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PUBLICATION RECORD

EFFECTIVE DATE	REVISION NUMBER	DESCRIPTION
01/06/2004	00	New Technical Basis Document for the K-25 Site – Introduction. First approved issue. Initiated by Joseph Alvarez.
05/04/2006	01	Incorporates introductory language from NIOSH. Updates document for biennial review. No further changes resulted as a result of formal internal review. Incorporates NIOSH formal review comments. Approved issue of Revision 01. Training required: As determined by the Task Manager. Initiated by Jay J. Maisler.

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ACRONYMS AND ABBREVIATIONS

DOE	U.S. Department of Energy
EEOICPA	Energy Employees Occupational Illness Compensation Program Act
NIOSH	National Institute for Occupational Safety and Health
TBD	technical basis document
U.S.C.	United States Code

1.1 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 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 [probability of causation] 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 the facility 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.

1.1.1 Purpose

This Site Profile can be a tool when performing dose reconstructions for K-25 workers. The Integrated Modules for Bioassay Analysis (IMBA) computer code is a tool useful for internal dose calculations. Information on measurement uncertainties is an integral component of the NIOSH approach. This document describes how to evaluate uncertainty associated with K-25 exposure and dosimetry records.

1.1.2 Scope

The Site Profile is divided into five major sections: Site Description, Occupational Medical Dose, Occupational Environmental Dose, Occupational Internal Dose, and Occupational External Dosimetry, in addition to this Introduction.

1.2 SITE DESCRIPTION

The Site Description TBD (ORAU-TKBS-0009-2) contains a brief description of the facilities and processes used in the processing of uranium. The K-25 Site processed thousands of tons of uranium through diffusion cascades for more than 40 years beginning in February 1945. The vast majority was natural uranium from ore, but some was recycled material obtained from spent reactor fuel.

1.3 OCCUPATIONAL MEDICAL DOSE

The Occupational Medical Dose TBD (ORAU-TKBS-0009-3) provides information about the dose that individual workers received from X-rays that were required as a condition of employment. These included preemployment X-rays, annual chest X-rays during physical examinations, and health monitoring X-rays to determine the effects of inhalation of uranium. The frequency of required X-rays varied over time. All radiation workers received annual chest X-rays from 1944 through 1980, and every 5 years after 1980. Nonradiation workers received annual chest X-rays until 1960, but none after 1960. Workers with a potential to inhale uranium dust might have had X-rays as frequently as monthly in 1944 and 1945, and bimonthly from 1946 to 1959.

X-ray equipment and the techniques used for taking X-rays have changed over the years covered by this Site Profile. These factors were considered in estimating the dose that a worker would have received from the X-ray. Favorable assumptions were made to ensure that there was no underestimation of the worker's dose if there was a doubt about the technique used. The parameters included tube current and voltage, exposure time, filtration, source-to-skin distance, view (posterior-anterior or lateral), and any other factor that could affect the dose the worker received.

Doses to exposed organs from the chest X-ray have been calculated. The calculated dose considers the uncertainty associated with each of the parameters mentioned above. The doses received by the organs in the body are listed in tables for convenient reference for dose reconstruction.

1.4 OCCUPATIONAL ENVIRONMENTAL DOSE

The Occupational Environmental Dose TBD (ORAU-TKBS-0009-4) applies to workers who were not monitored for external or internal radiation exposure. Workers received an environmental dose when working outside buildings on the site from inhalation of radioactive materials in the air, direct radiation from plumes, contact with particles on the skin, and direct exposure to radionuclides incorporated in the soil.

Inhalation of environmental radionuclides results in internal dose to the whole body or body organs. Whole- or partial-body external dose results from deposited radionuclides or submersion in a cloud of radioactive material.

The internal dose for workers outside facilities was determined from air concentrations resulting from releases from stacks, individual building releases, and the purge cascade and other operations at K-25. Unmonitored workers could have been exposed to occupational doses internally from onsite releases to the air.

The air concentration of radionuclides was determined using use well-documented source terms developed for the Oak Ridge Dose Reconstruction (Burmeister 1996, 1997a,b) coupled with documented environmental monitoring data to estimate radionuclide-specific airborne concentrations for $^{234, 235, 238}U$, $^{238, 239, 240, 241, 242}Pu$, ^{237}Np, and ^{99}Tc (Shonka 2003). These radionuclides were determined to account for most of the potential missed dose from the inhalation and submersion pathways.

External doses to workers from onsite ambient radiation levels and from submersion in a cloud of radioactive material were estimated from onsite environmental dosimeters.

1.5 OCCUPATIONAL INTERNAL DOSE

The Occupational Internal Dosimetry TBD (ORAU-TKBS-0009-5) describes the internal dosimetry program at K-25. A bioassay program based on urinalysis for uranium started when K-25 began processing uranium. Urinalysis techniques used over the years followed the technology development for uranium detection. Urinalysis was preferred over *in vivo* techniques because *in vivo* minimum detectable activities were relatively high and thus of limited use for detecting uranium intakes. The processing of recycled uranium from spent reactor fuel introduced other radionuclides to K-25, in particular plutonium, americium, curium, neptunium, and ^{99}Tc. These radionuclides were also best analyzed in urine. In general, the fraction of dose from these radionuclides in relation to uranium was very small and usually immeasurable if the uranium dose was small.

This TBD discusses interferences that might be encountered in the collection and analysis of bioassay samples and uncertainties in the bioassay measurements. It presents information that might be useful in estimating possible missed doses due to monitoring practices that were inadequate in comparison to modern standards. It also presents methods for evaluating potential doses that might fall in this category.

1.6 OCCUPATIONAL EXTERNAL DOSE

The Occupational External Dosimetry Program TBD (ORAUT-TKBS-0009-6) discusses the program for measuring skin and whole-body doses to workers. It develops methods for evaluating external doses to workers that evolved as new techniques and equipment. Techniques changed as concepts in radiation protection changed. This TBD discusses dose reconstruction parameters, K-25 practices and policies, and dosimeter types and technology for measuring the doses from different types of radiation. It also discusses the evaluation of doses measured from exposure to beta, gamma, and neutron radiation.

This TBD discusses sources of bias, workplace radiation field characteristics, responses of different beta/gamma and neutron dosimeters in workplace fields, and adjustments to the recorded dose measured by dosimeters in specific years.

Some sources of potential dose could be missed because of the limitations of dosimetry systems and the methods of reporting low doses. This TBD discusses missed dose as a function of dosimeter type, year, and type of radiation.

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