Infrastructure failures or human error can increase a plethora of risks in newly built storage tanks, but especially older storage facilities.

The presence of an immediate leak warning system is crucial as it is the last sentinel before escalation to a disaster and it should be the conclusion of a site risk assessment.

The avoidance of environmental regulations violations, loss of product, fire and explosion, fatality, and damage to internal and third party property are all good reasons to invest in proven-in-use early warning oil leak and spill detection systems.

**WHERE TO MONITOR IN A TANK FARM**

1. **Groundwater monitoring**
   Even sophisticated tank gauging systems cannot detect small leaks of oil or fuel from large tanks to groundwater. Current health standards allow drinking water to contain less than 1 ppm of hydrocarbons. This means that an undetected leak of 1 liter/gallon of hydrocarbons can contaminate more than 1 million liter/gallons of groundwater. Managers of contaminating facilities risk personal prosecution, huge remediation costs, severe fines and adverse publicity. A Leakwise ID-221 oil sheen detector installed in a groundwater monitoring well near the tank will give a reliable warning on hydrocarbon seepage into groundwater much earlier than any manual sampling. An array of monitoring wells with ID-221 sensors in the perimeter of a tank farm will give an indication of leak drifting and layer trend. If the groundwater is already contaminated by a thick oil layer, ID-225 sensors can be installed in the monitoring wells to monitor the progress of remediation activity, as these sensors can linearly measure oil layer thickness up to 200 mm.

2. **Floating roof drainage pipe monitoring**
   Rain water accumulated on a storage tank’s concave roof affects its floatation, making it necessary to drain the water. This is usually done through a flexible pipe running from the floating roof down the tank through the oil product, with an outlet above ground near tank base.
   However, the risks are:
   - Oil product from the tank can penetrate the flexible pipe through pinholes or cracks and be discharged through the drainage system unnoticed,
   - Oil product from the tank can run over the roof through the roof’s seal if the floatation of the roof is un-balanced, and then exit through the roof’s water drainage pipe. This can happen also during heavy rain and partially clogged drainage pipe,
   - Local regulations may require that drained roof water will be treated. This may be avoided by monitoring the drained water and diverting the water to treatment only if contaminated with oil.
   - Oil product overfill.
   Monitoring the drain exit of each tank is essential for informing management that leaks have occurred and which tank needs to be repaired.

3. **Tank bunded (diked) area**
   Drainage channels and sumps around storage tanks collect and drain storm water. However, they also collect any hydrocarbons from leaking pipes, valves or pumps. Accidental overfill should also be contained in the bunded area. These sumps, which can be wet or dry, should be continuously monitored for the following reasons:
   - Health and safety – undetected buildup of flammables in the bund area creates harmful vapours and possible fire or explosion,
   - Environmental – leaks or spills must be detected before they are released from the contained area,
   - Economic – product loss is a direct cost against the business. However, an additional cost can be incurred when clean storm water from the bunded area is sent for unnecessary treatment.
   A Leakwise ID-223 oil sheen detector installed in the collecting sump will continuously monitor the water before releasing it to public water. If oily water is detected, an alarm will be set off and the water outlet valve will be closed. The oily water could then be (manually or automatically) diverted into an API separator or any other oily water treatment system. Such operation method will reduce the load on the treatment system, may reduce treatment system size, and eventually cut treatment costs.

4. **Monitoring oil separators**
   In many tank storage facilities water is collected and sent to a separator,
or interceptor, where oil is separated and water is discharged directly to the sea, river or public water. In other cases, water from the tank area could be treated in an API separator. A Leakwise ID-225 oil layer thickness monitor will continuously monitor the thickness of the accumulated oil and inform the operator when to skim the oil. Oil skimmers can be automatically controlled by the ID-225 sensor, starting the skimming at a user-set oil thickness, and stopping before water is removed with the oil. This can result in considerable savings in treatment and disposal costs.

5. Monitoring water treatment discharge
Installing a Leakwise ID-223 sensor in the final retention tank will continuously monitor the discharged water and ensure that the treatment process is running smoothly. An oil overflow to the exit chamber will be detected and the operator notified, or the system can automatically stop the discharge and contain the oil, allowing the operator to take an appropriate corrective action.

6. Monitoring an offshore terminal
Installing Leakwise ID-227 sensor at tanker offloading terminals will continuously monitor oil spills during loading/offloading at loading docks or monobuoys. The sensor is mounted on a wave rider that can be self-contained with solar panel and battery, and communicate through point-to-point radio or cellular communications, or be wired to an onshore controller. Such monitoring enables operators to react when unnoticed oil spills occur during oil product transfer, especially at night.

THE TECHNOLOGY
The Leakwise technology is based on low power electromagnetic energy absorption operating continuously. Water, hydrocarbons (oils in short) and dry air have different absorption values of energy. A Leakwise sensor is a device that floats on water surface. It senses this energy absorption of the surrounding and indicates whether it floats on clean water, floats on water contaminated by an oil layer on top, floats on oil only, or is just resting dry (air). In addition, after an oil-on-water layer is detected, the sensor continuously monitors the oil layer thickness buildup and trend up to 25 mm. The technology is sensitive to all hydrocarbons stored in most tank farms, and will detect also emulsions of oil in water.

The floating sensor is wired to a controller which powers it and analyses the incoming signal. The result is displayed on the front panel of the controller, and is also available as dry contact relays and 4-20mA output, which can be used for operating local devices (like valves), or wired to site control room. A digital controller can accept multiple sensors and in addition has a Modbus link via RS-485 and an optional cellular connectivity. Built in test is part of the controller.

INSTALLATION EXAMPLE
Adding fuel leaks and spills monitoring systems can be challenging for existing large fuel storage facilities, where the wiring infrastructure was not prepared in advance to accept such systems. One solution is to use a battery-operated system with a small solar panel, and a wireless communication to the control room. Wireless can be either a point-to-point radio link or a cellular link.

For example, ID-223/2000 sensors were installed in 23 tank bunded areas in a French tank facility. Outside the dike a battery-operated controller was installed for each sensor, with point-to-point wireless link at 869.4 - 869.65 MHz, fixed channel, 500mW transmit power, and line-of-sight range up to 5km.

A point-to-point receiver was installed in the control room with a receiving antenna installed on a mast on the roof. The communication from all transmitters was verified at the receiver to have a success of 99.9 % (during a test period of two months and more than 17,000 transmissions, with several thunder storms during this period). Communication security is achieved by digital encryption of transmissions.

The customer previously had a bad experience with other leak detection systems that had reliability issues. Prior to purchase, the customer wanted to be sure that Leakwise technology would work reliably on a range of insoluble hydrocarbons including crude oil. They commissioned a third-party consulting company to test the Leakwise technology. Tests with crude oil and diesel, both at ambient and chilled temperatures, clearly showed that the technology reliably detected these types of oils. In addition, the tests established that the technology continued to work reliably even when the sensor was coated by crude oil and oil layer thickness continued to increase or decrease.

FOR MORE INFORMATION
This article was written by Shimon David, technical director, Agar Environmental. www.leakwise.com.