

<p><b>ORAU Team</b>  <b>Dose Reconstruction Project for NIOSH</b></p> <p>Technical Basis Document for the Argonne National Laboratory - West – Introduction</p>	<p>Document Number:  ORAUT-TKBS-0026-1  Effective Date: 12/01/2004  Revision No.: 00  Controlled Copy No.: _____  Page 1 of 7</p>
<p>Subject Expert: Norman D. Rohrig</p> <p>Document Owner:</p> <p>Approval: <u>Signature on File</u> Date: <u>11/30/2004</u>  Norman D. Rohrig, TBD Team Leader</p> <p>Approval: <u>Signature on File</u> Date: <u>12/01/2004</u>  Judson L. Kenoyer, Task 3 Manager</p> <p>Concurrence: <u>Signature on File</u> Date: <u>11/30/2004</u>  Richard E. Toohey, Project Director</p> <p>Approval: <u>Signature on File</u> Date: <u>12/01/2004</u>  James W. Neton, Associate Director for Science</p>	<p>Supersedes:</p> <p style="text-align: center;">None</p>

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**RECORD OF ISSUE/REVISIONS**

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Draft	11/29/2004	00-B	Incorporates NIOSH review comments. Initiated by Norman D. Rohrig.
12/01/2004	12/01/2004	00	First approved issue. Initiated by Norman D. Rohrig.

## ACRONYMS

ANL-W	Argonne National Laboratory-West
EEOICPA	Energy Employees Occupational Illness Compensation Program Act of 2000
INEEL	Idaho National Engineering and Environmental Laboratory
MDA	minimum detectable activity
NIOSH	National Institute for Occupational Safety and Health
TBD	Technical Basis Document
U.S.C.	United States Code

## 1.0 INTRODUCTION

Technical Basis Documents (TBDs) and Site Profile Documents 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 about the affected site(s). These documents may be used to assist the National Institute for Occupational Safety and Health (NIOSH) 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 mean an “atomic weapons employer facility” or a “Department of Energy facility” as defined in the Energy Employees Occupational Illness Compensation Program Act of 2000 [EEOICPA; 42 U.S.C. § 7384l(5) and (12)].

This Site Profile documents historical practices at the Argonne National Laboratory – West (ANL-W) and provides information for the evaluation of both internal and external dosimetry data for unmonitored and monitored workers; the document can serve as a supplement to, or substitute for, individual monitoring data. This document provides a profile of ANL-W that contains technical basis information for the evaluation of the total occupational radiation dose for EEOICPA claimants.

### 1.1 PURPOSE

This Site Profile provides supporting technical data for the evaluation, with claimant-favorable assumptions, of the total radiation dose that can reasonably be associated with a worker’s ANL-W occupational radiation exposure. This dose results from exposure to external and internal radiation sources in ANL-W facilities, from ANL-W occupationally required diagnostic X-ray examinations, and from exposure to onsite environmental releases. The discussions include doses that could have occurred while the worker was not monitored or that dosimetry programs could have missed. Since ANL-W began operations, the development of newer and more reliable scientific methods and protection measures has led to changes in radiation detection ability and recording practices. This Site Profile provides the methods to account for these changes.

The doses are evaluated using the NIOSH Interactive RadioEpidemiological Program and the Integrated Modules for Bioassay Analysis program. This document describes the uncertainty evaluation for ANL-W exposure and dose records, which is an integral component of the NIOSH approach to dose reconstruction.

### 1.2 SCOPE

The Site Profile consists of this Introduction and five major TBDs: Site Description, Occupational Medical Dose, Occupational Environmental Dose, Occupational Internal Dose, and Occupational External Dosimetry.

#### **Site Description**

The Site Description TBD (ORAU 2004a) briefly describes the facilities and processes at ANL-W since the early 1950s. The ANL-W site is a part of the Idaho National Engineering and Environmental Laboratory (INEEL) site. INEEL is about 50 miles west of Idaho Falls, Idaho, in the Arco desert and covers about 890 square miles. ANL-W developed and operated reactors at two locations: One south of the INEEL Central Facilities Area (CFA) and one presently at the east edge of the site. The present site is about 35 miles west of Idaho Falls and covers about 900 acres. The Site Description TBD provides information about the facilities at ANL-W and identifies unusual events.

### Occupational Medical Dose

The Occupational Medical Dose TBD (ORAU 2004b) provides information about the dose that individual workers received from X-rays required as a condition of employment. These X-rays included preemployment and chest X-rays during periodic physical exams. The frequency of required X-rays varied over time and as a function of worker age. Both the X-ray equipment and the techniques for taking X-rays have changed over the years covered by this TBD. 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 used, claimant-favorable assumptions have been made to ensure that the dose is not underestimated. Important parameters include the tube current and voltage, exposure time, source-to-skin distance, and the view (posterior–anterior or lateral). This TBD provides the calculated doses to other exposed organs from the chest X-ray. The calculated dose accounts for the uncertainty associated with each of the parameters. Tables list the various organ doses for convenient reference by the dose reconstructors.

### Occupational Environmental Dose

The Occupational Environmental Dose TBD (ORAU 2004c) discusses the maximum dose to the whole body and organs that workers could have received when working outside the buildings at the ANL-W. This dose could be the result of inhalation of radioactive materials in the atmosphere, direct radiation from effluent plumes, and direct exposure to radionuclides that could have become incorporated into the soil.

The radionuclide concentrations at the 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. A screening process using dose conversion factors from the International Commission on Radiological Protection demonstrates that, of the 56 radionuclides on the annual effluent list, 9 radionuclides ( $^{144}\text{Ce}$ ,  $^{131}\text{I}$ ,  $^{147}\text{Pm}$ ,  $^{238}\text{Pu}$ ,  $^{239/240}\text{Pu}$ ,  $^{106}\text{Ru}$ ,  $^{89}\text{Sr}$ ,  $^{90}\text{Sr}$ , and  $^{91}\text{Y}$ ) contribute about 95% of the total internal dose. This TBD provides calculated annual intakes of these radionuclides based on standard breathing rates and exposure times.

Measurement of direct gamma values at the ANL-W facility fence provides annual external whole-body dose to workers from ambient radiation and from submersion in the annual radioactive material concentration.

### Occupational Internal Dose

The Occupational Internal Dose TBD (ORAU 2004d) discusses the internal dosimetry program at ANL-W.

This TBD contains a comprehensive default table to guide internal dose reconstruction in cases with minimal data. In addition, the TBD discusses the *in vivo* and *in vitro* minimum detectable activities (MDAs), the analytical methods, and the reporting protocols for the radionuclides at ANL-W. These parameters varied somewhat over the years for each of the radionuclides, but the capabilities were relatively consistent through the history of the site. The primary radionuclides of concern are those associated with spent high-enriched fuels: Mixed fission products, mixed activation products, plutonium (with a predominance of  $^{238}\text{Pu}$ ), americium, and uranium (both high-enriched and depleted).

This TBD describes information for reconstruction for workers with no confirmed intakes but who could have been exposed, in the early days, in circumstances in which monitoring did not occur, or for monitored readings below the detection limits. The document discusses methods for the evaluation of these potential doses and provides additional data for the evaluation of the worst-case scenario and for unmonitored workers.

**Occupational External Dosimetry**

The Occupational External Dosimetry TBD (ORAU 2004e) discusses the program for measuring skin and whole-body doses to the workers. This document describes the dose reconstruction parameters, practices, and policies, and the dosimeter types and technology for measuring the dose from the different types of radiation. Discussion includes evaluation of doses measured from exposure to beta, gamma, and neutron radiation. Tables provide test results for various dosimeters exposed to different exposure geometries, radiation types, and energies. This TBD provides detailed discussion of sources of bias, workplace radiation field characteristics, responses of the different beta/gamma and neutron dosimeters in the workplace fields, and the adjustments to the recorded dose measured by these dosimeters during specific years.

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

**REFERENCES**

- ORAU (Oak Ridge Associated Universities), 2004a, *Technical Basis Document for the Argonne National Laboratory - West – Site Description*, ORAUT-TKBS-0026-2, Oak Ridge, Tennessee.
- ORAU (Oak Ridge Associated Universities), 2004b, *Technical Basis Document for the Argonne National Laboratory - West – Occupational Medical Dose*, ORAUT-TKBS-0026-3, Oak Ridge, Tennessee.
- ORAU (Oak Ridge Associated Universities), 2004c, *Technical Basis Document for the Argonne National Laboratory - West – Occupational Environmental Dose*, ORAUT-TKBS-0026-4, Oak Ridge, Tennessee.
- ORAU (Oak Ridge Associated Universities), 2004d, *Technical Basis Document for the Argonne National Laboratory - West – Occupational Internal Dose*, ORAUT-TKBS-0026-5, Oak Ridge, Tennessee.
- ORAU (Oak Ridge Associated Universities), 2004e, *Technical Basis Document for the Argonne National Laboratory - West – Occupational External Dosimetry*, ORAUT-TKBS-0026-6, Oak Ridge, Tennessee.