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United States Government **Department of Energy**

memorandum

DATE: March 8, 1999

REPLY TO
ATTN OF: Office of Environmental Guidance cc:DiCerbo:6-5047

SUBJECT: DOE's Underground Storage Tank (UST) Leak Detection Workshop

TO: Distribution

The Office of Environmental Guidance, RCRA/CERCLA Division (EH-231) sponsored an Underground Storage Tank (UST) Leak Detection workshop in Atlanta, Georgia on April 26, 1994. The workshop was designed to familiarize participants with the regulatory and technical basis for identifying and reporting leaks from USTs. The workshop utilized a combination of lectures and interactive discussions and included the following modules:

- Leak detection methods and deadlines;
- Inventory control including measurements and calculations;
- Recordkeeping;
- Designing and implementing a teak detection program;
- Selecting the proper leak detection technology;
- What to do when a leak occurs; and
- Contracting considerations

The following materials are from this training course.

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III. APPENDIX (cont.)

E. Ordering Information on Underground Storage Tanks (EPA 510-F-98-016), August 1998
Publications from the EPA Office of Underground Storage Tanks

INTRODUCTION

Welcome to the Department of Energy/Environmental Protection Agency Leak Detection Seminar! This workshop is sponsored by the DOE Office of Environmental Guidance, RCRA/CERCLA Division (EH-231). Today's presentation was put together to help managers of Federal underground storage tanks (USTs) understand the leak detection requirements of 40 CFR Part 280.

The purpose of the UST program is to protect water resources in the United States by providing UST owners and operators with the information they need to maintain and upgrade their systems.

This notebook is arranged in three sections. The first is an overview of leak detection methods, the second section contains a copy of all the slides used in today's presentation, and the last section contains the appendices.

This manual provides an overview of the information covered during the seminar on leak detection methods. If you have any questions after you leave today, consult the list of additional information on UST systems found in Appendix C or contact the appropriate State or Federal program person for your facility. A list of all UST program contacts appears in Appendix B.

A. Presenters

F. UNDERGROUND STORAGE TANK DETECTION WORKSHOP PRESENTERS

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Jerry DiCerbo is with the Office of Environmental Guidance, RCRA/CERCLA Division and has worked on UST issues for nearly four years. He prepared the "Regulatory Underground Storage Tank (UST) Guidance" and five "Information Briefs" that discuss various aspects of USTs to assist DOE field personnel in meeting the Federal UST requirements. Jerry is currently chairman of the Federal Facilities UST Coordination Workgroup. In addition to this leak detection course, Jerry is developing a three hour introductory UST video that should be available this year.

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Bill Faggart recently relocated to Washington to become the release detection contact for EPA's Office of Underground Storage Tanks. Prior to this, he worked with EPA Region II's UST program in New York for three years as UST Program Coordinator for the Virgin Islands. During that time, Bill worked to improve program outreach by a number of methods, including a series of leak detection seminars. These methods, which serve as the basis of today's presentation, were developed to assist the regulated community in becoming familiar with the leak detection options available to achieve compliance with the Federal UST regulations. Bill also assisted the Virgin Islands Department of Planning and Natural Resources staff in developing a standardized inventory control form used throughout the Territory, and helped with the development of a local newsletter to keep the regulated community abreast of the newest program developments. Finally, to make the regulations more accessible, Bill created a computerized version of 40 CFR

Part 280, making the technical regulations available in the form of a hypertext-linked *Windows* help file.

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Steve Nacht is a chemical engineer who was one of the original members of EPA's Office of Underground Storage Tanks (OUST) when it was formed in 1984. While in OUST, he provided much of the technical support during the development of the proposed rule. He wrote the Interim Prohibition Guidance document and Interpretive Rule, worked on the design of the tank testing research facility in Edison, New Jersey, assisted in the development of a cathodic protection manual, and evaluate numerous technologies for preventing and detecting releases from USTs.

Since 1986 he has been a consulting engineer providing UST management services, remediation of USTs, and regulatory compliance assistance to public and private clients. Currently, he is Manager of Federal Marketing for Baker Environmental, Inc., an environmental engineering firm headquartered in Pittsburgh, PA. Steve has a B.S. in Chemical Engineering, and is active in the Society of American Military Engineers.

B. Leak Detection Methods for Tanks

B. LEAK DETECTION METHODS FOR TANKS

A major thrust of the UST program lies in the early detection of leaks. Early detection in this area is certainly the ounce of prevention that is worth many pounds (*and* dollars!) of cure. The UST program allows for a large number of options in meeting leak detection requirements. Upon looking over the charts on the two pages that follow - *"What do you have to do?"* and *"When do you have to do it?"* - you can check your current status and examine the options you have available to you. As you can see on the charts, there are two major groups of leak detection techniques. These are enumerated below.

I. Inventory Control Methods
   a. Inventory Control
   b. Tightness Testing
   c. Statistical Inventory Reconciliation (SIR)

II. Monthly Monitoring Methods
   a. Automatic Tank Gauging (ATG)
   b. Manual Tank Gauging
   c. Secondary Containment with Interstitial Monitoring
   d. Groundwater Monitoring
   e. Vapor Monitoring

The first group, centered about *Inventory Control*, is available to everyone until at least December 1998. However, common inventory reconciliation will ultimately be phased out and replaced with methods capable of detecting much smaller leaks. SIR, however, is one inventory-based technique that can continue to be used. A number of other alternatives appear in the second group, *Monthly Leak Detection Methods*. While inventory control remains an option for now, you should probably consider upgrading before the last minute. Contractors are likely to be extremely busy as the deadline approaches.

What follows is a brief summary of some of these common leak detection methods from which you can choose.

What Do You Have To Do? Minimum Requirements

You must have Leak Detection, Corrosion Protection, and Spill/Overfill Prevention.

LEAK DETECTION	
New Tanks ***2 Choices***	• Monthly Monitoring* • Monthly Inventory Control & Tank Tightness Testing Every 5 Years (You can only use this choice for 10 years after installation.)**
EXISTING TANKS ***3 Choices***	• Monthly Monitoring* • Monthly Inventory Control & Annual Tank Tightness Testing (This choice can only be used until December 1998.) • Monthly Inventory Control & Tank Tightness Testing Every 5 Years (This choice can only be used for 10 years after adding corrosion protection and spill/overfill prevention or until December 1998, whichever is later.)
NEW & EXISTING PRESSURIZED PIPING ***Choice of one from each set***	• Automatic Flow Restrictor • Automatic Shutoff Devices • Continuous Alarm System *-and-* • Annual Line Testing • Monthly Monitoring*
NEW & EXISTING SUCTION PIPING ***3 Choices***	• Monthly Monitoring* (Except automatic tank gauging) • Line Testing Every 3 Years • No Requirements (If the system has the characteristics described in the final regulations.)
CORROSION PROTECTION	
NEW TANKS ***3 Choices***	• Coated and Cathodically Protected Steel • Fiberglass • Steel Tank clad with Fiberglass
EXISTING TANKS ***4 Choices***	• Same Options as New Tanks • Add Cathodic Protection System • Interior Lining • Interior Lining with Cathodic Protection
NEW PIPING ***2 Choices***	• Coated and Cathodically Protected Steel • Fiberglass
EXISTING PIPING ***2 Choices***	• Same Options as for New Piping • Cathodically Protected Steel
SPILL/OVERFILL PREVENTION	
ALL TANKS	• Catchment Basins *-and-* • Automatic Shutoff Devices *-or-* • Overfill Alarms *-or-* • Ball Float Valves

* Monthly monitoring includes: Automatic Tank Gauging (ATG), Groundwater Monitoring, Vapor Monitoring, Interstitial Monitoring, Other Approved Methods.

** Very small tanks may also be able to use Manual Tank Gauging.

When do you have to act? Important Deadlines

Most leak detection deadlines have already passed!

TYPE OF TANK & PIPING	LEAK DETECTION	CORROSION PROTECTION	SPILL/OVERFILL PREVENTION
NEW TANKS & PIPING	At installation	At installation	At installation
EXISTING TANKS** Installed: Before 1965 or unknown 1965-1969 1970-1974 1975-1979 1980-December 1988	By No Later Than: December 1989 December 1990 December 1991 December 1992 December 1993	Required for *all* by December 1998	Required for *all* by December 1998
EXISTING PIPING** Pressurized Section	 December 1990 Same as existing tanks	 Required for *all* by December 1998	 Not applicable Not applicable
* New tanks and piping are those installed after December 1988. ** Existing tanks and piping are those installed before December 1988.			

I. INVENTORY CONTROL METHODS

A. INVENTORY CONTROL

Summary

Inventory control is a readily available and inexpensive means of leak detection that, when used in conjunction with periodic tightness testing, can be used by all UST owners until at least 1998. Inventory reconciliation is very similar to maintaining a checking account: accurate tracking of deposits and withdrawals is essential or a correct assessment of the remaining balance.

Careful records are maintained on all product deliveries, product sales, and tank inventories. Measurements of the tank product level must be performed on a daily basis. At the end of the month, the difference between book inventory and measured inventory is compared to an acceptable range of error. If the monthly shortage or overage exceeds that range of error, a leak may be present.

UST inventory is typically performed using a gauging stick marked off in eighths of an inch.

The stick is inserted vertically into the tank, either through a gauge hole or through the drop tube. When the stick strikes the bottom of the tank, it is removed and the level to which the product has risen on the stick is recorded. This value is converted to gallons using a tank calibration chart provided by the manufacturer for that particular make and model of tank. This number is recorded, along with deliveries, meter readings, and water present, on an appropriate form. Once a month, the data must be analyzed to determine if the volume measured in the tank agrees with sales and delivery records.

There are five major steps involved in leak detection using inventory control:

Step 1: **Tank Gauging.**
Measurement of product and water in the tank. This should be done to the nearest 1/8-inch.

Step 2: **Volumetric Conversion.**
Determination of the volumes of product and water using an appropriate tank calibration chart.

Step 3: **Tank Inventory Control.**
Account for all deposits and withdrawals from the tank.

Step 4: **Recording & Reconciliation of Data.**
Proper use of a form designed for daily recording of tank information and for monthly reconciliation of results.

Step 5: **Interpretation.**
Determination of whether tank inventory data fall within an acceptable range of error. This has been set to 1% of the month's throughput plus 130 gallons. If this amount is exceeded for two consecutive months, UST integrity is suspect and must be reported and verified.

Again, inventory control cannot be used by itself. It must always be used in combination with tank tightness testing (described below). Thanks must be tested every 12 months, unless they also have corrosion protection, along with spill and overfill devices. If these are in place, tank tightness testing is only required every five years.

Also, monthly inventory control with tank tightness testing is only a *temporary* choice, available for a maximum of 10 years after corrosion protection and spill/overfill prevention are in place, or until December 1998, whichever is later. After that, some other approved method must be used.

An example of an inventory control form developed by the Office of Underground Storage Tanks and instructions for its use appears in Appendix A.

Limitations and Problems

1. With tanks installed or upgraded prior to December 1998, this form of leak detection is usable only until December 1998. Tanks installed or upgraded after the 1988 date can continue to use the method for up to ten years following the date of installation or modification. In either instance, tank tightness tests are required in conjunction with inventory control. Again, see the tables on *"What you have to do?"* and *"When do you have to act"* for further information.

2. Inventory control is inadequate for determining small leaks (less than 1 gallon/hour). Accuracy drops with large tank sizes.

Problems and Solutions

There are a number of factors that influence how effective inventory control is for leak detection purposes. Apparent losses can be traced back to poor bookkeeping, poorly calibrated dispensers, and even theft. The table below is intended to help you find sources of discrepancy that may or may not point to a leaking UST. It should not be regarded as conclusive, but should assist you in covering some of the major problems associated with inventory control.

Problems	Possible Causes	Possible Solutions
Large differences between consecutive gauges.	Tank is improperly gauged. Slanted stick. Dipstick not wiped.	Take consecutive gauge readings. Wipe stick between gauges.
Catastrophic loss of product!	Tank damaged from careless gauging.	If not present, a striker plate should be placed in the base of the tank. Stick the tank *carefully!*
Poor accuracy of product reading.	No clear product line on the stick.	Use a notched stick or product finding paste. Remove the pole quickly.
Water in tank. Unexplained increase in the tank fluid level.	Water in the delivery truck. Leaking tank in a high groundwater area.	Measure water with a water-finding paste. Take water gauges following deliveries.
Unexplained loss of product associated with deliveries.	Product evaporation during deliveries.	Use vapor control. Use pressure relief valves.
Delivery amounts do not agree with stick measure.	Calibration charts do not correspond to the tanks in use.	Ask tank manufacturer to provide proper charts. If not available, tank calibration is a possibility.
Imbalance in inventory.	Calibration chart not used correctly.	Use the chart appropriately. Interpolate if chart is not to the nearest 1/8-inch.

Problems	Possible Causes	Possible Solutions
Unexplained losses or gains.	Dispenser meter readings are incorrect.	Calibrate the pump meter. Read meters when gauges are taken.
Inventory imbalance.	Data are not recorded completely and accurately.	Follow correct procedures for filling out the inventory control sheet.

B. TIGHTNESS TESTING

Summary

Tank and line tightness testing have been shown to be effective and affordable tools in detecting releases. No permanent modification or installation of equipment is necessary, and there is a number of commercial methods currently available. There is a drawback, however, in that the UST systems must be temporarily removed from service while the test is performed.

There are two broad classifications of tightness tests from which to choose: *volumetric* and *non-volumetric*. One common volumetric measure involves intentional overfilling of the tank. Contents of the tank are stirred to insure a constant temperature prior to actual testing to limit any thermal effects that might influence test accuracy. Additional product is added to the tank through a clear, graduated standpipe attached to the fill pipe. In a 10,000 gallon tank, a loss of 0.05 gallons from the tank will result in nearly an inch drop in the standpipe.

Non-volumetric tests are somewhat more diverse in the methods used. Since changes in tank volume are not measured directly, these tests are more qualitative than quantitative. Typically, they will simply indicate whether the tank is tight or not. One example of a non-volumetric test involves putting the tank under a slight vacuum. Sensitive listening gear is used to listen for the sound of air bubbles being drawn into the tank and through the tank contents. The bubbles indicate holes are present in the tank.

Another non-volumetric method introduces a special tracer compound into the tank. Samples of soil vapor are drawn up from sampling locations placed around the UST system and sent off for analysis. If the tracer is discovered in the collected samples, a leak is present. This type of method is particularly useful on sites where background levels of petroleum products in the soil would make regular vapor monitoring untenable.

Note that tightness tests can generally be set up to test either the tank, the piping, or both at once. Checking both the tank and its associated piping at once is generally economically advantageous. However, if a leak is indicated, the tank and lines must then be tested separately to find the actual source of the release.

Limitations or Problems

1. A high water table can interfere with proper tightness testing. Height of ground water should be known prior to testing.

2. Air pockets trapped in the tank during certain types of tightness testing can interfere with accurate measurement.

3. Tanks may have to be removed from service for a couple of days for the test to be performed. It is essential that adequate waiting time be observed to allow tank contents to achieve a constant temperature once the tank has been filled. Upon overfilling, additional waiting time is necessary.

4. Manifolded tanks can make testing more difficult.

C. STATISTICAL INVENTORY RECONCILIATION

Summary

Statistical inventory reconciliation (SIR) is a variant on the inventory control theme. The same data are used--tank inventory, product delivery, and product sales--and the same equipment can be used--a simple tank gauging stick and an appropriate calibration chart. However, SIR goes far beyond the capabilities of simple inventory control. By statistically analyzing variations in the data, SIR can take a month's worth of data and detect leaks approaching one gallon per day. (By comparison, regular inventory control methods can detect a leak of perhaps ten gallons per day.) This figure depends, of course, on the *quality* of the data collected. If poor data are supplied, then the method becomes less sensitive, and the chances of detecting a small leak early on are diminished.

Currently, SIR services are offered by approximately six vendors in the United States. Monthly data are forwarded to the service provider in paper form, on computer diskette, or sent via modem.

The same method can also be used as a yearly tightness test. By using at least three consecutive months of data, SIR is capable of meeting the precision requirements of a tightness test but at a lower cost.

SIR analysis also has the advantage over inventory control in that it can actually point to a number of related problems that the operator may never have noticed. For example:

- Loss of product due to theft
- Improperly calibrated sales meters

- Incorrect tank gauging chart in use
- Poor data collection methodology
- Location of holes in a tank

It should be noted that SIR is an UST system test. That is, it will detect a leak anywhere in the tank or its piping. The method *generally* cannot discern where the leak originates. If a test comes back as having failed, suggesting loss from the system, it is usually necessary to fall back to some alternative means to localize the leak to the piping or to the tank. A volumetric tank tightness test is the usual method.

Limitations and Problems

1. The method requires that facility personnel measure product carefully and accurately.

2. SIR is currently certified only for tanks under 18,000 gallons.

II. MONTHLY MONITORING METHODS

A. AUTOMATIC TANK GAUGING

Summary

Automatic tank gauging (ATG) systems are a means by which both inventory control and sophisticated leak testing can be performed with minimal operator involvement and interruption of service. ATG systems are permanently installed in the USTs, monitoring product level, water level, and temperature variations. Optionally, product dispensers can also be monitored by the ATG. The control panel, located in the facility building, can be connected to printers, computers, alarm systems, and phone dialers to provide remote alarm capabilities.

In inventory mode, ATG systems provide nearly all information necessary for keeping track of all product and water levels. Many systems have built-in thermal printers that provide simple hardcopy of results to later be placed in an inventory form. Inventory analyses done by ATG systems produce far better results than can be achieved by manual sticking of the tank.

In leak detect mode, ATG systems commonly measure product level changes when the UST system is not in use. Any variation in tank level over a period of one to six hours may flag a possible leak. ATG systems differ primarily in the means used to determine product level and temperature. Other differences include the number of "bells and whistles" that can be added to the system at a future date. The modular construction of many ATG systems allow for easy upgrades at a later date.

The newest ATGs have begun to incorporate some statistical analysis of tank data and monitor tank level at any time that the tank is temporarily inactive. This eliminates the need for a block of down time for leak detection data collection. Further, the limits of detection have been improved to 0.1 gallon per hour--essentially that of a tank tightness test!

Limitations and Problems

1. Less effective for larger tanks (i.e., >12,000 gallons).

2. Shallow groundwater can interfere with proper measurement. This can be largely overcome if the ATG is equipped with a water sensor.

3. Currently, EPA *requires* inventory reconciliation to be used as part of ATG use.

4. ATGs are currently restricted to use for tank leak detection *only!*

B. MANUAL TANK GAUGING

Summary

Similar to inventory control, manual tank gauging is a cheap and reliable means for determining the presence of leaks in smaller tanks of limited throughput. An example would be used oil storage tanks. The method works well on tanks under 550 gallons, but can be used on tanks as large as 2000 gallons.

Manual tank gauging is performed weekly. The tank must be removed from service for at least 36 hours while the test is being conducted. At the beginning of the test period, the level of product in the tank is measured twice in succession. The average of the two readings is used in conjunction with a tank calibration chart to determine tank volume. At the end of the test period, the tank level is again measured twice in succession. The volume is looked up once more on the calibration chart. The final volume is compared with the initial volume in an effort to determine the presence of leaks. The absolute difference in the readings is compared with the table below.

If the difference in the two volumes is equal to or greater than those shown in the table, the UST may either be leaking or may have holes allowing water to enter.

Limitations and Problems

1. The method is only applicable to tanks under 2000 gallons.

2. Manual tank gauging can be used as the sole form of leak detection only on tanks *under* 550 gallons.

3. The method requires the tank to be removed from service for the duration of the test.

Manual Tank Gauging Standards			
Tank Capacity	***Minimum Test Duration***	***Weekly Standard***	***Monthly Standard (4-week average)***
<551 gallons	36 hours	10 gallons	5 gallons
551-1000 (64" tank diameter)	44	9	4
551-1000 (48" tank diameter)	58	12	6
551-1000 (if using tank tightness testing)	36	13	7
1001-2000 (requires tank tightness testing)	36	26	13

C. Secondary Containment and Interstitial Monitoring

Summary

Secondary containment is an excellent method of not only leak detection, but leak protection--the product never makes it into the environment before being detected. Unlike other methods discussed, however, this option is one that is limited to new installations. Existing tank systems cannot be upgraded economically.

Tanks with secondary containment take several forms. Most familiar are the double-walled tanks. In effect, you have a tank within a tank. The space between the tanks, the interstitial space, provides a region to check for leaks. Many double-walled tanks use vapor and/or liquid sensors to check for product and/or water. Other types of sensors are also available. Note that this level of sophistication is not absolutely necessary; you can simply monitor the interstitial space on a monthly basis using a stick with product and water pastes.

One other innovative method available to some tanks is to intentionally fill the interstitial space with dyed brine. A reservoir of the dyed water atop the tank is monitored for fluid level. If the level goes down and colored water is found in the bottom of your product tank, you know the inner tank has been breached. If the level is down but there is no sign of the water in the inner tank, the outer tank must have a leak.

Double-walled tanks are not the only forms of secondary containment. Tanks can also be placed in a concrete vault. Such a dry, basement-like enclosure, in which the operator is free to climb down and visually inspect the tanks, actually results in the tanks not being considered as USTs at all! This method is generally not used for petroleum tanks on account of the costs involved.

Another option is to line the excavation pit and line trench with a special plastic sheet before the tanks and backfill are added. Monitoring wells are installed inside the lined pit. Should a leak occur, the plastic liner acts as secondary containment to prevent product from contaminating the environment. The monitoring wells serve a dual purpose in that they are also used to withdraw any water that may accumulate in the pit. With an excavation pit liner, you will have to deal with contaminated backfill if a leak does occur, but this is much better than permitting the release to migrate off-site into the larger environment!

Limitations and Problems

1. Not cost effective for use with existing tanks.

2. More costly than many options. Double-walled tanks are like having a tank within a tank. Their costs are roughly equivalent to two tanks as well.

3. Pit liners may not be appropriate on sites with very high groundwater levels.

D. GROUNDWATER MONITORING

Summary

Groundwater monitoring involves the permanent installation of one or more monitoring wells placed in the vicinity of the tank or lines. The wells are checked at least monthly, either manually or by automatic sensors, for the presence of floating product. When installed properly, monitoring wells can serve as effective means of leak detection for UST systems.

The key phrase here is “installed properly.” Monitoring wells are not suited to all locations. Further, if installed by unknowledgeable personnel, the locations of wells may be such that not even a catastrophic failure of tanks or lines would be detected. For this reason, it is essential that trained and experienced people be employed when considering this option.

Just a few of the factors that influence whether monitoring wells can be used at a site include: soil type, depth to the water table, and seasonal fluctuations of groundwater. Monitoring wells are most effective when the water table is rather shallow. Ideally, the water level should be only slightly deeper than the depth of the excavation pit. Monitoring wells are generally not to exceed 20 feet in depth from ground level.

The wells, themselves, are usually constructed of 2-inch or 4-inch PVC piping. The lower portion of the piping is slotted to permit the entrance of water and, if present, product. The length of pipe that is slotted, or "screened," must be enough to cover seasonal variations in the water table. Inadequate screening cannot see product that is floating above the slots.

Monitoring wells must be capped and locked to prevent tampering. Delivery trucks have been known to fill monitoring wells, putting hundreds of gallons directly into the ground! Distinctive cover plates are available to market the existence of the wells.

Before monitoring wells can be installed, a site assessment must be performed to determine the characteristics of the site in terms of soil type, groundwater levels, and groundwater flow directions.

Limitations and Problems

1. Monitoring wells are intended to monitor groundwater. Thus, groundwater must be present and no deeper than 20 feet below the surface.

2. Soils must allow adequate flow of groundwater. Excessive clay content can be problematic.

3. The screened interval must be adequate to monitor the full seasonal variation of the water table.

4. To adequately cover a typical fueling station site's tanks and lines, three to four wells may be necessary. State programs usually have specific guidelines on number and positioning of the wells.

E. VAPOR MONITORING

Summary

Vapor monitoring, in many ways, is quite similar to groundwater monitoring. A well must be dug and screened, and the well must be checked at least monthly for the presence of a release. Additionally, a thorough and complete site assessment is similarly required to assure that vapor monitoring is a viable option at a given site.

As its name implies, vapor monitoring seeks out the fumes that are given off during a release of product. The method requires a detector, either permanently mounted in the well or temporarily applied once a month. The level of sophistication may range from petroleum sensitive tapes to photoionization detectors to automated alarm systems.

As with groundwater monitoring wells, vapor wells require soils that permit the product to easily migrate and be detected. Tank and line backfill is usually preferred. Unlike groundwater monitoring wells, vapor wells do not require a relatively shallow water table.

Limitations and Problems

1. Soils must permit the flow of vapors. Excessive amounts of fine silts or clay limit vapor monitoring usefulness.

2. Residual vapors on a site from previous leaks or spills can trigger false alarms.

3. Surface spills can trigger false alarms if the well is improperly installed or if site pavement is in poor condition.

4. Methane gas can cause false alarms in some sensor types.

5. High water tables can drown vapor sensors.

C. Leak Detection Methods for Piping

C. LEAK DETECTION METHODS FOR PIPING

Piping is believed to be an even greater cause for product releases than are the tanks to which it is attached. Piping systems under pressure are particularly prone to leaks. Leak detection is thus every bit as important for piping as it is for the tanks.

There are two basic types of piping used in UST systems. One is *suction piping.* Product is pulled up from the tank by a pump mounted in the dispenser. If constructed properly, with the lines dipping back down toward the tank and with a single check valve located immediately below the dispenser, no further detection is required. The system is exceedingly safe. If the piping develops a hole, product will flow back into the tank when the pump is shut off.

If the section system has its check valve located down at the tank instead of up under the pump, there is a chance that a hole in the line will allow some loss of product. Still, the amounts would be relatively small, and the operator is apt to notice some operating problems with the pump as a result of air getting into the lines. As a result, suction systems of this type need to have the lines pressure tested, but only every three years.

Unfortunately, suction systems, regardless of type, have some limitations that make them inappropriate for use at some facilities. For example, suction systems dispense product more slowly than pressurized systems. This usually restricts their use to comparatively low-throughput facilities.

Pressurized piping is more commonly employed. A submersible pump is installed in the tank and supplies product at pressures between 28 and 32 pounds per square inch. Large losses of product can occur each time the pump is activated. Because of this, all pressurized piping systems were required to be outfitted for leak detection by December of 1990.

There are two requirements for leak detection in pressurized piping (refer back to the chart *"What do you have to do?"*). One is the use of either an annual tightness test or monthly monitoring method. Any of the appropriate monthly methods described above for tanks can also be used for piping--vapor monitoring, groundwater monitoring, interstitial monitoring, and SIR. Second, pressurized piping requires the continuous use of one of three types of devices: an *automatic flow restrictor*, an *automatic shutoff device*, or a *continuous alarm system.*

Most pressurized UST systems utilize flow restrictors. "Red Jacket" is one particular make of such a restrictor. Automatic flow restrictors do a test of the lines each time the pump is turned on. The restrictors are mechanical devices, mounted to the pump housing, which reduce flow to a trickle if the lines do not pressurize properly. The ultimate "alarm" is actually the person futilely trying to pump some gas!

Automatic flow shutoff devices are relatively new. Again the equipment monitors line pressure. If operating conditions are out of tolerance, the lines are completely shut down. There are two types of monitoring used in shutoff devices. One looks for *pressure decreases* over time in the lines when the pumps are not running. Another type monitors the rate of *pressure increase* in a piping system once the pumps are activated.

Continuous alarm systems also monitor line pressures. As the name implies, an alarm is sounded if a possible leak is discovered. The alarm should be clearly audible to facility personnel.

D. Record Keeping Requirements

D. RECORD KEEPING REQUIREMENTS

There are certain records that should be readily available at times of inspection to demonstrate facility compliance with certain requirements. There are several major requirement categories.

1. Leak Detection

- Monitoring results for the last 12 months, and the most recent tightness test (if appropriate).
- Copies of performance claims provided by manufacturers of the leak detection equipment in use.
- Records of recent maintenance, repair, and calibration of leak detection equipment installed on the site (*e.g.*, pressure restrictors).

2. Corrosion Protection

- Records showing the results of the last two annual inspections of corrosion protection equipment. The inspections must have been carried out by properly trained professionals.

3. Repaired or Upgraded USTs

- Records must be kept demonstrating the system was properly repaired or upgraded.

4. Closures

- Site assessment results of permanent UST closures must be maintained for three (3) years.

5. State-specific

- Any other records which may be required by State programs.

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While the discussion for today has centered on leak detection requirements, there remain several other issues that should not be ignored by facility managers--corrosion protection, spill protection, overfill protection, and chemical UST secondary containment. All tanks installed after December 1998 are required to have these features at the time of installation. And all older, existing tanks must have them installed by December 1998. These items are described briefly below.

Corrosion Protection

Corrosion of steel tanks and lines is a major contributor to leaks. There are a number of ways to circumvent this problem:

- *Fiberglass Tanks and/or Lines*. No steel, no corrosion! Composite or jacketed tanks are also acceptable. This is a new tank option.

- *Steel Tanks with Sacrificial Anodes.* New steel tanks, such as the popular Sti-P_3 tank, generally use a couple of anodes attached to either end of the tank. The anodes, typically made of zinc or magnesium, will discharge current to the steel tank, thus protecting the steel at the expense of the anodes. This option is generally only for new tanks. Steel lines can also be protected in a similar manner.

- *Impressed Current Systems.* These systems use an external dc power supply to provide current to anodes buried in the soil surrounding an existing tank system. The positive lead from the power supply is attached to the buried anodes, while the negative lead is attached to the structure to be protected (the tanks and/or liens). This is the only realistic alternative for existing steel tanks.

Spill Prevention

All tank fills must be equipped with spill buckets to capture any product remaining in the delivery hose. The spill buckets typically have a valve to permit the product to drain back into the tank following delivery.

Overfill Prevention

All tanks must be equipped with devices that prevent the tank from being filled to the very top. Fittings typically located on the top of tanks may leak if the tank is overfilled. In some cases, overfilled tanks result in product being lost through the vent pipes!

There are several methods of overfill protection readily available. One of the more common is the use of a float device within the drop tube. As the product level rises, the float closes a valve in the drop tube, causing the flow to shut off at the proper level. This is an easy retrofit for older tanks.

Secondary Containment (Chemical USTs)

By 1998, all existing hazardous substance USTs must be fully upgraded to new chemical UST standards. That means that, in addition to corrosion protection, and spill and overfill prevention, that the tank must have secondary containment with interstitial monitoring. In other words, if you are currently using a common single-walled tank, it will have to be replaced.

While these requirements are set for 1998, it cannot be emphasized enough that you should begin thinking of them now. 1998 promises to be an extremely busy year for contractors. If you want your projects done before the deadline, do not wait until that deadline is upon you!