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Alternative Economical Solution to AST Dike Area Linings

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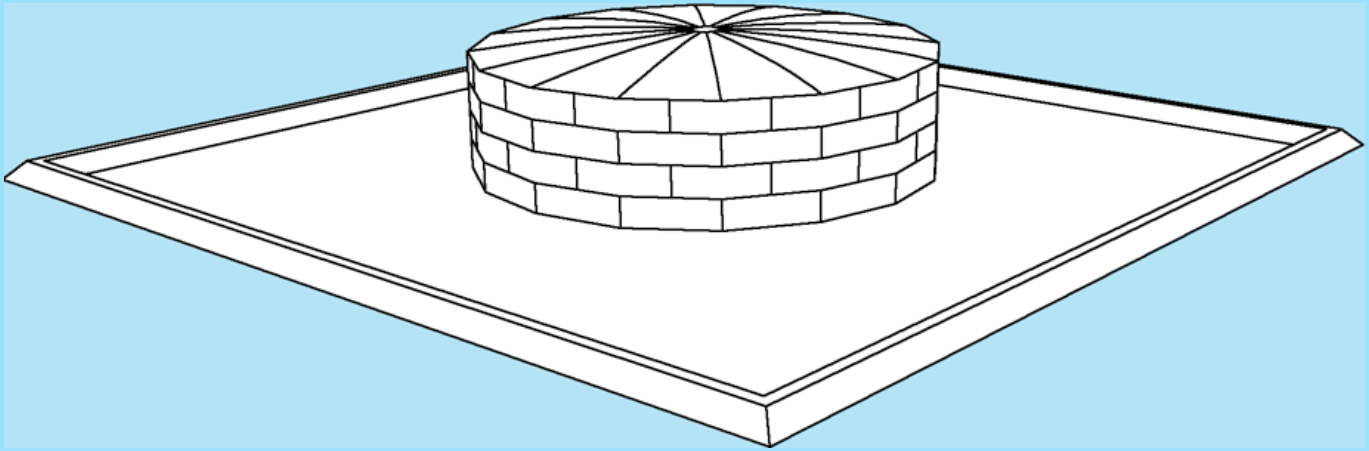
1. Introduction

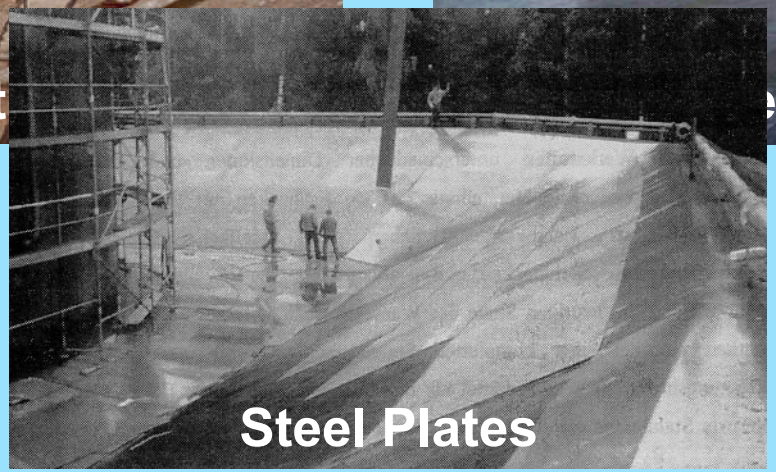
Most legislative requirements mandate that a diked and impervious lined area around the tank must contain up to 110% of the largest tanks capacity.



Dike areas must be constructed of materials that will withstand chemical attacks caused by the substance released from the tank.

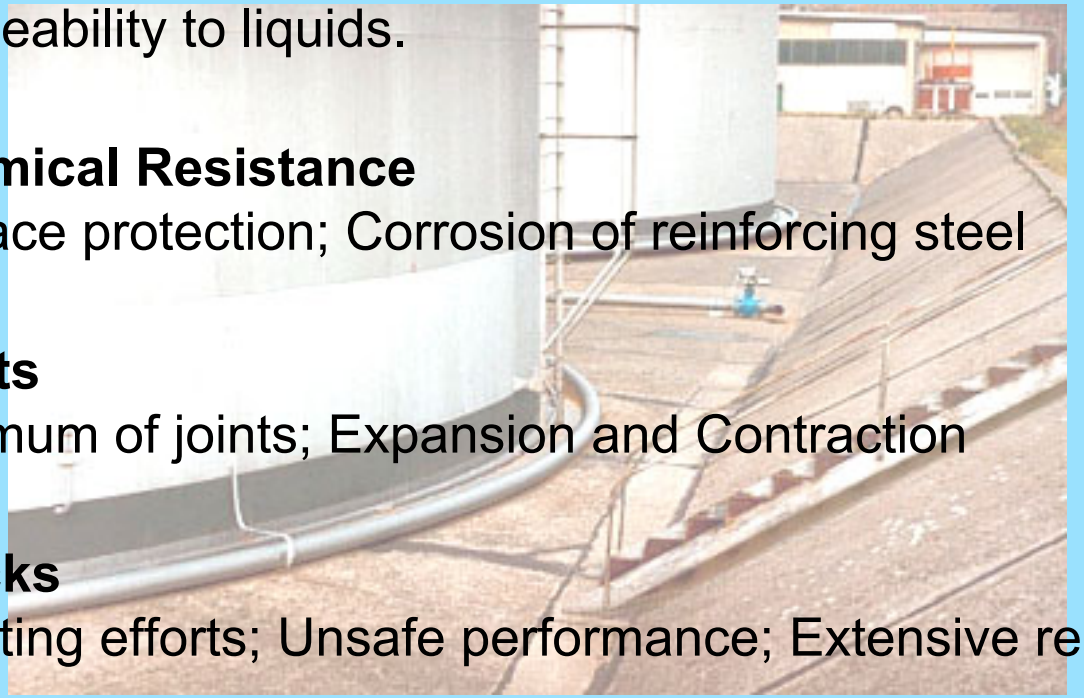
2. Designs for AST Dike Linings

Mostly used today are concrete structures, synthetic liners and steel plates.



2.1 Concrete Structures

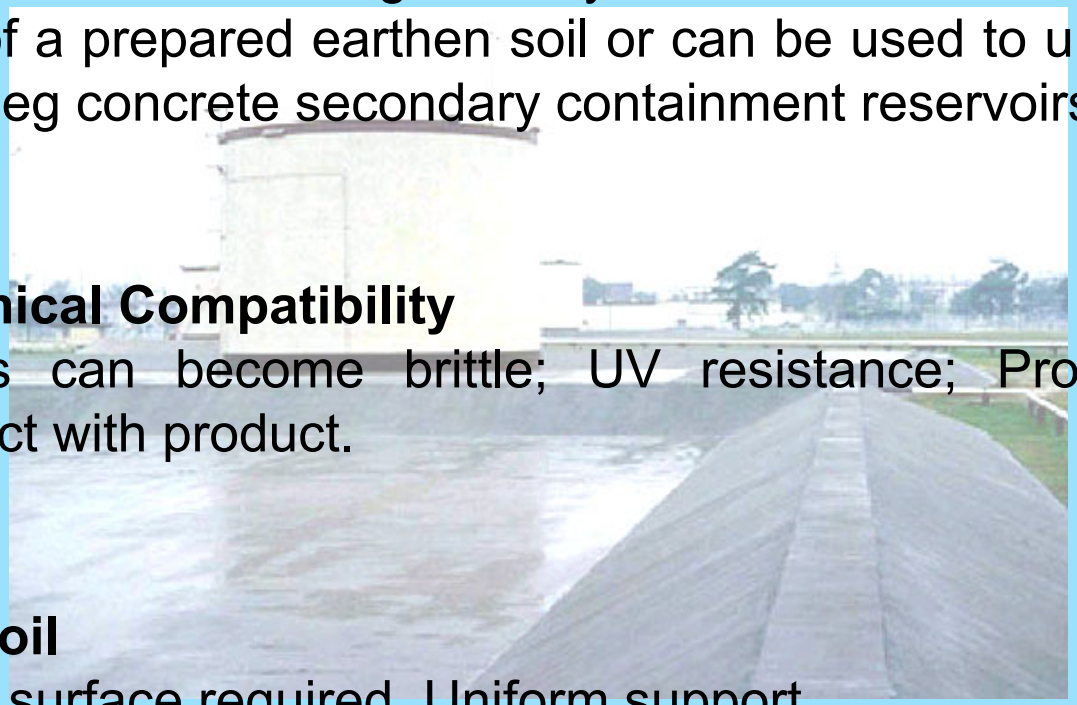
These structures are typically constructed of steel reinforced concrete. A concrete structure's ability to safely contain a release is dependent on its structural integrity and its impermeability to liquids.



- **Chemical Resistance**
  Surface protection; Corrosion of reinforcing steel
- **Joints**
  Minimum of joints; Expansion and Contraction
- **Cracks**
  Locating efforts; Unsafe performance; Extensive repairs

2.2 Synthetic Liners

This design features the use of large synthetic liner sections. The material is available in rolls, which can be up to 10m wide and 100-150m long. The synthetic liners can be used on top of a prepared earthen soil or can be used to upgrade existing eg concrete secondary containment reservoirs.

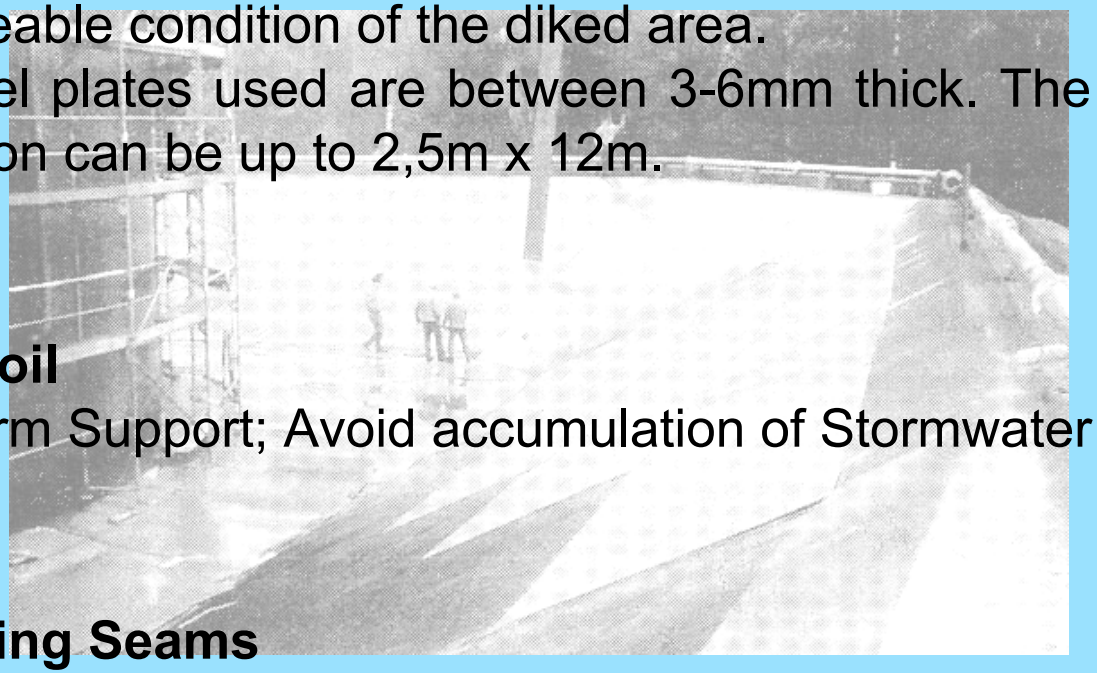


- **Chemical Compatibility**
  Liners can become brittle; UV resistance; Prolonged contact with product.

- **Subsoil**
  Level surface required, Uniform support,

2.3 Steel Plate Lining

Some regulations questioned impermeability of certain designs. This necessitated the upgrade of dike secondary containment areas with steel plate to guarantee for an impermeable condition of the diked area.
The steel plates used are between 3-6mm thick. The sheet dimension can be up to 2,5m x 12m.



- **Subsoil**
  Uniform Support; Avoid accumulation of Stormwater

- **Welding Seams**
  Testing; Anti corrosion coating

2.4 Financial and Environmental Aspects

Whatever design is selected, it obviously must comply with the requirements of legislative bodies. The costs are substantial for each. After making the financial commitment, depending on the system selected, there will still be additional costs to satisfy all requirements.

These costs include analysing storm water and its treatment. It is possible for small, undetected releases to be washed into drains or retention areas.

The impermeable form of secondary containment for diked areas is a means of protecting the environment but the overall responsibility does not stop there.

3. Alternative Solution

The set task was to find an alternative to impervious tank field linings.

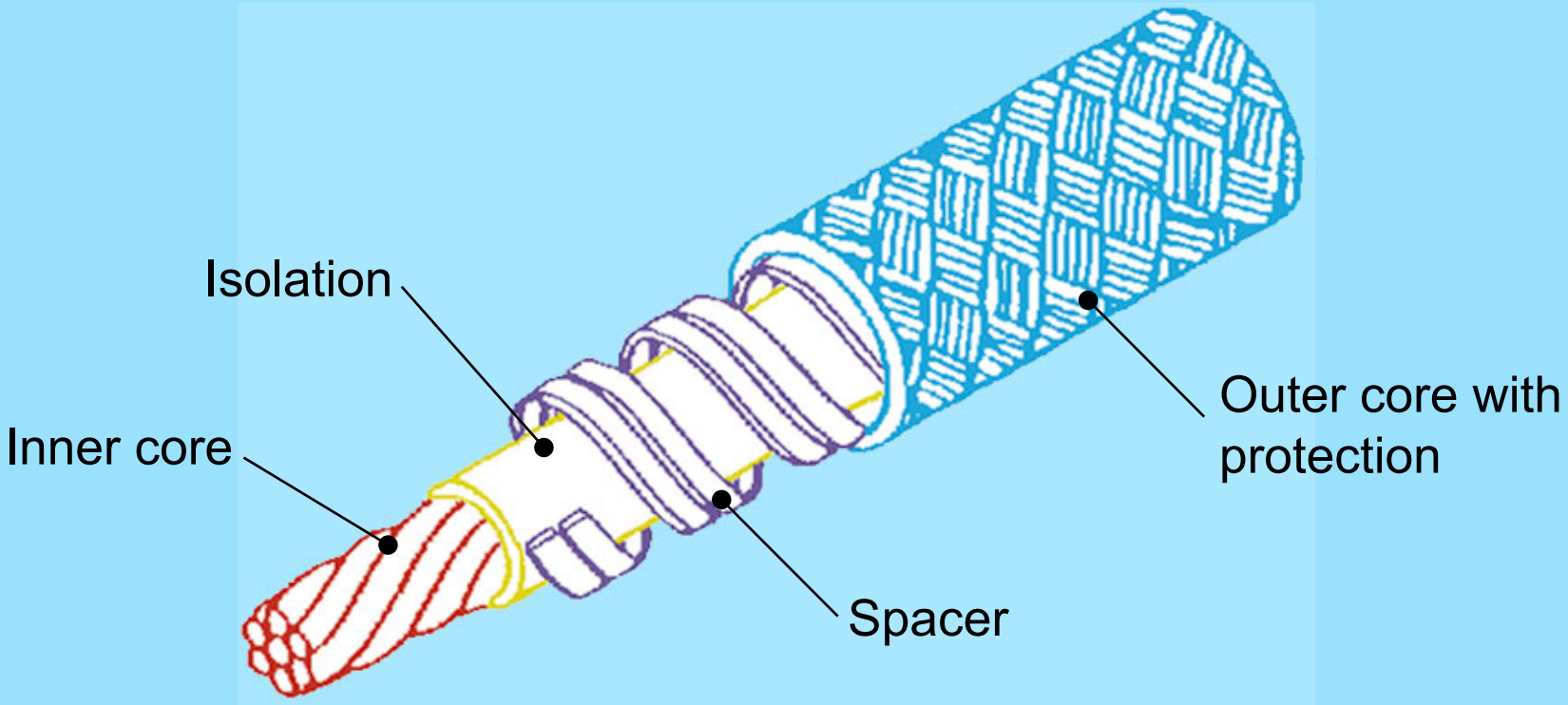
The likelihood for a catastrophic release of the entire tank is close to zero (repetitive inspections, advanced technical standards). This statement is supported by close analysis of cracking characteristics.

Prior to a catastrophic release there will be a small leak, which will increase over time and thus cause a failure of the entire tank. If this time frame is reduced by fast and reliable detection and location of small releases the necessity to line the entire tank filed is no longer valid. Thus only a reduced form of secondary containment around the tank is needed to sufficiently hold a release until precautions or repairs are initialized.

The system has been approved by the German authorities and is currently in the approval process at the Florida DEP.

3.1 Used Sensor Cable

Sensor cable to detect and locate all types of liquid



A special sensor cable designed to detect only hydrocarbons while ignoring water is used.

3.1.1 Performance of the Sensor System

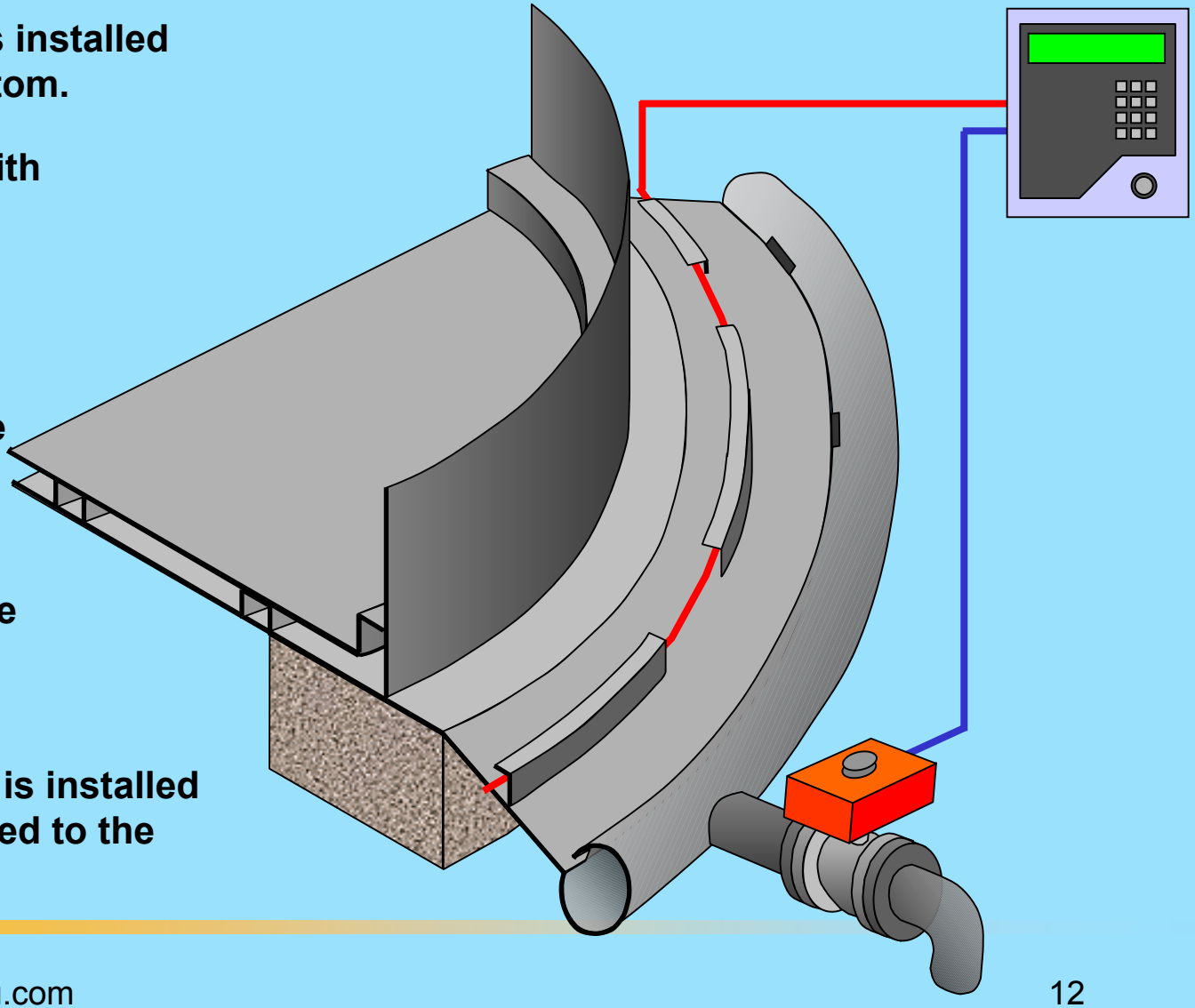
- Fast and reliable automatic detection and location of liquid leakage(s).
- Automatic indication of leakage, cable break and short circuit.
- Automatic data logging of all events with date and time in a non-volatile memory.
- Intrinsically safe system, FM and UL approved.

3.1.1 Performance of the Sensor System

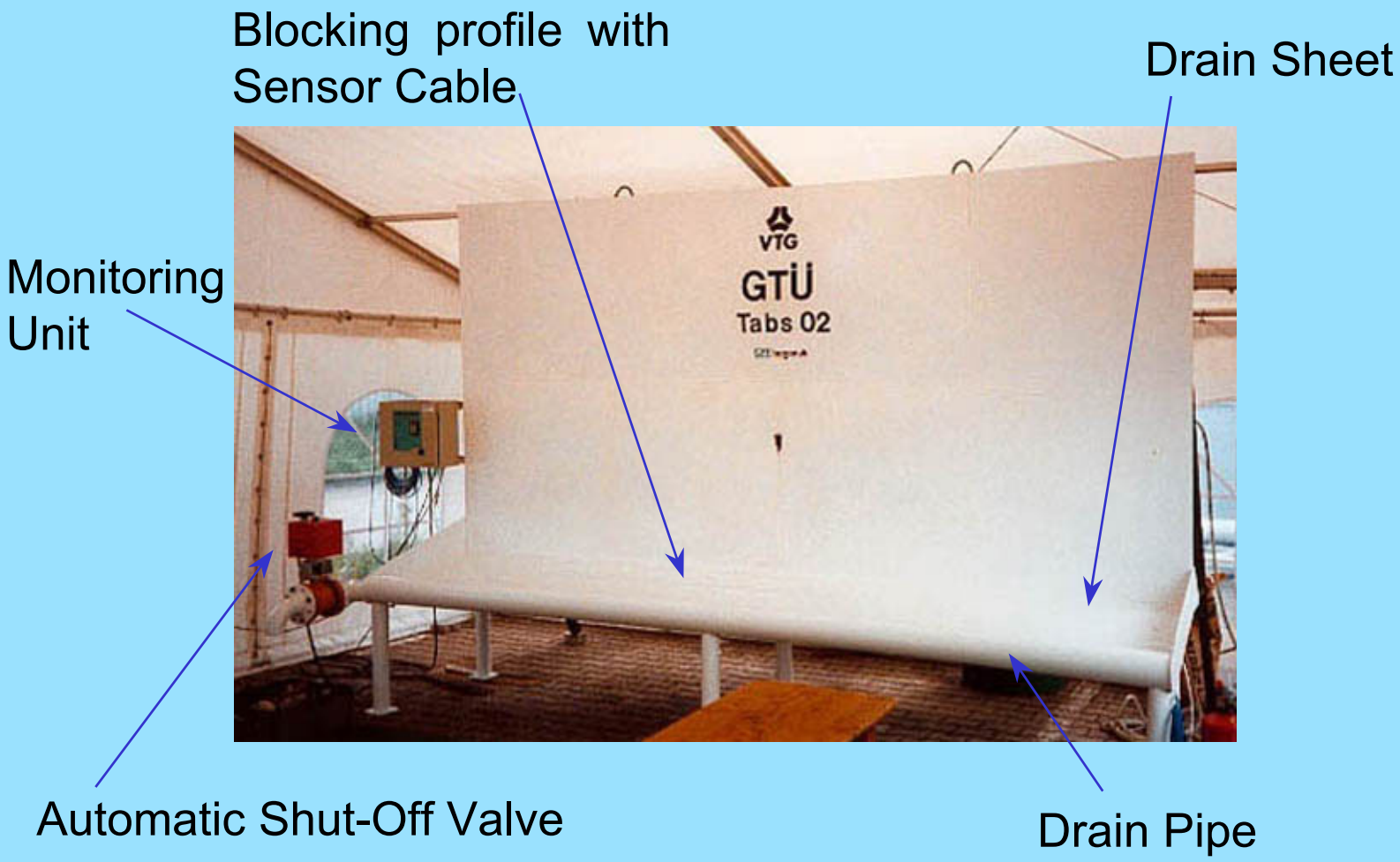
- The monitoring unit can operate up to 8 channels. Each channel can be equipped with a sensor string up to 4920ft (1500m) long.
- Each channel is equipped with a relay which can be used for the actuation of external devices (eg. valves or pumps).
- Automatic restart after loss of power (Watch-dog).
- Password protection for unauthorised operation or unintended alarm deletions.

3.2 Installation

1. The drain sheet is installed onto the tank bottom.
2. The drain pipe (with slots) is installed.
3. Blocking profiles are installed.
4. The shut-off valve is installed. A relay at the monitoring unit activates the valve closed during an alarm condition.
5. The sensor cable is installed and then connected to the monitoring unit.



3.2.1 Trials


Blocking profile with Sensor Cable
Drain Sheet
Monitoring Unit
VTG
GTÜ
Tabs 02
Automatic Shut-Off Valve
Drain Pipe

3.2.1 Trials

The Automatic Shut-Off valve is connected to the monitoring unit. Under normal operation the valve is open to drain water. With a leakage the valve will be closed automatically to create a safe secondary containment around the entire tank.

3.2.1 Trials

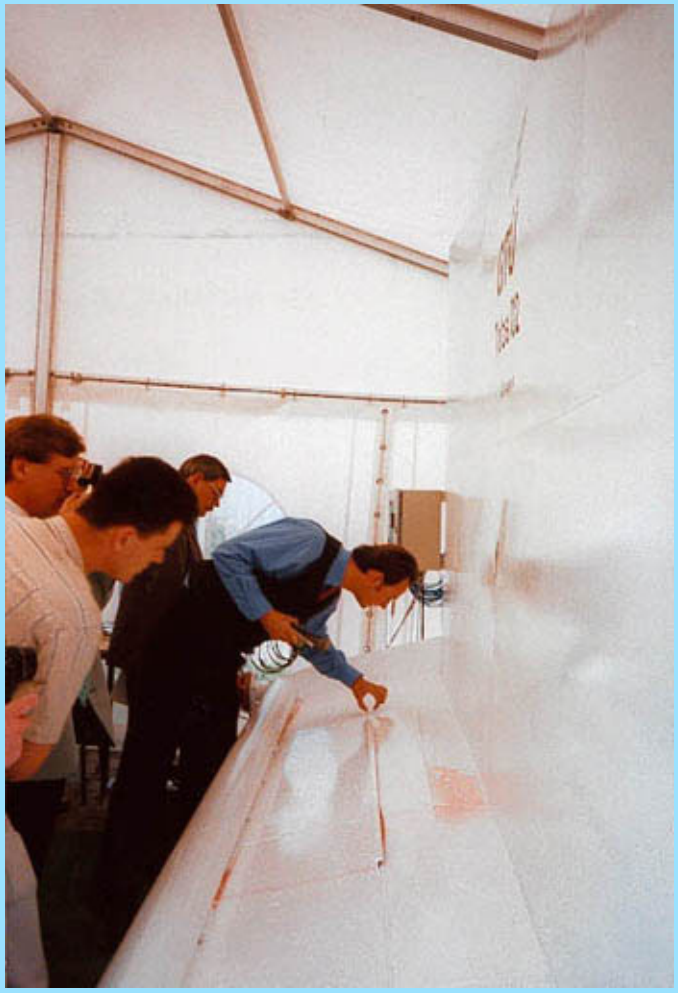
The trial engineer is pouring a bucket of water on to the sensor cable to show that it will not cause an alarm. The water is then guided to the draining device.

3.2.1 Trials

The simulated leakage (light heating oil) is flowing down the tank shell and is contacting the sensor cable. The sensor cable is protected by the L-steel profile, which is also helping to spread the leakage along the sensor cable to allow better penetration.

3.2.1 Trials

The trial engineer and the spectators are investigating the sensor cable.



3.2.2 Installations

The water collected in the drain pipe is then drained to a remote location.

3.2.2 Installations

Tank located in a dike area which was determined to be permeable (water test over 72 hours) was upgraded with the tank shell monitoring system.

3.2.2 Installations

Opening in drain pipe

3.2.2 Installations

During rainy conditions the automatic shut-off valve remains open to drain the rainwater.

3.2.2 Installations

Tank located in a clean environment. The tank is equipped with a double bottom system and the tank shell monitoring system.

3.2.2 Installations

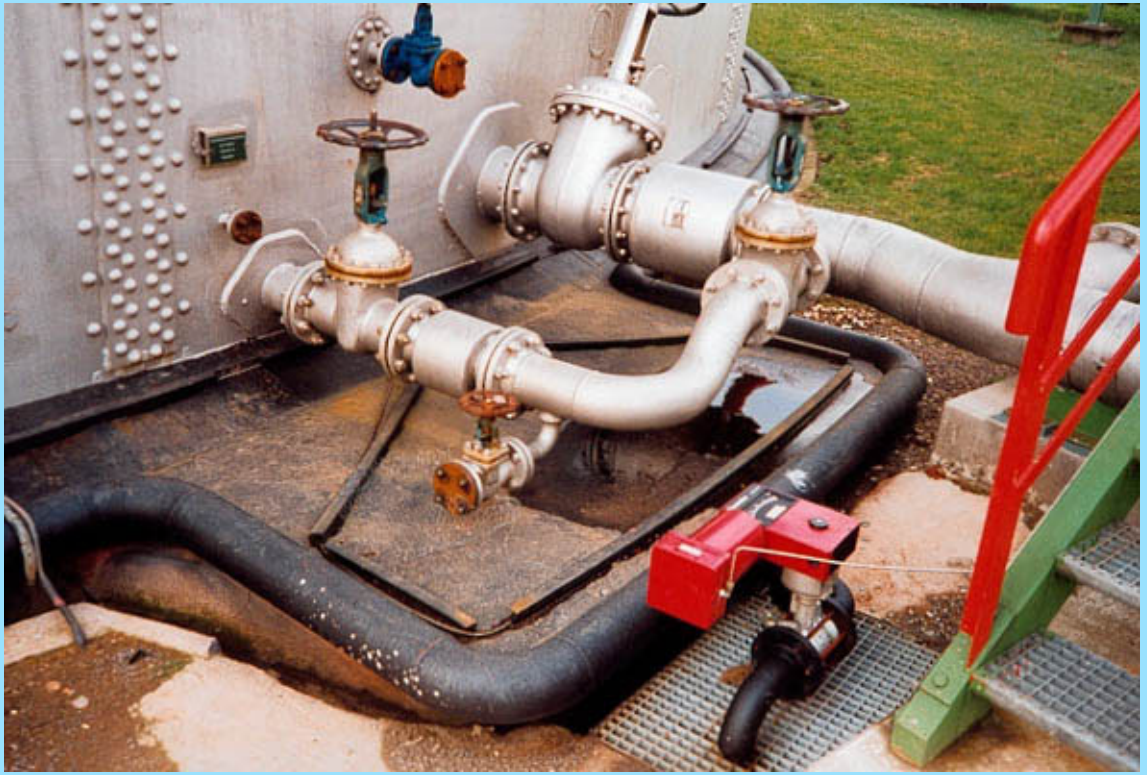
Tank located in a earthen diked area has been upgraded with the tank shell monitoring system.

3.2.2 Installations

Tank shell monitoring system retrofitted on existing tanks.

3.2.2 Installations

Additional pumps and valves can be monitored by expanding the system accordingly.



3.2.2 Installations

Tank shell monitoring system adopted by nature.

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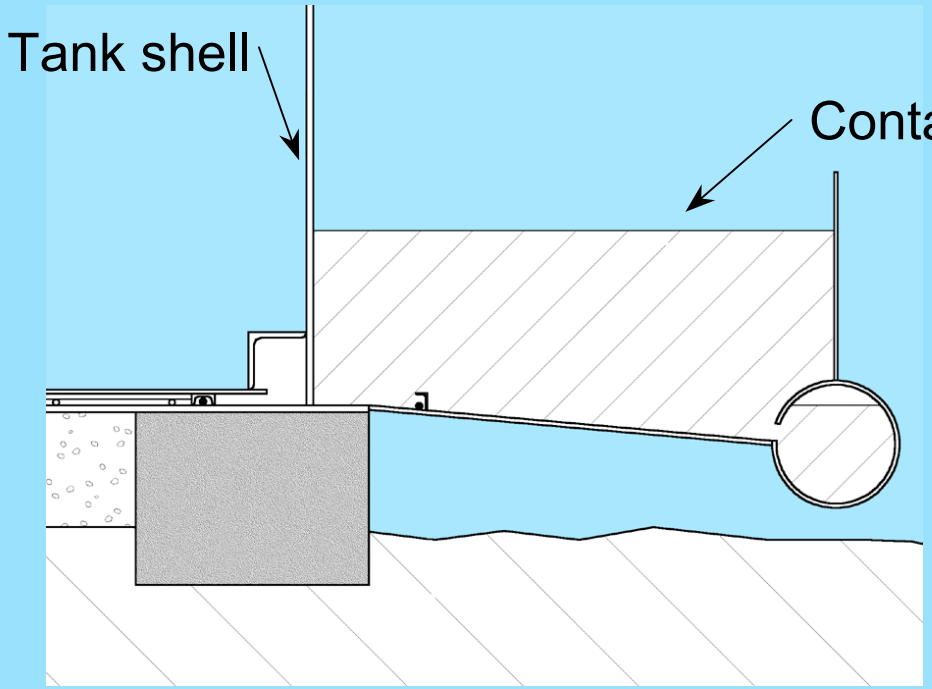
Tank shell monitoring system adopted by nature.

3.3 Overfill Control



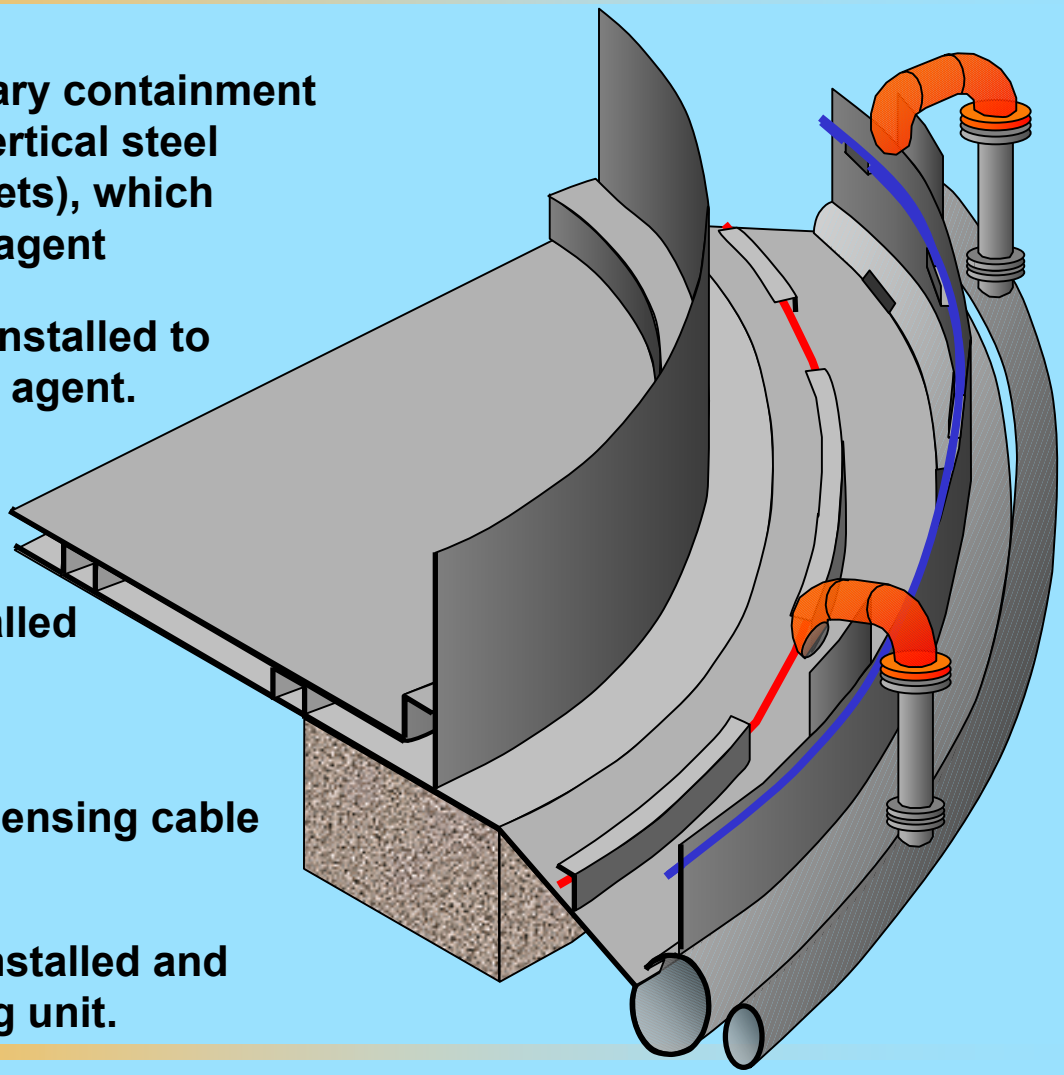
The capacity of the system is designed to contain an amount equal to (or exceeding) the volume of product (worst case scenario) as calculated by the fill valve flow rate relative to the time interval from alarm until the pump is closed or stopped.

4. Fire Protection

- Fast, reliable and automatic detection and location of heat sources
- Continuos monitoring of the sensor cable
- Detection of highest temperature and monitoring of temperature increase
- User adjustable alarm settings
- The environmentally harmful extinguishing agent is safely contained
- Pre-alarming of fire hazards with the tank shell system

4. Fire Protection

1. The capacity of the secondary containment is increased by installing vertical steel skirting (with diversion sheets), which contains the extinguishing agent
2. Perimeter supply piping is installed to distribute the extinguishing agent.
3. Vertical aeration pipes are installed.
4. Nozzle assemblies are installed to direct the foam onto the diversion sheet.
5. L-Profiles to hold the heat sensing cable are installed.
6. The heat sensing cable is installed and connected to the monitoring unit.



5. Questions

Thank you very much for your kind attention.

Also, please feel free to contact me via e-mail for any later questions you might have:

rue@eco-gtu.com