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AUG 07 1997

DOE-1275-97

Mr. James A. Saric, Remedial Project Manager
U.S. Environmental Protection Agency
Region V-SRF-5J
77 West Jackson Boulevard
Chicago, Illinois 60604-3590

Mr. Tom Schneider, Project Manager
Ohio Environmental Protection Agency
401 East 5th Street
Dayton, Ohio 45402-2911

Dear Mr. Saric and Mr. Schneider:

TRANSMITTAL OF THE FINAL INTEGRATED ENVIRONMENTAL MONITORING PLAN AND RESPONSES TO THE THREE REMAINING OHIO ENVIRONMENTAL PROTECTION AGENCY COMMENTS ON THE INTEGRATED ENVIRONMENTAL MONITORING PLAN

References:

(1) Letter and enclosures, J. Reising, U.S. DOE to J. Saric, U.S. EPA and T. Schneider, OEPA, "Responses to U.S. EPA and OEPA Comments on the Draft Final IEMP and Responses to OEPA Comments on the Draft Final OSDF Groundwater/Leak Detection and Leachate Monitoring Plan," dated May 23, 1997.

(2) Letter, J. Saric, U.S. EPA to J. Reising, U.S. DOE, "IEMP RTC," dated July 10, 1997.

(3) Letter and enclosure, T. Schneider, OEPA to J. Reising, U.S. DOE, "Conditional Approval - Integrated Environmental Monitoring Plan," dated July 11, 1997.

This letter serves to submit the subject document. The document has been revised to its final form by incorporating actions associated with the comment responses in Reference 1, and several Department of Energy (DOE) initiated changes. The comment responses contained in Reference 1 were approved in References 2 and 3. A listing of the DOE initiated changes and responses to the three comments received via Reference 3 is enclosed.

Recycled and Recyclable

If you have any questions regarding this submittal, please contact Robert Janke at (513) 648-3124, or Kathleen Nickel at (513) 648-3166.

Sincerely,

FEMP:Nickel

Johnny W. Reising
Fernald Remedial Action
Project Manager

Enclosures: As Stated

cc w/encs:

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DOE Initiated Changes to the IEMP (Draft Final to Final version)

Global Changes:

Minor typographical errors were corrected as needed.

Procedures referenced in the individual media sections have been updated to reflect current applicable procedures.

Individual media sections have had minor editorial changes to reflect the SCQ more consistently

Section 1:

Figure 1-1 was revised to reflect incorporation of the Natural Resource Impact Monitoring Plan (NRIMP) into the IEMP.

Section 2:

No substantive DOE initiated changes

Section 3:

Added a sub-section on Monitor Well Maintenance (Section 3.6.2.5)

Section 4:

Revised Table 4-1 to more accurately reflect OU5 FS commitments regarding sampling for BTV constituents.

Revised Table 4-2 by highlighting trichloroethene as an IEMP surface water parameter.

Minor revisions were made to Tables 4-3 through 4-15 to more accurately reflect requirements specified in Table 4-2 and to provide better inter-table consistency.

Text in Section 4.5.2.1 (Water Collection Procedure) was revised to more accurately portray program requirements.

Sections 5, 6, 7, and 8:

No substantive DOE initiated changes.

RESPONSES TO OEPA SUPPLEMENTAL COMMENTS ON SECTION 6.0 OF THE DRAFT FINAL INTEGRATED ENVIRONMENTAL MONITORING PLAN FOR MARCH 1997

Commenting Organization: OEPA Commentor: OFFO
Comment #: 1
Comment: Please provide a table that specifically indicates what individual air monitoring data will be reported in the quarterly IEMP report. Please include any and all of the individual project monitoring in this table.

Response: DOE will report the TLD, radon and bi-weekly air particulate (TSP and total uranium) results on a quarterly basis. Quarterly composite data from the air monitors may lag behind other data due to the amount of time necessary for sample analysis, data review and evaluation. Data collected from point sources (stacks) and project specific monitoring data will be integrated into the IEMP reporting framework to support sitewide data interpretations, compliance reporting and the collective decision making process discussed in Section 1 of the IEMP. Project specific work plans will contain the sampling and analysis requirements for any project-specific air monitors.

The following table is a summary of the air monitoring data which will be included in the IEMP quarterly report. Figures refer to the maps in Section 6 of the IEMP.

Quarterly IEMP Data Report

Data Description	Location Description	Reference
Bi-weekly TSP	All locations	Figure 6-2
Bi-weekly uranium	All locations	Figure 6-2
Radon	All continuous monitoring locations	Figure 6-3
TLD	All locations	Figure 6-4
Quarterly air composite*	All locations	Figure 6-2
Monitored stacks*	Stacks requiring monitoring per 40 CFR 61, Subpart H	
Project-specific air data*	See project-specific work plans	

* Data may lag behind one quarter.

Action: No revision of the IEMP required.

Commenting Organization: OEPA Commentor: OFFO
Comment #: 17
Comment: Stating that the detection level is based on vendor information is not sufficient. Factors such as instrument background, environmental background,.and count time (exposure time) must be included to show at

what levels radon concentrations an be detected.

Response: Documentation for the Lower Limit of Detection or Minimum Detectable Concentration will be provided as the basis for statements made in the IEMP text. Attachment A contains the formulae for the LLD and MDC for Continuous Radon Monitors. Attachment B contains the formula for the LLD for Alpha Track-etch detectors.

Action: No revision of the IEMP required.

Commenting Organization: OEPA Commentor: OFFO
Comment #: 20

Comment: OEPA and USEPA are requesting the sampling procedures used for air monitoring for formal review as a part of the FEMP "Application for Approval to Use Environmental Measurements to Demonstrate Compliance with NESHAPs Subpart H, dated May 23, 1997."

Although these procedures have been forwarded to the OEPA in the "recent" past DOE-FN may wish to update the high volume air sampling procedures due to the change in the use of data from environmental surveillance to compliance monitoring.

Response: High volume air sampling procedure will be revised prior to the implementation of the IEMP in January, 1998. The revision process will include incorporating IEMP related changes such as the number and locations of the monitors. OEPA holds a controlled procedure manual (OP-2208) and will receive the revised procedures as they are issued. Copies of these procedures were forwarded to the USEPA during the July 21 - 25, 1997 NESHAP inspection.

Action: No revision of the IEMP required.

ATTACHMENT A

LLD and MDC Formulae for Continuous Radon Monitors

Using terminology referenced in EPA 520/1-80-012 "Upgrading Environmental Radiation Data", the LLD of an instrument is defined as,

> ...The LLD is an *a priori* ESTIMATE of the detection capabilities of a given measurement process. It is based on the premise that from a knowledge of the background count and measurement system parameters (i.e., detection efficiency), an *a priori* (before the fact) limit can be established for a particular measurement. This limit does not depend on the sample activity, but rather on the detection capability of the measurement process itself...

The equation for LLD is derived using statistical parameters involving Type I and II error probabilities (both usually set at 0.05). The following equation is used for determining the LLD for the Pylon AB-5 CPRD (units are COUNTS for a one hour interval):

$$LLD = K\,[2.71 + 4.65 * S_b]$$

where, S_b = the standard deviation of the combined electronic & CPRD (instrument background) count for one hour.

NOTE: K = 1 since we are only interested in counts (i.e. no correction factors).

The manufacturer supplies the background countrate upon calibration of the unit. Assuming Poisson statistics, S_b is given by the following relationship:

$$S_b = (R_b * T_b)^{0.5}$$

where, R_b = the instrument background countrate (cpm), and
T_b = the instrument background count interval (minutes).

Substituting, the LLD equation becomes:

$$LLD = 2.71 + 4.65 * (R_b * T_b)^{0.5}$$

Utilizing typical manufacturer supplied values, the LLD becomes:

$$\begin{aligned} LLD &= 2.71 + 4.65 * (0.75 * 60)^{0.5} \\ &= 2.71 + 4.65 * (45)^{0.5} \\ &= 34 \text{ counts} \end{aligned}$$

Also, from the same document:

> ...The MDC considers not only the instrument characteristics (background and efficiency), but all other factors and conditions which influence the measurement. It is an *a priori* estimate of the activity concentration that can be practically achieved under a specific set of typical measurement conditions. These include the sample size, counting time, self-absorption and decay corrections, chemical yield and any other factors that comprise the activity

concentration determination...

The equation for MDC is also derived using statistical parameters involving Type I and II error probabilities (both usually set at 0.05). The following equation is used for determining the MDC for the Pylon AB-5 CPRD (units are pCi/L):

$$MDC = K_{mdc} * (2.71 + 4.65 * S_b)$$
$$= K_{mdc} * LLD$$

where,
- S_b = the standard deviation of the instrument background count,
- LLD = the instrument LLD, and
- K_{mdc} = the proportionality factor, in this case relating the detector response to the activity concentration in a sample (pCi*minutes/L/cpm).

The manufacturer supplies the inverse of the proportionality constant upon calibration of the unit (known as the Sensitivity). Utilizing typical manufacturer supplied values, the MDC becomes:

$$MDC = [1/(1.50*60)]*34$$
$$= \mathbf{0.38 \sim 0.4\ pCi/L}$$

ATTACHMENT B

LLD formula for LLD for Alpha Track-etch detectors
(Vendor Provided)

An Analysis of the Lower Limit of Detection for Radtrak

Introduction

The stated minimum reportable exposure for Radtrak has been 30 pCi/l day. The expected precision and probability of detection at this level are not stated; however, these factors are essential for clearly establishing a lower limit of detection or a minimum reportable value. This report reviews the statistical bases for establishing a lower limit of detection for Radtrak. The implications for an unambiguous definition are discussed also.

Statistical Background

Statistical hypotheses testing has been the accepted approach to define a lower limit of detection in radioactivity measurements. The hypothesis becomes "Are the results of an exposed group of detectors statistically different from the results of an unexposed group?" The minimum exposure that becomes statistically different is the lower limit of detection.

The difficulty arises from defining statistically different. There is no official definition so one can set a subjective definition based on the tolerability of making two types of errors. The Type I error identifies an unexposed detector as an exposed detector while the Type II error identifies an exposed detector as unexposed. The acceptability of both errors is based on the consequences of their occurrence. The probability of making the Type I error (false positive) is usually called α and is typically set between 1% and 10%. The Type II error (false negative) probability is called β .

More thorough treatment is provided by Donn and Wolke (1977). Figure I is excerpted from their report and shows the relation between the errors and the detector populations. The lower limit of detection is μ_s , the mean result of the exposed population. Unfortunately, the true values for the mean and variance of the populations are not known; they are only estimated by sampling. The ability to define the lower limit of detection becomes influenced by how well one estimates the population parameters. In general, the more counts or observations made, the better the estimate.

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Donn and Wolke have prepared a curve relating α ; the mean probability of detection (e.g. $1-\beta$); and a value, $C_s/\sqrt{V_s}$. This last value is the inverse of the net sample coefficient of variation (i.e. net counts/net std. dev.) Setting two of these factors defines the third.

Application to Radtrak.

The value $C_s/\sqrt{V_s}$ is equal to

$$\frac{C\,(\text{gross}) - \dfrac{A\,(\text{gross})}{A\,(\text{background})}\,C\,(\text{background})}{\left[C\,(\text{gross}) + \left(\dfrac{A\,(\text{gross})}{A\,(\text{background})}\right)^2 C\,(\text{background})\right]^{1/2}}$$

where

C_{gross} = gross counts
A_{gross} = area counted to get C_{gross}
$C_{background}$ = background counts
$A_{background}$ = area counted to get $C_{background}$

The proposed α value is 0.1 and β value of 0.05. This means that 10% a group of unexposed detectors may report positive and 5% of a group of detectors exposed at the LLD will report as zero.

From Figure 2 the $C/\sqrt{V_s}$ must equal 3.6. Table I lists the minimum sample area that must be read to get a value of 3.6 for different sheet background levels. Current QC procedures determine the background from 9 samples each evaluated over $10mm^2$, setting $A_{background}$ equal to $90mm^2$. The results of Table I indicate that the standard read area of $10mm^2$ is insufficient to detect 30 pCi/l day for the proposed values of α and β .

Table II presents the actual lower limit of detection for a read area of $10mm^2$ and $15.6mm^2$ using $\alpha = 0.1$ and $\beta = 0.05$. The $15.6mm^2$ area is that expected for fiber optic analysis (6 fields at $2.6mm^2$ per field).

Table III presents the mean probability of detection with = 0.1 and a read area of $10mm^2$ for a 30 pCi/l day lower limit of detection.

Implications

With a fixed read area and sheets of different background, Radtrak has a varying lower limit of detection that could be perceived as inconsistency by an unsuspecting user. For detectors exposed more than one month, the practical effect of the error for a homeowner is trivial. An LLD of 30 pCi/l day converts to 1 pCi/l for a one month exposure which is far below the 4 pCi/l EPA guide. The effect may be important when the LLD of 30 pCi/l day is used in a contract specification or when Radtrak is used for less then one month.

For example, assume a person uses a Radtrak device for 15 days with a background of 1 track/mm^2. With $\alpha = 0.1$ and $\beta = 0.05$, the LLD is 61 pCi/l day which would convert to 4 pCi/l. The expected precision at this level is 1/3.6 = 0.278 at one standard deviation. The 95% confidence interval for the reported value ranges from 1.78 pCi/l to 6.22 pCi/l.

Finally, the definition of the minimum reportable dose should not equal the lower limit of detection. If they are the same, the half the detectors exposed at the LLD will report as zero. If one averages the readings, a negative bias will occur because half the values will be zero and the others will range above the LLD. The minimum reportable value is more appropriately defined at the demarcation of α and β as represented by the vertical dashed line in Figure I. If the LLD is set at 30 pCi/l day then the minimum reportable would be 16.3 pCi/l day. If no changes in analysis are made, the worst case LLD of 60 pCi/l day would result in a minimum reportable value of 32.5 pCi/l day. For detectors exposed at 32.5 pCi/l day, 5% will report greater than 57 pCi/l day.

Summary

Using statistical methods a lower limit of detection can be determined for different situations. The recommended definition is that level with an α = 0.1 and a β = 0.05. The lower limit of detection will vary with background for a given counting area. To define a fixed lower limit of detection, the area counted must be varied depending on sheet background.

The lower limit of detection is not suitable as the minimum reportable value nor should the minimum reportable value be implied to be the lower limit of detection. The minimum reportable value should be set at the level where 5% of the samples exposed at the lower limit of detection would be reported as zero.

Table I

READ AREA TO ACHIEVE AN LLD OF 30 pCi/l DAY

WITH α = 0.1 AND β = 0.05

Sheet Background tr/mm^2	Read Area mm^2
1	30
0.9	28
0.8	26
0.7	24.5
0.6	23
0.5	21
0.4	19
0.3	18
0.2	16
0.1	14.5

Table II

LOWER LIMIT OF DETECTION FOR A READ AREA OF

$10mm^2$ and $15.6mm^2$

Sheet Background tr/mm^2	LLD at $10mm^2$ pCi/l day	LLD at $15.6mm^2$ pCi/l day
1	61	45.7
0.9	61	44.9
0.8	58	42
0.7	58	41
0.6	54.9	40.4
0.5	51.9	37.5
0.4	51.9	34.7
0.3	48.8	33.9
0.2	45.8	31
0.1	42.7	28.2

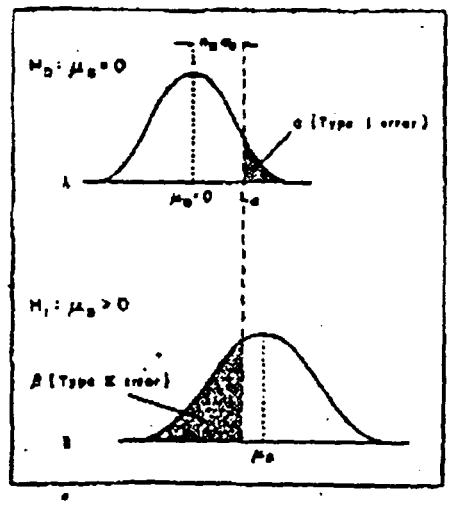
Table III

THE MEAN PROBABILITY OF DETECTION FOR α = 0.1,

READ AREA OF $10mm^2$ AT 30 pCi/l day

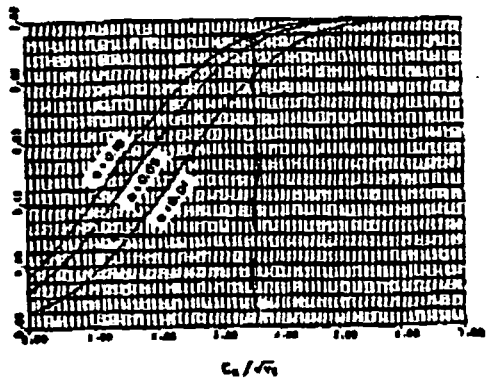
Sheet Background tr/mm^2	Mean Probability of Detection
1	0.73
0.9	0.75
0.8	0.77
0.7	0.78
0.6	0.80
0.5	0.82
0.4	0.84
0.3	0.85
0.2	0.86
0.1	0.89

Figure I



Detection of a net activity above background. The figure shows the relationship of Type I and Type II errors to the derived net count distributions for the null hypothesis (H_0) and the alternative hypothesis (H_1).

Figure II



Mean probability of detection ($\bar{Q}a$) as a function of the ratio of net sample count to net sample standard deviation. Curves are presented for α = 0.01, 0.05 and 0.10.

From Donn & Wolke. The statistical interpretation of counting data from measurements of low-level radioactivity. Health Physics 32:1;1977.