ORAU Team **Dose Reconstruction Project for NIOSH** Technical Information Bulletin – Analysis of Coworker Bioassay Data for Internal Dose Assignment	Document Number: ORAUT-OTIB-0019 Effective Date: 12/29/2004 Revision No.: 00 Controlled Copy No.: _____ Page 1 of 6
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RECORD OF ISSUE/REVISIONS

ISSUE AUTHORIZATION DATE	EFFECTIVE DATE	REV. NO.	DESCRIPTION
Draft	11/10/2004	00-A	New technical information bulletin for the analysis of coworker bioassay data for internal dose assignment. Initiated by Elizabeth M. Brackett.
Draft	11/18/2004	00-B	Incorporates internal review comments. Initiated by Elizabeth M. Brackett.
12/29/2004	12/29/2004	00	First approved issue. Initiated by Elizabeth M. Brackett.

1.0 PURPOSE

This document assigns responsibility for and guidance on the analysis of coworker internal dosimetry data for the purpose of assigning doses to unmonitored or partially monitored workers. The general approach outlined herein is to be used, but the specific details are guidance rather than requirements. Deviation from the guidance could be necessary because the dosimetry data sets will have unique characteristics based on facility procedures, periods of monitoring, and other factors. Deviations from the guidance must be documented.

2.0 BACKGROUND

This method assumes that the dosimetry results for groups of workers are lognormally distributed. Studies of worker dosimetry results (bioassay results, dosimeter results, etc.) tend to support this assumption. Alternate distributions can be used if the data for a particular set do not appear to be lognormally distributed.

In general, dosimetry is associated with workers who have the largest potential for exposure. While there can be exceptions to this such as accidents, it remains very unlikely that any unmonitored worker received a dose greater than the most exposed monitored worker at a site.

The 50th-percentile (median) result and the 84th-percentile result are calculated for the data set on a monthly basis where there are adequate results. The period could need to be lengthened where the data sets are small or sporadic. For internal dose, intake rates must be determined from the calculated bioassay distributions. The geometric standard deviation (GSD) is calculated by dividing the 84th percentile by the 50th percentile.

This method avoids the need to define the minimum detectable activity or amount (MDA) for uncensored data sets. In addition, the method eliminates the need to remove what could appear to be unreasonable outliers because the data distribution is evaluated rather than the individual datum.

3.0 RESPONSIBILITIES AND FLOW OF INFORMATION

Figure 1 shows the process flow of the following responsibilities:

Team Leader
Responsible for coordinating all aspects of the process for a given site. Ensures that each identified party has required information and maintains schedules.

Obtains information or answers in response to questions identified by the SME.

Compiles all information, including the following details, into the appropriate site technical basis document (TBD).

- Documents intake periods and intake rates of primary (monitored) radionuclides and associated absorption types.

- If appropriate, documents radionuclides associated with the primary radionuclides that should be included in intake calculations. The associated radionuclides and their relative activities should be specified.

Task 1
Obtains identified dosimetry data sets and makes them available, in a database with query ability, to individuals who review or analyze the data.

Subject Matter Expert (SME)
Reviews the data sets to determine completeness and usability and to identify shortcomings.

Determines which data sets are useful for assigning coworker doses and, for sites with several methods of monitoring (e.g., urine and lung counting), determines which method to use to assign best estimates of dose and which data are to be used to verify reasonableness.

Documents information required for proceeding with data analysis to be turned over to the Team Leader for investigation and resolution. Information that could be needed for a given site includes:

- Interpretation of bioassay results (e.g., units, period of collection, and codes).
- Unmonitored radionuclides in the source term (e.g., specific ratios of plutonium, neptunium, and technetium contaminants in recycled uranium).
- Appropriate assumed intake periods (i.e., for missing periods in the data, determine if there should have been monitoring or if there was no potential for intakes).
- Conversion of results from mass to activity units.
- Identification of "positive" results, if results are listed as less than the MDA or if the data are incomplete.

Determines periods for analyzing the data (e.g., monthly or quarterly). This is a matter of judgment that includes consideration of the monitoring frequency and the amount of available data.

Addresses any data adjustments (e.g., normalization of bioassay results to 24-hour sample period, recovery efficiency) needed before data analysis can be performed.

Data Statistics Analyzer
If any anomalies are found in the data, contacts the Team Leader and explains the situation. After reviewing the data and the anomalies, and based on professional judgment, the Team Leader and SME may recommend deviations from the data analysis instructions. Deviations and their bases must be documented.

Analyzes the data:

Sorts data for each identified period (e.g., month or quarter) from low to high results and ranks the data. All data are to be included in the ranking.

Calculates the percentile midpoint represented by the rank.

Log-transforms the data.

Calculates the *z*-score of each percentile.

Plots the *z*-scores versus the natural logarithms of their respective data (this step is optional).

Uses the *z*-scores and associated natural logarithms of the data to determine a line equation and the associated fit parameter, R^2. ($R^2 > 0.9$ indicates a reasonable fit.) The line equation is

$$y = mx + b$$

where

y = natural logarithm of the data
m = slope of the line
x = *z*-score
b = *y*-intercept

Note: Results with values less than or equal to 0, as well as results recorded as less than MDA, where MDA can be a numeric value or the letters *MDA*, are excluded from the line fit.

Calculates the 50th percentile, the GSD, and the 84th percentile for each period of dosimetry data:

50^{th} percentile = e^b
GSD = e^m
84^{th} percentile = $e^m * e^b$

Provides the resultant values to the SME in a columnar format suitable for pasting into IMBA. Columns contain the period of the data, an effective bioassay date, the 50th-percentile values, and the 84th-percentile values.

Modeler
Determines intake rates by performing fits of the two data bioassay data sets (50th- and 84th-percentile results) associated with each radionuclide.

- For most data sets, intakes will be assumed to be chronic. There could be large, short-term releases that need to be addressed individually.
- Uses site information (e.g., dates of shutdowns; known operating periods), where possible, to break the chronic intake into periods. These periods should be adjusted as necessary to obtain a reasonable fit but assumed intake periods should not be very small.
- Assesses intakes for each of the absorption types associated with a given facility. Documents intake regimes and rationale for fits.

Provides intake rates and periods, with documentation, including rationale for intake periods, to the Team Leader.

Tool Development Group
Develops tools to determine organ doses in accordance with the TBD.

Figure 1: Process Flow