



Property Risk Consulting Guidelines

XL Risk Consulting

A Publication of AXA XL Risk Consulting

PRC.9.2.1.2

HANDLING FLAMMABLE AND COMBUSTIBLE LIQUIDS ON DOCKS, PIERS AND WHARVES



INTRODUCTION

Water transport remains the cheapest method of moving bulk materials available today. With liquids, it is rivaled only by pipeline. Because certain materials can be transported profitably only via ship or barge, many facilities do not arrange for alternative modes of transportation, such as rail, road or pipeline. Therefore, any serious damage to docking at such facilities could stop all production until repairs are completed. This could take 12 months or more and could be very costly.

This section summarizes protection recommended for docks, wharves and piers where flammable and combustible liquids are handled. Where possible, regulations concerning International Waters and River authorities are noted.

POSITION

Follow PRC.17.24 in all general aspects for port and dock operations.

Piers handling flammable and combustible liquids should conform to NFPA 30. Guidance can also be found in the International Safety Guide for Oil Tankers & Terminals (ISGOTT) and the International Safety Guide for Inland Navigation Tank-barges and Terminals (ISGINTT).

Adhere to NFPA 58 and API RP 2510 for LPG terminals and to NFPA 59A in all particulars for LNG facilities. Several publications on the safe operation and protection of LNG and LPG terminals were also published by the Society of International Gas Tanker and Terminal Operators (SIGTTO).

Management Programs

Docks range in size from very small, simple facilities for a single river barge to very large, complex ones for multiple supertankers. The management of small docks may be from a central location responsible for a number of these installations, while large docks are usually managed locally. Irrespective of whether loss prevention programs are handled by local or central management, the programs should still incorporate all of the features covered in PRC.1.0.1 (*OVERVIEW*), AXA XL Risk Consulting's total management program for loss prevention and control. When developing this program, pay particular attention to the following important areas:

Process Hazard Evaluation Program

Design all loading and unloading operations to be safe by the use of instrumentation. Protect piping, tanks and pressure vessels with adequate pressure relieving devices. Provide intermediate alarms to allow the operator time to take corrective action. Provide automatic shutdown for equipment wherever possible without endangering other operations. Provide redundant instrumentation for all critical controls. Include both separate signal transmitters and receivers in redundant loops. Install a comparator to notify operators when control and redundant signals differ.

To limit the amount of materials released by equipment failure, install shutdown systems including: block valves; venting; and purging or flooding of equipment with a nonhazardous fluid. Combustible vapor detectors should actuate these systems where appropriate.

Consider using combustible vapor detectors to detect accidental releases of gases or liquefied gases.

Design and specify equipment considering all possible operating conditions, both normal and abnormal. Pay particular attention to suitability of the equipment and piping to handle the materials and to withstand external environmental influences such as thermal or mechanical shock or water or salt induced corrosion.

Operator Training Program

Terminals should have a written, comprehensive and up to date Operating Manual, including procedures, practices and drawings relevant to the specific terminal.

Enforce adherence to written operating procedures. Educate all operators in the hazards of the process and functions of the safety control equipment. Forbid operations when any of the safety equipment is out of order. Train operators in manual emergency shut-down procedures. Give operators written authority to implement those procedures.

At least annually, schedule re-education and re-training of the operators. Include testing to assure proper performance of all assigned duties with particular emphasis on emergency shutdowns.

Pre-Emergency Planning

AXA XL Risk Consulting's PEPlan is the pre-emergency plan found in *OVERVIEW*. It may be used as a general reference to develop a customized plan. More specific guidance can be found in the International Safety Guide for Oil Tankers & Terminals and the International Safety Guide for Inland Navigation Tank-barges and Terminals. The emergency plan should include the following features:

- A fire and disaster alarm system.
- An emergency communications system, including radio where needed.
- An adequately trained, staffed and equipped organization of employees for firefighting, release mitigation and other duties. Small terminals with few or no employees on site may have to rely on outside organizations to meet these needs.
- Emergency procedures for vessel removal from a berth
- A planned program of cooperation with neighboring plants and with public firefighting and disaster control organizations.
- Contingency plans to handle the materials in case the loading/unloading facilities are damaged or destroyed.
- Evacuation drills should be held frequently, typically at least once every three months, and all key and supervisory personnel at the facility should have a thorough knowledge of the evacuation plans

Inspection, Testing and Preventive Maintenance Programs

Inspect, test and maintain storage tanks, piping, instrumentation, electrical equipment and pressure/vacuum relief devices according to a schedule established with proper consideration given to both design and service conditions. Include nondestructive testing, IR scanning and vibration analysis in inspection techniques. Establish a detailed, recordkeeping system, including life extension forecasts or projections.

Inspect, test and maintain fire protection equipment in accordance with NFPA 25, PRC.12.0.2 and PRC.12.5.1.

Management of Change

Terminals should perform regular reviews, at least annually, of their facilities and operations to identify potential hazards and the associated risks. In addition, reviews are required in case of any changes which are made to the facility's physical arrangements or procedures. Pay particular attention to the following areas:

- Conduct a process hazards evaluation for all new or modified equipment. Determine the need for new or different safety equipment or measures.
- Whenever the use of equipment is changed from one service to another, or when other changes are made, examine the inspection and maintenance program and modify it as necessary. Monitor daily operating changes.
- Verify new construction materials and all maintenance parts and supplies as conforming to original (or modified) design specifications. Ensure that "replacement in kind" contains no hidden changes.
- Incorporate a program for handling new construction, including the control of outside contractors.
- Update operations procedure manuals after each modification which results in a change in operating procedure.
- Review and follow through expeditiously on all inspection recommendations from insurance, code enforcement and regulatory agencies.
- Update P&IDs with an on-site check to confirm the as built condition. Document any changes from design specifications and perform additional process hazard analysis if needed.

Security and Surveillance

Verify that site security is in compliance with the International Ship and Port Facility Security (ISPS) Code (See PRC.17.24 for additional information) or the local Coast Guard or shipping regulations. The ISPS Code should be followed where applicable. The following should be considered:

- Physical barriers such as fences or walls to restrict land access to the facility.
- Continuously manned guard stations at all entrances to the facility.
- Hourly recorded guard tours of areas which are not continuously occupied.

Monitor all automatic fire protection systems including fire and combustible vapor detectors at a constantly attended location.

Other Management Programs

Incorporate the following programs into the loss prevention and control program:

- Welding, cutting, and other “hot work” permit programs.
- A program for handling impairments to fire protection equipment using AXA XL Risk Consulting’s “RSVP” program.
- Smoking regulations.

Operations

Berthing

Arriving vessels should be provided with general port information as soon as practical. Place at the controls an experienced harbor pilot who has full knowledge of the main currents as well as counter and eddy currents at the specific berth. The ship master should be provided with a mooring plan (procedure for mooring the vessel). The plan should be discussed and agreed on between the ship master and the pilot. Require Speed-of-Approach equipment for ships greater than 140,000 Dead Weight Tons (DWT) cargo capacity or for Liquefied Petroleum Gas (LPG) or Liquefied Natural Gas (LNG) ships with cargo capacities greater than 880,000 ft³(25,000 m³). This equipment should preferably be of the radar type and located on the two end breasting dolphins (the mooring posts or buoys at the ends of the dock or pier).

Maximum speeds and distances should be set by knowledgeable personnel and strictly enforced by management.

Require all LPG and LNG ships to cool their tanks off-shore, before docking.

Establish a communication protocol before berthing. Keep the docking/berthing master, all line handlers (dock and afloat), the tug captains and the pilot in communication on the same frequency.

International law requires any ship that catches fire while at the pier must be cut adrift and must be pulled away or leave under its own power. This law differs from some river authority laws, which require the ship or barge to remain at the pier.

Loading and Unloading

Before starting any operation, the ship master and terminal representative should agree in writing on the product transfer procedures and emergency procedures. A safety checklist should be completed and signed by the ship master and the terminal representative.

Include the following precautions during loading and unloading operations:

- Lay fire hoses to the ship, but do not connect them. In the event of a fire or spill, connect them if the ship is not to be pulled away from the pier.
- Place towing cables at front and back of the ship 3 ft (1 m) above the water so the ship can be towed away from the pier, if necessary.
- Use break-away or quick release type product line manifolds. Install quick release couplings on all loading arms. This type of coupling consists of two fail-safe ball valves with a three or

five-fingered coupling between which opens (uncouples) upon air failure. This enables the ship to pull away from the dock in an emergency without manually uncoupling the product lines.

- Use quick release mooring hooks with load readouts located in the dock office. Activate the release either from the ship or electrically from the central control room. Electrically insulate the mooring lines from the ship to avoid static electricity when mooring lines first connect the ship with the dock.
- Comply with API RP 2003 for protection from static electricity and stray currents caused by the relaxation static electrical charges in crude oil. Provide insulating flanges on all ship-to-shore connections. These should have a resistance of at least 1000 ohms when in service. A tanker/shore bonding cable, as might still be required by some national and local regulations, does not replace the requirement for an insulating flange or hose. Since the use of a bonding cable has been found to be ineffective for its intended purposes but has itself created a possible hazard to safety, the use of tanker/shore bonding wires is not recommended.

Use oil booms to reduce the size of a spill, reduce the fire area, and contain a foam blanket when applied. Use the booms as soon as possible after the ship has tied up at the dock and before loading/unloading commences.

Special precautions might be required for any non-standard operations, including double banking, over the tide cargo operations or operations where tankers are not always afloat.

Construction

Piers

Use separate piers for handling LPG and LNG.

Use fire resistant materials to construct all piers, wharves, sea islands and docks. Do not use metal grating as it rapidly becomes untenable when exposed to fire.

Berthing dolphins, located fore and aft of the pier, may be of wooden construction with a polypropylene or nylon cover to reduce friction.

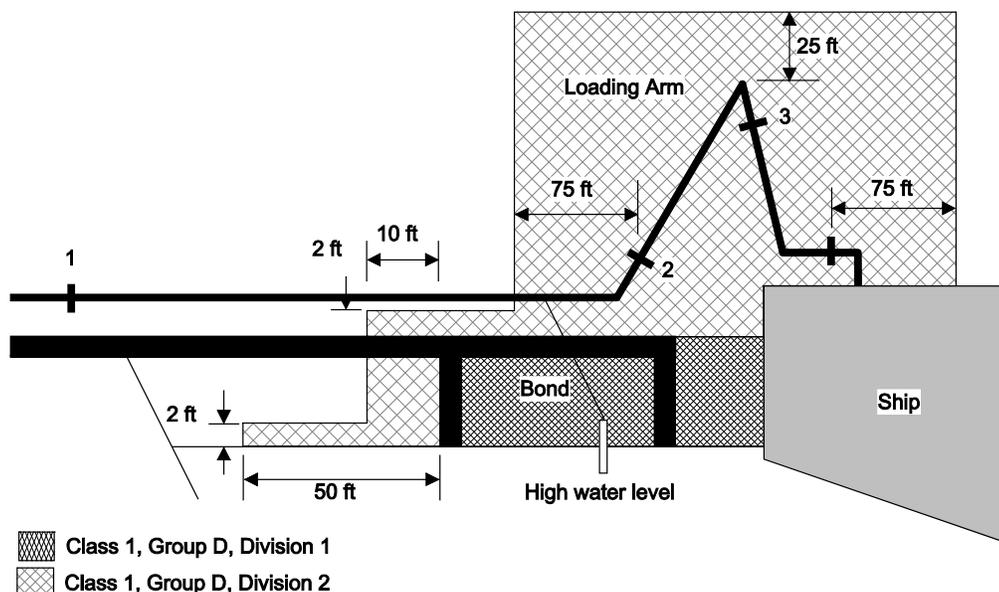
If an existing pier is constructed of combustible materials, follow these steps to slow the spread of fire:

- Construct fire stops by replacing segments of the combustible materials with noncombustible material. Install these firestops on 150 ft (45 m) centers. Extend each firestop 10 ft (3 m) horizontally across the full width of the pier and down to the lowest possible water level.
- Install noncombustible draft curtains at the firestops below the pier and extend them to a point 5 ft (1.5 m) above the high water level.

If the pier is noncombustible, install draft curtains at 150 ft (45 m) intervals to confine the damage done by heat trapped under the pier.

Area Classification and Electrical Equipment

Piers and wharves should be electrically classified in accordance with applicable NFPA codes, including NFPA 70, and API RP 500. Equipment should meet the requirements of NFPA 70. Use [Figure 1](#) as a guideline:



Install an insulating flange at 1 or 2 when excessive stray currents are present.
 For piers with cathodic protection, install insulating flange at 1 and 2.
 Insulating flange 3 can be used instead of 2.
 1 ft = 0.305 m

Figure 1: Electrical Area Classification

If oil sumps are installed, the area within 5 ft (1.5 m) in all directions should be Class 1, Group D, Division 1.

For LPG and LNG installations, the area within 5 ft (1.5 m) in all directions from regular connected and disconnected product transfer connection points should be Class 1, Group D, Division 1.

Pipelines

Piping for hydrocarbon products should be welded with as few joints as possible. Flanged joints should be protected from fire by shielding or fire proofing. Also incorporate the following:

- Provide substantial pipe support and protection against damage e.g. from vehicles, vibration, expansion and fire.
- Install a sufficient number of valves to limit the size of a spill. Valves should be electrically or pneumatically operated and provided with a reliable supply or fail safe.
- Install emergency shut-off valves near the shore manifold. Emergency valves should be capable of being remotely activated from a control room and clearly marked locations on shore and the wharf.
- Indicating type check valves in pipes that are used for unloading only.
- On wooden or concrete piers, make sure that product piping is grounded to the water to maintain the same potential as the vessel.

Provide the following features for all sea bed pipelines to and from a sea island or offshore loading:

- Install a fail-safe emergency block on the sea bed just before the riser interlocked to the main emergency shutdown system on the piers.
- Place pipelines on the sea bottom; do not bury them.
- Place buoys along the pipeline to prevent ships from passing over the lines and damaging them. Prohibit anchorage in the area.
- Prohibit fishing boats from lowering their nets in this area.

Control Rooms

If the control room is located on the dock, take the following measures:

- Fireproof the main supporting members of the control room for 3 h per UL 1709.
- Use only noncombustible insulation in walls, roofs and ceilings.
- Pressurize the room.
- Use a double airlock door arrangement.
- Place the air intake valve at least 25 ft (7 m) above the pier level, and 10 ft (3 m) or more above the roof of the control room or in a safe location.

Protection

Sprinklers

Install foam/water deluge systems below piers, docks, wharves and sea islands to protect against pool fires. These systems can be manual or automatic with release mechanisms at strategic locations. Due to the corrosion expected, use neoprene or Teflon® seats for valves. Design each system in accordance with NFPA 13 and NFPA 16 to provide 0.16 gpm/ft² (6.5 L/min/m²) with a 30 min foam supply.

Protect any bunker tanks, LPG or LNG drip/drain drums and slop tanks with automatic or manual deluge systems designed according to NFPA 13 and NFPA 15 to deliver 0.25 gpm/ft² (10.2 L/min/m²) over the entire area. Also, provide foam generators over the trestle area and over any pumps on the pier that are used for flammable liquid service.

Monitors

Generally, the number of monitors depends on the size and complexity of the pier, the equipment being protected and the particular type of nozzle being used.

Install monitors on each side of the loading arms a minimum of 50 ft (15 m) and a maximum of 100 ft (30 m) from the equipment to be protected. Install monitors high enough to apply foam to the deck of an empty tanker. For ships below 200,000 DWT, install the monitors a minimum of 40 ft (12 m) above the deck. For ships 200,000 DWT or larger, install remotely controlled monitors 70 ft (21 m) above mean high water.

Use foam monitor nozzles of at least 500 gpm (1,890 L/min) capacity. For ships in excess of 50,000 DWT use 1,000 gpm (3,790 L/min) nozzles for effective range and fire control capacity. For multi-level manifolds, use two monitors on the top level and four below the manifold deck.

Design foam systems in accordance with NFPA 11 and size the foam concentrate supplies to last at least 30 min during a worst case incident.

Hydrants

Install standard two-way hydrants along the water main on 150 ft (45 m) centers on the piers and wharves and on 300 ft (90 m) centers for the trestles. Place a hydrant on the shore side of any divisional valve in long pier approaches.

Fire Boat Connection

Install a four way fire boat connection in a readily accessible location at the far end of the pier. The connection should be equipped with at least four-2 ½ in. (65 mm) connections with non-return valves and isolation valves and sized to allow a minimum of 1000 gpm (3790 L/min) to be added to the fire main by the fire boat.

International Connections

Marine terminals with a fire water system should be provided with at least one 2 ½ in (65 mm) connection for supplying a ship's fire system. Two connections are recommended for tankers over 20,000 DWT and three connections should be installed for ships over 100,000 DWT.

Fire Mains

Fire mains should be installed in accordance with NFPA 24. Size the fire mains to supply the sprinklers, deluge, water spray, monitors and hydrants which could be expected to be in use simultaneously during a worst case incident. The hydrant system and mains should provide this amount of water at the most remote areas at a pressure of 100 psi (6.9 bar).

Do not use mains smaller than 6 in. (150 mm). If necessary, protect mains from freezing. When fire fighting water is received from onshore, place a valve on the shore to isolate the pier if it becomes untenable. Place a sectional valve mid-way down any trestle that is greater than 150 ft (45 m) long.

Fire Pumps

Fire pump installations should conform to NFPA 20. Use vertical turbine type pumps that are listed to take suction from the sea, river or lake. If this is not possible, then provide a water supply sized for 4 h at the maximum expected demand.

Install a minimum of two fire pumps, not larger than 2500 gpm (9470 L/min). Drive fire pumps by electric motors, steam turbines or diesel engines, with at least 50% being diesel engine driven. Meet the maximum water demand with the largest pump out of service. Locate the pumps at least 100 ft (30 m) from the loading arms and the nearest moored tanker or barge. Install a below deck sprinkler system with foam capabilities below the fire pumps to protect the pumps from pool fires. Structural barriers or booms could be viable alternatives. Table 1 indicates the minimum water supplies.

TABLE 1: MINIMUM WATER SUPPLIES

Installation	Water Supply
Barge pier or wharf handling: Products with flash points below 100°F (37.8°C) including product in drums. Or Product heated above its flash point	1,500 gpm (5,680 l/min)
Tanker berth at wharf or jetty handling vessels of less than 50,000 DWT	1,500 gpm (5,680 l/min)
Tanker berth at wharf or jetty handling vessels of 50,000 DWT and more	4,000 gpm (15,100 l/min)
Tanker piers or wharf handling crude (regardless of size)	4,000 gpm (15,100 l/min)

NOTE: In some countries, policy requires land based fire pumps to also supply the ship's water hydrant system. This can result in the need for larger capacity pumps.

Portable Fire Fighting Equipment

Portable and wheeled dry chemical fire extinguishers should be provided. Locate portable fire extinguishers such that travel distance does not exceed 50 ft (15 m). Place wheeled extinguishers in accessible locations not more than 50 ft (15 m) from loading arm gantries. For jetties and wharfs handling ships of less than 50,000 DWT install at least 4 x 30 lb (13.5 kg) portable extinguishers and 2 x 150 lb (68 kg) wheeled units. For tanker berths handling vessels of 50,000 DWT and more, install at least 6 x 30 lb (13.5 kg) and 4 x 150 lb (68 kg) extinguishers.

Where no fixed monitors are installed, at least 2 x 500 gpm (1,890 l/min) trailer-mounted foam/water monitors should be provided, together with 100 gal (380 L) foam tanks and in-line educators. Monitors should be preconnected to a hydrant within 50 ft to 100 ft (15 m to 30 m) of the equipment to be protected, including the loading arms and tanker or barge deck in the manifold area.

Other Protection

Locate hydrocarbon gas detectors and smoke detectors in control room air intakes. Interlock them to shut down the fresh air suction and recirculate air in the case of an alarm. Protect under the raised floor of the control room with gaseous extinguishing agents activated by a crosszoned smoke detection system. Protect motor control centers, sub-stations and transformer vaults with gaseous extinguishing agents. Cut off transformer vaults with 3 h fire barriers.

Place gas detectors or any other means of detecting hydrocarbons and hydrogen sulfide in areas where spills and leaks could occur (e.g. loading arms/cargo hoses, valve manifolds, transfer pumps,

etc) or where gases could accumulate. Space detectors according to the manufacturer's specifications, or 500 ft² (46.5 m²) per detector, whichever is less. Install all detection systems in accordance with NFPA 72.

Install a vapor recovery unit for any LNG, LPG or gasoline loading. Do not use the ship's recovery unit. Install an automatic deluge system around the unit to absorb and dissipate any gas releases. Design this system for 0.16 gpm/ft² (6.5 L/min/m²) over the entire area.

Use fixed dry chemical systems to extinguish spill fires on solid deck piers handling ships of 100,000 DWT and larger. This system should allow a quick response to larger pressure or spill fires, which would be difficult to control with wheeled units. Design the system according to NFPA 17 and include a 40 lb/s (18 kg/s) turret nozzle capable of 5 sec bursts, hand lines designed for 6.6 lb/s (3 kg/s) and a storage tank for 30 s or 1500 lb (680 kg) supply of powder. Fluidize the powder using nitrogen from three 399 ft³ (11.3 m³) cylinders. Note: Twin agent units should be available if fixed foam units are not provided.

DISCUSSION

Piers, docks and wharves are vulnerable to collisions caused by pilot error, damage caused by storms and fires and explosions due to accident or sabotage. They make attractive terrorist targets. Firefighting access will always be restricted because of the surrounding water. Pier operators do not have control of the ships or barges. These facilities also have the high property values and even higher business interruption potential.