Texas Commission on Environmental Quality

INTEROFFICE MEMORANDUM

To: Area Directors
Regional Directors
Air Section Managers
Field Operations Support Division

Date: May 24, 2006

Thru: Jennifer A. Sidnell, Director
Field Operations Support Division

From: Stephen M. Ligon, Manager
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Subject: Leak Detection and Repair (LDAR) Guidance

Attached is a revised and enhanced guidance document to assist air investigators when conducting LDAR investigations.

The Field Operations Division Leak Detection and Repair (LDAR) Evaluation and Enforcement Considerations document dated December 31, 2004 was approved and implemented as an investigation protocol for the Houston Air Initiatives conducted in FY 2005. This document contains 16 pages of background information, technical basis, and guidance to investigators for evaluating a company's ability to identify leaking components.

This revised guidance document incorporates a new LDAR Investigation Procedure Summary that was developed as a summary from the original document to effectively serve as a "user's manual" for investigators, providing a more focused technical reference document. The revised guidance also includes: 1) the original approved document as Appendix A; 2) forms for instrument checks and sampling data as Appendix B; and 3) a form for describing records requested from a regulated entity as Appendix C.

These documents will be uploaded to the FODWEB after approval.

Attachment

TCEQ Field Operations Division
Leak Detection and Repair (LDAR) Investigation
and
Enforcement Protocol

INVESTIGATION PROCEDURE SUMMARY

To fully comprehend the basis and background of the LDAR investigation protocol, investigators must first read and understand Appendix A (Leak Detection and Repair Program Evaluation and Enforcement Considerations). Monitoring and Calibration Forms are contained in Appendix B. An example LDAR Document Request List is contained in Appendix C.

Length of Investigation - LDAR investigations should be completed within sixty total days from the last day on-site. A maximum of fourteen days should be spent for the on-site portion of the investigation.

Prior Notification - Determine whether the company should be provided prior notification based on the FODSOP high performance guidance located on FODWEB.

Pre-Investigation:

A. Obtain and review copies of the submitted LDAR semi-annual monitoring reports (or records) for the last 4 to 6 monitoring periods (or the last 1 to 2 years). If there are no federal or state regulations that require submittal of these reports, the monitoring records should be reviewed during the first day on site. (Appendix A, Page 9, Activities Prior to Going On Site, Item 1)

B. Evaluate the company supplied reports (or records) to determine compliance with applicable reporting and other LDAR requirements. (Appendix A, Page 10, Activities Prior to Going On Site, Item 4)

C. Determine the Regulated Entity's average claimed historical leaker rate from the obtained information. There needs to be at least 4 to 6 monitoring period leak rates quarterly, semi-annual, etc.). Leak rates should be determined only from the population of interest and should be for the same leak rate in a permit provision or as defined in a rule, i.e. 500ppm and 10,000ppm. (Appendix A, Page 6, Determining Minimum Number of Components to Sample)

D. Determine the associated leak definition and the population for components of interest to be sampled during the investigation. Include all valves. Examples are: valves in Light Liquid and Gas Vapor service [LL/GV], pumps in LL service, connectors in LL/GV service, and valves in LL/GV service. Example: LL/GV valves in Ethylene Unit = 5,540 (Appendix A, Page 6, Considerations on Assuring a Fair Comparison and Estimating Emissions). Only include the components designated as Difficult to Monitor (DTM), if they are part of the population of interest to be sampled.

E. Calculate the TCEQ monitoring sample size based on the population count for the components of interest. Minimum sample size is determined based on applying this number to the left column in Table 1 of

Appendix A, Page 7 and cross referencing the historical RE average leak percentage to the top row of Table 1.

F. Determine the critical number of leaking components from Table 2, Appendix A, Page 8 following the same method as listed above.

Determining the Sampling Plots:

A. Simple sources where components are basically located at ground level. (Example: Gas Plants, Compressor Stations, Tank Farms, etc.)

1. If possible, obtain plot plans of the process unit(s) to be sampled from the company's general/permit files. If no plot plans are in the files, obtain these on the first day of the on-site investigation. The plot plans should contain latitude/longitude or some other type of location information for the area of the site you are interested in sampling, along with a scale in feet/meters.

2. Construct a grid overlay of the selected process unit(s) by segmenting the unit plot plan(s) into 60 foot square grids (recommended). These plots/grids should not overlap. If plot plans adequately detailing the specified unit cannot be obtained from the regional files, the investigator may request (**when on-site only**) the RE to provide them. Unit Block Plot Plans with colored block grids on a 60 foot square grid overlay are desirable and can usually be produced by the RE CAD department. Investigator judgement should be used for determining the size of grid blocks. Smaller units may need smaller grids. Units 30 feet and larger, like tank farms, may need larger grids of 200 feet or more. Consecutively number each plot to identify the ground level sampling points. (Appendix A, Page 9, Sampling Plan Development)

3. The investigator may then employ either a table of random numbers or a web-site, such as Research Randomizer (www.randomizer.org), to select an unsorted number of plot/grid points to sample. Ensure that a sufficient number of plots are selected in order to meet the minimum sample size without running out of plots. The investigator shall sample the plots in the order each plot number was randomly generated. (Appendix A, Pages 8-9, Sampling Plan Development)

B. Complex Sources where components are located on multi-level platforms. (Example: Chemical Plants, Refineries, etc.)

1. Follow paragraph A1 and A2 above prior to going on site if possible.

2. In addition to paragraph B1, grid plots should be established for each platform level that contains components of interest. It is discretionary upon the investigator to determine if elevated platforms should be considered as a separate plot based on safety. Example: climbing a 200 foot distillation tower to sample two valves is not safe and/or a wise use of the investigators time and should not be considered a plot. If an elevated source with few components is not included in the plot grid, the investigator should note this in the investigation report along with the reason that this area was not considered for sampling. This should be done prior to going on-site, if the plot plan is detailed

enough to determine multi-levels. In most cases, you will need to perform a walk through of the unit on the first day and determine how many multi-levels are in each ground-level plot. Use the form and example in Appendix B to number the elevated plots.

3. If already on-site, you can use the REs internet access to run a random numbers table or call back to the regional office and have someone run one for you and relay the random plot numbers to you following paragraph A3 above.

Calibration:

Perform both Method 21 Response Time and Calibration Precision checks prior to arriving at the site to ensure equipment is working properly. These checks can be performed on-site, if you know the instrument is functioning properly. If performed the day before sampling, then the instrument response is re-verified once on-site by re-calibrating using a zero gas and a single span gas. Record these checks on the proper form and include them as an attachment to the investigation report. Refer to the forms package in Appendix B. Copy and file these forms in accordance with instructions on forms.

On-Site Investigation:

A. Perform an entrance meeting with the RE representatives. Describe investigation purpose to RE in terms of units to be monitored. Ask for leaker information based on appropriate leak definition, current plot plans and verify applicability of various LDAR regulations for the units to be monitored, etc. (See Appendix C for example document request list to be presented at entrance meeting.) In addition, the investigator should provide the RE the opportunity to perform concurrent, comparative monitoring with the REs LDAR contractor. [Note: It is recommended that the company representative be requested to calibrate their equipment against the investigator's gas standards to help identify any potential underlying problems with calibration standards/techniques. For unmanned sources or sources that are known not to have LDAR personnel on-site, notice to the RE can be given the morning of the inspection, prior to leaving the office, so they have the opportunity to get a contractor on-site.]

B. Obtain a copy of the list identifying current components designated on the Delay of Repair (DOR) list from the RE, so that those components can be evaluated for timeliness of repair as they are encountered during the sampling. Request that the information include the dates when each leaking component was placed on the shutdown/DOR list. (Appendix A, Page 10, On Site Activities, Item 1)

C. Implement the sampling plan:

   1. Once on-site (if necessary), identify the grids on the plot plans and map out ground level plot grids and any elevated plot grids as detailed above and generate the random plot numbers.

   2. The investigator will sample all of the components in the population of interest located in each plot established in the sampling plan prior to proceeding to the next plot. Monitoring forms are contained in Appendix B. The investigator shall record at a minimum the following information:
      a. the ambient background concentration in each plot,
      b. the actual component identifier (tag number),

c. actual ppmv rate measured for each monitored component,
d. any monitoring readings taken by the RE,
e. any other relevant information documented by the investigator during the sampling.

The sampling will be concluded when the minimum number of samples have been collected and all components in the population of interest in the final plot have been sampled.

D. During the investigation, look for visual leaks from components, open-ended lines, open waste water drains, and other components, depending on the applicable regulations governing the REs LDAR program.

E. Review company records to complete the evaluation of the facility's LDAR program. (Appendix A, Page 10, On-Site Activities, Item 3)

F. Fill out an exit interview form listing any additional information request and all known potential violations. Conduct an exit interview with the RE representatives notifying them of the current investigation findings. Request that the RE representative sign the exit interview form and give them a copy.

Post Investigation:

A. Determine the TCEQ number of leaking components found during the monitoring investigation. Calculate the actual leaker rate based on monitoring data. Compare the TCEQ leaking component count against the REs Critical Number of Leakers determined from Appendix A, Table 2 on page 8. If the sampled number of leaking components equals or exceeds the critical number of leakers, this indicates that the actual leaker rate is greater than or equal to the RE claimed historic leaker rate plus 2%. If critical number is equaled or exceeded, then enforcement is required. If the TCEQ sampling results in a number of leaking components less than the critical number of leakers from Appendix A, Table 2, then we can conclude that there is insufficient evidence to reject the company claimed leaker rate. (Appendix A, Page 10, Post Investigation Evaluation Results and Analysis)

B. If the Critical Number of Leakers is exceeded, calculate the annual emissions for the population of components of interest using the screening range factors derived from the appropriate EPA, NSR, or EI reference materials based on the company claimed historic leak value and the TCEQ sample based leak value. Include this information in the investigation documentation.

C. Determine the appropriate violation class of 1, 2, 2a, or 3 to characterize any documented violations of the LDAR program as defined in Appendix A, Enforcement Guidance, Nature of Violations, page 11. Be aware that the current Enforcement Initiation Criteria (EIC) is being revised and will include specific category A and B violations for the LDAR program.

D. Review any additional records requested.

E. **Investigation Report:** The investigation type code will be NSR3. The report will follow the standard **Narrative (Exceptions) Report of Investigation Findings** located at:

http://home.tnrcc.state.tx.us/internal/enforcement/air_inspect/)

F. In accordance with field operations division guidance, notify the RE of the final investigation findings prior to issuing the NOV or NOE.

Appendix A
LDAR Investigation and Enforcement Protocol

Leak Detection and Repair
Program Evaluation and Enforcement Considerations

OBJECTIVE

The purpose of this document is to provide guidance on how to evaluate a Leak Detection and Repair (LDAR) program that has been implemented at a regulated entity site, focusing primarily, but not exclusively, on evaluating the ability of the company's program to identify leaking components. Failure of a program to find leakers when they exist may have many causes, but one primary outcome: emissions, often quite large in quantity, are undercontrolled. This document also provides guidance on an appropriate enforcement response where findings indicate a failure to perform various aspects of a LDAR program. In addition, this document provides additional background on LDAR programs and the basis of the statistical methods employed in the evaluation procedures.

A properly implemented LDAR program is one where all components subject to the program are properly identified, the documentation required by the program is in place, the personnel charged with conducting the component screening properly perform EPA Reference Method 21 (or the Audio/Visual/Olfactory, AVO) leak evaluation, and leaking components are repaired within the time constraints of the rules. The impacts of an improperly implemented program can be significant. For example, a site with only 1000 valves with no LDAR program can easily emit over 100 tons per year of fugitive emissions from those valves. The same site with a properly implemented program will reduce emissions to only 3 tons per year. With such emissions at risk, it is reasonable to find ways to carefully evaluate each aspect of an LDAR program: recordkeeping, Method 21(leak detection) implementation, and component repair.

This document presents a procedure to test effectiveness of an implemented LDAR program to actually find equipment leaks when they exist. This procedure will involve selecting a number of components from a population of components of interest, screening (monitoring) them using Method 21 procedures, and then deciding whether or not the program the company has put into place is effective at finding leakers when they exist using a decision rule based on number of leakers found. The decision rule will be based on number of components sampled, number of those sampled components found to be leaking, the size of the component population, company historical leaker data, and a threshold of leaking percentage above which undercontrol of emissions will be significant. The difference in emissions from a site with 25,000 valves having a reported leaker rate of 0.1% (fairly typical) versus the same site with an actual leaker rate of 5.5% (also not uncommon) is over 1000 tons per year. This example is not an unusual one.

BACKGROUND AND PREPARATION

Necessary Evaluator Background and Tools

The proper evaluation of a LDAR program requires that the investigator:

- Understands the specific LDAR program(s) requirements for the process unit under evaluation.
- Demonstrates proficiency in actually performing EPA reference Method 21 screening and in calculating emissions based on program parameters.
- Understands the importance of ‘simple random sampling’ in the selection of components to be screened and the effect of that on the evaluation findings.

In order to convey the program evaluation results, the investigator should:

- Understand how to calculate emissions based on the evaluation results.
- Clearly characterize the seriousness of the findings where evaluation results indicate that the program was improperly implemented. The effect of a LDAR program failure to control emissions when the company relied on the controls associated with a properly implemented program to achieve VOC offsets in a non-attainment area are more significant that the same emissions not used to achieve the control. Similarly, if the company relying on an enhanced LDAR program to limit emissions above and beyond BACT in order to net-out and thus avoid PSD review is more serious to the airshed than similar emissions where those reductions were not being so used. Other considerations such as relative ozone reactivity of the VOCs should be considered in airsheds where the emission of such VOCs is important as an overall strategy to achieve and maintain the NAAQS in that airshed, or where the VOCs are HAPS.

The following documents are indispensable in preparing for an LDAR program investigation/evaluation. These documents should be in the library of the evaluator as they will be referred to often:

Appendix A
LDAR Investigation and Enforcement Protocol

- Copies of the various LDAR rules. Components subject to the rules, leak definition, monitoring (screening) frequency, skip periods, timeframes for repair are all found in the various rules and permitting programs. An evaluation cannot be conducted without knowing all the rules of the program, particularly since many components will be governed by multiple, overlapping, rules. Permits, Chapter 115, NSPS, NESHAP, MACT standards may all actually apply to a given component's fugitive emissions at a given site.

  It should be noted that many fugitive area emissions are being authorized under the provisions of permit by rule (PBR, 30 TAC 106). A careful review of any PI-8 used to characterize how the emissions authorized by PBR are limited is an indispensable element of the evaluation where this type of authorization is being employed.

- 1995 EPA publication EPA-453/R-95-017, Protocol For Equipment Leak Emission Estimates. This publication can be obtained from the EPA TTN website as follows:

  Main Document: http://www.epa.gov/ttn/chief/efdocs/lks95_ch.pdf
  Appendices: http://www.epa.gov/ttn/chief/efdocs/lks95_ap.pdf

  This is the primary document upon which most of the emissions estimates and short and long term control effectiveness are based.

- The New Source Review Guidance entitled Air Permits Technical Guidance for Chemical Sources: Equipment Leak Fugitives is available on the NSR Guidance Documents web page under the Chemical Section documents:

  Document: http://www.tnrcc.state.tx.us/permitting/airperm/nsr_permits/files/fugitive.900.pdf

  This publication contains emissions rates and control efficiencies recognized for various LDAR programs, and it contains NSR permit boiler plate language for various LDAR programs of the TCEQ.

- The Point Source Emissions Inventory Guidelines published annually and made available on the following web page:

  Web Page: http://www.tnrcc.state.tx.us/air/aqp/psei.html

  The Guidelines located on this page also provides details on characterizing emissions from fugitive sources.

- Existing OPLEAKS investigation protocol forms. This document supercedes the elements of the OPLEAKS investigation protocol related to sample size determination and selection of components to sample. In addition, the OPLEAKS forms did not include fields to record the monitoring data collected by the company if they choose to do comparative monitoring during the evaluation. Therefore, while the forms package for recording screening data associated with the OPLEAKS protocol can continue to be used with this method, they will likely need modification to more efficiently and effectively capture the data needed to support the documentation of the investigation. These forms are available on the TCEQ T-net at:

  Web Page: http://home.tnrcc.state.tx.us/internal/enforcement/air_inspect/index.htm

It is not necessary to be a statistician to perform the evaluation described in this document, but a basic understanding of the statistical theory behind the sampling and hypothesis testing used in the evaluation procedure is necessary to avoid either biasing the sampling results or invalidating any statistical inference based on the sample selected. More detailed explanations of sampling, statistical estimation, and hypothesis testing are found in the following resources:

- An outstanding book addressing sampling from a population, constructing confidence intervals and performing hypothesis testing based on a hypergeometric distribution is Lecture Notes in Statistics: Exact Confidence Bounds when Sampling from Small Finite Universes. An Easy Reference Based on the Hypergeometric Distribution by Tommy Wright. Published by Springer-Verlag, 1991. ISBN 0-387-97515-2. This book is offered for sale on the Web at a number of locations. This book should be part of the evaluators library as it provides extensive tables that can be used to determine sample size and confidence limits for populations up through 2000 in size without resorting to computer programs. In addition, it has an macro written in SAS that can be used to calculate any confidence intervals based on the hypergeometric distribution.

- A statistical book of the choice of the investigator that covers sampling without replacement from a finite population based on the hypergeometric distribution (as opposed to the normal approximation of same), hypothesis testing, confidence interval estimation, and sampling strategies related to taking a 'simple random sample'. The book should also contain a random number table, which will prove useful in developing the sampling plan described later. Most good introductory textbooks will cover these topics.

- There are outstanding resources on the web, two of which are:

  The National Institution of Standards and Technology (NIST) engineering handbook is an excellent resource and is located at:

  Web Site: http://www.itl.nist.gov/div898/handbook/index.htm

  A second very good site that provides excellent instruction in all aspects of statistics used in this document is 'Sticigui: Statistics Tools for Internet and Classroom Instruction with a Graphical User Interface', a website built and maintained by Dr. Philip C. Stark at University of California, Berkley:

  Web Site: http://stat-www.berkeley.edu/~stark/SticiGui/

  This website has numerous interactive javascript applets that are very useful in gaining an understanding of the statistical theory of sampling, etc.

Brief Explanation of Sampling, Decision Rule, and Hypothesis Testing
Statistics is used in two ways in this type of LDAR program evaluation: in estimating the leaker rate of the population and in helping decide whether or not the company's monitoring has been effective in detecting leakers with the program they have put in place.

We will use a decision rule and a hypothesis test to evaluate whether or not the company has been able to find leakers with their LDAR monitoring program. In order to make use of our decision rule, we will obtain a representative sample from the population of components of interest at the site, determine the number of leakers in that sample, and calculate the leaker rate. Our decision rule will be whether or not our sample number of leakers results in a leaker rate that exceeds the company leaker rate by 2% or more. If our calculated leaker rate is 2% or more larger than the company historical value, we will reject the notion that the company leaker rate is correct and conclude that they have failed to properly implement Method 21. Because of the method used to determine how many components to sample, and because we will select components to sample in such a way as to provide each component in the population a relatively equal chance of being sampled, we will be able to state what our Type I statistical error rate is for our hypothesis test when we employ our decision rule. Type I error, part of any statistical hypothesis test, is the chance of concluding that the company leaker rate is wrong when it is actually correct.

If we apply our sampling results to our decision rule and find that we have sampling evidence sufficient to reject the company claim that their leaker rate is true in favor of our alternative hypothesis that the true leaker rate is at least 2% larger than the company claimed rate, we will be able to state the power of our test to detect the difference. The sampling plan that will be created will enable us to constrain the Type II error associated with our claim. A Type II error is made when the sample based leaker rate is really right but we fail to reject the company determined value. We control the Type I and Type II error rates by sampling enough components, and doing so in a way that avoids introducing bias into our results. In our evaluation we will sample sufficient components to control Type I error rate to no more than 5% (alpha (α)$\leq$ .05) and our Type II error rate to no more than 20%(beta(β)$\leq$.20) resulting in a power of 80%.

If we sample and determine that we should reject the company claimed leaker rate, then we will use our calculated leaker rate to be the best reflection of actual leaker rate of the population sampled. We will calculate the difference in emissions (tons per year) based on the company vs our leaker rate. This emissions estimate will be used to evaluate the appropriate enforcement response to the undercontrolled emissions found when our decision rule is used to reject the company leaker rate.

Considerations on Assuring a Fair Comparison and Estimating Emissions
We use a statistical sampling technique because we wish to be able to reliably draw conclusions about the leaker rate of the population without monitoring (screening) each component in the population. We are interested in population leaker rate because it is used directly to calculate emissions from the population for regulatory LDAR programs, emissions inventory, and State Implementation Plan (SIP) purposes. Calculating emissions from fugitive emissions sources is fully described in the EPA and NSR guidance documents referred to in the 'tools' section above. In short, emissions from a population of components is calculated on a component type/ type of service basis (e.g., valves in light liquid, valves in gas service, etc), summing the individual contributions of each component/service to arrive at a population tons per year of emissions.

It is critically important that we clearly define the population of components of interest and that we sample the correct number of components from that population. If we do so, we can use the information to test the company claimed leaker rate, and further, we can use the leaker rate in calculating emissions.
If we have drawn a sample in a valid way from a population and our decision rule indicates that we must reject the company claim, then we can conclude that Method 21 was not properly implemented. The next step is to decide the impact of the program failure on controlling emissions. Estimating emissions involves multiplying the number of components of a given type in a given service by the factors for that component type for that service.

If our population of interest is valves and connectors in light liquid service, then we must use in our testing the total count of valves and connectors in light liquid service and their historical leaker rate. Based on that information, we can select a sample size and sample enough valves and connectors to apply our decision rule. If, based on applying our decision rule against our sampling results, we reject the claimed leaker rate provided by the company, then we can say that the company was wrong about the leaker rate when valves and connectors were the population of interest. Further, our sample results will enable us to state what the leaker rate is from that population as a whole. If we want to estimate the emissions from the population, we need more detail. We can't simply assume that the overall leaker rate is correct for both valves and connectors. We must calculate the leaker rate for valves and connectors separately in order to calculate emissions correctly.

For example, if a company had 1000 components in a population of interest comprised of 250 valves and 750 connectors and claimed a leaker rate of 1% (10 of 1000 components), we could test that claim by selecting at random 254 components and sampling them. If we found at least 6 leakers in our random sample of components we could reject the company claim of 1% leakers and state that the true leaker rate is 3% or more. We would have evidence that the company had failed to implement Method 21 correctly. In fact, based on our 254 component sample, if we found 13 leakers, we could say the leaker rate of the population as a whole was 5.1%, and further, that a 95% confidence interval about that mean would be 5.1% ± 2.3%. We would not, however, estimate emissions by assuming 5.1% of the valves and 5.1% of the connectors were leaking. If our sample was comprised of 84 valves, 3 of which were found to be leaking (3.6% leakers) and 170 connectors, 10 of which were found leaking (5.88%), then we would use our sample percentages by component type to estimate emissions from the population.

In summary, while we can use our decision rule to establish whether or not the company has properly implemented Method 21 for the entire population of interest, we can only estimate leaker rates and associated emissions for the population we have sampled. If our evaluation assesses only valves in gas service, then we cannot use the sampling derived leaker rate to estimate the leaker rate of connectors.

SAMPLE SIZE, CRITICAL NUMBER DETERMINATION, AND SAMPLING PLAN

Obtaining a representative sample from a population of interest is critical to the proper evaluation of a LDAR program. This section addresses the methods used to determine sample size, critical number of leaking components, and development of an appropriate sampling plan.

Determining Minimum Number of Components to Sample

From the company provided LDAR records or reports, determine the average number of components in the population and the population average leaker rate for the last 4 to 6 monitoring periods or enough to cover at least the most recent full year of monitoring results.

To determine the minimum number of components to sample, locate the claimed leaker rate within the range of values in the column headings of Table 1. Locate the total component population in the row headings on the left margin of the same table. The value in the intersection of the column and row is the necessary minimum sample size.

Table 1: Minimum Number of Components to Sample based on Component Population Count and Company Determined Leaker Rate

Note: (Values based on a hypergeometric distribution, alpha=0.05, beta=0.20, Null Hypothesis=company claim leaker rate is correct, Alternate Hypothesis= the actual leaker rate is greater than or equal to company claimed leaker rate plus 2%)

Total Population Component Count	Company Claimed Leaker Rate (# leaking components/ # components in the population)										
	up to 0.005	0.006 up to 0.010	0.011 up to 0.015	0.016 up to 0.020	0.021 up to 0.025	0.026 up to 0.030	0.031 up to 0.035	0.036 up to 0.040	0.041 up to 0.045	0.046 up to 0.050	0.051 up to 0.055
100 to 150	87	101	110	110	116	120	124	124	127	129	131
151 to 300	139	159	165	173	193	200	213	218	226	233	236
301 to 400	152	167	183	204	228	265	278	284	290	296	305
401 to 500	155	172	201	234	250	278	280	295	300	312	328
501 to 600	158	207	220	263	281	295	343	349	354	359	362

601 to 700	159	211	238	266	303	319	343	353	370	391	402
701 to 800	161	223	253	268	310	362	386	389	392	408	422
801 to 900	162	234	272	297	331	385	385	392	422	439	462
901 to 1,000	163	245	278	298	337	387	391	411	443	456	481
1,001 to 1,500	165	254	280	330	386	414	451	486	526	551	567
1,501 to 2,000	167	256	316	359	392	460	495	525	565	599	629
2,001 to 2,500	214	258	316	361	416	462	515	562	598	613	671
2,501 to 3,000	216	258	316	390	443	485	557	581	634	660	703
3,001 to 6,000	218	260	320	393	471	532	600	639	704	742	806
6,001 to 10,000	219	261	354	422	472	555	622	676	738	790	850
10,001 to 25,000	219	262	355	423	498	557	643	696	773	823	894
25,001 to 100,000	220	262	356	424	499	579	644	715	790	854	924
100,001 to 250,000	220	301	356	424	499	579	644	715	791	855	924

Determining the Critical Number of Leakers

To determine the critical number of leakers, locate the claimed leaker rate within the range of values in the column headings of Table 2. Locate the total component population in the row headings on the left margin of the same table. The value in the intersection of the column and row is the critical number of leakers.

Appendix A
LDAR Investigation and Enforcement Protocol

Table 2: Critical Number of Leakers based on Sample Size from Table 1
Note: (Values based on a hypergeometric distribution, alpha=0.05, beta=0.20, Null Hypothesis=company claim leaker rate is correct, Alternate Hypothesis = the actual leaker rate is greater than or equal to company claimed leaker rate plus 2%)

Total Population Component Count	Company Claimed Leaker Rate (# leaking components/ # components in the population)										
	up to 0.005	0.006 up to 0.010	0.011 up to 0.015	0.016 up to 0.020	0.021 up to 0.025	0.026 up to 0.030	0.031 up to 0.035	0.036 up to 0.040	0.041 up to 0.045	0.046 up to 0.050	0.051 up to 0.055
100 to 150	2	3	4	4	5	6	7	7	8	9	10
151 to 300	3	4	5	6	8	9	11	12	14	16	17
301 to 400	3	4	6	7	9	12	14	15	17	20	21
401 to 500	3	4	6	8	10	12	14	16	18	20	23
501 to 600	3	5	7	9	11	13	17	19	21	23	25
601 to 700	3	5	7	9	12	14	17	19	22	25	28
701 to 800	3	5	7	9	12	16	19	21	23	26	29
801 to 900	3	6	8	10	13	17	19	21	25	28	32
901 to 1,000	3	6	8	10	13	17	19	22	26	29	33
1,001 to 1,500	3	6	8	11	15	18	22	26	31	35	39
1,501 to 2,000	3	6	9	12	15	20	24	28	33	38	43
2,001 to 2,500	4	6	9	12	16	20	25	30	35	39	46
2,501 to 3,000	4	6	9	13	17	21	27	31	37	42	48
3,001 to 6,000	4	6	9	13	18	23	29	34	41	47	55
6,001 to 10,000	4	6	10	14	18	24	30	36	43	50	58
10,001 to 25,000	4	6	10	14	19	24	31	37	45	52	61
25,001 to 100,000	4	6	10	14	19	25	31	38	46	54	63
100,001 to 250,000	4	7	10	14	19	25	31	38	46	54	63

Sampling Plan Development
The sampling plan should be developed prior to conducting the site visit to avoid introducing bias in the selection of components to sample. The sampling plan should assure that sampling is from the population of interest. One would not want to sample just valves if one were interested in establishing the leaker rate for all component types, nor would one want to sample from only one area if one were interested in components from the entire site. The statistics underlying the hypothesis test rely on how components are chosen to be sampled. Sampling must be conducted in such a way that each component in the finite population of components of interest has a reasonably equal chance of being chosen for sampling. Once a given component is sampled it will not be resampled during the evaluation. Statistically, this is called taking a simple random sample without replacement from a finite population.

Deciding how many components to sample has been addressed in Table1. How we select those components is very important. There are several ways to obtain a simple random sample and there are ways to take a sample that results in anything but a simple random sample. If we need to sample 165 components and we went to the site, selected a given pipe run and sampled the first 165 components along that run, we would have taken a 'sample of convenience' resulting in information that could tell us about those 165 components, but would be useless in making inferences from the sample to the larger population. Our evaluation demands that we estimate the population leaker rate based on a representative sample.

The way raffle tickets are chosen at raffles is an example of taking a simple random sample from a finite population without replacement. All the raffle tickets are placed in a hopper (finite population), someone spins the hopper, and then reaches into it and selects a ticket (simple random sample, each ticket has an equal chance of being selected). Once a ticket is pulled from the hopper, it is not returned to that hopper for that raffle(sample without replacement). The process is repeated until the requisite number of tickets have been drawn. We can do something similar at a site: we could get the master component log, and using a random number table, select components to sample from that list and then go into the field and find and sample the components whose numbers we had previously selected. This, however, is impractical.

The preferred way of selecting components to be sampled is to overlay a grid onto a plot plan of the site or portion of a site that contains the population of components of interest. It is important that the grid thus established include the multi-story areas of the site, if any. The intersection of the grid lines would then become sampling plot centers, each plot center being uniquely numbered. If the grid was laid out using latitude and longitude then finding the plot centers once on site using a GPS device would be very simple. Once plot centers were established and numbered, then a list of plot numbers to be sampled could be selected at random using a random number table. Note that because we desire to sample without replacement, if any plots thus selected overlap, then we should discard one of the plots in favor of another that does not cause an overlap in the plots finally selected. All of these steps should be taken prior to stepping foot on the site, if possible, thus reducing the chance of introducing bias in our sample.

The plots thus selected should be 30' radius circular plots for three reasons:

1) each component of interest within the plot will be sampled, thus reducing the potential of bias in selecting components to be sampled within a plot.
2) It is pretty easy to keep track of sampling progress in a 30' circular plot even at the most complex sites.
3) Such small plots will assure that multiple plots are selected for sampling.

CONDUCTING A LDAR PROGRAM EVALUATION

Activities prior to going on-site

1) Obtain company LDAR monitoring reports (or records) for the last 4 to 6 monitoring cycles. These reports should contain: population component count by component type, service type and the number of leakers and calculated leaker rate for each component type. The monitoring results should also contain the leak definition and any information that would be pertinent to our properly conducting Method 21 monitoring at the site for the components of interest. Plot plans should also be obtained. These plot plans should contain latitude/longitude or some other type of location information for the area of the site that we are interested in sampling. The listing of various LDAR programs governing the components to be sampled should also be acquired.

2) Calculate the sample size needed based on the population of interest. Minimum sample size is determined based on applying company derived data to Table 1 above; Table 2 is used to determine the 'critical number of leakers'.

3) Construct a sampling plan and have the predefined list of plots and location of plots on a plan identified. Make

sure extra plots are selected.

4) Evaluate the previous company supplied leaker reports or records to determine compliance with the reporting and other requirements of the LDAR rules that apply.

On-Site Activities

1) Obtain a copy of the 'delay of repair' list from the company so that those components can be evaluated for timeliness of repair as they are encountered during the sampling.

2) Implement the sampling plan and collect the data. The company representative should be provided the opportunity of concurrent sampling, and if they elect to do so, their sample results should be recorded along with that collected by the investigator. Also, it is recommended that the company representative be asked to calibrate their equipment against the investigator's standards to help identify any potential underlying problems with calibration standards. Collect at least the minimum number of samples called for by the sampling plan.

3) After the completion of the sampling, conduct an on-site file review to evaluate other elements of the program. Such file review should include but not be limited to a review of Method 21 calibration records, leaker logs, and a verification that leaker repairs were made timely in accordance with the governing rule(s). Records of company sampling from previous monitoring periods should be acquired and date stamps of successive components sampled evaluated to see if the crew conducting sampling was allowing sufficient time to properly sample based on the characteristics of the equipment they used. Inquiries about any activities at the site that may have affected the population of components sampled, such as turnarounds, piping system rework, etc., should be made. Determine whether all calibration, recordkeeping, repair, and reporting requirements have been met for the component population of interest.

Post Investigation Evaluation Results and Analysis

1) Sum the total number of leakers from the data collection worksheets. Compare the number of leakers found against the 'critical number of leakers ' obtained from Table 2. If the sampled number of leaking components equals or exceeds the critical number of leakers, then do the following:

   a) Reject the hypothesis that the company leaker rate is the true leaker rate.
   b) Calculate the leaker rate based on our sample size and number of leakers found.
   c) Calculate the annual emissions for the population of components represented by the sample using screening range factors derived from the appropriate EPA, NSR or EI reference materials based on the company claimed value and our sample based leaker rate. Include this information in the enforcement documentation.

   If our sampling results in a number of leakers less than the critical number of leakers from Table 2, then we can conclude that there is insufficient evidence to reject the company claimed leaker rate.

2) Evaluate the performance of the company against the other requirements of the LDAR programs for the population of components of interest. Document any other non-compliance issues.

ENFORCEMENT GUIDANCE

Risks of the Program

Appendix A
LDAR Investigation and Enforcement Protocol

The primary impediments to a successful implementation of the LDAR workpractice standard include failure to properly cap open ended lines, failure to properly monitor the components, failure to repair the leaking components in a timely manner, and failing to keep the required detailed records. The risk from emissions that would have otherwise been reduced through the LDAR program are not minimal. For example, at one site located in a nonattainment area a collection of 351 components were subject to a LDAR program. If the operator of this LDAR program failed to properly calibrate the instrument prior to use which resulted in the inability of the equipment to properly sense the concentration of VOC around the components, then the emissions from those 351 components would amount to as much as 44.9 tons of air contaminants per year. However, if the same components were regulated by a properly implemented program, fugitive emissions would be limited to 1.3 tons per year. If the site is located in a nonattainment area classified as severe with a major source threshold of 25 tons per year then these additional emissions due to the failure to implement the program properly would result in the equivalent of adding close to two major sources of VOCs to that airshed, without even considering the emissions offsets that would have been required for new sources in that area.

Nature of Violations
There are essentially three kinds or classes of violations in a LDAR program.

Violation Class 1: No program in place where one is required. This may be for the site as a whole or for a portion of the site, such as a new business unit added to the site but for which the LDAR program was never initiated.

Violation Class 2: Failure to properly conduct EPA Reference Method 21, the standard instrument method used to detect leaking components. This violation may stem from an improperly calibrated instrument, from failure to sample components long enough to allow the instrument to actually register the correct VOC concentration proximate to the leaking components, or from improper probe placement.

Violation Class 2a: Failure meet substantive requirements of a LDAR program not related to recordkeeping or Method 21 performance. Examples include failure to cap open ended lines or to double block valves where required, failure to repair equipment tagged for turnaround in a timely manner and similar violations.

Violation Class 3: Failure to keep records of monitoring or calibration data.

The following two examples illustrate violation classes 1 and 3. An example of a class 2 violation is given in the Evaluation of a LDAR Program Example, below. Note that these examples are for illustrative purposes. In all instances, the final resolution of a violation situation must adhere to agency policy and guidance on enforcement matters.

Enforcement Example 1: Class 1 Violation
Company fails to conduct a monitoring program for two years where a monthly monitoring frequency is required. Air contaminant is VOC.

Steps to be taken:

a) Determine uncontrolled, annualized emissions.

- Tons/Yr per component type in given service=(Number of Components *EPA Average Emissions Factor)*(1-Controlled Emissions Factor)*8760 hrs/yr

Since no actual equipment monitoring data is available on which to quantify fugitive emissions, the EPA average factors must be used. Obtain the emissions factors from the most stringent rule to which collection of components is subject. Factors are published in EPA guidance and the TCEQ guidance identified in the section "Necessary Evaluator Background and Tools". This is due to the fact that many fugitive sources are subject to numerous LDAR programs. In many cases, companies voluntarily submit to LDAR programs in permitting in order to obtain VOC offsets. It is important to determine to which rules the collection is subject, and in what role (e.g., offset of non-attainment emissions) the emissions reductions play.

- Total emissions from the LDAR program=
  Sum of tons/yr per each component type in given service

b) Describe the context of the violation.

- The following should be conveyed in describing the violation:
  - If the annualized emissions total equals or exceeds the major source threshold for the geographic location;
  - If the source is in a nonattainment area, and the LDAR related emissions reductions were used to establish VOC offsets;
  - If the LDAR program emissions reductions were used to establish VOC offsets for PSD review avoidance; or,
  - If the annualized emissions total equals or exceeds the Prevention of Significant Deterioration (PSD) review threshold or the Nonattainment Review threshold for modifications requiring BACT review.
  - The date the program was originally required at the site.

Enforcement Example 2: Class 3 violation

If the company conducted monitoring, and failed to keep some of the records, but not enough to call the entire program into question, then the following should be conveyed in describing the violation:

If the company failed to keep any calibration records or leaker or leak repair records, then the violation should be treated as Example 1, above. If the company failed to keep some of the calibration records, then the description should include information on the relative importance of the records missed in assuring that the program was controlling emissions appropriately.

EVALUATION OF A LDAR PROGRAM: COMPLETE EXAMPLE

Background for LDAR Investigation and Enforcement Example 3: Class 2 Violation

Assume the decision has been made to conduct an evaluation of chemical manufacturer X's LDAR program this year. The company is required to conduct a LDAR program with a leak definition of 10,000 ppm with quarterly monitoring. In order to simplify this example, assume that the population of components of interest at this site is valves in 100% volatile organic compound (VOC) gas service, and the components are located across the entire site. This site is characterized as a synthetic organic chemical manufacturing (SOCMI) facility and is located in an ozone attainment area. A properly implemented LDAR program with this monitoring frequency and with this leak definition yields a 97%

emissions reduction over the uncontrolled emissions for those components.

Step 1. Obtain information on the LDAR program
The investigator conducting the evaluation obtains the following information from LDAR program reports required to be submitted to the agency quarterly:

Results of quarterly monitoring by company			
Calendar Quarter	**Population Count of Components**	**Number of Leaking Components**	**Fraction of Leaking Components**
3QTR2003	25069	14	0.00056
4QTR2003	25033	21	0.00084
1QTR2004	24054	47	0.00195
2QTR2004	24740	25	0.00101
Average	24724	≈27	0.00109

Based on the above component count we can use the EPA average emissions factors for SOCMI facilities to calculate emissions, both controlled and uncontrolled, from this source. Applying the emissions factors to the count of components in this example (emissions factors from Table 2-2, page 2-13 of EPA publication EPA-453/R-95-017) would result in 1,448 tons of emissions annually from these 24,724 valves as follows:

Uncontrolled Emissions (tpy) = Emissions Factor (lb/hr) * component count
= 0.00597 kg/hr *2.24 lb/kg*8760 hr/yr *24,724 components
= 2,896,311 lbs or 1,448 tons per year.

A properly implemented LDAR program employing quarterly sampling and a 10,000 ppm leak limit definition would reduce emissions by 97%, resulting in the following emissions:

Controlled Emissions (tpy) =2,896,311lb/yr *(1-.0.97)
=86,899 lbs or 43.4 tons per year

Step 2. Determine sample size, critical number, and sampling plan
The investigator uses the average values from Step 1 and applies them to Tables 1 and 2 above and establishes the minimum component sample size of 219 and a critical number of leaking components of 4.

The investigator takes out a plot plan, constructs a grid overlay of the site, numbering the grid line intersections consecutively. Utilizing a table of random numbers, the investigator selects a number of grid points which will be used as 30' radius plot centers in which component sampling will take place. Note that the plots selected should not overlap.

Step 3. On-site Activities
The investigator will review leaker logs, calibration records, and inquire if any operational events have occurred that might have an effect on fugitive components, such as fires, etc. The investigator will then begin sampling the

components from each plot established in the sampling plan. The investigator will measure each component of interest in the plot prior to moving to the next previously selected plot. Actual component identifier, actual ppmv rate measured and other such information should be captured. It is insufficient to simply record 'leaking' on the record. Sampling should continue until the minimum number of samples have been taken. Where the minimum number of components is reached prior to finishing the last plot, the additional components in that plot should be sampled.

Step 4. Post investigation processing

In this example the investigator samples 219 components and finds that 12 are leaking, for a sample leaker rate of 5.5%[(12/219)*100=5.5%]. Statistically speaking, the chance of finding 12 leaking components of a sample size of 219 by chance alone if the actual leak rate is 0.0011 (27 leakers in a population of 24,724 components) is less than 1 chance in 2.6E-18. Compare this with the chances of winning the Texas Lotto, which is far better, being "only" about 1 in 47 million. (Note: This is calculated by using the hypergeometric function in quattro pro or excel: @hypgeomdist(12,219,27,24724)). Based on our findings, we have sufficient evidence to reject the null hypothesis. Further, our sample based leaker rate of 5.5% is the best available estimate of the population leaker rate for the valves in 100% VOC gas service at the site, since that is the population of interest we selected prior to the beginning the evaluation.

Step 5. Characterizing the violation

Because we found reason to reject the company claim when applying our sampling results to our decision rule, we conclude that regardless of the fact that the company had a LDAR program in place, they were unable to find leakers when they exist and therefore the workpractice has failed to control emissions as required. There is no way to know if the company failed to properly conduct Method 21 due to equipment problems, to operator error, or due to some combination of reasons. We do know, however, that if Method 21 were properly implemented then the leaking components would consistently be found. After we again confirm that 'nothing unusual happened in the process unit since the last company monitoring cycle' then we conclude that Method 21 has not been properly implemented. There may be other violations, such as failure to cap open ended lines or to tag leaking components, or fix 'turn around tagged' components at the turnaround, or record keeping problems, and those violations should be documented and resolution of them pursued. In this example we will not consider those additional violations further, we will simply talk about the risk to the environment of the Method 21 monitoring failure.

Step 6. Applying the Enforcement Guidance to this example

a) **Determine uncontrolled and controlled emissions based on findings**

From Step 1 above, we had determined that had emissions been controlled properly from this collection of valves, we would have expected emissions of 43.4 tons per year. Our findings indicate that the company failed to monitor correctly, resulting in emissions of up to 1,448 tons per year.

Since we have actual data, we do not have to rely on EPA average factors. We can (and should) make use of EPA screening range factors to decide how much emissions were attributable to the flawed LDAR program. The company claimed a leaker rate of 27 leakers/24,724 valves, or a leaker rate of 0.0011. Our sampling indicates a leaker rate of 12 leakers in 219 components sampled, or a rate of 0.055. Using the 10,000 ppm screening range factors from Table 2-5, page 2-19 of EPA guidance document EPA-453/R-95-017, we can calculate the difference between these two leaker rates as follows:

Emissions leakers (tpy)=

=leaking component count * 0.0782kg/hr *2.25 lb/kg *8760 hrs/yr *1 ton/2000lbs

Emissions non-leakers(tpy)=
=non leaking component count * 0.000131kg/hr *2.25 lb/kg *8760 hrs/yr *1 ton/2000lbs

Emissions total (tpy)=
=Emissions leakers + Emissions non-leakers

Emissions based on company claimed leaker rate:
Emissions for company claimed 0.0011 (0.11%) leaker rate (27 leakers of 24,724 valves):

Emissions leakers (tpy)=
=27components*0.0782kg/hr * 2.25 lb/kg *8760 hrs/yr *1ton/2000 lbs
=20.8 tons per year

Emissions non-leakers(tpy)=
=(24,724-27) *0.000131kg/hr * 2.25 lb/kg *8760 hrs/yr *1ton/2000 lbs
=31.9 tons per year

Emissions total (tpy) based on company claimed leaker rate of 0.011%=
=20.8 tpy + 31.88 tpy
=52.7 tpy

Emissions based on sample based leaker rate:
Emissions for 0.055 (5.7%) leaker rate found by the investigator (1352 leakers of 24,724 valves):

Emissions leakers (tpy)=
=1352 components *0.0782kg/hr * 2.25 lb/kg *8760 hrs/yr *1ton/2000 lbs
=1,041.9 tons per year

Emissions non-leakers(tpy)=
=23,372components *0.000131kg/hr * 2.25 lb/kg *8760 hrs/yr *1ton/2000 lbs
=30.2 tons per year

Emissions total (tpy) based on investigator determined leaker rate of 5.5%=
=1041.9 tpy + 30.2 tpy
=1072.1 tpy

Difference between company claimed emissions and investigator determined leaker rate:
Difference of emissions between company claim of 0.11% leakers and TCEQ determined leaker rate of 5.5% is over 1000 tons per year as follows:

Emissions Difference = emissions at 5.47% leakers -emissions at 0.109% leakers
= 1072.1 tpy - 52.7 tpy
= 1019.4 tpy were left uncontrolled due to the failure of the company program.

b) Describe the context of the violation.
Whether we calculate emissions based on average emissions factors or screening range factors, the environment

was subjected to the equivalent of 10 major sources of VOC emissions in the attainment area in which the site is located. The outcome of this violation would be to make it more difficult for the area to maintain the National Ambient Air Quality Standard (NAAQS. Had this same violation occurred in a non-attainment area, then the out come would have been more significant, as it may have impeded the ability of the area to achieve attainment of the NAAQS. Since the evaluation was based on the most recent 4 quarterly monitoring period, that information should also be clearly conveyed.

ACKNOWLEDGMENTS
The author of this document is Brad Toups, manager of the Industrial Emissions Assessment Section in the Technical Analysis Division of the TCEQ Office of Environmental Planning, Analysis, and Assessment(OEPAA). Questions regarding this document should be directed to Mr. Toups at (512) 239-1872 (btoups@tceq.state.tx.us).

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Appendix B

CONTENTS

1) Method 21 Calibration Check Form
2) Daily Span Count Check Form.
3) LDAR Elevated Plot Form with a Completed Example.
4) Sampling Data Cover Sheet and Sampling Data Form
5) Method 21 Response Time Check

TCEQ Method 21 Calibration Precision Check

August 2005

Required quarterly or prior to field use whichever is later.

Date Performed:________________ Name of Staff Performing Check: ________________________

Signature of Staff Performing Check: _______________________

Analyzer Make:__Thermo Enviro________ Model:___TVA 1000B____ Serial No:____________

Gas Used (normally methane):__Methane__________ Gas certifications attached?___Y___ (y/n)

Step 1 Allow instrument to warm up for 45 minutes.
Step 2 Zero instrument using gas with less than 1 ppmv THC.
Step 3 Calibrate instrument using ~500 ppmv standard.
Step 4 Introduce zero gas into the instrument probe using a Tedlar bag and allow to stabilize.
Step 5 Introduce the ~500 ppmv standard into the probe using Tedlar bag.
Step 6 Record instrument response below.
Step 7 Introduce the zero gas into the probe using Tedlar bag.
Step 8 Repeat Steps 5 through 7 two more times.

Expected	Zero	Diff	10	Diff	495	Diff	9,999	Diff
Trial 1								
Trial 2								
Trial 3								
Ave Diff								
Precision								

Calibration Precision = 100 * (Average Difference / Expected Reading)

= 100 * (__________) / (________)

= ________ percent

NOTE: IF CALIBRATION PRECISION PERCENTAGE IS NOT LESS THAN 10 PERCENT THE INSTRUMENT IS NOT MEETING METHOD 21 CRITERIA AND MUST BE REPAIRED AND THE ABOVE LISTED PROCEDURES REPEATED!

Keep one copy of this document in the instrument case, attached a copy to your investigation report, and place the original in instrument file at regional office.

Daily TVA-1000B Span Count

Example: $\frac{\text{Span Counts - Zero Counts}}{\text{Span Concentration (PPM)}} = \frac{25502 - 4100}{102 \text{ (PPM)}} = 210$ Counts/ppm

---

Date Performed: _______________ Name of Staff Performing Check: ______________________

Analyzer Make:________________ Model:__________________ Serial Number:_______________

Zero Counts: ______________ (Should be < 5000 counts)

---

10 PPM Span Gas (Must = 175 - 250 counts/PPM Methane)

_________ Counts - ________ Zero Counts / 10 PPM = ______________ Counts/PPM

Are counts within range? Yes____ No____

---

495 PPM Span Gas (Must = 175 - 250 counts/PPM Methane)

_________ Counts - ________ Zero Counts / 495 PPM = ______________ Counts/PPM

Are counts within range? Yes____ No____

10,000 PPM Span Gas (Must = 175 - 250 counts/PPM Methane)

_________ Counts - ________ Zero Counts / 10,000 PPM = ______________ Counts/PPM

Are counts within range? Yes____ No____

COMMENTS:____

____

____

____

LDAR ELEVATED PLOT FORM

Ground Level Plot #	Number of Levels	Level 2 Plot Number	Level 3 Plot Number	Level 4 Plot Number	Level 5 Plot Number	Level 6 Plot Number	Level 7 Plot Number	Level 8 Plot Number	Level 9 Plot Number	Level 10 Plot Number	Level 11 Plot Number	Level 12 Plot Number

LDAR ELEVATED PLOT FORM - (Example)

Ground Level Plot #	Number of Levels	Level 2 Plot Number	Level 3 Plot Number	Level 4 Plot Number	Level 5 Plot Number	Level 6 Plot Number	Level 7 Plot Number	Level 8 Plot Number	Level 9 Plot Number	Level 10 Plot Number	Level 11 Plot Number	Level 12 Plot Number
1	1											
2	2	21										
3	2	22										
4	3	23	31									
5	2	24										
6	1											
7	1											
8	6	25	32	38	41	43						
9	5	26	33	39	42							
10	3	27	34									
11	3	28	35									
12	3	29	36									
13	4	30	37	40								
14	1											
15	1											
16	1											
17	1											
18	1											
19	1											
20	1											

TCEQ LDAR Sampling Data Sheet Dover

September 2005

Investigation Date(s):	
Regulated Entity (RE) Name:	
RE and Customer Identification Numbers:	
Air Account Number:	
Location of Company:	
Process Unit Name:	
Population of Interest:	
Total Component Count:	
Reported Leak Rate:	
Date Last Monitored:	
Minimum Sample Size:	
Total Monitored:	
Applicable Regulations:	
Leak Definition for Population of Interest:	
Instrument Type:	
Instrument Serial No:	
Calibration Gases Used:	
Will Facility Staff Verify Leaks?	
Name of Facility Staff Verifying Leaks:	
Date of Last Response Time Check for TCEQ Analyzer:	
Date of last Calibration Precision Check For TCEQ Analyzer:	

RN Name		Sampling Data Form						Page: 7
Air Acct #								Date:
RN #	RN							Instrument Operator:
CN #	CN							Note Taker:
	TCEQ	RE		LEAK	EQUIP	EQUIP	VOC	UNIT:
TAG NO.	VALUE	VALUE	PLOT #	DEFIN	TYPE	SIZE	TYPE	DESCRIPTION/COMMENTS
1								
2								
3								
4								
5								
6								
7								
8								
9								
10								
11								
12								
13								
14								
15								
16								
17								
18								
19								
20								
21								
23								

TCEQ Method 21 Response Time Check

August 2005

Required upon purchase and any other time modifications are make to probe assembly.

Date Performed:___________ Name of Staff Performing Check: ______________________

Signature of Staff Performing Check: ____

Analyzer Make: Thermo Enviro Model: TVA 1000B Serial No: _______________

Gas Used (normally methane): Methane

Gas certification attached? Y (y/n)

Step 1	Allow instrument to warm up for 45 minutes.
Step 2	Zero instrument using gas with less than 1 ppmv THC.
Step 3	Calibrate instrument using ~500 ppmv standard.
Step 4	Calculate 90 percent of ~500 ppmv standard. This is the “target value”.
Step 5	Introduce zero gas into the instrument probe via Tedlar bag and allow to stabilize.
Step 6	Document the time required for the instrument to respond from the zero reading to the target value.
Step 7	Record values for this response time check below.
Step 8	Repeat steps 5 through 7 two additional times.

	Cal Gas 10		Cal Gas 495		Cal Gas 9,999	
Expected	9	Time	445.5	Time	9,000	Time
Trial 1						
Trial 2						
Trial 3						
Ave Time						

NOTE: IF AVERAGE IS GREATER THAN 30 SECONDS THE INSTRUMENT IS NOT MEETING METHOD 21 REQUIREMENTS AND MUST BE REPAIRED AND PROCEDURES REPEATED!

Keep one copy of this document in the instrument case, attached a copy to your investigation report, and place the original in instrument file at regional office.

Adjust expected time based on actual calibration gas ppmv.

Appendix C

CONTENTS

Table of records typically requested from a regulated entity.

Investigation Notes Related to Records Request

Regulated Entity/Site Name				**TCEQ Add. ID No. RN No. (optional)**	
Investigation Type	NSR 3	**Contact Made In-House (Y/N)**		**Purpose of Investigation**	
Regulated Entity Contact		**Telephone No.**		**Date Contacted**	
Title		**Fax No.**		**Date Faxed**	

NOTICE: The information provided in this Note is intended to provide clarity to records requested to the date of this Note during the investigation process between the agency and the company and *does not represent agency findings related to violations*. Any additional records needed will be communicated by telephone to the regulated entity representative.

Issue	**Records Request** **For Records Request, identify the necessary records, the regulated entity (company) contact if different from above, and the date due to the agency.**					
No.	**Description of Records Requested**	**Date Range**	**Request Date**	**Commit Date**	**Regulated Entity Contact**	**Rec'd Date**
1	Fugitive Monitoring Database on Disc to include the following monitoring data (include DTM and UTM)					
	Process Unit Name					
	Component Number					
	Area and Sub-Area if applicable (and if DTM or UTM)					
	Component Service including LL, HL, etc.					
	Component Type					
	Date					

Document Acknowledgment. Signature on this document establishes only that the regulated entity (company) representative received a copy of this document and associated continuation pages on the date noted. If contact was made by telephone, document will be faxed to regulated entity; therefore, signature not required.

Investigator Name (Signed &Printed)	**Date**	**Regulated Entity Representative Name (Signed & Printed)**	**Date**

If you have questions about any of the information on this form, please contact your local TCEQ Regional Office.
Individuals are entitled to request and review their personal information that the agency gathers on its forms. They may also have any errors in their information corrected. To review such information, call 512/239-3282.

COPIES: Original: for Regulated Entity Representative, Copy: TCEQ

Issue	**Records Request** **For Records Request, identify the necessary records, the regulated entity (company) contact if different from above, and the date due to the agency.**					
No.	**Description of Records Requested**	**Date Range**	**Request Date**	**Commit Date**	**Regulated Entity Contact**	**Rec'd Date**
	Time Stamp					
	Reading					
	Instrument Number					
	Operator					
2	Master Component List on Disc to include the following:	Current				
	Component Number					
	Area and Sub-Area if applicable (and if DTM or UTM)					
	Component Service including LL, HL, etc.					
	Component Type					
3	List of Components on Shutdown (SD). (include signature and reason). Include the dates when each leaking component was placed on the shutdown list.					
4	Date(s) when a leaking component was taken out of service as allowed by 3 TAC 115.352(2)(C). [Delay of repair component which has been isolated from the process and does not remain in service.]					

Document Acknowledgment. Signature on this document establishes only that the regulated entity (company) representative received a copy of this document and associated continuation pages on the date noted. If contact was made by telephone, document will be faxed to regulated entity; therefore, signature not required.			
Investigator Name (Signed &Printed)	**Date**	**Regulated Entity Representative Name (Signed & Printed)**	**Date**

If you have questions about any of the information on this form, please contact your local TCEQ Regional Office.
Individuals are entitled to request and review their personal information that the agency gathers on its forms. They may also have any errors in their information corrected. To review such information, call 512/239-3282.

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Issue	Records Request For Records Request, identify the necessary records, the regulated entity (company) contact if different from above, and the date due to the agency.					
No.	**Description of Records Requested**	**Date Range**	**Request Date**	**Commit Date**	**Regulated Entity Contact**	**Rec'd Date**
5	Provide the expected VOC emissions whenever the process unit was shut down for repair of components or other equipment, including: the total emissions; the calculations used; and engineering assumptions applied.					
6	Provide records concerning the dates and nature of each extraordinary effort to repair any leaking component.					
7	Provide records concerning the calculation showing the estimated VOC emission rates of a leaking component as required by 30 TAC 115.352(2)(A)(i)(II) if extraordinary efforts were not initiated.					

Document Acknowledgment. Signature on this document establishes only that the regulated entity (company) representative received a copy of this document and associated continuation pages on the date noted. If contact was made by telephone, document will be faxed to regulated entity; therefore, signature not required.			
Investigator Name (Signed &Printed)	**Date**	**Regulated Entity Representative Name (Signed & Printed)**	**Date**

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Issue	**Records Request** **For Records Request, identify the necessary records, the regulated entity (company) contact if different from above, and the date due to the agency.**					
No.	**Description of Records Requested**	**Date Range**	**Request Date**	**Commit Date**	**Regulated Entity Contact**	**Rec'd Date**
8	Provide records for each process unit with leaking components, updated each day after a leaking component was determined to require a process unit shutdown to repair and where extraordinary efforts to repair the component were not pursued, including the following: the date, calculations, and estimated emissions of VOC as required by 115.352(2)(A)(i)(III); the date, calculations, and comparison of emissions of VOC as required by 115.352(2)(A)(i)(IV); and the date of each process unit shutdown required due to VOC emissions of leaking components exceeding the expected VOC emissions from the shutdown.					
9	EI factors used for EI calculations					
10	2002 and 2003 leakers used for EI calculations					
11	Quarterly Precision Calibrations					
12	Daily Calibrations					
13	Calibration Gases Certifications					
14	Percent Leakers Documentation [Note: For the last 8 quarters (or 2 years)]					
15	LDAR Semi-annual Reports					

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Appendix C
LDAR Investigation and Enforcement Protocol

Issue	Records Request For Records Request, identify the necessary records, the regulated entity (company) contact if different from above, and the date due to the agency.					
No.	**Description of Records Requested**	**Date Range**	**Request Date**	**Commit Date**	**Regulated Entity Contact**	**Rec'd Date**
16	Weekly audio, visual, and/or olfactory (AVO) inspection records					
17	Copy of the log or database notations, as required to be maintained by 30 TAC 115.354(10)(C), detailing each change to the database concerning the monitored concentration, date and time read, repair information, addition or deletion of components, or monitoring schedule.					
18	Documentation identifying the components of each process unit in highly reactive VOC service, as required by 30 TAC 115.781.					
19	Unit Plot Plans (The scale for the plot plans need to be in feet.)					
20	Information concerning the monitoring frequency for each unit to be monitored (ie: quarterly, semi-annual, or annually).					

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