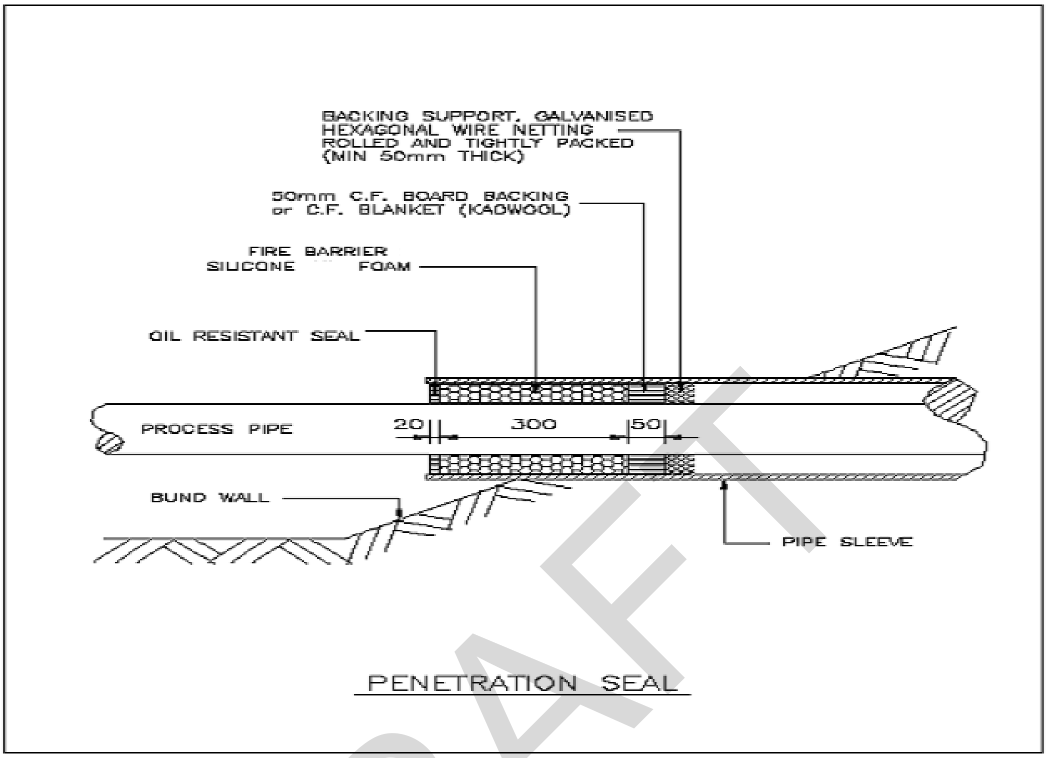


TYPICAL ARRANGEMENT FOR PROTECTING
AND ANCHORING A MEMBRANE LINER

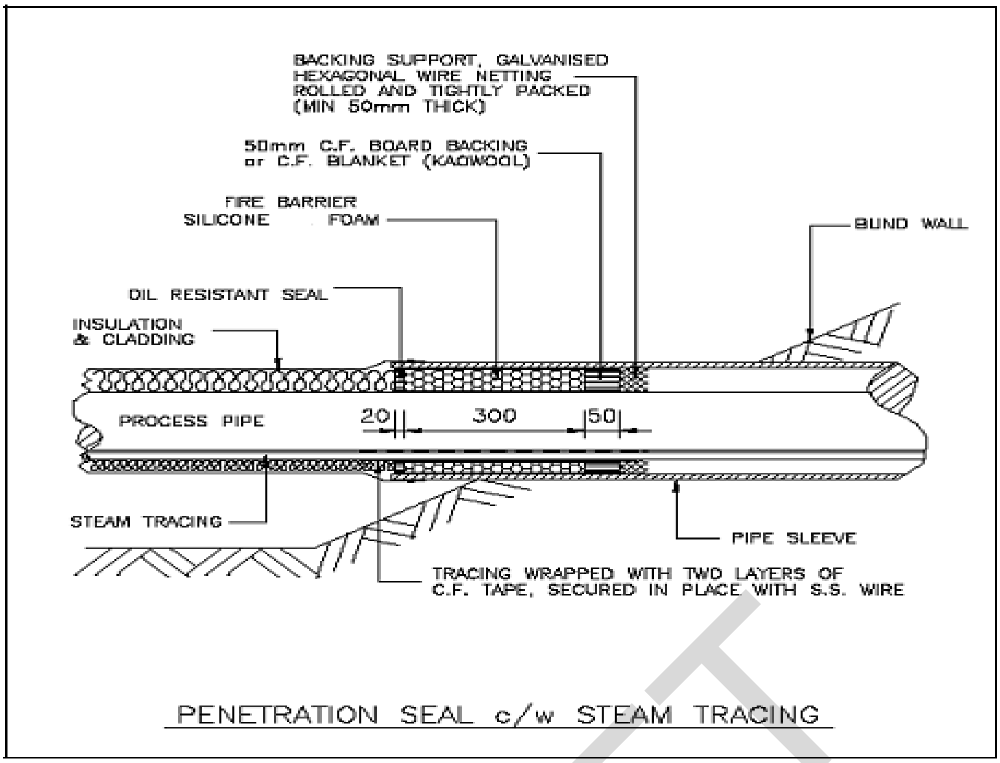
Appendix 5: Examples of Pipe Penetration through Walls

Wherever possible, penetrations through compound walls and floors should be avoided.

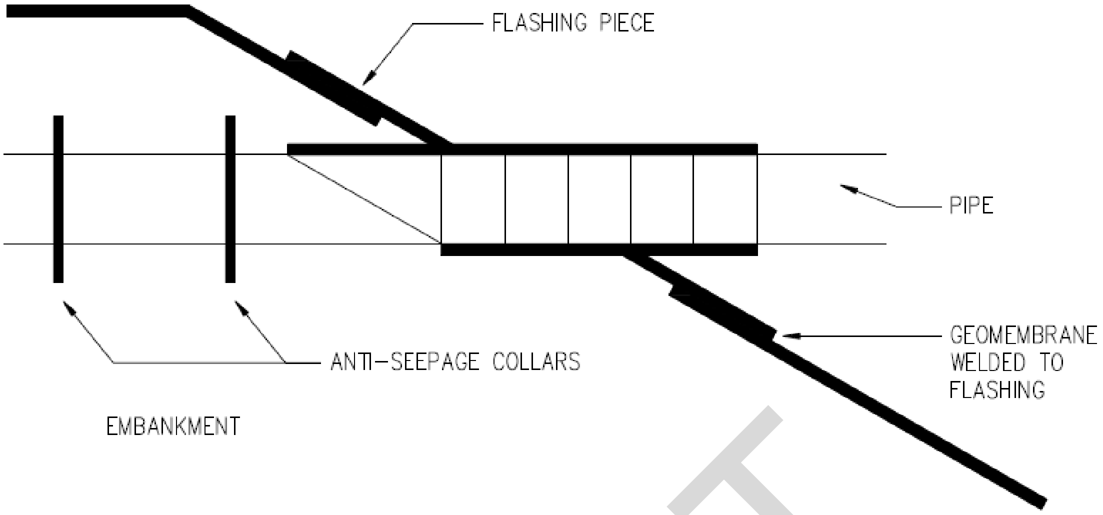
Earthen wall existing retrofit



Earthen wall existing retrofit with steam tracing


BACKING SUPPORT, GALVANISED
HEXAGONAL WIRE NETTING
ROLLED AND TIGHTLY PACKED
(MIN 50mm THICK)
50mm C.F. BOARD BACKING
or C.F. BLANKET (KAOWOOL)
FIRE BARRIER
SILICONE FOAM
BUND WALL
OIL RESISTANT SEAL
INSULATION
& CLADDING
PROCESS PIPE
20
300
50
STEAM TRACING
PIPE SLEEVE
TRACING WRAPPED WITH TWO LAYERS OF
C.F. TAPE, SECURED IN PLACE WITH S.S. WIRE
PENETRATION SEAL c/w STEAM TRACING

Example of a pipe penetration through earthen compound wall (existing retrofit)



ARRANGEMENT FOR SEALING PIPE
PENETRATING A GEOMEMBRANE LINER

Appendix 6: Relationship between seepage and permeability

This Appendix, applicable to flammable substances is in conjunction with Section 4.11 of these Guidelines.

The Darcy Equation can be used to estimate the required thickness of clay barrier to ensure the loss rate does not exceed 1 mm/hr:

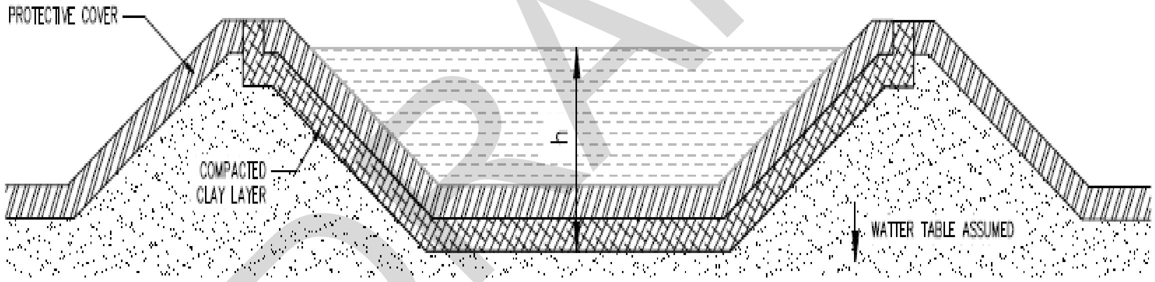
Seepage, V = k x i

Where

- k = coefficient of permeability
- i = hydraulic gradient = z/l
- l = barrier thickness
- z = hydrostatic head = p x h [1]
- p = liquid density and h = height shown below

EXAMPLE

Assume barrier ('clay') permeability coefficient of 0.0001 mm/sec (1 x E-7m/s) Calculate seepage for compounded water (density = 1 kg/litre)



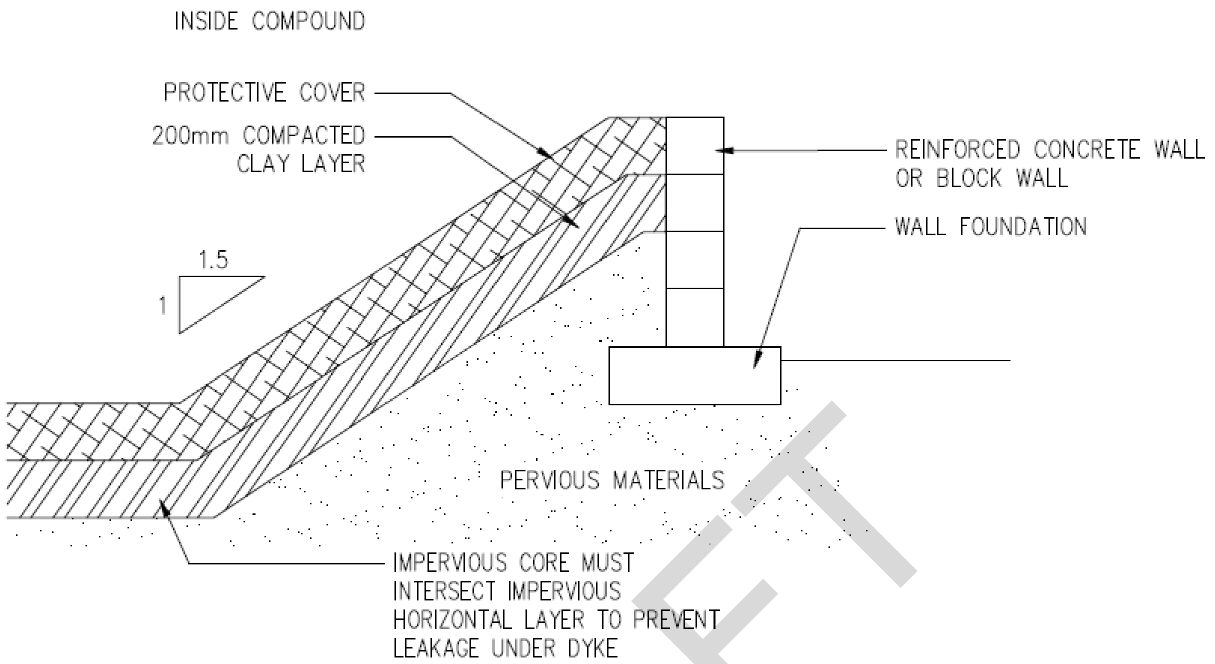
PERVIOUS SEEPAGE / PERMEABILITY: – CLAY BLANKET

l (thickness)		z (head)		v (seepage)
250	mm	500	mm	0.72 mm/hr
250	mm	750	mm	1.08 mm/hr
250	mm	1000	mm	1.44 mm/hr
250	mm	1250	mm	1.80 mm/hr
250	mm	1500	mm	2.16 mm/hr

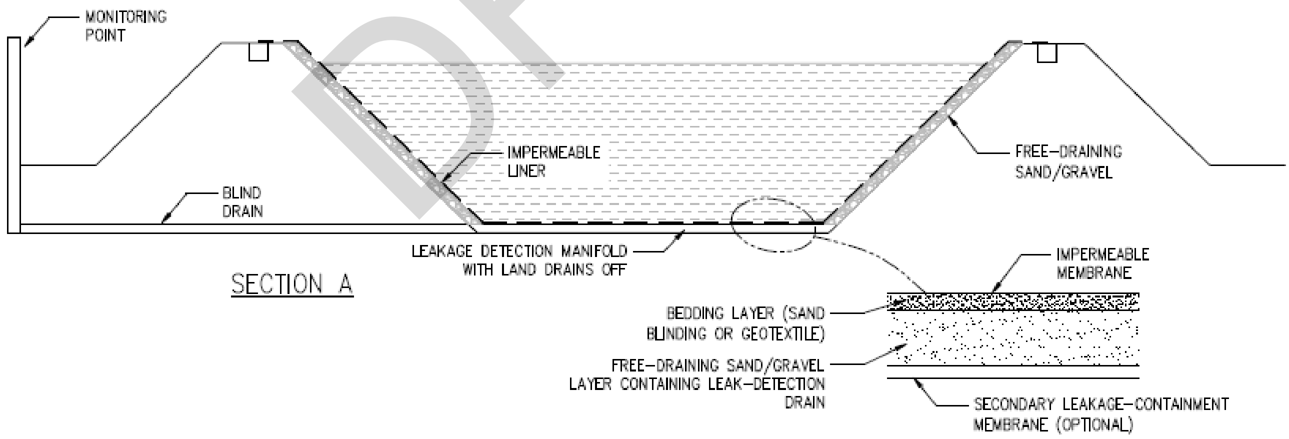
300 mm	500 mm	0.60 mm/hr
300 mm	750 mm	0.90 mm/hr
300 mm	1000 mm	1.2 mm/hr
300 mm	1250 mm	1.50 mm/hr
300 mm	1500 mm	1.80 mm/hr
350 mm	500 mm	0.51 mm/hr
350 mm	750 mm	0.77 mm/hr
350 mm	1000 mm	1.03 mm/hr
350 mm	1250 mm	1.29 mm/hr
350 mm	1500 mm	1.54 mm/hr

Required barrier thickness to achieve seepage criteria increases in proportion to the hydrostatic head requirement.

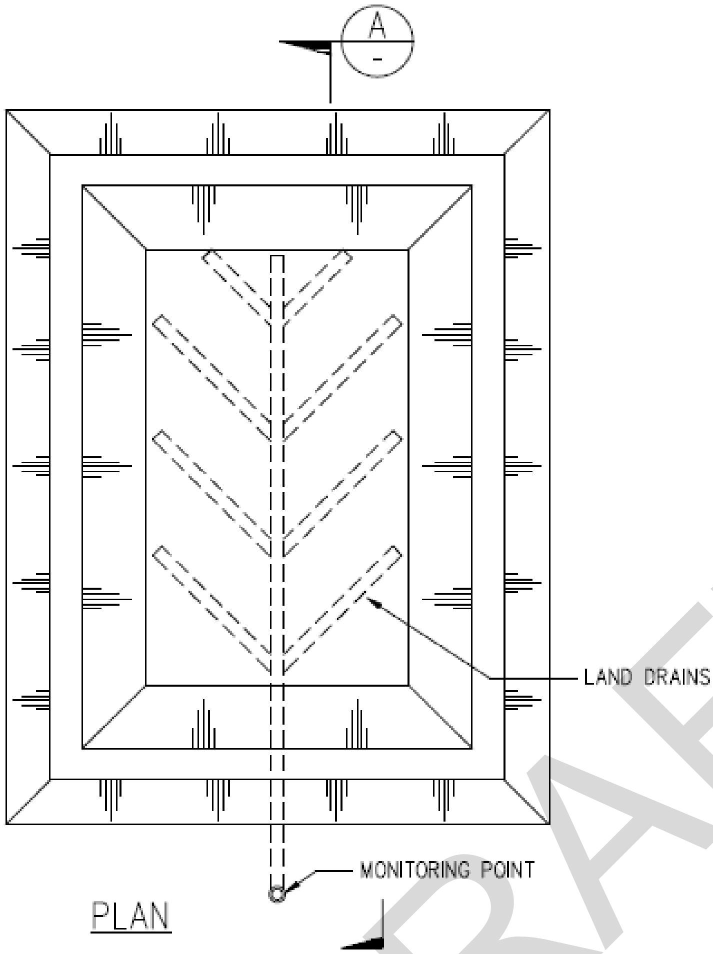
Appendix 7: Other Examples - Compound, Impounding basin, lagoon



EARTH / CONCRETE BUND WALL EXAMPLE



IMPOUNDING BASIN



LEAKAGE DETECTION SYSTEM FOR A LINED LAGOON

Localised compound floor material test.

This was a simple “material at hand” existing brown rock compound floor test to gain knowledge of the suitability of the locally sourced material. The test tank was steel plate from a tank floor replacement. It was simply made into a rough cylinder on site then welded.

The cylinder’s trench was marked out then excavated into the compacted high clay index brown rock floor. Bentonite was mixed in a concrete mixer and the trench filled, the cylinder lowered in and left to set. Three sites across the compound floor were tested. The transpiration tank was a 200 litres drum.

This type of test does not test the other areas such as pipe sleepers, earth rods, access step foundations or the heel of the wall to floor connection.

Appendix 8: Overfill Protection

OVERFILL LEVEL (MAXIMUM CAPACITY)

Tank rated capacity is a theoretical tank level far enough below the overfill level to allow time to respond to the final warning (eg the LAHH) and still prevent loss of containment/damage. It may also include an allowance for thermal expansion of the contents after filling is complete

Response Time 3

TANK RATED CAPACITY

The LAHH is an independent alarm driven by a separate level sensor etc. It will warn of a failure of some element of a primary (process) control system. It should be set at or below the tank rated capacity to allow adequate time to terminate the transfer by alternative means before loss of containment/damage occurs.

Ideally, and where necessary to achieve the required safety integrity, it should have a trip action to automatically terminate the filling operation

The LAH is a second alarm (derived from the ATG where fitted). This alarm is the first stage overfilling protection, and should be set to warn when the normal fill level has been exceeded. It MUST NOT be used to control filling.

Factors influencing the alarm set point are: providing a prompt warning of overfilling and maximising the time available for corrective action while minimising spurious alarms such as those due to transient level fluctuations or thermal expansion

Response Time 2

NORMAL FILL LEVEL (NORMAL CAPACITY)

Defined as the maximum level to which the tank will be intentionally filled under routine process control.

Where an ATG is fitted, provision of an operator configurable 'notification' driven from this ATG may assist with transfers though it offers minimal if any increase in safety integrity.

Response Time

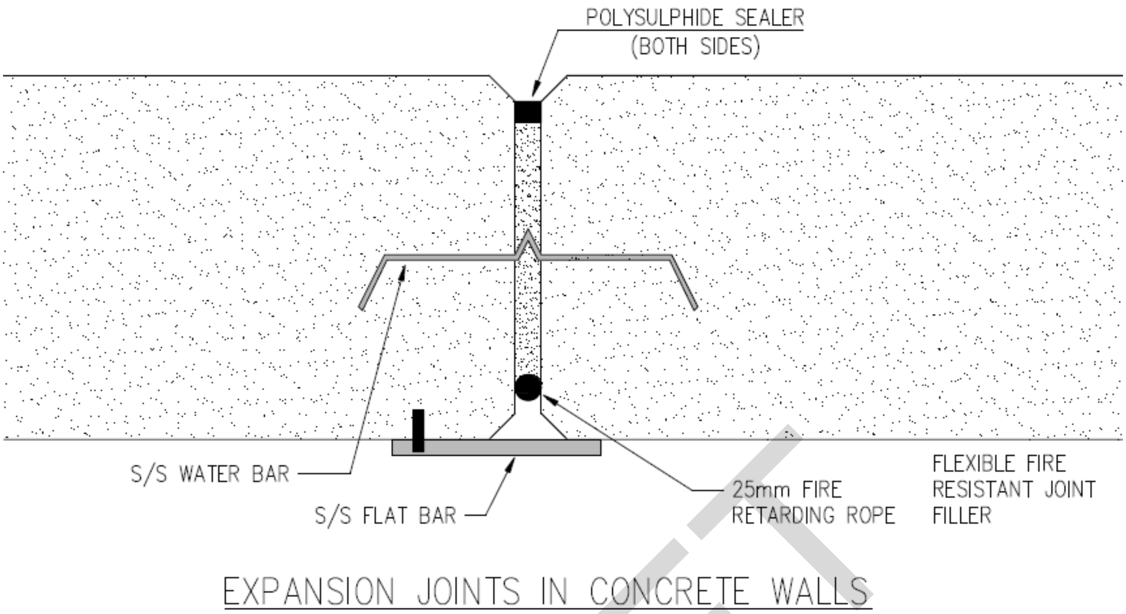
⬡ Trip where necessary ◯ Alarm △ Notification (optional)

LAH = Level alarm high LAHH = Level alarm high high ATG = Automatic Tank Gauge

For further information refer to API RP 2350 Overfill Protection for Storage Tanks in Petroleum Facilities.

Where multiple tanks are blended into a single tank the blend management system should be capable of proving that the sum of the flows is equal to the volumetric rise in level of the receiving tank. Where this is in error, an alarm should be provided and as a minimum step, manual intervention is required to ratify the reason for the alarm condition.

Appendix 9: Example of expansion joints in concrete compound walls



Fire retarding rope is to be placed on both sides of an internal compound wall and may be placed on the internal side only of an external wall.

Water barrier, rope and polysulphide sealant can be omitted in compound wall footings. The water barrier is to be grade 316 stainless steel 1.0 mm thick

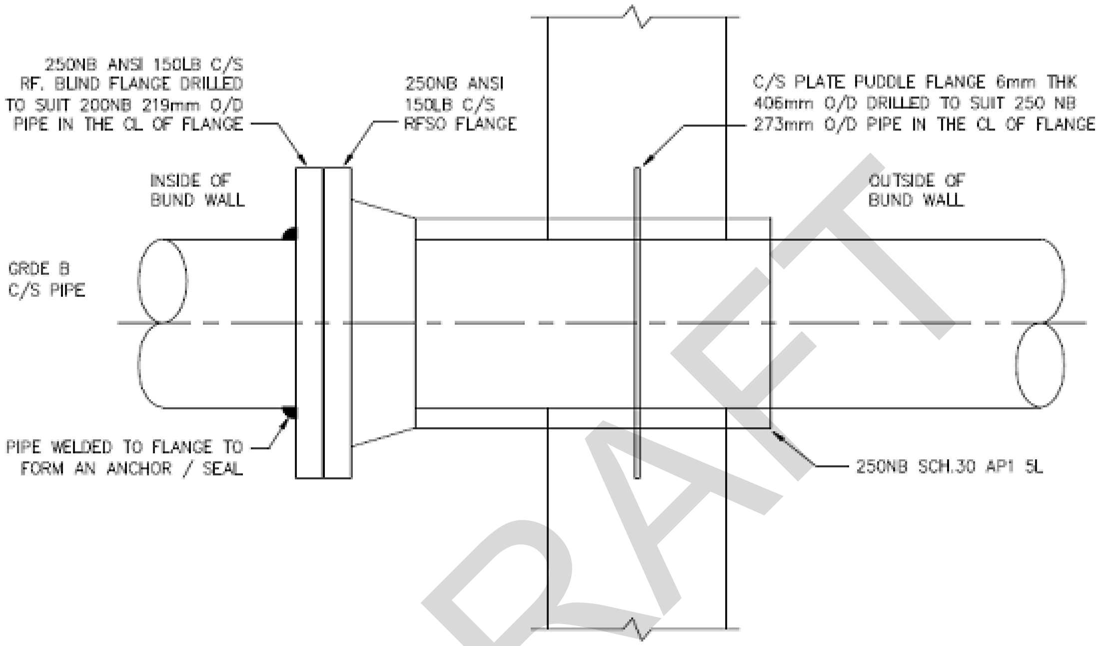
A stainless steel flat barrier 4 mm thick is to be placed over the joint to protect the caulking. The bolt holes are to be slotted vertically for expansion, and also horizontally if bolted on both sides of the concrete joint.

Appendix 10: Example of concrete compound wall pipe penetration

This is an example of a puddle flange cast into a compound wall – a 200 NB pipe in a 250 NB sleeve passing through a compound wall. The wall needs to be reinforced sufficiently to withstand all of the stresses imparted by the pipe in a fire case. It may be necessary to apply fire proofing to the concrete wall in the vicinity of the penetration to avoid spalling of the concrete.

With this detail, expansion and contraction of the piping for all foreseeable situations needs to be adequately catered for to prevent damage to the wall.

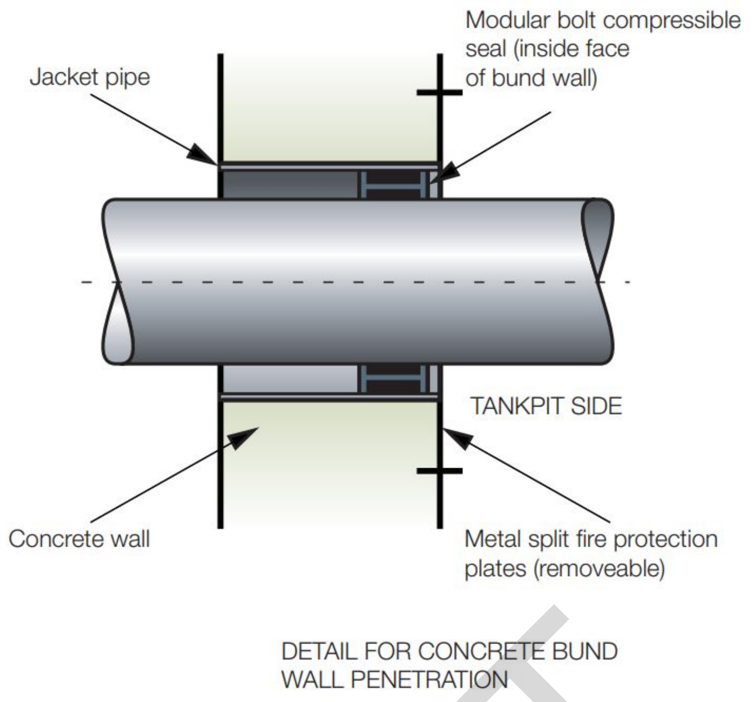
Where the pipe cannot be anchored to the wall a different approach is required.



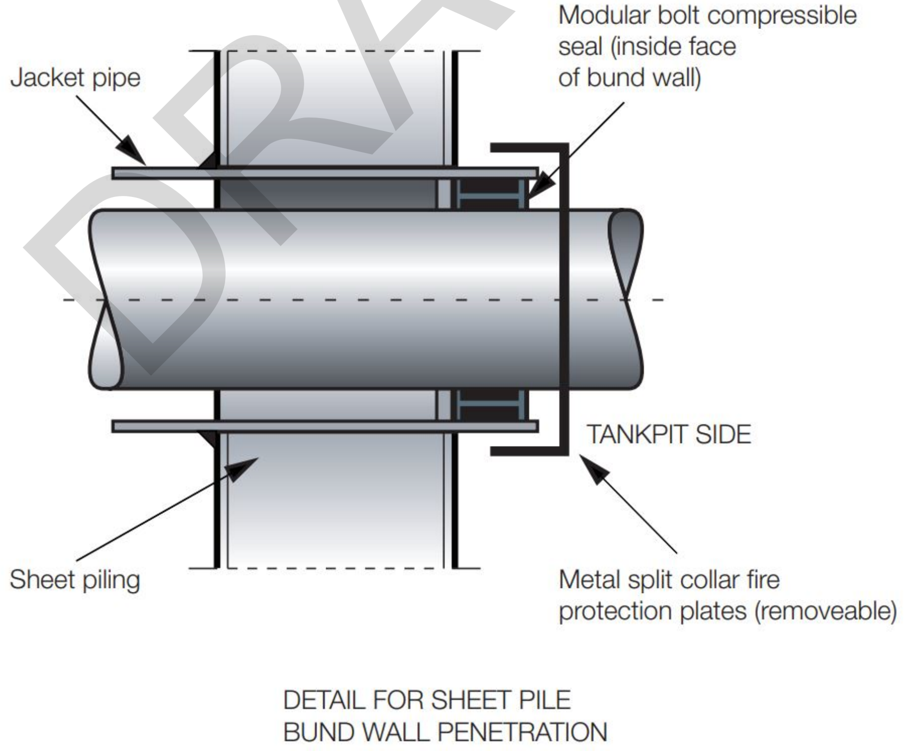
EXAMPLE PUDDLE FLANGE CAST INTO A BUND WALL

Note: Wherever possible, penetrations through compound walls and floors should be avoided.

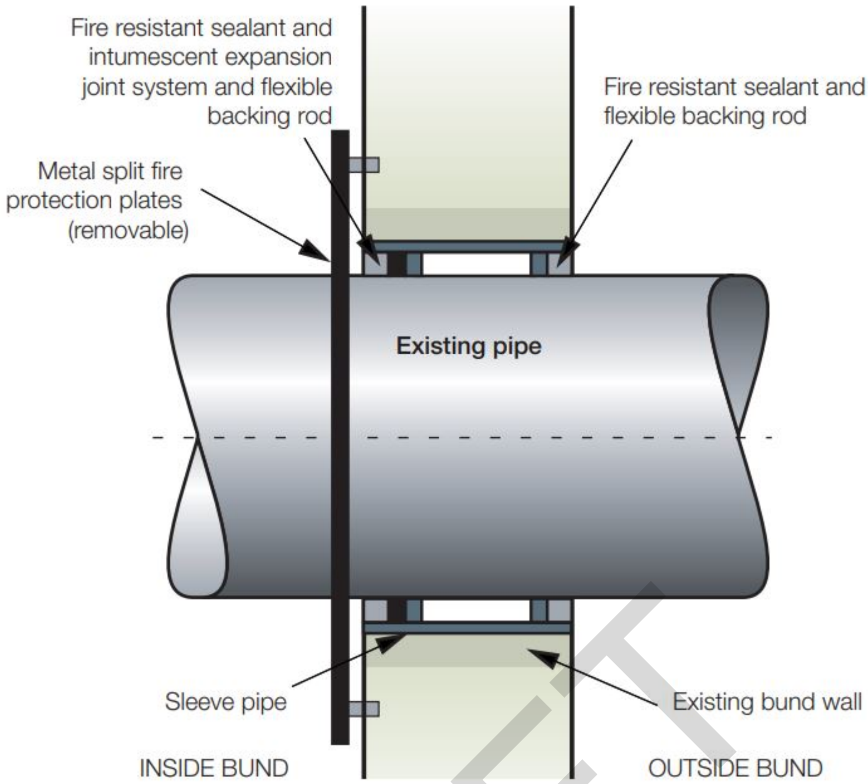
Part 4 – 'Engineering against loss of secondary and tertiary containment' of the Buncefield Recommendations includes additional guidance on pipe penetrations. Additional examples include an additional concrete bund wall penetration design, a design for a sheet pile bund wall penetration and a design for a sealed sleeve upgrade option.



Detaill for concrete bund wall penetration

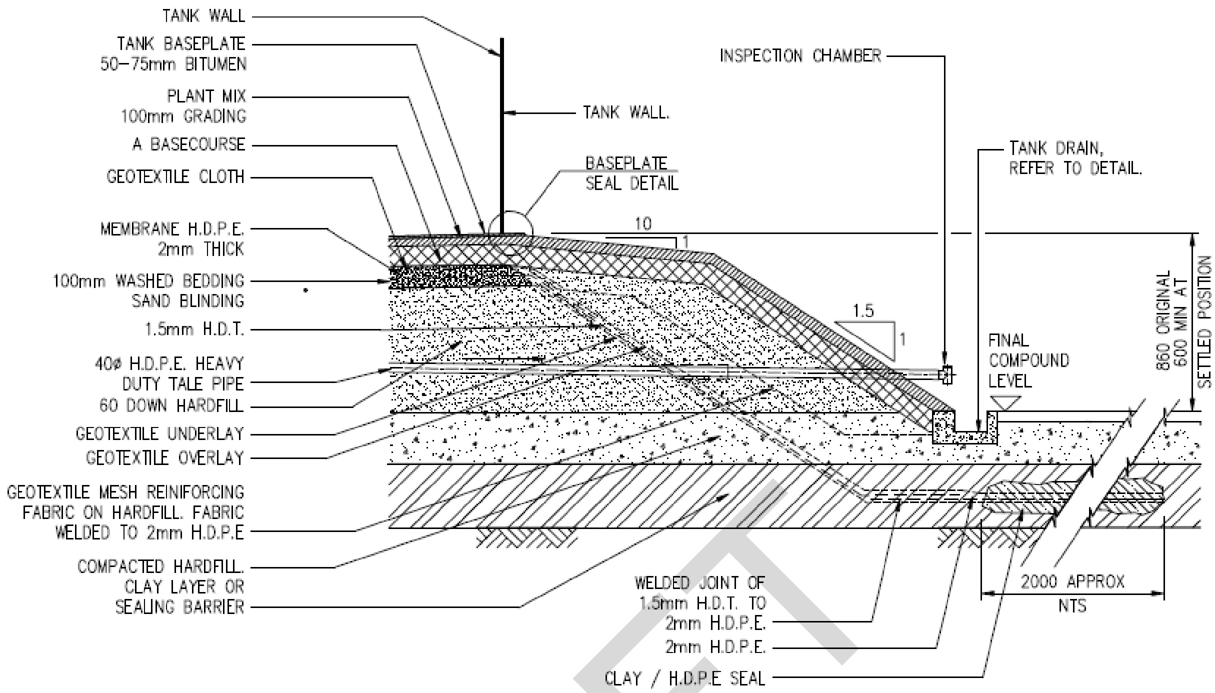


Detaill for sheet pile bund wall penetration



Detail for a sealed sleeve upgrade option

Appendix 11: Example of vertical tank earthen foundation



EXAMPLE OF EARTH FOUNDATION – DETAIL 1

The continuation of the compound floor sealing under the foundation pad is an important detail. Over time, the loads upon the tank foundation tend to cause settlement of the original base resulting in a cone down effect. This may result in tension cracks in a compacted compound floor.

The tank drain runs full circumference at the base of the tank pad foundation and has lateral/s that lead to the compound drain sump trap. The compound drain valve is always outside of the compound and is sized for the fire-fighting water case.

The telltale drains to the outside of the foundation skirt and enables detection of a leak into the foundation.

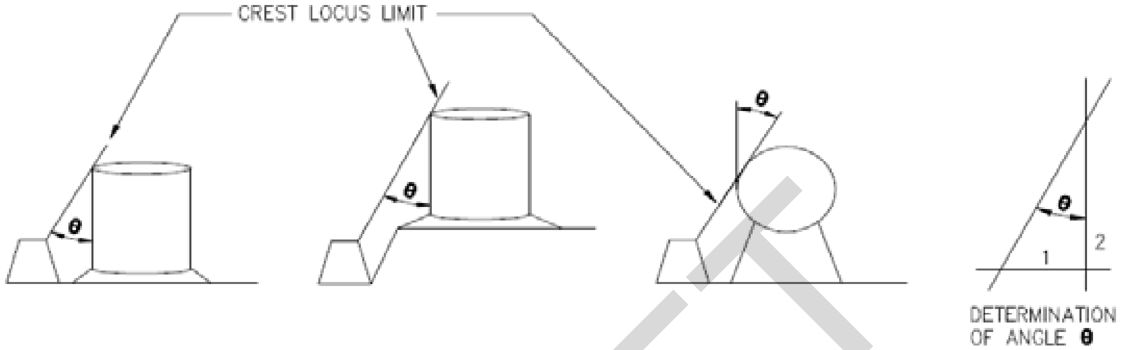
Appendix 12: Crest Locus Limit

The inside edge of the compound wall must be spaced from the tank so that it is outside the crest locus limit.

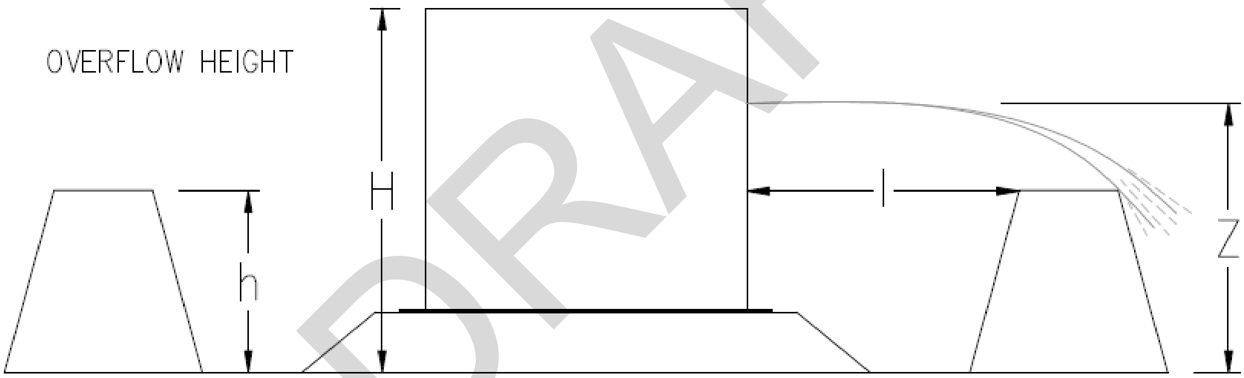
Crest Locus

Tan θ = 0.5

θ = 26.5^0



Crest Locus Refinement - Jetting



For a small diameter sharp edged hole in a tank shell: C_v = velocity coefficient.

$l^2 = 4C_v^2(z-h)(H-z)$

In practice $C_v \approx 0.99$. For this purpose assume $C_v = 1$ Conservatively then:

$l = [4(z-h)(H-z)]^{0.5}$

Therefore for a given compound height <u>*h*</u>, distance *l* is at minimum when: z = 0.5*H*+0.5*h*

giving the solution:

lmin = H-h

Appendix 13: Shields around tanks

Where there is a possibility that non-flammable substances will not fall directly fall into a compound should a tank leak, it may be possible to utilise a shield around the tank to deflect the hazardous substance into the compound. The shield is to be installed to allow for ease of removal for inspection. In this example, the shield stands off the shell by 40mm allowing air movement in order to prevent continuous dampness that could result in corrosion of the shell.

Example – Shielded tanks

Appendix 14: Tertiary Containment

Tertiary containment provides an additional barrier to prevent the uncontrolled spread of hazardous liquids. This minimises the consequences of a failure in the primary and secondary containment systems. Tertiary containment is achieved by means external to and independent of the primary and secondary containment systems, such as site drainage and sumps, diversion tanks, impervious liners and/or flexible booms.

Tertiary containment can be provided by raised mounds or canals, concave paved areas with isolatable storm drains, ramp down car parks etc. around a site, or storage areas within a site.

The mounds may be planted for landscaping enhancement but care should be taken when choosing the plant species. Shallow rooting species such as grasses are preferable to deeper rooting species. The deeper rooting species such as trees potentially allow for root penetrations through the tertiary containment wall, thus compromising the integrity of the containment system.

Channeling within a tertiary containment system is required to direct overspills away from sensitive areas within, for example, office blocks, adjacent public places or highways, or ignition sources if flammable spills.

The tertiary containment system leak integrity should be designed having regard to the location of the site within the surrounding environment, for example, presence of underground streams, aquifers, potable water catchment areas etc.

- Tertiary containment will be utilised when there is an event that causes loss of containment, for example, compound joint failure or firewater overflowing from a compound during a prolonged tank fire, and is intended to ensure that loss of hazardous substances does not result from such an event.
- Tertiary containment plans must be prepared as part of an effective emergency response plan, having regard to the ground and location characteristics of the site.
- Tertiary containment measures minimise the consequences of a major incident that causes the failure of or exceeds the storage capacity of the secondary containment system.

Tertiary containment enables time to mobilise additional measures to be deployed if an incident escalates.

Example 1 – Example of tertiary containment area.

In this example, the entire site is hard paved with a perimeter concrete nib wall. There are individual ramped storage areas within the site where localised spills are trapped. The site's surfaces outside of the storage areas are contoured to this catchment and sump area. The float switch of the pump has lockouts driven from analyzers for contamination.

The system should be designed and operated to ensure that only clean rainwater is discharged into the environment. Contaminated material (including rainwater) that is collected should be disposed of correctly. The more toxic or rain susceptible areas can be roofed over to minimise the possibility of contamination.

With such a system the design of the total available catchment volume and pumping capacity over time should take into account the 50 year rainfall case. (Subject to Resource Consent conditions).

Where hydrocarbons are involved, it may be necessary to provide a separator. This could be an under/over weir system to enable at least simple primary oil separation with dedicated pumps for recovery, plate interceptors, absorbers etc.

When designing a hazardous site in a vacant area, thought should be given to the possible need for increasing the protection systems when the surrounding area becomes developed.

Example 2 – example of compounded yard that can be utilised as tertiary containment.

This photo is of an agricultural supplier store with external hard paved area that has been contoured into several catchment areas with hi-lighted drain sumps. The combined sumps lead to an isolation valve prior to exiting the site. The store room has significant secondary containment system capacity.

From inside the store looking out showing the compound ramp and contoured paving.

Appendix 15: Threshold quantities for secondary containment register

					Exceeded
Item	Substance	Classification	Quantity	Threshold	Yes / No

Appendix 16: Secondary Containment Capacities Register

Provide a unique tank number, location or identification on the site plan.

The description should be sufficient to ensure that each tank can be unequivocally identified.

The register may be combined with other HSWA criteria such as hazardous areas required for class 2.1.1, 2.1.2 and 3.1 flammable substances. Secondary containment capacity of large systems may require a surveyors report to establish the capacity.

Location or Tank Number	Description	Total Pooling Potential litres	Secondary containment Capacity Required Litres	Secondary Containment Capacity Provided Litres	Hazardous Area Metres	Protected Place Metres.	Public Place Metres.

Appendix 17: Compound Testing

Height (mm) of water above the compound floor at test start:____mm. (Use ullage method from lip of still well.)

Date / Time	Weather	Comments	Compound Dip mm	Compound Loss mm	Evaporation Dip mm	Evaporation Loss/Gain[1] mm	Net Seepage Loss (A+B)

[1] In this column, a loss is expressed as a negative amount and a gain is expressed as a positive amount

Appendix 18: Evaluation

Process safety

Risks must be evaluated at the design phase of a project. Options for determining effectiveness include:

- Layer of Protection Analysis (LOPA) and Safety Integrity Level (SIL) determination – hazard evaluation and risk assessment methodologies recommended in the Buncefield Report.
- “What if” Analysis. A “what if” analysis explores every possible scenario that could be expected to happen and measures need to be in place to mitigate the events.

It is insufficient to rely on written procedures without a rigorous audit process established to mitigate the human failure weakness that may come to the fore.

The legislation that applies in this Section is: Primary duty of care HSWA s36 Duty of PCBU who designs secondary containment systems HSWA s.39 Duty of PCBU who manufactures secondary containment systems HSWA s.40 Duty of PCBU who imports secondary containment systems HSWA s.41 Duty of PCBU who supplies secondary containment systems HSWA s.42 Duty of PCBU who installs, secondary containment systems HSWA s.43

Technical evaluation

Prior to upgrading existing, or building new, above-ground secondary containment systems, technical and operability studies should be undertaken to assess the actual or potential effects of these facilities on the surrounding environment.

The UK Process Safety Leadership Group’s final Buncefield Report “Safety and environmental standards for fuel storage sites” is a leading example of accepted practice for the storage of flammable liquids. The report covers the processes required to ensure that the impacts on people and the environment from the primary and secondary containment is understood, and that the design eliminates the risk as far as is reasonably practicable. It is the expectation of WorkSafe that the PCBU will implement these standards or a control which will achieve an outcome which is similar or better.

Factors that should be taken into account when designing containment systems include the following:

- proximity to, and environmental sensitivity of, surface waters
- proximity to, and environmental sensitivity of, groundwater
- nature and volume of products stored
- resistance of containment materials to the product stored
- service loading on containment media

- provision for a sealing membrane under tanks
- seismic and climatic hazards
- the interfaces of the various structural elements within the compound
- leak detection devices
- overfill protection devices, and
- provision for the management of fire control water.

Overfill protection of the primary container

Overfill protection systems, including instrumentation, devices, alarm enunciators, valves and components comprising the indicators, alarms and shutdown systems, should be assessed using BS EN 61511 or equivalent standard, which sets a minimum performance for SILs. This includes the following considerations for overfill protection:

- design, installation, operation, maintenance and testing of equipment;
- management systems;
- the redundancy level including diversity, independence and separation;
- fail safe provisions, proof test coverage and frequency; and
- consideration of the common causes of failure.

Refer also to Appendix 8 ‘Overfill Protection’ of these Guidelines.

Appendix 19: Perimeter Drainage System