

Identifier: **SOP-5142**
(formerly ESH-17-201, R3)

Revision: **0**



Effective Date: 4/7/2009

Next Review Date: 3/17/2014

Environmental Programs Directorate

Standard Operating Procedure

for **AIRNET—ESTABLISHING AND USING ACTION LEVELS**

APPROVAL SIGNATURES:

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1.0 PURPOSE AND SCOPE

This standard operating procedure (SOP) applies to the AIRNET ambient air monitoring network at the Los Alamos National Laboratory (LANL) only. It describes how to calculate AIRNET action levels, how to evaluate AIRNET data against action levels, and the response to data that exceed these levels.

Waste and Environmental Services workers shall implement this procedure when calculating AIRNET action levels, evaluating AIRNET data against action levels, and the actions to take in response to AIRNET monitoring data that exceed these levels.

2.0 BACKGROUND AND PRECAUTIONS

2.1 Background

This procedure implements aspects of “AIRNET - Quality Assurance Project Plan” (WES-SOP-5140).

2.2 Precautions

None

3.0 EQUIPMENT AND TOOLS

None

4.0 STEP-BY-STEP PROCESS DESCRIPTION

4.1 Alpha and Beta Action Levels

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| Worker | <ol style="list-style-type: none">1. After alpha/beta data have been determined to be valid or have had qualifiers applied to them (described in SOP-5140, SOP-5141, SOP-5149), they are to be compared to action levels, as described and defined in section 5.0. Since alpha/beta data are not used for compliance determinations, there are no alert action levels (AALs).<hr/>2. Alpha and beta activities are closely related to the concentrations of radon decay products in the atmosphere, which can fluctuate widely over time with atmospheric conditions, but are reasonably uniform within the sampling area at any one time.

To discount large temporal variations, the IAL is determined by the mean of only the current alpha or beta data set under review plus or minus 3s (where 3s is three times the standard deviation of the data). The standard deviation is determined using at least 1 year of recent measurements with outliers and rejected data removed. Outliers will be removed by performing the Rosner's or Dixon's tests as appropriate (see memo ESH-17:02-109, 2002). For alpha/beta data, both high and low IALs are used.<hr/>3. Update the alpha/beta investigation levels about every 2 years using the most recent 1 to 5 years of net concentration data. |
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- Worker
4. Determine high and low IALs for both alpha and beta as follows:
 - a. Collect 1 to 5 years of net concentration data.
 - b. Remove rejected data from this data subset.
 - c. Calculate the mean of the net historical data for each sample period.
 - d. Subtract this net historical sample-period mean from each net concentration value in that sample period to derive a “normalized” set of differences for each sample period.
 - e. Calculate 3s of the normalized differences from all of the sample periods in the data subset.
 - f. Record this 3s value in the AIRNET database “Action Levels” table in the alpha or beta IAL locations.
 - g. Have a peer perform 100 percent verification of all calculations and data entry.
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5. If an alpha or beta IAL is exceeded, see section 4.6. Also, use professional judgment to determine if the following are of diagnostic value:
 - a. Request gamma analysis of the filter for abnormally high amounts of naturally occurring ^{210}Pb .
 - b. If so, request the half filter be dissolved and standard isotopic analyses plus ^{210}Po and/or ^{210}Pb analyses be performed.
 - c. If a natural source is suggested, no further action is required. Record results in a memorandum to file.
 - d. If a LANL source is suggested, notify appropriate management and attempt to identify the source. Record results and findings in a memorandum to file.

4.2 Tritium Action Levels

- Worker
1. After tritium data have been determined to be valid or have had qualifiers applied to them (described in SOP-5140, SOP-5141, SOP-5149), they are to be compared to action levels, as described and defined in section 5.0. If an action level is exceeded, see sections 4.6 and 4.7.

Tritium sources at the Laboratory include stacks and diffuse sources mostly at Area G. Area G emissions increase greatly during hot weather. Therefore, the investigate action levels for Area G stations are calculated differently from those for other stations. Based on professional judgment, other stations may be evaluated in the same way as Area G stations (e.g., station at Technical Area 16).
 2. **Tritium IALs for stations *outside Area G*.**

Outside Area G, atmospheric conditions have very little effect on atmospheric tritium concentrations. It is appropriate to compare current values to the long-term historical mean and 3s value, on a station-by-station basis. The mean and standard deviation are determined using 1 to 5 years of the most recent net concentration data, with outliers and rejected data removed. Outliers will be removed by performing the Rosner's or Dixon's tests as appropriate (see memo ESH-17:02-109, 2002).
 3. Update the tritium IALs about every 2 years by using the most recent 1 to 5 years of net concentration data for stations *other than Area G*.
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Worker

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4. Determine the IAL for tritium as follows:
 - a. Collect 1 to 5 years of net concentration data.
 - b. Remove rejected data from this data subset.
 - c. Calculate the mean of the net historical data by station.
 - d. Calculate 3s of each station mean.
 - e. Add 3s to the station mean. Do so for all stations.
 - f. Store the “mean+3s” values in the AIRNET database “Action Levels” table in the tritium station locations.
 - g. Have a peer perform 100 percent verification of the calculations and data entry.
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5. If an IAL is exceeded outside Area G see section 4.6,
If the AAL is exceeded outside Area G see section 4.7.
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6. **Tritium IALs for Area G stations.**

At Area G atmospheric conditions have a large effect on atmospheric tritium concentrations. Therefore, for Area G stations, 1 to 5 years of the most recent net concentration data (for each individual station) will be used to calculate IALs for each 2-week sampling period. The IAL is a five-period (10 week) average net concentration plus its corresponding **2s**. The mean and standard deviation are determined using 1 to 5 years of the most recent net concentration data, with outliers and rejected data removed. Outliers will be removed by performing the Rosner’s or Dixon’s tests as appropriate (see memo ESH-17:02-109, 2002).

7. Update the tritium IALs about every 2 years by using the most recent 1 to 5 years of net concentration data for stations *within Area G*.
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8. Determine the IAL for Area G tritium as follows:
 - a. Collect 1 to 5 years of net concentration data.
 - b. Remove rejected data from this subset.
 - c. Remove outliers using the Rosner’s or Dixon’s tests as appropriate (see memo ESH-17:02-109, 2002)
 - d. Calculate the multi-year mean of the net historical data by station, using the period of interest as well as the two periods immediately before, and the two periods immediately after the period of interest (i.e. a “five period rolling average”).
 - e. Calculate 2s of each station/period mean.
 - f. Add 2s to each applicable station/period mean for all stations and periods.
 - g. Store these “mean+2s” values in the AIRNET database “Action Levels” table in the Area G tritium station locations.
 - h. Have a peer perform 100 percent verification of the calculations and data entry.
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9. If an IAL is exceeded at Area G, see section 4.6,
If the tritium concentration exceeds 150 pCi/m³ professional judgment is used. Directions in section 4.7 are not required.
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4.3 Uranium Action Levels

Worker

1. After uranium (U) data have been determined to be valid or have had qualifiers applied to them (described in SOP-5140, SOP-5141, SOP-5149), they are to be compared to action levels, as described and defined in this section and section 5.0.

2. The concentration of airborne uranium varies significantly from site to site and over time. Naturally occurring uranium has a $^{234}\text{U}/^{238}\text{U}$ activity ratio of one. This ratio is different for depleted or enriched uranium (both primarily from LANL). This concentration variability and its isotopic distribution depend on the type and amount of local soils available for resuspension; the conditions (which are strongly weather dependent) of these soils and local uranium emissions. It is thus not appropriate to establish long-term or wide-area uranium investigation action levels.

Only non-natural airborne uranium is of concern, so a real-time IAL is used for testing the relationship of ^{234}U to ^{238}U in air samples. This IAL is calculated by comparing the difference of the two isotopic concentrations to their propagated uncertainty. If the difference is larger than the 3s propagated uncertainty, the IAL is exceeded; that is, non-natural uranium may have been detected. The calculation is repeated for each station at each period.

There is no IAL for ^{235}U because the above test already provides a method of detecting non-natural uranium. Also, ^{235}U measurements rarely exceed detectable levels.

3. Calculate the IAL for ^{234}U and ^{238}U every sample period for each sample.

4. Determine the IAL for uranium isotopes as follows:
 - a. Calculate the difference between the ^{234}U and ^{238}U net air concentrations for each period (usually a quarter) and location.
 - b. Propagate the uncertainties by calculating the squareroot of the sum of the squares of the ^{238}U uncertainty and the ^{234}U uncertainty. Divide the answer by 2 to convert from 2s to 1s uncertainty.
 - c. Compare the $^{234}\text{U} - ^{238}\text{U}$ concentration difference to the propagated 1s uncertainty.
 - d. Have a peer perform 100 percent verification of the calculations and data entry.

6. If the $^{234}\text{U} - ^{238}\text{U}$ concentration difference is more than 3 times the propagated 1s uncertainty the IAL has been exceeded. See section 4.6.

If the AAL (see this paragraph) for any radionuclide below is exceeded, see section 4.7. The following AALs correspond to an annual dose of 1 mrem if the concentration is continuously present for the year:

$$^{238}\text{U} = 830 \text{ aCi/m}^3$$

$$^{235}\text{U} = 710 \text{ aCi/m}^3$$

$$^{234}\text{U} = 770 \text{ aCi/m}^3$$

4.4 Plutonium and Americium Action Levels

Worker

1. After the plutonium (Pu) and americium (Am) data have been determined to be valid or have had qualifiers applied to them (described in SOP-5140, SOP-5141, and SOP-5149), they are to be compared to action levels, as described and defined in this section and section 5.0.

Worker

2. Plutonium and americium isotopes are present in the environment in small amounts, primarily due to past atmospheric testing of nuclear devices. As the concentrations of these constituents are so low in LANL air samples, it is reasonable to compare current values with the mean (and range) of earlier values. Therefore, current values are compared, on a station-by-station basis, to a multi-year historical mean plus 3s.

The historical data set used to establish the IAL will include 1 to 5 years of the most recent net concentration data, with outliers and rejected data removed. Outliers will be removed by performing the Rosner's or Dixon's tests as appropriate (see Memo ESH 17:02 109, 2002).

3. Update the plutonium and americium IALs about every 2 years by using the most recent 1 to 5 years of net concentration data.

4. Determine the IAL for plutonium and americium as follows:

- a. Collect 1 to 5 years of net concentration data.
- b. Remove rejected data from the data subset.
- c. Calculate the mean of the net historical data by station.
- d. Calculate 3s of each station mean.
- e. Add 3s to the applicable station mean. Do so for all stations.
- f. Store these "mean+3s" values in the AIRNET database "Action Levels" table in the plutonium and americium station locations.
- g. Have a peer perform 100 percent verification of the calculations and data entry.

6. If an IAL is exceeded outside Area G see section 4.6.

If the AAL for any radionuclide below is exceeded, see section 4.7. The following AALs correspond to an annual dose of 1 mrem if the concentration is continuously present for the year:

$$^{238}\text{Pu} = 210 \text{ aCi/m}^3$$

$$^{238/239}\text{Pu} = 200 \text{ aCi/m}^3$$

$$^{241}\text{Am} = 190 \text{ aCi/m}^3$$

4.5 Gamma Spectroscopy Action Levels

Worker

1. After the gamma spectroscopy data have been determined to be valid or have had qualifiers applied to them (see SOP-5140, SOP-5141, and SOP-5149), they are to be compared to action levels, as described and defined in this section and section 5.0. If an action level is exceeded, see sections 4.6 or 4.7.

2. Gamma spectroscopy is used to analyze samples for a large number of gamma emitters. Very rarely do any of the results exceed the MDA for any radionuclide; therefore, the IAL for a gamma spectroscopy result is defined as a measured concentration greater than its detection limit (MDA)..

Worker

3. Evaluate gamma spectroscopy data by observing whether the value is shown with a “<” symbol for a radionuclide. If there is no “<” symbol, the IAL is exceeded. If the current value exceeds the IAL, see section 4.6.

⁷Be, ⁴⁰K, and ²¹⁰Pb are naturally occurring and do not have an IAL. Thus, if there is no “<” in front of them, they do not exceed the IAL. If non-natural radionuclides, other than those listed in the following step are detected (i.e., no “<” in front of the result), they should be investigated.

3. If the AAL for any radionuclide below is exceeded, see section 4.7. The following AALs, in fCi/m³, correspond to an annual dose of 1 mrem if the concentration is continuously present for the year (Naturally occurring radionuclides are not included.):

⁷³ As = 1,100	⁵⁷ Co = 130	¹³⁷ Cs = 1.9	⁸³ Rb = 34	⁷⁵ Se = 17
⁷⁴ As = 220	⁶⁰ Co = 1.7	⁵⁴ Mn = 28	⁸⁶ Rb = 56	⁶⁵ Zn = 9.1
¹⁰⁹ Cd = 59	¹³⁴ Cs = 2.7	²² Na = 2.6	¹⁰³ Ru = 260	

4.6 Actions When an Investigation Action Level is Exceeded

Worker

1. Determine the cause for exceeding an IAL as follows (except as indicated for individual analyses as noted above):

[NOTE: Performing the steps below is a matter of professional judgment. If a datum barely exceeds the IAL, it may not warrant contacting facility personnel to assess causes unless there are other indications that a release occurred.]

 - a. Review field collection data sheets, if appropriate, and/or consult with field personnel to determine if anything was noted during sample collection.
 - b. Review calculations to ensure correct results.
 - c. Consult the AIRNET analytical chemist about possible analytical errors (e.g., out-of-control equipment, poor tracer recovery, potential cross contamination, etc.).
 - d. Check operational activities for any abnormal releases involving the radionuclide in question or any atmospheric nuclear testing being conducted or significant radiological accidents worldwide.

If it is apparent which facility caused the elevated reading, contact the facility manager, operational health physicist, and/ or the radiological control technicians and discuss any changes in operational activities that could explain the reported value.

Worker

- e. If the elevated value cannot be attributed to one of the above causes and samples were originally split, consider submitting the second half of the sample for analysis. If a sample is not submitted, skip to the next step.

When data are received from the second sample, test whether there is a statistical difference between the two data results. If there is a statistical difference, continue evaluation to assess whether contamination could have occurred to the higher sample after field collection. If the higher sample cannot be shown to have been contaminated, consider further evaluation.
- f. Using a time plot of the data or a standardized trend analysis, review previous sampling periods and determine whether there is an obvious trend occurring for this sampling location. If an obvious upward trend is identified, use best professional judgment to assess additional actions. Likewise, if this appears to be a one-time spike, continue the evaluation to determine potential causes.
- g. Document all actions taken (e.g., date and who was contacted, what was provided, results from resubmission, etc.) in the health physics review memorandum (see SOP-5148) or a subsequent follow-up memorandum.

4.7 Actions When Alert Action Level is Exceeded

Worker

1. Perform the following only when an AAL in a publicly accessible area is exceeded:
 - a. Perform all the steps in section 4.6 above.
 - b. Determine the effective dose equivalent (EDE) to the nearest receptor according to ESH-17-502, Air Pathways Dose Assessment.
 - If the EDE exceeds 1 mrem, also determine the EDE to the maximally exposed individual from all Laboratory emissions according to ESH-17-503, Calculation of Doses from Unplanned Airborne Releases.
 - If the station is a Federal Facility Compliance Agreement (FFCA) location, notify the Rad-NESHAP Air Quality Monitoring Project Leaders immediately.
 - If station is located where a Facility Manager (FM) is responsible, contact the FM to determine whether an official Department of Energy (DOE) “occurrence report” needs to be initiated.
 - c. Provide written confirmation of actions taken to the responsible project leader. Provide justification if no further action is needed.
 - d. Document the data review and actions taken (e.g., the date and who was contacted, what was provided, where the sample was resubmitted, results from the resubmission, etc.).

4.8 Records Management

Worker

1. Maintain and submit the following records to the AIRNET Project Leader:
 - a. Original laboratory result indicating the high value
 - b. Details of any actions taken
 - c. Data analysis and review
 - d. Exposure assessments performed

AIRNET Project Leader 2. Submit the inactive records generated from this procedure to the Records Processing Facility, according to EP-DIR-SOP-4004, Records Transmittal and Retrieval Process.

5.0 DEFINITIONS

Action Level – A numerical value that has been established by statistical analysis or set according to regulatory limits and used as a criterion for action. There are two types of action levels: investigation (IAL) and alert (AAL).

Investigation Action Level (IAL) – A level used to indicate that an air concentration value has exceeded the maximum expected value for the sampling environment and that an investigation into causes is warranted.

Alert Action Level (AAL) – A level used to indicate that a release or other significant problem may have occurred and that special actions are necessary to document the release or problem. AALs are based on the airborne concentrations that would correspond to a 1-mrem dose if the concentration were present an entire year. The 10-mrem concentrations in 40CFR61, Appendix E, Table 2 are used as the basis for AAL calculations.

[NOTE: When the AAL is less than the IL, the AAL is not exceeded, unless the IAL has also been exceeded.]

6.0 PROCESS FLOW CHART

N/A

7.0 ATTACHMENTS

None

8.0 REVISION HISTORY

Revision No. <i>[Enter current revision number, beginning with Rev.0]</i>	Effective Date <i>[DCC inserts effective date for revision]</i>	Description of Changes <i>[List specific changes made since the previous revision]</i>	Type of Change <i>[Technical (T) or Editorial (E)]</i>
0	01/03/96	New document	
1	05/15/96	Revised applicability to samples collected after 1995	
2	09/23/97	Inserted table of levels from AIRNET plan; revised levels based on 1996 sampling data.	
3	03/19/02	New process implemented for setting action levels, deleted attachment listing action levels.	
0	03/01/08	Division/Group name change, new Procedure number.	
0	4/7/2009	New document number and reformatted for WES division. Formerly ESH-17-201, R3.	

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