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Document Title: **External Coworker Dosimetry Data for Area IV of the Santa Susana Field Laboratory, the Canoga Avenue Facility (Vanowen Building, and the De Soto Avenue Facility (sometimes referred to as Energy Technology Engineering Center [ETEC] or Atomics International)**	Document Number: ORAUT-OTIB-0077 Revision: 00 Effective Date: 08/03/2009 Type of Document OTIB Supersedes: None

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PUBLICATION RECORD

EFFECTIVE DATE	REVISION NUMBER	DESCRIPTION
08/03/2009	00	New technical information bulletin to provide external coworker data for Santa Susana workers. Incorporates formal internal and NIOSH review comment. Training required: As determined by the Objective Manager. Initiated by Matthew H. Smith.

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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 to assist in 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 information to allow dose reconstructors to assign doses that are based on site coworker data to workers who were employed at Area IV and associated sites and for whom there are no or limited monitoring data. For convenience, this TIB refers to these workers as Santa Susana Field Laboratory (SSFL) workers regardless of employment location and employer.

The data in this TIB should be used to assign doses for gaps in dosimetry records. The data are to be used in conjunction with ORAUT-OTIB-0020, *Use of Coworker Dosimetry Data for External Dose Assignment* (ORAUT 2008).

2.0 BACKGROUND

The Oak Ridge Associated Universities (ORAU) Team is conducting a series of coworker data studies to permit dose reconstructors to complete certain cases for which external or internal monitoring data are unavailable or incomplete. Cases that do not have complete monitoring data fall into one of several categories:

- 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 is available, but it is insufficient to facilitate a dose reconstruction.

As described in ORAUT-OTIB-0020 (ORAUT 2008), some cases without complete monitoring data can be processed based on assumptions and methodologies that do not involve coworker data. For example, many cases in the first category can be processed by the assignment of ambient external and internal doses based on information in the relevant site technical basis documents.

3.0 GENERAL APPROACH

As described in ORAUT-OTIB-0020 (ORAUT 2008), the general approach to the development of coworker data for cases without 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 have been assigned had the worker been monitored.

4.0 APPLICATIONS AND LIMITATIONS

Some SSFL workers could have worked at one or more other major sites in the DOE complex during their employment histories. Therefore, the data in this TIB must be used with caution to ensure that, for likely noncompensable cases, unmonitored external doses from multiple site employments have been overestimated. This typically requires the availability of the recorded doses or information for external coworker dosimetry data for all relevant sites.

The data in this TIB address penetrating gamma and neutron radiation.

External onsite ambient dose should be applied as specified in the latest revision of ORAUT-PROC-0060*, Occupational Onsite Ambient Dose Reconstruction for DOE Sites* (ORAUT 2006a) and ORAUT-TKBS-0038-4, *Area IV of the Santa Susana Field Laboratory, the Canoga Avenue Facility (Vanowen Building), the Downey Facility, and the De Soto Avenue Facility (sometimes referred to as Energy Technology Engineering Center [ETEC] or Atomics International) – Occupational Environmental Dose* (ORAUT 2007a).

5.0 COWORKER DATA DEVELOPMENT

5.1 DOSIMETRY DATA

The SSFL data was manually entered into a database for an epidemiological study of workers at Rocketdyne (Atomics International) covering the period 1948 to 1999. Exposure information was compiled from the following sources: Rocketdyne radiation safety folders, NRC - REIRS, DOE-REMS, Landauer dosimetry, Individual facilities, the U.S. Army, and the U.S. Air Force. 6,675 workers were monitored for radiation exposure and of those 5,801 were included in the study. 350 workers who were employed for less than 6 months and 524 workers with insufficient identifying information were excluded from the study (Boice 2006). Also note that these data include results from workers who had duties at the Canoga, DeSoto, and Downey sites. The number of datapoints used for each year is shown in Tables 2 and 3.

The SSFL database contains dosimetry data for penetrating dose, which is a combination of gamma and fast neutron dose. Because it was difficult to separate statistically significant neutron dose from the penetrating dose, and because shallow dose data is not available in the database described above, the neutron dose component (which represented less than 5% of the total data points available) was left embedded with gamma dose, resulting in penetrating dose values that are favorable to claimants. An analysis of average neutron dose revealed that the average value for any individual year was bounded by the 95^{th} percentile values for penetrating dose given in this OTIB.

5.2 ADJUSTMENT FOR MISSED DOSE

According to OCAS-IG-001, *External Dose Reconstruction Implementation Guideline* (NIOSH 2007), missed doses are to be assigned for reported zero readings for each monitoring cycle to account for the possibility that doses were received but either not recorded by the dosimeter or not reported by the site. In addition, reported dose values of less than one-half the applicable minimum detection limits are to be assigned as missed dose. Annual maximum potential missed doses are calculated by multiplying the number of zero or unrecorded badge readings by the reported dosimeter limit of detection (LOD) and summing the results. These values are used as the 95th-percentile values of a lognormal distribution to calculate the probability of causation, which is determined by the U.S. Department of Labor. Therefore, in the Interactive RadioEpidemiological Program (IREP), Parameter 1 is equal to the calculated maximum annual missed doses multiplied by 0.5, and Parameter 2 is equal to 1.52. These values represent the geometric mean and geometric standard

deviation, respectively, for each year of analysis. Table 1 lists the maximum annual missed dose by monitoring period.

Table 1. Missed external doses (rem).

Monitoring period	Penetrating LOD	Exchange frequency	Maximum potential annual missed penetrating dose
1948–1962	0.04	Weekly	2.08
1963–1979	0.04	Monthly	0.480
1980–present	0.01	Quarterly	0.040

6.0 COWORKER ANNUAL DOSE SUMMARIES

Based on the described information and approaches, SSFL coworker annual external dosimetry summaries were developed for use in the evaluation of external penetrating dose for certain workers who were potentially exposed to workplace radiation but for whom there is no or limited monitoring data from DOE. These summaries were developed using the following steps:

Step 1. The reported penetrating dose was modified for each worker to account for partial years of employment. This permits the dose reconstructor to assign an appropriate prorated dose to account for partial years of employment or potential exposure.

Step 2. One-half of the maximum potential annual missed doses in Table 1 were added to the reported annual doses from Step 1 (with the exception of reported positive doses, in which case the maximum missed dose was reduced by the dose that corresponded to one badge exchange because it is not possible that all individual badge results were zero if a positive annual dose was reported).

Step 3. The 50th- and 95th-percentile annual coworker penetrating doses were derived from the doses from Step 2 by ranking the data into cumulative probability curves and extracting the 50th- and 95th-percentile doses for each year.

Step 4. Table 2 lists the results of the coworker analysis. These percentile doses should be used for SSFL workers for whom there are no or limited monitoring data using the methodologies in Sections 5.0 and 6.0 of ORAUT-OTIB-0020 (ORAUT 2008). In general, the 50th-percentile dose can be used as a best estimate of a worker's dose when professional judgment indicates that the worker was probably exposed to intermittent low levels of external radiation. The 50th-percentile dose should generally not be used for workers who were routinely exposed. For routinely exposed workers (i.e., workers who were expected to have been monitored and routinely exposed), the 95th-percentile dose should be applied. However, other options are available through the guidance in ORAUT-OTIB-0020. For instance, for cases in which routine monitoring data exist and coworker dose is used to supplement missing quarters or years, the percentile dose should be the one that is consistent with the recorded doses unless there is reason to believe that the worker's job or location in that year differed significantly from the job or location during the years dose was recorded. For workers who are unlikely to have been exposed, external onsite ambient dose should be used rather than coworker doses.

Step 5. Table 3 lists penetrating dose values (as described in the steps above) that have been adjusted using the guidance in Section 8.0 of ORAUT-OTIB-0052, *Parameters to Consider When Processing Claims for Construction Trade Workers* (ORAUT 2007b). This guidance is applicable for construction trade workers who meet the criteria in Section 3.0 of that TIB.

The data from Tables 2 and 3 should be used with the appropriate dose conversion factors and site-specific correction factors as discussed in the external section of the site profile *Atomics International – Occupational External Dose* (ORAUT 2006b).

7.0 ATTRIBUTIONS AND ANNOTATIONS

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

Table 2. Annual external coworker doses modified to account for missed dose (mrem).

Year	Penetrating 95th percentile	Penetrating 50th percentile	Number of Datapoints
1948	6,335	1,070	46
1949	4,261	1,140	74
1950	3,190	1,835	118
1951	3,124	1,084	224
1952	1,849	1,118	276
1953	2,037	1,125	298
1954	2,480	1,062	369
1955	3,269	1,057	435
1956	2,211	1,073	374
1957	1,890	1,077	621
1958	3,116	1,032	797
1959	2,523	1,035	1031
1960	2,775	1,065	1412
1961	2,229	1,080	1447
1962	2,544	1,440	1983
1963	970	270	2063
1964	1,710	280	1905
1965	1,875	360	1554
1966	1,286	240	1023
1967	860	230	938
1968	886	225	813
1969	848	240	744
1970	1,938	240	717
1971	718	240	615
1972	807	240	504
1973	640	230	519
1974	670	240	522
1975	676	240	609
1976	850	230	717
1977	1,015	235	748
1978	1,038	240	843
1979	823	240	827
1980	290	35	811
1981	293	35	847
1982	847	35	864
1983	1,325	25	781
1984	445	25	701
1985	915	20	639
1986	338	20	639
1987	318	20	572
1988	218	20	588
1989	794	20	584
1990	422	20	502
1991	573	20	437
1992	100	20	914
1993	75	20	928
1994	55	20	926
1995	45	20	891
1996	54	20	883
1997	95	20	891
1998	35	20	896
1999	28	20	889

Table 3. Annual external coworker doses modified in accordance with ORAUT-OTIB-0052 (mrem) (ORAUT 2007b).

Year	Penetrating 95th percentile	Penetrating 50th percentile	Number of Datapoints
1948	8,461	1,090	46
1949	5,557	1,188	74
1950	4,057	2,161	118
1951	3,965	1,109	224
1952	2,181	1,157	276
1953	2,444	1,167	298
1954	3,064	1,079	369
1955	4,169	1,072	435
1956	2,687	1,094	374
1957	2,238	1,100	621
1958	3,954	1,037	797
1959	3,124	1,041	1031
1960	3,477	1,083	1412
1961	2,712	1,104	1447
1962	3,153	1,608	1983
1963	1,270	290	2063
1964	2,306	304	1905
1965	2,537	416	1554
1966	1,712	248	1023
1967	1,116	234	938
1968	1,152	227	813
1969	1,099	248	744
1970	2,625	240	717
1971	917	248	615
1972	1,042	240	504
1973	808	234	519
1974	849	240	522
1975	858	240	609
1976	1,102	234	717
1977	1,332	241	748
1978	1,365	248	843
1979	1,064	248	827
1980	400	43	811
1981	404	43	847
1982	1,180	43	864
1983	1,849	29	781
1984	617	29	701
1985	1,275	20	639
1986	467	20	639
1987	440	20	572
1988	299	20	588
1989	1,105	20	584
1990	585	20	502
1991	796	20	437
1992	135	20	914
1993	99	20	928
1994	71	20	926
1995	57	20	891
1996	70	20	883
1997	127	20	891
1998	43	20	896
1999	33	20	889

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