



Statistical Inventory Reconciliation

Standardized Inspection Manual

Section 3.3

Tennessee Department of Environment & Conservation

Division of Underground Storage Tanks

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**STATE OF TENNESSEE
DEPARTMENT OF ENVIRONMENT AND CONSERVATION
DIVISION OF UNDERGROUND STORAGE TANKS**

**TECHNICAL CHAPTER 3.3
STATISTICAL INVENTORY RECONCILIATION (SIR)**

1. DISCLAIMER

This document is guidance only and does not affect legal rights or obligations. Agency decisions in any particular case will be made applying applicable laws and regulations to the specific facts. Mention of trade names or commercial products does not constitute an endorsement or recommendation for use.

2. PURPOSE

The purpose of this technical chapter is to assist Division of Underground Storage Tanks (Division) staff in understanding the regulatory requirements of Statistical Inventory Reconciliation (SIR) and provide guidance on acceptable practices for using this method of leak detection. It will describe SIR practices for the SIR vendor and will serve as a guide for inspectors.

This technical chapter contains the current policy of the Division based on the statute and regulations governing the Tennessee Petroleum Underground Storage Tank program. This document supersedes all previously published versions. The most current version of this technical chapter will be posted and always available on the Division's website.

3. AUTHORITY

All rules referred to in this technical chapter are contained in Chapter 0400-18-01 and are available on the Division of Underground Storage Tanks website at <https://publications.tnsosfiles.com/rules/0400/0400-18/0400-18.htm>

4. APPLICABILITY

SIR can be used on all petroleum underground storage tank (UST) and/or piping systems installed prior to July 24, 2007 as the primary method of leak detection (interstitial monitoring is required for tanks or piping installed on or after July 24, 2007¹). SIR monthly monitoring leak detection results may include the product piping; however, a means of catastrophic line leak detection such as a mechanical or electronic line leak detector is also required on all pressurized piping by rules .04(2)(b)1.(i) and .04(4)(a) when SIR is used for monthly monitoring.

SIR may only be used as a method of monthly monitoring and may not be used as a method of tank or line tightness testing as outlined in rules .04(3)(b) and .04(4)(b).

¹ Required by Rule 0400-18-01-.02(1)(c)

5. INTRODUCTION

SIR is performed using computer software that analyzes daily inventory, delivery, and daily dispensing data collected over a period of time (not to exceed thirty (30) days) to determine if the UST system is leaking. Each operating day, product level measurements are made using a gauge stick or an electronic device such as an automatic tank gauge as required by rules .04(3)(e)1. and .04(4)(d)1. The owner/operator shall keep complete records of all dispensing and delivery data.²

There are companies (“SIR vendors”) that specialize in performing SIR. If one of these companies is used by a tank owner/operator, then the tank owner/operator will submit the applicable SIR data to that company in accordance with a schedule established by the vendor (not to exceed 30 days). That data is analyzed by a SIR vendor and a report of the results is sent to the tank owner/operator. As an alternative, there are some SIR vendors that make versions of their SIR program available as packaged software that may be operated by a trained person on a personal computer. Such systems are sometimes referred to as “stand alone” SIR systems and are designed to conduct a SIR evaluation of the data entered by the owner/operator without the assistance of an outside SIR data analyst. An owner/operator who uses “stand alone” SIR systems may not make modifications to the software and may only operate the system as designed and are precluded from doing anything that will alter the sensitivity of the method, or affect the probability of detection or probability of false alarm². Any programming modifications or software upgrades that affect the probability of detection (Pd) or probability of false alarm (Pfa) must be done by the SIR method developer or current SIR method owner and may require additional third-party review and/or certification.³

In some cases, a SIR vendor may have licensed a local company (licensee) to operate their SIR program in lieu of sending data directly to the SIR vendor’s home office. Under those arrangements, only persons adequately trained in data analysis by the SIR vendor should have the ability to engage in any data screening or monthly SIR result determination when operating the SIR program.

6. DEFINITIONS

Calculated Leak Rate, may be called “leak rate” or “estimated leak rate”, is a calculated number that determines the difference from zero (0) gallons per hour (gph). To make a SIR determination, the leak rate is compared to the leak threshold (see definition below). If the calculated leak rate for the SIR data exceeds the threshold, then the SIR report should indicate a “fail”⁴; however, if it is less than the threshold it is a “pass”.⁵ SIR vendors must use a quantitative method⁶ and must report the **calculated leak rate** in the SIR results.⁷

Calculated leak rates may be reported with a positive or negative sign before them, and some results may be reported as a “gain” or “gaining trend”. A gain could be due to thermal product expansion, measurement error, or possibly water intrusion. Regardless if the calculated leak rate is positive or negative, if the absolute value of the calculated leak rate is greater than the threshold,

² Required by Rule 0400-18-01-.04(1)(a)2.

³ Required by Rule 0400-18-01-.04(1)(a)5.

⁴ Required by Rule 0400-18-01-.04(3)(e)4.(ii) and .04(4)(d)4.(ii)

⁵ Required by Rule 0400-18-01-.04(3)(e)4.(i) and .04(4)(d)4.(i).

⁶ Required by Rule 0400-18-01-.04(3)(e)4. and .04(4)(d)4.

⁷ Required by Rule 0400-18-01-.04(3)(e)3. and .04(4)(d)3.

then the SIR result should be declared a “fail”⁸ and Division rules require it be treated as a suspected release.⁹

Inconclusive means the data quality will not provide a conclusive result. An inconclusive may be caused by several conditions and does not mean that a UST system is leaking; it simply means that the data are of inferior quality and a conclusive determination is not possible. An owner/operator must investigate the causes of inconclusive results.¹⁰ Most SIR vendors have a procedure for investigating inconclusive results, and many times a vendor can advise tank owners why the results were inconclusive according to data characteristics. How an owner/operator should address inconclusive results is described in Division rules .04(3)(e)6., .04(4)(d)6., and in this technical chapter.

Leak Threshold (sometimes called “threshold”). This is the reference point the SIR method uses to declare a “pass” or “fail”.

- If the calculated leak rate is **greater than** the threshold (0.1 gph), then the correct SIR result would be a “fail” according to rules .04(3)(e)4.(ii) and .04(4)(d)4.(ii).
- If the calculated leak rate is **less than** the threshold, then the correct SIR result would be a “pass” according to rules .04(3)(e)4.(i) and .04(4)(d)4.(i).

The threshold is determined in the third party evaluation, and is set at ½ the Performance Standard. In order to meet the Performance Standard of 0.2 gph, the threshold for monthly SIR methods must be 0.1 gph. If the calculated leak rate is more than 0.1gph, the SIR vendor shall declare a “fail” as required by rules .04(3)(e)4.(ii) and .04(4)(d)4.(ii).

Minimum Detectable Leak Rate (MDL) is a measure of data quality and varies according to monthly raw data. The monthly raw data is often called a dataset. Each dataset is unique and data quality can vary from very good to very poor. When a SIR vendor determines the MDL for a given data set, they are determining the *smallest* leak that can reliably be detected at the 95% Pd and 5% Pfa level as required by rule .04(1)(a)4. The MDL is a screening technique which determines if the data is acceptable for monthly SIR analysis. The MDL of the dataset is compared to the Performance Standard as follows:

- If the MDL is less than or equal to the Performance Standard (0.2 gph), the dataset is valid for monthly SIR analysis.¹¹
- If the MDL is greater than the Performance Standard (0.2 gph), the data may be analyzed, however the SIR result is not valid for monthly SIR analysis, since the data does not meet the Performance Standard at the 95% Pd and 5% Pfa confidence level required by rule .04(1)(a)4.

When the MDL is greater than the Performance Standard, some SIR vendors may simply issue an inconclusive for that dataset, and not report a calculated leak rate since the SIR result will not be valid.

Performance Standard is the criterion that the method must meet for it to be used for leak detection. It is 0.2 gph for monthly monitoring. Any SIR method that cannot meet this standard is not acceptable for leak detection. A Third Party evaluator subjects the SIR method to a series of tests according to a specific approved protocol. If the method does not pass the third-party evaluation certifying its ability to detect a leak of a specified size, then it cannot be listed on the

⁸ Required by Rule 0400-18-01-.04(3)(e)4.(ii) and .04(4)(d)4.(ii)

⁹ Required by Rule 0400-18-01-.04(3)(e)6.(i) and .04(4)(d)6.(i)

¹⁰ Required by Rule 0400-18-01-.05(1)(a)3.

¹¹ Required by Rule 0400-18-01-.04(1)(a)4.

National Work Group on Leak Detection Evaluation (NWGLDE) List as required by rule .04(1)(a)5. The website for NWGLDE is www.nwglde.org.

Probability of Detection (Pd) and Probability of False Alarm (Pfa) are performance standards established in rule .04(1)(a)44. which all leak detection methods must meet to be considered acceptable as valid UST methods. The Pd for all leak detection methods must be at least 95%, which is another way of saying that the method is capable of detecting leaks of 0.2 gph at least 95 out of 100 times. A Pfa of no more than 5% means that false alarms should not happen more than 5 times in 100. This is sometimes referred to as the 95/5 confidence level. The Pd and Pfa are a quality measure that helps insure that the leak of a specified size is not missed, and that the method is not declaring tight tanks to be failing.

7. REQUIREMENTS

All SIR methods used in Tennessee must be able to meet the performance standard of 0.2 gph with a maximum threshold of 0.1 gph. All SIR methods must have a probability of detection (Pd) of at least 95% with a probability of false alarm (Pfa) of no more than 5% as required by rule .04(1)(a)4. SIR methods are Third Party evaluated to determine if the method meets the above criteria. Methods that meet the criteria are placed on a list maintained by the NWGLDE which is posted on their website at www.nwglde.org. Any method not appearing on the website has not been properly evaluated and will not be acceptable to the Division as a valid leak detection method in accordance with rule .04(1)(a)5. The NWGLDE only lists SIR methods, not individual licensees of the methods.

SIR is a method of monthly monitoring allowed by rule .04(3)(e) and .04(4)(d); therefore, a SIR report must be generated each month as required by rules .04(3)(e)2. and .04(4)(d)2. Merely collecting monthly raw data and saving it for submission to a SIR vendor for data analysis at a future date is not monthly monitoring and is a violation of UST rules. The SIR raw data must be analyzed by SIR software during the month of data collection. A report of the results of data analysis shall be generated during the monthly data collection period as required by rules .04(3)(e)2. and .04(4)(d)2.

There is a capacity limitation for SIR use on single tanks. These limitations may be found on the NWGLDE website and in Appendix 1 of this Technical Chapter.

SIR may be used on manifolded UST systems as long as the total capacity of the manifolded system does not exceed the capacity for which the method was approved. If the capacity of the manifolded system exceeds the listed capacity, another method of leak detection must be used.¹² If SIR is used on manifolded systems, then product level measurements must be collected for each individual tank although there will only be a single SIR result for all tanks that are manifolded.¹³

Where SIR is used on a UST system with a blending valve in a multi-product dispenser (MPD), the number of SIR results will correspond to the number of products being blended. For example, if there is regular, mid-grade and premium gasoline at a facility, there should be a SIR result for regular and premium, even though the facility is selling three grades of gasoline.

If a SIR vendor requires more than one (1) month of data for initial evaluation, another method of monthly release detection shall be conducted during that period as required by rules .04(3)(e)5. and .04(4)(d)5.

¹² Required by Rule 0400-18-01-.04(1)(a)5.

¹³ Required by Rule 0400-18-01-.04(3)(e)1 and .04(4)(d)1.

SIR methods must be **quantitative**. A **quantitative** test reports results in terms of a numerical leak rate based on characteristics of the dataset. Rules .04(3)(e)4.(ii) and .04(4)(d)4.(ii) specify 0.1gph as the threshold for determining a “fail”, so vendors may not declare a pass if the calculated leak rate exceeds 0.1gph

Rules .04(3)(e)2.(i) and .04(4)(d)2.(i) require that monthly SIR results include the raw data that was provided to the SIR vendor to generate the SIR result. For specific requirements, see the **RECORDKEEPING** section below.

Rules .04(3)(e)1. and .04(4)(d)1. require SIR data collection to be conducted in accordance with the following:

- Inventory volume measurements for petroleum inputs, withdrawals, and the amount still remaining in the tank are recorded each operating day (for SIR purposes this is defined as any day the tank contains one inch or more of product);
- The equipment used to take daily inventory readings is in good state of repair and is capable of measuring the level of petroleum over the full range of the tank's height to the nearest one-eighth of an inch;
- The petroleum inputs are reconciled with delivery receipts by measurement of the tank inventory volume before and after delivery;
- Deliveries are made through a drop tube that extends to within one (1) foot of the tank bottom;
- Product level measurements which are taken using a gauge stick shall be taken through a drop tube;
- Petroleum dispensing is metered and recorded within the local standards for meter calibration or an accuracy of six (6) cubic inches for every 5 gallons of petroleum withdrawn;
- Meters must be calibrated at least annually. All dispensers at retail facilities must have meters calibrated in accordance with local standards for meter calibration, or an accuracy of six (6) cubic inches for every five (5) gallons withdrawn. The Tennessee Department of Agriculture's Division of Regulatory Services requires certified individuals to conduct meter calibrations as a local standard.
- The measurement of any water level in the bottom of the tank is made and recorded to the nearest one-eighth of an inch at least once a month.

Product level measurements are required to be collected **each** day that one inch or more of product is stored in the tank.¹⁴ This includes seasonal tanks, such as kerosene or tanks located at marinas (see the Atypical UST Systems document), tanks not in operation during holidays or extended absence by owner/operator, or tanks that are temporarily out of service. A log of monthly water level measurements is required for review during the inspection in accordance with rules .04(3)(e)1.(vi) and .04(4)(d)1.(vi).

¹⁴ Required by Rule 0400-18-01-.04(3)(e)1.(i) and .04(4)(d)1.(i)

8. CONTINUOUS IN-TANK LEAK DETECTION SYSTEMS

Continuous In-Tank Leak Detection Systems (CITLDS) is a third party approved leak detection method utilizing data from the ATG and dispenser meters which are statistically analyzed to produce a monthly record similar to a SIR analysis. These systems are designed to operate continuously while the tank is in normal operation. These methods combine the automatic data collection features of Automatic Tank Gauging Systems (ATGS) with the statistical data analysis used in Statistical Inventory Reconciliation (SIR) systems. This allows the systems to monitor the tank continuously, using data collected continually. These systems then can operate without interfering with normal tank operation. CITLDS is commonly utilized at high throughput locations.

The techniques described in the U.S. EPA Leak Detection " titled "**Standard Test Procedures For Evaluating Release Detection Methods: Statistical Inventory Reconciliation**" dated May 2019 as follows:

There are two types of SIR release detection methods: traditional and continuous. Traditional SIR uses an ATG or takes daily manual liquid level readings of the product in the tank and reconciles them with the amounts of dispensed and delivered product. Continuous SIR performs the same product reconciliation as traditional; however, it can differentiate between line and tank leaks and can compensate for temperature variations with a continuous in-tank leak detection system (CITLDS). For continuous SIR, data are gathered from all designated input devices during tank quiet times when there are no sales and no deliveries and then SIR vendor software programs perform leak-test calculations when enough data is recorded.

Most CITLDS methods use an ATG to gather product-level data; this is considered a hybrid SIR method. Other CITLDS methods gather product-level data from input devices such as dispenser totalizers and point-of-sale records. CITLDS are well suited to facilities that are open 24 hours a day, 7 days a week, as long as the volume of the product sold from USTs does not exceed the throughput limit of the CITLDS method and there is enough quiet time to collect enough data.

The SIR methods then use these inventory records to perform a statistical analysis of inventory discrepancies. CITLDS methods, in comparison to periodic measurements, provide a larger quantity of data, which compensate for temperature and typically provide better data for SIR analysis. Various components that might contribute to these discrepancies are generally isolated before a leak rate is estimated. In addition to a leak rate estimate, some SIR methods claim to provide information on a variety of sources of inaccuracies such as dispensing meter error, delivery error, manual liquid level measurement error, temperature effects, theft, and vapor loss.

Continuous ATGS and Continual reconciliation systems are listed under Continuous In-Tank Leak Detection Methods on the NWGLDE website, www.nwglde.org

9. CITLDS REPORTS

CITLDS reports will show only a single result for all tanks containing that product grade. For example, if a location has two diesel tanks which are manifolded, the CITLDS report will issue one result for the two diesel tanks. If the report is a 'fail' for the diesel product, then individual tank and/or line tightness tests will need to be conducted on each diesel UST system as required by rules .04(3)(e)6.(i), .04(4)(d)6.(i), .05(1)(a)3., and .05(3)(a).

10. RECORDKEEPING

Upon transfer of ownership, including, but not limited to, sale of the UST systems, originals and/or copies of all documents required to satisfy the reporting and recordkeeping requirements shall be transferred to the new owner of the USTs at the time of ownership transfer. See rule .03(2)(d).

Owners and operators of underground storage tanks using SIR to meet the tank and/or piping release detection requirement must determine the leak status of their underground storage tanks monthly after the end of the data collection for that time period.¹⁵ UST system owners and operators may use SIR or another method to meet the tank release detection requirement, as long as the method meets specified performance standards.¹⁶ For UST system owners and operators who use SIR methods that have difficulty meeting the tank release detection requirement, owners can address this by:

- Conducting a more frequent analysis;
- Sending data more expeditiously by electronic means;
- Using a SIR vendor that currently meets the monthly requirement;
- Discussing changing method or data collection procedures with their SIR vendor or other SIR vendors in order to meet release detection requirement; or
- Selecting another type of release detection method in accordance with Rule .04(1)(d)

UST owners and operators have the option of performing their SIR analyses more frequently using inventory data from the current monthly monitoring period combined with data from the previous monthly monitoring period. For example, for vendors that require 30 days of data, tank owners and operators could:

- Collect data approximately every 20 days and combine this with approximately 10 days of previous inventory data for a combined 30 days of data; and
- Receive leak status results from their vendors in a timely manner.

This example assumes the SIR vendor will use data submitted by the owner and operator for the previous monitoring period or the owner and operator will resend that previously submitted data to their vendor. The result is more frequent analyses of the UST system's leak status.

The owner/operator shall receive the SIR analysis monthly after the end of the data collection for that time period as required by rules .04(3)(e)2. and .04(4)(d)2. The owner/operator must retain the last twelve months of SIR results as required by rules .03(2)(b)11. and .04(5)b. A monthly report consisting of the inventory record used (raw data) plus the resulting SIR determination must be maintained by the owner/operator as required by rules .04(3)(e)2. and .04(4)(d)2. Inventory data must be analyzed at least every month as required by rules .04(3)(e)2. and .04(4)(d)2. Failure to submit raw data for SIR analysis on a monthly basis is not monthly release detection and will not be acceptable to the Division.

The Division does not currently require the use of a specific form for reporting SIR results, so there may be some variation in appearance of SIR reports. Some SIR reports may include a summary sheet as part of the records. Monthly SIR reports must be reported in a format established by the Division and in accordance with instructions provided by the Division Rule 04(5).

¹⁵ Required by Rule 0400-18-01-.04(3)(e)2. and .04(4)(d)2.

¹⁶ Required by Rule 0400-18-01-.04(1)(a)4.

The following items are required:

- Facility Information;
- Owner Information;
- Name of SIR method and version used;
- Name, address, and phone number of SIR provider;
- Date of report generation and month/time period being analyzed;
- Tank Information (tank number, capacity, contents);
- The minimum detectable leak rate and calculated leak rate for the data set;
- The number of days analyzed and required per 3rd party certification;
- A result that is either 'Pass', 'Fail', or 'Inconclusive'; and
- Raw data (daily stick readings to one-eighth inch and converted to gallons, deliveries, sales, reconciliation with book value, daily variances, or any additional information the SIR vendor requires).

See the following example of SIR reports

11. SIR RESULT EXAMPLES

The following illustrate some SIR results and remarks for each.

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EXAMPLE 1: "What not to do"

001	SIR Monthly Tank Evaluation report				Date of Report: 9/8/2019												
Facility Name								ID#:									
Tank Location	Avenue																
	TN				Tel:												
Tank Owner Location																	
	FL				Tel:												
TANK OPERATOR								Tel:									
SIR Provider																	
SIR Version	V1.0				<ID:		Site Dir:										
Period Covered	08/19	Fixed Threshold		23 usable days per month required													
TANK				Current Month			07/19	06/19									
TANK ID	Product	Max. SIR size (gal)	Size (gal)	Leak Threshold (gph)	MDL rate (gph)	Calc. Leak rate (gph)	Pass, Fail or Inconclusive										
							P	F	I	P	F	I	P	F	I		
Unlead	REGULAR	45 K	10152	0.100	0.036	0.026	X			X							
Midgrade	MIDGRADE	45 K	10152	0.100	0.015	-0.022	X			X							
Premium	PREMIUM	45 K	10152	0.100	0.031	-0.030	X			X							

This is a SIR Summary Report. Notice the amount of information contained in this report although this report does not show the raw data used. The location information, SIR vendor information, size and product grade, the leak threshold being used, MDL and calculated leak rates and SIR result are all shown. This report also indicates the SIR version used by the vendor and the minimum number of usable days required by the vendor. The MDLs for these data sets are all below 0.2 gph, so the calculated leak rates are valid. The calculated leak rates are compared with the leak threshold to determine the SIR result.

The "date of report" was conducted 8 days after the end of the monthly period covered (08/19). This is a violation of rules .04(3)(e)2. and/or .04(4)(d)2.

Example 2: "What not to do"

Company :
 Tank ID :
 Period : 01/26/19 - 3/30/19

Location :
 Product : UNLEADED

Dates	Sales	Receipts	Book	Closing Stick	Daily O/S	Cumulative O/S
01/26/19	1015.3	0.0		3643.0		
01/27/19	193.7	0.0	3449.3	3456.0	6.7	6.7
01/31/19	1126.3	0.0	2329.7	2373.0	43.3	50.0
02/04/19	1077.9	0.0	1295.1	1246.0	-49.1	0.9
02/05/19	254.3	0.0	991.7	973.0	-18.7	-17.8
02/06/19	288.9	0.0	684.1	659.0	-25.1	-42.9
02/10/19	1123.2	5000.0	4535.8	4529.0	-6.8	-49.7
02/13/19	752.7	0.0	3776.3	3800.0	23.7	-26.0
02/17/19	1050.2	0.0	2749.8	2769.0	19.2	-6.8
02/19/19	557.0	0.0	2212.0	2187.0	-25.0	-31.8
02/20/19	566.6	0.0	1590.4	1606.0	15.6	-16.2
02/21/19	327.3	0.0	1278.7	1220.0	-58.7	-74.9
02/25/19	1441.6	5006.0	4784.4	4840.0	55.6	-19.3
02/26/19	193.3	0.0	4646.7	4744.0	97.3	78.0
03/02/19	414.3	0.0	3356.7	3327.0	-29.7	26.8
03/04/19	579.6	0.0	2747.4	2689.0	-58.4	-31.6
03/06/19	630.5	0.0	2058.5	2138.0	79.5	47.9
03/09/19	924.9	0.0	1213.1	1108.0	-105.1	-57.2
03/10/19	408.9	0.0	699.1	820.0	120.9	63.7
03/11/19	422.7	0.0	397.3	285.0	-112.3	-48.6
03/12/19	136.3	3450.0	3598.7	3800.0	201.3	152.7
03/14/19	253.5	0.0	3546.5	3565.0	18.5	171.2
03/16/19	712.1	0.0	2852.9	2689.0	-163.9	7.3
03/19/19	775.8	0.0	1913.2	1907.0	-6.2	1.1
03/22/19	851.7	0.0	1055.3	1040.0	-15.3	-14.2
03/23/19	145.9	0.0	894.1	949.0	54.9	40.7
03/25/19	522.4	0.0	426.6	332.0	-94.6	-53.9
03/27/19	325.2	3454.0	3460.8	3486.0	25.2	-28.7
03/30/19	859.2	0	2626.8	2819.0	192.0	163.5

Number of Days Submitted:	30	Absolute Average O/S:	58.1
Minimum Daily Sales :	136.3	Minimum Product in Tank:	285.0
Maximum Daily Sales :	1441.6	Maximum Product in Tank:	4840.0
Average Daily Sales :	630.4	Number of Deliveries :	4
Total Product Sold :	18912.8	Total Product Delivered :	16910.0

Even though this SIR report issues a PASS for this tank, notice the period covered: January 26 – March 30. There are many missing days in this 64-day period covered by the data. January 26 and 27 were weekend days and the next day sales reading recorded was January 31, which was a Thursday. It is unlikely the location was closed during those days. There are large variations in sales figures when there are missing days. This indicates that product levels are not being measured daily. Notice the MDL is almost above 0.2 gph and the calculated leak rate is 0.095 gph. Even though this data has been declared a "pass", it is extremely close to being a SIR "fail". If this result is for the month of March, the SIR vendor had to go back to January to get enough days to do the analysis since there were only 15 days of data for March. **In this example, even though the results indicate a "pass", the tank owner/operator is not conducting SIR properly; therefore, the results would not be accepted by the Division since he is not measuring product levels daily.**

Results of each SIR analysis must be reported following rules .04(3)(e)4. and .04(4)(d)4. as either "Pass", "Fail", or "Inconclusive", which are defined as:

PASS: If the absolute value of the calculated leak rate **does not exceed** the predetermined value of 0.10 gph **and** the minimum detectable leak in the monthly data does not exceed 0.20 gph **and** the number of valid daily readings is equal to or greater than the number required for a valid result as certified in the Third Party evaluation, the results may be reported as a "Pass";¹⁷

FAIL: If the absolute value of the calculated leak rate **exceeds** the predetermined value of 0.10 gph **and** the minimum detectable leak in the monthly data does not exceed 0.20 gph, the results shall be reported as a "Fail";¹⁸

If the gain **exceeds** 0.10 gph or **is due to measurable water incursion** then it must be reported as a 'fail' following rules .04(3)(4)4.(ii) and .04(4)(d)4.(ii) and the appropriate procedures followed.

INCONCLUSIVE: An "Inconclusive" result may be reported if any of the following conditions exist:¹⁹

- a) If a leak rate cannot be calculated using the available data; or
- b) there is an insufficient number of usable days in a 30-day period for a vendor to make a determination within the 95% Pd and 5% Pfa certification limits; or
- c) the minimum detectable leak (MDL) rate for the dataset for the month exceeds 0.2 gph.

If a monthly report indicates an inconclusive result then the owner/operator shall immediately implement the recommended actions from the SIR vendor for determining the cause of the inconclusive result as required by rule .04(1)(a)2. If the reason for the inconclusive results is a mechanical problem, such as meter drift, then the tank owner must immediately correct the problem. If the next **consecutive** month's SIR result is also inconclusive then the tank owner must report this to the Division as a suspected release within seventy-two (72) hours of receiving the SIR report as required by rules .04(3)(e)6., .04(4)(d)6., and rule .05(1)(a)3., and follow the procedures outlined in the **REPORTING** section below.

12. REPORTING

The tank owner is required to report the following conditions as a suspected release to the Division within 72 hours:²⁰

- Any monthly SIR result which is a "Fail" under rules .04(3)(e)6.(i) and .04(4)(d)6.(i); or
- Any second consecutive month in which the tank received an "Inconclusive" SIR result under rule .04(3)(e)6.(ii) and .04(4)(d)6.(i); or
- Unexplained presence of water in the tank under rule .05(1)(a)2

¹⁷ Required by Rule 0400-18-01-.04(3)(e)4.(i) and .04(4)(d)4.(i)

¹⁸ Required by Rule 0400-18-01-.04(3)(e)4.(ii) and .04(4)(d)4.(ii)

¹⁹ Required by Rule 0400-18-01-.04(3)(e)4.(iii) and .04(4)(d)4.(iii)

²⁰ Required by Rule 0400-18-01-.05(1)(a)

13. REFERENCES

Evaluation Protocol for Continuous In-Tank Leak Detection Systems Revision, Ken Wilcox and Associates, January 7, 2000

Introduction to Statistical Inventory Reconciliation For Underground Storage Tanks, EPA 510-B-95-009, September 1995

Standard Test Procedures for Evaluating Leak Detection Methods: Statistical Inventory Reconciliation Methods, EPA/530/UST-90/007, June 1990

Protocol for Determining Applicability of a SIR Method for Manifolded Tanks and Determining Size Limitation, Developed under coordination by the SIR team of the National Work Group on Leak Detection Evaluations, November 1996

14. APPENDICES

APPENDIX 1 - SIR Vendor/ Method Quick Reference Guide

APPENDIX 2 - SIR Report Example

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APPENDIX 1

SIR Vendor/ Method Quick Reference Guide

Revised January 2021

Manufacturer/ Vendor	Model	Threshold	Data Days	Single Tank Capacity	Manifolded Aggregate Tank Capacity
ACCENT Environmental Services, Inc.	SIRmadeSimple Version 1.0	0.05	21	45,000	4 Tank maximum=<45,000
AIUT Ltd.	Fuelprime IRC Version 2.4	0.1	30	30,000	50,000
	Fuelprime IRC Version 3.20	0.05	14	33,521	3 Tank maximum=<33,521
ASIS Automation and Fueling Systems, Inc.	FOX SIR V1 FOX SIR V2	0.1 0.05	30	20,000	60,000
Mostyle Pty. Ltd.	GreenScan SIR 3.0.1.2	0.1 0.05	30	30,000	4 Tank maximum =<45,000
Computerizing, Inc.	Computank Version 3.0	0.05	30	18,000	not evaluated for manifolded tanks
DocCanDo, LP	DocCanDo SIR 1.0	0.1	30	32,286	32,286
EnviroSIR, LLC	EnviroSIR Version 1.0	0.1 0.05	28	45,000	4 Tank maximum =<45,000
Fairbanks Environmental, Ltd.	Wetstock Wizard Version 4.4	0.1	30	45,000	4 Tank maximum =<45,000
Leighton Obrien Technologies, Ltd.	Monitor/ Redone	0.05	26	33,675	5 Tank maximum =<60,000
National Environmental, LLC	Tanknetics SIR Version 2.1	0.1 0.05	28	45,000	4 Tank maximum =<45,000
Simmons Corporation	Clearview (Version I)	0.1	2.8 to 11.6	36,096	3 Tank maximum =<36,096
	Simmons SIR 5.7 L.M.	0.1 0.05	27	60,000	5 Tank maximum=<60,000
	Simmons SIR 5.7	0.05	30	18,000	not evaluated for manifolded tanks

Manufacturer/ Vendor	Model	Threshold	Data Days	Single Tank Capacity	Manifolded Aggregate Tank Capacity
SIR International, Inc.	Mitchell's SIR Program V 2.6	0.05	23	45,000	4 Tank maximum =<45,000
	Mitchell's SIR Program V 2.7	0.1	23		
SIR Monitor	SIR Monitor	0.05	90, then 30	18,000	not evaluated for manifolded tanks
SIR Phoenix	SIR Phoenix	0.05	90, then 30	18,000	not evaluated for manifolded tanks
SIR Phoenix	SIR Phoenix, LEOMA V 01.50	0.1	28	18,000	4 Tank maximum =<45,000
TeleData Inc.	TankMate SIR V4.1	0.05	15	60,000	3 Tank maximum =<60,000
Total SIR, LLC	Total SIR Version 2.0	0.1	23	45,000	4 Tank maximum =<45,000
		0.05			
Veeder Root (Originally listed as Entropy Ltd.)	Precision Tank Inventory Control System Rev. 90	0.05	30	22,500	3 Tank maximum =<60,000
Veeder Root (Originally listed as USTMAN Industries, Inc.)	USTMAN Ver. 94.1	0.05	30	30,000	30,000
	USTMAN SIR Ver 95.2	0.05	30	60,000	4 Tank maximum =<60,000
	USTMAN 95.2A	0.1			
Veeder-Root (Originally listed as Watson Systems, Inc. and Enviroquest Technologies Ltd.)	Watson SIRAS version 2.0	0.1 0.05	30	30,000	not evaluated for manifold tanks
	Watson SIRAS version 2.8.3		30	30,000	
Warren Rogers Associates	WRA Petro Network S3	0.1	6	100,000	5 Tank maximum =<100,000
	WRA SIRA System V. 5.2	0.05	30	36,000	3 Tank maximum =<36,000
	WRA SIRA System V. 5.1	0.05	30	18,000	not evaluated for manifold tanks
SIR Phoenix	SIR Phoenix, LEOMA V 01.50	0.1	28	18,000	4 Tank maximum =<45,000
TeleData Inc.	TankMate SIR V4.1	0.05	15	60,000	3 Tank maximum =<60,000
Total SIR, LLC	Total SIR Version 2.0	0.1	23	45,000	4 Tank maximum =<45,000

Manufacturer/ Vendor	Model	Threshold	Data Days	Single Tank Capacity	Manifolded Aggregate Tank Capacity
		0.05			
Veeder Root (Originally listed as Entropy Ltd.)	Precision Tank Inventory Control System Rev. 90	0.05	30	22,500	3 Tank maximum =<60,000
Veeder Root (Originally listed as USTMAN Industries, Inc.)	USTMAN Ver. 94.1	0.05	30	30,000	30,000
	USTMAN SIR Ver 95.2	0.05	30	60,000	4 Tank maximum =<60,000
	USTMAN 95.2A	0.1			
Veeder-Root (Originally listed as Watson Systems, Inc. and Enviroquest Technologies Ltd.)	Watson SIRAS version 2.0	0.1	30	30,000	
	Watson SIRAS version 2.8.3	0.05	30	30,000	not evaluated for manifold tanks
Warren Rogers Associates	WRA Petro Network S3	0.1	6	100,000	5 Tank maximum =<100,000
	WRA SIRA System V. 5.2	0.05	30	36,000	3 Tank maximum =<36,000
	WRA SIRA System V. 5.1	0.05	30	18,000	not evaluated for manifold tanks

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APPENDIX 2

MONTHLY STATISTICAL INVENTORY RECONCILIATION (SIR) REPORT

MONTH _____ YEAR _____

FACILITY ID #			
TANK LOCATION	Street Address:	City:	
	Phone ()	Zip:	
TANK OWNER	Name:		
	Address:		
	City:	State:	Zip: Phone: ()
TANK OPERATOR	Name:		Phone: ()
SIR Provider			Phone: ()
SIR Version			Date of SIR report:
Performance standard	What is the required number of useable inventory days per month?		
Period Covered			

Tank Number	Tank Content	Tank Capacity	Useable Number of Data records	This Month						Last Month					
				Leak Threshold	MDL	Calculated Leak rate	Pass, Fail, Inconclusive			Pass, Fail, Inconclusive					
				gallons	days	Gph	Gph	Gph	P	F	I	P	F	I	

This form shall be used when Statistical Inventory Reconciliation has been chosen as the method of monthly release detection.

1. A report shall be generated monthly, after the end of the data collection for that time period.
2. The monthly result must be reported as "pass", "fail", or "inconclusive".
3. A "Calculated Leak Rate" must be reported monthly.
 - a. The test result is "Pass" only if the absolute value of the calculated leak rate is less than the leak threshold.
 - b. If the absolute value of the calculated leak rate for a tank is greater than or equal to the leak threshold, the result is "fail" for that month.
 - c. If the Minimum Detectable Leak (MDL) rate for a tank is greater than 0.2 gph and the absolute value of the calculated leak rate is less than the leak threshold, the result is "inconclusive" for that month.
4. If the monthly result is "fail", or if the monthly result is "inconclusive" for two months consecutively, the owner/operator must notify the Underground Storage Tank Division of a suspected release within 72 hours.

Recommendations/Comments for monthly results:

Person conducting evaluation		
Signature		Date