**NIOSH Draft White Paper**

# NIOSH Investigation into the Issues Raised in Comment 1 from SCA-TR-TASK1-005

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**Revision 0**

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**This white paper has been generated to support the NIOSH Response to Comment 1 in SCA-TR-TASK1-0005**

# NIOSH Investigation into the Issues Raised in Comment 1 from SCA-TR-TASK1-005

## 1.0 PURPOSE

The purpose of this white paper is to summarize the results of an investigation that was performed by NIOSH in regards to the assessment of the routine airborne releases at the Idaho National Laboratory (**INL**). The results of this investigation are intended to assist NIOSH with its response to Comment 1 in SCA-TR-TASK1-0005 (SC&A 2006).

## 2.0 SUMMARY OF RESULTS

In general, NIOSH has determined that the key issues that were raised in SCA-TR-TASK1-0005 (SC&A 2006), regarding the assessment of the routine airborne releases at the Idaho National Laboratory (**INL**), do not interfere with the ability to perform dose reconstructions.

## 3.0 BACKGROUND

Comment 1 was made in regards to the information provided in Revision 00 of the document titled *Technical Basis Document for the Idaho National Engineering and Environmental Laboratory (INEEL) – Occupational Environmental Dose* (ORAUT 2004). Even though the current version of this document is Revision 02, Comment 1 is still considered to be a valid comment, since no significant changes have been made to the environmental intakes that were previously reported in the technical basis document (ORAUT 2004, 2010). However, it should be noted that the title of this technical basis document has been changed to *Technical Basis Document for the Idaho National Laboratory and Argonne National Laboratory West – Occupational Environmental Dose* for Revision 02 (ORAUT 2010). In addition, to simplify identifying and/or referring to this technical basis document (**TBD**) in the subsequent sections of this white paper, all versions of this document will be referred to as the ***environmental TBD***.

### 3.1 Summary of the Issue

Comment 1 as stated in the INL Issue Resolution Matrix for Findings and Key Observations (i.e. Attachment 5 of SCA-TR-TASK1-0005) (SC&A 2006).

Issue 1: (5.1.1.1) Routine Airborne Releases - Source terms provided require improvement for use in determining the worker intake from airborne releases at different INL facilities. The data NIOSH uses do not take into account the deficiencies in the environmental monitoring equipment and their locations, and, in addition, NIOSH does not assess the uncertainties associated with the meteorological dispersion model used for the INL site. Most importantly, the source terms do not account for worker inhalation of resuspended contaminated soils and materials around the INL facilities.

Sections regarding Comment 1 that are in the main body of the INL site profile review (i.e. Sections 5.1.1.1.1, 5.1.1.1.2, and 5.1.1.1.3 of SCA-TR-TASK1-0005) (SC&A 2006). Note that the portions of Sections 5.1.1.1.1 and 5.1.1.1.2 that were merely quoting other documents have been omitted in this document for brevity, and the omitted portions are denoted by "(QUOTED PORTION OF ANOTHER DOCUMENT OMITTED)".

5.1.1.1.1 Completeness and Quality of Release Data Used

(1) The INELHDE [*Idaho National Engineering Laboratory Historical Dose Evaluation*] report uses effluent release data primarily from stack monitoring and air sampling systems installed across the INL site. There were a total of 23 air samplers; 12 within the site, and 11 outside the INL boundaries. The INELHDE claims:

(QUOTED PORTION OF ANOTHER DOCUMENT OMITTED)

The ambient air monitors at various INL site locations had been found to be deficient in meeting the siting requirements specified in 40 CFR 58 (near obstructions) and meeting minimum flow rate for particulates specified in 40 CFR 50 (e.g., 2.5 cfm versus 39 cfm), as cited in a DOE report, Tiger Team Assessment of the Idaho National Engineering Laboratory, DOE/EH-0178, 1991 (DOE-HQ 1991). NIOSH should evaluate the adequacy of the stack release data for use in the TBD. The Tiger Team report states the following:

(QUOTED PORTION OF ANOTHER DOCUMENT OMITTED)

Radiological effluent sampling and monitoring systems throughout INL facilities had not been evaluated to ensure that they would detect, quantify, and respond adequately to unplanned releases (DOE-HQ 1991). Also, airborne effluent particulates from INL operations had not been adequately characterized, and measurements and sampling techniques did not ensure a representative sample for effluent monitoring systems (DOEHQ 1991). Several quotations from the Tiger Team report illustrate these deficiencies (and point to areas that NIOSH should investigate further):

(QUOTED PORTION OF ANOTHER DOCUMENT OMITTED)

Given these deficiencies in the INL stack monitoring and air sampling systems identified by the DOE Tiger Team audit, it is unlikely that the INELHDE results would be complete and representative of the actual effluent releases from different INL facilities. This would further impact the quality and the validity of the dose assessments. NIOSH should evaluate the uncertainties associated with these issues, so that the recommended worker intake values from environmental releases would be truly claimant favorable. In 2003, SC&A performed a study of radioactive release source terms for two major INL programs for the CDC (SC&A 2003). This study reviewed stack monitoring data and uncertainties associated with the data. SC&A provided this report to NIOSH for use in the preparation of the INL Site Profile.

(2) During the site expert interview conducted by SC&A, INL environmental staff indicated that other unplanned (episodic) releases occurred at different facilities that are not included in the INELHDE. Therefore, they are also not included in the NIOSH TBD. For instance, there was an incident at the INTEC (ICPP) in the early 1990s where particulate releases were observed as a result of a new steam cleaning process of the CPP stack. The airborne material released was believed to be Cs-137 attached to white insulation material. Measurable radioactivity was associated with these releases. This information is not included in the TBD for the use of dose reconstructions.

5.1.1.1.2 Dispersion Model

The Environmental TBD uses a mesoscale model (MESODIF), which employs an objective regional trajectory computational scheme, combined with the Gaussian diffusion equation for a continuous point source, to estimate dispersion for transport of releases. It is a forward timemarching Gaussian plume model in which successive, small plume elements (or puffs) are advected throughout the computational area. The following quotations, taken from the INELHDE (DOE 1991a), describe the use of the mesoscale dispersion data from MESODIF model for the calculations of average ground level air concentrations at INL facilities:

(QUOTED PORTION OF ANOTHER DOCUMENT OMITTED)

MESODIF is a trajectory model that specifically requires spatial information describing upper boundary layer meteorological conditions. INL, however, does not have a real-time database that could be used in defining model trajectories. This caused significant uncertainties in accurately estimating the dispersion of released materials. This deficiency was noted in the DOE-HQ 1991 Tiger Team report (DOE-HQ 1991), a contemporaneous report of the INELHDE:

(QUOTED PORTION OF ANOTHER DOCUMENT OMITTED)

First, the mesoscale model used by INL in the INELHDE is only appropriate for evaluating dispersion coefficients for locations at greater than 20 km distance, and is not appropriate for those facilities that are within 20 km of each other. It is definitely not suitable for determining dispersion of airborne releases within several hundred feet from a facility building or a stack. Many INL facilities, however, are within 20 km from each other. Second, even for facilities located more than 20 km from each other, the dispersion coefficients calculated by this model are deficient and not representative. Third, and most important, the workers considered in this site profile are more impacted by the release plumes at the facility where they worked than those from more distant facilities; this mesoscale model is not capable of addressing such short distance dispersion coefficient factors. NIOSH should re-examine the validity of the mesoscale model data used in the occupational environmental TBD.

5.1.1.1.3 Other Observations

NIOSH should list the routine airborne release activities and associated uncertainties for each INL facility in the Occupational Environmental Dose TBD. This data would be helpful for the dose reconstructors to assess whether the worker intakes are applicable to the claim they are considering. An example would be useful, showing how the worker exposure could be calculated using the release activities, uncertainty values, and weighting factors.

### 3.2 Actions from 2011 Working Group Meeting

NIOSH: Revisit meteorological dispersion model, especially for relatively close proximity to release points.

## 4.0 NIOSH INVESTIGATION RESULTS

This investigation primarily reevaluated the appropriateness of the meteorological dispersion model that was used to estimate the environmental intakes in the *environmental TBD* and investigate the issues raised about exposures that occurred relatively close to a given release point. Secondary issues regarding the workers' inhalation of resuspended radioactivity and deficiencies in the INL's environmental monitoring equipment were also investigated.

### 4.1 Investigation of the Meteorological Dispersion Model

The *environmental TBD* utilized dispersion isopleths that were obtained from the *Idaho National Engineering Laboratory Historical Dose Evaluation* (**INELHDE**) to estimate annual average environmental air concentrations from stack emissions for each of the major operating areas on the INL site (ORAUT 2010, DOE 1991a, DOE 1991b). The dispersion isopleths in the INELHDE were generated using the MESODIF dispersion model, which is a mesoscale diffusion model that is valid for distances up to about 150 km (DOE 1991a). NIOSH has investigated the claim in Comment 1 of SCA-TR-TASK1-0005 (SC&A 2006) that "the mesoscale model used by INL in the INELHDE is only appropriate for evaluating dispersion coefficients for locations at greater than 20 km distance, and is not appropriate for those facilities that are within 20 km of each other", and has not found evidence to that effect. The MESODIF model wasn't limited to distances of 20 km or greater, it was one of the first models capable of modeling atmospheric dispersion beyond 20 km.

The applicable distances for most atmospheric dispersion models are dependent on the applicable distances for the atmospheric dispersion coefficients being used (i.e. the $\sigma_x$, $\sigma_y$, and $\sigma_z$ parameters being used). Detailed technical information regarding the MESODIF model is provided in the NOAA Technical Memorandum ERL ARL-44 (Start et al. 1974). For the $\sigma_y$ parameter, MESODIF uses the two equations in **Figure 1**. For the $\sigma_z$ parameter, MESODIF uses the equation in **Figure 2**.

constraints to conform better to observed plume behaviors. For horizontal diffusion, $\sigma_y$ is represented by the general forms (Slade, 1968),

$$\sigma_y = A*x^{.85} \quad \text{(for } x < 20 \text{ km)} \tag{5a}$$

and

$$\sigma_y = A'*x^{.5} \quad \text{(for } x \geq 20 \text{ km)} \tag{5b}$$

where

x = distance along puff trajectory from the source,

A = stability-category dependent coefficient of proportionality chosen to fit empirical curves of $\sigma_y$ versus distance (Yanskey et al., 1966)

A' = stability-category dependent coefficient of proportionality for continuity at 20 km between equations (5a) and (5b).

The exponents of x in equations (5a) and (5b) were selected to fit the $\sigma_y$-curves reported by Yanskey et al., (1966). At and beyond 20 km, the horizontal diffusion rate is slowed to the Fickian rate (proportional to the square root of time or distance). To describe $\sigma_y$ during changes of stability category,

**Figure 1 – Horizontal Dispersion Coefficient ($\sigma_y$) from ERL ARL-44 (Start et al. 1974)**

The basic representation of $\sigma_z$ is

$$\sigma_z = B*x^{\gamma} \tag{7}$$

where

B = stability-dependent coefficient of proportionality chosen to fit empirical curves of $\sigma_z$ versus distance (Yanskey et al., 1966),

$\gamma$ = stability-dependent exponent of travel distance, and

x = distance along puff trajectory from source.

**Figure 2 – Vertical Dispersion Coefficient ($\sigma_z$) from ERL ARL-44 (Start et al. 1974)**

In **Figure 1**, Equation 5a clearly indicates that the MESODIF model is applicable for distances less than 20 km. NIOSH also attempted to research the basis for the $\sigma_y$ and $\sigma_z$ parameters to determine if there was a minimum applicable distance associated with the $\sigma_y$ and $\sigma_z$ parameters. The NOAA Technical Memorandum ERL ARL-44 (Start et al. 1974) indicates that the two $\sigma_y$ equations came from the 1968 version of *Meteorology and Atomic Energy* (Slade 1968). The two $\sigma_y$ equations in **Figure 1** could not be located in the 1968 version of *Meteorology and Atomic Energy* (Slade 1968). The NOAA Technical Memorandum ERL ARL-44 (Start et al. 1974) also indicates that the "stability-category dependent coefficient of proportionality" and the exponents in the two $\sigma_y$ equations came from the $\sigma_y$ curves in the document IDO-12048, titled *Climatography of the National Reactor Testing Station* (Yanskey et al. 1966). Similarly, the NOAA Technical Memorandum ERL ARL-44 (Start et al. 1974) indicates that the "stability-category dependent coefficient of proportionality" in the $\sigma_z$ equation came from the $\sigma_z$ curves in IDO-12048 (Yanskey et al. 1966). IDO-12048 (Yanskey et al. 1966) indicates that curves for effluent releases with a 3 to 10 minute duration are based on the graphs in the document titled *Graphs for Estimating Atmospheric Dispersion* (Hilsmeier et al. 1962), which were based on Pasquill's original graphs, and that the that curves for effluent releases with a 15 to 60 minute duration are based on the graphs in the document titled *Methods of Estimating Air Pollutant Dispersion Over Relatively Smooth Terrain from Routine Meteorological Observations* (Markee 1963). Based on the starting distances on those graphs, the minimum applicable distance for the atmospheric dispersion coefficients being used by MESODIF is <u>at least</u> 100 m (0.1 km). In addition, when distance ranges for dispersion coefficients are specified they are typically just the distance ranges that the dispersion estimates are based, and not a specification of applicability. Therefore, the dispersion coefficients being used MESODIF may be applicable to distances less than 100 m (328 ft).

## 4.2 Dispersion of Airborne Releases within Several Hundred Feet of Release Point

NIOSH has also investigated the claims in Comment 1 of SCA-TR-TASK1-0005 (SC&A 2006) that "It is definitely not suitable for determining dispersion of airborne releases within several hundred feet from a facility building or a stack." and "…the workers considered in this site profile are more impacted by the release plumes at the facility where they worked than those from more distant facilities; this mesoscale model is not capable of addressing such short distance dispersion coefficient factors." Based on the findings discussed in **Section 4.1** above, NIOSH determined that the MESODIF model is suitable for determining the dispersion of airborne releases at distances of 100 m to 150 km from their release points. No information was found to indicate that the MESODIF model is suitable for determining the dispersion of airborne releases within 100 m (328 ft) of their release points. However, NIOSH has also determined that the contribution to the environmental air concentrations from stack releases within 100 m of the receptor are not likely significant.

The *Supplement to Technical Basis Document 4 for the Idaho National Engineering and Environmental Laboratory: INEEL Occupational Environmental Dose* (***environmental TBD supplement***) indicates that with the exception of the Aircraft Nuclear Propulsion Project's releases, the vast majority of the INL's operational radioactive airborne effluent releases were from the Idaho Chemical Processing Plant (**ICPP**), Test Reactor Area (**TRA**), and Experimental Breeder Reactor-II (**EBR-II**) areas, in that order (Peterson 2004). The ICPP has 2 significant radioactive airborne effluent release points; the 76.2 m high main stack and the 50 m high Fourinel Dissolution Process & Fuel Storage (**FAST**) stack (CDC 2002). The majority of the radioactive airborne effluents at the TRA were released via the main stacks for each of the TRA's three reactors, all three were 76.2 m stacks; the majority of the radioactive airborne effluents at EBR-II were released via its 61 m main stack (CDC 2002).

As previously indicated, the *environmental TBD* utilized dispersion isopleths that were obtained from the INELHDE to estimate annual average environmental air concentrations from the annual stack emissions for each of the major operating areas on the INL site using the MESODIF dispersion model (ORAUT 2010, DOE 1991a). The operational releases were treated as occurring at a uniform rate over the year (DOE 1991a). Dispersion isopleths were calculated by NOAA for a ground-level elevation assuming that the INL's total annual airborne effluent was released from a 76 m stack midpoint between the ICPP and TRA (Peterson 2004). **Figure 3** is a map of the INL site, which shows where the various operating areas were located on the site. Because the dispersion isopleths were not generated by modeling the actual release points for the INL's radioactive airborne effluents and because the modeled airborne effluent release point was over 100 m from any routinely occupied location, the concern that the workers are more impacted by the release plumes at the facility where they worked than those from more distant facilities is not applicable to the *environmental TBD*.

With the exception of fumigation conditions, which only occur about 1% of the calendar year at the INL (DeMarrais et al. 1960), the minimum travel distance for a plume originating from a stack to reach the ground is when $\sigma_z$ equals the stack height. As indicated in **Figure 2** above, the vertical dispersion coefficients being used by the MESODIF model are based on the $\sigma_z$ curves in IDO-12048 (Yanskey et al. 1966). Using the $\sigma_z$ curves in that document and the release height used for the dispersion calculations, one can determine what the shortest travel distance for a plume originating from the modeled release point to reach the ground is.

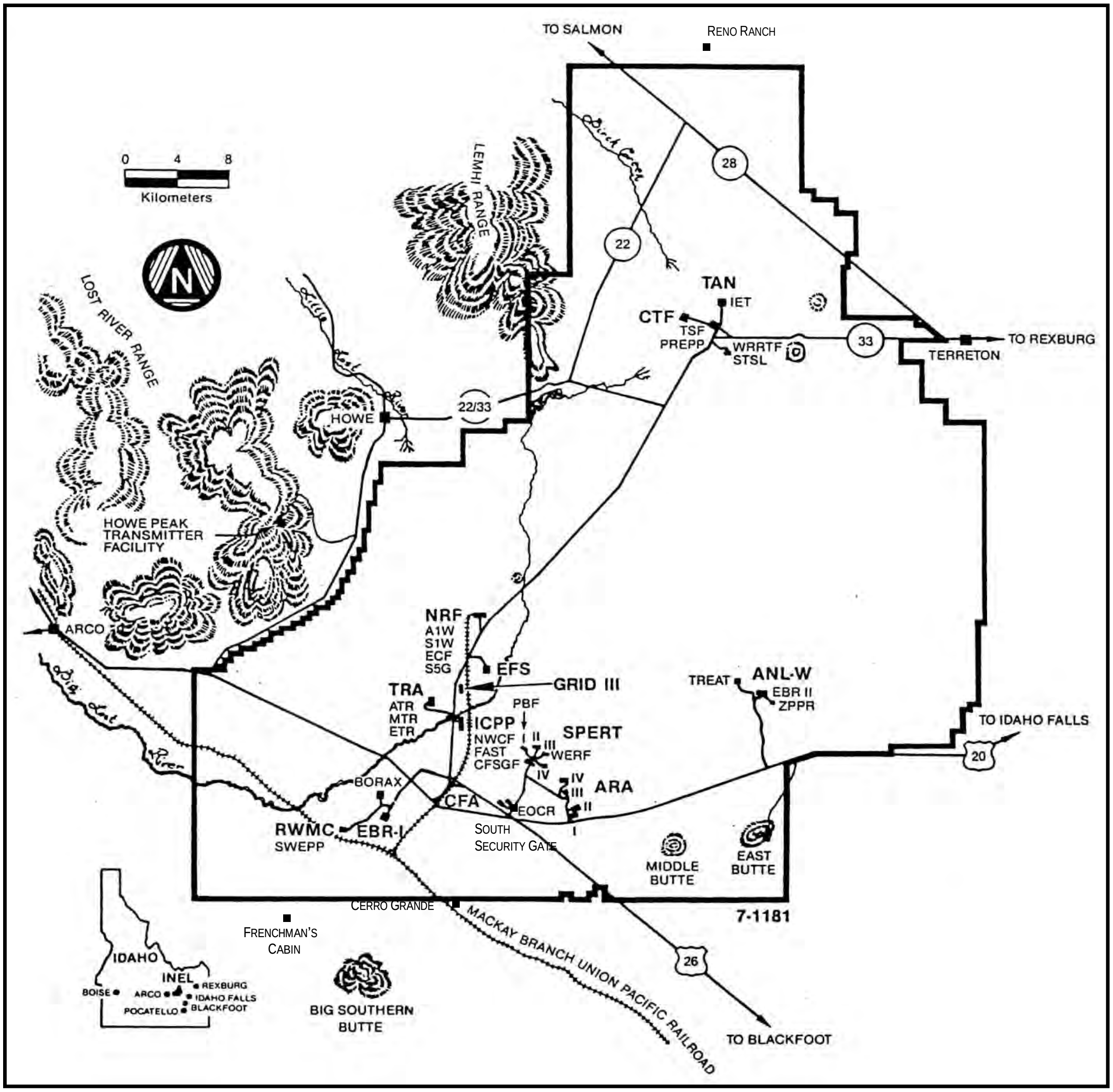


**Figure 3 – Map of INL Site (Hoff et al. 1987)**

As previously indicated, the dispersion isopleths were based on the assumption that the INL's total annual airborne effluent was released from a 76 m (250 ft) stack midpoint between the ICPP and TRA. **Figures 4 and 5** are the $\sigma_z$ curves from IDO-12048 (Yanskey et al. 1966) with the modeled stack height and minimum travel distances depicted on them. **Figure 4** is the $\sigma_z$ curves for 3-15 minute releases and **Figure 5** is the $\sigma_z$ curves for 15-60 minute releases. Based on those curves the minimum travel distance for a plume originating from a stack to reach the ground is over 300 m (984 ft). Therefore, it is unlikely that the INL workers were more impacted by the release plumes at the facility where they worked than those from more distant facilities. In addition, **Figures 4 and 5** demonstrate that the MESODIF model was not exceeding its minimum applicable distance when the dispersion isopleths, which were used for the *environmental TBD*, were generated.

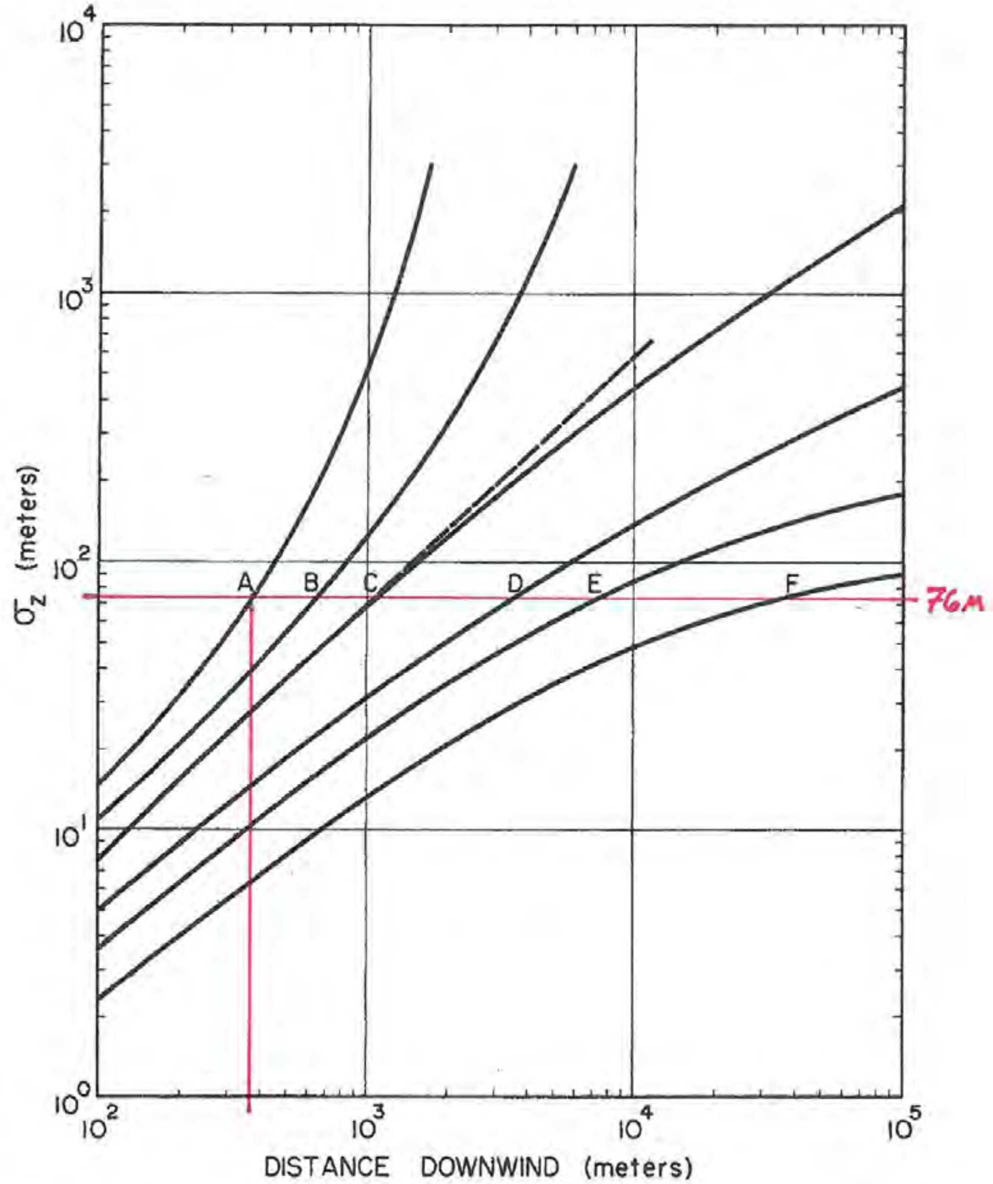


**Fig. 3-3** $\sigma_z$ versus distance downwind by stability class — 3 to 15 minute release time (Hilsmeier-Gifford).

**Figure 4 – Vertical Dispersion Coefficients from IDO-12048 for 3 to 15 Minute Releases (Yanskey et al. 1966)**

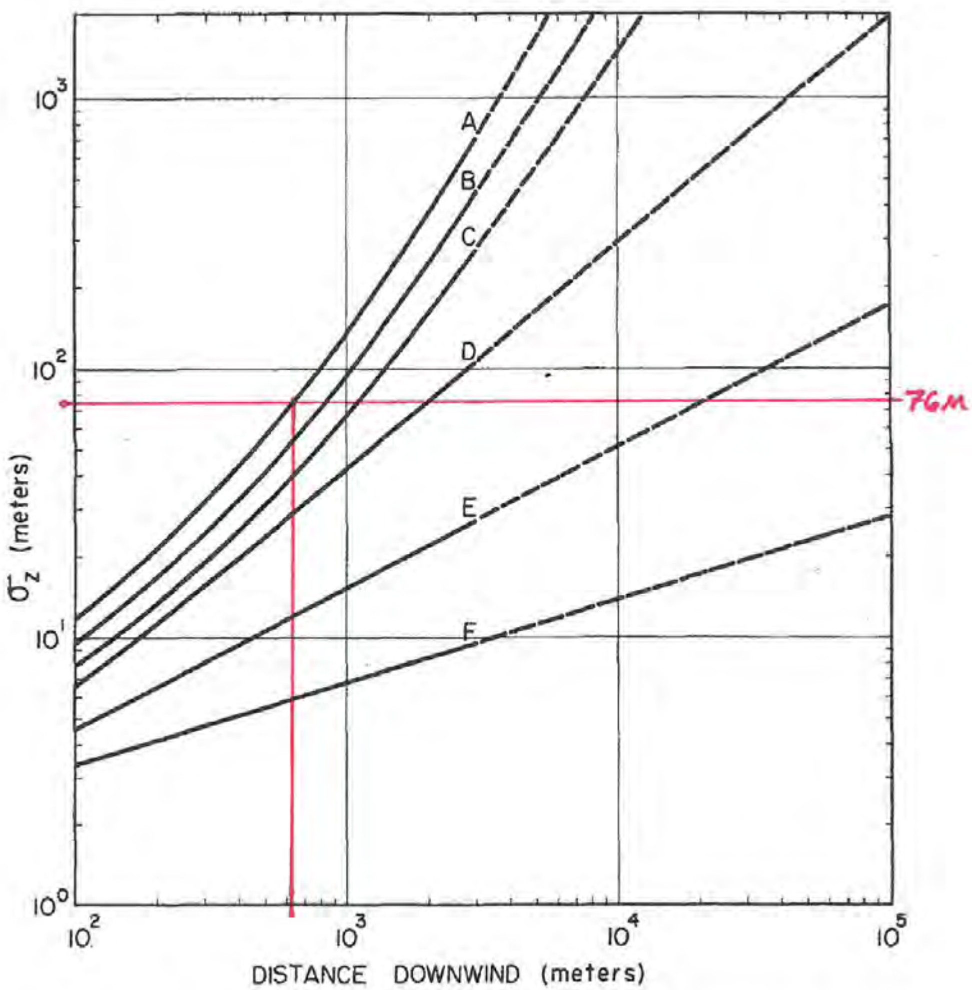


Fig. 3-6 $\sigma_z$ versus distance downwind by stability class -- 15 to 60 minute release time (Markee).

**Figure 5 – Vertical Dispersion Coefficients from IDO-12048 for 15 to 60 Minute Releases (Yanskey et al. 1966)**

### 4.3 Worker Inhalation Attributable to Resuspension of Contamination

NIOSH has also investigated the claim in Comment 1 of SCA-TR-TASK1-0005 (SC&A 2006) that "…the source terms do not account for worker inhalation of resuspended contaminated soils and materials around the INL facilities." NIOSH agrees that the source terms used to estimate the INL workers' environmental intakes did not include potential contributions from resuspended contaminated soils and materials around the INL facilities. However, NIOSH has found nothing to indicate that those contributions were significant relative to the contributions from the stack emissions.

A review of the environmental air monitoring data provides supporting evidence that the resuspension of contamination was not a significant contribution to the onsite environmental air concentrations. Figure 4-4 in the *environmental TBD* provides a comparison of the summarized onsite and offsite environmental air concentrations for the years of 1978–1986. The summarized data in Figure 4-4 of the *environmental TBD* and the more detailed data in the INL's environmental monitoring reports show a close correlation between the onsite and offsite environmental air concentrations, with the only exceptions being from episodic release events at the INL site. If resuspension was a significant contributor to the environmental air concentrations at the INL site, one would expect the differences between the onsite and offsite environmental air concentrations to be more significant than what they are.

In addition, the contributions to the INL workers' internal doses from intakes of resuspended environmental radioactivity would be limited for the following reasons. When contamination is deposited on the soil, it usually becomes attached to the larger soil particles (DOE 1994). Because a significant fraction of the soil particles have an aerodynamic equivalent diameter (AED) of > 10 μm, most of the soil particles are not considered to be respirable. Also, the radionuclides deposited at the INL were typically beta-gamma emitters, which contribute to the internal dose much less than alpha emitting radionuclides.

The only reports that were found that attributed elevated environmental air concentrations to the resuspension of contaminated soils were two of the environmental monitoring data reports (the report for the 4$^{th}$ quarter of 1974 and the report for the 1$^{st}$ quarter of 1975) (Walker 1975a, Walker 1975b). The environmental monitoring data report for the 4$^{th}$ quarter of 1974 indicated that the higher gross beta radioactivity during the 4$^{th}$ quarter of 1974 at the Experimental Breeder Reactor-I (**EBR-I**) and Experimental Field Station (**EFS**) sampling locations "was probably the result of primarily of atmospheric discharges of particulate radioactivity at ICPP with some contribution from radioactivity contamination in the soil near the sampling location" (Walker

1975a). **Figure 6** in an excerpt of Highlights Section from that quarterly report, and **Figure 7** is a map depicting the onsite environmental air monitoring locations at the INL site.

> The onsite atmospheric sampling station at EFS, EBR-I, PBF, and ITSA showed significant gross beta radioactivity above the background level at Idaho Falls during the last quarter of 1974. The higher gross beta radioactivity at EFS and EBR-I was probably the result primarily of atmospheric discharges of particulate radioactivity at ICPP with some contribution from radioactivity contamination in the soil near the sampling location. The higher gross beta radioactivity at PBF is due to the high activity collected during the week of October 11-18 and is attributed to ICPP operations. The activity was determined to be fission products including Co-60, Cs-134, and Cs-137. The increased beta radioactivity above background at the ITSA sampling station is probably a result of work activity at the Radioactive Waste Management Complex (RWMC) with some contribution from ICPP as a result of the release of Sb-125 into the atmosphere.

**Figure 6 – Excerpt of the Highlights Section of the Environmental Monitoring Data Report for 4th Quarter of 1974 (Walker 1975a)**

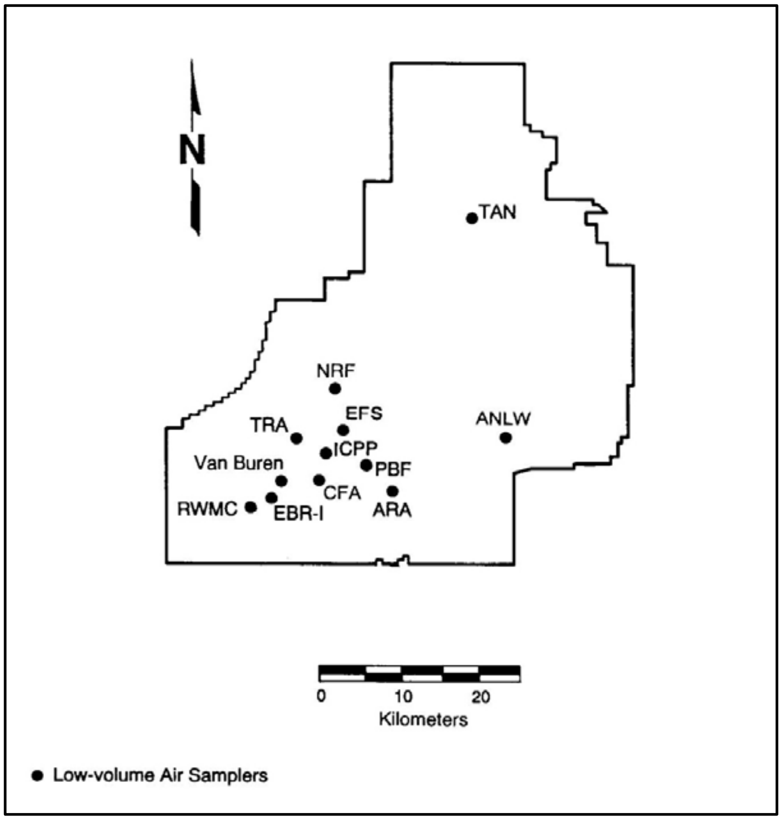


**Figure 7 – Onsite Environmental Air Monitoring Stations**

The environmental monitoring data report for the 1st quarter of 1975 attributed the higher gross beta radioactivity measured at EBR-I and the Naval Reactor Facility (**NRF**) during the 1st quarter to the resuspension of radioactive contamination on the soil near the sampling locations. **Figure 8** in an excerpt of Highlights Section from that quarterly report.

> The onsite atmospheric sampling stations at EBR-I and NRF showed significant beta particulate radioactivity above the background level at Idaho Falls for the month of January and at EBR-I for the month of February. The higher beta particulate radioactivity was due to the higher Cs-137 concentrations collected during the first week in January and the second week in February at EBR-I and the higher Ru-106 concentration collected at NRF during the first week in January. Resuspension of radioactive contamination on the soil near the sampling locations is believed to be the source of the higher Cs-137 and Ru-106 concentrations.

**Figure 8 – Excerpt of the Highlights Section of the Environmental Monitoring Data Report for 1st Quarter of 1975 (Walker 1975b)**

NIOSH has determined that resuspension was not likely a significant contributor to the elevated environmental air sample results at the EBR-I and EFS sampler locations during late-1974 and early-1975 for the following reasons.

1) The elevated environmental air sample results for EBR-I and EFS from late-1974 and early-1975 were within the annual fluctuations of the background sampling location for 1974–1975, so the elevated results could have just been localized fluctuations in the levels of background radioactivity. **Figures 9 and 10** depict this for EBR-I and **Figure 11** depicts this for EFS.
2) The quick return to normal air concentrations indicates that the surface contamination causing the elevated air concentrations was mitigated. Given that it is unlikely that the surface contamination would have been naturally mitigated within such a short period of time and given that no reports of any decontamination work could be found for the months immediately after these elevated measurements, it's unlikely that the resuspension of surface contamination was the primary cause of the elevated air concentrations.
3) Onsite environmental air samplers for other locations also had elevated air concentrations for the same period (e.g. CFA, ITSA/RWMC, NRF, PBF/SPERT, TAN, and TRA), but the elevated results from those locations weren't attributed to resuspension and don't appear to have been factored into the assumption that was made about the cause of the elevated results. **Table 1** provides a summary of the environmental air concentrations for the EBR-I, EFS, CFA, ITSA/RWMC, NRF, PBF/SPERT, TAN, TRA, and Idaho Falls air monitoring locations for the 4th quarter of 1974 and the 1st quarter of 1975.

**Table 1**

| Summary of Environmental Air Monitoring Results for Selected Monitoring Locations (µCi/ml)[a] | | | | | | |
|---|---|---|---|---|---|---|
| Locations[b] | 4th Quarter 1974 | | | 1st Quarter 1975 | | |
| | Oct | Nov | Dec | Jan | Feb | Mar |
| EBR-I | 3.2E-13 | 2.7E-13 | 4.6E-13 | 3.3E-13 | 3.4E-13 | 3.2E-13 |
| EFS | 2.1E-13 | 2.3E-13 | 2.4E-13 | 2.2E-13 | 2.4E-13 | 2.4E-13 |
| | | | | | | |
| CFA | 1.9E-13 | 2.0E-13 | 2.0E-13 | 2.0E-13 | 2.1E-13 | 2.2E-13 |
| ITSA/RWMC[c] | 2.1E-13 | 2.1E-13 | 1.8E-13 | 1.9E-13 | 2.2E-13 | 2.7E-13 |
| NRF | 1.8E-13 | 2.7E-13 | 1.8E-13 | NA[d] | 2.1E-13 | 2.3E-13 |
| PBF/SPERT | 2.7E-13 | 1.9E-13 | 1.8E-13 | 1.8E-13 | 1.9E-13 | 2.2E-13 |
| TAN | 1.4E-13 | 1.9E-13 | 1.6E-13 | 1.7E-13 | 1.6E-13 | 2.0E-13 |
| TRA | 1.8E-13 | 2.7E-13 | 1.8E-13 | 1.9E-13 | 1.8E-13 | 2.2E-13 |
| | | | | | | |
| Idaho Falls | 1.3E-13 | 1.4E-13 | 1.3E-13 | 2.0E-13 | 2.3E-13 | 2.3E-13 |

Notes:
a - The values in this table were obtained from the graphs in the Environmental Monitoring Data Reports for the 4th quarter 1974 and 1st quarter 1975 (Walker 1975a, Walker 1975b).
b - The EBR-I and EFS locations are the locations where the elevated air concentrations were attributed to resuspension. The locations following them are other locations with elevated air concentrations (i.e. above the offsite/background sampling location). The Idaho Falls location is the offsite/background sampling location.
c - The Environmental Monitoring Data Report for the 2nd quarter of 1974 indicates that the ITSA sampling location is associated with the burial grounds (Walker 1974). Beginning with the 1975 reports, the ITSA sampling location appears to have been renamed as the RWMC location (Walker 1975a, Walker 1975b).
d - NA – not available.

The elevated January 1975 result for the NRF sampling location appears to have been due to a single hot particle of Ru-106 that was on the weekly sample collected during the first week of January 1975. This is indicated in **Figure 8** and **Figure 12**. **Figure 12** is a graphical depiction of monthly results for the NRF sampling location. It should also be noted that exposures received at the NRF are not covered under the EEOICPA, because it is a facility used exclusive for the Naval Nuclear Propulsion Program.

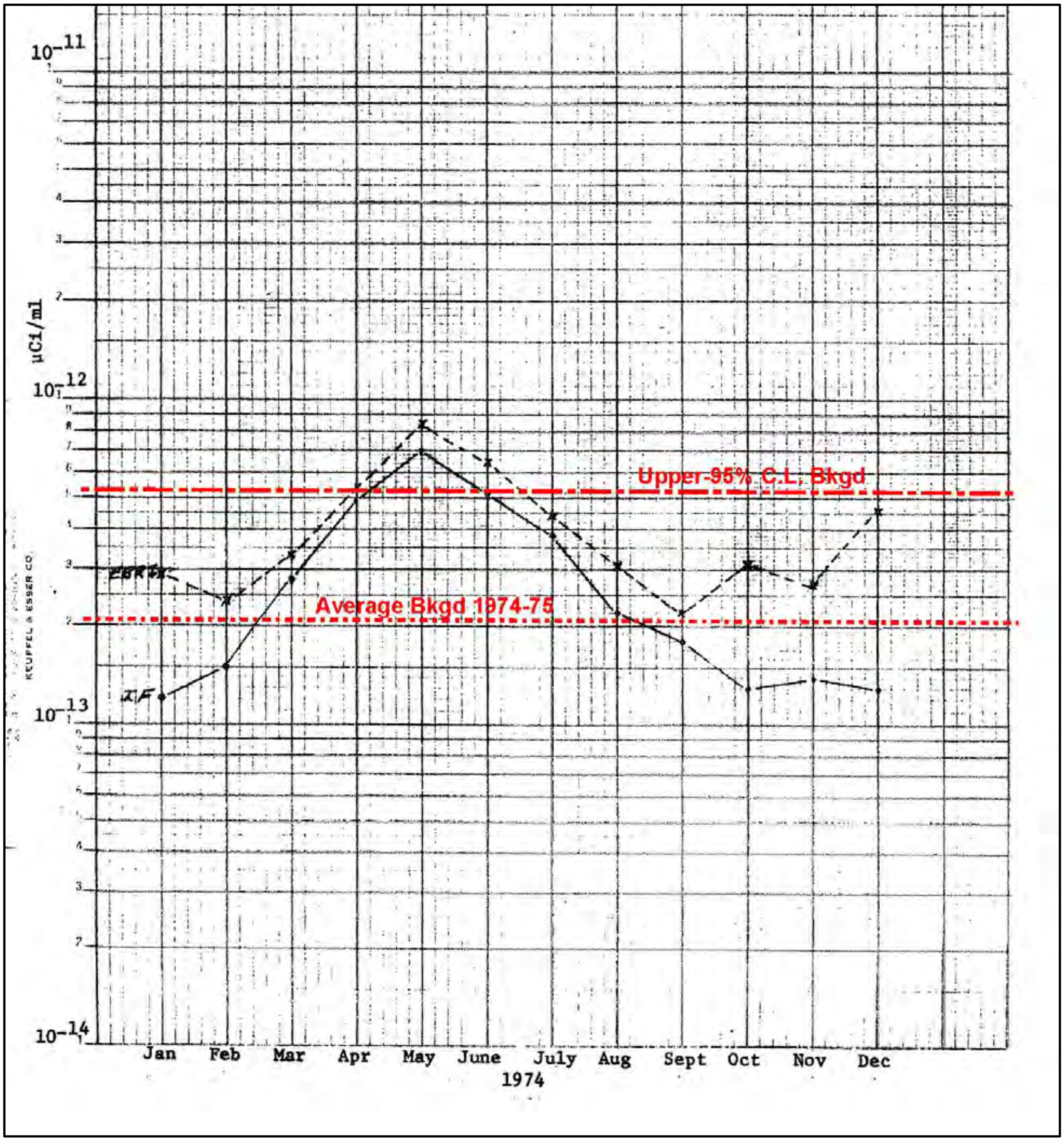


**Figure 9 – CY-1974 - Monthly Gross Beta Environmental Air Concentrations at EBR-I and Background Location at Idaho Falls (Walker 1975a)**

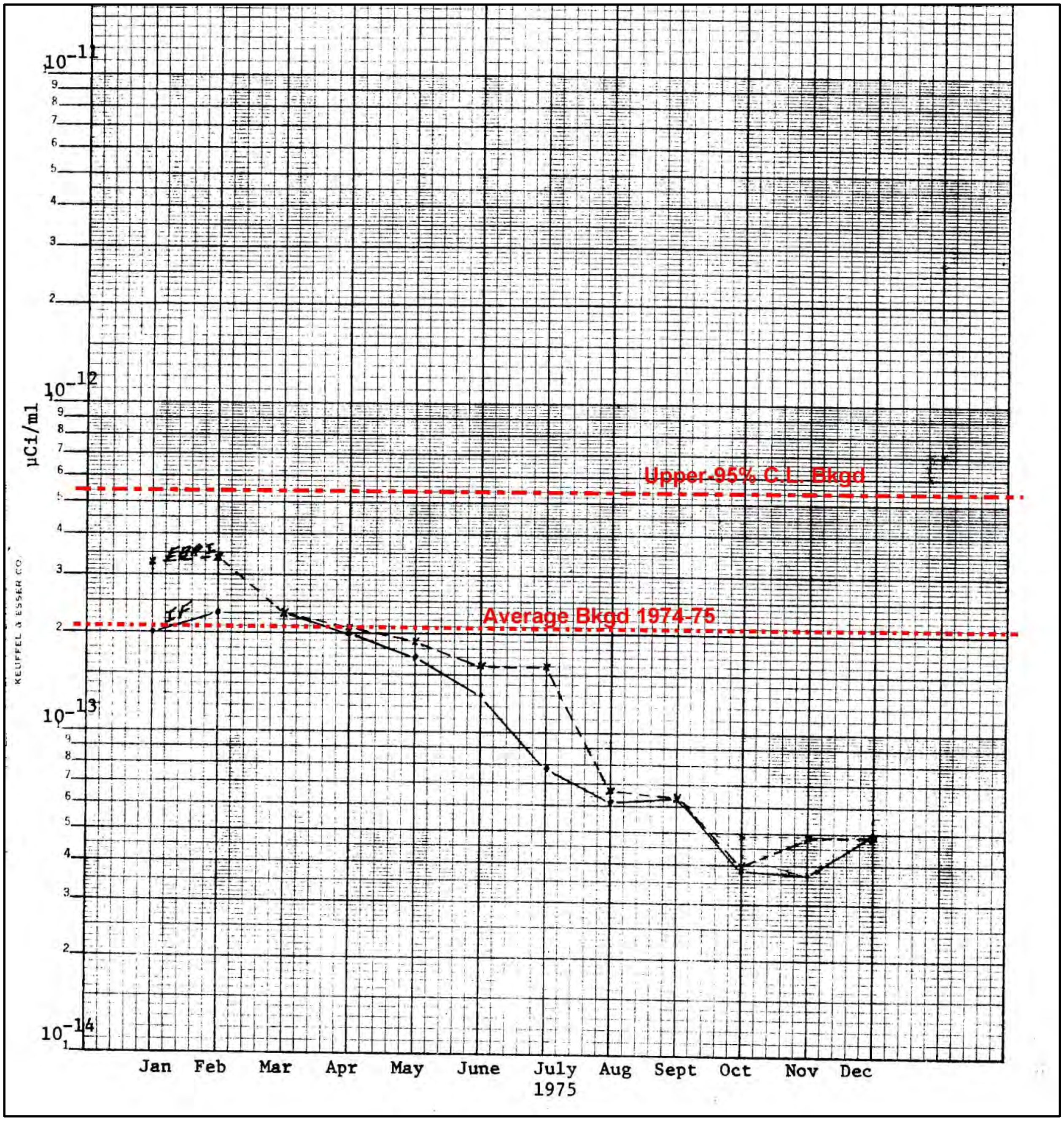


**Figure 10 – CY-1975 - Monthly Gross Beta Environmental Air Concentrations at EBR-I and Background Location at Idaho Falls (Sill 1976)**

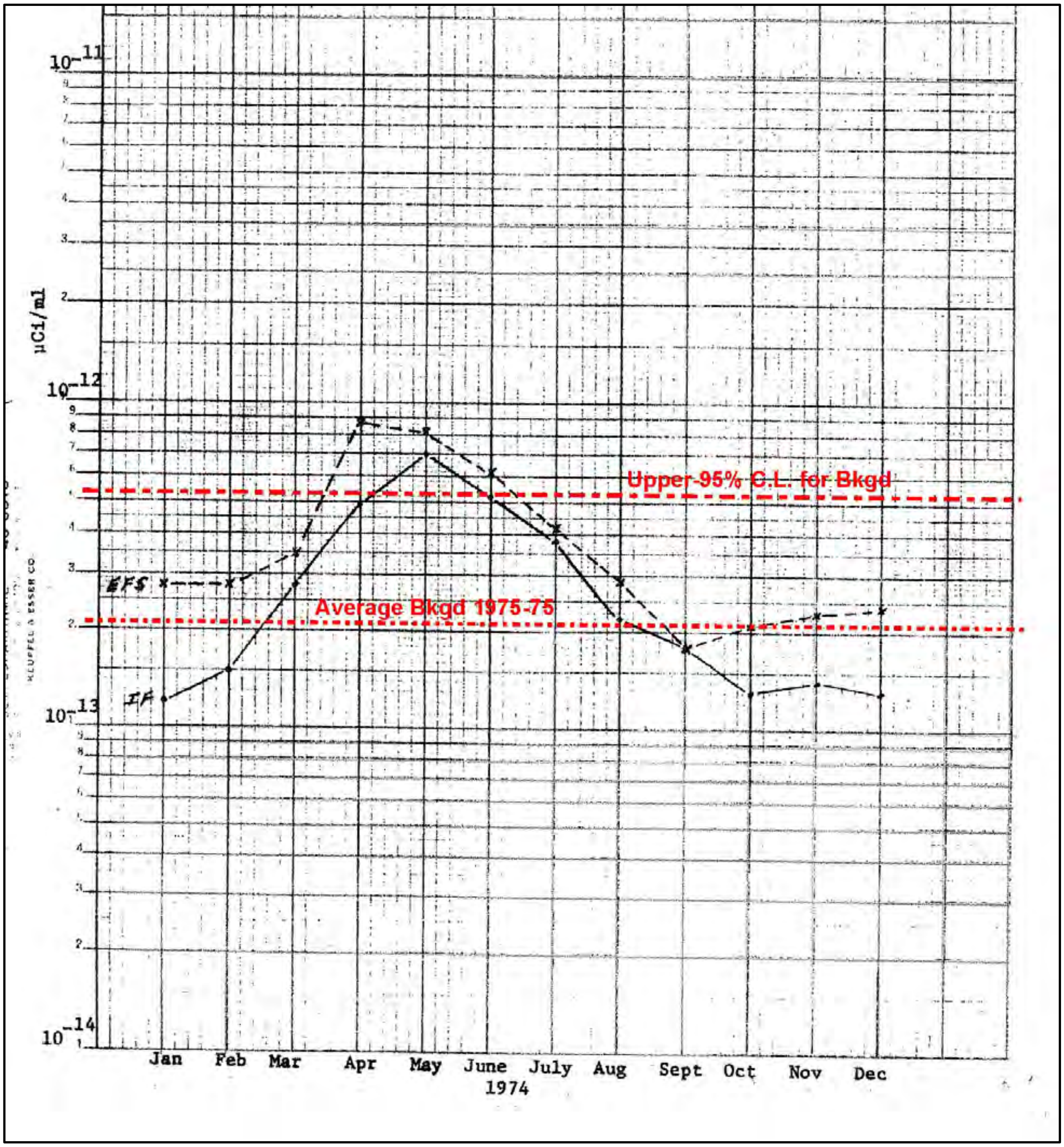


**Figure 11 – CY-1974 - Monthly Gross Beta Environmental Air Concentrations at EFS and Background Location at Idaho Falls (Walker 1975a)**

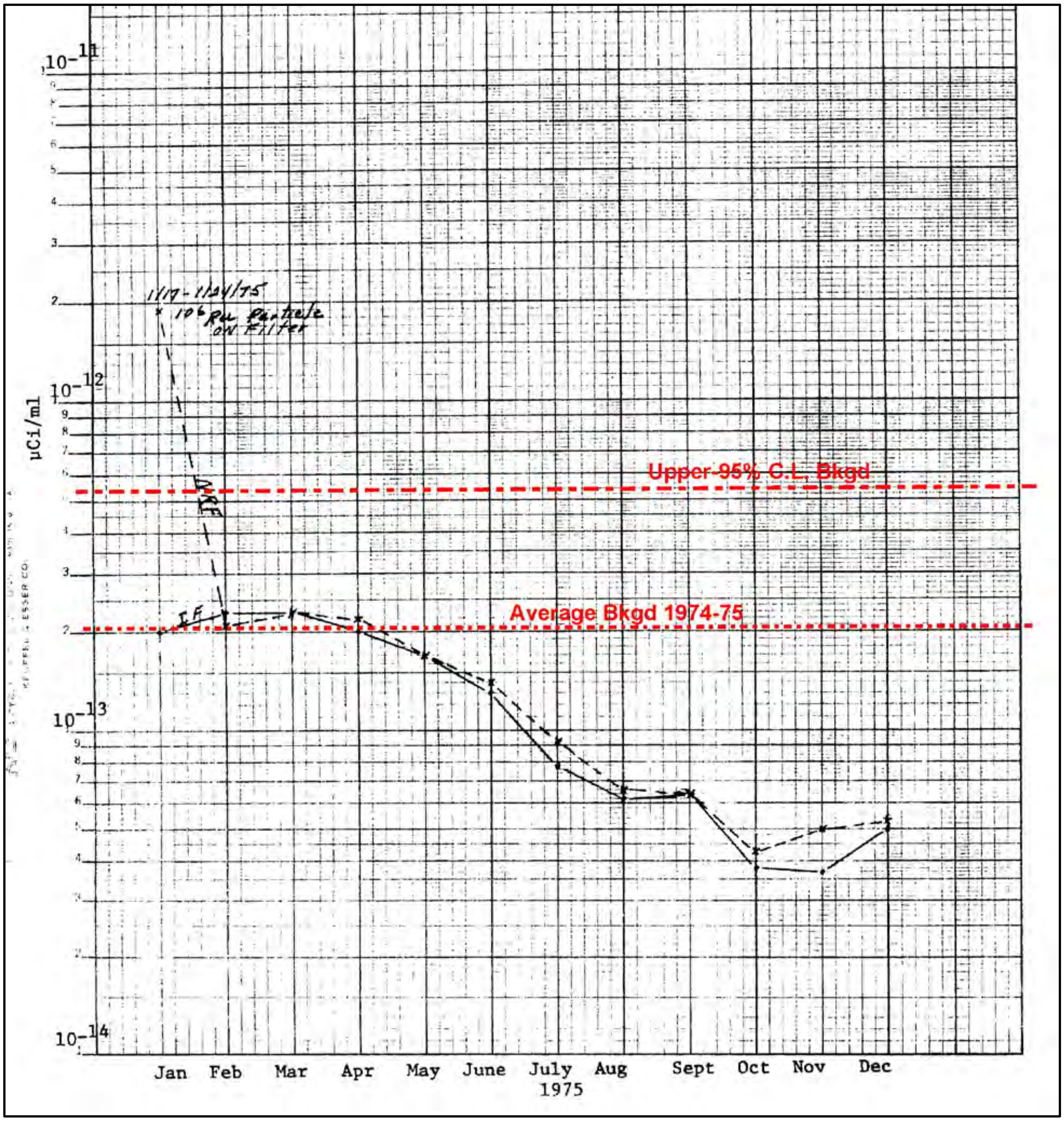


**Figure 12 – CY-1975 - Monthly Gross Beta Environmental Air Concentrations at NRF and Background Location at Idaho Falls (Sill 1976)**

## 4.4 Deficiencies in Environmental Monitoring Equipment

NIOSH acknowledges that there were deficiencies regarding the number of and the locations of the INL's environmental air sampling stations. However, those deficiencies were likely what prompted the original author of the *environmental TBD* to estimate the environmental intakes from the stack releases versus the air concentrations measured by the environmental air sampling stations. Because the environmental air sampling data was not used to estimate the environmental intakes in the *environmental TBD*, any deficiencies with the environmental monitoring equipment are not relevant to the *environmental TBD*.

## 5.0 CONCLUSIONS & RECOMMENDATIONS

In general, NIOSH has determined that the key issues that were raised in SCA-TR-TASK1-0005 (SC&A 2006), regarding the assessment of the routine airborne releases at the INL, do not interfere with the ability to perform dose reconstructions. NIOSH has confirmed that the MESODIF dispersion model is applicable for distances less than 20 km. Based on the atmospheric dispersion coefficients being used by the MESODIF model, the minimum applicable distance for the MESODIF model is <u>at least</u> 100 m (0.1 km). NIOSH has also determined that the contribution to the environmental air concentrations from stack releases within 100 m of the receptor are not likely significant.

In regards to worker inhalation attributable to the resuspension of contamination, NIOSH agrees that the source terms used to estimate the INL workers' environmental intakes did not include potential contributions from resuspended contaminated soils and materials around the INL facilities. However, NIOSH has found nothing to indicate that those contributions were significant relative to the contributions from the stack emissions. In addition, a review of the environmental air monitoring data provides supporting evidence that the resuspension of contamination was <u>not</u> a significant contribution to the onsite environmental air concentrations.

In regards to the deficiencies with the INL's environmental monitoring equipment, NIOSH determined that any deficiencies with the environmental monitoring equipment are not relevant to the *environmental TBD*, because the environmental air sampling data was not used to estimate the environmental intakes in the *environmental TBD*.

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