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PUBLICATION RECORD

EFFECTIVE DATE	REVISION NUMBER	DESCRIPTION
05/07/2004	00	New document for the INEEL Introduction. Incorporates responses to OCAS comments. First approved issue. Initiated by Norman D. Rohrig.
12/13/2006	01	Approved revision as a result of biennial review. Revised language in the Purpose section as required by NIOSH. Attribution and Annotation section added. Constitutes a total rewrite of document. Incorporates internal, NIOSH, and DOL formal review comments. This revision results in no change to the assigned dose and no PER is required. Training required: As determined by the Task Manager. Initiated by Norman D. Rohrig.
04/26/2007	02	Approved Revision 02 revised to change document owner and to better identify references in the text. This revision results in no change to the assigned dose and no PER is required. Training required: As determined by the Task Manager. Initiated by Jo Ann M. Jenkins.
03/12/2010	03	Revised to combine the INL and ANL-W Introductions into a single document. Updated NIOSH required language. Incorporates formal internal and NIOSH review comments. Training required: As determined by the Objective Manager. Initiated by JoAnn M. Jenkins.

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ACRONYMS AND ABBREVIATIONS

ANL-W	Argonne National Laboratory–West
CFA	Central Facilities Area
CFR	Code of Federal Regulations
DOE	U.S. Department of Energy
DOL	U.S. Department of Labor
EEOICPA	Energy Employees Occupational Illness Compensation Program Act of 2000
INL	Idaho National Laboratory
MDA	minimum detectable activity
mi	mile
NIOSH	National Institute for Occupational Safety and Health
No.	Number
ORAU	Oak Ridge Associated Universities
POC	probability of causation
Pt.	Part
SRDB Ref ID	Site Research Database reference identification (number)
TAN	Test Area North
TBD	technical basis document
U.S.C.	United States Code
§	section or sections

1.1 INTRODUCTION

Technical basis documents and site profile documents 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). These documents may be used to assist NIOSH staff in the completion of the individual work required for each dose reconstruction.

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 [EEOICPA; 42 U.S.C. § 7384l(5) and (12)]. EEOICPA defines a DOE facility as "any building, structure, or premise, including the grounds upon which such building, structure, or premise is located … in which operations are, or have been, conducted by, or on behalf of, the Department of Energy (except for buildings, structures, premises, grounds, or operations … pertaining to the Naval Nuclear Propulsion Program)" [42 U.S.C. § 7384l(12)]. Accordingly, except for the exclusion for the Naval Nuclear Propulsion Program noted above, any facility that performs or performed DOE operations of any nature whatsoever is a DOE facility encompassed by EEOICPA.

For employees of DOE or its contractors with cancer, the DOE facility definition only determines eligibility for a dose reconstruction, which is a prerequisite to a compensation decision (except for members of the Special Exposure Cohort). The compensation decision for cancer claimants is based on a section of the statute entitled "Exposure in the Performance of Duty." That provision [42 U.S.C. § 7384n(b)] says that an individual with cancer "shall be determined to have sustained that cancer in the performance of duty for purposes of the compensation program if, and only if, the cancer … was at least as likely as not related to employment at the facility [where the employee worked], as determined in accordance with the POC [probability of causation[1]] guidelines established under subsection (c) …" [42 U.S.C. § 7384n(b)]. Neither the statute nor the probability of causation guidelines (nor the dose reconstruction regulation, 42 C.F.R. Pt. 82) define "performance of duty" for DOE employees with a covered cancer or restrict the "duty" to nuclear weapons work (NIOSH 2007).

The statute also includes a definition of a DOE facility that excludes "buildings, structures, premises, grounds, or operations covered by Executive Order No. 12344, dated February 1, 1982 (42 U.S.C. 7158 note), pertaining to the Naval Nuclear Propulsion Program" [42 U.S.C. § 7384l(12)]. While this definition excludes Naval Nuclear Propulsion Facilities from being covered under the Act, the section of EEOICPA that deals with the compensation decision for covered employees with cancer [i.e., 42 U.S.C. § 7384n(b), entitled "Exposure in the Performance of Duty"] does not contain such an exclusion. Therefore, the statute requires NIOSH to include all occupationally-derived radiation exposures at covered facilities in its dose reconstructions for employees at DOE facilities, including radiation exposures related to the Naval Nuclear Propulsion Program. As a result, all internal and external occupational radiation exposures are considered valid for inclusion in a dose reconstruction. No efforts are made to determine the eligibility of any fraction of total measured exposure for inclusion in dose reconstruction. NIOSH, however, does not consider the following exposures to be occupationally derived (NIOSH 2007):

- Background radiation, including radiation from naturally occurring radon present in conventional structures
- Radiation from X-rays received in the diagnosis of injuries or illnesses or for therapeutic reasons

[1] The U.S. Department of Labor (DOL) is ultimately responsible under the EEOICPA for determining the POC.

1.1.1 Purpose

This site profile documents historical practices at Idaho National Laboratory (INL) and Argonne National Laboratory–West (ANL-W) (which is within the INL site). The site profile can be used to evaluate internal and external dosimetry data for unmonitored and monitored workers and can serve as a supplement to individual monitoring data. It contains technical basis information to be used to evaluate the total occupational radiation dose for EEOICPA claimants.

The purpose of this Introduction is to provide a summary of the contents of the five technical basis documents (TBDs) that, along with this Introduction, constitute the INL and ANL-W Site Profile.

1.1.2 Scope

The site profile consists of six technical basis documents (TBDs): (1) this Introduction, (2) Site Description, (3) Occupational Medical Dose, (4) Occupational Environmental Dose, (5) Occupational Internal Dose, and (6) Occupational External Dosimetry.

Site Description
The Site Description TBD (ORAUT 2007a) briefly describes the facilities and processes at INL since the early 1950s. The INL site, about 50 mi west of Idaho Falls in the Arco desert, covers about 890 mi^2. There are many additional offices and a few laboratories in Idaho Falls as well. Previous names for the INL site were the National Reactor Testing Station (1949 to 1974), the Idaho National Engineering Laboratory (1974 to 1997), and the Idaho National Engineering and Environmental Laboratory (1997 to 2005).

The Central Facilities Area (CFA), formerly a Navy gunnery testing facility, now provides support facilities, central services, and laboratories. Radioactive wastes from the site and from the Rocky Flats Plant are handled and stored at the Radioactive Waste Management Complex. Argonne National Laboratory-West developed and operated reactors at two locations: (1) south of CFA and (2) at the east edge of the site. Highly enriched uranium spent fuel was reprocessed at the Idaho Chemical Processing Plant along with the resultant high-level waste. The Test Reactor Area supported three large research reactors, several smaller reactors, and several laboratories. Test Area North (TAN) was home to the Aircraft Nuclear Propulsion Program and the Loss of Fluid Test program. Armor for the U.S. Army is constructed at the Specific Manufacturing Capability facility at TAN. Reactor safety tests were conducted at the Special Power Excursion Reactor Test facilities. The Army Reactor Area was used to test reactors and was the site of an accident at Stationary Low-Power Reactor No. 1 (Horan and Gammill 1963).

The Site Description TBD provides information about the facilities and identifies unusual events that took place at INL facilities.

Occupational Medical Dose
The Occupational Medical Dose TBD (ORAUT 2009) provides information about the dose that individual workers received from X-rays that were required as a condition of employment. These X-rays included chest X-rays during preemployment and periodic physical exams. The frequency of required X-rays varied over time and as a function of the worker's age. Both the X-ray equipment and the techniques for taking chest X-rays that are covered by this TBD have changed over the years. These factors have been taken into account in determining the dose that a worker would have received from the X-ray. When there was a doubt about the technique that was used, assumptions that are favorable to claimants were made to ensure that the dose has not been underestimated. Important parameters include the tube current and voltage, exposure time, source-to-skin distance,

and view (posterior-anterior or lateral). Doses to other exposed organs from the chest X-ray have been calculated. The uncertainty that is associated with the calculated dose takes into account the uncertainty that is associated with each of the parameters mentioned above. Tables list doses to organs in the body for convenient reference by dose reconstructors.

Occupational Environmental Dose

The Occupational Environmental Dose TBD (ORAUT 2010) provides the maximum dose to the whole body and body organs that workers could have received when working outside buildings at a given location at INL or ANL-W from inhalation of radioactive materials in the atmosphere, from direct radiation from effluent plumes, and from direct exposure to radionuclides and radiation sources that might have become incorporated in the soil.

The radionuclide concentrations at INL and ANL-W areas are based principally on measurements of stack effluents coupled with ground-level maximum annual average air concentrations from the National Oceanic and Atmospheric Administration. Of the 56 radionuclides that have been assigned to the annual effluent list, nine of them (^{144}Ce, ^{131}I, ^{147}Pm, ^{238}Pu, $^{239/240}$Pu, ^{106}Ru, ^{89}Sr, ^{90}Sr, and ^{91}Y) have been demonstrated to contribute about 95% of the total internal dose by a screening process using dose conversion factors from the International Commission on Radiological Protection. Annual intakes of these radionuclides were calculated with standard breathing rates and exposure times.

Annual external whole-body dose to workers from ambient radiation and from submersion in the annual radioactive material concentration is provided by the measurement of direct gamma values at the INL facility fences.

Occupational Internal Dose

The Occupational Internal Dose TBD (ORAUT 2007b) discusses the internal dosimetry program at INL and ANL-W.

This TBD contains a comprehensive default table to guide internal dose reconstruction in cases with minimal data. In addition, the TBD discusses *in vitro* minimum detectable activities (MDAs), analytical methods, and reporting protocols for radionuclides. As expected, these parameters varied somewhat over the years for each of the evaluated radionuclides, but the capabilities were relatively consistent through the history of the site. The primary radionuclides of concern are those that are associated with spent highly enriched fuels such as mixed fission products from a variety of reactor types, mixed activation products, plutonium (with a predominance of ^{238}Pu), americium, and highly enriched and depleted uranium. This TBD discusses *in vivo* MDAs, analytical methods, and reporting protocols for X- and gamma-ray emitting radionuclides.

This TBD presents information for workers who could have been exposed in the early days, but had no confirmed intakes. This could have occurred under circumstances in which monitoring programs were not required or when the monitored readings were below detection limits. The document discusses methods for evaluating potential doses that fall in this category and provides additional data for the evaluation of the worst-case scenario and for unmonitored workers.

Occupational External Dosimetry

The Occupational External Dosimetry TBD (ORAUT 2007c) discusses the program for measuring skin and whole-body doses to workers. This document describes dose reconstruction parameters, practices, policies, and dosimeter types and technologies for measuring doses from different types of radiation. Discussion includes evaluation of measured doses from exposure to beta, gamma, and neutron radiation. Tables provide test results for various dosimeters that were exposed to different exposure geometries, radiation types, and energies. Sources of bias, workplace radiation field

characteristics, responses of beta/gamma and neutron dosimeters in workplace fields, and adjustments to the recorded dose these dosimeters measured during specific years are discussed in detail.

Missed dose is discussed as a function of dosimeter type, year, and energy range. In addition, the document describes the use of external dosimetry technical basis parameters to facilitate the efforts of dose reconstructors.

1.2 ATTRIBUTIONS AND ANNOTATIONS

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

Norman Rohrig served as the initial Document Owner for this document. Mr. Rohrig was previously employed at INL, which shared boundaries with ANL-W and used the same dosimetry systems. His work involved management, direction, or implementation of radiation protection and/or health physics program policies, procedures, or practices in relation to atomic weapons activities at the site. This revision has been overseen by a new Document Owner, who is fully responsible for the content of this document, including all findings and conclusions. In all cases where such information or previous studies or writings are included or relied upon by the Document Owner, JoAnn M. Jenkins, those materials are fully attributed to the source.

REFERENCES

Horan, J. R., and Gammill, W. P., 1963, "The Health Physics Aspects of the SL-1 Accident," *Health Physics*, volume 9, pp. 177–186. [SRDB Ref ID: 26108]

NIOSH (National Institute for Occupational Safety and Health), 2007, *Radiation Exposures Covered for Dose Reconstructions Under Part B of the Energy Employees Occupational Illness Compensation Program Act*, OCAS-IG-003, Rev. 0, Office of Compensation Analysis and Support, Cincinnati, Ohio, November 5.

ORAUT (Oak Ridge Associated Universities Team), 2007a, *Idaho National Laboratory – Site Description*, ORAUT-TKBS-0007-2, Rev. 03, Oak Ridge, Tennessee, August 17.

ORAUT (Oak Ridge Associated Universities Team), 2007b, *Idaho National Laboratory – Occupational Internal Dose*, ORAUT-TKBS-0007-5, Rev. 02, Oak Ridge, Tennessee, July 30.

ORAUT (Oak Ridge Associated Universities Team), 2007c, *Idaho National Laboratory - Occupational External Dosimetry*, ORAUT-TKBS-0007-6, Rev. 02, Oak Ridge, Tennessee, June 18.

ORAUT (Oak Ridge Associated Universities Team), 2009, *Idaho National Laboratory and Argonne National Laboratory - West – Occupational Medical Dose*, ORAUT-TKBS-0007-3, Rev. 02, Oak Ridge, Tennessee, December 21.

ORAUT (Oak Ridge Associated Universities Team), 2010, *Idaho National Laboratory and Argonne National Laboratory - West – Occupational Environmental Dose*, ORAUT-TKBS-0007-4, Rev. 02, Oak Ridge, Tennessee, January 8.