Best Practice Guide BPGCS005

OIL STORAGE GUIDLINES

Background:

Companies across all manufacturing sectors, store oil in varying quantities, typically between 5m^3 to 75m^3. Stored oil is used for a variety of purposes ranging from process water heating to generator fuel supply or simple space heating. Diesel motor fuel for the company's own use may also be stored. These Guidelines provide advice on current Best Practice for oil storage as regards the prevention and early detection of oil leakage to the external environment.

The Guidelines address the issues associated with the storage of oil that would be typically used as an energy source within any industrial/commercial premises. Many aspects of the Guidelines may be applicable to the storage of other liquids and "oils" such as bulk cooking oils etc., which may also pose a similar risk to the environment. However the storage of many materials, e.g. highly flammable or toxic materials, would have important additional or alternative storage requirements (e.g. Control of Major Accidents and Hazards, see section 8 of Environmental Legislation on http://www.envirocentre.ie) to those detailed here and would need to be considered separately on a case by case basis. Equally the Guidelines are not intended to deal with fire/explosion issues or for large-scale storage at oil terminals, oil transfer stations, etc.

The need for appropriate oil storage facilities:

It is well established in many environmental audits of industrial premises in Ireland that a very significant proportion of oil storage facilities are unsatisfactory. This may be due to one or more factors including poorly bunded (secondary containment) tanks, inadequate distribution pipelines, unsuitable filling points, infrequent inspection and maintenance etc.

While oil storage is commonplace the potential consequences to the environment and to the company of oil spillage are frequently overlooked or insufficiently appreciated. Oil may escape a storage facility either as a single catastrophic spillage or, though a prolonged low level of initially undetected seepage, which can often be equally or potentially more damaging.

Once in the external environment the recovery of oil from soil, groundwater or surface water streams/rivers and drains is difficult, costly and often ultimately ineffective.

Typically in cases of a sudden loss the oil will flow to the nearest surface water drain or watercourse where it may cause damage to varying degrees. Damage may range from oiling of aquatic birds, fouling of wetlands, fishery damage, rendering of the waters unsuitable for livestock watering, fouling of fishing gear/boats and marinas, loss of amenity, odour nuisance etc.

Oil will also quickly contaminate soil in the vicinity of the oil escape and potentially contaminate the groundwater, which underlies most premises in Ireland. Once in contact with the water table oil spreads over its surface and can migrate unseen to contaminate distant wells and springs. As oil is, for practical reasons, normally stored and piped in close proximity to buildings it is not unusual for escaped oil to flow under the buildings. Here the oil is inaccessible to clean up and as a result of evaporation of the lighter fractions, from even small quantities of oil, may render the buildings uninhabitable for an extended period due to oil fume/odour.

In addition to the direct environmental damage arising there is a potential for significant costs to the originator in terms of post-spill cleanup and compensation claims. These costs have significant implications for the availability of future insurance cover and for the level of premium demanded. For a high profile company to be associated with environmental damage, through negligence or otherwise, may undermine its established reputation and image in the market and this may be of an equal or greater financial cost.

The forthcoming EU Directive *On environmental liabilities with regard to preventing and remedying environmental damage* will create a marked increase in the extent of cost liabilities incurred from a spill and consequently has important implications for any enterprise that stores oil. Under this proposed Directive, which is expected to come into force in 2005, any significant environmental damage must be rectified or compensated for. Often restoration will not be technically possible, (e.g. contamination of groundwater or ecological damage is seldom capable of being fully restored through intervention). In such cases the appointed Authority calculates the cost of restoration and that cost is levied on the offender for allocation to protection/enhancement of a similar environmental resource elsewhere such that the damage caused is fully offset. Enforcement of the levies under the Directive is to be monitored by the EU.

Above ground oil storage tanks:

Oil may be stored above or below ground. For most *company's* oil is stored in free standing, above ground storage tanks and this Guideline is intended to address the issues associated with such storage. Back filled underground storage facilities are generally

unnecessary and are to be avoided as an adequate level of inspection and leak detection cannot be readily achieved without sophisticated measures being in place.

Many of the requirements to ensure safe storage of oil are best addressed prior to installation, however many can be readily retrofitted to existing facilities.

Location:

The first consideration for oil storage is location. Where oil tanks are not already in place, or can be conveniently relocated, appropriate site selection is an important factor in reducing the risk and consequences of uncontained spillage.

An oil storage location should meet the following conditions:

Firm level ground

Sloping ground should be avoided as such sites promote offsite migration of any oil escape. Areas of particularly permeable soils such as non clay, or of open gravely/sandy consistency should be avoided as any spilled oil in the storage vicinity will quickly penetrate to deeper levels potentially contaminating underlying groundwaters.

Storage on (flat) rooftops is to be avoided. Tanks in such inaccessible locations are seldom if ever inspected and smaller tanks (e.g. 1,000 - 2,000 litres) may be exposed to being blown over in high winds. Even minor spillage/leakages from such an area will almost certainly enter the roof gutters to be immediately carried to surface water drains. Small, continuous, leaks may possibly go undetected for a long time. Depending on the scale of the oil escape there is also a high risk of the fabric of the building becoming oil saturated to the point of having to be vacated for an extended period.

Remote from surface drains, streams and wells/boreholes.

It is generally recommended that the oil storage tank(s) and the associated filling area and distribution pipe work be at least 10 metres distant from surface water courses (rivers, streams, field drains) and 50 metres from wells or boreholes. When selecting a location consideration should also be given to the proximity of surface water drains, sewer manholes etc.

Secure against unauthorised access

The facility should be such that access for oil filling can only take place with the prior notification of an appropriate company staff member. Such is not always the case where a regular filling contract with a local oil supplier routinely takes

place and where the recipient is only advised at the delivery completion/sign off stage.

Similarly the site should be secured against vandalism, a common source of oil escape.

Readily visible for supervision and inspection

As well as allowing for a specified routine of inspection the location should facilitate early detection of any oil leakage through casual observation by staff.

Readily accessible for filling and maintenance

An analysis of spill statistics shows that overfilling is a common cause of oil escape and frequently results as a consequence of misinformation on the actual capacity, or residual capacity, of the tank. As most oil delivery road tankers are only supported by a single operator/driver it is desirable that the receiving tank be within direct sight of the delivery tanker. Failing this a second person must be in attendance throughout the filling period. A notice should be located immediately adjacent to the filling point detailing established filling procedures and emergency response measures.

Protected against accidental impact

Oil tanks are commonly located in yard areas, which, among other possible benefits, facilitate oil delivery. However such areas are at high risk from impacts by heavy goods vehicles, delivery vans, forklifts etc. This can be readily prevented by the installation of suitable barriers.

Oil storage tank specifications and installation:

Medium to large oil tanks are typically constructed of steel and should be of sufficient build quality (with an appropriate inspection and maintenance routine) to have a lifetime of about twenty years. Smaller tanks, particularly in more recent years, are usually constructed of plastic (polyethylene). If existing plastic tanks are to be relocated or moved care should be taken to establish that embrittlement has not occurred with age.

Prior to purchase the specification of the tanks should be examined to ensure that they are manufactured under an accredited quality control system and conform to an appropriate standard of construction. Steel tanks will also require to be protected with a suitable anticorrosion surface coating, ideally applied by the tank manufacturer. Installation, commissioning and final inspection should be carried out by suitably qualified and competent personnel. In many instances the tank supplier may provide installation.

Once installed, tanks (and spill protection bunds) should be checked for oil tightness and the tank(s) clearly and permanently labelled detailing oil grade, capacity and, where appropriate, a tank identification number.

Secondary containment:

Irrespective of oil tank specifications accidental spillages or leakages are commonplace. Secondary containment allows any accidental escape of oil to be contained and recovered. Note: *Secondary containment should not be confused with double skinned tanks (see Section 10 below) which although the latter serve a useful purpose in lessening the risk of oil entering the environment, on their own most designs do not do so in a sufficiently comprehensive manner.*

Normally secondary containment is provided by means of an above ground ***"bund"*** i.e. an impermeable wall and base within which the tank sits, raised above the floor, on plinths. It serves to capture any oil leakage irrespective of whether it arises from leakage of the tank itself or from associated equipment such as filling and off take points, sighting gauges etc., all of which should be located within the bund. Most oil storage facilities use reinforced concrete/masonry bunds that are constructed in situ. Block wall construction is generally not recommended, however, for small quantities of oil, purpose built Glass Reinforced Plastic (GRP) bunds, or similar, may be suitable.

It is recommended that the following bund specifications be met:

- The bund must be impermeable to oil and water and be of sufficient structural strength to withstand, with a sufficient margin of safety, the pressure exerted by a sudden oil tank collapse and the subsequent (lesser, but prolonged) pressure of the volume contained. Note: *Direct physical testing for water tightness involves a very detailed procedure that includes filling the bund with water and monitoring water levels over a lengthy period. For a number of reasons this is usually only practical prior to the installation of tanks and fittings. For bunds determined to present a low risk (on the basis of their volume, contents and location) a thorough inspection conducted by an appropriately experienced Chartered Engineer will normally suffice. However as many facilities are subject to an Environmental Protection Agency (EPA) Integrated Pollution Control (IPC) licence which may specify, additional, direct physical testing the procedure adopted should be undertaken in the light of the specific licence conditions and in consultation with the EPA if necessary.*

- The bund capacity should be sufficient to contain 110% of the tank's maximum capacity. Casual or occasional storage of oil drums or similar items that would consume bund capacity should not be permitted.

- Where there is more than one tank within the bund the capacity should be sufficient to accommodate 110% of the largest tank's maximum capacity or 25% of the total maximum capacities of all tanks, whichever is the greater. (The additional bund volume compensates for loss of capacity due to accumulated rainwater and also provides some limited margin of safety in the event of tank overfilling.)

- Ideally the bund should be configured such that the additional 10% bund capacity results in sufficient wall height of at least 250mm remaining above the surface of the spilled oil. This is to accommodate wave effects that could otherwise result in oil flowing over the wall such as might arise in the case of a sudden tank collapse. For ventilation purposes and to allow access/egress the wall height should not exceed 1.5m

- The distance and height of the bund wall relative to that of the tank(s) should also be taken into consideration to ensure that any oil loss due to tank puncture does not result in oil spouting beyond the confines of the bund.

- To facilitate routine inspection of external tank surfaces and ancillary equipment a distance of at least 750mm between the tank wall and that of the bund, and 600mm between the tank base and the floor, should be provided.

- Steel tanks are to be separated from the concrete support plinths by an intervening damp proof membrane to protect against rust corrosion.

- The bund must be free of any service holes, drainage valves or similar openings.

- The bund base slopes towards a rainwater sump of sufficient size to accommodate a submersible (normally portable) pump for oil recovery and regular rain water removal. The chosen pump should be of a specification suited to this purpose and is normally subject to the oil having a flash point of more than 32 ^{0}C. (In this regard the following flash points should be noted: Kerosene 40 ^{0}C, Gas Oil 70 ^{0}C, Light Fuel Oil 95 ^{0}C, Medium Fuel Oil 105 ^{0}C)

Tank fixtures and fittings to be located within the bund:

Oil tanks will have a number of ancillary items each potentially a source of oil loss and which consequently need to be contained within the bund. These items and the necessary precautions to be incorporated in their design and operation are set out below:

Tank vent pipe:

The tank will normally be fitted with a breather, or vent, pipe. In the event of accidental overfilling of the tank the excess oil will overflow through this vent. Consequently the vent pipe should be readily visible during filling. The vent should be directed downwards and have its outlet within the bunded area.

Oil filling point:

The oil filling reception pipe should be located within the bund. This pipe is directed so that it fills through the top of the tank and should be fitted with both a shut off valve* and screw cap (this cap should be attached by chain to prevent accidental misplacement or loss during filling). Adequate working space should be provided at the fill point to allow for easy and efficient connection and disconnection.

A purpose designed, removable, drip tray should be provided beneath the connection point to catch any residual oil during filling and disconnection of the flexible tanker hose. This drip tray should be regularly emptied. Prior to filling, the bund should be free of any accumulated rainwater.

These measures avoid any unnecessary contamination within the bund area thereby avoiding oiling of any subsequent rainwater accumulations as these present disposal difficulties and costs.

Fixed oil draw off point:

Ideally penetration of the bund wall by pipelines or other services should be avoided. Where these exist an adequate seal in the exit hole must always be maintained.

The seals associated with in-line filters should be maintained in good condition and free of oil seepage.

Flexible oil draw off point:

Where the tank is provided with a flexible draw off pipe for filling of site vehicles etc. the hose must be fitted with a lockable shut off valve* located at the fixed exit point from the tank. The delivery end of the flexible pipe should be fitted with a “squeeze to open” valve. When not in use the dispensing head should be “docked” within the bund (and

ideally within a suitable covered receptacle to catch any drippage thereby preventing unnecessary contamination of the wider bund area.)

It should be noted that such a refuelling area must be sited over an impermeable surface graded so as to direct any spillage and inevitable minor drippage through an adequately sized, designed and serviced below ground oil interceptor. Suitable prefabricated oil interceptor packages – often constructed in GRP or equivalent - are available from a number of specialist companies, on a supply and install basis if required.

Oil tank drain valve:

The oil tank drain valve*, used for occasional draw-off of accumulated water condensate, should be fitted with a lock to prevent oil loss through vandalism.

Oil level gauges:

Sight gauges are commonly used as a means of direct monitoring of oil volumes. While simple and reliable in operation, if damaged they can potentially result in the loss of the entire tank contents. Consequently, where fitted, sight gauges must incorporate a failsafe spring loaded shut off valve located at the base such that the gauge is isolated while not in use.

Alternative means of monitoring oil levels exist, some mechanical and some electronic. These have the advantage of operating from within, or from the top of, the tank thereby eliminating them as a source of oil loss.

Mechanical float type gauges can prove unreliable while traditional dip sticks, although inconvenient and cannot provide continuous readings, are totally reliable. Also dipsticks can, with the use of water reactive marker pastes, monitor accumulated water condensate levels within the bottom of the tank.

Electronic gauges can allow for remote monitoring of oil levels and models are available with varying degrees of sophistication. Many are fitted with an alarm activated by any sudden oil level losses and with a high level alarm to warn of impending overfilling. While remote monitoring and alarming have considerable merit and are strongly recommended as providing additional worthwhile protection they should not be regarded as a substitute for direct oil delivery supervision and regular storage inspection.

Whatever oil level recording system is used it should read “full” at not more than 95% of actual capacity. All level recorders and alarm systems should be regularly checked for accuracy and performance.

** All valves should be clearly marked in a manner that the open and shut positions can be readily determined.*

Distribution pipelines (external):

Corrosion of distribution pipelines and leakages at pipeline joints are a common source of oil leakage. Of necessity these pipelines are outside the protection of the bund. Low-level pipeline leakages may take many months before being detected at which point total losses can amount to one or more tank volumes.

Protection of pipelines between the storage tank and point of use can be difficult. Such distribution lines should not be buried as this prevents inspection and is likely to promote corrosion. Pipelines should be run in impermeable concrete channels fitted with removable protective covers to facilitate routine inspection and preventive maintenance. (At some industrial sites these channels may be directed to additional containment). The channels should be routed through areas that avoid exposure to excessive loadings (e.g. in-house vehicular traffic). Where site layout constraints do not allow for channelling pipelines should be routed in pipe racks at a height that protects against accidental damage and where inspection/leakage detection is not compromised. A third option is the use of double walled pipelines however these are not normally used except for specific high (environmental) risk chemicals.

In all cases extensive lengths of pipelines and pipeline branches should be provided with isolation valves.

Depending on the grade/specification of the oil and the degree of exposure to severe weather consideration should be given to protection from freezing (but not so as to impair periodic inspection of pipeline integrity).

If not constructed of a material that is resistant to corrosion pipelines should be provided with an adequate anti corrosion coating. All distribution lines and routes should be clearly marked.

Roofing of oil storage facilities:

Simple open sided roofing cover of the bunded area largely eliminates rainwater accumulations. Where such accumulations do arise they are difficult to maintain oil free (see *Oil Filling Point* above) and require controlled disposal as an oily waste.

Double skinned tanks:

There are a number of manufacturers who supply double skinned tanks. These tanks provide useful added protection in that any leakage through the primary skin is contained in the void between the primary and secondary skin. Such double skinned tanks can be provided with a detection system that will alarm in the event of any liquid entering this void. Most double skinned tank designs are ***not*** an adequate substitute for properly bunded tanks as the tank fixtures and fittings, as detailed above, are usually outside the protection of the double skin and consequently any leakage from such areas will not be contained.

Inspection and maintenance:

A formal inspection routine should be established for all oil storage tanks and associated distribution pipe work and similar ancillary equipment. In addition a Preventative Maintenance Programme should be established where re-application of anti corrosion coatings, valve replacement/refurbishment, pipe work renewal etc. is undertaken at predetermined intervals. Where a company has an Environmental Management System (EMS) in place (whether an own company EMS or an accredited EMS such as *EMAS* or *ISO 14001*) it would usually incorporate this inspection and maintenance routine. In such a case the inspection/maintenance activities would be formally recorded and include details of time, date, findings, work undertaken, recommended future work and the name/status of the person undertaking the inspection/maintenance.

The bund should be inspected at least weekly and any accumulated rainwater removed by submersible pump for subsequent controlled disposal. Similarly the bund should be maintained free of any occasional accumulated leaves or rubbish.

Small scale oil storage:

At many premises varying amounts of lubricating oils, cutting oils, hydraulic oils etc. may be held in steel or plastic drums and IBCs (Intermediate Bulk Containers). Storage of these or similar items within the oil tank bund should not be permitted as this may consume unavailable bund capacity.

While this Guideline is not primarily intended to cover drum storage the principal considerations involved are summarised below.

- There are numerous suppliers of "off the shelf" systems that can provide effective spill protection. These systems include lockable covered storage, dispensing racks, spill protection for work stations and mobile units that allow protection to be maintained while drums are brought to separate points of use within the premises.

- For more extensive drum storage areas that may require regular access to movements of forklifts etc. bunding can be provided by means of a raised kerb over an extended area and ramped to allow access by authorised users such as adequately trained fork lift operators. To prevent rainfall runoff contamination (which will invariably become contaminated where residual contents are adhering to the outside of used, or in-use, drums) it is strongly recommended that the drum storage area be roofed.

- In addition, or where covered storage cannot be provided, in-ground oil interceptors are recommended. Interceptors should have a lockable valve on the outlet and it contents should only be discharged where it has been shown to be free of residual oil. Many suppliers exist who can provide a range of pre-fabricated systems suited to the specific needs of the user.

Additional equipment:

Occasional minor drips and leakages of oil involving minor quantities (e.g. less than 1-5 litres) may occur. At minimum simple spill protection equipment to be held locally should include specialist absorbent mats/pillows and granules for containment/cleanup of oil. Adequate quantities should be held in stock and be available for immediate use. Such equipment is readily available from a number of specialist suppliers.

Oil/oily water disposal:

Contact of oil with water is to be avoided as far as is practicable. Nonetheless water condensate will likely arise as tank bottoms and will require periodic, controlled, disposal. Similarly rainwater accumulation will arise in uncovered storage facilities (Consequently the bund area should be maintained free of minor occasional oil drippage etc., firstly by good management/maintenance and secondly by use, if necessary, of specialist oil absorbents – See *Additional Equipment*)

Accumulated rainwater should not be discharged to surface water drains unless it can be confirmed that it is not contaminated. If contaminated the rainwater will require disposal by a specialist licensed waste disposal contractor. It is the responsibility of the originator of the "waste" to ensure that the contractor retained has the necessary permits for the task. In the long term the costs of regular contaminated rainwater disposal will likely exceed that of covered storage and provision of such cover should be evaluated in this light.

Oily water condensate, and recovered oil from any accidental spillage, should be disposed of by recycling and the services of a specialist, licensed, waste oil recycler should be engaged for this task.

Information on waste legislation is available on *www.envirocentre.ie*.

Decommissioning:

At some point oil tanks require to be renewed, upgraded or may become redundant as, for example, where a company switches to gas. At that time the oil storage tank(s) and associated bunds, distribution pipes etc. should be decommissioned rather than left idle.

Decommissioning will require safe collection and controlled disposal of any residual unused oil that may be in the tank(s) or in the distribution system. This will also apply to any apparently "empty" tanks as these inevitably contain some oil residuals including oily water condensate. Any contaminated concrete bund surfaces etc. and nearby contaminated surface soils should be removed and similarly disposed of by a specialised, licensed, contractor. Disposal should be undertaken with the prior approval of the relevant local authority or Environmental Protection Agency. It is the responsibility of the originator of the "waste" to ensure that the contractor retained has the necessary permits for the task.

OIL STORAGE - KEY REQUIREMENTS

ISSUE	COMMENTS
SITING	
Firm level ground	*Avoid on-roof storage*
>10 metres distant from drains, streams etc.	
>50 metres distant from wells/boreholes	
Secure against unauthorised access	
Readily visible and accessible	
Protected against accidental impact	
INSTALLATION	
Competent installers	
Post installation inspection and testing	
TANK SPECIFICATION	
Appropriate quality of construction	*May be constructed of steel or plastic*
Corrosion resistant construction or coating	
SECONDARY CONTAINMENT (BUND)	*Double skinned tanks, while useful, not usually adequate "secondary containment"*
Bund should be 110% of tank's max capacity or, where more than one tank is stored, 25% of total max capacity of all tanks whichever is the greater	*The bund should not be used to store occasional items which will consume capacity*
Bund wall at least 250mm higher than spilled oil surface	*Wall should not be so high as to prevent easy access/egress/inspection etc.*
At least 750mm between bund walls and tank, 600mm between tank and base	
Steel tanks to be supported on plinths with dam proof course	
Absence of any holes / drainage valves etc. in bund wall	
Rainwater sump	*Water should not be gravity drained via a dump valve, but should be pumped under controlled disposal conditions*
Consideration of roof cover	*Eliminates rainwater accumulation and subsequent disposal difficulties/costs*
TANK FITTINGS AND FIXTURES	
All tank fittings and fixtures are to be located within the bund	*These include: Tank vent pipe, Oil Filling Point, Fixed Oil Draw-off Point, Flexible Oil Draw-off Point, Tank Drain Valve, Oil Level Gauges*

ISSUE	Comments
Clear labelling of tank contents and capacity	
Notice detailing designated contact personnel	
VALVES	
Lockable	
Clear marking for on/off positions	
DISTRIBUTION PIPELINES	
Pipelines to covered (accessible) ducts or in protected overhead pipe racks.	*Installation of buried pipelines should be avoided.*
Corrosion resistant construction or coating	
PROCEDURES	*Ideally incorporated as part of an overall site Environmental Management System (EMS)*
Strict supervision of delivery	
Regular inspection and "preventative maintenance" of tank, fixtures and fittings, bund and distribution pipes	
Regular emptying of "drip tray"	*A removable drip tray should be provided under the filling connection/disconnection point*
Controlled disposal of recovered oil or oily water (including contaminated rainwater)	*This will require the use of a licensed contractor. It is the responsibility of the originator of the material for disposal to ensure that the contractor has all necessary permits*