Regulations for the Storage of Refined Petroleum Products

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Abstract

Refined liquid petroleum products such as gasoline, kerosene, diesel fuel contain hazardous substances known to cause health problems by polluting both the surface and underground water resources. These products must be stored safely to prevent leaks and spills. Explosions are another potential danger from stored petroleum products. This paper reviews regulations and guidelines on the storage of liquid petroleum products above the ground and under the ground, installing new storage tanks, modifying existing tanks, and closing or removing the used underground tanks.

Introduction

Optimization of petroleum products storage tank and loading facilities, as well as the whole system of oil products storage, loading/unloading processes and transportation has become one of the priorities of the current development of all the major oil producing and refining companies.

Liquid petroleum products such as gasoline, diesel, motor fuel, heating fuel, jet fuels, and kerosene must be stored safely to prevent leaks and spills. These products can pollute both underground and surface water sources. A leak of only one drop per second can release about 300 gallons of petroleum into the environment in one year. It only takes a few quarts of leaked fuel to severely pollute underground drinking water.
Explosions are another potential danger from stored petroleum products. Vapors from an underground leak can collect in basements, sumps, pits or other underground structures, and can explode. The explosion hazard from leaking above-ground storage tanks is even greater.

Therefore, the storage of liquid petroleum products, above-ground or underground, presents a potential threat to public health and the environment. Petroleum fuels contain a number of potentially toxic compounds which are considered carcinogenic (cancer-causing).

Above-ground storage tanks, underground storage tanks, and piping must all be protected against corrosion when in contact with the ground. Large losses can occur from not adequately protecting even small underground pipes from corrosion. Even new tanks and piping may leak if they are not properly installed. Frequently, the only way to discover a leak before it becomes a major problem, is to keep track of the amount of fuel you use and subtract it from the amount you received. This is one method of inventory control.

**Hazards associated with oil product storage**

The storage and transfer of liquid materials in crude oil and petroleum product terminals creates the potential for leaks or accidentally releases from tanks, pipes, hoses, and pumps during loading and unloading of products. The storage and transfer of these materials also poses a risk of fire and explosion due to the flammable and combustible nature of the materials stored.

Hazards associated with crude oil and petroleum product storage primarily include the following:

- Chemical hazards
- Fire and explosions
- Confined spaces
Chemicals Hazards

Occupational exposures may be most likely related to the dermal contact with fuels and inhalation of fuel vapors during fuel loading and unloading. Exposure should be prevented through the implementation of occupational health and safety management programs and measures.

Fire and Explosions

Fire and explosions are another potential danger from petroleum products. Vapours from an underground leak that collect in basements, sump pits or other underground structures could explode.

Fire and explosion hazards at crude oil and petroleum product storages may result from the presence of combustible gases and liquids, oxygen, and ignition sources during loading and unloading activities, and/or leaks and spills of flammable products. Possible ignition sources include sparks associated with the buildup of static electricity, lightning, and open flames. The following measures are specific to terminal facilities:

- Crude oil and petroleum product terminals storage facilities should be designed, constructed, and operated according to international standards for the prevention and control of fire and explosion hazards, including provisions for distances between tanks in the facility and between the facility and adjacent buildings, provision of additional cooling water capacity for adjacent tanks, or other risk based management approaches.

- Implementing safety procedures for loading and unloading of product to storage systems (e.g. rail and tanker trucks, Static electricity may be generated by liquids moving in contact with other materials, including pipes and fuel tanks during loading and unloading of product. In addition.
A number of products stored at terminal facilities are listed as “accumulator oils” including natural gasolines, kerosenes, white spirits, motor and aviation gasolines, jet fuels, naphthas, heating oils, clean diesel oils, and lubricating oils. Accumulator oils take longer to dissipate electric charges and hence represent a higher risk of ignition from static electricity.

- Prevention of potential ignition sources such as:
  - Proper grounding to avoid static electricity buildup and lightning hazards (including formal procedures for the use and maintenance of grounding connections)
  - Use of intrinsically safe electrical installations and non-sparking tools
  - Implementation of permit systems and formal procedures for conducting any hot work during maintenance activities, including proper tank cleaning and venting.

- Preparation of a fire response plan supported by the necessary resources and training, including training in the use of fire suppression equipment and evacuation.
- Procedures may include coordination activities with local authorities or neighboring facilities.

Facilities should be properly equipped with fire suppression equipment that meets internationally recognized technical specifications for the type and amount of flammable and combustible materials stored at the facility. Examples of fire suppression equipment include mobile / portable equipment such as fire extinguishers, and specialized vehicles, as well as flammable vapor-air mixtures such as within vapor space of tanks, within vapo space of rail / truck tankers during loading / unloading, near vapor disposal / recovery systems, near discharge vents of atmospheric tanks, in proximity to a leak or spill.
Confined Spaces

Confined space hazards, as in any other industry sector, can, in the worst case scenario, potentially lead to fatalities if not properly managed. Confined space entry by workers and the potential for accidents may vary among terminal facilities depending on design, on-site equipment, and infrastructure.

Confined spaces in crude oil and petroleum product terminals may include storage tanks, some secondary containment areas, and storm water / waste water management infrastructure.

What is so Important About Storing Oil?

Pollution incidents are having a significant adverse effect on the environment. Most incidents result from leakage, which may occur at the time the oil is delivered or because of storage problems thereafter.

The consequences of such leaks can be catastrophic for wildlife, including fish. It can also affect human health and, of course, is detrimental to the environment in general.

Major Risk of Storage locations

The risk arising from the storage of oil has a great deal to do with its proximity to water, such as rivers, canals, wells, etc. In fact, if the store is within 10 meters of a water course or 50 meters of a borehole, then it is considered to be a “significant risk”.

Regulations Required for petroleum products storage

All organizations (private and governmental) that store significant amounts of oil must follow the following regulations and take steps to ensure accidental spillage or leakage doesn’t result in pollution of the environment:
• The primary containers in which the oil is stored must be strong enough for their intended purpose without risk of bursting or leaking.

• In the event that there is a leak, then there must be secondary containment to ensure the oil is not able to escape. The secondary containment may take a variety of forms and there are defined capacities that vary according to the size and nature of the primary storage.

• The protection provided by the secondary containment must encompass the primary container, any valves, related pipe work, sight gauge, etc.

• The oil storage installation must be protected from damage by impact or collision. Protection may be provided by some form of protective barrier.

• Other protective measures may also be required if, for example, there is any underground pipe work connected to the storage.

If an underground petroleum tank is more than 20 years old the potential for leaking increases dramatically, especially if it's not protected against corrosion. New tanks and piping can leak, too, especially if they are not installed properly.

How quickly the petroleum products reach groundwater?

Preventing tank spills and leaks is especially important because gasoline, diesel and fuel oil can move rapidly through surface soil layers and into groundwater. How quickly the petroleum product reaches groundwater depends upon local soil properties and unique geologic and hydrologic conditions. The more porous the soil (sands and gravels, for example), the faster the rate of downward pollutant movement to groundwater. Even though diesel fuel and fuel oil are more dense than gasoline and move more slowly through the soil, they too may eventually reach groundwater.
The solution to all these problems is to follow the following regulations:

1. Installation inspection: Make sure that petroleum product storage tanks are installed properly and protected from corrosion and have secondary containment for leaks and spills.
2. Leak detection: Inspect storage tanks and pipes regularly to prevent leaks.
3. Inventory control: Measure the amount of fuel used compared to the amount purchased.

**Location of Newly Petroleum Products Storage Tanks**

The most important aspect of a liquid petroleum storage tank location is its proximity to a water source. Petroleum storage tanks should be located at least 50 meters from a water well. Minimum separation distances regulate only new well installation. Existing wells are required to meet separation requirements in effect at the time of well construction.

One gallon of gasoline containing one percent benzene can contaminate about two million gallons of ground water. Preventing spills and leaks is especially important because gasoline can move quickly through the soil. Although diesel fuel and fuel oil are more dense than gasoline and move more slowly through the soil, they too will eventually reach ground water.

The location of a new tank should be more than 50 meters away from a well or spring, to provide reasonable assurance that subsurface flow or seepage of contaminated groundwater will not reach the well or spring. If possible, the tank should also be located down slope from the well or spring.
In addition to maintaining an adequate distance from a drinking water well or spring, location for a new tank should be based on the following considerations:

- **Soil or sand characteristics:** Every site has unique geologic and hydrologic conditions that can affect ground-water movement. Petroleum products reach ground water more quickly if local soil is permeable. Sands and gravels are examples of permeable soils. It is preferable to locate a new tank at least 75 to 150 meters away from well, to provide reasonable assurance that subsurface flow or seepage of contaminated ground water will not reach well. If possible, the tank should also be located down slope from the well.

  New underground storage tanks are required to be installed using backfill materials recommended by the manufacturer. Use clean backfill during installation to decrease the negative effects of surrounding soils or sand. Highly corrosive clays, wet soils, and acid soils can significantly speed up the rate of corrosion of unprotected underground metal tanks and piping.

- **Soil or sand stability:** Assess the ability of the underlying soil to support both underground and above ground tanks. Properly anchor tanks in special locations, such as hillsides. Be sure that pipes cannot twist or break if the tank is bumped or disturbed.

- **Depth to groundwater.** Floodways or areas where the water table is close to the surface are poor locations for storage tanks. Tanks placed in such areas require special installation. To reduce pollution potential, an above ground tank may be preferable to an underground tank in these situations.

- **Current and previous land use.** Sites that contain abandoned pipes and tanks, agricultural drainage tiles, or waste materials pose special installation problems. Any
metal already in the ground at your chosen site will increase corrosion rates for the unprotected tank.

- **Traffic.** Assess traffic patterns around the tank. Determine whether the location of the tank or dispenser will block movement of farm vehicles during refueling or cause special problems if any work needs to be done on the tank. Protect the tank and piping from collisions with any and fuel vehicles.

  Proper installation is one way to minimize the leaking potential of the tank or the piping connected to it. Scratches on a metal tank that were caused by careless installation can increase corrosion and tank deterioration.

**Tank Design and Installation**

  Proper installation is one sure way to minimize the leaks from the tank and piping. Even a minor scratch on a metal tank caused by careless installation can increase corrosion and tank deterioration. Follow the manufacturer's recommendations for installation.

**Corrosion and its prevention**

  Corrosion (rust) is the deterioration of a metallic material due to a reaction with its environment. Corrosion damage to tanks is caused when a metal underground tank and its underground surroundings act like a battery. Part of the tank can become negatively charged, and another part positively charged. Steel underground tanks can be protected from corrosion if they are bonded to a thick layer of noncorrosive material, such as fiberglass reinforced plastic. Also, the corrosion problem can be entirely avoided by using tanks made of noncorrosive material, such as fiberglass.

  Other methods of corrosion protection include cathodic protection systems (sacrificial anodes) or internal lining. They are made of noncorrosive synthetic materials and can also be effective in
protecting metal tanks. Liners must be internally inspected according to regulations or combined with a cathodic protection systems.

**Underground Tanks**

All new underground petroleum storage tanks and related piping must be constructed of non-metallic materials such as fiberglass, or if metallic, have corrosion protection. Methods of corrosion protection include using interior liners, "sacrificial anodes" which are connected to the tank, or "impressed current" systems.

A sacrificial anode is a special material which has a greater tendency to corrode than the tank material. The anode will typically protect the tank for up to 30 years. Interior liners are made of non-corrosive synthetic materials and can be effective in protecting metal tanks. Impressed current systems provide a source of electron loss instead of the tank, thus preventing corrosion.

Regulations require that all new underground tanks (other than heating oil for on-site use with a maximum of 5,000 gallons) have spill and overfill protection. Spill protection typically consists of a catch basin for collecting spills when the tank is filled. Overfill protection can be either a warning buzzer or an automatic shutoff. Spill and overfill protection are important; they can prevent pollution from a number of small releases over a long period of time.

**Above-ground Tanks**

Regulations, applying to installation of larger above-ground tanks, seek to reduce the potential for both pollution and fire. Requirements include:

1) enclosing the tank within a secure 2 meters fence or well-ventilated building constructed of non-combustible material; and

2) constructing a fire wall between the fuel dispensing area and the tank.
To decrease pollution potential, tanks should be placed within a secondary containment structure consisting of a dike and a pad. All piping should be above ground within the dike or may go over the dike wall, but it must be placed below ground within 3 meters of the dike wall. Above-ground piping must be made of steel and coated to prohibit corrosion. Any below-ground piping may be either steel or fiberglass, but steel must be coated and cathodically protected.

**Monitoring Spill/Overfill**

It is important to regularly monitor underground tanks containing petroleum products, especially if the tank is more than 20 years old. Regulations for new underground tanks (over 1,100 gallons) require that all tanks have a method of detecting leaks.

- Select the tank location carefully to ensure ease of installation and reliability of chosen leak-detection methods.
- Test the tank periodically for leaks, and
- measure the tank inventory on a monthly (or more frequent) basis to help detect leaks before major problems develop.

The closer the tank is to a water well, the more important it is to ensure that an adequate leak-detection system is in place. Inventory control must be performed every operating day for underground systems which store and dispense fuel on a regular basis. While inventory measurement will not detect very small leaks, it will at least provide a warning that further investigation may be necessary.

Even when a tank has been tested and proven tight, existing regulations and good practice require that you regularly monitor the tank to detect leaks. Some good monitoring methods are:

- Measure tank liquid levels. A decrease in liquid level over time without any withdrawal of fuel or an increase in liquid level without increased supply may indicate a leak. Use a measuring stick to measure tank liquid level, but be sure that the stick does not puncture or damage the bottom of the tank.
- Heating oil and gasoline supply companies can test the storage tank for leaks with precision monitoring instruments, such as automatic tank gauges.

**Tank Closure**

Unused tanks will continue to corrode and cause residual fuel to leach and contaminate the groundwater.
- Determine the location of any unused tanks on your property.
- Also, determine whether or not the tanks still hold residual fuel. These tanks should be emptied and sealed, or removed and disposed of properly. Take precautions to prevent an explosion or other problem. Deaths have occurred due to improper closure.

**Conclusion**

In view of the hazards related to storing liquid petroleum products, which cause serious environmental and health problems, it is imperative that all precautions should be taken while installing the tanks. Frequent checkups should be conducted and preventive measures should adopted to reduce the risk of leakages, spills explosions to avoid disasters.
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