Introduction to Statistical Inventory Reconciliation

For Underground Storage Tanks in Michigan

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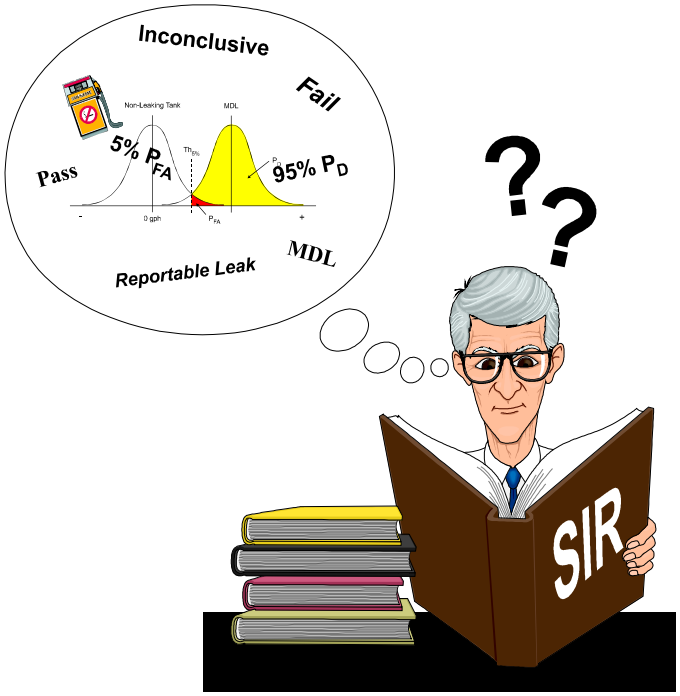

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Contents

NOTE: The requirements for underground storage tanks referred to in this booklet can be found in the Michigan Underground Storage Tank Rules.

DISCLAIMER: Any reference to or depiction of commercial products in this booklet is solely for explanatory purposes and is not intended as an endorsement of these products.

For any questions or further information concerning this document, please contact the Michigan Department of Environmental Quality, Underground Storage Tank Division, Technical Review Unit at 517-373-8168.

Why You Should Read This Booklet

State and federal laws require underground storage tank systems (USTs) to have leak detection. One of the available leak detection methods is Statistical Inventory Reconciliation (SIR). In this method, a trained professional uses sophisticated computer software to conduct a statistical analysis of inventory, delivery, and dispensing data.

SIR can allow the owner or operator of an UST facility to meet leak detection requirements without an extensive outlay of capital, using only the equipment that most facilities have readily at hand—a tank stick and a tank chart used for inventory control. The SIR analysis itself is usually provided as a service by vendors who charge a monthly fee based on the number of tanks.

This booklet provides basic information on the method—what it is, how it works, factors that impact data quality—to assist you in determining if SIR is appropriate to your needs.

If you need information on leak detection requirements and the various methods of leak detection available to you, see **Straight Talk on Tanks**. For a free copy, call the Storage Tank Division of the Michigan Department of Environmental Quality at 517-373-8168 or send an e-mail to DEQ-STD-TANKS@state.mi.us, or download the document from the website at http://www.deq.state.mi.us/std/rules/mustr.html.

How Does SIR Work?

On the face of it, SIR looks very similar to old-fashioned inventory control—the owner or operator, using simple equipment, tracks tank volumes, deliveries, and sales. However, the similarity ends there. Simple inventory control is relatively imprecise. Depending on your system throughput, you could be losing hundreds of gallons every month without realizing anything is wrong!

By contrast, SIR analysis can be very sensitive and accurate. A SIR vendor can take the same inventory data and analyze them for releases so small that many would go unnoticed with inventory control. By using a month's worth of good tank data, it is possible for SIR methods to detect a release of just over 1½ pints per hour (that's about 145 gallons per month) from a tank or its product lines 95 times out of a hundred.

The mechanics of how SIR works are beyond the scope of this booklet. SIR vendors actually use a variety of statistical tools to evaluate inventory data, and no two vendors' methods are exactly alike—the information they collect and the results they provide can vary. Still, for fundamental release detection purposes, there are only three possible bottom-line responses for any SIR test: *PASS*, *FAIL*, or *INCONCLUSIVE*. These bottom-line responses are described below and on the following pages.

PASS—According to the analyzed data, the UST system tests tight.

FAIL—Analyzed data indicate a loss of product from the system or an influx of groundwater. However, a *FAIL* does not *necessarily* indicate that your system is leaking. A *FAIL* may indicate miscalibrated dispensers, inaccurately metered deliveries, or stolen product. There is also a chance that a *FAIL* is a false alarm. **If you receive a *FAIL*, you must first notify the Storage Tank Division (STD) within 24 hours by reporting a suspected release.** Then, you should explore possible reasons for the *FAIL* (see page 6). Keep your local STD district office informed as to your findings.

INCONCLUSIVE—Analyzed data cannot make the call. There is a chance that the information provided to the SIR vendor is so bad that it is not possible to make a determination. This often can be traced back to poor tank sticking or bookkeeping practices (for example, a new hire who has received inadequate training). Whatever the reason, an *INCONCLUSIVE* result means, in effect, that you have failed to perform leak detection on the UST in question for that month. You are in violation of the state leak detection requirements for that month and should investigate for possible errors. However, you do not need to report a suspected release unless the *INCONCLUSIVE* is the second one (i.e., you had an *INCONCLUSIVE* last month also). **Two consecutive *INCONCLUSIVES* are treated like a *FAIL*, and require you to report a suspected release within 24 hours** (See page 6).

Necessary Equipment

One of the major attractions of SIR for UST owners and operators is that it does not require a large, up-front investment of capital—the primary cost is subscribing to the SIR vendor's services. The equipment needed to use the method is usually already found on-site at most UST facilities.

Gauge Stick Or Other Gauges

A gauge stick, made of wood or other non-sparking material, is used to measure the depth of liquid in the UST. Typically, such sticks are marked or notched in 1/8-inch increments starting with the bottom of the stick. It is important that the stick be in good condition. Sticks that have worn ends, cut-off ends, or worn-off numbers are not acceptable and should be replaced.

Other forms of gauges can also be used if they are available and in good operating condition. Automatic tank gauges, for instance, can simplify measuring tank volumes. (Keep in mind, of course, that some automatic tank gauging systems can serve as acceptable monthly tank leak detection methods by themselves.)

Whatever form of gauge you choose to use, you must follow the SIR vendor's instructions carefully to gather useful data. If you fail to follow the vendor's instructions, you may end up with inconclusive test results.

Pastes For Finding Fuel Or Water

If you use a gauge stick, you can improve the quality of your readings if you use a fuel-sensitive paste smeared over about six inches of the stick where you expect the fuel level to be. The paste changes color where it comes into contact with the fuel.

Similarly, you can use a water-sensitive paste on the end of the stick to monitor for the presence of water in the bottom of the tank. While water in the tank can come with your deliveries or as a result of condensation of moisture inside the tank, it can also come from groundwater leaking in through holes or through loose fittings high in your tank.

Tank Chart

The strapping chart used to convert stick measurements into gallons must be the right one for the tank. The chart should have stick measurements listed to 1/8 of an inch to minimize math errors that occur when using charts marked off to the nearest inch. SIR vendors can quickly determine if the chart is inappropriate to your tank, and will often generate a proper one for your tank.

Calibrated Dispensing Meters

A poorly calibrated totalizer can produce bad data that may be mistaken for some types of releases. While many SIR vendors can identify this pattern as a possible cause of a *FAIL*, it is wise to avoid the problem entirely. Keep your dispensers in good operating condition and have them periodically recalibrated as recommended by your equipment manufacturer and as required by state and local weights and measures agencies.

Forms

The SIR vendor typically provides forms on which daily stick readings, sales, and deliveries are recorded. These forms often resemble the inventory sheets usually maintained at UST facilities. In some instances, SIR vendors may allow submission of the data on a facility's own inventory sheets. Some vendors may also permit submission of data in electronic format, such as computer spreadsheets.

SIR Reporting And Recordkeeping

What You Should Provide To The Vendor

Although SIR vendors may ask for a variety of information, some of the more common elements include:

- ☑ Tank size (capacity, diameter, and length).
- ☑ Tank type, material of construction, and manufacturer.
- ☑ Product type.
- ☑ Date each stick measurement was taken.
- ☑ Daily opening stick measurement and volume.
- ☑ Daily closing stick measurement and volume.
- ☑ Daily sales volume.
- ☑ Gross deliveries over the course of the month.
- ☑ Thirty days of observations.

What The Vendor Should Provide To You

Vendors supply different levels of service to their clients. You will need to consult with individual vendors to find the collection of features you desire. However, there is a core of reporting elements that should be common to all SIR analyses. These include:

☑ Clear and timely reporting of results in terms of PASS, FAIL, or INCONCLUSIVE.

☑ Complete and annotated copies of inventory records used in the analysis, showing such problems as errors in delivery records or bad measurements tossed out by the test.

☑ Suggestions as to the likely cause of any test failure or inconclusive result.

☑ Instructions on follow-up actions to be taken in the event of a FAIL or INCONCLUSIVE (for example: "Notify your local STD district office of a failed test result within 24 hours").

Also, the form should report the calculated leak rate in gallons per hour and the leak threshold at which a leak would be declared based on the data provided for each tank. The minimum detectable leak rate (MDL) for your data may also be provided by some vendors. (See page 9).

Your SIR vendor may also supply you with other useful information and services beyond the basics itemized above. SIR vendors may further provide:

☑ Off-site storage of leak detection records.

☑ Potential reasons for a FAIL other than a release of product:
- Apparent product theft
- Missed product delivery entry
- Suspected totalizer miscalibration

☑ Potential reasons and possible solutions for any INCONCLUSIVE results.

☑ Possible location of leak within the system (such as tank or piping).

☑ Assessment of tank sticking practices.

☑ Special tank-specific strapping charts for those tanks needing them (such as tilted tanks and odd-sized tanks).

What You Should Keep On File

The minimal recordkeeping requirements for facilities using SIR are the same as for other release detection methods:

- ☑ All written performance claims pertaining to the SIR method used and the manner in which those claims were justified or tested by the vendor (such as a third-party evaluation of the method) must be kept on file for five years.

- ☑ The monthly SIR reports, along with the results of any other sampling, testing, or monitoring, must be kept for at least two years.

- ☑ Records of equipment calibration and maintenance must be kept for at least two years. Any schedules of required calibration and maintenance provided by the SIR vendor must be kept for five years.

What To Do When You Get A "*FAIL*"

When your UST system fails a SIR monthly analysis, you must report the incident to the STD within 24 hours as a suspected release.

At the same time, you need to begin to investigate the cause of the failed test. Within 14 days, you must determine the cause of the *FAIL* and report back to the STD. Your SIR vendor may, on the basis of the test results, be able to provide you with areas to examine, such as a miscalibrated totalizer. You must have any defective equipment repaired or replaced immediately.

Unless the *FAIL* is positively linked to equipment problems, you must have the system tightness tested or the site checked for evidence of a release (such as sampling in the excavation zone). You must report the results to the STD. If a release is confirmed, the STD will provide instructions for any necessary cleanup action.

What To Do When You Get An "*INCONCLUSIVE*"

An *INCONCLUSIVE* means you have failed to meet leak detection requirements. However, the steps you must take upon getting an *INCONCLUSIVE* are:

- ☑ Check for possible error in the data sent to the SIR vendor.

- ☑ Check for possible equipment errors.

- ☑ If last month's report was a *PASS*, and you have checked for errors, wait for next month's report.

- ☑ If second consecutive *INCONCLUSIVE*, report a suspected release within 24 hours.

- ☑ Perform tank and line tightness tests.

An *INCONCLUSIVE* should in no way be taken as demonstrating the failings of a given vendor's method—it is inherent to *all* methods. Even if vendors use terms other than "inconclusive", to represent the same condition.

In all cases, you will want to double check your operating procedures to see what caused the *INCONCLUSIVE* and prevent its recurrence. Your SIR vendor will provide assistance in locating the problem and offer suggestions to improve your data collection.

Answers To Frequently Asked Questions

"Can SIR be used on manifolded tanks?"

SIR methods can be used on tank systems that have multiple tanks linked together by siphon bars. This generally requires that all tanks in the manifolded system be individually stuck for inventory measurements and the manifolded system will be treated as one unit. As with single tank systems, no product deliveries or sales should be made during the time the sticking and totalizer readings are taking place.

Ask the SIR vendor for a copy of the approval letter to verify whether the SIR method is approved for manifolded tanks.

"Can SIR be used as an annual tightness test?"

The performance requirements for a tightness test are more stringent than for monthly monitoring methods, however, tank tightness testing will not be required as long as each SIR monthly report is a *PASS*. Also a line tightness test will not be required if the SIR method can detect a 0.08-gallon per hour leak rate with at least 95% probability of detection and less than 5% probability of false alarm.

Remember that inventory control with tightness testing can only be used for a limited time if still allowed for your tank. You may want to consider moving now to an approved method of monthly monitoring, such as automatic tank gauge systems, monitoring wells, or monthly SIR analyses.

"Why did a SIR vendor fail my tank for a leak under 0.2 gph?"

First of all, **it is a misconception that *any* leakage into the environment, no matter how small, is acceptable**. Even small leaks over long periods of time can result in extensive contamination that can cost you substantial time and money for soil and groundwater clean up.

Secondly, the performance standard by which leak detection methods (including SIR) are measured says that leaks of 0.2 gph must be detected in 95 out of 100 times. Further, false alarms should not happen more than five times in a hundred. However, some leak detection methods have a capability of detecting much smaller leaks with higher probability of detection and lower probability of false alarm; therefor,

on the basis of a statistical analysis of the data you provide the vendor, the SIR vendor can make the call as to whether your system tests tight or not.

Typically, a *FAIL* will be called for apparent releases that exceed 0.05 gph. See the question below on "estimated leak", "threshold", and "MDL" for additional information.

"What is the difference between 'qualitative' and 'quantitative' SIR methods?"

Although there are many methods that are employed by vendors performing SIR analyses, they break down into two major classifications: *qualitative* and *quantitative*.

Qualitative methods do not provide estimated leak rates. When a vendor's qualitative method is evaluated to demonstrate its capability of meeting the EPA performance standard, it simply reports results in terms of *PASS, FAIL,* or *INCONCLUSIVE*. These results are compared with the evaluator's knowledge of which tanks are leaking in a test set of tank records. None of these qualitative methods is approved for use in Michigan.

Quantitative methods also categorize results in terms of *PASS, FAIL,* or *INCONCLUSIVE,* but they go further by actually providing **a numerical estimate of the leak rate**, typically in gallons per hour. In evaluating the performance of the method, the evaluator compares the method's estimates with the actual leak rates imposed on the test set of tank records.

"What is this 'estimated leak rate', 'threshold', and 'MDL' stuff all about?"

These are technical statistical terms often used by quantitative SIR vendors to provide their clients with more detailed information on their analyses. They provide insight beyond the simple *PASS, FAIL,* and *INCONCLUSIVE*, including just how bad a leak appears to be (estimated leak rate) and how good the data are that you have been providing to the vendor for analysis.

The ***estimated leak rate*** is the number a quantitative SIR method comes up with for the amount of product your tank appears to be losing. The number is usually expressed in gallons per hour.

This estimated leak rate is rarely, if ever, zero. All tanks, whether leaking or tight, will generally show a leak rate. The question is, is this leak rate significant? This is where the "threshold" comes in.

The ***threshold*** is basically an action level leak rate. That is, if the estimated leak rate exceeds the threshold leak rate, the SIR vendor declares a *FAIL*.

Finally, the ***MDL*** is the ***Minimum Detectable Leak***. The MDL is the smallest leak rate the vendor can determine for the data provided with a P_D of 95% or better. The MDL is tied to the threshold and is usually twice the threshold leak rate.

Fortunately, most vendors who provide this level of detail often provide a "plain English" translation as well.

“Can SIR be used as a monthly test of my piping, too?”

Yes. SIR is a test of the entire UST system. Losses are reported regardless of their origins. So, whether you are losing product as a result of a tank leak, a line leak, miscalibrated equipment, or theft, a *FAIL* will result if the estimated leak rate exceeds the threshold for calling a leak. Remember, though, that if you are using pressurized lines, you will also need to have an automatic flow restrictor, shutoff device, or continuous alarm in place to fully meet piping leak detection requirements. However, when SIR is the monthly monitoring release detection method and the SIR method is capable of detecting a 0.08 gallon per hour leak rate, then no line tightness test will be required as long as the SIR monthly report is a *PASS*.

“How much does SIR cost?”

Unlike most other methods, SIR has no installation costs and equipment costs are minimal—a well-calibrated dispensing meter and a good stick are about all you need. While vendor costs will vary, monthly monitoring for a facility with three USTs costs about $800 to $1200 per year. (These figures are based on estimates in 1995.)

“There are so many vendors. How do I choose?”

Whether you have decided to invest in SIR services or other leak detection methods, the basic steps are similar:

- ☑ Request information from the vendors you are interested in. Compare their services, option packages, and prices to see which vendors best meet your needs. Ask for references and check them.

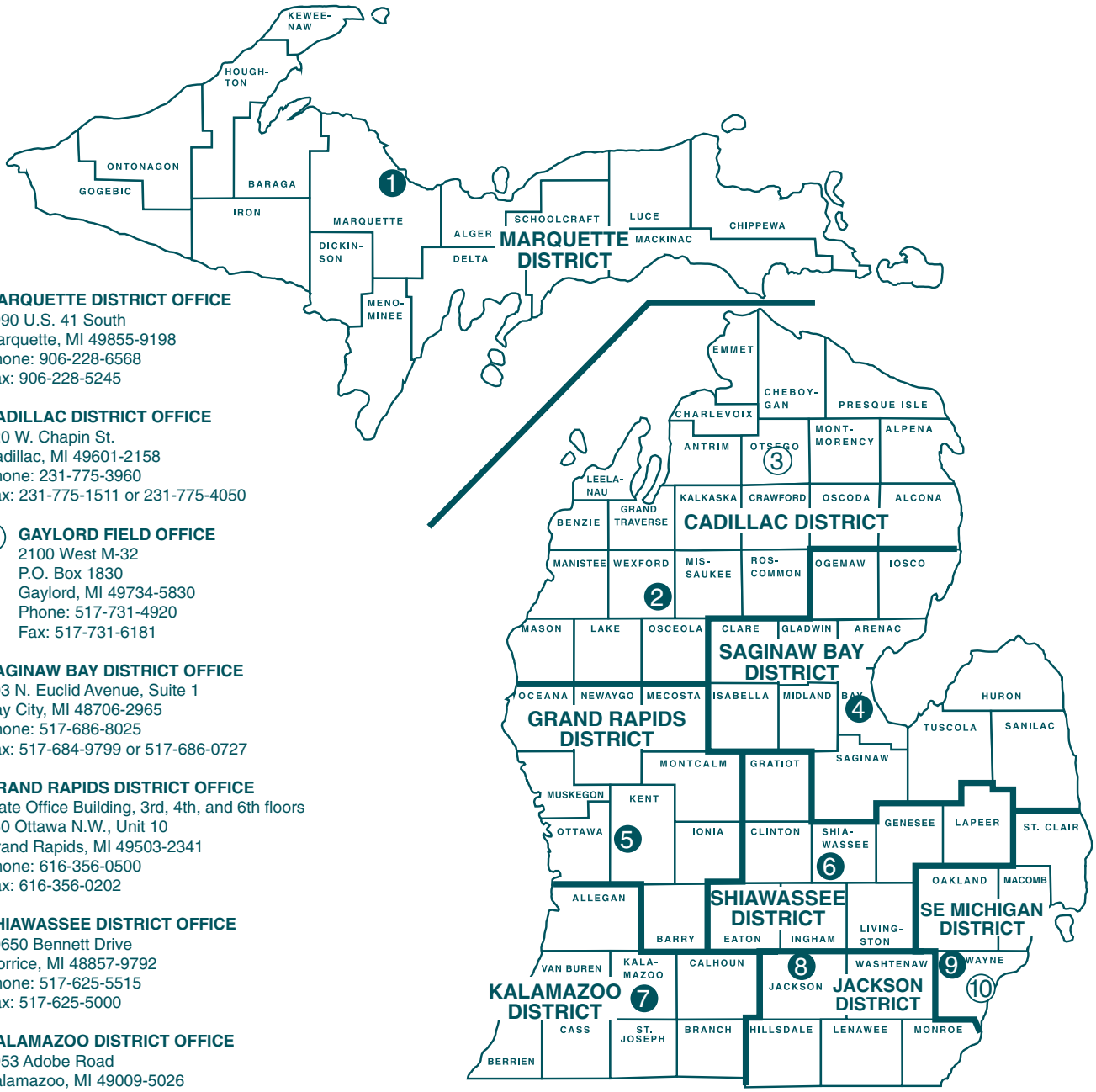
- ☑ Verify that the SIR system is approved in Michigan by asking the vendor for a copy of the approval letter or by calling the STD.

- ☑ Contact the Better Business Bureau to see if there have been any complaints lodged against the vendor.

MICHIGAN DEPARTMENT OF ENVIRONMENTAL QUALITY

District and Office Boundaries and Locations

John Engler, Governor • Russell J. Harding, Director



9 denotes district office

10 denotes field office

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