CHAPTER 19

Marine Terminal Fire Protection

Marine terminal fire prevention and protection are key elements in reducing risk and improving safety.

This chapter contains general guidance and specific recommendations on fire protection at marine terminals, including the prevention, detection, signalling and operation of fire detection and protection systems.

In addition to national regulatory requirements, capability should be based on the guidance contained within this chapter and the outputs of a formal risk assessment.

The guidance on firefighting equipment in this chapter should be considered alongside chapter 5, which addresses firefighting theory.

19.1 Marine terminal fire protection

19.1.1 General

Fire safety at marine terminals is provided through overlapping levels of protection as follows:

- Prevention and isolation.
- Detection and alarm facilities.
- Protection equipment and systems.
- Fire proofing.
- Emergency and escape routes.
- Emergency planning.
- Fire protection philosophy.
- Evacuation procedures.

Fire safety at marine terminals is a balance between design features, operational procedures, emergency planning and training. Fire systems should be based on a designed risk assessment performed by experts in firefighting systems.

Fire protection alone will not provide an acceptable level of safety. Fire protection measures should not interfere with mooring or other operations.

Automatic detection of fire and rapid response of emergency personnel using fire protection equipment will limit the spread of fire and the hazard to life and property at all locations in a marine terminal.

Fire protection facilities should be designed to contain and control fires that may occur in defined areas and to provide time for emergency exit.

Emergency exit facilities are needed to ensure the safe evacuation of all personnel from the affected area in the event that fire protection facilities do not successfully control a fire.

19.1.2 Fire proofing

Fire proofing makes equipment fire resistant by using non-combustible or limited combustible material.

To ensure availability of equipment in the event of a fire, terminal fire proofing should consider protection of the following:

- Fire water and foam system actuators.
- Emergency isolation valves.
- ERS for MLAs.
- Electrical switch gear rooms.
- Control rooms/buildings.

19.1.3 Location and spacing of fire detectors

Fire detection at marine terminals is usually provided in high risk areas, e.g. pumping stations, control rooms and electrical switch gear rooms. Detectors may also be fitted at valve manifolds, loading arms, operator sheds and on other equipment or in areas susceptible to hydrocarbon leaks and spills or that contain ignition sources.

To function effectively, fire detection devices should be properly positioned. Detailed requirements for detector placement in confined areas can be found in appropriate codes and standards. However, for flame detectors located outdoors, 3D flame detector mapping software is available that will ensure that the cone of vision covers the intended hazard that is being protected. Thermal radiation software may be used to determine the heat flux of a potential fire and assist in the locating of heat detectors.

Heat, smoke, gas and flame detectors should be installed in a grid pattern at their recommended spacing or at reduced spacing for faster response. Each system should be engineered for the specific area being protected, with due consideration given to ventilation flow patterns.

Detection systems that activate fire-extinguishing systems should be arranged using a cross-zone array. In a cross-zone array, no two adjacent ionisation or photoelectric type detectors should be in the same detection circuit zone. The first detector that is activated should start the fire alarm system, while a second detector, located on an adjacent circuit, should activate the fire-extinguishing system after a timer delay, which allows occupants to evacuate.

19.1.4 Fire-extinguishing system compatibility

When a detection system is part of an automatic fixed fire-extinguishing system, complete compatibility between the systems is essential. Detection devices and systems that are highly

susceptible to false alarms should be avoided, especially when they are connected to fixed fire-extinguishing systems for automatic activation (see section 19.4).

19.2 Alarm and signalling systems

Alarm and signalling systems have a number of significant functions:

- Rapidly transmit an alarm or signal to indicate the detection of fire before there is significant damage.
- Initiate emergency evacuation of personnel in the vicinity of the fire.
- Transmit an alarm to notify responsible parties and initiate an automatic extinguishing system, where fitted.
- Have the capability to stop product transfer, via the ESD system, where fitted.
- Be capable of automatically self-testing and warning of malfunction.

19.2.1 Types of alarm systems

Alarm systems are used to indicate an emergency and to summon assistance.

The various alarm systems range from a local system providing an alert signal at the facility, to one which alerts at a remote station attended by trained personnel 24 hours per day, e.g. a fire or police station or a third party answering service.

The type of system installed at a particular location should be based on a risk assessment (see chapter 4) with input from competent personnel in the field of fire protection considering applicable local regulations.

19.2.2 Alarm and signalling systems

Any variation or combination of the types of alarm and signalling systems previously described can be used to meet local circumstances. Alarm systems provide signals that can be audible, visual or both.

In a large terminal facility, or where the terminal is an integral part of a large plant or processing facility, a coded signal system is preferred. The facility should be divided into a grid system, with each grid area identified by a numbered code. The coded signal system should include a code transmitter that triggers an alert at the specific location and also activates the general alarm.

Emergency reporting can also be achieved by using a dedicated emergency telephone system. Additionally, manual fire alarm activation points can be installed instead of, or to supplement, the telephone reporting system.

When a dedicated telephone system is used, a dedicated telephone should be installed in the control room or supervisory station to receive emergency calls. The telephone should only receive incoming calls and extensions should also be provided at other locations that have preliminary emergency responsibility.

The general alarm system should, at a minimum, consist of one or more air horns, electric horns or steam whistles that are strategically located to ensure maximum coverage throughout the terminal. The alarm should be clear, audible and distinctive from signals used for other purposes and should be heard throughout the terminal regardless of background noise.

Auxiliary alarms should be provided for indoor locations or remote areas where the general alarm cannot be heard. These alarms may be bells, air or electric horns. Whichever devices are provided, they should be the same throughout the facility and should be distinct from other alarms.

19.2.3 Electric power sources

Electric power should be available from two highly reliable sources. The usual arrangement is an Alternating Current (AC) primary power supply, with an Emergency Power Supply System (EPSS) as a secondary power supply. The EPSS may be provided a trickle charger supplying an emergency battery system, or an uninterrupted power supply for standby power. In some locations, authorities may require an emergency generator as the EPSS a secondary power supply in case the primary supply fails.

The capacity of the EPSS varies with the type of alarm system and the requirements of local authorities. For local or proprietary alarm systems, when signals are registered only at the terminal or plant central control room or central supervisory centre, the EPSS usually provides for loss of primary power for a minimum period of 24 hours under quiescent load conditions, plus a minimum 15 minute supply under emergency conditions if an alarm is triggered.

If the EPSS is provided by a battery backup system, there should be a further 20% additional safety margin above the calculated amp-hour capacity provided to support alarms during evacuation.

Emergency power wiring from the EPSS shall not be routed in the same raceway or distribution routeing as the primary supply, to prevent fire damage to both primary and EPSS wiring and so losing power to the critical equipment.

In auxiliary and remote station systems, where trouble signals from the loss of local operating power might not be transmitted to the receiving station, a 60 hour emergency power supply with capacity to operate the entire system if the power is cut off over a weekend is usually required.

19.3 Detection and alarm systems at terminals

19.3.1 General

The specification for the detection and alarm systems on terminals should be risk assessed (see chapter 4) and depend on a number of factors including:

- Products handled.
- Tanker size and number berthed per year.
- Pumping rates.
- Proximity of hazardous equipment with respect to other equipment or hazards, i.e. equipment spacing and electrical area classification.
- Proximity of tankers to the terminal and to hazardous terminal equipment.
- Proximity of the terminal to residential, commercial or other industrial properties.
- Installation of emergency isolation valves.
- Length of pipeline and quantity of product between isolation valves.
- Number and nature of fixed fire-extinguishing systems that are connected to detection and alarm systems.
- Whether the terminal is continuously manned or periodically unmanned.
- Ability of the emergency response unit at the terminal, or within the terminal's organisation, to provide a timely and effective response. This could include consideration of any agreed external emergency response unit. Proximity and mutual aid agreement with any outside emergency response units and their capacity, availability and response time.
- Requirements imposed by local regulatory bodies.
- Desired degree of protection beyond regulatory requirements.
- Degree of effective protection that a manufacturer's detection and alarm system offers.

The alarm system should raise local audible and visual alarms, and possibly a general alarm if the terminal is manned, depending upon local circumstances. It should indicate an alarm at a continuously attended central fire control panel, showing the location of the activated detection and fire-extinguishing system. Where fixed gas detection equipment is installed or the detection system covers more than a single detection zone, the panel should indicate the location of the activated gas detector.

Use of detection equipment that is designed to activate fixed firefighting systems automatically is recommended where a terminal extends away from shore in such a way that manual firefighting is difficult, dangerous or ineffective. This is also recommended wherever firefighting boats are not available, accessibility to firefighting vehicles is poor or at locations where trained firefighting personnel is limited in number and/or not always available for rapid response.

For manually actuated fire protection systems, the detection system should sound a local alarm and send a signal to an attended control room upon activation.

Equipment and terminal areas that can be monitored with automatic fire or gas detection systems include transfer pumps, valve manifolds, MLA areas, control rooms, electrical switch gear enclosures, operator's sheds, below deck areas and other equipment or areas susceptible to hydrocarbon leaks and spills or that contain ignition sources.

19.3.2 Control rooms/control buildings

Detection and alarm equipment in control rooms must meet local regulations. The installation of additional gas and fire detection devices with associated alarm equipment depends on site specific factors, e.g. control room pressurisation and attendance. Based on a risk assessment (see chapter 4), control rooms/buildings should be protected from fire by the installation of fire proofing, deluge systems and emergency air supply.

The following general detection and alarm facilities are recommended for control rooms or buildings:

- Manual fire alarm activation points should be provided at all exits, and along escape routes, spaced according to travel distances in appropriate codes and standards.
- A fire detection system should be installed in any area of a control building that is unattended. Each detector should raise a local alarm in attended control rooms and should activate an alarm at the main fire control panel.
- Combustible gas detectors should be installed in the fresh air intake vents of pressurised control rooms and inside non-pressurised control rooms. Each gas detector should sound a local alarm and a main fire control panel alarm.

For terminals handling low flash products, where control rooms are not continuously attended, a fixed fire-extinguishing system, activated automatically upon detection of fire, should be installed. The gas or fire detection system should then be arranged in a cross-zone array (see section 19.1.3).

19.4 Firefighting equipment

Terminal firefighting equipment is located throughout the facility and much of it is exposed to weather. Terminals should ensure that all firefighting equipment is maintained under a PMS, as per OCIMF/SIGTTO's *Jetty Maintenance and Inspection Guide*.

On the jetty, firefighting equipment should be ready for immediate use. While this may not involve the rigging of fire hoses, the preparations for emergency operation of the firefighting equipment should be apparent and communicated to tanker personnel. Consideration should be given to having portable extinguishers available for use adjacent to the jetty manifold area.

Any alternative or supplemental firefighting services provided should deliver at least the equivalent capability as required under the minimum provisions detailed in table 19.1.

Fixed firefighting systems should be capable of full operation within the first five minutes of a fire.

19.4.1 Terminal firefighting equipment

At some terminals, the local authority or port authority may provide the main firefighting capability. The type and quantity of firefighting equipment should meet the minimum requirements detailed in table 19.1 and be risk assessed (see chapter 4) based on the following factors:

- Sizes of tankers that can be accommodated.
- Location of terminal, berth and accessibility.
- Nature and quantity of the cargoes handled.
- Potential impact of oil spillage.
- Areas to be protected.
- Prevailing environmental conditions, including terminals located in cold climates where freezing of water occurs.
- Regional fire response capability, response times and access to terminal facilities/jetties.
- Reciprocal arrangements (mutual aid societies).
- Level of training and experience of local emergency response organisations.

19.4.2 Portable and wheeled fire extinguishers and monitors

Portable fire extinguishers should be provided at every marine terminal berth on a scale relative to the size, location and frequency of use of the berth and compatible with flammable liquid fires (see table 19.1).

Portable fire extinguishers should be located so that a fire extinguisher can be reached without travelling more than 15m. Wheeled extinguishers should be located in accessible positions at each end of loading arm gantries or at the berth approach access point.

Fire-extinguisher locations should be permanent and conspicuously identified by luminous background paint or suitably coloured protective boxes or cabinets. The top or lifting handle of a fire extinguisher should not be at a height of more than one metre.

Carbon dioxide (CO_2) extinguishers have little value at berths or on jetties, except at points where minor electrical fires could occur. However, enclosed electrical sub-stations or switch rooms located on marine terminals should be equipped with an adequate number of CO_2 extinguishers or should have a fixed CO_2 system installed.

Foam extinguishers with a capacity of at least 100 litre of pre-mixed low expansion foam solution are suitable for use at berths.

Portable foam/water monitors (see table 19.1) should have a discharge capacity of at least 115m^3/hr of foam and water in solution.

Fixed or portable water/foam monitors (see table 19.1) should be provided (one located on either side of the shore manifold) with the ability to reach the tanker and shore manifolds.

19.4.3 Terminal fixed firefighting equipment

19.4.3.1 Fire water supply

Fire water at marine terminals is often provided by the unlimited supply available from the sea, rivers or dock basin.

When fire water supply is obtained from static storage, e.g. a tank or reservoir, the reserve for firefighting purposes should be equivalent to at least four hours of continuous use at the maximum design capacity of the firefighting system. The reserve for firefighting should be additional to that required by any other user taking water from the same static storage. The piping arrangements at such storage facilities should be organised to prevent use of the firefighting reserve for other purposes and the integrity of the make-up water supply to such a reserve would need to be assured.

Fire water flow rates and pressures should cover both extinguishing and cooling water requirements for a fire that might realistically occur. In providing fire water, consideration of climatic conditions and risks from freezing should be assessed at the system design stage. For typical flow rates, more information is available in table 19.1.

Installation	Minimum recommended provisions
Barge berth, wharf, or jetty handling liquids with a flashpoint at or below 60°C including materials in drums, and any product heated above its flashpoint OR Tanker berth at a wharf or jetty handling ships of less than 20,000 tonnes DWT and less than one ship per week	Fire main incorporating isolating valves and fire hydrants with a pressurised water supply of not less than 115m³/hr Two fixed or portable water/foam monitors, one on either side of the shore manifold, capable of reaching the tanker outboard manifold Foam tank or totes to provide at least 15 minutes of foam coverage through two monitors 2 x 9kg portable dry chemical extinguishers 2 x 50kg wheeled dry chemical extinguishers 1 international shore fire connection
Tanker berth at a wharf or jetty handling ships of less than 50,000 tonnes DWT OR Tanker berth at a wharf or jetty handling ships of less than 20,000 tonnes DWT and more than one ship per week	Fire main incorporating isolating valves and fire hydrants with a pressurised water supply of not less than 350m³/hr Two fixed or portable water/foam monitors, one on either side of the shore manifold, capable of reaching the tanker outboard manifold Fixed supply of foam should be in place at the berth via a foam tank or totes to provide at least 30 minutes of foam coverage through two monitors 4 x 9kg portable dry chemical extinguishers 2 x 50kg wheeled dry chemical extinguishers 1 international shore fire connection
Tank berth at a wharf or jetty handling ships of 50,000 tonnes DWT or larger	Fire main incorporating isolating valves and fire hydrants with a pressurised water supply of not less than 700m³/hr Two fixed elevated water/foam monitors, one on either side of the shore manifold Fixed supply of foam should be in place at the berth via a foam tank or totes to provide at least 30 minutes of foam coverage through two monitors 6 x 9kg portable dry chemical extinguishers compatible with flammable liquid fires 2 x 50kg wheeled dry chemical extinguishers compatible with flammable liquid fires 1 international shore fire connection
Sea island	Fire protection facilities as above according to use and size of tanker Portable equipment: 6 x 9kg portable dry chemical extinguishers 2 x 50kg wheeled dry chemical extinguishers 1 international shore fire connection

Table 19.1: Minimum recommended provisions or equivalent (see section 19.4.3.7 for existing terminals with single monitor)

19.4.3.2 Fire pumps

Permanently installed fire pumps should be provided on a scale that will ensure adequate reserve capacity to allow for contingencies, e.g. fire pump maintenance, repairs or breakdowns.

Electric motor, diesel engine and steam turbine driven pumps are acceptable. All pumps should have a reliable power or fuel supply to meet the requirements in section 19.4.3.1 and table 19.1.

When the fire pumps are to be located on a wharf or jetty, a safe and protected location is essential to ensure that the fire pumps will not become immobilised during a fire at the marine terminal, or do not in themselves present a potential ignition source. When selecting a location for the fire pumps, consideration should be given to the loading gantry and the nearest moored tanker or barge.

To reduce the risk of a fire impacting the fire pumps, fuel tanks should be located remotely from the fire pump engine. Systems for fire detection and firefighting should be fitted to the tank.

When practical, fire pump installations should be protected from a sea surface fire penetrating the underside or below deck area of the installation. Protection may be achieved by structural barriers, booms or water spray systems or by installing the fire pump on a solid deck. Whenever electric motor driven pumps are installed, careful routeing and fire protection of power cables should be considered.

19.4.3.3 Fire main piping

Permanent fire water mains and/or foam/water solution mains should be installed on marine terminals and along the approach routes to berths. Mains should extend as near to the heads of marine terminals as possible and be provided with a number of accessible hydrants.

Fire hydrants generally consist of headers with individual valves fitted with a fire hose connection suitable for the type of fire hose coupling in use. Isolating valves should be fitted to prevent the loss of all firefighting systems because of a single fracture or blockage of the fire main network. The isolating valves should be positioned so that, in the event of fire main failure in the berth area, there will still be a supply at the berth approach. When the berth fire main is extended from a shore installation, an isolating valve(s) should be provided at the shoreside end of the wharf or jetty. Additional fire hydrants should be provided upstream of an isolating valve.

For sea island berths, isolating valves should be positioned on the fire main grid so that at least 50% of the grid will continue to operate in the event of a single point failure, or during necessary maintenance, and still provide enough hydrants for the total fire water demand.

Fire main construction materials should be compatible with the water supply.

The minimum capacities and pressures for fire water mains depend on whether the system is to be used for cooling or production of foam (see table 19.1).

When freezing conditions are encountered, fire mains that are not maintained in the dry mode should be protected from freezing. In particular, when the fire water supply is obtained from an onshore grid, any wet section of the grid should be buried below the frost line or otherwise protected from freezing. Buried fire mains need to be suitably coated and wrapped to prevent corrosion. Cathodic protection may also be necessary.

Drain valves should be conveniently and suitably located on the fire mains and flushing points should be provided at the extremities of the fire main grid.

19.4.3.4 Fire hydrants and hose reels

The number, location and spacing of fire hydrants or hose reels at marine terminals will be determined by the facilities to be protected. At the berth or MLA areas, it is often difficult to achieve uniform spacing of fire hydrants, whereas on approach or access routes, uniform spacing can usually be achieved. Hydrants should be spaced at intervals of not more than 45m in the

berth or manifold areas and not more than 90m along the approach or access routes. Each fire hydrant should be equipped with a hose, nozzle and spanner.

Hose connections should be of a design compatible with those of the local or national fire authorities.

Fire hydrants should be readily accessible from roadways or approach routes and located or protected in such a way that they will not be susceptible to physical damage.

19.4.3.5 Pump-in points for firefighting boats

If tugs are used to berth or unberth, or standby tankers, at a terminal, they may be equipped to pump firefighting water into the terminal's fire main system.

Pump-in points should be provided at suitable, accessible locations near the extremities of the fire mains and preferably where firefighting boats can be securely moored. In an extreme emergency, a fire boat can then be used to augment the fire water supply to the shore fire main grid.

Pump-in points should have at least 4 x 63mm hose inlets or the equivalent. The hose inlets should have screw-down valves and/or be fitted with Non-Return Valves (NRVs) and be installed to minimise the possibility of hose kinking.

The location of these inlets should be highlighted, e.g. by appropriate signage and white painted hydrants.

19.4.3.6 Foam systems

Foam concentrate should be properly proportioned and mixed with water at a point downstream of fire water pumps and upstream of foam making equipment and application nozzles and monitors. The flow rate may need to be increased if fluorine free foam is used.

Fixed pipelines for expanded (aerated) foam are not recommended because the fully developed foam cannot be projected effectively due to loss of kinetic energy and the high friction losses through such systems.

The type of foam concentrate selected, i.e. protein, fluoroprotein, Aqueous Film Forming Foam (AFFF), or alcohol/polar solvent resistant type concentrate (hydrocarbon surfactant type concentrate), depends upon the fuel type and formulation, of whether aspirating or non-aspirating equipment is installed and ease of re-supply.

See section 5.3.2.1 for environmental issues with AFFF and Alcohol Resistant Aqueous Film Forming Foam (AR-AFFF).

There are several systems that can be adopted for feeding foam concentrate into foam making equipment at the berths. Some of the principal systems are described below.

Direct foam pick-up from atmospheric tanks

This method incorporates direct foam induction via a flexible pick-up tube connecting a monitor to either an adjacent foam storage tank at atmospheric pressure, a tank truck, a portable trailer or a drum. One storage tank may be used to supply more than one fixed monitor. Such monitors would be positioned near ground or deck level.

Displacement proportioner foam unit using pressure vessels

This unit may contain foam concentrate in one large pressure vessel, possibly of 4.5m^3 capacity, or two smaller pressure vessels of 2.3m^3. The foam proportioner unit is positioned between the fire pumps and the downstream foam making equipment. The system functions by using bypassed fire main water to pressurise a bladder inside the storage vessel and displace the foam concentrate from the storage vessel into a foam system main.

Sufficient hydrants should be provided on the foam main from which portable foam making equipment, including monitors, can be operated.

Dedicated foam concentrate pipeline system using atmospheric foam tanks

This system comprises three main components:

1. Foam concentrate bulk storage in tanks or other vessels.
2. Foam pumps for delivering the foam concentrate into the foam pipeline grid. The pumps may be rotary gear electric motor/diesel driven or water turbine driven using a bypass from the fire main.
3. Pipeline grid, possibly of 75mm diameter, traversing the berth approach and the berth, providing numerous take-off points for the attachment of foam induction hoses for connecting portable or fixed equipment.

The foam concentrate grid to the take-off points should have a proportioner to proportion the exact amount of foam concentrate at the take-off point. The foam concentrate pressure at this point should be higher than the fire main pressure (typically 1-barg above the fire main pressure).

When pipelines for foam solution or concentrate are provided, the lines should have several accessible take-off (hydrant) points that should be spaced not more than two or three standard hose lengths apart. Isolating valves should be fitted to retain the utility of the line in the event of fracture. Suitable pipeline drain valves and wash out facilities should be provided. A foam solution pipeline of this type should be designed for a minimum solution rate of 115m³/hr.

Foam concentrate can also be distributed through a smaller bore pipe system to the tanks supplying the inductors of fixed or mobile foam making appliances.

Variable flow injection incorporating atmospheric foam tank and foam pump(s)

This system involves pumping foam concentrate into a foam main via a metering device or variable flow injector. The foam pump(s) would normally be driven by an electric motor and would take suction from an atmospheric foam tank.

Supplies of bulk foam concentrate associated with any fixed foam monitor or foam/water sprinkler system should ensure continuous foam application until the arrival of adequate backup firefighting resources, either water borne or land based. The bulk foam concentrate supply should ensure continuous foam application at design flow conditions, as detailed in table 19.1.

19.4.3.7 Monitors (or cannons)

Monitors may be used for foam and water, although specific types may be designed solely for foam. Large capacity monitors would normally be on a fixed mounting or on a portable unit. The provision of fixed monitors should be considered for tanker berths handling ships in excess of 20,000 tonnes DWT. The scale of provision should be related to the size, location and frequency of use of each individual berth (see table 19.1).

The number and capacity of foam monitors required will depend on local circumstances and conditions, including the capacity of the fire water supply system. Existing facilities may have a single elevated foam monitor provided for berth and tanker firefighting duty. The discharge capacity of a single monitor should not be less than 115m³/hr and should meet the capacity requirements detailed in table 19.1.

The monitors should be supplied from the berth fire main and be either manually activated at each monitor riser or activated from a remote manual or motorised isolating valve controlling a group of monitors, depending upon the design. Manually operated monitors should be pre-positioned before transfer operations.

Monitors can be situated at berth or wharf deck level, e.g. at small terminals, or mounted on fixed towers. The effective height of the liquid stream required from a monitor is dictated by the particular use envisaged. Fixed monitors should be positioned on towers, or on top of gangway access towers, to ensure that foam discharge will provide unrestricted coverage of the marine transfer equipment and the tanker manifold in all laden and ballast conditions.

Monitors may be manually or remotely controlled either from the tower base or at a distance. Tower base controls may need special protection. Reduced visibility caused by smoke may limit the effectiveness of manually operated fixed towers. Remote control can be achieved by electronic means, hydraulically or with a mechanical linkage. The remote control point for elevated monitors should be in a safe location. However, the selection of a safe location will depend upon the character and size of the berth involved. Where practicable, the monitor control point should be at least 15m from the probable location of fire.

The water monitors should be mounted at berth or wharf deck level and be fitted with variable nozzles capable of discharging either a spray or a jet. They should be capable of cooling the berth structure as well as the adjacent hull of a tanker. In some cases, it may be necessary to provide elevated water monitors in place of, or additional to, deck mounted monitors to allow water discharge above maximum freeboard height.

19.4.3.8 Below deck fixed protection systems

Below deck fixed protection systems are installed when the marine terminal extends over water and away from shore in such a way that firefighting would be difficult or dangerous, or when firefighting boats are not available. In these situations, this type of system will provide a safe base of operations during a large tanker fire and is especially useful where large spill fires on the sea beneath the berth are a possibility.

When firefighting boats are available to provide a quick response, a fixed water spray or deluge system may be installed below deck for cooling non-fire resistant, unprotected supports and exposed structures, should there be a local surface fire. The rate of discharge for such a system should be at least 10.2 litres per minute per square metre.

When firefighting boats are not available or cannot provide a quick response to a fire, a fixed system of foam/water sprinklers may be installed below deck for cooling and protecting the supporting structure that is constructed of non-fire resistant, unprotected materials.

Under these circumstances, such a system would provide rapid below deck fire control and extinguishment. A system of this type should discharge not less than 6.5 litres per minute per square metre. When supporting piles and beams are constructed with fire resistant materials, for example concrete, a fixed system of foam/water sprinklers discharging at reduced application rates may be advisable.

19.5 Access for firefighting services

Parking areas should be provided for firefighting vehicles close to marine terminal approaches. The provision of a layby or passing area on jetty approach structures should also be assessed, including hazardous zone classification. Consideration should be given to any limitations regarding the maximum axle weights for vehicles accessing berth structures and the ability to turn and exit the jetty head.