CODE OF PRACTICE FOR

OIL STORAGE INSTALLATIONS

1992

BUILDING AUTHORITY

HONG KONG

FOREWORD

The Standing Advisory Committee established by regulation 4 of the Building (Oil Storage Installations) Regulations is required to carry out a regular review of the Code of Practice for the design, construction and operation of storage installations for petroleum products.

This Code of Practice first drawn up in 1972 was amended in 1982. This latest revision takes into account the current requirements for pollution control, changes to International storage tank standards and changes to the construction standards in Hong Kong.

Notwithstanding the title of this Code of Practice it should also be regarded as the Code of Practice for the Design Construction and Maintenance of Oil and Petroleum Feedstock Installations published by the Building Authority under the Building (Oil Storage Installations) Regulations.

Building Authority

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1. GENERAL

1.1 *SCOPE*

This Code of Practice deals with the design, construction and maintenance of oil storage installations and associated works for petroleum products in Hong Kong. For the purposes of this Code of Practice such oil storage installations and associated works are tanks in bunded areas with its drainage system and pipelines as defined in the Building (Oil Storage Installations) Regulations, a group of tanks for licensing control purposes within a required bunded area, or series of such areas with shared facilities.

Spillage of petroleum products in Hong Kong could be exceptionally damaging because of the territory's intensive use of its coastal land and restricted waters. Consequently, one of the primary objectives of the recommendations in this Code is to reduce the risk of environmental pollution associated with the storage of petroleum products and the operation of oil storage installations and associated works.

Reducing fire and explosion hazards is also an objective of the recommendations in this Code. Safety distances and fire walls are required to limit this hazard. Fire fighting will continue to be the responsibility of the Director of Fire Services under the Fire Services Ordinance, although some degree of overlap with this Code of Practice is inevitable.

Dangerous Goods licences granted pursuant to the provisions of Dangerous Goods Ordinance, Chapter 295 are subject to licensing conditions imposed by the Director of Fire Services from time to time.

Apart from specific structural requirements for the tanks and bunds themselves structural design and construction is subject to the Building (Construction) Regulations.

1.2 *STANDARDS AND CODES OF PRACTICE*

Any reference in this Code of Practice to a publication shall be construed as follows:

(i) where a date is included in the reference, the reference is to the edition of that date, together with any amendments, supplements or addenda published at 31st December 1991;

(ii) where no date is included in the reference, the reference is to the edition current at 31st December 1991 together with any amendments, supplements or addenda published at that date; and

(iii) any reference to any publication is a reference to so much only as is relevant in the context in which such a publication is quoted.

1.3 *DEFINITIONS AND CHARACTERISTICS*

This Code of Practice covers storage facilities for petroleum products in liquid or solid state. Such petroleum products may consist of crude petroleum or semi-refined or wholly refined petroleum.

It is customary to divide petroleum products into three classes, according to the flash points, and for the purposes of this Code of Practice the Category 5 classification in the Dangerous Goods (Application and Exemption) Regulations Cap. 295 is used as follows:

Class 1 products have a flash point below 23°C

Class 2 products have a flash point of or exceeding 23°C but not exceeding 66°C

Class 3 products have a flash point of or exceeding 66°C

Any product which is artificially heated above its flash point for storage or handling should be treated as though it is Class 1.

All petroleum products must be regarded as combustible to a greater or lesser degree. Flash point may be taken as a rough index (but without a precise mathematical relationship) to ignitability.

The colour of petroleum products may vary from colourless through the range of yellow and brown to black.

The specific gravity of petroleum products varies from about 0.6 for the products of lowest-boiling point to just over 1.0 for the heaviest liquid products.

The odour of petroleum products varies over a wide range. Products with the lowest-boiling point, when highly refined, may have a sweet, ethereal type of odour, or no odour whereas at the other end of the scale crude petroleum products can have a pungent smell which often betrays the presence of strongly odorous sulphur components such as mercaptans.

For the purposes of this Code of Practice the following definitions shall apply:

'associated works' includes the bunded area and the drainage system of such installations and any pipe-lines within the bunded area, together with any receipt and issue pipe-lines to related jetties.

'oil storage installations' means any tank having a capacity of not less than 110 000 litres, or a group of tanks any one of which is a tank having a capacity of not less than 110 000 litres, constructed above ground for the purpose of storing petroleum products;

'petroleum products' means crude petroleum or petroleum feed-stock, and includes semi-refined petroleum and wholly refined petroleum which is liquid or solid at ambient temperatures and pressures;

'storage facility' means a group of tanks and any pipelines within a required bunded area, or series of such bunded areas, together with any receipt of issue pipelines to related jetties;

'tank' means any static tank for the storage of petroleum products.

1.4 *HAZARDS*

The storage of petroleum products presents several hazards to the environment. The most obvious of these are explosion, fire and gross spillage which may give rise to loss of life or the destruction of property and damage to the environment in general. However, also of importance are the less obvious hazards, such as inhalation of petroleum products vapour and the tainting of food contaminated by it.

The flammable and potentially explosive nature of petroleum products are the primary hazard and it follows that precautions against explosion and outbreak and spread of fire are of the utmost importance.

Gross spillage of petroleum products, especially the black oils, is similarly a very serious environmental hazard and clearly every precaution must be taken to prevent the accidental rupture of a tank becoming a major disaster by failure to retain the spilt product within the confines of the storage facility.

The more volatile petroleum products give off a vapour which may be slightly anaesthetic and may also cause suffocation if present in a quantity sufficient to displace oxygen in air. Some aromatic hydrocarbon compounds which are mainly produced in petrochemical processes, but which may also be present in conventional petroleum product fractions as components of the mixtures, are severely toxic. Care must be taken to avoid inhalation of such vapours; in particular benzene and to a lesser degree to toluene.

2. DESIGN AND CONSTRUCTION

2.1 *SAFETY DISTANCES*

It is generally not practicable to prevent the escape of petroleum vapour from conventional fixed roof tanks which contain volatile products, e.g. Class 1 petroleum, during the daily breathing cycle or when filling. Tanks should be placed so that any vapour will have diffused in the atmosphere to a concentration well below the lower flammable limit before reaching any area which may be designated a non-hazardous area.

The distances given are minimum recommendations, and refer to the horizontal distance in plan between the nearest points of the specified features, e.g. tanks, filling points, openings in buildings, boundaries.

2.1.1 CLASS 1 PETROLEUM PRODUCTS

(1) A group of small tanks, each 10 m diameter or less, none of which contains Class 2 or Class 3 petroleum product artifically heated above its flash point, may be regarded as one tank. Such small tanks may be placed together in groups, no group having an aggregate capacity of more than 8 000 m^3. The distance between individual tanks in the group need be governed only by constructional and operating convenience.

(2) The distances given in Table 1 are recommendations for Class 1 petroleum products stored in conventional above-ground fixed roof tanks.

(3) The distances given in Table 2 are recommendations for Class 1 petroleum products stored in floating roof tanks. For tanks greater than 18m in height the distances in Table 2 should be increased in a ratio proportionate to the height of the tank.

Table 1—Location and spacing for fixed roof tanks storing Class 1 petroleum products

Factor	Recommended distances
1. Between groups of small tanks as in item 2.1.1(1)	15 m
2. Between a group of small tanks and any tank outside the group	15 m
3. Between tanks not being part of a group of small tanks	Half the diameter of the larger tank, the diameter of the smaller tank or 15 m, which ever is least, but in no case less than 10 m
4. Between a tank and any filling point, filling shed or a building	15 m
5. Between a tank and outer boundary of storage facility, any designated non-hazardous area, or any fixed source of ignition	15 m

Table 2—Location and spacing for floating roof tanks storing Class 1 petroleum products

Factor	Recommended distances
1. Between two floating roof tanks	10 m for tanks up to an including 45 m diameter. 15 m for tanks over 45 m diameter. The size of the larger tank should govern the spacing
2. Between a floating roof tank and a fixed roof tank	Half the diameter of the larger tank, the diameter of the smaller tank, or 15 m, which ever is least, but in no case less than 10 m
3. Between a floating tank and any filling point, filling shed or a building not containing a possible source of ignition	10 m
4. Between a floating roof tank and outer boundary of storage facility, any designated non-hazardous area, or any fixed source of ignition	15 m

Note: For tanks greater than 18 m in height, the above recommended distance should be increased by a ratio equal to height/18.

2.1.2 CLASS 2 PETROLEUM PRODUCTS

It is unnecessary to space tanks for the storage of Class 2 petroleum products at a distance greater than required for constructional and operating convenience. However tanks for the storage of Class 2 petroleum products should be spaced from tanks for the storage of Class 1 petroleum products at the distances given in Table 1, and at a distance of not less than 10 m from the outer boundary of the storage facility. Consideration should be given at the planning stage to the possibility of tanks for the storage of Class 2 petroleum products being required in the future for storage of Class 1 petroleum products. Where such a possibility exists it is recommended that Class 2 petroleum product storage should be planned to Class 1 petroleum product recommendations.

2.1.3 CLASS 3 PETROLEUM PRODUCTS

The spacing of tanks for the storage of Class 3 petroleum products need to be governed by constructional and operational convenience only.

2.1.4 SAFETY DISTANCES WHERE THE TOTAL CAPACITY OF THE OIL STORAGE INSTALLATION IS LESS THAN 7 000 m^3

(1) The distance given in Table 3 are recommendations for Class 1 petroleum products.

(2) It is unnecessary to space tanks for the storage of Class 2 petroleum products at a distance greater than required for construction and operating convenience. However tanks for the storage of Class 2 petroleum products should be spaced from tanks for the storage of Class 1 petroleum products at the distances given in Table 3, and at a distance of not less than 6m from the outer boundary of the storage facility. Consideration should be given at the planning stage to the possibility of tanks for the storage of Class 2 petroleum products being required in the future for storage of Class 1 petroleum products. Where such a possibility exists it is recommended that Class 2 petroleum product storage should be planned to Class 1 petroleum product recommendations.

(3) The spacing of tanks for the storage of Class 3 petroleum products need to be governed by constructional and operational convenience only.

Table 3—Location and spacing for tanks storing Class 1 petroleum products where the total capacity is less than 7 000 m^3

Factor	Recommended distances
1. Between tanks of 10 m diameter or less and 14 m in height or less	To suit constructional and operating convenience
2. Between tanks more than 10 m diameter or 14 m in height	Half the diameter of the larger tank, the diameter of the smaller tank, or 15 m, which ever is least, but in no case less than 10 m
3. Between a tank and any filling point, filling shed or a building	15 m, but where tanks are 10 m diameter or less, distances may be reduced to not less than 6 m

Factor	Recommended distances
4. Between a tank and outer boundary of storage facility, any designated non-hazardous area or any fixed source of ignition	15 m, but where tanks are 10 m diameter or less, distances may be reduced to not less than 6 m

2.2 *TANKS TO BE EQUIPPED WITH A FLOATING ROOF*

Tanks for the storage of Class 1 petroleum products and greater than 1 000 m^3 capacity must be equipped with a floating roof.

2.3 *FLOATING ROOF TANK*

A floating roof tank is defined as one that incorporates either:

(i) A pontoon or double-deck metal floating roof in an open-top tank in accordance with API Standard 650; or

(ii) A fixed metal roof with ventilation at the top and roof eaves in accordance with API Standard 650 and containing a metal floating roof or cover meeting any one of the following requirements—

(*a*) A pontoon or double-deck metal floating roof meeting the requirements of API Standard 650.

(*b*) A metal floating cover supported by liquid tight metal floating devices that provide sufficient buoyancy to prevent the liquid surface from being exposed when half of the flotation is lost.

A tank with an internal metal floating pan, roof or cover that does not meet the requirements of 2.3(ii) or one that uses plastic foam (except for seals) for flotation, even if encapsulated in metal or fibreglass, shall be considered a fixed roof tank.

2.4 *FIRE FIGHTING*

The provision of the fire service installations should be in accordance with the requirements of the Director of Fire Services. The details of the installations are outside the scope of this Code of Practice.

The layout of the tanks as distinct from their spacing should receive careful consideration bearing in mind the accessibility for fire fighting. The layout should meet the requirements of the Director of Fire Services.

2.5 *STRUCTURAL PROVISIONS*

Foundations, site investigations and other structural works are covered by the Building (Construction) Regulations. Structural requirements given in this Code of Practice are directly related to the tanks themselves or structural provisions to prevent fire, explosion and environmental pollution.

3. FOUNDATIONS

3.1 *GENERAL*

The choice of foundation for the tank will depend upon the soil conditions, but other factors such as, ground water level, possible flooding of the site, restrictions on level, likely settlement, and the availability of construction materials, may influence the final selection. The choice of foundation will be left to the registered structural engineer but reference should be made to the particular recommendations for tank foundations given in BS2654:1984 and API Standard 650. Foundation design should be carried out in accordance with the Building (Construction) Regulations. The top surface shape or profile of the foundation is termed:

(i) Cone Up where the tank bottom centre is higher than the periphery; or

(ii) Cone Down where the tank bottom slopes to a central drainage sump.

3.2 *COMPACTED GRANULAR FOUNDATIONS*

The material used in a tank foundation pad and to replace any unsatisfactory underlying soft spots, should be sound, clean, durable and preferably granular. It should bind to form a dense surface when laid in 150 mm layers and rolled with a 6 tonnes to 10 tonnes roller. The top surface of the pad should incorporate a stable permeable granular drainage layer.

The compacted granular foundation should be covered with a smooth bitumen-sand mix of 50 mm thick to weather-proof the foundation to provide a barrier to spillage within the bunded area and to protect the tank bottom. Rigid surfacing material such as plaster or concrete will crack with foundation movement and is not recommended.

The exposed edge of the foundation pad should be sloped away from the tank with a fall of not less than 1 in 10 across a strip not less than 500 mm wide, and then sloped down to the bund floor at 1 in 1.5. After the water test, the pad top surface should be trimmed to provide a space below the bottom plate edge for the perimeter seal, or provided with other peripheral seal details to ensure effective water-shedding. An example is given in Fig. 3.1.

An alternative means of providing a continuous level support for the tank edge, with a firm location of the peripheral seal incorporating assured water-shedding, is a reinforced concrete kerb ring built in the top layers of the pad. An example is given in Fig. 3.2.

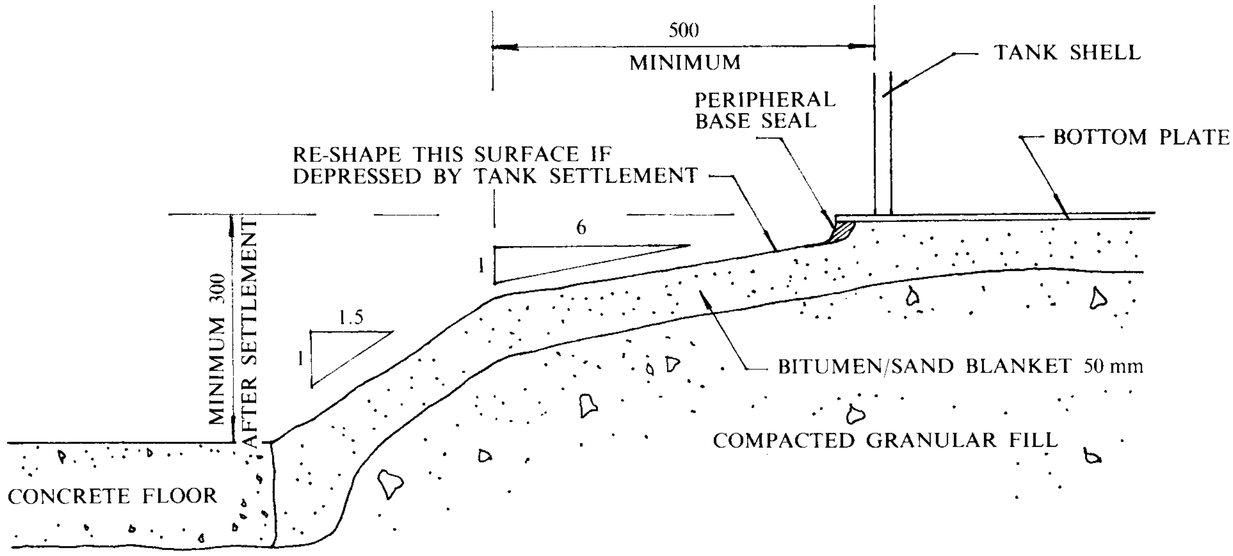

Figure 3.1—Details of finish around foundation pad

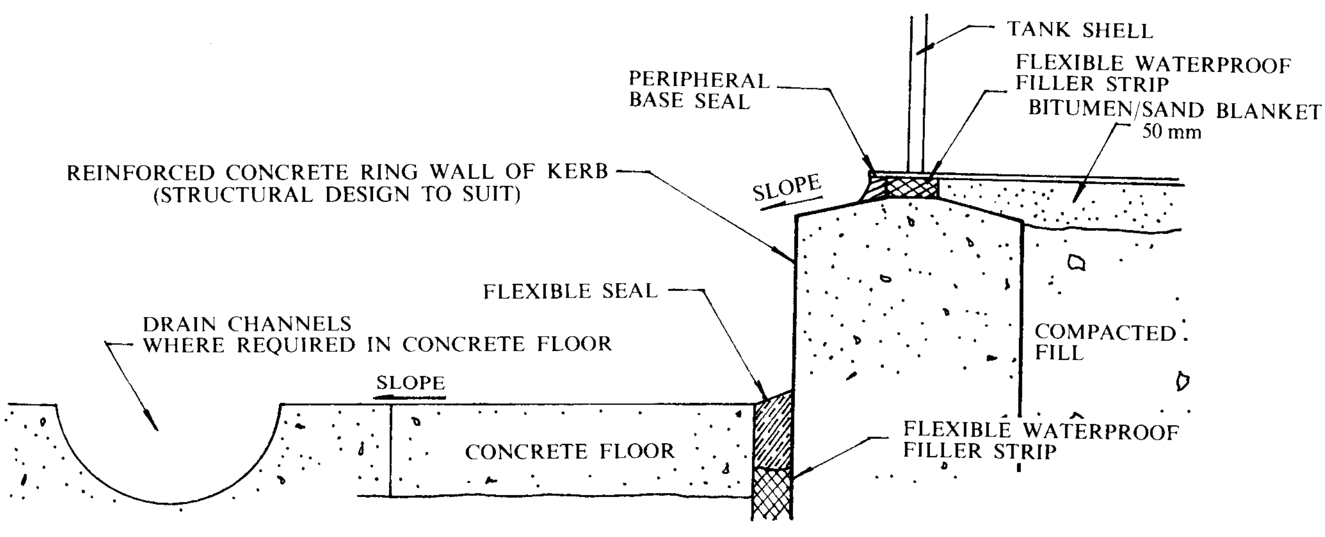

Figure 3.2—Detail around concrete ring base

Where the bottom profile of the tank is designed cone down particular care should be taken to ensure that expected settlements do not cause excessive stress in the bottom plate. If settlements may be predicted, the foundation pad and tank base should be constructed cone up to allow for movements under load which will result in the required cone down profile. The bottom plate levels should be checked against the predictions after completion of the water test. The limits imposed by internal columns supporting the tank roof should also be considered.

3.3 *CONCRETE RING WALL FOUNDATIONS*

Concrete ring wall foundations are particularly suited to natural ground conditions where it is necessary to distribute the loads deriving from the tank shell. In addition to adequately distributing the vertical loading, the ring wall should be designed to carry the horizontal forces produced by the contained material under the surges during tank filling. The provisions of Appendix B to API Standard 650 will apply. The ring wall should not have any perforations or penetrations.

If the ring wall is expected to settle under working load and is surrounded by concrete paving within a bunded area, a suitable flexible sealed joint should be provided at paving level. Ring walls may conveniently be used on top of raft foundations or pile caps. They may serve to lift the tank to a higher elevation where this is operationally desirable, and also to anchor tall tanks against overturning by wind and to resist uplift due to high internal pressure.

3.4 *BEARING CAPACITY GROUND IMPROVEMENT*

Vibration or driving of coarse granular material into a soft silt or clay or weak compressible fill material to form columns or piles may be an economical alternative to piling or other method of improving the bearing capacity of soil. It should be remembered however, that these granular columns may well act in a similar manner to piles and that it may be necessary to treat the tank foundation as a piled design and not as a flexible foundation on compacted ground.

3.5 *OTHER FOUNDATIONS*

Concrete raft or piled foundations may be considered appropriate for the tank foundation in which case the design and construction should comply with the appropriate provisions of the Building (Construction) Regulations.

3.6 *SETTLEMENT*

Probable settlements should be calculated from the soil properties derived from the site investigation, and both the load applied by the foundation and the ground movement should be considered. The effect of the expected settlement on the tank structure and on connecting pipe-work should be evaluated and provision made in the detail design for this settlement. Particular care should be taken when calculation indicates a differential settlement between the tank foundation and the foundations of connecting structures, such as pipe racks, etc. Where the foundations of tanks settle under load, this settlement may affect the foundations of adjoining structures and buildings and due assessment should be made of this possibility; in addition, the spread of load from tank foundations should be considered in relation to adjoining tanks and buildings, both existing and planned. Consideration of this aspect of foundation design may influence the spacing of tanks and the layout of storage areas and may override the minimum spacing criteria.

4. BUNDED AREAS

4.1 *CONTAINMENT VOLUME*

Tanks containing petroleum products should be within a bunded area constructed to contain the maximum spillage from the largest tank. For Class 1 petroleum products, the containment volume of the bunded area should be not less than 105% of the maximum operating capacity of the largest tank, excluding the displacement of all other tanks and foundations. The bunded area should be self-contained with no weirs or overflows to other areas, but it may contain tanks storing Class 2 and Class 3 petroleum products.

For Class 2 and Class 3 petroleum products, the containment volume of the bunded area should be not less than 100% of the maximum operating capacity of the largest tank, excluding the displacement of all other tanks and foundations. The volume of any other bunded area may be taken into account if connected by relief spillways or weirs which are adequate to carry the overflow resulting from the largest tank releasing 100% of its contents in 15 minutes.

In order to limit the spread of fire and to facilitate fire fighting, it may be necessary to divide the bunded area into smaller compartments by the provision of fire walls.

The height of the fire wall measured from the outside ground level should range from a minimum height of 2 m to a maximum height of 3.7 m, to afford protection for personnel engaged in fire fighting. They should be located such that a reasonable close approach could be made to a tank fire, and adequate means of escape be provided over such fire walls.

The total capacity of the tanks for the storage of Class 1 products within one compartment (of fire walls) should not exceed 60 000 m^3 in the case of conventional fixed roof tanks and should not exceed 120 000 m^3 in the case of floating roof tanks. Should the tank capacity be below the above mentioned figures, the bunded area need not be further compartmented and the bund walls would serve as fire walls for fire fighting purposes.

4.2 *WALL CONSTRUCTION*

For the purpose of calculating the strength and stability of embankments or walls, the density of petroleum products should be taken as equal to that of water.

4.2.1 EARTH OR ROCK BUND CONSTRUCTION

Where it is proposed to use excavated material or natural rock material to form a bund, the profile should conform with the provisions of BS 6031:1981

Compaction of the material should be carried out with appropriate plant in layers generally in accordance with BS 6031:1981. An impermeable surfacing is to be applied after the material has been selected, graded and placed to provide an embankment.

On completion, the inner sloping face of the bund should be protected from erosion by concrete blinding, precast slabbing or some other suitable material. The top surface and outer face may be covered with any erosion-resistant material such as chunam plaster, or grass may be grown and maintained.

An acceptable facing for bund embankments is reinforced sand-cement render which should be:

(i) A mixture of 4 parts sand to 1 part cement with minimum water for workability, the sand being the type normally used in reinforced concrete construction;

(ii) Not less than 50 mm thick;

(iii) Reinforced with light wire mesh; and

(iv) Laid in panels with sealed movement joints at suitable intervals; horizontal joints will not normally be required.

The inclusion of a waterproofing admixture is recommended good practice.

Good quality well maintained chunam plaster is acceptable for slope protection above maximum spillage level.

4.2.2 OTHER WALL CONSTRUCTION

Reinforced concrete, prestressed concrete or reinforced masonry walls may be considered suitable bund wall construction in which case the design and construction should comply with the appropriate provisions of the Building (Construction) Regulations.

If masonry walls are used, and where the masonry is capable of absorbing petroleum products and becoming saturated, the wall should be rendered impermeable. A dense sand/cement petroleum resisting render is one suitable material.

All wall and base joints should be provided with a water seal and properly bonded at intersections. An expansion joint should occur within a bund wall at intervals not exceeding 30 m.

4.3 *FLOOR CONSTRUCTION*

4.3.1 GENERAL

The floor construction of a bunded area should be capable of preventing petroleum products penetrating into the ground below the bund floor under the design head of petroleum products. Particular attention should be given to the specification for the floor construction when the bund is sited on reclaimed land and contamination of the reclamation material would lead to the escape of petroleum products into the sea or adjacent water courses.

4.3.2 CONCRETE FLOOR

Concrete floor construction should have a thickness of not less than 125 mm, reinforced and laid on solid ground. The reinforcement expressed as a percentage of the gross crosssectional area of the concrete, should be not less than—

0.25 in each direction where plain bars are used; or

0.20 in each direction where deformed bars or high yield wire mesh is used.

Joint spacing and curing methods should be such as to ensure that drying shrinkage is controlled and that cracking does not occur over the area of the pour.

Joints between bays should be sealed to prevent penetration of petroleum products and rainwater. Bitumen should not be used as a sealant in bunds containing Class 1 petroleum products and if used elsewhere should be renewed when it has cracked through embrittlement: annual repair may be necessary. Other jointsealing materials should be resistant to the petroleum products and to the deteriorating effect of strong sunlight.

4.3.3 ASPHALT AND BITUMEN FLOORS

Asphaltic and bituminous specifications may be considered for bund floor construction, but should be prepared with the solvent effects of the stored petroleum products in mind and should also take into account the possible deterioration under conditions of exposure to strong sunlight. Surface layers of reflective material should be considered.

4.3.4 OTHER MATERIAL

Other materials may be suitable as a bund floor construction provided that it can be demonstrated that in 48 hours the petroleum products do not penetrate more than 50% of the floor thickness.

4.3.5 EARTH BUND

Compacted granular rock materials are not permitted as an acceptable bund floor construction.

4.3.6 MEMBRANES

Membranes of polythene, neoprene or other sheet materials would be necessary when one of the following conditions exist:—

(i) Granular soil underlies the tank basin;

(ii) A water table that is used for drinking water or is ecologically vital underlies the tank basin;

(iii) Nearby waterways or surface water could become contaminated if a spill occurred;

(iv) Buildings in the immediate area could become infiltrated by spilled product;

(v) Product could seep into low-lying areas;

(vi) Product could seep from property limits.

In such circumstances, it is essential that a blanket of suitable material be provided to protect the membrane from deterioration as a result of exposure to ultra-violet light and accidental physical damage. Membranes laid in sheet form should be joined sheet to sheet in a manner which renders them effectively continuous and impermeable. The membrane should be effectively joined to the bund wall foundation pad construction to form a continuously impermeable bund floor.

The joint between the membrane and any concrete floor slab or foundation should be designed to accommodate, as far as possible, the predicted differential settlement. If the predicted differential settlement could cause the membrane to rupture, without an effective means of prevention, such membranes should not be relied upon to provide a continuously impermeable bund floor.

4.3.7 SUB-BASE MATERIAL

Where the substratum immediately beneath the proposed bund floor construction has large open voids, the use of compacted crushed rock is not appropriate because fines may be washed out of the floor layer to form swallow holes. The use of well-compacted fill as a base for a concrete bund floor is, however, permissible.

5. TANKS

5.1 *GENERAL*

The design, fabrication, site erection and testing of above ground vertical steel welded tanks should comply with BS 2654:1984 or API Standard 650. For above ground horizontal steel tanks, the provisions of BS 2594:1975 and the Appendix to BS 799:Part 5:1975 should apply.

5.2 *TANK BEARING PADS*

Vertical steel tanks should be placed upon a bearing pad, giving complete support to the bottom plate, constructed in accordance with the recommendations of 3. Essentially the tank bearing pad is intended to transfer the vertical steel tank loads evenly to the ground, piled foundation or concrete foundation below. The impervious layer specified in 3.2 under the bottom plate may be omitted where the concrete bund floor is effectively continuous under the tank foundation.

The tank bearing pad should be at such a level that stormwater from the most severe rainstorm would not accumulate to a depth which will reach the steel tank base.

5.3 *CORROSION PROTECTION*

Where a steel tank is constructed appropriate design details and finishing materials should be employed to protect all parts of the shell against corrosion.

Adequate paint systems should be applied to all external surfaces and regularly maintained.

The underside of the tank bottom plate is not accessible after erection of the tank, so the construction should include permanent means to guard against water coming in contact with the steel. Pre-painting with bitumen or bitumen-based coating applied on a clean dry surface is recommended; although this coating may be burned along the weld lines later, the bitumen-sand layer specified in 3.2 will provide a barrier to ground-water flooding, capillary movement and vapour. External water should be prevented from seeping under the tank by a peripheral seal which should be water-tight, flexible and readily accessible for inspection and repair. The joint profile should be designed so that water flows away from the seal. Examples are given in Figs. 3.1 and 3.2. It should be noted that the corrosive tropical marine atmosphere in Hong Kong may be exacerbated by industrial pollutants, and that sea-water used for fire-fighting is applied copiously during regular tests.

5.4 *VALVES*

Valves should be fabricated to the requirement of the appropriate British Standard or API Standard. Valves used should preferably give full bore opening and be constructed in materials resistant to corrosion or abrasion from the product they control. They should be designed with a suitable factor of safety relative to the pressures and stresses likely to be met in service. Glands should be designed to permit repacking without removing the valve from service.

The bodies of terminal valves on jetties and in pipelines should be of steel construction throughout. Where valves are not of the rising spindle type, they should embody a clear indication of valve position. In cases where the products handled may solidify in low temperature weather conditions (e.g. heavy fuel oil), the valves should be capable of being heated by steam or other safe means.

5.5 *LEAK DETECTION*

Each tank should be provided with a suitable leak detection system.

6. DRAINAGE

6.1 *GENERAL*

For safety and environmental reasons, petroleum products should not be allowed to escape either by seepage or through drains.

In all areas where surface water cannot be contaminated with petroleum products (e.g. general areas outside bunded areas, yard areas remote from filling points, roadways, and general offices) disposal drainage should be provided for stormwater and sewage in the normal manner. See figure 6.1.

However, all areas where surface water may be contaminated with petroleum products (e.g. within a bunded area, filling areas or pipe racks/trenches) should be provided with drainage facilities in accordance with the following. See also figure 6.1.

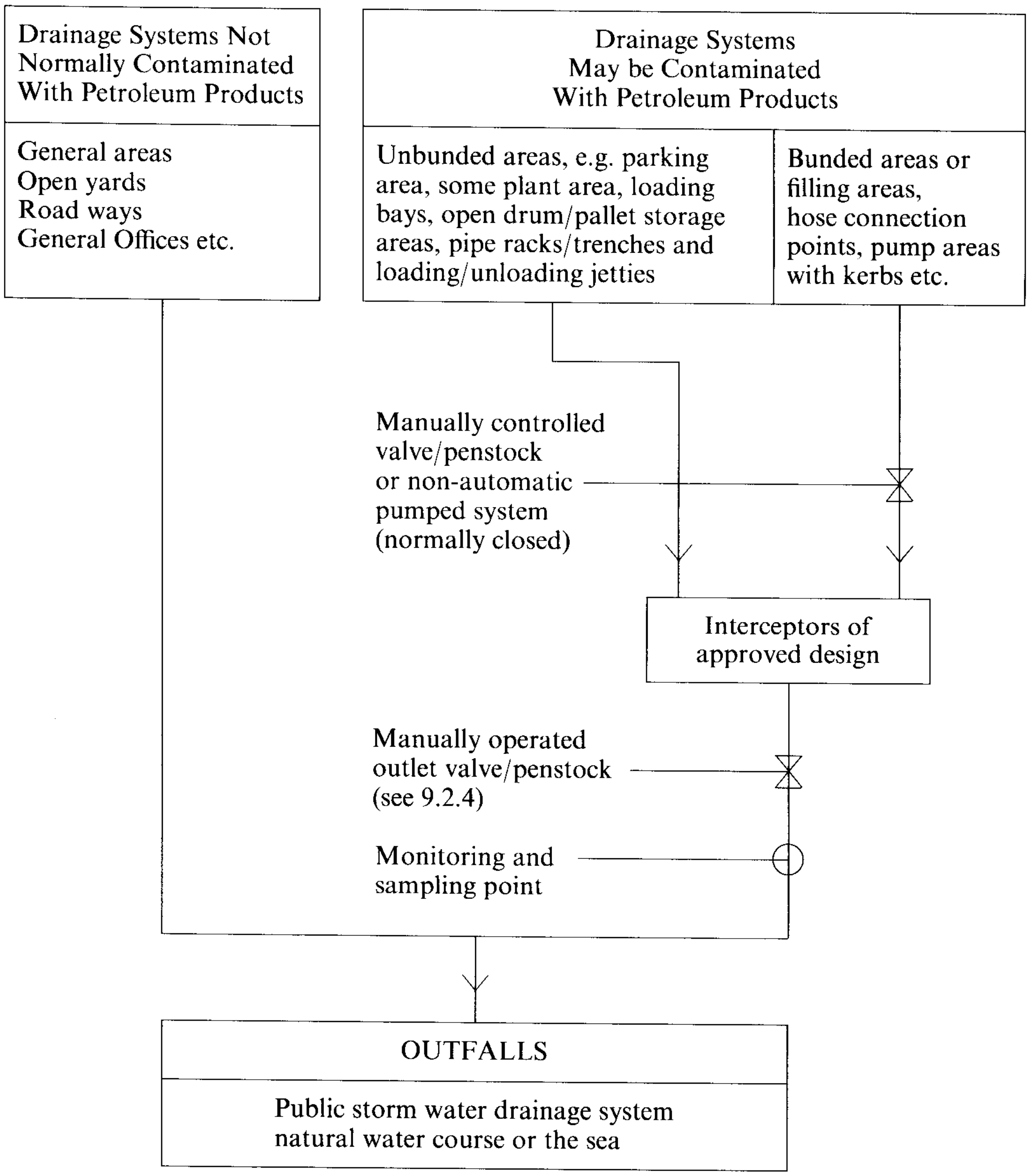

Figure 6.1—Flow diagram of drainage system

6.2 *BUNDED AREAS*

6.2.1 BASIC PRINCIPLES

Any drainage system around above-ground tanks and from tank drain valves should run to one or more interceptors through a pumped or valve-controlled system or as described below. For large bunded areas, it is preferable to have a system of channels within the bund to collect storm water to the point of discharge, thus reducing the falls required on the bund floor itself to a minimum. For small areas, it is sufficient to allow the bund floor to fall to the discharge point. A sand trap and grating may be provided at the outlet to protect the outlet control valve or pump from debris. The provision of other intermediate sand traps or chambers within the bunded area is not recommended because they may retain petroleum products or sludge.

All surface water discharged from bunded areas should pass through purpose designed interceptors.

It is most important that no surface water should be automatically drained from bunded areas. To ensure that free petroleum products inside the bunded area are not passed through the interceptors at a rate beyond their capacity, the discharge of water from the bunded area should be:—

(i) By a non-automatic pumped system. That is to say that the pumps should not switch on automatically but should be activated manually as a normal maintenance procedure following rain; or

(ii) By a gravity system controlled by manually operated valves or penstocks. Such valves and penstocks may be motorised but should require manual activation as a normal maintenance procedure following rain.

The purpose of the bunded area is to contain the maximum spillage from the largest tank. The above systems should be designed and constructed to ensure that there is no leakage when the pumps are off or when the valves or penstocks are closed.

6.2.2 ACCESS

Proper walkways should be provided to reach all tanks and valves within bunded areas to permit attendance to any operational or emergency need before the complete discharge of surface water from the bunded area.

6.2.3 VALVES AND PENSTOCKS

Valves and penstocks controlling the discharge of surface water from bunded areas should be accessible under all circumstances from the outside of the bund and the discharge should be into an open pit or channel so that the flow is clearly visible from the position of valve operation. All valves and penstocks should have a direct spindle operation and should incorporate an indicating device (e.g. a 'rising spindle' or an indicating headstock) which clearly shows when the valve or penstock is in a fully closed position.

6.2.4 TANK ROOF DRAINAGE

Primary and emergency drainage should be provided for floating roof tanks generally in accordance with the provisions of BS 2654:1984 or API 650. However, the number and size of primary drains and the number and size of the outlets should be determined to suit the maximum rainfall intensity predicted for a 'one in ten year' rain storm in Hong Kong. Account should be taken of any limitations of head over the outlets arising from the structural design of the roof. The design should also be compatible with the operation of fixed water installations, for fire protection, where they exist.

6.3 *UNBUNDED AREAS*

In high risk unbunded areas, such as loading bays, package filling points, where small operational spills are probable, surface water drains should be provided with an interceptor before discharging into the public storm water drainage system, natural water course or the sea.

A storm overflow bypass in the interceptor should only be considered for the storm water drainage of large unbunded areas under such conditions where the majority of the pollutants would be carried by the initial downpour and would be first to fill the interceptor and be treated.

6.4 *WEATHERPROOF SIGNS*

To ensure the proper operation of the various bunded area drainage valves and interceptor valves, a weatherproof sign should be erected at the location of each valve or penstock to provide on-the-spot information on the purpose of the valve or penstock and when it should be opened or closed.

6.5 *PUMPS AND HOSES*

Pumps and hose connection points should be located within an area constructed with a concrete floor and perimeter kerbs, with drainage through a sump and an outlet valve leading to an interceptor to separate any spillage. A steel drip pan serving the same purpose is an acceptable alternative for isolated pumps.

6.6 *OTHER CONSIDERATIONS*

Drainage system should be designed to cover the maximum flow that could be predicted for a 'one in ten year' rain storm in Hong Kong.

Drainage system should normally consist of self-cleaning drains. (These require a minimum flow velocity 0.75 m/sec when flowing at one-quarter depth.) However, to prevent fire spread, piped drainage collecting water from areas susceptible to petroleum products contamination should be designed as a continuously surcharged drainage system. Pipes shall be laid horizontally and be kept water sealed by min. 50 mm. Every open drain channel shall 'run dry' after rain. Consideration should, however, also be given to probable ground settlement.

7. INTERCEPTORS

7.1 *GENERAL*

Interceptors should be provided in accordance with the following requirements:

(i) Surface-water drains passing out of the area where surface water may be contaminated with petroleum products must be provided with interceptors;

(ii) Interceptors must be individually designed to deal with the maximum expected surface water/petroleum products flow and must be large enough to process the maximum amount of petroleum products which might be expected from a spillage occurring in the area served by each interceptor, under the controlled flow of a drainage valve of the bunded area. API and IP recommendations should be used in interceptor design so far as its outfall quality meets the requirements set by the Director of Environmental Protection from time to time. Multiple plates concept could also be used for interceptor design in order to meet the outfall quality requirements;

(iii) Interceptors must have a separating capacity to satisfy the maximum rate of flow possible through the draw-off system. These interceptors should also be adequately designed to avoid any unduly long draw-off period after rain in order to ensure that proper observation of the interceptor could be maintained throughout the draw-off period, and to minimise the duration of having the drainage valves of the bunded area open;

(iv) To provide ready access for cleaning and easy inspection, the chambers of interceptors are best left open, with a guardrail or wall around the perimeters. Where the top is partially covered, sufficient unobstructed openings should be incorporated to give a clear view of the inlet flow, a portion of each chamber and the outlet flow. With multiple plates design, mesh should be provided over the openings to prevent the introduction of debris;

(v) Interceptors should be located outside the bunded areas. All water from within the bunded area should pass through the interceptor. A bypass should not be provided unless for the purpose of 6.3. The design should prevent water from the bunded area from entering the bypass;

(vi) For the purpose of 6.3, wherever a storm overflow is provided in an interceptor, the interceptor should be designed to treat all surface water collected during the first (t+2) minutes of a 'one in ten year' rainstorm, where t is the time (in minutes) required for the rain falling on the most distant part of the large unbunded area to reach the interceptor;

(vii) Each interceptor should be provided with a means of removing the floating petroleum product;

(viii) A valve or penstock should be fitted between the outlet weir of the interceptor and the discharge point into the storm drains or outfall;

(ix) The valve or penstock at the interceptor outlet should also clearly indicate its open/closed position by a direct device. The location of the valve should envisage the need for operation if the interceptor is filled to the brim during a spillage emergency; and

(x) A sample point should be provided at each outlet valve from the interceptor to facilitate sampling and monitoring of analytical quality control of the effluent.

8. ELECTRICAL

8.1 *GENERAL*

Special precautions needed to safeguard against fires or explosions which might otherwise arise from the use of electricity, or from lightning or static electricity, near flammable liquids or in dangerous atmospheres peculiar to the petroleum industry are set out in the Institute of Petroleum's Electrical Safety Code.

9. OPERATION

9.1 *GENERAL*

The Building Authority must be satisfied that the operating instructions for each oil storage installation and associated works are satisfactory before granting a licence. For the purposes of this Code the instructions need cover only those procedures which are pertinent to avoidance of fire, explosion and environmental pollution.

Operating instructions should be as simple and specific as practicable. Where various tasks are carried out at increasing levels of responsibility, the division of work should be reflected in the instruction for each grade of personnel, so that every essential operation is provided for. A general statement of aims and objectives may be desirable for staff understanding, but should not be used as a substitute for adequate description of each task a person is expected to perform. For licensing purposes the operation instructions are written in English, but it is essential that they be also written in Chinese, and explained to the personnel by a member of the licensed operator's staff who himself knows the procedures and is proficient in English and Chinese.

Personnel should be trained for the tasks assigned to them and be given an understanding of the reasons behind various procedures. It is desirable that they also understand related operations even though they are not responsible for them, as such understanding reduces the risk of accident through ignorance or negligence.

9.2 *PROCEDURES*

Instructions should cover the following items; description of the actual procedure will depend upon the particular physical characteristics and management control of each oil storage installation and associated works.

9.2.1 HANDLING

Handle bulk petroleum products in accordance with the Institute of Petroleum Marketing Safety Code.

9.2.2 BUNDED AREA DRAINAGE VALVES

Operate the bunded areas drainage valves to ensure that:—

(i) They are normally kept closed except when actually discharging surface water under supervision;

(ii) They are checked and closed at the end of each day;

(iii) They are closed whenever a tank within the bunded area is receiving stock; and

(iv) Discharge of stormwater collected in the bunded area should not commence before rain has stopped unless the interceptor into which it is discharged has been designed to cater for such discharge pattern.

9.2.3 INTERCEPTOR

Observe the interceptor during operation to check that the outflow is free of petroleum products; if the discharge is polluted close the outlet valve, then clean out the floating petroleum products before reopening the valve.

Skim out the interceptor whenever there is an excessive accumulation of petroleum products on the water surface. Clean out the separated sludge regularly. The recovered sludge should be collected in suitable containers properly labelled and disposed of in compliance with the Waste Disposal (Chemical Waste) (General) Regulation (Cap. 354). A record should be kept of cleaning dates and quantity of recovered sludge. See also 9.3.

Inspect the interceptor water level regularly; to ensure that petroleum products cannot pass directly to the outlet. During each regular check, turn the interceptor outlet valve to confirm that it operates easily and can be shut tight when necessary.

Interceptors must always contain the required amount of water to prevent petroleum products from escaping. They should be examined regularly and all sludge, petroleum products, mud, etc should be cleaned out whenever necessary. If a serious leak or spillage occurs within the plant, interceptors should be cleaned immediately afterwards. Petroleum products should not be allowed to remain indefinitely in an interceptor.

9.2.4 INTERCEPTOR OUTLET VALVE

There are different opinions as to whether an interceptor outlet valve should be kept normally open or closed. For an interceptor which serves only bunded or kerbed areas, the valve or penstock at the interceptor outlet can normally be kept either open or closed, but should be closed whenever there is a real danger of oil discharging from the interceptor e.g. during a large spillage emergency which has not been controlled within the bunded or kerbed area, or when there is an excessive accumulation of petroleum products in the interceptor which can lead to an occurrence of floating petroleum products in the outflow.

For the purpose of 6.3 and 7.1(6), an interceptor might also be required to intercept surface runoff collected from high risk unbunded areas. Under such circumstances, it is recommended that the interceptor outlet valve be kept normally open to allow potentially contaminated runoff to flow unimpeded through the interceptor during rainfall. If for particular reasons the interceptor outlet valve is required to be kept normally closed, then adequate arrangement will have to be made to prevent flooding and overflowing from the drainage system and the interceptor, and to ensure that:—

(i) intercepted oil in the oil interceptor;
(ii) pockets of oil accumulated in the drainage system; and
(iii) contaminants on the surface of the high risk unbunded areas.

would not be carried into any public storm water drain, natural water course or the sea.

9.2.5 PUMP AND HOSE CONNECTION POINTS

The outlet valve from the kerbed area should be kept closed whenever the apparatus is in use. Spilt petroleum products should be cleaned up immediately. All spillage should be collected in suitable containers properly labelled and disposed of in compliance with the Waste Disposal (Chemical Waste) (General) Regulation (Cap. 354). See also 9.3.

9.2.6 CONTINGENCY PLAN

The operating instructions should also include a contingency plan including a Fire Order for dealing with fire, spillage and other environmental pollution incidents.

The contingency plan should:—

(i) assess the nature and size of a possible spillage;
(ii) identify nearby sensitive areas e.g. beaches, mariculture zones, sites of ecological interests and sea-water intakes and measures to be adopted if a spillage affects these areas;
(iii) establish a viable operational organization and define the role of the different personnel;
(iv) determine the alerting and communication procedures;
(v) formulate actions to deal with a spillage i.e. stop source of spillage, containment, recovery and final cleanup;
(vi) establish means of disposing of collected petroleum products;
(vii) list available equipment and sources of outside resources; and
(viii) establish training and exercise needs.

The management and operational staff should be trained in implementation of the plan, including the proper and expeditious deployment of equipment, and an instruction to inform all relevant Government Departments immediately.

Full-scale contingency plan practice drills involving the management and operational staff should be held at intervals not exceeding twelve months. Familiarization drills, not requiring full-scale deployment of equipment, involving operational staff should be held at the intervening six-month period between annual drills.

9.3 *SLUDGE DISPOSAL*

Sludges removed from tanks and oily wastes resulting from other operations, including inspections of tanks are classifiable as chemical waste under the Waste Disposal (Chemical Waste) (General) Regulation (Cap. 354) gazetted on 7.2.92, and their disposal will have to comply with this regulation. This regulation controls all aspects of chemical waste disposal, including packaging, labeling, storage, collection, transport, treatment and final disposal of chemical waste. Chemical waste producers will have to be registered with the Director of Environmental Protection and will be required to dispose of their waste at facilities licensed for this purpose. They will also need to provide adequate temporary storage for their waste prior to collection or treatment.

9.4 *EFFLUENT DISCHARGE*

A licence under the Water Pollution Control Ordinance (WPCO) (Cap. 358) will be required for the effluent from oil storage installations and associated works located in declared Water Control Zones. Oil storage installations and associated works located outside Water Control Zones might also need to obtain discharge consent from the Director of Environmental Protection. In both cases, effluent standards will be imposed with reference to the Technical Memorandum issued under section 21(1) of the WPCO.

9.5 *PROTECTIVE MEASURES*

Adequate provision should be made to protect against the effect of static electricity. The provisions detailed in Section 9 of the European Model Code of Safe Practice in the Storage and Handling of Petroleum Products (Part II):1980, or equivalent approved by the authority, will be deemed to be acceptable.

9.6 *TANK ROOF DRAINS*

Tank roof drains should be regularly inspected and properly maintained to prevent blockage.

10. INSPECTION AND REPAIR

10.1 *EXTERNAL INSPECTIONS*

Steel tanks should be regularly inspected to disclose any signs of corrosion or movement which, if left uncorrected, may lead to eventual structural failure.

An external inspection should be made as required by the Regulations. During this external inspection the following matters should be considered:

10.1.1 EXTERNAL COATING

Where a paint system is used, this breaks down as it ages. Minor spot rusting can appear very disfiguring but may be tolerated until large areas fail, at which stage complete repainting should be recommended: it may be practicable to postpone 100% repaint by touching up limited areas but this will depend on the individual case. Other forms of repair such as laminating resin are equally acceptable.

10.1.2 BOTTOM JOINT

The lower 300 mm strip of the tank shell, the welded joint, and the edge of the bottom plate are vulnerable and may be treated separately with a more highly protective coating or repainted more frequently. The steel should not be covered with a thick layer of any material which may hide corrosion below it: where a thick covering exists it should be removed at selected points and the condition of the steel examined, and if water has penetrated and caused rusting the covering may need to be completely discarded.

10.1.3 PERIPHERAL BASE SEAL

The flexible seal which prevents water penetrating the interface of tank bottom and foundation pad must be kept fully effective. Even small cracks will allow the passage of sufficient water to sustain corrosion leading to bottom plate failure. Defective seals should be cut out and replaced, not merely surface-coated. During this work the opportunity should be taken to examine any exposed base-plate surfaces normally hidden.

10.1.4 PERIMETER OF BOTTOM PLATE

The bottom plate may be tilted upward due to settlement in the tank foundation pad. If a gap has formed under the edge it should be cleaned out, rust inhibiting paint brushed or sprayed in, and gap filled with sand-bitumen mix carefully rammed in, leaving a recess to accept the flexible seal.

10.1.5 INSULATION

An external layer of insulation and its sheathing will conceal any corrosion on the steel underneath. Where such corrosion is suspected, sufficient insulation should be lifted to allow adequate inspection. All joints and perforations in the sheathing should be checked and made rainproof because water inhibits the effectiveness of the insulation. Where the design has proved deficient, modifications may be required.

10.1.6 EARTHING CONNECTIONS

Connections should be inspected and any damage or corrosion should be repaired.

10.1.7 TANK FOUNDATIONS

Tank Foundations including concrete ring walls should be included in the external inspection, and any signs of settlement or of distress investigated and corrected.

10.1.8 SETTLEMENT RECORDS

Recorded settlement should be checked and where there is indications of significant development of differential settlements this should be stated in the inspection certificate, with recommendations for additional monitoring as appropriate. Large tanks on soft ground or reclamations may be expected to show continuing settlement during the first few years of their use.

10.1.9 FOUNDATION PADS

Foundation pads may be distorted by settlement, and where the surface does not shed rainwater rapidly it should be stripped, the pad re-shaped, and resurfaced. This could be done with the tank bottom removed or with the jacking up of the tank. At this stage it may be advantageous to give the top surface a substantial cross-fall and form a step at the tank-base edge to facilitate the insertion of a flexible seal. Pad Surfacing deteriorates in time to the state where it no longer functions as an impervious membrane; its replacement by a new surface as specified in 3.2 may be necessary. Where a rigid surface of cement plaster or concrete has been used and is in sound condition the joints or cracks may require re-sealing, but if it is extensively broken a more satisfactory repair would be complete replacement by a new flexible surfacing.

10.2 *INTERNAL INSPECTIONS*

General and internal inspections should be carried out in accordance with the regulations or whenever there is reason to suspect that a tank has developed serious deterioration which cannot be detected by external inspection alone. Corrosion of the underside of the bottom plate should be assumed where its outer edge is severely corroded and the flexible seal defective, or where recent work on the joint has covered a previous long-standing defect, as noted in 10.1.2.

10.2.1 ULTRASONIC MEASUREMENT

Ultrasonic Measurement of Plate Thickness may be carried out by machines which measure the residual amount of sound metal. However accurate the individual readings, each indicates the thickness only at one point and widely-spaced readings may entirely miss small localized corrosion spots.

10.2.2 BOTTOM PLATES

Bottom Plates may be inspected after the tank has been cleaned and gas freed. The top surface is usually rough from corrosion, and may be undulating due to localized limited settlement in the base pad having allowed the plate to sag and stretch; when the tank is emptied, some areas rebound upwards forming springy domes.

10.2.3 VISUAL EXAMINATION

For adequate visual examination, good lighting is essential and flameproof floodlighting should be used in preference to torches. In certain conditions it is possible to see discolourations on the tank floor which may indicate thin spots or pin-hole perforations: these may be quickly tested by hammer-blows, and if they do not fail may be subjected to ultrasonic measurement. Small pieces of the plate may be cut out for inspection and replaced by new patches welded in place.

10.2.4 TESTING

Selection of spots for hammering should be made by the certifying engineer or under his direct supervision. For ultrasonic readings, he should personally select not less than 20% of the positions and give clear instructions for the remainder, and he should also observe a sufficient number of the readings to satisfy himself that the operation is properly carried out. Particular attention should be given to positions alongside lap welds.

10.2.5 SLUDGE DISPOSAL

During each regular inspection, the sludges removed from the tanks should be collected in suitable containers properly labelled and disposed of in compliance with the Waste Disposal (Chemical Waste) (General) Regulation (Cap. 354). See also 9.3.

10.3 *REPAIRS*

Repairs should be carried out to the same quality control as that required for new construction.

10.4 *WATER TEST*

A Water Test should be carried out after completion of the repairs, by filling the tank to its maximum capacity and checking the water level for 48 hours. If there is any drop in level the cause should be investigated and corrected, and the tank re-tested. After the satisfactory completion of a test the tank may be returned to service.

11. MARINE POLLUTION EQUIPMENT

11.1 *GENERAL*

Marine pollution equipment should be maintained at oil storage installations in accordance with the following minimum requirements.

11.2 *BOOM*

11.2.1 LENGTH

A total length of boom not less than 2.5 times the maximum length of vessel permitted to berth at the oil storage installation.

11.2.2 SPECIFICATION

The boom should be of an internationally recognised type and be fitted with anchorage equipment to the manufacturer's specification. It would also be desirable if special connectors could be provided to enable the boom to be connected to government booms which have a 'unicorn' type of connection.

11.2.3 ANCILLIARY EQUIPMENT

The operator should also maintain in stock the ancilliary equipment necessary for the proper deployment of the boom.

11.3 *DISPERSANT*

11.3.1 QUANTITY

Stocks of dispersant are required to be held based upon the deadweight tonnage of the maximum size of vessels permitted to berth at the oil storage installation, in accordance with the following:

(i) Tankers up to 150 000 DWT–8 000 litres;

(ii) Tankers up to 100 000 DWT–5 500 litres;

(iii) Tankers up to 50 000 DWT–2 700 litres; and

(iv) Coastal Tankers and local oil barges under 10 000 DWT–1 100 litres.

11.3.2 SPECIFICATIONS

The quantities specified at 11.3.1 are based upon concentrate type (Type III) dispersants; in the case of Type II dispersant for which dilution is required before application, the specified quantities should be calculated by multiplying the dilution factor. The chemical dispersant held in stock must be of a type approved by the Hong Kong Government and the supplier of the dispersant must posses a valid supplier's licence issued by the Director of Environmental Protection. In addition the operator must possess a valid user's licence also issued by the Director of Environmental Protection.

11.4 *OIL SKIMMER*

11.4.1 QUANTITY

One oil skimmer.

11.4.2 SPECIFICATION

The oil skimmer should be able to work in open sea condition and capable of skimming up at least 10 m^3 of medium fuel oil per hour from the sea.

11.4.3 ANCILLARY EQUIPMENT

The operator should also maintain in stock ancillary equipment necessary for recovery oil skimmed from the sea by the oil skimmer. The ancillary equipment should be capable of receiving 18 m^3 skimmed oil.

11.5 *OIL SORBENT MATERIAL*

11.5.1 QUANTITY

At least 1 000 sheets of sorbent pads or 500 m of such material.

11.5.2 SPECIFICATION

The sorbent material should be of either organic or inorganic material, which can only absorb hydrocarbon products. The sorbent pad should be not less than 450 mm wide and 4 mm thick.

11.6 *MAINTENANCE*

The marine pollution equipment specified in this Code should be regularly inspected and maintained in accordance with the manufacturer's maintenance specification and schedule; in the absence of such a specification and schedule then the equipment should be inspected and maintained at intervals not exceeding six months.

12. ASSOCIATED EQUIPMENT

12.1 *SECURITY*

For reasons of security and safety the area of the storage facility, including pumping equipment and loading and unloading facilities should be enclosed and prevented from unauthorised access. A security fence erected for this purpose should be at least 1.8 m high constructed within the lot. For safety reasons, the fence should have at least two means of exit, separated by at least 5 m, to provide escape routes in case of emergency. Gates should be capable of opening outwards in an emergency and should not be self-locking.

12.2 *PIPE LINES*

Pipes and pipe fittings should be fabricated to the requirement of the appropriate British Standard or API Standard and should have an adequate safety factor for service conditions. Pipe-lines should preferably be of all-welded construction. They should be installed in accordance with sound engineering principles and practice, with the necessary provision made for thermal expansion or contraction.

Pipelines connected to major tank units should be provided with sufficient flexibility to allow for any expected settlement. Flanges should be of adequate strength for the pressure requirements of the line at the maximum temperatures likely to be experienced in service. Mating flanges should be of similar form and materials. Isolating flanges, blanks or spades used to segregate sections of a pipe-line system should be of adequate strength and embody a means of indicating clearly their location and setting.

Publications refered to

BS 799:Part 5:1975	Oil Burning Equipment
BS 2594:1975	Horizontal Mild Steel Welded tanks
BS 2654:1984	Vertical Steel Welded tanks with Butt-Welded Shells for the Petroleum Industry
BS 6031:1981	Earthworks

Institute of Petroleum Marketing Safety Code 1978

Institute of Petroleum Electrical Safety Code 1965

American Petroleum Institute Standard 650: 7th Edition: Welded Steel Tanks for Oil Storage

European Model Code of Safe Practice in the storage and handling of Petroleum Products (Part II):1980