ORAU TEAM
Dose Reconstruction
Project for NIOSH

Oak Ridge Associated Universities I Dade Moeller I MJW Technical Services

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Subject Expert(s): Matthew H. Smith

Approval:	Richard E. Merrill Signature on File for Matthew H. Smith, Document Owner	Approval Date:	11/10/2011
Concurrence:	Signature on File John M. Byrne, Objective 1 Manager	Concurrence Date:	11/10/2011
Concurrence:	Keith A. McCartney Signature on File for Edward F. Maher, Objective 3 Manager	Concurrence Date:	11/11/2011
Concurrence:	Signature on File Kate Kimpan, Project Director	Concurrence Date:	11/10/2011
Approval:	Signature on File James W. Neton, Associate Director for Science	Approval Date:	11/14/2011

☐ New ☐ Total Rewrite ☒ Revision ☐ Page Change

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PUBLICATION RECORD

EFFECTIVE DATE	REVISION NUMBER	DESCRIPTION
12/29/2004	00	New technical information bulletin to provide general information to allow ORAU Team dose reconstructors to assign doses to workers at DOE sites who have no or limited monitoring data, based on site coworker external dosimetry data. First approved issue. Initiated by Steven E. Merwin.
10/07/2005	01	Provides clarifications and updates to reflect recent OCAS guidance. Approved issue of Revision 01. Training required: As determined by the Task Manager. Initiated by Steven E. Merwin.
12/04/2008	02	Approved revision that cancels changes from draft revisions 01 PC-1-A and 01 PC-1-B. Section 3.0 was revised to include language developed during the review of this TIB by the Advisory Board Working Group on Procedures. Section 7.0, Attributions and Annotations was added. Editorial changes include an update of Section 1.0, Purpose, and movement of Section 6.0, References, to the end of the document with consequent renumbering of following sections. References updated as necessary. Incorporates formal internal and NIOSH review comments. Training required: As determined by the Task Manager. Initiated by Matthew H. Smith.
11/14/2011	03	Comparison of the K-25 coworker data to maximum likelihood estimates was removed from Section 6.0 in response to Quality of Science (10-year review) comments. No changes occurred as a result of formal internal and NIOSH review. Training required: As determined by the Objective Manager. Initiated by Matthew H. Smith.

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ACRONYMS AND ABBREVIATIONS

DOE	U.S. Department of Energy
LOD	limit of detection
NIOSH	National Institute for Occupational Safety and Health
OCAS	Office of Compensation Analysis and Support
ORAU	Oak Ridge Associated Universities
TIB	technical information bulletin
U.S.C.	United States Code
§	section or sections

1.0 PURPOSE

Technical information bulletins (TIBs) are not official determinations made by the National Institute for Occupational Safety and Health (NIOSH) but are rather general working documents that provide historic background information and guidance concerning the preparation of dose reconstructions at particular sites or categories of sites. They will be revised in the event additional relevant information is obtained about the affected site(s). TIBs may be used to assist NIOSH staff in the completion of individual dose reconstructions.

In this document, the word "facility" is used as a general term for an area, building, or group of buildings that served a specific purpose at a site. It does not necessarily connote an "atomic weapons employer facility" or a "Department of Energy (DOE) facility" as defined in the Energy Employees Occupational Illness Compensation Program Act of 2000 [42 U.S.C. § 7384l(5) and (12)].

The purpose of this TIB is to provide general information to allow Oak Ridge Associated Universities (ORAU) Team dose reconstructors to assign doses based on site coworker external dosimetry data to workers at DOE sites who have little or no individual monitoring data. This TIB is to be used in conjunction with separate TIBs or other approved documents that provide site-specific coworker data.

2.0 BACKGROUND

The ORAU Team is conducting a series of coworker data studies to permit dose reconstructors to complete certain cases for which external and/or internal monitoring data are unavailable or incomplete. For the purpose of this document, coworkers are considered to be workers at a site (potentially grouped by work location, job description, or other appropriate category) whose measured doses are considered representative of those that were received by one or more claimants with no individual monitoring data.

Cases without individual external monitoring data can fall into one of several categories, including:

- The worker was unmonitored and, even by today's standards, did not need to be monitored (e.g., a nonradiological worker).
- The worker was unmonitored, but by today's standards would have been monitored.
- The worker might have been monitored but the data are not available to the dose reconstructor.
- Partial information for the worker might be available, but it is insufficient to facilitate a dose reconstruction.

Some cases with little or no individual monitoring data can be processed in the absence of completed coworker studies, most notably those falling under the first category listed above. For example, nonradiological workers with no potential for workplace radiation exposures may be assigned onsite ambient doses. Even some cases falling under the second and third categories above do not require coworker studies (e.g., radiological workers who may in some cases be assigned reasonable upper limits provided that the total probability of causation is less than 45%). In relation to the last category above, if sufficient information is available, a prorated dose can be assigned in certain circumstances.

3.0 GENERAL APPROACH

The general approach to applying coworker data for cases with little or no individual external monitoring data is to assign either 50th- or 95th-percentile doses with the intent that the assigned

doses represent, but do not underestimate, the doses that would be assigned had the employee been monitored. As described in Section 5.0, the percentile doses include consideration of missed dose. This is necessary because the coworker data are intended to represent the results for unmonitored workers had they been monitored, and missed doses are assigned for each dosimeter result reported as zero or less than one-half of the limit of detection (LOD) as equal to the LOD divided by 2 using OCAS-IG-001, *External Dose Reconstruction Implementation Guideline* (NIOSH 2007) guidance for monitored workers.

Site-specific coworker datasets that contain 50th- and 95th-percentile penetrating and nonpenetrating doses are provided in separate, site-specific TIBs. In general, the 50th-percentile dose may be used as a best estimate of a worker's dose when professional judgment indicates the worker was likely exposed to intermittent low levels of external radiation. The 50th-percentile dose should not be used for workers who were routinely exposed. For routinely exposed workers (i.e., workers who were expected to have been monitored), the 95th-percentile dose should be applied. Also note that certain construction trades (e.g., pipefitters) might have received higher exposures than construction trade workers in general; therefore, they might fall into the category of workers who were expected to have been monitored. For workers who are unlikely to have been exposed, external onsite ambient dose should be used rather than coworker doses. The site-specific TIBs also provide information on the sources of the site data, validation of the data, and conversion of the data to annual doses to be applied in dose reconstructions.

The coworker doses in the site-specific TIBs should be treated as constant values. However, they do not include all factors that must be applied by the dose reconstructor to assign doses. Specifically, site-specific adjustments based on technical considerations (e.g., dosimeter bias) must be incorporated by the dose reconstructor based on the site technical basis documents. In addition, organ dose conversion factors based on OCAS-IG-001 (NIOSH 2007) must be applied; for likely compensable or likely noncompensable cases, they should be applied in the same manner in which they are applied for monitored employees. Otherwise, the organ dose conversion factors should be applied as a triangular distribution.

4.0 APPLICATIONS AND LIMITATIONS

In parallel with the development of site-specific TIBs that document the external coworker datasets to be used in dose reconstructions, cases not yet completed are screened to identify those cases that require external coworker data to facilitate case processing. As previously described, some cases with little or no individual monitoring data have been processed using methods that are not dependent on coworker data. Cases that are identified as requiring coworker data should be processed as described in Section 6.0.

Some workers are concerned that their dose records are not accurate because they were encouraged or instructed by a supervisor not to wear their badges (dosimeters), or they were not given badges while doing jobs that could have resulted in exposures sufficient to exceed an administrative or regulatory dose limit. If this concern is expressed by a claimant verbally in an interview or in written correspondence, the dose reconstructor should try to determine if this could have happened by examining the dose records and considering the workplace conditions, potential source terms, and incident reports. In cases in which the dose reconstructor believes this could have happened, it might be necessary to modify the dose reconstruction and/or perform additional research.

5.0 DEVELOPMENT OF SITE COWORKER DATASETS AND DISTRIBUTIONS

External dosimetry data for DOE sites are potentially available from several sources. These include the Center for Epidemiologic Research databases maintained by ORAU, the Comprehensive Epidemiologic Data Resource databases maintained by DOE, other datasets maintained by DOE, and

data maintained by the sites themselves. In addition, claimant data that have been submitted by DOE sites to NIOSH in response to requests for this dose reconstruction project provide a useful subset of sitewide data.

Development of site-specific data summaries and distributions involves a careful examination of the various data sources with the objective of identifying the most complete and accurate dataset available. Before the analysis of the selected data and the development of summary statistics and dose distributions, a sampling of the data are compared to claim-specific data that have been submitted to NIOSH by the DOE sites. This comparison helps to verify the accuracy and completeness of the site data that was selected for use in coworker studies because the data that have been submitted to NIOSH are often more detailed than the sitewide datasets (e.g., individual badge data are typically provided to NIOSH, while the sitewide data often represent annual summarized data). The comparison also provides information that is needed to adjust the sitewide datasets to account for missed dose, partial year data, etc. If significant issues arise during the course of this comparison that shed doubt on the accuracy or completeness of the site data that was selected for analysis, additional evaluations should take place to ensure that a valid dataset has been selected.

The specific datasets that were selected for a particular site and the rationale for their selection are documented in site-specific coworker data TIBs titled *External Coworker Dosimetry Data for [the DOE Site]*. Before publication of these site-specific TIBs, the data are subjected to an independent and separately documented validation process.

Once coworker data have been selected to represent a particular site, the data are analyzed for the purpose of developing annual 50th- and 95th-percentile doses. Before calculating the percentile doses, however, the doses are adjusted to account for missed dose based on the badge exchange frequency and the dosimeter limit of detection (LOD). For example, the median annual reported dose might be zero at a particular site and in a particular year, but it would be inappropriate to assign a dose of zero as a median value because of the potential for missed dose, which must be included in the dose estimates for claimants (NIOSH 2007). Specifically, one-half of the maximum annual missed doses are added to the reported annual doses, except for reported positive doses in which case the maximum missed dose is reduced by the dose that corresponds to one badge exchange (because it is not possible that all individual badge results were zero if a positive annual dose was reported). The 50th- and 95th-percentile annual penetrating and shallow doses are then derived by ranking the data into cumulative probability curves and extracting the 50th- and 95th-percentile doses for each year. Additional details on the incorporation of missed dose in the site coworker data are provided in the site-specific TIBs.

The site-specific external coworker dosimetry data TIBs provide information on adjustments to the data that were necessary to develop annual doses and distributions for use in dose reconstructions. For example, partial year dosimetry data in the site data are extrapolated to provide annual values that represent the doses that would have been received for a full year of employment for all monitored employees. The objective is to provide data on the annual doses that were received by employees had they been monitored for a full year; dose reconstructors may then prorate the data for individual cases, as appropriate, to account for partial years of employment.

6.0 APPLICATION OF SITE COWORKER PERCENTILE DOSES

Data are presented in a table in each site-specific external coworker TIB as 50th- and 95th-percentile annual penetrating and nonpenetrating doses for monitored workers. These doses, together with the application of dosimeter bias factors and organ dose conversion factors as described in Section 3.0, are intended to represent reasonable estimates of doses for workers who were not monitored. Also as described in Section 3.0, the 50th-percentile doses should be applied if the worker was likely

exposed intermittently, and the 95th-percentile doses should be applied if the worker was likely exposed routinely. External onsite ambient doses should be used instead of external coworker doses if the worker was unlikely to have been exposed. Doses should be prorated, as appropriate, to account for partial years of exposure.

The approach this document describes is highly likely to result in a significant overestimate of external dose for unmonitored workers. This overestimate is attributable largely to the manner in which missed doses are applied to the coworker datasets [e.g., the use of nLOD/2 as prescribed in OCAS-IG-001 (NIOSH 2007) and described in Section 5.0 above]. This overestimate is intentional, because the nLOD/2 approach is known to overestimate a monitored individual's actual dose when the majority of monitoring results are low in comparison with the LOD (NIOSH 2007), and it would be inappropriate to treat unmonitored individuals who perhaps should have been monitored differently than individuals who happen to have been monitored.

7.0 ATTRIBUTIONS AND ANNOTATIONS

All information requiring identification was addressed via references integrated into the reference section of this document.

REFERENCES

NIOSH (National Institute for Occupational Safety and Health), 2007, *External Dose Reconstruction Implementation Guideline*, OCAS-IG-001, Rev. 03, Office of Compensation Analysis and Support, Cincinnati, Ohio, November 21.