Document Title:	Document Number:	ORAUT-TKBS-0011-1
Rocky Flats Plant – Introduction	Revision:	01
	Effective Date:	11/30/2006
	Type of Document:	TBD
	Supersedes:	Revision 00

Subject Experts: Craig A. Little and Robert Meyer

Approval:	Signature on File Robert Meyer, Document Owner	Approval Date:	11/15/2006
Approval:	Signature on File John M. Byrne, Task 3 Manager	Approval Date:	11/15/2006
Concurrence:	Signature on File Edward F. Maher, Task 5 Manager	Concurrence Date:	11/15/2006
Concurrence:	Signature on File James P. Griffin, Deputy Project Director	Concurrence Date:	11/16/2006
Approval:	Brant A. Ulsh Signature on File for James W. Neton, Associate Director for Science	Approval Date:	11/30/2006

☐ New ☒ Total Rewrite ☐ Revision ☐ Page Change

FOR DOCUMENTS MARKED AS A TOTAL REWRITE, REVISION, OR PAGE CHANGE, REPLACE THE PRIOR REVISION AND DISCARD / DESTROY ALL COPIES OF THE PRIOR REVISION.

PUBLICATION RECORD

EFFECTIVE DATE	REVISION NUMBER	DESCRIPTION
04/20/2004	00	New technical basis document for the Rocky Flats Plant – Introduction. First approved issue. Initiated by Robert Meyer.
11/30/2006	01	Approved Revision 01 to incorporate responses to union comments. Added Section 1.2, Attributions and Annotations. Constitutes a total rewrite of the document. Incorporates internal 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 Robert Meyer.

TABLE OF CONTENTS

ACRONYMS AND ABBREVIATIONS

DOE	U. S. Department of Energy
EEOICPA	Energy Employees Occupational Illness Compensation Program Act of 2000
IREP	Interactive RadioEpidemiological Program
IMBA	Integrated Modules for Bioassay Analysis
MDA	minimum detectable activity
NIOSH	National Institute for Occupational Safety and Health
POC	probability of causation
RFP	Rocky Flats Plant
TBD	technical basis document
U.S.C.	United States Code
§	section or sections

1.1 PURPOSE

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) define "performance of duty" for DOE employees with a covered cancer or restrict the "duty" to nuclear weapons work.

As noted above, the statute 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 contains an exclusion with respect to the Naval Nuclear Propulsion Program, 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 dosimetry monitoring results are considered valid for use in 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:

- Radiation from naturally occurring radon present in conventional structures
- Radiation from diagnostic X-rays received in the treatment of work-related injuries

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

This Site Profile provides specific information about documentation of historical practices at the Rocky Flats Plant (RFP). Dose reconstructors can use this Site Profile to evaluate internal and external dosimetry data for unmonitored and monitored workers and to serve as a supplement to, or substitute for, individual monitoring data. This document contains technical basis information the Oak Ridge Associated Universities (ORAUT) Team can use to evaluate the total occupational radiation dose for EEOICPA claimants.

This document also provides supporting technical data to evaluate, with assumptions that are favorable to claimants, the total RFP occupational radiation dose that can reasonably be associated with a worker's radiation exposure. This dose results from exposure to external and internal radiation sources in RFP facilities, occupationally required diagnostic X-ray examinations, and onsite environmental releases.

Doses are evaluated using the NIOSH Interactive RadioEpidemiological Program (IREP) and Integrated Modules for Bioassay Analysis (IMBA) computer programs. Information on measurement uncertainties is an integral component of the NIOSH approach. This document describes the evaluation of uncertainty for RFP exposure and dose records.

1.2 SCOPE

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

The Site Description TBD (ORAUT 2004a) describes RFP facilities and processes used in the development of nuclear weapons. RFP operations played an important role in the U.S. nuclear weapons program; these operations included production of weapons components. This TBD contains documentation to assist in the evaluation of worker dose from RFP operations and processes.

In March 1951, the U.S. Atomic Energy Commission announced its decision to build RFP in Colorado, and groundbreaking occurred in July 1951. From the beginning, the Plant was a manufacturing facility. The primary mission and general activities at the Plant remained essentially the same from the time it opened until 1989, when DOE suspended plutonium operations. RFP had two major missions – production of plutonium triggers (or *pits*) for nuclear weapons, and processing of weapons for plutonium recovery. Early designs that were solid units made mostly of uranium gave way to a plutonium pit design in the mid-1950s. Plutonium pits or triggers are components of fission bombs, and can be used to initiate the fusion reaction in hydrogen bombs. Plutonium was received from the DOE Savannah River and Hanford sites and from retired warheads and residues.

Parts were formed and machined from plutonium, uranium, beryllium, stainless steel, and other materials. Plutonium and uranium recovery and waste handling facilities were present on the site to handle radioactive wastes produced in these processes.

The Occupational Medical Dose TBD (ORAUT 2004b) provides information about doses received by individual workers from X-rays that were required as a condition of employment. Entrance, exit, and periodic physical examinations were performed on all employees as part of the requirements for employment at RFP. These examinations could include radiographic examinations of the lungs and, for some employees, possible radiographs of the lumbar spine.

Doses to exposed organs from the chest X-rays have also been calculated. The calculated dose takes into account the uncertainty associated with machine type, examination frequency, and job

classification. This TBD contains tables of the doses received by the various organs in the body for convenient reference by dose reconstructors.

Occupational environmental dose (described in ORAUT 2004c) is the dose workers receive when working outside buildings, from inhalation of or direct exposure to radioactive materials in the air, and from direct exposure to radionuclides incorporated in the soil.

Internal dose can result from inhalation of radioactive materials, and whole- or partial-body external dose can result from deposited radionuclides or submersion in a cloud of radioactive material. Although plutonium ($^{239/240}$Pu, ^{241}Pu) is the primary material of concern for offsite exposures, tritium, natural thorium, enriched uranium, depleted uranium, and ^{241}Am were other radionuclides of possible concern identified in historical exposure studies of the public.

External doses to workers from onsite ambient radiation levels are determined from measurements reported in and estimated from site annual environmental reports.

The Occupational Internal Dosimetry TBD (ORAUT 2005) discusses the RFP internal dosimetry program and develops estimates of potential intakes. Workers at RFP had the potential to take in plutonium, americium, enriched uranium, and depleted uranium, as well as smaller quantities of other radionuclides. This TBD describes available source term information including isotopic composition, solubility, and particle size (where applicable) for plutonium, americium, enriched uranium, depleted uranium, and other radionuclides. Site-specific internal dosimetry information for other radionuclides such as tritium, thorium, curium, and neptunium is very limited.

The primary modes of intake have been chronic or acute inhalation, or via breaks in the skin (wounds). Urinalyses provide data reflecting such intakes. Lung counts provide estimates of radionuclide quantities present in the lungs. The TBD discusses these two data sets in detail, including history, sensitivity, and pertinent methods.

The internal exposure record for a specific worker consists of bioassay data and reports of involvement in incidents, accidents, or special situations. The TBD contains samples of records and reports that provide explanations of terms important to dosimetry.

The TBD discusses minimum detectable activities (MDAs), analytical methods, and reporting protocols in relation to urinalysis methods for the radionuclides encountered at RFP. Those parameters changed over the years for each radionuclide. The TBD discusses details of these variables.

The TBD also discusses MDAs, analytical methods, and reporting protocols for *in vivo* lung counts for X- and gamma-emitting radionuclides. The *in vivo* measurement equipment and techniques, which were developed in the late 1950s, have been in regular use at RFP since 1964. The TBD contains a discussion of the lung counter systems including ^{241}Am-specific MDAs and reporting levels for the various periods during which these parameters changed. It provides detailed information to assist dose reconstructors in interpreting data encountered in worker records.

The Occupational External Dosimetry TBD (ORAUT 2004d) describes the methods, concepts, and evolution of systems for measuring occupational external dose to workers. It provides supporting technical data to evaluate, with assumptions that are favorable to claimants, external RFP occupational doses associated with worker radiation exposures covered under the EEOICPA. These doses include occupational external exposures in RFP facilities and onsite exposures to RFP environmental releases. The TBD evaluates unmonitored and monitored worker exposure and

missed dose. Consistent with NIOSH implementation guidelines, it provides guidance on the adjustment of occupational external recorded dose in light of the best information available.

1.3 ATTRIBUTIONS AND ANNOTATIONS

None.

REFERENCES

ORAUT (Oak Ridge Associated Universities Team), 2004a, *Technical Basis Document for the Rocky Flats Plant – Site Description*, ORAUT-TKBS-0011-2, Rev. 00, Oak Ridge, Tennessee, January 10.

ORAUT (Oak Ridge Associated Universities Team), 2004b, *Technical Basis Document for the Rocky Flats Plant – Occupational Medical Dose*, ORAUT-TKBS-0011-3, Rev. 00, Oak Ridge, Tennessee, February 9.

ORAUT (Oak Ridge Associated Universities Team), 2004c, *Technical Basis Document for the Rocky Flats Plant – Occupational Environmental Dose*, ORAUT-TKBS-0011-4, Rev. 01, Oak Ridge, Tennessee, June 29.

ORAUT (Oak Ridge Associated Universities Team), 2004d, *Technical Basis Document for Rocky Flats Plant – Occupational External Dosimetry*, ORAUT-TKBS-0011-6, Rev. 00, Oak Ridge, Tennessee, January 20.

ORAUT (Oak Ridge Associated Universities Team), 2005, *Technical Basis Document for the Rocky Flats Plant – Occupational Internal Dose*, ORAUT-TKBS-0011-5, Rev. 00 PC-1, Oak Ridge, Tennessee, December 13.