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EFFECT OF FLOODING ON FUEL STORAGE SYSTEMS

Introduction. Until the recent US flooding episodes, no serious consideration was given to flooding effect on fuel storage systems, which took everyone, by surprise. The magnitude and lasting effects of flooding was phenomenal. Flood water heights of 10 or 12 feet, filled the fuel tanks with water through the emergency vents and through the normal vents, which according to the fire codes are a minimum of 12 feet high from the ground. Water being heavier than the fuel, pushed the fuel out of the storage tanks into the running floodwater causing potential environmental pollution problems.

Another major flooding problem was floatation of fuel storage tanks. Unrestrained fuel storage tanks were lifted up and in some cases were carried downstream by the rushing water. It was not uncommon to see a floating tank rushing down the river through the cities and banging on the bridge piers and supports.

As a service to our clients, we have looked into potential flooding situations and prepared this report. The report is not intended to be a blue print of a complete study of flooding situations. Its main purpose is to make our clients aware of potential problems and urge them to have a plan of action in a flooding situation.

Discussion. How serious is the flooding problem on the fuel storage systems? No body knows the extent of the problem for sure. Nowadays the Federal Environmental Protection Agency (US EPA) and Underwriters Laboratories (UL) require every underground fuel storage tank (UST) to be anchored and restrained against flotation due to high underground water table. This requirement came into effect in 1984. But how many UST have been installed without restraints prior to that date and subject to floatation? Nobody knows for sure. There might be thousands of such USTs posing potential environmental problems in case of flooding. The buoyant USTs can rise and break the piping system and create pollution problems as well as emit fuel into the floodwater when fuel is pushed out of the tank when the tank is filled.

The aboveground storage tanks (AST) are a different story. In 1974, the US EPA delegated the responsibility of regulating ASTs to the governors of the individual states. Some states do require the ASTs to be restrained against floatation and some do not. Even the UL standards do not have specific requirement for restraining the tanks against floatation. UL is now planning to revise its standards to require restraints against floatation. The ASTs pose the potential danger of emitting fuel in the floodwaters through their emergency vents and normal vents, when floodwater replaces the fuel in the AST. The tainted floodwater can potentially pollute the drinking waters of the neighboring communities.

Another major problem in a flooding situation associated with AST without restraints is that the tank may actually be lifted and carried by the floodwater. It can be a nerve wrecking experience seeing a fuel storage tank containing fuel floating on the rivers and banging on piers and supports of bridges.

A good number of ASTs float even if they are full. The only exception is the ASTs encased in 6 inch reinforced monolithic concrete vaults. They are heavy and resist floatation even when they are empty or half-empty. For example, Convault ASTs from 125 gallon to 2,000 gallon do not float even if they are empty. Convault tanks 4,000 gallon to 8,000 gallon will not float if they are half-empty. With a Convault tank, one will not witness a fuel tank rushing downstream in a turbulent river.

Analysis of Flooding Problems. The fuel storage tanks problems associated with flooding situations warrant a serious consideration. Potentially two different problems are encountered in the flooding situations, which are addressed below.

Flood water entering the fuel storage through vents and tank's openings. If fuel storage is in an area subject to floods, the owner/operator should continuously monitor and analyze the situation. If the flood is expected to rise and cover the emergency vent and other nipples on the tank top, the owner should make sure that all connections except the emergency vent are closed and water tight. The emergency vent is normally closed. However, it might not be watertight. In a study conducted by Convault, it was found that none of the emergency vent manufacturers could guaranty that the emergency vent will be watertight. If emergency vent is covered with floodwater, it may allow the water enter the tank and then let the fuel flow out of the tank when the tank is filled with water and fuel. The owner/operator will be faced with an executive decision to whether leave the emergency vent in place and have a potential pollution problem. Alternatively, replace the emergency vent with a normal pipe cap, which can be tightened to make it watertight. The problem with this decision is in case of a fire the tank will not have an emergency venting capability and could explode if the fire burns for extended period. There is no one simple or easy decision. The decision will have to be made on a case-by-case situation after considering the potential of a fire and the expected height of the floodwater. It will be a judgmental call and has to be made by the owner/operator.

In an extremely high level flood, the water may cover the normal vent, which is normally 12 feet above the ground. If such a situation can exist, then the owner/operator should also consider capping off the normal vent with a standard pipe cap. In this situation, the tank will have neither emergency venting nor normal venting capability. In case of a fire, the tank can potentially be extremely dangerous. One may argue that in a flooding situation, the probability of a fire is small. In majority of situations, probably this is a valid argument. However, the potential of having a fire still exists. Contrary to the weather forecasts, it is possible that the area may not get flooded at all. At the same time due to an accidental fuel spill or other situations, a fire could become a reality. Again, it is a judgmental call and only the owner/operator should make the decision after a careful analysis of all the factors.

Buoyancy Problem. Fuel storage tanks, especially large ones, float when submerged in water. Some large tanks when empty may float even if they are anchored to the slab. Depending on the tank volume and the slab thickness, there is the possibility of a tank including its slab both float. It is strongly recommended to check the buoyancy of the tank and its slab to make sure the tank will not float when submerged. If necessary, the slab can be made thicker to be heavy enough to prevent it from floating.

Concrete encased ASTs such as Convault tanks, are heavy and resist the floatation forces. In fact, Convault tanks up to 2,000-gallon capacity will not float if they are completely submerged and even if they are empty. Larger Convault tanks such as 4,000 LP and D2,000 LP will not float if anchored. Convault tank sizes 6,00 gallon and larger will not float if anchored and half full with fuel.

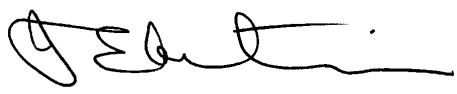
Conclusion. The problem of fuel storage systems in a flooding situation can be serious. Pollution of natural resources such as water and soil can be very costly. Prior to installation of a fuel storage system, the flooding probability of the fuel storage area should be determined. If the area is prone to flooding, the following course of action could help prevent future liabilities for the owners and operators of the fuel storage systems.

1. ***Prior to purchase and installation of the tanks, determine under what conditions the tank will float. Purchase the appropriate storage tanks and provide floatation restraints, if required. Find out if the tanks:***

    - ***Will float, when empty.***
    - ***Will float, when empty and anchored to a slab.***
    - ***How much fuel is required in the tank to prevent it from floating.***

2. ***Prepare a contingency plan of action to prepare the fuel storage system to deal with the flood. The plan should call for the review of different scenarios and recommend a decision mode for each scenario. The plan should consider:***
    - ***Anticipated flooding height.***
    - ***Should the tank be filled to keep it from floating?***
    - ***Should the emergency vent cap be replaced with a pipe cap and made watertight?***
    - ***Should the normal vent cap be replaced with a pipe cap and made watertight.***

3. ***Prepare a contingency plan of action for evacuation of your personnel***



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