ORAU TEAM
Dose Reconstruction
Project for NIOSH

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Use of Coworker Dosimetry Data For External Dose Assignment	

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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.

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1.0 PURPOSE

Technical Information Bulletins (TIBs) are general working documents that provide 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. TIBs may be used to assist the National Institute for Occupational Safety and Health 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 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 Technical Information Bulletin (TIB) is to provide general information to allow ORAU Team dose reconstructors to assign doses to workers at DOE sites who have little or no individual monitoring data, based on site coworker external dosimetry 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 received by one or more claimants with no individual monitoring data.

Cases without individual external monitoring data may 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 non-radiological worker).
- the worker was unmonitored, but by today's standards would have been monitored.
- the worker may have been monitored but the data are not available to the dose reconstructor.
- the worker may have partial information, but the available information 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, non-radiological workers with no potential for workplace radiation exposures may be assigned on-site 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 (POC) is less than 45%. Regarding the last category above, if sufficient information is available, a prorated dose could 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 doses assigned represent, but do not underestimate, the doses that would be assigned had the employee been monitored. As described in section 6.0, 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 to null monitoring results for monitored workers.

Site-specific coworker data sets containing 50th and 95th percentile penetrating and non-penetrating 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. For workers who are unlikely to have been exposed, external on-site ambient dose should be used rather than co-worker doses. The site-specific TIBs also provide information on the sources of the site data, validation of the data, and conversion of the data into annual doses to be applied in dose reconstructions.

The coworker doses presented in the site-specific TIBs shall be treated as constant values. However, they do not include all factors that must be applied by the dose reconstructor in order 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 (TBDs). Additionally, organ dose conversion factors based on OCAS-IG-001 must be applied; for likely compensable or likely non-compensable cases, they shall be applied in the same manner in which they are applied for monitored employees, and otherwise they shall 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 data sets to be used in dose reconstructions, cases not yet completed are screened to identify those cases requiring external coworker data to facilitate case processing. As described previously, some cases with little or no individual monitoring data have been processed using methods not dependent on coworker data. Cases identified as requiring coworker data shall be processed as described in Section 7.0.

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 the CATI 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 may be necessary to modify the dose reconstruction and/or perform additional research.

5.0 REFERENCES

1. NIOSH (National Institute for Occupational Safety and Health), *External Dose Reconstruction Implementation Guideline*, Rev. 0, OCAS-IG-001, Office of Compensation Analysis and Support, Cincinnati, Ohio, 2002.

2. ORAUT (Oak Ridge Associated Universities Team), ORAUT-OTIB-0026, *External Coworker Dosimetry Data for the K-25 Site, Rev 00*, May 31, 2005.

3. ORAUT (Oak Ridge Associated Universities Team), ORAUT-RPRT-0032, Historical Evaluation of the Film Badge Dosimetry Program at the Y-12 Facility in Oak Ridge, Tennessee: Part 1 – Gamma Radiation, Rev 00, April 13, 2005.

6.0 DEVELOPMENT OF SITE COWORKER DATA SETS AND DISTRIBUTIONS

External dosimetry data for DOE sites are potentially available from several sources. These include the Center for Epidemiologic Research (CER) databases maintained by Oak Ridge Associated Universities (ORAU), the Comprehensive Epidemiologic Data Resource (CEDR) databases maintained by the Department of Energy, other data sets maintained by the Department of Energy, and data maintained by the sites themselves. Additionally, claimant data submitted by DOE sites to NIOSH in response to requests for the purposes of this dose reconstruction project provide a useful subset of site-wide data.

Development of site-specific data summaries and distributions involve a careful examination of the various data sources with the objective of identifying the most complete and accurate data set available. Prior to 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 submitted to NIOSH by the DOE sites. This comparison helps verify the accuracy and completeness of the site data selected for use in coworker studies since the data submitted to NIOSH are often more detailed than the site-wide data sets (e.g., individual badge data are typically provided to NIOSH, while the site-wide data often represent annual summarized data). The comparison also provides information needed to adjust the site-wide data sets to account for missed dose, partial year data, etc. Should significant issues arise during the course of this comparison that shed doubt on the accuracy or completeness of the site data selected for analysis, additional evaluations will take place to ensure that a valid data set has been selected.

The specific data sets 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].” Prior to 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 50^{th} and 95^{th} percentile doses.. Prior to 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 to claimants.[1] 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 corresponding 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 included 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 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.

7.0 APPLICATION OF SITE COWORKER PERCENTILE DOSES AND A COMPARISON TO MAXIMUM LIKELIH0OD DOSES

Data are presented in Table 2 of each site-specific external coworker TIB as 50th percentile and 95th percentile annual penetrating and non-penetrating 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 are to be applied if the worker was likely exposed intermittently, and the 95th percentile doses are to be applied if the worker was likely exposed routinely. External on-site ambient doses are to be used instead of external coworker doses if the worker was unlikely to have been exposed. Doses shall be prorated, as appropriate, to account for partial years of exposure.

The approach described in this document 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 data sets (e.g., the use of nLOD/2 as prescribed in OCAS-IG-001 and described in Section 6.0 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 null,[1] and it would be inappropriate to treat unmonitored individuals who perhaps should have been monitored differently than individuals who happen to have been monitored.

The extent to which the coworker data assigned according to the principles established in this document represent overestimates can be demonstrated by comparing site-specific percentile doses calculated according to these principles to doses calculated using the maximum likelihood approach. For example, Table 7-1 below compares the percentile doses for K-25 obtained from ORAUT-OTIB-0026 (the site-specific coworker TIB[2]) to doses calculated from the same data set but using the maximum likelihood approach (in the same manner as was performed for Y-12 film badge data[3]). When comparing the values in Table 7-1, note that the LOD assumed for the maximum likelihood analysis was the same as given in ORAUT-OTIB-0026. Also, the calculated maximum likelihood doses for 1954-1958 were replaced with the value from 1959 because of an overwhelming number of individuals who had null results (i.e., the geometric mean values for this period were very low and the GSD values were very high), and the year 1945 has not been included in the table because the data were insufficient to facilitate a maximum likelihood analysis. Finally, the 95th percentile doses provided in the table for the maximum likelihood approach are calculated from the relevant geometric means (GMs) and geometric standard deviations (GSDs).

Table 7-1. Comparison of K-25 external coworker penetrating doses (rem) modified to account for missed dose from ORAUT-OTIB-0026 to doses calculated using maximum likelihood approach.[a]

Year	ORAUT-OTIB-0026 50th%	ORAUT-OTIB-0026 95th%	Maximum Likelihood Geometric Mean (GM)	Maximum Likelihood Geometric Standard Deviation (GSD)	Maximum Likelihood 95th%
1946	0.805	1.455	0.046	6.383	0.970
1947	0.780	1.015	0.031	4.110	0.317
1948	0.780	1.264	0.013	7.321	0.344
1949	0.780	1.035	0.021	5.168	0.313
1950	0.780	0.841	0.006	5.518	0.100
1951	0.780	1.052	0.014	5.324	0.219
1952	0.780	0.951	0.017	4.150	0.177
1953	0.780	1.096	0.029	4.316	0.321
1954	0.780	0.913	0.037	4.783	0.486
1955	0.780	0.835	0.037	4.783	0.486
1956	0.780	0.855	0.037	4.783	0.486
1957	0.780	1.088	0.037	4.783	0.486
1958	0.780	1.049	0.037	4.783	0.486
1959	0.810	1.245	0.037	4.783	0.486
1960	0.791	1.154	0.032	4.497	0.379
1961	0.778	0.942	0.023	3.112	0.149
1962	0.780	0.824	0.015	2.423	0.064
1963	0.780	0.840	0.019	2.261	0.073
1964	0.780	0.841	0.016	2.208	0.059
1965	0.780	0.936	0.026	3.172	0.174
1966	0.780	0.952	0.022	3.744	0.193
1967	0.780	0.928	0.026	3.691	0.223
1968	0.780	0.906	0.006	7.157	0.153
1969	0.780	0.946	0.012	4.911	0.164
1970	0.780	1.041	0.012	6.720	0.275
1971	0.780	1.092	0.019	4.007	0.186
1972	0.779	1.034	0.026	2.822	0.143
1973	0.780	0.871	0.012	3.521	0.095
1974	0.835	1.065	0.079	2.416	0.337
1975	0.062	0.111	0.016	2.564	0.075
1976	0.060	0.149	0.045	1.643	0.102
1977	0.060	0.089	0.023	1.896	0.066
1978	0.052	0.136	0.040	1.746	0.100
1979	0.060	0.088	0.029	1.619	0.064
1980	0.060	0.145	0.064	2.051	0.209
1981	0.060	0.085	0.046	1.546	0.094
1982	0.060	0.060	0.046	1.478	0.087
1983	0.060	0.060	0.037	1.723	0.091
1984	0.060	0.060	0.032	1.787	0.083
1985	0.060	0.060	0.033	1.601	0.072