

<p>ORAU Team NIOSH Dose Reconstruction Project</p> <p>Technical Basis Document for INEEL – Introduction</p>	<p>Document Number: ORAUT-TKBS-0007-1 Effective Date: 05/07/2004 Revision No.: 00 Controlled Copy No.: _____ Page 1 of 7</p>
<p>Subject Expert: Norman Rohrig</p> <p>Document Owner:</p> <p>Approval: <u>Signature on File</u> _____ Date: <u>04/27/2004</u> Norman Rohrig, TBD Team Leader</p> <p>Approval: <u>Signature on File</u> _____ Date: <u>04/26/2004</u> Judson L. Kenoyer, Task 3 Manager</p> <p>Concurrence: <u>Signature on File</u> _____ Date: <u>04/26/2004</u> Richard E. Toohey, Project Director</p> <p>Approval: <u>Signature on File</u> _____ Date: <u>05/07/2004</u> James W. Neton, OCAS Health Science Administrator</p>	<p>Supersedes:</p> <p style="text-align: center;">None</p>

TABLE OF CONTENTS

Record of Issue/Revisions 2

Acronyms 3

1.0 Introduction and Purpose 4

1.1 Scope 4

References 7

RECORD OF ISSUE/REVISIONS

ISSUE AUTHORIZATION DATE	EFFECTIVE DATE	REV. NO.	DESCRIPTION
Draft	03/09/2004	00-A	New draft document for INEEL Introduction. Initiated by Norman Rohrig.
Draft	04/13/2004	00-B	Incorporates responses to OCAS comments. Initiated by Norman Rohrig.
05/07/2004	05/07/2004	00	First approved issue. Initiated by Norman Rohrig.

ACRONYMS

CFA	Central Facilities Area
EEOICPA	Energy Employees Occupational Illness Compensation Program Act of 2000
INEEL	Idaho National Engineering and Environmental Laboratory
MDA	minimum detectable activity
NIOSH	National Institute of Occupational Safety and Health
ORAU	Oak Ridge Associated Universities
TAN	Test Area North
TBD	Technical Basis Document
U.S.C.	United States Code

1.0 INTRODUCTION AND PURPOSE

The Energy Employees Occupational Illness Compensation Program Act of 2000 (EEOICPA), provides for compensation of workers (or their survivors) who have developed selected types of cancer if radiation is judged more likely than not to have caused the cancer. The Act requires determination of radiological doses from ionizing radiation received by workers in the U.S. Department of Energy and its predecessor agencies (the U.S. Atomic Energy Commission and the Energy Research and Development Agency).

This Site Profile documents historical practices at the Idaho National Engineering and Environmental Laboratory (INEEL) site and can be used to evaluate both internal and external dosimetry data for unmonitored and monitored workers and serve as a supplement to individual monitoring data. This document provides a site profile of the INEEL that contains technical basis information to be used to evaluate the total occupational radiation dose for EEOICPA claimants.

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 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 EEOICPA (42 U.S.C. 7384l (5) and (12)).

This Site Profile provides supporting technical data to evaluate the total INEEL occupational radiation dose that may reasonably be associated with the worker's radiation exposure. This dose results from exposure to external and internal radiation sources in INEEL facilities, to INEEL occupationally required diagnostic X-ray examinations, and to onsite environmental releases. The discussions include doses that could have occurred while the worker was not monitored or that could have been missed. Over the years new and more reliable scientific methods and protection measures have been developed. The methods needed to account for these changes are identified in this document.

The doses are evaluated using the NIOSH Interactive RadioEpidemiological Program and the Integrated Modules for Bioassay Analysis computer program. Information on measurement uncertainties is an integral component of the NIOSH approach. This document describes the uncertainty evaluation for INEEL exposure and dose records.

1.1 SCOPE

The Site Profile comprises six major TBDs: this Introduction, Site Description, Occupational Medical Dose, Occupational Environmental Dose, Occupational Internal Dose, and Occupational External Dosimetry.

Site Description

The Site Description TBD (ORAU 2003) briefly describes the facilities and processes at INEEL since the early 1950s. The INEEL site, about 50 miles west of Idaho Falls in the Arco desert, covers about 890 square miles. Many additional offices and a few laboratories have been located in Idaho Falls. Previous names for the INEEL site were the National Reactor Testing Station and the Idaho National Engineering Laboratory.

The Central Facilities Area (CFA) was a Navy gunnery testing facility and now provides support facilities, central services, and some laboratories. Radioactive wastes from the site and from the Rocky Flats Environmental Testing Station are handled and stored at the Radioactive Waste Management Complex. Argonne National Laboratory-West developed and operated reactors at two locations south of CFA and at the east edge of the site. High-enrichment uranium spent fuel was reprocessed at the Idaho Chemical Processing Plant, and the resultant high-level waste was processed there. 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. The Loss of Fluid Test program was later conducted there. 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 various reactors and was the site of an accident at Stationary Low-Power Reactor No. 1.

The site description TBD provides information about the facilities and identifies unusual events that took place at the INEEL facilities.

Occupational Medical Dose

The Occupational Medical Dose TBD (ORAU 2004a) provides information about the dose that individual workers received from X-rays that were required as a condition of employment. These X-rays included pre-employment and chest X-rays during 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 used 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 has not been underestimated. Important parameters include the tube current and voltage, exposure time, source to skin distance, and the view (posterior-anterior or lateral). The doses to other exposed organs from the chest X-ray have been calculated. The uncertainty on the calculated dose takes into account the uncertainty associated with each of the parameters mentioned above. Tables list the doses received by the various organs in the body for convenient reference by the dose reconstructors.

Occupational Environmental Dose

The Occupational Environmental Dose TBD (ORAU 2004b) is the maximum dose to the whole body and organs that workers could have received when working outside the buildings at a given site at the INEEL from inhalation of radioactive materials in the atmosphere, from direct radiation from effluent plumes, and from direct exposure to radionuclides that may have become incorporated into the soil.

The radionuclide concentrations at INEEL site 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 assigned to the annual effluent list, 9 radionuclides (^{144}Ce , ^{131}I , ^{147}Pm , ^{238}Pu , $^{239/240}\text{Pu}$, ^{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 INEEL facility fence.

Occupational Internal Dose

The Occupational Internal Dose TBD (ORAU 2004c) discusses the internal dosimetry program at INEEL.

This TBD contains a comprehensive default table to guide internal dose reconstruction in cases with minimal data. In addition, the TBD discusses the *in vitro* minimum detectable activities (MDAs), the analytical methods, and the reporting protocols for the radionuclides at INEEL. As expected, these parameters varied somewhat over the years for each of the radionuclides evaluated, although 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 (from a variety of reactor types), mixed activation products, plutonium (with a predominance of ²³⁸Pu), americium, and uranium (both high-enriched and depleted). This TBD discusses the *in vivo* MDAs, the analytical methods, and the reporting protocols for the X- and gamma-ray emitting radionuclides.

This TBD presents information for workers with no confirmed intakes, but who could have been exposed in the early days, in circumstances in which monitoring programs were not required, or for monitored readings below the 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 (ORAU 2004d) discusses the program for measuring skin and whole body doses to the workers. This document describes the dose reconstruction parameters, practices and policies, and 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. 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 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 the external dosimetry technical basis parameters to facilitate the efforts of the dose reconstructors.

REFERENCES

ORAU (Oak Ridge Associate Universities), 2003, *Technical Basis Document for the Idaho National Engineering and Environmental Laboratory (INEEL) – Site Profile*, ORAUT-TKBS-0007-2, Revision 0, Oak Ridge, Tennessee.

ORAU (Oak Ridge Associate Universities), 2004a, *Technical Basis Document for the Idaho National Engineering and Environmental Laboratory (INEEL) – Occupational Medical Dose*, ORAUT-TKBS-0007-3, Revision 0, Oak Ridge, Tennessee.

ORAU (Oak Ridge Associate Universities), 2004b, *Technical Basis Document for the Idaho National Engineering and Environmental Laboratory (INEEL) – Occupational Environmental Dose*, ORAUT-TKBS-0007-4, Revision 0, Oak Ridge, Tennessee.

ORAU (Oak Ridge Associate Universities), 2004c, *Technical Basis Document for the Idaho National Engineering and Environmental Laboratory (INEEL) – Occupational Internal Dose*, ORAUT-TKBS-0007-5, Revision 0, Oak Ridge, Tennessee.

ORAU (Oak Ridge Associate Universities), 2004d, *Technical Basis Document for the Idaho National Engineering and Environmental Laboratory (INEEL) – Occupational External Dosimetry*, ORAUT-TKBS-0007-6, Revision 0, Oak Ridge, Tennessee.