Reference Guide for

An Overview of the Dose Reconstruction Process

February 2009

Table of Contents

1 Introduction

In July 2001, the Department of Labor (DOL) began administering Part B of the Energy Employees Occupational Illness Compensation Program Act (EEOICPA). For all cases where cancer was claimed, the case file was perused to see if the employee fell into the a special class for Special Exposure Cohort (SEC) as defined under by the Health and Human Services' National Institute for Occupational Safety and Health (NIOSH). If not, the case was then forwarded to NIOSH for a dose reconstruction to determine if the employee's cancer was at least as likely as not (50 percent or greater) caused by exposure to radiation during covered employment (as defined under the EEOICPA.

Since the inception of this program, NIOSH has modified their processes. These changes have impacted the dose reconstruction process and DOL's procedures. Previously denied claims have had to be reopened and returned to NIOSH for new dose reconstructions.

2 Purpose

The purpose of this training is to provide guidance to claims examiners on the dose reconstruction process, address changes in policy reflected in bulletins and circulars for Program Evaluation Reports (PERs) and Program Evaluation Plans (PEPs), and to discuss the new classes added to Special Exposure Cohort status.

3 Goal

Upon conclusion of this training, the claims examiner should be able to

- understand the parts of a dose reconstruction
- know what parts to review for accuracy relating to employee demographics
- know whether the dose reconstruction was a best estimate, overestimate, or underestimate
- know why when more cancers are added to an "overestimate" , it is no unusual for the POC to decrease
- know where in a dose reconstruction report to find language concerning site related Program Evaluation Reports or Program Evaluation Plans
- understand how to read a IREP report
- understand purpose of the OCAS-1 form
- know what a CATI is

4 Radiation

(The following was taken from the Health Physics Society web page at: http://hps.org/publicinformation/ate/faqs/radiation.html as noted in the footnote)

Radiation is energy that comes from a source and travels through space and may be able to penetrate various materials. Light, radio, and microwaves are types of radiation that are called nonionizing. The kind of radiation discussed in this document is called ***ionizing radiation*** because it can produce charged particles (ions) in matter.

Ionizing radiation is produced by unstable atoms. Unstable atoms differ from stable atoms because unstable atoms have an excess of energy or mass or both. Radiation can also be produced by high-voltage devices (e.g., x-ray machines).

Unstable atoms are said to be ***radioactive***. In order to reach stability, these atoms give off, or emit, the excess energy or mass. These emissions are called ***radiation***. The kinds of radiation are electromagnetic (like light) and particulate (i.e., mass given off with the energy of motion). Gamma radiation and x rays are examples of electromagnetic radiation. Gamma radiation originates in the nucleus while x rays come from the electronic part of the atom. Beta and alpha radiation are examples of particulate radiation.

Interestingly, there is a "***background***" of natural radiation everywhere in our environment. It comes from space (i.e., cosmic rays) and from naturally occurring radioactive materials contained in the earth and in living things.

4.1 Radiation Exposure from Various Sources

Source	Exposure
External Background Radiation	60 mrem/yr, US Average
Natural K-40 and Other Radioactivity in Body	40 mrem/yr
Air Travel Round Trip (NY-LA)	5 mrem
Chest X-Ray Effective Dose	10 mrem per film
Radon in the Home	200 mrem/yr (variable)
Man-Made (medical x rays, etc.)	60 mrem/yr (average)

4.2 What Types of Radiation are there?

The radiation one typically encounters is one of four types: alpha radiation, beta radiation, gamma radiation, and x radiation. Neutron radiation is also encountered in nuclear power plants and high-altitude flight and is emitted from some industrial radioactive sources.

- **Alpha Radiation**
  Alpha radiation is a heavy, very short-range particle and is actually an ejected helium nucleus. Some characteristics of alpha radiation are:

  1. Most alpha radiation is not able to penetrate human skin.
  2. Alpha-emitting materials can be harmful to humans if the materials are inhaled, swallowed, or absorbed through open wounds.
  3. A variety of instruments has been designed to measure alpha radiation. Special training in the use of these instruments is essential for making accurate measurements.
  4. A thin-window Geiger-Mueller (GM) probe can detect the presence of alpha radiation.
  5. Instruments cannot detect alpha radiation through even a thin layer of water, dust, paper, or other material, because alpha radiation is not penetrating.
  6. Alpha radiation travels only a short distance (a few inches) in air, but is not an external hazard.
  7. Alpha radiation is not able to penetrate clothing.

  Examples of some alpha emitters: radium, radon, uranium, thorium.

- **Beta Radiation**
  Beta radiation is a light, short-range particle, and is actually an ejected electron. Some characteristics of beta radiation are:

  1. Beta radiation may travel several feet in air and is moderately penetrating.

  2. Beta radiation can penetrate human skin to the "germinal layer," where new skin cells are produced. If high levels of beta-emitting contaminants are allowed to remain on the skin for a prolonged period of time, they may cause skin injury.
  3. Beta-emitting contaminants may be harmful if deposited internally.
  4. Most beta emitters can be detected with a survey instrument and a thin-window G-M probe (e.g., "pancake" type). Some beta emitters, however, produce very low-energy, poorly penetrating radiation that may be difficult or impossible to detect. Examples of these difficult-to-detect beta emitters are hydrogen-3 (tritium), carbon-14, and sulfur-35.
  5. Clothing provides some protection against beta radiation.

  Examples of some pure beta emitters: strontium-90, carbon-14, tritium, and sulfur-35.

- **Gamma and X Radiation**

  Gamma radiation and x rays are highly penetrating electromagnetic radiation.

Some characteristics of these radiations are:

1. Gamma radiation or x rays are able to travel many feet in air and many inches in human tissue. They readily penetrate most materials and are sometimes called "penetrating" radiation.
2. X rays are like gamma rays. X rays, too, are penetrating radiation. Sealed radioactive sources and machines that emit gamma radiation and x rays respectively constitute mainly an external hazard to humans.
3. Gamma radiation and x rays are electromagnetic radiation like visible light, radiowaves, and ultraviolet light. These electromagnetic radiations differ only in the amount of energy they have. Gamma rays and x rays are the most energetic of these.
4. Dense materials are needed for shielding from gamma radiation. Clothing provides little shielding from penetrating radiation, but will prevent contamination of the skin by gamma-emitting materials.
5. Gamma radiation is easily detected by survey meters with a sodium iodide detector probe.
6. Gamma radiation and/or characteristic x rays frequently accompany the emission of alpha and beta radiation during radioactive decay.

Examples of some gamma emitters: iodine-131, cesium-137, cobalt-60, radium-226, and technetium-99m.

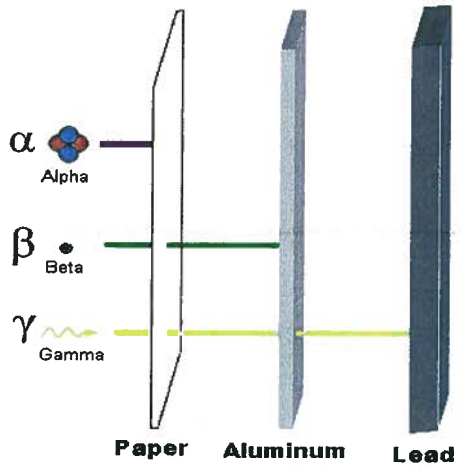


Figure 1 - Types of Radiation[1]

4.3 Radiation Dose

In the United States, ***radiation absorbed dose***, ***dose equivalent,*** and ***exposure*** are often measured and stated in the older units called ***rad***, ***rem***, or ***roentgen (R)***, respectively. For practical purposes with gamma and x rays, these units of measure for

[1] http://en.wikipedia.org/wiki/Radiation

exposure or dose are considered equal. This exposure can be from an external source irradiating the whole body, an extremity, or other organ or tissue resulting in an ***external radiation dose***. Alternately, internally deposited radioactive material may cause an ***internal radiation dose*** to the whole body or other organ or tissue.
Smaller fractions of these measured quantities often have a prefix, e.g., milli (m) means 1/1,000. For example, 1 rad = 1,000 mrad. Micro (μ) means 1/1,000,000. So, 1,000,000 μrad = 1 rad, or 10 μR = 0.000010 R.

The International System of Units (SI) for radiation measurement is now the official system of measurement and uses the "gray" (Gy) and "sievert" (Sv) for absorbed dose and equivalent dose respectively. Conversions are as follows:

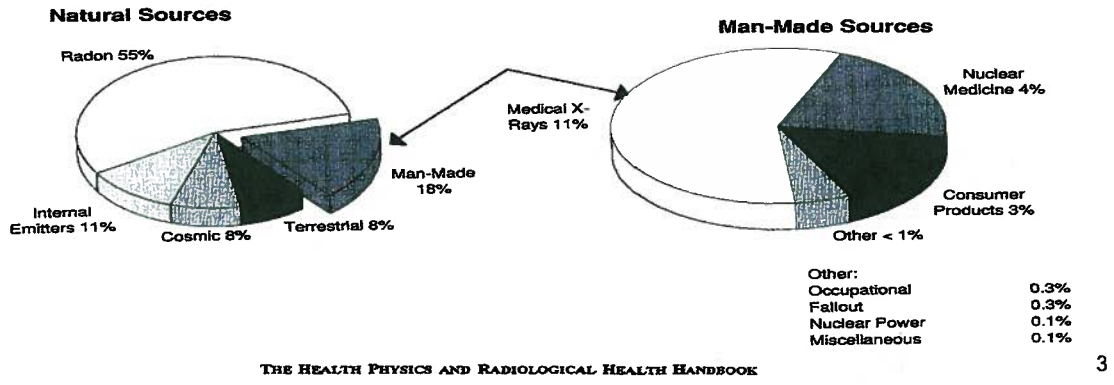
- 1 Gy = 100 rad
- 1 mGy = 100 mrad
- 1 Sv = 100 rem
- 1 mSv = 100 mrem

With radiation counting systems, radioactive transformation events can be measured in units of "disintegrations per minute" (dpm) and, because instruments are not 100% efficient, "counts per minute" (cpm). Background radiation levels are typically less than 10 μR per hour, but due to differences in detector size and efficiency, the cpm reading on fixed monitors and various handheld survey meters will vary considerably.[2]

5 External Radiation Dose

External radiation exposure or dose is received from external exposure from sources external to the body. We receive external dose every day from the sun. We receive external dose when we have x-rays, nuclear medicine, or radiation therapy. Employees covered under the EEOICPA may have been exposed to radiation during the course of their employment.

This diagram below illustrates radiation that naturally occurs in our environment in comparison to radiation that is man-made.



THE HEALTH PHYSICS AND RADIOLOGICAL HEALTH HANDBOOK 3

Figure 2 - US Background Radiation Levels

[2] http://hps.org/publicinformation/ate/faqs/radiation.html

[3] From "The Health Physics and Radiological Health Handbook".

5.1 Acute vs. Chronic External Exposure

- Acute external exposures are short-term exposures. Dose is delivered quickly (minutes to hours).
- Chronic external exposures are continuous exposures. Dose is delivered constantly over a period of time.

5.2 Measuring External Dose - Dosimetry

Dosimetry is a generic term for radiation-exposure or radiation-dose measurement techniques. There are both external and internal dosimetry techniques.

Examples of External dosimetry include:

- Film badges,
- Thermoluminescent Detectors (TLDs),
- Neutron detectors,
- Pocket (pencil) dosimeters

➢ Results are in roentgen (R), rad, or rem depending on era and reporting practices

6 Internal Dose

An internal dose of radiation is the radiation exposure to or dose received from radioactive materials entering the body (intake) via:

- Inhalation
- Ingestion
- Absorption
- Wound / Injection

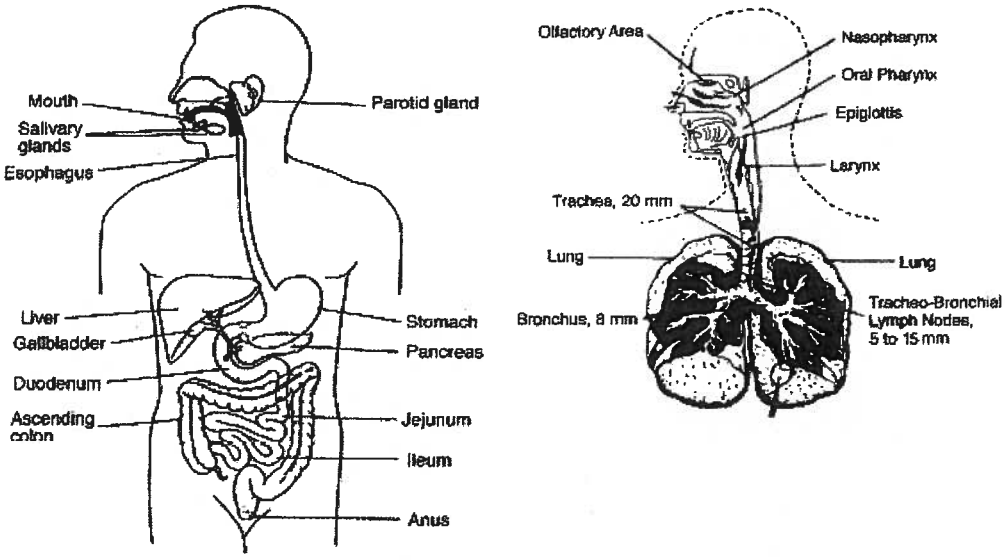


Figure 3 - Ingestion vs. Inhalation

6.1 Measuring Internal Dose - Dosimetry

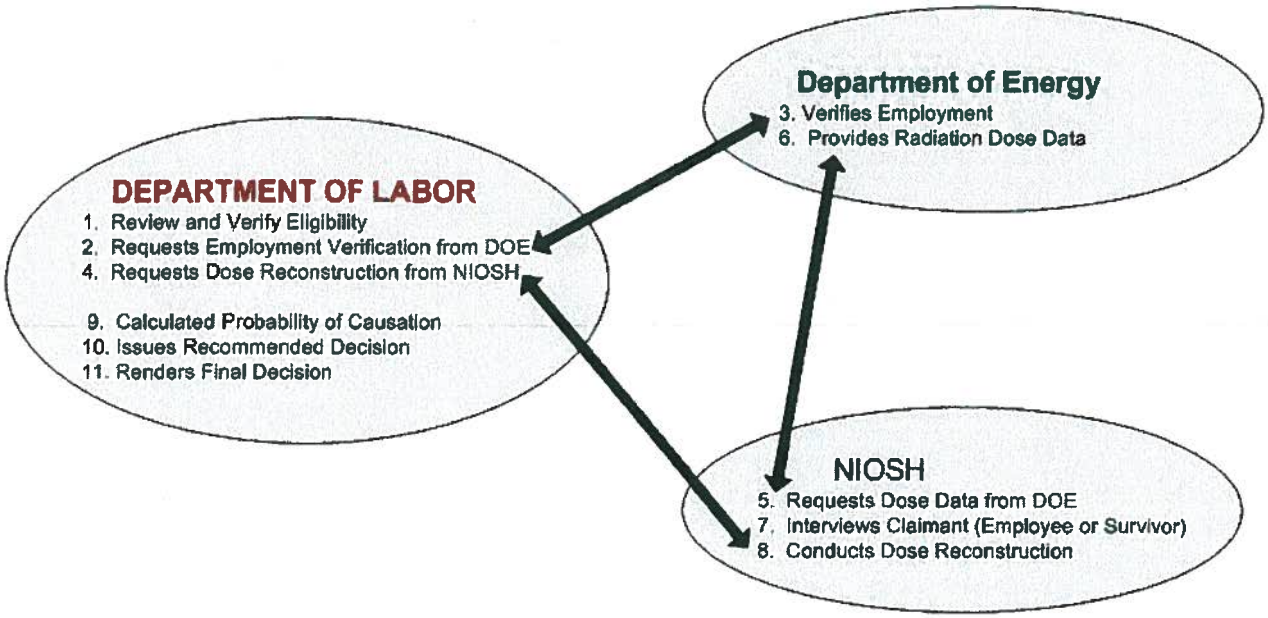
As noted earlier, dosimetry is a generic term for radiation-exposure or radiation-dose measurement techniques. There are both external and internal dosimetry techniques.

Bioassay is the determination of kinds, quantities, or concentrations and, in some cases, the locations of radioactive material in the human body, whether by direct measurement (in vivo counting) or by analysis and evaluation of materials excreted or removed (*in vitro*) from the human body.

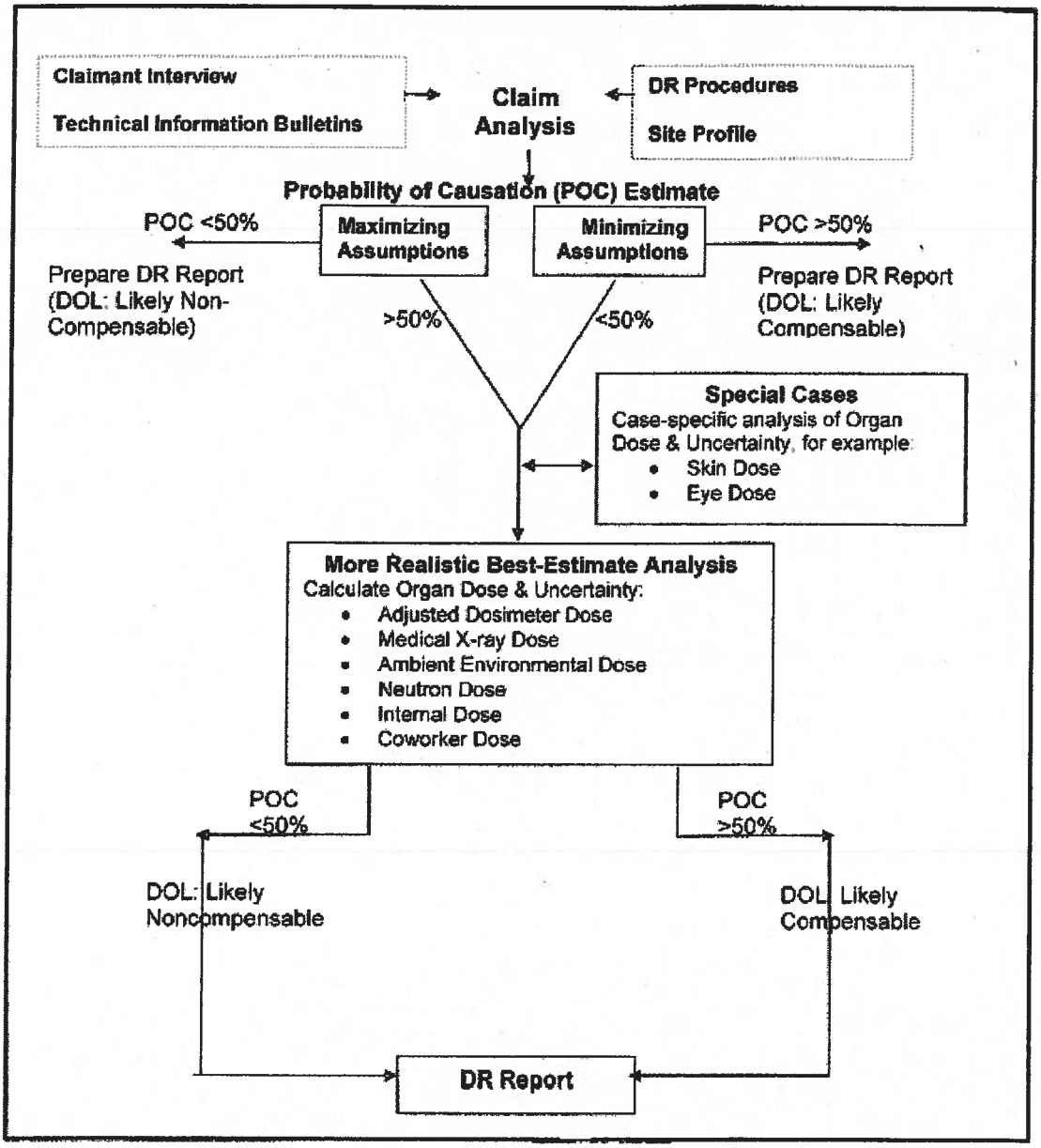
Examples of Internal dosimetry include:

- *In-vivo*: to measure radioactivity in the body (lung counts, whole body counts, wound counting, etc.)
- *In-vitro*: measure bodily excretions (urine, fecal, nasal smears) for radioactivity

7 Claims Flow Process



8 Dose Reconstruction Flow Diagram



9 Special Exposure Cohorts

9.1 What is Special Exposure Cohort (SEC)

The EEOICPA established a Special Exposure Cohort (SEC) for certain classes of employees. The statutory SEC classes include employees who have been diagnosed with a specified cancer and who:

- worked at gaseous diffusion plants in Paducah, Kentucky, Portsmouth, Ohio, or Oak Ridge, Tennessee for a total of at least 250 days before February 1, 1992, and were monitored for radiation exposure with dosimetry badges or had jobs with similar exposures to those monitored;
- worked before January 1, 1974, on Amchitka Island, Alaska and were exposed to radiation related to the Long Shot, Milrow or Cannikin underground nuclear tests.

The Act also authorizes the Secretary of Health and Human Services (HHS) to add other classes of employees to the SEC. Below are listings that include of the statutory SEC classes, as well as new classes of employees that HHS has added to the SEC. These include employees who worked for a number of work days aggregating at least 250 work days occurring either solely under one employment class or in combination with work days within the parameters established for one or more other classes of employees in the SEC.

9.2 The Specified Cancers under the Act

An employee, who meets the SEC employment criteria and develops one or more of the cancers in the following table under the listed conditions, may be found eligible without the need for dose reconstruction and the application of any further guidelines to determine that the exposure to radiation caused the cancer.

SEC Specified Cancers

Type of Cancer	Except...	Onset at least . . .
Leukemia	Chronic lymphocytic leukemia	2 years after first exposure
Lung cancer (primary or secondary)	In situ cancer discovered during or after a post-mortem exam (i.e., diagnosed after death)	----------
Lymphomas	Hodgkin's	5 years after first exposure
Multiple myeloma	----------	5 years after first exposure
Primary cancer of the: Thyroid Male or female breast	----------	5 years after first exposure

SEC Specified Cancers		
Type of Cancer	**Except...**	**Onset at least . . .**
Esophagus Stomach Pharynx (inc. tonsils) Small intestine Pancreas Bile ducts Gall bladder Salivary gland Urinary bladder (inc. ureter and urethral) Brain Colon (inc. rectum) Ovary Liver (except if cirrhosis or hepatitis B is indicated)		
Bone Cancer (primary or secondary)	----------	----------
Renal Cancer (primary or secondary but NOT other renal conditions)	----------	----------

Note: Mesothelioma is not an SEC cancer and must receive a dose reconstruction.

9.3 Statutory SEC Classes

Site	SEC dates	Procedure Chapter	For at least...	Bulletins	Doses NIOSH *can* reconstruct
Amchitka	12/1/65-1/1/74	Ch. 2-500, 3	N/A		all doses
Oak Ridge Gaseous Diffusion Plant	9/44-2/1/92	Ch. 2-500, 3	250 workdays	02-08, 02-09	all doses
Paducah Gaseous Diffusion Plant	7/52-2/1/92	Ch. 2-500, 3	250 workdays	02-08, 02-09	all doses
Portsmouth Gaseous Diffusion Plant	9/54-2/1/92	Ch. 2-500, 3	250 workdays	02-08, 02-09	all doses

9.4 Approved SEC Classes added after the Act

Site/Class Name	SEC class dates	Effective Date	Bulletin #	Bulletin Issue Date	class definition	Doses NIOSH *can* do/ Info they can use
Allied Chemical	1/1/59-12/31/76	03-Mar-07	No. 07-15	9-May-07	all employees	everything except internal "non-uranium'
Ames Laboratory	1/1/42* - 12/31/54	7-Sep-06	No. 07-01	17-Oct-06	all employees	Occupational medical X-ray doses
Ames Laboratory	1/1/55-12/31/70	12-Oct-07	No. 08-06	16-Nov-07	renovation workers in Wilhelm Hall	everything except dose from thorium
CANEL	1/1/58-12/31/65	23-Nov-08	No. 09-03	24-Nov-08	all employees	Occupational medical and select internal & external for some individuals
Combustion Engineering	1/1/1965 - 12/31/1972	02-Apr-08	No. 08-21	02-Apr-08	all employees	Occupational medical X-ray doses
Dow Chemical (Madison Site)	1/1/57-12/31/60	22-Jul-07	No. 07-25	3-Aug-07	all employees	everything except internal thorium
General Atomics	1/1/60-12/31/69	18-Mar-07	No. 07-17	9-May-07	all employees	everything except internal thorium
Hanford (100, 200 & 300 Areas during DuPont years of Operation)	Start of processing through 8/31/46	12-Oct-07	No. 08-03	19-Oct-07	rad workers in 100, 200, 300 Areas	all doses except internal from fission products and plutonium
Hanford 300 Area: 9/1/1946-12/31/1961 or 200 Area (east & west) 1/1/1949-12/31/1968	Area specific - see definition	30-Jun-08	No. 08-33	30-Jun-08	all employees in those areas	everything except internal americium in the 200 Area and internal thorium for the 300 Area

Site/Class Name	SEC class dates	Effective Date	Bulletin #	Bulletin Issue Date	class definition	Doses NIOSH *can* do/ Info they can use
Harshaw	1/1/42-11/30/49	03-Mar-07	No. 07-16	9-May-07	all employees	all external
Horizons (AWE, Cleveland, OH)	1/1/52-12/31/56	30-Jun-08	No. 08-34	30-Jun-08	all employees	All doses except internal dose during the operational period
Iowa Army Ammunition Plant "Line 1"	3/49 - 1974	19-Jun-05	No. 05-06	06-Sep-05	Line one and assoc. AEC work	actual measured exposure of individual worker
Iowa Army Ammunition Plant "Radiographers"	5/48-3/49	24-Sep-05	No. 06-04	21-Nov-05		cannot estimate
Kellex Pierpont (AWE, Jersey City, NJ)	1/1/43-12/31/53	30-Jun-08	No. 08-36	30-Jun-08	all employees	Occupational medical X-ray doses
Lawrence Livermore National Laboratory (LLNL)	1/1/1950 - 12/31/1973	02-Apr-08	No. 08-20	02-Apr-08	"employees who WERE monitored"	All doses except internal from fission and activation products
Linde Ceramics Plant	10/1/42-10/31/47	7-Jan-06	No. 06-06	4-Apr-06	all employees	rad survey & film badge data for external + occ. med X-rays
Los Alamos National Lab. - RaLa exposure	9/1/44-7/18/63	9-Dec-06	No. 07-11	28-Feb-07	RaLa operations in Tech Areas 10, 35 & Bldgs. H, Sigma & U in Tech Area 1	all doses except internal radioactive lanthanum (RaLa) and its daughter products - barium & strontium
Los Alamos National Laboratory	1/ 1/43 - 12/31/75	22-Jul-07	No. 08-08	3-Aug-07	tech areas with rad	NIOSH can do most exposures, except for a half dozen oddball radionuclides
Mallinckrodt Chemical Works	1949 - 1957	13-Nov-05	No. 06-05	27-Dec-05	Uranium Division	indiv. Occ. External for certain cancers

Site/Class Name	SEC class dates	Effective Date	Bulletin #	Bulletin Issue Date	class definition	Doses NIOSH *can* do/ Info they can use
Mallinckrodt Chemical Works	1942* - 1948	12-May-05	No. 06-03	issue date of bul. 05-03	Uranium Division	cannot estimate
Monsanto Chemcial Company	1/1/43-12/31/49	18-Mar-07	No. 07-18	9-May-07	all employees	internal from polonium and ext. from beta-photon, occ. med. X-rays and ambient environmental
Mound Plant	10/1/1949 - 2/28/1959	02-Apr-08	No. 08-19	02-Apr-08	all employees	All doses except internal Ra, Th & Ac
Nevada Test Site (NTS)	1/27/51-12/31/62	26-Jul-06	No. 06-16	12-Sep-06	monitored or should have been monitored	ext. monitoring + occ. med. X-rays
NUMEC (Parks Township)	6/1/60-12/31/80	30-Jun-08	No. 08-37	30-Jun-08	all employees	SEC based on bioassay data integrity issues. If internal and external dose data exist it will be used, along with medical X-rays.
NUMEC Apollo	1/1/57-12/31/83	29-Nov-07	No. 08-12	16-Jan-08	all employees	medical & some internal uranium
Oak Ridge Institute for Nuclear Studies (ORINS)	5/15/50-12/31/63	9-Dec-06	No. 07-09	9-Feb-07	Cancer Research Hospital	all external
Pacific Proving Ground (PPG)	1946 - 1962	26-Jul-06	No. 06-15 & 07-05	27-Sep-06	monitored or should have been monitored	film badge monitoring, field rad surveys + occ med. X-rays
Rocky Flats - Neutron Areas	04/01/1952-12/31/1958	05-Sep-07	No. 08-01	15-Oct-07	Also applicable to Rocky Flat SEC classes are Bulletins 08-11, 08-14 and Circular 08-03	

Site/Class Name	SEC class dates	Effective Date	Bulletin #	Bulletin Issue Date	class definition	Doses NIOSH *can* do/ Info they can use
Rocky Flats - Neutron Areas	1/1/1959-12/31/1966	05-Sep-07	No. 08-01	15-Oct-07		
S-50 (all workers)	7/9/44-12/31/51	9-Dec-06	No. 07-08	9-Feb-07	all employees	Occupational medical X-ray doses
SAM Laboratories (@ Columbia U)	8/13/42 - 12/31/47	30-Jun-08	No. 08-35	30-Jun-08	all employees	Occupational medical X-ray doses
Spencer Chemical (AWE, Pittsburg, Kansas)	1/1/56-12/31/61	14-Sep-08	No. 08-42	15-Sep-08	all employees	Occupational medical X-ray doses
W.R. Grace	1/1/1958-12/31/1970	22-Jul-07	No. 07-24	3-Aug-07	listed buildings--(locations of thorium work)	Probably everything except internal thorium.
Y-12 (Supersedes Y-12 class that became effective 9-24-2005)	3/1/43-12/31/47	14-Sep-08	No. 08-41	15-Sep-08	all employees	select internal for some individuals, external calutron + occ. Med x-rays
Y-12 Plant, "Radiological Activities"	3/43-12/47	24-Sep-05	No. 06-04 & 06-11	21-Nov-05	Uranium Enrichment	Occupational medical X-ray doses
Y-12 Plant, "Thorium and Cyclotron workers"	1/48-12/57	7-Sep-06	No. 07-04	26-Dec-06	monitored or should have been monitored	everything except internal thorium
* there is no covered employment under EEOICPA prior to August 13, 1942						

9.5 Proposed SEC classes for which NIOSH was set to recommend addition, but the Board did not Vote

Site	SEC dates	
Area IV of SSFL	January 1, 1955 – December 31, 1958	Board voted to Delay this 83.14

9.6 Proposed SEC classes for which DOL has received draft class language for comment

Site	Proposed SEC dates	notes/comments
Metallurgical Laboratory (83.14)	April 13, 1942 – June 30, 1946	
Vitro - Canonsburg (83.14)	April 13, 1942 – December 31, 1957	
Mallinckrodt (83.14)	all of 1958	
Hood Building (83.14)	August 14, 1946 – Dec. 31, 1963	NIOSH will pursue
MIT (83.14)	Aug. 12, 1942 – Aug. 13, 1946	No claimants

10 PEPS/PERS

Performance Evaluation Plan (PEP)	Performance Evaluation Report (PER)	Bulletin/Circular	Comments/Misc.
n/a	OCAS-PER-0001 Misinterpreted Dosimetry Records Resulting in an Underestimate of Missed Dose in Savannah River Site DR Effective 09-08-2003	**No Bulletin Necessary**	The underestimated missed dose resulted in a non-claimant favorable estimate of missed dose, NIOSH determined that the overestimated onsite ambient dose offset this underestimate. As a result, NIOSH considered that no further evaluation was necessary since the offset still resulted in a slight claimant favorable bias in the dose estimate and resulting probability of causation.
n/a	OCAS-PER-0002 Error in Surrogate Organ Assign. Resulting in an Underestimate of X-ray Dose in Savannah River Site DR Effective 12-15-2003	**No Bulletin Necessary**	An error in surrogate organ assignment for the liver, gall bladder and spleen (ovaries was assigned instead of lung) resulted in the underestimation of X-ray organ doses in three completed dose reconstructions. NIOSH evaluated the impact on the PoC in these three cases and found it to be minimal (0.5%), and the probable compensability status of these claims was unaffected. NIOSH considered that no revision of any completed dose reconstructions was warranted,

Performance Evaluation Plan (PEP)	Performance Evaluation Report (PER)	Bulletin/Circular	Comments/Misc.
n/a	OCAS-PER-003 Evaluation of the Effect of Adding Ingestion Intakes to Beth Steel Effective 01-28-2005	**No Bulletin Necessary**	A search of the existing claims in December 2004 indicated that seven of the Bethlehem Steel claims submitted to DOL had a PoC below between 40% and 50%. One of these claims included ingestion dose in the original version. Five of the remaining six did not exceed the PoC threshold above that may cause the claim to exceed a PoC of 50%. One however did exceed that threshold. However, NIOSH considered that the threshold was conservative in that it assumed the largest annual increase in dose occurred every year. NIOSH re-evaluated all six claims using the current version of the TBD and NIOSH found that none of them exceeded a PoC of 50%.
n/a	OCAS-PER-004 Application of Photofluorography at the Pinellas Plant Effective 02-15-2005	**No Bulletin Necessary**	NIOSH identified 11 potentially affected cases. After further review, NIOSH found that none exceeded a PoC of 50%.

Performance Evaluation Plan (PEP)	Performance Evaluation Report (PER)	Bulletin/Circular	Comments/Misc.
n/a	OCAS-PER-005 Misinterpreted Application of the External Dose Factor for Hanford DR Effective 06-09-2006	**No Bulletin Necessary**	An error in interpretation and application of the bias factor information in the Hanford External Dose Reconstruction TBD resulted in an underestimate of the external dose for certain Hanford claims. NIOSH identified 31 cases. Claims that were potentially affected by this error were identified and those that had not already been submitted to DOL were returned to the ORAU team for rework. The cases that had been submitted to DOL were reevaluated by removing the bias factor, thus developing a revised external dose. NIOSH recalculated the PoC for each of the affected claims. This evaluation found that although this error appeared upon discovery to be rather significant, there was no impact on compensation decisions made by DOL
n/a	OCAS-PER-006 External Dosimetry Target Organ for Prostate Cancer Effective 09-15-2006	**No Bulletin Necessary**	NIOSH determined that the effect of application of PER-6 to completed dose reconstructions would be to slightly decrease the PoC. NIOSH determined that no changes were warranted.

Performance Evaluation Plan (PEP)	Performance Evaluation Report (PER)	Bulletin/Circular	Comments/Misc.
n/a	OCAS-PER-007 Evaluation of the Effect of Revision 2 of the Site Profile on Previously Completed Bethlehem Steel Cases Effective 11-09-2006	The case-specific information for the three cases that NIOSH identified with PoCs exceeding 50% was forwarded to John Vance when the list was received. The district offices requested reworks of these three cases. DOL received signed PER forms from NIOSH, dated January 18, 2007, for these three cases.	From 579 dose reconstructions performed to date (November 14, 2006), NIOSH identified 22 cases, which were re-evaluated by completing a new dose estimate for each of the claims. As a result of revisions to the Bethlehem Steel TBD, three claims that were previously determined to have a PoC of less than 50% would now have a PoC greater than 50%. Eight cases that previously had a PoC greater than 50% would now have a PC less than 50%.
OCAS-PEP-008 Modification of NIOSH -IREP lung cancer risk model: impact of "combined" lung model on non-compensable lung cancer caims Effective 12-07-2006	OCAS-PER-008 Modification of NIOSH-IREP Lung Cancer Risk Model: Effect of Combined Lung Model on Non-compensable Lung Cancer Claims Effective 04-12-2007	**No Bulletin Necessary**	Scope of the PER is appropriate for the remaining cases and no further information is necessary from NIOSH.
OCAS-PEP-009 Evaluation of the Change in Target Organs for Dose Reconstruction Involving Lymphoma Effective 12-08-2006	OCAS-PER-009 Target Organs for Lymphoma Effective 03-08-2007	**Bulletin 07-21** issued June 15, 2007 **Bulletin 07-26** issued August 8, 2007	

Performance Evaluation Plan (PEP)	Performance Evaluation Report (PER)	Bulletin/Circular	Comments/Misc.
n/a	OCAS-PER-010 The Effect of Rocky Flats Neutron Dose Reconstruction Project Data Effective 04-13-2007	**Bulletin 08-01** issued October 15, 2007	
n/a	OCAS-PER-011 K-25 TBD and TIB Revisions Effective 09/26/07	**Bulletin 08-25** issued June 16, 2008	
OCAS-PEP-012 Evaluation of Highly Insoluble Plutonium Compounds Effective 03-29-2007	OCAS-PER-012 Evaluation of Highly Insoluble Plutonium Compounds Effective 08/07/07	**Bulletin 07-19** Issued May 16, 2007 **Bulletin 07-27** Issued August 8, 2007 (Letter Approach) **Bulletin 08-30** Issued June 16, 2008 (Action to take on cases with letters sent)	
OCAS-PEP-013 Evaluation of the Impact of Changes to the Isotopic Ratios for the Paducah Gaseous Diffusion Plant Effective 03-21-2007	OCAS-PER-013 Evaluation of the Impact of Changes to the Isotopic Ratios for the Paducah Gaseous Diffusion Plant Effective 08/13/07	**Bulletin 07-28** Issued September 6, 2007	
OCAS-PEP-014 Evaluation of the Impact of OTIB-0052, Construction Trade Workers Effective 03-29-2007	OCAS-PER-014 Construction Trade Workers, Effective 11/28/07	**Bulletin 08-10** Issued November 27, 2007 **Replacement -- Bulletin 08-31** issued June 16, 2008	

Performance Evaluation Plan (PEP)	Performance Evaluation Report (PER)	Bulletin/Circular	Comments/Misc.
n/a	OCAS-PER-015 Mallinckrodt TBD Revision Effective 07-31-2007	**Bulletin 07-29** Issued on September 20, 2007	
n/a	OCAS-PER-016 Implementation of IREP procedure for claims near 50% probability of causation Effective 09/25/07	**Bulletin 08-13** Issued January 23, 2008	
OCAS-PEP-017 Evaluation of Incomplete Internal Dosimetry Records from Idaho, Argonne-East and Argonne- West National Laboratories Effective 03-21-2007	OCAS-PER-017 Evaluation of Incomplete Internal Dosimetry Records from Idaho, Argonne-East and Argonne-West National Laboratories Effective 09/11/07	**Bulletin 08-04** Issued October 29, 2007	PER is for a specified group of claims (those where internal dose records were received)
n/a	OCAS-PER-018 Los Alamos National Laboratory TBD Revision Effective 07/31/07	**Bulletin 08-05** Issued October 29, 2007	
n/a	OCAS-PER-019 The Effect of Additional Neutron Dose Data from the Savannah River Site Effective 05-18-07	**MEMO** issued to Jacksonville DO with instructions to send copy of PER to claimants notifying of the change in DR but not in compensability of claim.	
n/a	OCAS-PER-020 Blockson TBD Revision Effective 07-31-07	**Bulletin 07-29** Issued on September 20, 2007	

Performance Evaluation Plan (PEP)	Performance Evaluation Report (PER)	Bulletin/Circular	Comments/Misc.
n/a	OCAS-PER-021 Rocky Flats Plant Dose Reconstruction Method Modifications, Effective 09/20/07	**Bulletin 08-01** issued October 15, 2007	
n/a	OCAS-PER-022 Chapman Valve TBD Revision, Effective 09/20/07	**Bulletin 08-24** issued May 9, 2008	
n/a	OCAS-PER-023 Argonne National Lab - West TBD Revision, Effective 09/20/07	**Bulletin 08-24** issued May 9, 2008	
n/a	OCAS-PER-024 General Steel Industries TBD Approval, Effective 09/25/07	**Bulletin 08-24** issued May 9, 2008	
n/a	OCAS-PER-025 Huntington Pilot Plant TBD Revision, Effective September 28, 2007	**Bulletin 08-24** issued May 9, 2008	
n/a	OCAS-PER-026 Pantex TBD Revision- ORAUT-TKBS-0013, Effective October 31, 2007	**Bulletin 08-28** issued June 16, 2008	
n/a	OCAS-PER-027 Clarksville and Medina Site Profile - ORAU-TBKS-0039, Effective October 31, 2007	**Bulletin 08-27** issued June 16, 2008	

Performance Evaluation Plan (PEP)	Performance Evaluation Report (PER)	Bulletin/Circular	Comments/Misc.
n/a	OCAS-PER-028 Pinellas TBD Revision, Effective October 31, 2007	**Bulletin 08-28** issued June 16, 2008	
n/a	OCAS-PER-029 Hanford TBD Revisions, Effective December 18, 2007	**Bulletin 08-26** issued June 16, 2008	
n/a	OCAS-PER-030 Savannah River Site TBD Revisions, Effective December 18, 2007	**Bulletin 08-32** issued July 16, 2008	
n/a	OCAS-PER-031 Y-12 TBD Revisions, Effective December 18, 2007	**Bulletin 08-29** issued June 16, 2008	
n/a	OCAS-PER-032 Nevada Test Site TBD Revisions, Effective December 18, 2007	**Bulletin 08-32 issued July 16, 2008**	

11 Sample Dose Reconstructions

NIOSH **OCAS**

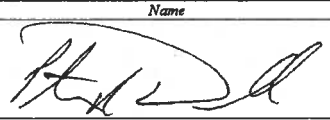
NIOSH Report of Dose Reconstruction under the Energy Employees Occupational Illness Compensation Program Act (EEOICPA)

NIOSH ID:	Social Security No.	DOL District Office
006924		Seattle Ccl

Energy Employee Name:	Claimant *Last*	Peter *First*	S *Middle*	*Date of Birth*

Covered Employment:	09/13/62 – 09/29/68 *Dates*	Sandia National Laboratory Albuquerque, NM *Location*

Cancer:	Multiple Myeloma *Type*	203.0 *ICD Code*	02/27/1980 *Date of Diagnosis*

Calculations Performed By:	Steven R. Reed *Name*	10/2/2007 *Date*
Peer Review Completed By:	Dann C. Smith, CHP *Name*	10/5/2007 *Date*
Dose Reconstruction Approved By:	 *Signature* Peter A. Darnell, CHP, RRPT *Name*	10/29/2007 *Date*

Covered Employee | NIOSH ID# 006924 | Social Security #

Introduction

The Energy Employees Occupational Illness Compensation Program Act of 2000 (EEOICPA), Executive Order No. 13179, and the Radiation Dose Reconstruction Rule (42 CFR 82)[1]

EEOICPA established a compensation program to provide a lump sum payment of $150,000 and medical benefits as compensation to covered employees suffering from designated illnesses incurred as a result of their exposure to ionizing radiation, beryllium, or silica while in the performance of duty for the Department of Energy and certain of its vendors, contractors, and subcontractors. This legislation also provided for payment of compensation to certain survivors of these covered employees.

In Presidential Executive Order No. 13179, the President designated the U.S. Department of Labor to administer this program for claims by current and former employees of nuclear weapons production facilities and their survivors who seek compensation for cancers caused by radiation exposures sustained in the performance of duty. The Executive Order also directed the Department of Health and Human Services to estimate (reconstruct) the radiation doses received by these employees. The Department of Labor uses the reconstructed radiation dose in evaluating whether the employee's cancer was at least as likely as not related to employment at the facilities covered by EEOICPA. To fulfill the responsibilities assigned to the Department of Health and Human Services, the National Institute for Occupational Safety and Health's (NIOSH) Office of Compensation Analysis and Support (OCAS) completes dose reconstructions using the methods described in the Radiation Dose Reconstruction Rule (42 CFR 82)[1] for the Department of Labor's use in making compensation decisions.

The Purpose of Radiation Dose Reconstruction
A radiation dose reconstruction is used to estimate the radiation dose received by the specific organ(s) in which a worker developed cancer, particularly when radiation monitoring data are unavailable, incomplete, or of poor quality. Even in instances when radiation dosimetry data are available, they rarely specify dose to an organ and often are based on monitoring procedures that do not meet modern standards.

The basic principle of dose reconstruction is to characterize the occupational radiation environment to which a worker was exposed using available worker and/or workplace monitoring information. In cases where radiation exposures in the workplace environment cannot be fully characterized based on available data, default values based on reasonable scientific assumptions are used as substitutes.

EEOICPA recognized that the process of estimating radiation doses would require dealing with uncertainties and limited data and thus required that the government establish methods for arriving at reasonable estimates of radiation dose received by an individual who was not monitored or inadequately monitored for exposures to radiation, or for whom exposure records are missing or incomplete. To the extent that the science and data involve uncertainties, these uncertainties are typically handled to the advantage, rather than to the detriment, of the claimant. NIOSH has used the best available science to develop the methods and guidelines for dose

reconstruction. These methods have been reviewed and commented upon by the public, including experts in the field of dose reconstruction, and the Presidentially-appointed Advisory Board on Radiation and Worker Health.

How Radiation Doses Are Reconstructed

NIOSH reconstructs radiation doses by evaluating all available, appropriate data relevant to the employee's radiation exposure. Some examples of data that may be included in the dose reconstruction include, but are not limited to, internal dosimetry (such as results from urinalysis), external dosimetry data (such as film badge readings), workplace monitoring data (such as air sample results), workplace characterization data (such as type and amount of radioactive material processed), and descriptions of the type of work performed at the work location.

Although the specific methods used for each dose reconstruction may vary, after a claim has been referred by the Department of Labor to NIOSH for a dose reconstruction, NIOSH typically requests the worker's personal radiation monitoring information from the Department of Energy. Upon receipt of the requested information, at least one voluntary informational interview with the claimant and/or survivors is conducted and a copy of the interview report is sent for review. After all of the necessary and available information is gathered, a dose is estimated, using the methods in the Radiation Dose Reconstruction Rule. After a NIOSH health physicist reviews the information, methods, and results, the claimant receives a draft copy of the dose reconstruction report followed by a concluding interview, during which the claimant can add any additional relevant information that may affect the dose reconstruction. If the claimant certifies that he/she has completed providing information and that the record for dose reconstruction should be closed, a final dose reconstruction report is sent to the claimant, the Department of Labor, and the Department of Energy.

As applied in the EEOICPA, dose reconstructions must rely on information that can be developed on a timely basis and on carefully stated assumptions. Therefore, the guiding principle in conducting these dose reconstructions is to ensure that the assumptions used are fair, consistent, and well-grounded in the best available science, while ensuring that uncertainties in the science and data are handled to the advantage, rather than to the detriment, of the claim when feasible. When dose information is not available, is very limited, or the dose of record is very low, NIOSH may use the highest reasonably possible radiation dose, based on reliable science, documented experience, and relevant data, to complete a claimant's dose reconstruction. In other instances, NIOSH may not need to complete fully a dose reconstruction because a partial dose reconstruction results in an estimated dose which produces a probability of causation of 50% or greater.

How Radiation Dose Reconstructions Are Used in Final Compensation Determinations

The results of an employee's dose reconstruction are used by the Department of Labor to determine the probability that a worker's cancer was "at least as likely as not" due to his/her occupational exposure to ionizing radiation during employment at a covered facility. Criteria and guidelines for making this determination are established by EEOICPA and the Probability of Causation Guidelines (42 CFR 81).[2] The dose reconstruction is not the final determination of a claim, but rather an interim product that is used by the Department of Labor in making its final

decision. Final determinations are made by the Department of Labor based on standards determined by EEOICPA and its implementing regulations.

Dose Reconstruction Overview

The Office of Compensation Analysis and Support has performed a dose reconstruction for Peter Claimant in accordance with the applicable requirements of the Energy Employees Occupational Illness Compensation Program Act. Records provided by the Department of Labor (DOL) indicate that Mr. Claimant worked at Sandia National Laboratory from September 13, 1962, through September 29, 1968, and that he was diagnosed with multiple myeloma in 1980. Information provided indicated that Mr. Claimant also worked at the Nevada Test Site (NTS) for much of his employment for Sandia after 1964, with additional trips to Honolulu, Hawaii and the Tonopah Test Site in Mercury, Nevada.

Mr. Claimant's radiation exposure was received during employment as a project engineer according to records provided by the Department of Labor and information provided in the interview process. To process this claim, the radiation dose assigned was overestimated using efficiency measures. Claimant-favorable assumptions related to radiation exposure and intake were applied, based on current science, documented experience, and relevant data. Using this approach, the dose to the red bone marrow was calculated to be 16.185 rem. The dose was calculated only for this organ because of the specific type of cancer associated with this claim.[9] Even under these assumptions, NIOSH has determined that further research and analysis will not produce a level of radiation dose resulting in a probability of causation of 50% or greater. In accordance with 42 CFR § 82.10(k),[1] NIOSH has determined that sufficient research and analysis have been conducted to consider this dose reconstruction complete. Per the requirements of 42 CFR § 82.10(j),[1] only the dose incurred up to the point of cancer diagnosis was included in this dose reconstruction.

The original dose reconstruction was re-evaluated regarding the assessment of plutonium (plutonium-239 and its mixtures) that is strongly retained in the lung (Type Super S)[11] and the effect this can have to potentially increase organ dose. The claim was evaluated considering all current dose reconstruction policies, procedures, technical basis documents, and technical information bulletins. The dose estimated in this dose reconstruction report is significantly lower than the dose estimated in the original version for the following reasons:

- The original dose estimation was overestimated using complex-wide maximizing assumptions. Site-specific technical basis documents were approved since the original version was released and were used for this revision.
- Lower measured and missed photon doses were calculated based on the site-specific information.
- Internal dose in the original version was multiplied by 2 to maximize the dose. The factor of 2 has been removed because the internal dose was calculated using a maximizing assumption.
- The on-site ambient dose has been revised using current site-specific information and only applied during unmonitored periods at Sandia.

Covered Employee	NIOSH ID#	Social Security #
Peter S. Claimant	006924	

This results in a reduction from 37.632 rem estimated in the original dose reconstruction to the value listed above. The changes in external and internal doses applied will be discussed throughout the report in the applicable sections, including the increase in medical X-ray doses applied.

If the facts surrounding this dose reconstruction change (e.g., the date of diagnosis is modified, an additional covered cancer is diagnosed, or additional covered employment is identified), the efficiency measures used to reconstruct the dose may not be applicable. In this case, if the facts were to change, the dose reconstructed for the red bone marrow could be substantially lower than that reported using the efficiency process.

Information Used

Department of Energy (DOE) dosimetry records were the primary data source. Specific parameters were applied to the records to assign organ dose based on the external and internal dose reconstruction guidelines.[3,4] Technical Information Bulletins and Technical Basis Documents were also used for dose reconstruction. When specific information useful for estimating doses was lacking, parameters were selected that maximized the dose estimate. Additionally, the dose reconstructor reviewed the record of the computer assisted telephone interview and considered the information in the dose estimate.

Dose Estimate

External Dose

External dose is received from radiation originating outside the body and is measured by dosimetry worn on the body. Radiation dose measured on a film badge or a thermoluminescent dosimeter may have been delivered quickly (acute) or slowly over the time the employee was exposed (chronic). DOE external dose records were evaluated for the external dose estimate.

During Mr. Claimant's employment at Sandia and NTS, he worked in various test areas monitoring and retrieving test equipment. His primary radiation exposure potential would have been to photon and electron radiation. He was monitored for radiation periodically during the period of 1965 through 1968 at NTS. All employment periods are addressed either with monitoring data or claimant-favorable assumptions of on-site ambient dose. However, external electron radiation was not considered in this dose reconstruction because it would not have added dose to the cancer site.

There was a thermal neutron component in the NTS film badge packet from 1966 through 1986 to record neutron dose. Since every film badge packet issued on site had this component regardless of potential for exposure, monitoring data are not necessarily indicators of exposure to thermal neutrons during routine activities. Most of the neutron exposure at NTS in this time frame occurred in Area 25 (a test reactor area). Low level exposure to neutrons in Area 12 would only intermittently have occurred and only involved workers who directly handled the fissile materials used for testing. During this activity, fast neutron monitoring was conducted using NTA film, and thermal neutrons were monitored using the standard NTS film badge. Mr. Claimant's responsibilities involved design and testing of instrumentation used in underground tests, including entering the tunnels to set-up and retrieve the instrumentation. He was not

monitored for fast neutrons, and it is unlikely that he was involved in the placement of the fissile materials; therefore, neutron exposures were not considered for this dose reconstruction.

For the purpose of estimating probability of causation, all photon doses, except on-site ambient, are assumed to be acute.[3] All on-site ambient doses are assumed to be chronic.

Radiation Type, Energy, and Exposure Geometry
The original dose reconstruction was performed in accordance with the Technical Information Bulletin: A Standard Complex-Wide Methodology for Overestimating External Doses Measured with Film Badge Dosimeters.[5] However, the revised dose reconstruction was performed in accordance with site-specific information using the Site Profile for Sandia National Laboratories in Albuquerque, New Mexico, and the Tonopah Test Range, Nevada[12] and the Technical Basis Document for the Nevada Test Site – Occupational External Dose.[15] A claimant favorable organ dose conversion factor of 1 was applied to the measured and missed photons doses. Additionally, an uncertainty factor of 1.3 was applied to the measured photon dose.[15] To maximize the probability of causation, a photon energy range of 100% 30–250 keV was applied and for 1965, the doses were multiplied by 1.25 to account for low energy photons that were attenuated by the lead filter that covered a portion of the dosimeter prior to 1966.[15]

Dosimeter Dose
Individual dosimeter results were used to reconstruct Mr. Claimant's dose for his work at NTS. Corrections to the reported doses were applied as described above. The measured dose in the original dose estimate has been reduced from 0.060 rem to 0.039 rem because the maximizing factor of 2^5 has been removed and replaced with the site specific parameters discussed above.

Missed Dose
A potential missed dose was assigned to each actual or potential dosimeter cycle to maximize the potential external doses received by Mr. Claimant. A missed dose represents the dose that could have been received but may not have been recorded due to the dosimeter detection limits or site reporting practices.

Based on information provided in the Technical Basis Document for the Nevada Test Site – Occupational External Dose,[15] the total number of dosimeter cycles assigned was 48 for photons. This number was based on a monthly badge exchange for each full or partial year of employment that Mr. Claimant worked at NTS from 1965 through 1968. Based upon a review of personnel radiation monitoring systems at NTS, a limit of detection (LOD) of 0.040 rem for photons was used in this dose reconstruction.[15] This results in a maximum potential missed dose for Mr. Claimant of 2.040 rem from photons. Per the requirements of the External Dose Reconstruction Implementation Guideline,[3] this value was used as the 95th percentile of a lognormal distribution for the purpose of calculating probability of causation.

The missed doses applied in the original dose estimate were calculated using a maximizing assumption by multiplying the missed dose by 2.[5] As mentioned earlier, site specific information has been used for the current dose estimate and the factor of 2 has been removed. This reduced the missed dose from 3.760 rem applied in the original dose reconstruction to the value listed above.

Covered Employee	NIOSH ID#	Social Security #
Peter S.	006924	

On-Site Ambient Dose
Mr. Claimant was assigned on-site ambient radiation doses during part of his employment at the Sandia National Laboratory during the unmonitored period prior to 1965. This accounts for any doses from stack releases or other radiation sources that may have been unmonitored at the site. The on-site ambient doses assigned in this revision were based on the highest ambient doses recorded on site using Table 4-2 of the site profile.[12] An annual dose of 0.010 rem was applied for each full or partial year of employment from 1962 through 1964. For 1965 through 1968, measured and missed doses were applied; therefore, on-site ambient doses were not applied. A total on-site ambient dose of 0.030 rem was assigned.

The original dose estimate was performed prior to the issuance of the Site Profile for Sandia National Laboratories in Albuquerque, New Mexico, and the Tonopah Test Range, Nevada.[12] The on-site ambient doses assigned were in accordance with guidance in Appendix B of the procedure, Occupational On-Site Ambient Dose Reconstruction for DOE Sites[8] at the time of that estimate. The doses were based on an assumption of 1.000 rem per year and resulted in a total ambient dose of 7.000 rem to the red bone marrow. The original dose estimate was a gross overestimate of dose for a worker at Sandia and NTS based on current site-specific data for each site.[12,13]

Occupational Medical Dose
In addition to the estimated dose received from site operations, the dose received from diagnostic X-ray procedures that were required as a condition of employment was also included in the overall dose to the red bone marrow. Based on the records provided by the Department of Energy, Mr. Claimant had periodic chest examinations with a pre-screening lumbar spine exam in 1962. The chest X-ray doses applied for 1962 and 1964 were applied assuming photofluorographic exams, and the remaining X-ray doses were applied based on a large chest, or standard X-ray, examinations.[12] The total dose assigned from the chest X-rays was 0.725 rem to the red bone marrow. The lumbar spine X-ray was applied assuming a four-view procedure. The total dose assigned from the lumbar spine procedure was 0.169 rem to the red bone marrow for a total X-ray dose of 0.894 rem. A multiplication factor of 1.3 has been applied to ensure claimant favorability and to account for uncertainty.

The original dose reconstruction was based on information in Table 6-5 of the Technical Information Bulletin: Dose Reconstruction from Occupationally Related Diagnostic X-Ray Procedures[6] and an assumed annual X-ray procedure each year of employment. A total X-ray dose of 0.167 rem was assigned. The dose assigned in this version of the dose reconstruction is based on site specific X-ray parameters and actual records provided for Mr. Claimant. The X-ray dose increased from the previous version due to the application of the photofluorographic exams in 1962 and 1964, and the application of the four-view lumbar spine procedure.

Internal Dose
Radioactive materials taken into the body cause internal dose. A chronic intake of radioactive material occurs over an extended period (weeks or longer) and an acute intake occurs over a short period (minutes to hours). Regardless of the rate at which the intake occurs, the internal dose received from radioactive materials having long half-lives occurs over an extended period

and is considered chronic. The internal dose was calculated for the red bone marrow for each year from 1962 to the date of diagnosis using the limiting air concentrations from Sandia, which are equivalent to the limits for NTS.

The assigned internal doses are based on information provided in the Technical Information Bulletin: Internal Dose Overestimates for Facilities with Air Sampling Programs[7] and the application of a graded approach to ensure a claimant-favorable internal dose estimate in accordance with the Technical Information Bulletin: Application of Internal Doses Based on Claimant-Favorable Assumptions for Processing as Best Estimates.[10] Based on Mr. Claimant's job description as a project engineer, it was assumed that he did not work directly with unconfined radioactive materials and was intermittently exposed to airborne radioactive materials during the performance of his duties. This approach assumes hypothetical chronic intakes based on limiting air concentrations as further described below; the total internal dose assigned based on this approach was 14.202 rem.

Assigned internal doses for each radionuclide are based on limiting air concentration values and the associated intakes that would be expected for radiological workers. The use of limiting air concentrations was the metric used at Sandia[12] and NTS[14] during the early years of operation and was based on total alpha and total beta counting for particulate radioactive contamination. Because of variability over time of specific radionuclide fractions, and the fact that they were not identified for every air sample, rather than estimating radionuclide fractions, the internal dose assigned for this dose reconstruction assumes 100% of the intake to the single radionuclide that produces the largest dose per unit intake to the organ of concern, a claimant-favorable assumption. Because the annual organ dose is the dose of interest under EEOICPA, and the annual dose varies from year to year for a given radionuclide (due to absorption type and other considerations), the largest dose contributor could change over the years. Rather than determining which radionuclide/absorption type combination produces the largest total dose, for each year between the start of exposure and the date of diagnosis, the annual internal dose has been evaluated individually, and the largest dose is assigned, an additional claimant-favorable assumption.

The total internal dose assignment based on this approach also evaluates potential ingestion intakes (considered separately from inhalation intakes) as described in the Technical Information Bulletin: Internal Dose Overestimates for Facilities with Air Sampling Programs.[7] Some forms of plutonium exhibit longer lung clearance times than those used in the ICRP model for insoluble (Type S) plutonium. This can result in higher doses to some organs, so dose modification factors were developed as described in the Technical Information Bulletin: Estimating Doses from Plutonium Strongly Retained in the Lung.[11] Mr. Claimant's dose is estimated to the red bone marrow, part of the systemic system (portions of the body not included in the respiratory or gastrointestinal tracts), using measured air concentrations. The dose to the systemic system from an inhalation of plutonium is the result of plutonium that is absorbed into the bloodstream. Because Type Super S plutonium is retained in the lungs for a longer time than more soluble forms of plutonium (Types M and S), less is transferred to the blood and hence the dose is lower than for an equal intake of Type M or Type S plutonium. Therefore, dose adjustments for plutonium (plutonium-239 and its mixtures) strongly retained in the lung (Type Super S) are not required for this dose reconstruction.

Covered Employee	NIOSH ID#	Social Security #
Peter S.	006924	

The original dose reconstruction used the same assumptions based on limiting air concentrations and then multiplied the calculated dose by 2 to further maximize the dose estimate. This dose reconstruction removed the factor of 2 because the internal dose calculated based on the hypothetical intakes based on limiting air concentrations is a maximizing estimate in itself. Therefore, the original estimate of 28.405 rem was reduced to the dose as described above.

Dose from Radiological Incidents

The record of the telephone interview was evaluated carefully by the dose reconstructor. Specific information related to areas where work was performed and duties was used in the dose reconstruction. Also, the interview recorded that Mr. Claimant was believed to have entered areas downwind of test areas after tests were completed. Environmental internal doses were calculated for Mr. Claimant which would account for entry into these areas; however, the assigned internal dose based on the limiting air concentrations was much higher and used for the dose estimate. The assignment of claimant-favorable dose as discussed above addresses any potential dose received during unmonitored periods including an incident involving potential skin/wound contamination from any abrasion received while touring a uranium mine, which would not be covered for the uranium mines under the EEOICPA. No information was raised in the interview or noted in the DOE dosimetry record to suggest that the doses estimated in this dose reconstruction are not claimant-favorable.

Uncertainty

Except for missed dose, point estimates (constant values) were used for external organ dose input into the NIOSH-Interactive RadioEpidemiological Program (NIOSH-IREP). Missed doses were divided by 2 and a lognormal distribution was applied in accordance with the External Dose Reconstruction Implementation Guideline.[3] Internal doses were applied as a lognormal distribution with a geometric standard deviation of 3.0.[7]

Possible Overestimate of Radiation Dose

There are a number of reasons to believe that this dose estimate represents a larger dose than Mr. Claimant's true radiation dose received while working at Sandia and NTS. The most important reasons for this include:

- Claimant-favorable assumptions were used to convert potential whole body dose to dose to the red bone marrow. Had more realistic assumptions been applied, the estimated dose to the red bone marrow would have been smaller.
- Internal doses were estimated by using claimant-favorable assumptions regarding hypothetical intakes based on limiting air concentrations that were unlikely to have occurred. The actual internal doses received by Mr. Claimant would have been considerably smaller than those calculated using these assumptions.
- The actual doses to the red bone marrow from occupational medical X-ray procedures are likely to be smaller than were calculated based on the maximizing assumptions used in this dose reconstruction.
- The missed doses estimated for Mr. Claimant are likely much larger than any doses that were unmonitored or unrecorded.

Covered Employee	NIOSH ID#	Social Security #
Peter S.	006924	

Summary

Peter S. Claimant was exposed to various sources of radiation during his employment at the Sandia National Laboratory and the Nevada Test Site (NTS). The estimated dose to Mr. Claimant was calculated to be 16.185 rem. The reported dose is a significant *overestimate* of Mr. Claimant's occupational radiation dose which will support claim determination. Attachment 1 contains the IREP dose reconstruction summary sheets that will be used by the Department of Labor to make the final probability of causation determination of the claim.

References

1. 42 CFR 82, *Methods for Radiation Dose Reconstruction Under the Energy Employees Occupational Illness Compensation Program Act of 2000*; Final Rule, Federal Register/Vol.67, No. 85/Thursday, May 2, 2002, p 22314, SRDB Reference ID 19392.

2. 42 CFR 81, *Guidelines for Determining the Probability of Causation Under the Energy Employees Occupational Illness Compensation Program Act of 2000*; Final Rule, Federal Register/Vol.67, No. 85/Thursday, May 2, 2002, p 22296, SRDB Reference ID 19391.

3. NIOSH, (2006) *External Dose Reconstruction Implementation Guideline, Rev 2*, OCAS-IG-001, National Institute for Occupational Safety and Health, Office of Compensation Analysis and Support, Cincinnati, Ohio, SRDB Reference ID 29929.

4. NIOSH, (2002) *Internal Dose Reconstruction Implementation Guideline, Rev 0*, OCAS-IG-002, National Institute for Occupational Safety and Health, Office of Compensation Analysis and Support, Cincinnati, Ohio, SRDB Reference ID 22402.

5. ORAUT (Oak Ridge Associated Universities Team), ORAUT-OTIB-0010, *Technical Information Bulletin: A Standard Complex-Wide Methodology for Overestimating External Doses Measured with Film Badge Dosimeters, Rev 01*, June 5, 2006, SRDB Reference ID 29953.

6. ORAUT (Oak Ridge Associated Universities Team), ORAUT-OTIB-0006, *Technical Information Bulletin: Dose Reconstruction from Occupationally Related Diagnostic X-Ray Procedures, Rev 03 PC-1*, December 21, 2005, SRDB Reference ID 20220.

7. ORAUT (Oak Ridge Associated Universities Team), ORAUT-OTIB-0018, *Technical Information Bulletin: Internal Dose Overestimates for Facilities with Air Sampling Programs, Rev 01*, August 9, 2005, SRDB Reference ID 19436.

8. ORAUT (Oak Ridge Associated Universities Team), ORAUT-PROC-0060, *Occupational On-Site Ambient Dose Reconstruction for DOE Sites, Rev 01*, June 28, 2006, SRDB Reference ID 29986.

Covered Employee	NIOSH ID#	Social Security #
Peter S.	006924	

9. ORAUT (Oak Ridge Associated Universities Team), ORAUT-OTIB-0005, *Technical Information Bulletin: Internal Dosimetry Organ, External Dosimetry Organ, and IREP Model Selection by ICD-9 Code, Rev 02 PC-1*, February 10, 2006, SRDB Reference ID 22595.

10. ORAUT (Oak Ridge Associated Universities Team), ORAUT-OTIB-0033, *Technical Information Bulletin: Application of Internal Doses Based on Claimant-Favorable Assumptions for Processing as Best Estimates, Rev 00*, April 20, 2005, SRDB Reference ID 19457.

11. ORAUT (Oak Ridge Associated Universities Team), ORAUT-OTIB-0049, *Technical Information Bulletin: Estimating Doses for Plutonium Strongly Retained in the Lung, Rev 00*, February 6, 2007, SRDB Reference ID 29975.

12. ORAUT (Oak Ridge Associated Universities Team), ORAUT-TKBS-0037, *Site Profile for Sandia National Laboratories in Albuquerque, New Mexico, and the Tonopah Test Range, Nevada, Rev 00*, June 22, 2007, SRDB Reference ID 32531.

13. ORAUT (Oak Ridge Associated Universities Team), ORAUT-TKBS-0008-4, *Technical Basis Document for the Nevada Test Site – Occupational Environmental Dose, Rev 00 PC-1*, December 8, 2006, SRDB Reference ID 29995.

14. ORAUT (Oak Ridge Associated Universities Team), ORAUT-TKBS-0008-5, *Technical Basis Document for the Nevada Test Site – Occupational Internal Dose, Rev 00 PC-1*, July 20, 2006, SRDB Reference ID 29996.

15. ORAUT (Oak Ridge Associated Universities Team), ORAUT-TKBS-0008-6, *Technical Basis Document for the Nevada Test Site – Occupational External Dose, Rev 01*, July 30, 2007, SRDB Reference ID 34013.

Covered Employee
Peter S. Claimant

NIOSH ID#
06924

Social Security #

ATTACHMENT 1: IREP Input Tables

PERSONAL INFORMATION								
Claimant Name	NIOSH ID #	Claimant SSN	DOL District Office	Gender	Birth Year	Year of Diagnosis	Cancer Model	Should alt model be run?
Peter S. Claimant	006924		SE	Male		1940	1990 oma and multiple my	No

CLAIMANT CANCER DIAGNOSIS						
	Primary Cancer #1	Primary Cancer #2	Primary Cancer #3	Secondary Cancer #1	Secondary Cancer #2	Secondary Cancer #3
Cancer Type	Multiple Myeloma	N/A	N/A	N/A	N/A	N/A
Date of Diagnosis	1990	N/A	N/A	N/A	N/A	N/A

EXPOSURE INFORMATION							
Number of exposures							
53							
Exposure #	Exposure Year	Exposure Rate	Radiation Type	Dose Distribution Type	Parameter 1	Parameter 2	Parameter 3
1	1986	acute	photons E=30-250kv	Constant	0.038	0.000	0.000
2	1985	acute	photons E=30-250kv	Lognormal	0.300	1.520	0.000
3	1986	acute	photons E=30-250kv	Lognormal	0.240	1.520	0.000
4	1987	acute	photons E=30-250kv	Lognormal	0.240	1.520	0.000
5	1988	acute	photons E=30-250kv	Lognormal	0.240	1.520	0.000
6	1982	chronic	photons E=30-250kv	Constant	0.010	0.000	0.000
7	1983	chronic	photons E=30-250kv	Constant	0.010	0.000	0.000
8	1984	chronic	photons E=30-250kv	Constant	0.010	0.000	0.000
9	1982	acute	photons E=30-250kv	Constant	0.358	0.000	0.000
10	1984	acute	photons E=30-250kv	Constant	0.358	0.000	0.000
11	1986	acute	photons E=30-250kv	Constant	0.002	0.000	0.000
12	1987	acute	photons E=30-250kv	Constant	0.002	0.000	0.000
13	1988	acute	photons E=30-250kv	Constant	0.002	0.000	0.000
14	1982	acute	photons E=30-250kv	Constant	0.038	0.000	0.000
15	1982	acute	photons E=30-250kv	Constant	0.130	0.000	0.000
16	1982	chronic	alpha	Lognormal	0.028	3.000	0.000
17	1983	chronic	alpha	Lognormal	0.093	3.000	0.000
18	1984	chronic	alpha	Lognormal	0.122	3.000	0.000
19	1985	chronic	alpha	Lognormal	0.147	3.000	0.000
20	1986	chronic	alpha	Lognormal	0.168	3.000	0.000
21	1987	chronic	alpha	Lognormal	0.187	3.000	0.000
22	1988	chronic	alpha	Lognormal	0.200	3.000	0.000
23	1989	chronic	alpha	Lognormal	0.187	3.000	0.000
24	1970	chronic	alpha	Lognormal	0.145	3.000	0.000
25	1971	chronic	alpha	Lognormal	0.129	3.000	0.000
26	1972	chronic	alpha	Lognormal	0.117	3.000	0.000
27	1973	chronic	alpha	Lognormal	0.108	3.000	0.000
28	1974	chronic	alpha	Lognormal	0.100	3.000	0.000
29	1975	chronic	alpha	Lognormal	0.095	3.000	0.000
30	1976	chronic	alpha	Lognormal	0.091	3.000	0.000
31	1977	chronic	alpha	Lognormal	0.087	3.000	0.000
32	1978	chronic	alpha	Lognormal	0.083	3.000	0.000
33	1979	chronic	alpha	Lognormal	0.080	3.000	0.000
34	1980	chronic	alpha	Lognormal	0.077	3.000	0.000
35	1982	chronic	electrons E>15keV	Lognormal	0.201	3.000	0.000
36	1983	chronic	electrons E>15keV	Lognormal	0.494	3.000	0.000
37	1984	chronic	electrons E>15keV	Lognormal	0.719	3.000	0.000
38	1985	chronic	electrons E>15keV	Lognormal	0.904	3.000	0.000
39	1986	chronic	electrons E>15keV	Lognormal	1.058	3.000	0.000
40	1987	chronic	electrons E>15keV	Lognormal	1.185	3.000	0.000
41	1988	chronic	electrons E>15keV	Lognormal	1.291	3.000	0.000
42	1989	chronic	electrons E>15keV	Lognormal	1.177	3.000	0.000
43	1970	chronic	electrons E>15keV	Lognormal	0.958	3.000	0.000
44	1971	chronic	electrons E>15keV	Lognormal	0.784	3.000	0.000
45	1972	chronic	electrons E>15keV	Lognormal	0.660	3.000	0.000
46	1973	chronic	electrons E>15keV	Lognormal	0.548	3.000	0.000
47	1974	chronic	electrons E>15keV	Lognormal	0.457	3.000	0.000
48	1975	chronic	electrons E>15keV	Lognormal	0.380	3.000	0.000
49	1976	chronic	electrons E>15keV	Lognormal	0.317	3.000	0.000
50	1977	chronic	electrons E>15keV	Lognormal	0.264	3.000	0.000
51	1978	chronic	electrons E>15keV	Lognormal	0.221	3.000	0.000
52	1979	chronic	electrons E>15keV	Lognormal	0.185	3.000	0.000
53	1980	chronic	electrons E>15keV	Lognormal	0.155	3.000	0.000

OTHER ADVANCED FEATURES			
Sample Size	Random Seed		
2000	99		
User Defined Uncertainty Distribution			
Dose Distribution Type	Parameter 1	Parameter 2	Parameter 3
Lognormal	1.000	1.000	0.000

12 Sample CATI

NIOSH

Energy Employees Occupational Illness Compensation Program Act (EEOICPA) Dose Reconstruction Telephone Interview

NIOSH Claimant ID	Batch Id	Social Security No	DOL District Office	Date of Birth
6924	173		Seattle, WA	12/27/1940

Energy Employee Name: _____ (Last) _____ (First) S. (Middle)

Home Address: _____ (Street)

City / State / Zip: Seattle (City) WA (State) 98112 (Zip) Current Phone Ext: _____

Covered Employment

09/13/1962 To 09/29/1968 Sandia National Laboratories

Date Interview Conducted: 04/21/2004 (Date) 01:55 pm (Time)

Interview Conducted By: Gwen

Section 1: Introductory Questions

	Yes	No	Don't Know
Did you receive a letter about the interview from NIOSH?	☑	☐	☐
Do you wish to be interviewed?	☑	☐	
Do you have any questions about the process?	☑	☐	
Do you have any questions or concerns before we get started?	☐	☑	

Section 2: Employment				
Employer	**Supervisor**	**Job Title**	**Start Date**	**End Date**
Sandia National Laboratories	See comments	Project Engineer	09/13/1962	09/29/1968

See Comments in Section 9

Section 3: Detailed Work History	Sandia National Laboratories: Project Engineer 09/13/1962-09/29/1968

How many hours per week did you work on this job? 40+ hrs/wk

How many hours per week did your job involve potential exposure to radiation and/or radioactive materials? * hrs/wk

Which buildings or locations did you work in, for each of your routine duties?

Building/Location	Description of Routine Duties
Nevada Test Site (All test areas), Honolulu, HI, South Pacific and Livermore, CA.	From 9/62 to 6/6[ ]as stationed at Sandia National Lab in Albuquerque, New Mexico. (Continue to comments)

What types of radioactive Materials were present or processed, in what physical form(s)(solid, liquid, gas) and quantity? ☐ None

Radionuclide	Yes	No	Don't Know	Isotopes(s)	Quantity	Solid	Liquid	Gas
Tritium	☑	☐	☐	Not sure	Not sure	☐	☐	☑
Cobalt	☑	☐	☐	Not sure	Not sure	☐	☐	☐
Strontium/Yttrium (Sr/Y)	☑	☐	☐	Not sure	Not sure	☐	☐	☐
Technetium (Tc)	☐	☐	☑			☐	☐	☐
Iodine	☐	☐	☑			☐	☐	☐
Cesium (Cs)	☐	☐	☑			☐	☐	☐
Thallium (Tl)	☐	☐	☑			☐	☐	☐
Lead (Pb)	☐	☐	☑			☐	☐	☐
Polonium (Po)	☐	☐	☑			☐	☐	☐
Radon (Rn) - progeny	☑	☐	☐	Not sure	Not sure	☐	☐	☑
Radium (Ra)	☐	☐	☑			☐	☐	☐
Actinium (Ac)	☐	☐	☑			☐	☐	☐
Europium (Eu)	☐	☐	☑			☐	☐	☐
Thorium (Th)	☐	☐	☑			☐	☐	☐
Protactinium (Pa)	☐	☐	☑			☐	☐	☐
Uranium (U) - natural	☑	☐	☐	Not sure	Not sure	☑	☐	☐
Uranium (U) - enriched	☑	☐	☐	Not sure	Not sure	☑	☐	☐
Neptunium (Np)	☐	☐	☑			☐	☐	☐
Plutonium (Pu)	☑	☐	☐	Not sure	Not sure	☑	☐	☐
Americium (Am)	☐	☐	☑			☐	☐	☐
Curium (Cm)	☐	☐	☑			☐	☐	☐
Californium	☐	☐	☑			☐	☐	☐
Others (1)						☐	☐	☐
(2)						☐	☐	☐
(3)						☐	☐	☐

What Types of production processes involving radioactive materials occurred in areas where you worked: Machining of weapons grade radioactive materials

What types of radiation-generating equipment were present or used (e.g., neutron devices, radiography equipment)? Neutron Generators, Radio Isotopes generators and monitoring equipment

What specific tasks did you perform, using what types of radioactive materials (in what quantities), and/or radiation generating equipments? Type: See above Quantity: Not sure

Task: See general comment 1

What exposure/contamination control measures were used to protect you? ☐ None

General Area Measures (Frequency of Use)	Always	Sometimes	Never	If sometimes, when?
Fume Hoods	☐	☑	☐	Working on equipment
Glove boxes	☐	☑	☐	Working on equipment
Shielding	☐	☑	☐	Lead - Working on equipment
Remote Control Devices / Robotics	☐	☐	☑	
Local ventilation	☐	☑	☐	Instrumentation Trailers at Nevada Test
Other enclosures	☐	☐	☑	
Personal Measures				
Anti-contamination clothing	☐	☑	☐	See comments
Respirators	☐	☑	☐	See comments
Showers	☐	☑	☐	See comments
Other personal protective equipment	☐	☐	☑	

Section 4: Radiation Monitoring

Employer Data: Sandia National Laboratories: Project Engineer 09/13/1962-09/29/1968

	Yes	No	Don't Know
Did you conduct your work under a Special Work Permit(SWP) or a Radiation Work Permit (RWP)	☐ SWP ☐ RWP	☐	☑
If Yes During What Times			
Did you or your co-workers (working in the same area as you) routinely wear radiation dosimeter badges?	☐ Routine ☑ Intermittent	☐	☐

For which Duties or in which Buildings or locations, and during what time period (e.g. which years) did you or your co-workers (working in the same areas as you) routinely wear radiation dosimetry badges?

Building/ Location	Time Period	Duties	Wore Badge	Co-Worker Wear Badge	Frequency Badge Worn	Badge Exchange Frequency	Body Location Badge
Nevada Test Site (All test areas), Honolulu, HI, South Pacific and Livermore, CA.	1/65 To 9/68	From 9/62 to 6/64 Mr. [redacted] was stationed at Sandia National Lab in Albuquerque, New Mexico. (Continue to comments)	☑	☑	See comments	Weekly when worn	Chest or belt area

	Yes	No	Don't Know
Did you participate in a biological radiation-monitoring program such as urine, fecal, breath, or in-vivo/whole body count?	☐ Urine ☐ Breath ☐ Fecal ☐ In-vivo	☐	☑
Do you have copies of your dosimeter badge or biological monitoring records?	☐ Badge ☐ Biological	☑	☐
If yes, are you willing to provide copies to us? ☐ Yes ☐ No			
If no, reason:			
Did you routinely survey yourself (frisk) for external contamination? **If yes, did you frisk before showering?** ☐ Before ☐ After	☐	☑	☐
Was there general area air monitoring for radiation performed in the work environment? **If yes, which areas:**	☐	☐	☑
Were there any radiation surveys taken to characterize potential for external exposure? **If yes, when did these occur:**	☐	☐	☑
Was there monitoring for exposure to radon in any of the buildings or areas you worked? **If yes, which buildings or areas:**	☐	☐	☑
Were you ever restricted from the workplace or certain job duties because you had reached a radiation dose limit?	☑	☐	☐

Section 5: Required Medical Screening X-Rays				
Employer Data	Sandia National Laboratories: Project Engineer 09/13/1962-09/29/1968			
		Yes	No	Don't Know
Were you required to have medical x-ray for this job as a condition of employment?		☐	☐	☑
Do you have any records of these X-rays?	☐ All x-rays ☐ Some x-rays	☐	☐	
If Yes, would you be willing to provide us with copies of these records?	☐ Yes ☐ No			
If no, reason				

Section 6: Radiation Incidents

Employer Data: **Sandia National Laboratories: Project Engineer 09/13/1962-09/29/1968**

Were you ever involved in an accident involving radiation exposure or contamination? Yes ☑ No ☐ Don't Know ☐

Incident

What happened, where, and **Date: (MM/YYYY):**

Location: Nevada Test Site

Description of Incident: There were several times (6 or less) when nuclear tests were vented into atmosphere. Sometimes he and others were down wind of the tests. There was residual contamination in the area that he would travel through from time to time.

Which radioactive materials were involved, and in what form and quantity **Physical Form** **Quantity**

Isotopes Not sure

Was radiation-generating equipment involved? ☑ Yes ☐ No ☐ Don't Know

If Yes, What Type Nuclear Devices

Who was involved? Dozens

What actions were taken to remedy the exposure or contamination?
None, because they were not aware at the time they were being exposed

What were your location and activities during the incident?

Location	Activities
In test areas	Monitoring and Retrieving test monitoring equipment

What precautions were taken to protect you?
None

What types of personal protective equipment, if any, did you use?
None

How long were you exposed during the incident?
30 minutes to 4 hours.

Did you receive chelation therapy or other medical treatment as a result of radiation exposure from this incident?
☐ Yes, Chelation Therapy ☐ Yes, Other Medical ☑ No ☐ Don't Know

Explain

Did you receive biological monitoring after the incident?
☐ Yes, Urine ☐ Yes, Breath ☐ Yes, ☐ Yes, In-vivo ☑ No ☐ Don't Know

Section 7: Other Relative Info

Employer Data: Sandia National Laboratories: Project Engineer 09/13/1962-09/29/1968

		Yes	No	Don't Know
Are you aware of any records related to the information you have provided that may help us estimate your doses?	Personal Physician			
	Site Medical Records			
	Incident Reports			
	Safety Meeting Notes			
	Other			
Have we missed asking you about any conditions, situations, or practices that occurred during this job, which you think, may be useful to us in estimating your radiation doses?		☑	☐	☐

If yes, please describe:

[redacted] visited various South Pacific detention site after tests from early years.

Section 8: Final Questions - Identifying Co-workers and Other Witnesses		
Site: Sandia National Laboratories 09/13/1962-09/29/1968		
Can you name co-workers or other witnesses, such as consulting industrial hygienists or radiation safety specialists, who can confirm or expand upon the information you have provided us?	Yes ☑	No ☐

Name:	
Phone:	Ext:
Address:	PO Box:
Name:	
Phone:	Ext:
Address:	PO Box:

Section 9: Comments

General Comments Section

1. Design, developed, installed and retrieved test monitoring equipment at the test chamber. Observer of Uranium mines operations in New Mexico.

Section 2: Employment History

Employment History Comments

M[redacted] Supervisor was [redacted]

Section 3: Detailed Work History

Site Sandia National Laboratories 09/13/1962 To 09/29/1968

Covered Employee Hours per Week

M[redacted] worked 50 to 60 hours a week.

Covered Employee Hours per Week Exposure

From 1/65 to 9/68 M[redacted] was potentially exposed to radiation 40+ hours a week.

Duties

M[redacted] was a Project Engineer. He designed and developed nuclear test monitoring equipment and facilities.

From 6/64 to 1/65 M[redacted] worked at the Sandia Facility in Honolulu, HI and South Pacific Atmospheric Test Sites. He designed and developed nuclear test monitoring equipment and facilities.

From 1/65 to 8/67 Mr. [redacted] living and working at Nevada Test Site. He was the Sandia Resident Manager responsible for all Sandia Staff working on test projects at Nevada Test Site. He traveled to Tonopah Test Site and various uranium mines in New Mexico. He was working in the bottom of the Shafts and in the tunnels inside the test chambers prior to and after detention.

From 8/67 to 9/68 M[redacted] was stationed at Livermore, CA and traveling every week to Nevada Test Site. He was the Project Engineer for underground nuclear test instrumentation. He was working in the bottom of the shafts and in the tunnels inside the test chambers prior to and after detention.

Building: Nevada Test Site (All test areas), Honolulu, HI, South Pacific and Livermore, CA.

Personal Measures, Clothing When

When retrieving instrumentation after detention at Nevada Test Site.

Personal Measures, Respirators When

When retrieving instrumentation after detention at Nevada Test Site and working around hazardous materials.

Personal Measures, Showers When

After entering a post test tunnel or shaft.

Section 4: Radiation Monitoring

Section 9: Comments
Site Sandia National Laboratories 09/13/1962 To 09/29/1968

Radiation Monitoring Covered Employee Wore Dosimeters No/Dont Know

Occasionall[redacted]wore a radiation badge at Nevada Test Site and Tonopah Test Site.

Radiation Monitoring Restricted Due to Dose Limit Yes/No/Dont Know

M[redacted]was restricted from the work area approximately 6 times for weeks at a time at Nevada Test Site at different locations.

Section 5: Required Medical Screening X-Rays
Site Sandia National Laboratories 09/13/1962 To 09/29/1968

Medical Xrays Job Requirement

Mr.[redacted]had a pre-employment physical not sure if it included an X-Ray.

Appendix 1: NIOSH – OCAS TIB-0005

ORAU TEAM
Dose Reconstruction
Project for NIOSH

Oak Ridge Associated Universities I Dade Moeller & Associates I MJW Corporation

Document Title:	Document Number: ORAUT-OTIB-0005 Revision: 02 PC-1 Effective Date: 02/10/2006 Type of Document: OTIB Supersedes: Revision 01
Internal Dosimetry Organ, External Dosimetry Organ, and IREP Model Selection by ICD-9 Code	

Subject Expert: Scott R. Siebert

Document Owner Approval: Signature on File — Edward F. Maher, Task 5 Manager — Approval Date: 11/10/2005

Concurrence: Signature on File — Patricia C. Kimpan, Project Director — Concurrence Date: 11/10/2005

Approval: Signature on File — James W. Neton, Associate Director for Science — Approval Date: 12/02/2005

☐ 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
11/03/2003	00	ORAU technical information bulletin to clarify IMBA organ and IREP model selection First approved issue. Initiated by Elizabeth M. Brackett.
01/23/2004	01	Incorporates applicable external dosimetry organ selection. Approved issue of Revision 01. Initiated by Elizabeth M. Brackett.
03/05/2004	01 PC-1	IREP model correction for ICD-9 code 238.7 (added Bone model), remove IMBA/External/IREP model info from header rows for ICD-9 codes 194 and 205. Approved issue of page change 1. Initiated by Elizabeth M. Brackett.
05/07/2004	01 PC-2	IMBA and External model correction for ICD-9 code 231.8 (changed to med review on page 15), IMBA model correction for ICD-9 codes 235.8 and 235.9 (changed to med review on page 16), External model correction for ICD-9 code 185 (changed to bladder on page 8). Approved issue of page change 2. Initiated by Elizabeth M. Brackett.
10/29/2004	01 PC-3	IMBA model correction for ICD-9 code 189.2, 189.3, and 189.4 (changed to highest non-met organ/tissue on page 9), added footnote number 5 to Table 1 for ICD-9 code 232 on page 18. Changed DOL documentation to NIOSH Referral Summary Document (NRSD) on page 20. Approved issue of page change 3. Initiated by Scott R. Siebert.
12/02/2005	02	Adds information for ICD-9 codes 289.7 and 289.9, clarifies handling adenocarcinoma of the distal (lower third) esophagus, corrects external organ for ICD-9 codes 233.4 and 236.5, updates correct model selections for various cancers (to reflect guidance in OCAS TIB-012, except as directed by OCAS to mark many 200-204 organs as "Reserved"), adds likely primary cancer selection for secondary cancers. Changes references to "IMBA organ" to "Internal Dosimetry organ." Approved issue of Revision 02. Training required: As determined by the Task Manager. Initiated by Scott R. Siebert.
02/10/2006	02 PC-1	Approved page change revision. Updates Table 3-1 (pages 15 – 22) in Section 3.2 to reflect guidance in OCAS TIB-012 Rev 1 (internal and external organs for ICD-9 series 200 through 204 changed from "Reserved" to the specified organ) and changes OCAS-TIB-012 issue date and revision number in reference section (page 33). No sections were deleted. Training required: As determined by the Task Manager. Initiated by Scott R. Siebert. Approval: Signature on File 02/08/2006 Edward F. Maher, Task 5 Manager Signature on File 02/07/2006 Kate Kimpan, Project Director Signature on File 02/09/2006 James W. Neton, Associate Director for Science

1.0 PURPOSE

Technical Information Bulletins (TIBs) 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. TIBs may be used to assist the National Institute for Occupational Safety and Health in the completion of individual dose reconstructions.

This Technical Information Bulletin (TIB) provides guidance on selecting appropriate ICRP modeled organs/tissues to estimate the internal dose for specific ICD-9 codes, the appropriate organs/tissues to estimate external dose, and the appropriate model in the Interactive RadioEpidemiological Program (IREP). This TIB also provides information for selecting and assessing likely primary cancers for secondary cancers.

2.0 BACKGROUND

Under EEOICPA, the organs/tissues for which doses must be estimated are those delineated by the specified ICD-9 code received from the Department of Labor (DOL). While many ICD-9 codes are clear in their intended organ/tissue, additional guidance is necessary to identify the appropriate internal dosimetry organ, organ/tissue for external dose estimate, and IREP model to use for the organ/tissue. This TIB designates the appropriate internal dosimetry organ/tissue selection for the various ICD-9 coded cancers, the appropriate organ/tissue to estimate external dose, and the appropriate IREP model to use as well.

3.0 GUIDANCE

3.1 SELECTION OF APPROPRIATE ORGAN/MODEL

Table 3-1 correlates ICD-9 codes to the appropriate organ/tissue selection for internal dose estimate, the appropriate organ/tissue selection for external dose estimate, and the appropriate IREP model. Organs/tissues labeled "Highest non-met org/tiss" indicate that dose to the highest non-metabolic organ is to be used to represent the dose to the ICD-9 Code designated organ/tissue. A discussion of this term is included in section 4.0 of this bulletin. The remaining regions are described by the term used in the Integrated Modules for Bioassay Analysis (IMBA) software program.

3.2 SECONDARY CANCERS WITH UNKNOWN PRIMARY CANCER SITE

Another situation that needs to be assessed is the diagnosis of a secondary cancer with an unknown primary cancer location. It is accepted in medicine that cancer-causing agents such as ionizing radiation produce primary cancers. This means, in a case in which the primary site of cancer is unknown, the primary site must be established by inference to establish probability of causation. For each secondary cancer, the set of primary cancers producing approximately 75% of that secondary cancer among the U.S. population was identified (males and females were considered separately). Therefore, for secondary cancers with unknown primary site, Table 3-2 will be consulted to select likely primary sites, which will then be evaluated using IREP (reproduced from Table 7 in the IREP technical documentation).

Since each secondary cancer in Table 3-2 has more than one likely primary cancer site, each likely primary site must be evaluated using IREP to determine a probability of causation. If any one of the likely primary cancer sites yields a probability of causation greater than or equal to 50%, this site will be assumed to be the originating site for the secondary cancer and shall be submitted as such.

Table 3-1.

ICD-9 Code	Cancer code explanation	Internal Organ	External organ	IREP model
140	MALIGANT NEOPLASM LIP			
140.0	MALIG NEO UPPER VERMILION	Highest non-met org/tiss	Skin	Oral Cav and pharynx
140.1	MALIG NEO LOWER VERMILION	Highest non-met org/tiss	Skin	Oral Cav and pharynx
140.3	MALIG NEO UPPER LIP, INNER	Highest non-met org/tiss	Skin	Oral Cav and pharynx
140.4	MALIG NEO LOWER LIP, INNER	Highest non-met org/tiss	Skin	Oral Cav and pharynx
140.5	MALIG NEO LIP, INNER NOS	Highest non-met org/tiss	Skin	Oral Cav and pharynx
140.6	MALIG NEO LIP, COMMISSURE	Highest non-met org/tiss	Skin	Oral Cav and pharynx
140.8	MALIG NEO LIP NEC	Highest non-met org/tiss	Skin	Oral Cav and pharynx
140.9	MALIG NEO LIP/VERMIL NOS	Highest non-met org/tiss	Skin	Oral Cav and pharynx
141	MALIG NEO TONGUE			
141.0	MALIG NEO TONGUE BASE	Highest non-met org/tiss	Thyroid/Remainder[1]	Oral Cav and pharynx
141.1	MALIG NEO DORSAL TONGUE	Highest non-met org/tiss	Thyroid/Remainder[1]	Oral Cav and pharynx
141.2	MALIG NEO TIP/LAT TONGUE	Highest non-met org/tiss	Thyroid/Remainder[1]	Oral Cav and pharynx
141.3	MALIG NEO VENTRAL TONGUE	Highest non-met org/tiss	Thyroid/Remainder[1]	Oral Cav and pharynx
141.4	MALIG NEO ANT 2/3 TONGUE	Highest non-met org/tiss	Thyroid/Remainder[1]	Oral Cav and pharynx
141.5	MALIG NEO TONGUE JUNCTION	Highest non-met org/tiss	Thyroid/Remainder[1]	Oral Cav and pharynx
141.6	MALIG NEO LINGUAL TONSIL	LNET	Thyroid/Remainder[1]	Oral Cav and pharynx
141.8	MALIG NEO TONGUE NEC	Highest non-met org/tiss	Thyroid/Remainder[1]	Oral Cav and pharynx
141.9	MALIG NEO TONGUE NOS	Highest non-met org/tiss	Thyroid/Remainder[1]	Oral Cav and pharynx
142	MALIG NEO MAJOR SALIVARY			
142.0	MALIG NEO PAROTID	Highest non-met org/tiss	Thyroid/Remainder[1]	Oral Cav and pharynx
142.1	MALIG NEO SUBMANDIBULAR	Highest non-met org/tiss	Thyroid/Remainder[1]	Oral Cav and pharynx
142.2	MALIG NEO SUBLINGUAL	Highest non-met org/tiss	Thyroid/Remainder[1]	Oral Cav and pharynx
142.8	MALIG NEO MAJ SALIVARY NEC	Highest non-met org/tiss	Thyroid/Remainder[1]	Oral Cav and pharynx
142.9	MALIG NEO SALIVARY NOS	Highest non-met org/tiss	Thyroid/Remainder[1]	Oral Cav and pharynx
143	MALIGNANT NEOPLASM GUM			
143.0	MALIG NEO UPPER GUM	Highest non-met org/tiss	Thyroid/Remainder[1]	Oral Cav and pharynx
143.1	MALIG NEO LOWER GUM	Highest non-met org/tiss	Thyroid/Remainder[1]	Oral Cav and pharynx
143.8	MALIG NEO GUM NEC	Highest non-met org/tiss	Thyroid/Remainder[1]	Oral Cav and pharynx
143.9	MALIG NEO GUM NOS	Highest non-met org/tiss	Thyroid/Remainder[1]	Oral Cav and pharynx
144	MALIG NEO MOUTH FLOOR			
144.0	MALIG NEO ANT FLOOR MOUTH	Highest non-met org/tiss	Thyroid/Remainder[1]	Oral Cav and pharynx
144.1	MALIG NEO LAT FLOOR MOUTH	Highest non-met org/tiss	Thyroid/Remainder[1]	Oral Cav and pharynx
144.8	MALIG NEO MOUTH FLOOR NEC	Highest non-met org/tiss	Thyroid/Remainder[1]	Oral Cav and pharynx
144.9	MALIG NEO MOUTH FLOOR NOS	Highest non-met org/tiss	Thyroid/Remainder[1]	Oral Cav and pharynx
145	MALIG NEO MOUTH NEC/NOS			
145.0	MALIG NEO CHEEK MUCOSA	Highest non-met org/tiss	Thyroid/Remainder[1]	Oral Cav and pharynx
145.1	MALIG NEO MOUTH VESTIBULE	Highest non-met org/tiss	Thyroid/Remainder[1]	Oral Cav and pharynx

Table 3-1 (Continued).

ICD-9 Code	Cancer code explanation	Internal Organ	External organ	IREP model
145.2	MALIG NEO HARD PALATE	Highest non-met org/tiss	Thyroid/Remainder[1]	Oral Cav and pharynx
145.3	MALIG NEO SOFT PALATE	Highest non-met org/tiss	Thyroid/Remainder[1]	Oral Cav and pharynx
145.4	MALIG NEO UVULA	Highest non-met org/tiss	Thyroid/Remainder[1]	Oral Cav and pharynx
145.5	MALIG NEO PALATE NOS	Highest non-met org/tiss	Thyroid/Remainder[1]	Oral Cav and pharynx
145.6	MALIG NEO RETROMOLAR	Highest non-met org/tiss	Thyroid/Remainder[1]	Oral Cav and pharynx
145.8	MALIG NEO MOUTH NEC	Highest non-met org/tiss	Thyroid/Remainder[1]	Oral Cav and pharynx
145.9	MALIG NEO MOUTH NOS	Highest non-met org/tiss	Thyroid/Remainder[1]	Oral Cav and pharynx
146	MALIG NEO OROPHARYNX			
146.0	MALIG NEO TONSIL	LNET	Esophagus	Oral Cav and pharynx
146.1	MALIG NEO TONSILLAR FOSSA	LNET	Esophagus	Oral Cav and pharynx
146.2	MALIG NEO TONSIL PILLARS	LNET	Esophagus	Oral Cav and pharynx
146.3	MALIG NEO VALLECULA	ET2	Esophagus	Oral Cav and pharynx
146.4	MALIG NEO ANT EPIGLOTTIS	ET2	Esophagus	Oral Cav and pharynx
146.5	MALIG NEO EPIGLOTTIS JUNCT	ET2	Esophagus	Oral Cav and pharynx
146.6	MALIG NEO LAT OROPHARYNX	ET2	Esophagus	Oral Cav and pharynx
146.7	MALIG NEO POST OROPHARYNX	ET2	Esophagus	Oral Cav and pharynx
146.8	MALIG NEO OROPHARYNX NEC	ET2	Esophagus	Oral Cav and pharynx
146.9	MALIG NEO OROPHARYNX NOS	ET2	Esophagus	Oral Cav and pharynx
147	MALIG NEO NASOPHARYNX			
147.0	MALIG NEO SUPER NASOPHARYN	ET2	Esophagus	Oral Cav and pharynx
147.1	MALIG NEO POST NASOPHARYNX	ET2	Esophagus	Oral Cav and pharynx
147.2	MALIG NEO LAT NASOPHARYNX	ET2	Esophagus	Oral Cav and pharynx
147.3	MALIG NEO ANT NASOPHARYNX	ET2	Esophagus	Oral Cav and pharynx
147.8	MALIG NEO NASOPHARYNX NEC	ET2	Esophagus	Oral Cav and pharynx
147.9	MALIG NEO NASOPHARYNX NOS	ET2	Esophagus	Oral Cav and pharynx
148	MALIG NEO HYPOPHARYNX			
148.0	MALIG NEO POSTCRICOID	ET2	Esophagus	Oral Cav and pharynx
148.1	MALIG NEO PYRIFORM SINUS	ET2	Esophagus	Oral Cav and pharynx
148.2	MALIG NEO ARYEPIGLOTT FOLD	ET2	Esophagus	Oral Cav and pharynx
148.3	MALIG NEO POST HYPOPHARYNX	ET2	Esophagus	Oral Cav and pharynx
148.8	MALIG NEO HYPOPHARYNX NEC	ET2	Esophagus	Oral Cav and pharynx
148.9	MALIG NEO HYPOPHARYNX NOS	ET2	Esophagus	Oral Cav and pharynx
149	OTHER MALIG OROPHARYNX			
149.0	MALIG NEO PHARYNX NOS	ET2	Esophagus	Oral Cav and pharynx
149.1	MALIG NEO WALDEYER'S RING	LNET	Esophagus	Oral Cav and pharynx
149.8	MALIG NEO ORAL/PHARYNX NEC	ET2	Esophagus	Oral Cav and pharynx
149.9	MALIG NEO OROPHRYN ILL-DEF	ET2	Esophagus	Oral Cav and pharynx
150	MALIG NEO ESOPHAGUS			

Table 3-1 (Continued).

ICD-9 Code	Cancer code explanation	Internal Organ	External organ	IREP model
150.0	MALIG NEO CERVICAL ESOPHAG	Esophagus	Esophagus	Esophagus
150.1	MALIG NEO THORACIC ESOPHAG	Esophagus/stomach[6]	Esophagus/stomach[6]	Esophagus/stomach[6]
150.2	MALIG NEO ABDOMIN ESOPHAG	Esophagus/stomach[6]	Esophagus/stomach[6]	Esophagus/stomach[6]
150.3	MALIG NEO UPPER 3RD ESOPH	Esophagus	Esophagus	Esophagus
150.4	MALIG NEO MIDDLE 3RD ESOPH	Esophagus	Esophagus	Esophagus
150.5	MALIG NEO LOWER 3RD ESOPH	Esophagus/stomach[6]	Esophagus/stomach[6]	Esophagus/stomach[6]
150.8	MALIG NEO ESOPHAGUS NEC	Esophagus/stomach[6]	Esophagus/stomach[6]	Esophagus/stomach[6]
150.9	MALIG NEO ESOPHAGUS NOS	Esophagus/stomach[6]	Esophagus/stomach[6]	Esophagus/stomach[6]
151	MALIGNANT NEO STOMACH			
151.0	MALIG NEO STOMACH CARDIA	Stomach	Stomach	Stomach
151.1	MALIG NEO PYLORUS	Stomach	Stomach	Stomach
151.2	MALIG NEO PYLORIC ANTRUM	Stomach	Stomach	Stomach
151.3	MALIG NEO STOMACH FUNDUS	Stomach	Stomach	Stomach
151.4	MALIG NEO STOMACH BODY	Stomach	Stomach	Stomach
151.5	MALIG NEO STOM LESSER CURV	Stomach	Stomach	Stomach
151.6	MALIG NEO STOM GREAT CURV	Stomach	Stomach	Stomach
151.8	MALIG NEO STOMACH NEC	Stomach	Stomach	Stomach
151.9	MALIG NEO STOMACH NOS	Stomach	Stomach	Stomach
152	MALIG NEO SMALL BOWEL			
152.0	MALIG NEO DUODENUM	SI	Stomach	All digestive
152.1	MALIG NEO JEJUNUM	SI	Stomach	All digestive
152.2	MALIG NEO ILEUM	SI	Stomach	All digestive
152.3	MALIG NEO MECKEL'S DIVERT	SI	Stomach	All digestive
152.8	MALIG NEO SMALL BOWEL NEC	SI	Stomach	All digestive
152.9	MALIG NEO SMALL BOWEL NOS	SI	Stomach	All digestive
153	MALIGNANT NEOPLASM COLON			
153.0	MALIG NEO HEPATIC FLEXURE	ULI	Colon	Colon
153.1	MALIG NEO TRANSVERSE COLON	ULI	Colon	Colon
153.2	MALIG NEO DESCEND COLON	LLI	Colon	Colon
153.3	MALIG NEO SIGMOID COLON	LLI	Colon	Colon
153.4	MALIG NEO CECUM	ULI	Colon	Colon
153.5	MALIG NEO APPENDIX	ULI	Colon	Colon
153.6	MALIG NEO ASCEND COLON	ULI	Colon	Colon

Table 3-1 (Continued).

ICD-9 Code	Cancer code explanation	Internal Organ	External organ	IREP model
153.7	MALIG NEO SPLENIC FLEXURE	LLI	Colon	Colon
153.8	MALIG NEO COLON NEC	Colon	Colon	Colon
153.9	MALIG NEO COLON NOS	Colon	Colon	Colon
154	MALIG NEO RECTUM/ANUS			
154.0	MALIG NEO RECTOSIGMOID JCT	LLI	Colon	Rectum
154.1	MALIG NEO RECTUM	LLI	Colon	Rectum
154.2	MALIG NEO ANAL CANAL	LLI	Colon	Rectum
154.3	MALIG NEO ANUS NOS	LLI	Colon	Rectum
154.8	MALIG NEO RECTUM/ANUS NEC	LLI	Colon	Rectum
155	MALIGNANT NEOPLASM LIVER			
155.0	MALIG NEO LIVER, PRIMARY	Liver	Liver	Liver
155.1	MALIG NEO INTRAHEPAT DUCTS	Gallbladder	Bladder	Gallbladder
155.2	MALIG NEO LIVER NOS	Liver	Liver	Liver
156	MALIG NEO GB/EXTRAHEPATIC			
156.0	MALIG NEO GALLBLADDER	Gallbladder	Bladder	Gallbladder
156.1	MALIG NEO EXTRAHEPAT DUCTS	Gallbladder	Bladder	Gallbladder
156.2	MALIG NEO AMPULLA VATER	Gallbladder	Bladder	Gallbladder
156.8	MALIG NEO BILIARY NEC	Gallbladder	Bladder	Gallbladder
156.9	MALIG NEO BILIARY NOS	Gallbladder	Bladder	Gallbladder
157	MALIGNANT NEO PANCREAS			
157.0	MALIG NEO PANCREAS HEAD	Pancreas	Stomach	Pancreas
157.1	MALIG NEO PANCREAS BODY	Pancreas	Stomach	Pancreas
157.2	MALIG NEO PANCREAS TAIL	Pancreas	Stomach	Pancreas
157.3	MALIG NEO PANCREATIC DUCT	Pancreas	Stomach	Pancreas
157.4	MALIG NEO ISLET LANGERHANS	Pancreas	Stomach	Pancreas
157.8	MALIG NEO PANCREAS NEC	Pancreas	Stomach	Pancreas
157.9	MALIG NEO PANCREAS NOS	Pancreas	Stomach	Pancreas
158	MALIG NEO PERITONEUM			
158.0	MALIG NEO RETROPERITONEUM	Highest non-met org/tiss	Stomach	All digestive
158.8	MALIG NEO PERITONEUM NEC	Highest non-met org/tiss	Stomach	All digestive
158.9	MALIG NEO PERITONEUM NOS	Highest non-met org/tiss	Stomach	All digestive
159	OTHER MALIG NEO GI/PERITON			
159.0	MALIG NEO INTESTINE NOS	Colon	Stomach	All digestive
159.1	MALIG NEO SPLEEN NEC	Spleen	Stomach	All digestive
159.8	MALIG NEO GI/INTRA-ABD NEC	Highest non-met org/tiss	Stomach	All digestive
159.9	MALIG NEO GI TRACT ILL-DEF	Highest non-met org/tiss	Stomach	All digestive
160	MALIG NEO NASAL CAV/SINUS			
160.0	MALIG NEO NASAL CAVITIES	ET1	Thyroid/Remainder[1]	Other respiratory

Table 3-1 (Continued).

ICD-9 Code	Cancer code explanation	Internal Organ	External organ	IREP model
160.1	MALIG NEO MIDDLE EAR	Highest non-met org/tiss	Thyroid/Remainder[1]	Other respiratory
160.2	MALIG NEO MAXILLARY SINUS	Highest non-met org/tiss	Thyroid/Remainder[1]	Other respiratory
160.3	MALIG NEO ETHMOIDAL SINUS	Highest non-met org/tiss	Thyroid/Remainder[1]	Other respiratory
160.4	MALIG NEO FRONTAL SINUS	Highest non-met org/tiss	Thyroid/Remainder[1]	Other respiratory
160.5	MALIG NEO SPHENOID SINUS	Highest non-met org/tiss	Thyroid/Remainder[1]	Other respiratory
160.8	MALIG NEO ACCESS SINUS NEC	Highest non-met org/tiss	Thyroid/Remainder[1]	Other respiratory
160.9	MALIG NEO ACCESS SINUS NOS	Highest non-met org/tiss	Thyroid/Remainder[1]	Other respiratory
161	MALIGNANT NEO LARYNX			
161.0	MALIG NEO GLOTTIS	ET2	Esophagus	Other respiratory
161.1	MALIG NEO SUPRAGLOTTIS	ET2	Esophagus	Other respiratory
161.2	MALIG NEO SUBGLOTTIS	ET2	Esophagus	Other respiratory
161.3	MALIG NEO CARTILAGE LARYNX	ET2	Esophagus	Other respiratory
161.8	MALIG NEO LARYNX NEC	ET2	Esophagus	Other respiratory
161.9	MALIG NEO LARYNX NOS	ET2	Esophagus	Other respiratory
162	MALIG NEO TRACHEA/LUNG			
162.0	MALIG NEO TRACHEA	Lung	Lung	Lung
162.2	MALIG NEO MAIN BRONCHUS	Lung	Lung	Lung
162.3	MALIG NEO UPPER LOBE LUNG	Lung	Lung	Lung
162.4	MALIG NEO MIDDLE LOBE LUNG	Lung	Lung	Lung
162.5	MALIG NEO LOWER LOBE LUNG	Lung	Lung	Lung
162.8	MALIG NEO BRONCH/LUNG NEC	Lung	Lung	Lung
162.9	MALIG NEO BRONCH/LUNG NOS	Lung	Lung	Lung
163	MALIGNANT NEOPL PLEURA			
163.0	MALIG NEO PARIETAL PLEURA	Highest non-met org/tiss	Lung	Other respiratory
163.1	MALIG NEO VISCERAL PLEURA	Highest non-met org/tiss	Lung	Other respiratory
163.8	MALIG NEO PLEURA NEC	Highest non-met org/tiss	Lung	Other respiratory
163.9	MALIG NEO PLEURA NOS	Highest non-met org/tiss	Lung	Other respiratory
164	MALIG NEO THYMUS/MEDIASTIN			
164.0	MALIG NEO THYMUS	Thymus	Thymus	Other respiratory
164.1	MALIG NEO HEART	Heart Wall	Thymus	Other respiratory
164.2	MALIG NEO ANT MEDIASTINUM	Highest non-met org/tiss	Thymus	Other respiratory
164.3	MALIG NEO POST MEDIASTINUM	Highest non-met org/tiss	Thymus	Other respiratory
164.8	MALIG NEO MEDIASTINUM NEC	Highest non-met org/tiss	Thymus	Other respiratory
164.9	MALIG NEO MEDIASTINUM NOS	Highest non-met org/tiss	Thymus	Other respiratory
165	OTH/ILL-DEF MAL NEO RESP			
165.0	MALIG NEO UPPER RESP NOS	Lung	Lung	Other respiratory
165.8	MALIG NEO THORAX/RESP NEC	Lung	Lung	Other respiratory
165.9	MALIG NEO RESP SYSTEM NOS	Lung	Lung	Other respiratory

Table 3-1 (Continued).

ICD-9 Code	Cancer code explanation	Internal Organ	External organ	IREP model
170	MALIG NEO BONE/ARTIC CART			
170.0	MALIG NEO SKULL/FACE BONE	Bone surface	Bone Surface	Bone
170.1	MALIG NEO MANDIBLE	Bone surface	Bone Surface	Bone
170.2	MALIG NEO VERTEBRAE	Bone surface	Bone Surface	Bone
170.3	MALIG NEO RIBS/STERN/CLAV	Medical review	Bone Surface	Bone
170.4	MALIG NEO LONG BONES ARM	Bone surface	Bone Surface	Bone
170.5	MALIG NEO BONES WRIST/HAND	Bone surface	Bone Surface	Bone
170.6	MALIG NEO PELVIC GIRDLE	Medical review	Bone Surface	Bone
170.7	MALIG NEO LONG BONES LEG	Medical review	Bone Surface	Bone
170.8	MALIG NEO BONES ANKLE/FOOT	Bone surface	Bone Surface	Bone
170.9	MALIG NEO BONE NOS	Medical review	Bone Surface	Bone
171	MALIG NEO SOFT TISSUE			
171.0	MALIG NEO SOFT TISSUE HEAD	Highest non-met org/tiss	Thyroid/Remainder[1]	Connective Tissue
171.2	MALIG NEO SOFT TISSUE ARM	Highest non-met org/tiss	Remainder[2]	Connective Tissue
171.3	MALIG NEO SOFT TISSUE LEG	Highest non-met org/tiss	Remainder[2]	Connective Tissue
171.4	MALIG NEO SOFT TIS THORAX	Highest non-met org/tiss	Remainder[2]	Connective Tissue
171.5	MALIG NEO SOFT TIS ABDOMEN	Highest non-met org/tiss	Remainder[2]	Connective Tissue
171.6	MALIG NEO SOFT TIS PELVIS	Highest non-met org/tiss	Remainder[2]	Connective Tissue
171.7	MALIG NEO TRUNK NOS	Highest non-met org/tiss	Remainder[2]	Connective Tissue
171.8	MALIG NEO SOFT TISSUE NEC	Highest non-met org/tiss	Remainder[2]	Connective Tissue
171.9	MALIG NEO SOFT TISSUE NOS	Highest non-met org/tiss	Remainder[2]	Connective Tissue
172	MALIGNANT MELANOMA SKIN			
172.0	MALIG MELANOMA LIP	Skin	Skin	Malignant melanoma
172.1	MALIG MELANOMA EYELID	Skin	Skin	Malignant melanoma
172.2	MALIG MELANOMA EAR	Skin	Skin	Malignant melanoma
172.3	MALIG MELANOMA FACE NEC/NOS	Skin	Skin	Malignant melanoma
172.4	MALIG MELANOMA SCALP/NECK	Skin	Skin	Malignant melanoma
172.5	MALIG MELANOMA TRUNK	Skin	Skin	Malignant melanoma
172.6	MALIG MELANOMA ARM	Skin	Skin	Malignant melanoma
172.7	MALIG MELANOMA LEG	Skin	Skin	Malignant melanoma
172.8	MALIG MELANOMA SKIN NEC	Skin	Skin	Malignant melanoma
172.9	MALIG MELANOMA SKIN NOS	Skin	Skin	Malignant melanoma
173	OTHER MALIG NEOPL SKIN			
173.0	MALIG NEO SKIN LIP	Skin	Skin	Non-melanoma skin-Basal cell OR Non-melanoma skin-Squamous cell
173.1	MALIG NEO SKIN EYELID	Skin	Skin	Non-melanoma skin-Basal cell OR Non-melanoma skin-Squamous cell

Table 3-1 (Continued).

ICD-9 Code	Cancer code explanation	Internal Organ	External organ	IREP model
173.2	MALIG NEO SKIN EAR	Skin	Skin	Non-melanoma skin-Basal cell OR Non-melanoma skin-Squamous cell
173.3	MALIG NEO SKIN FACE NEC	Skin	Skin	Non-melanoma skin-Basal cell OR Non-melanoma skin-Squamous cell
173.4	MALIG NEO SCALP/SKIN NECK	Skin	Skin	Non-melanoma skin-Basal cell OR Non-melanoma skin-Squamous cell
173.5	MALIG NEO SKIN TRUNK	Skin	Skin	Non-melanoma skin-Basal cell OR Non-melanoma skin-Squamous cell
173.6	MALIG NEO SKIN ARM	Skin	Skin	Non-melanoma skin-Basal cell OR Non-melanoma skin-Squamous cell
173.7	MALIG NEO SKIN LEG	Skin	Skin	Non-melanoma skin-Basal cell OR Non-melanoma skin-Squamous cell
173.8	MALIG NEO SKIN NEC	Skin	Skin	Non-melanoma skin-Basal cell OR Non-melanoma skin-Squamous cell
173.9	MALIG NEO SKIN NOS	Skin	Skin	Non-melanoma skin-Basal cell OR Non-melanoma skin-Squamous cell
174	MALIG NEO FEMALE BREAST			
174.0	MALIG NEO NIPPLE	Breast	Breast	Breast
174.1	MALIG NEO BREAST-CENTRAL	Breast	Breast	Breast
174.2	MALIG NEO BREAST UP-INNER	Breast	Breast	Breast
174.3	MALIG NEO BREAST LOW-INNER	Breast	Breast	Breast
174.4	MALIG NEO BREAST UP-OUTER	Breast	Breast	Breast
174.5	MALIG NEO BREAST LOW-OUTER	Breast	Breast	Breast
174.6	MALIG NEO BREAST-AXILLARY	Breast	Breast	Breast
174.8	MALIG NEO BREAST NEC	Breast	Breast	Breast
174.9	MALIG NEO BREAST NOS	Breast	Breast	Breast
175	MALIG NEO MALE BREAST			
175.0	MALIG NEO MALE NIPPLE	Breast	Breast	Breast
175.9	MALIG NEO MALE BREAST NEC	Breast	Breast	Breast
176	KAPOSI'S SARCOMA			
176.0	SKIN-KAPOSI'S SARCOMA	Skin	Skin	Connective tissue AND Non-melanoma skin-Squamous cell
176.1	SOFT TISSUE-KAPOSI'S SARCOMA	Highest non-met org/tiss	Remainder[2]	Connective tissue AND Non-melanoma skin-Squamous cell
176.2	PALATE-KAPOSI'S SARCOMA	Highest non-met org/tiss	Thyroid/Remainder[1]	Connective tissue AND Non-melanoma skin-Squamous cell
176.3	GI SITES-KAPOSI'S SARCOMA	Colon	Stomach/Colon (location dependant)	Connective tissue AND Non-melanoma skin-Squamous cell

Table 3-1 (Continued).

ICD-9 Code	Cancer code explanation	Internal Organ	External organ	IREP model
176.4	LUNG-KAPOSI'S SARCOMA	Lung	Lung	Connective tissue AND Non-melanoma skin-Squamous cell
176.5	LYMPH NODES-KAPOSI'S SARCOMA	Highest non-met org/tiss	Remainder[2]	Connective tissue AND Non-melanoma skin-Squamous cell
176.8	SPF STS-KAPOSI'S SARCOMA	Highest non-met org/tiss	Remainder[2]	Connective tissue AND Non-melanoma skin-Squamous cell
176.9	KAPOSI'S SARCOMA NOS	Highest non-met org/tiss	Remainder[2]	Connective tissue AND Non-melanoma skin-Squamous cell
179	MALIG NEO UTERUS NOS	Uterus	Uterus	Female genitalia less ovary
180	MALIG NEO CERVIX UTERI			
180.0	MALIG NEO ENDOCERVIX	Uterus	Uterus	Female genitalia less ovary
180.1	MALIG NEO EXOCERVIX	Uterus	Uterus	Female genitalia less ovary
180.8	MALIG NEO CERVIX NEC	Uterus	Uterus	Female genitalia less ovary
180.9	MALIG NEO CERVIX UTERI NOS	Uterus	Uterus	Female genitalia less ovary
181	MALIG NEO PLACENTA	Uterus	Uterus	Female genitalia less ovary
182	MALIG NEO UTERUS BODY			
182.0	MALIG NEO CORPUS UTERI	Uterus	Uterus	Female genitalia less ovary
182.1	MALIG NEO UTERINE ISTHMUS	Uterus	Uterus	Female genitalia less ovary
182.8	MALIG NEO BODY UTERUS NEC	Uterus	Uterus	Female genitalia less ovary
183	MALIG NEO UTERINE ADNEXA			
183.0	MALIG NEO OVARY	Ovaries	Ovaries	Ovary
183.2	MALIG NEO FALLOPIAN TUBE	Ovaries	Ovaries	Ovary
183.3	MALIG NEO BROAD LIGAMENT	Ovaries	Ovaries	Ovary
183.4	MALIG NEO PARAMETRIUM	Uterus	Ovaries	Ovary
183.5	MALIG NEO ROUND LIGAMENT	Uterus	Ovaries	Ovary
183.8	MALIG NEO ADNEXA NEC	Ovaries	Ovaries	Ovary
183.9	MALIG NEO ADNEXA NOS	Ovaries	Ovaries	Ovary
184	MALIG NEO FEM GEN NEC/NOS			
184.0	MALIG NEO VAGINA	Muscle	Uterus	Female genitalia less ovary
184.1	MALIG NEO LABIA MAJORA	Skin	Uterus	Female genitalia less ovary
184.2	MALIG NEO LABIA MINORA	Skin	Uterus	Female genitalia less ovary
184.3	MALIG NEO CLITORIS	Skin	Uterus	Female genitalia less ovary
184.4	MALIG NEO VULVA NOS	Skin	Uterus	Female genitalia less ovary
184.8	MALIG NEO FEMALE GENIT NEC	Uterus	Uterus	Female genitalia less ovary
184.9	MALIG NEO FEMALE GENIT NOS	Uterus	Uterus	Female genitalia less ovary
185	MALIG NEO PROSTATE	Highest non-met org/tiss	Bladder	All male genitalia
186	MALIG NEO TESTIS			
186.0	MALIG NEO UNDESCEND TESTIS	Testes	Testes	All male genitalia

Table 3-1 (Continued).

ICD-9 Code	Cancer code explanation	Internal Organ	External organ	IREP model
186.9	MALIG NEO TESTIS NEC	Testes	Testes	All male genitalia
187	MALIG NEO MALE GENITAL NEC			
187.1	MALIG NEO PREPUCE	Skin	Testes	All male genitalia
187.2	MALIG NEO GLANS PENIS	Skin	Testes	All male genitalia
187.3	MALIG NEO PENIS BODY	Testes	Testes	All male genitalia
187.4	MALIG NEO PENIS NOS	Testes	Testes	All male genitalia
187.5	MALIG NEO EPIDIDYMIS	Testes	Testes	All male genitalia
187.6	MALIG NEO SPERMATIC CORD	Testes	Testes	All male genitalia
187.7	MALIG NEO SCROTUM	Testes	Testes	All male genitalia
187.8	MALIG NEO MALE GENITAL NEC	Testes	Testes	All male genitalia
187.9	MALIG NEO MALE GENITAL NOS	Testes	Testes	All male genitalia
188	MALIG NEO BLADDER			
188.0	MALIG NEO BLADDER-TRIGONE	Bladder	Bladder	Bladder
188.1	MALIG NEO BLADDER-DOME	Bladder	Bladder	Bladder
188.2	MALIG NEO BLADDER-LATERAL	Bladder	Bladder	Bladder
188.3	MALIG NEO BLADDER-ANTERIOR	Bladder	Bladder	Bladder
188.4	MALIG NEO BLADDER-POST	Bladder	Bladder	Bladder
188.5	MALIG NEO BLADDER NECK	Bladder	Bladder	Bladder
188.6	MALIG NEO URETERIC ORIFICE	Bladder	Bladder	Bladder
188.7	MALIG NEO URACHUS	Bladder	Bladder	Bladder
188.8	MALIG NEO BLADDER NEC	Bladder	Bladder	Bladder
188.9	MALIG NEO BLADDER NOS	Bladder	Bladder	Bladder
189	MALIG NEO URINARY NEC/NOS			
189.0	MALIG NEO KIDNEY	Kidney	Liver	Urinary organs less bladder
189.1	MALIG NEO RENAL PELVIS	Kidney	Liver	Urinary organs less bladder
189.2	MALIG NEO URETER	Highest non-met org/tiss	Liver	Urinary organs less bladder
189.3	MALIG NEO URETHRA	Highest non-met org/tiss	Liver	Urinary organs less bladder
189.4	MALIG NEO PARAURETHRAL	Highest non-met org/tiss	Liver	Urinary organs less bladder
189.8	MALIG NEO URINARY NEC	Bladder	Liver	Urinary organs less bladder
189.9	MALIG NEO URINARY NOS	Medical review	Liver	Urinary organs less bladder
190	MALIGANT NEOPLASM EYE			
190.0	MALIG NEO EYEBALL	Brain	Eye Lens	Eye
190.1	MALIG NEO ORBIT	Brain	Eye Lens	Eye
190.2	MALIG NEO LACRIMAL GLAND	Skin	Eye Lens	Eye
190.3	MALIG NEO CONJUNCTIVA	Skin	Eye Lens	Eye
190.4	MALIG NEO CORNEA	Skin	Eye Lens	Eye
190.5	MALIG NEO RETINA	Brain	Eye Lens	Eye
190.6	MALIG NEO CHOROID	Brain	Eye Lens	Eye

Table 3-1 (Continued).

ICD-9 Code	Cancer code explanation	Internal Organ	External organ	IREP model
190.7	MALIG NEO LACRIMAL DUCT	Skin	Eye Lens	Eye
190.8	MALIG NEO EYE NEC	Skin	Eye Lens	Eye
190.9	MALIG NEO EYE NOS	Skin	Eye Lens	Eye
191	MALIG NEOASM BRAIN			
191.0	MALIG NEO CEREBRUM	Brain	Thyroid/Remainder[1]	Nervous system
191.1	MALIG NEO FRONTAL LOBE	Brain	Thyroid/Remainder[1]	Nervous system
191.2	MALIG NEO TEMPORAL LOBE	Brain	Thyroid/Remainder[1]	Nervous system
191.3	MALIG NEO PARIETAL LOBE	Brain	Thyroid/Remainder[1]	Nervous system
191.4	MALIG NEO OCCIPITAL LOBE	Brain	Thyroid/Remainder[1]	Nervous system
191.5	MALIG NEO CEREB VENTRICLE	Brain	Thyroid/Remainder[1]	Nervous system
191.6	MALIG NEO CEREBELLUM NOS	Brain	Thyroid/Remainder[1]	Nervous system
191.7	MALIG NEO BRAIN STEM	Brain	Thyroid/Remainder[1]	Nervous system
191.8	MALIG NEO BRAIN NEC	Brain	Thyroid/Remainder[1]	Nervous system
191.9	MALIG NEO BRAIN NOS	Brain	Thyroid/Remainder[1]	Nervous system
192	MALIG NEO NERVE NEC/NOS			
192.0	MALIG NEO CRANIAL NERVES	Brain	Thyroid/Remainder[1]	Nervous system
192.1	MALIG NEO CEREBRAL MENING	Brain	Thyroid/Remainder[1]	Nervous system
192.2	MALIG NEO SPINAL CORD	Brain	Thyroid/Remainder[1]	Nervous system
192.3	MALIG NEO SPINAL MENINGES	Brain	Thyroid/Remainder[1]	Nervous system
192.8	MALIG NEO NERVOUS SYST NEC	Brain	Thyroid/Remainder[1]	Nervous system
192.9	MALIG NEO NERVOUS SYST NOS	Brain	Thyroid/Remainder[1]	Nervous system
193	MALIG NEO THYROID	Thyroid	Thyroid	Thyroid
194	MALIG NEO OTHER ENDOCRINE			
194.0	MALIG NEO ADRENAL	Adrenals	Thyroid/Remainder[1]	Other endocrine glands
194.1	MALIG NEO PARATHYROID	Thyroid	Thyroid/Remainder[1]	Other endocrine glands
194.3	MALIG NEO PITUITARY	Brain	Thyroid/Remainder[1]	Other endocrine glands
194.4	MALIG NEO PINEAL GLAND	Brain	Thyroid/Remainder[1]	Other endocrine glands
194.5	MALIG NEO CAROTID BODY	Brain	Thyroid/Remainder[1]	Other endocrine glands
194.6	MALIG NEO PARAGANGLIA NEC	Brain	Thyroid/Remainder[1]	Other endocrine glands
194.8	MALIG NEO ENDOCRINE NEC	Medical review	Remainder[2]	Other endocrine glands
194.9	MALIG NEO ENDOCRINE NOS	Medical review	Remainder[2]	Other endocrine glands
195	MALIG NEO OTH/ILL-DEF SITE			
195.0	MALIG NEO HEAD/FACE/NECK	Highest non-met org/tiss	Thyroid/Remainder[1]	Other and ill-defined sites
195.1	MALIG NEO THORAX	Highest non-met org/tiss	Remainder[2]	Other and ill-defined sites
195.2	MALIG NEO ABDOMEN	Highest non-met org/tiss	Remainder[2]	Other and ill-defined sites
195.3	MALIG NEO PELVIS	Highest non-met org/tiss	Remainder[2]	Other and ill-defined sites
195.4	MALIG NEO ARM	Highest non-met org/tiss	Remainder[2]	Other and ill-defined sites
195.5	MALIG NEO LEG	Highest non-met org/tiss	Remainder[2]	Other and ill-defined sites

Table 3-1 (Continued).

ICD-9 Code	Cancer code explanation	Internal Organ	External organ	IREP model
195.8	MALIG NEO SITE NEC	Highest non-met org/tiss	Remainder[2]	Other and ill-defined sites
196	MALIG NEO LYMPH NODES			
196.0	MALIG NEO LYMPH-HEAD/NECK	NA[3]	NA[3]	NA[3]
196.1	MALIG NEO LYMPH-INTRATHOR	NA[3]	NA[3]	NA[3]
196.2	MALIG NEO LYMPH-INTRA-ABD	NA[3]	NA[3]	NA[3]
196.3	MALIG NEO LYMPH-AXILLA/ARM	NA[3]	NA[3]	NA[3]
196.5	MALIG NEO LYMPH-INGUIN/LEG	NA[3]	NA[3]	NA[3]
196.6	MALIG NEO LYMPH-INTRAPELV	NA[3]	NA[3]	NA[3]
196.8	MALIG NEO LYMPH-MULT	NA[3]	NA[3]	NA[3]
196.9	MALIG NEO LYMPH NOS	NA[3]	NA[3]	NA[3]
197	SEC MALIG NEO GI/RESP			
197.0	SEC MALIG NEO LUNG	NA[3]	NA[3]	NA[3]
197.1	SEC MALIG NEO MEDIASTINUM	NA[3]	NA[3]	NA[3]
197.2	SEC MALIG NEO PLEURA	NA[3]	NA[3]	NA[3]
197.3	SEC MALIG NEO RESP NEC	NA[3]	NA[3]	NA[3]
197.4	SEC MALIG NEO SM BOWEL	NA[3]	NA[3]	NA[3]
197.5	SEC MALIG NEO LG BOWEL	NA[3]	NA[3]	NA[3]
197.6	SEC MALIG NEO PERITONEUM	NA[3]	NA[3]	NA[3]
197.7	SEC MALIG NEO LIVER	NA[3]	NA[3]	NA[3]
197.8	SEC MALIG NEO GI NEC	NA[3]	NA[3]	NA[3]
198	SEC MALIG NEO OTHER SITES			
198.0	SEC MALIG NEO KIDNEY	NA[3]	NA[3]	NA[3]
198.1	SEC MALIG NEO URIN NEC	NA[3]	NA[3]	NA[3]
198.2	SEC MALIG NEO SKIN	NA[3]	NA[3]	NA[3]
198.3	SEC MALIG NEO BRAIN/SPINE	NA[3]	NA[3]	NA[3]
198.4	SEC MALIG NEO NERVE NEC	NA[3]	NA[3]	NA[3]
198.5	SEC MALIG NEO BONE	NA[3]	NA[3]	NA[3]
198.6	SEC MALIG NEO OVARY	NA[3]	NA[3]	NA[3]
198.7	SEC MALIG NEO ADRENAL	NA[3]	NA[3]	NA[3]
198.8	OTHER SECONDARY MALIG NEO			
198.81	SEC MALIG NEO BREAST	NA[3]	NA[3]	NA[3]
198.82	SEC MALIG NEO GENITAL	NA[3]	NA[3]	NA[3]
198.89	SEC MALIG NEO NEC	NA[3]	NA[3]	NA[3]
199	MALIG NEOPLASM NOS			
199.0	MALIG NEO DISSEMINATED	Highest non-met org/tiss	Remainder[2]	Other and ill-defined sites
199.1	MALIG NEO NOS	Highest non-met org/tiss	Remainder[2]	Other and ill-defined sites
200	LYMPHOSARC/RETICULOSARC	LN(TH)	Thyroid	Lymphoma and multiple myeloma
200.0	RETICULOSARCOMA	LN(TH)	Thyroid	Lymphoma and multiple myeloma

Table 3-1 (Continued).

ICD-9 Code	Cancer code explanation	Internal Organ	External organ	IREP model
200.00	RETCLSRC UNSPEC EXT ORG	LN(TH)	Thyroid	Lymphoma and multiple myeloma
200.01	RETICULOSARCOMA HEAD	LN(ET)	Thyroid	Lymphoma and multiple myeloma
200.02	RETICULOSARCOMA THORAX	LN(TH)	Lung	Lymphoma and multiple myeloma
200.03	RETICULOSARCOMA ABDOM	Highest non-met org/tiss	Stomach	Lymphoma and multiple myeloma
200.04	RETICULOSARCOMA AXILLA	LN(TH)	Lung	Lymphoma and multiple myeloma
200.05	RETICULOSARCOMA INGUIN	Highest non-met org/tiss	Bladder	Lymphoma and multiple myeloma
200.06	RETICULOSARCOMA PELVIC	Highest non-met org/tiss	Bladder	Lymphoma and multiple myeloma
200.07	RETICULOSARCOMA SPLEEN	Spleen	Stomach	Lymphoma and multiple myeloma
200.08	RETICULOSARCOMA MULT	LN(TH)	Thyroid	Lymphoma and multiple myeloma
200.1	LYMPHOSARCOMA	LN(TH)	Thyroid	Lymphoma and multiple myeloma
200.10	LYMPHSRC UNSPEC EXT ORG	LN(TH)	Thyroid	Lymphoma and multiple myeloma
200.11	LYMPHOSARCOMA HEAD	LN(ET)	Thyroid	Lymphoma and multiple myeloma
200.12	LYMPHOSARCOMA THORAX	LN(TH)	Lung	Lymphoma and multiple myeloma
200.13	LYMPHOSARCOMA ABDOM	Highest non-met org/tiss	Stomach	Lymphoma and multiple myeloma
200.14	LYMPHOSARCOMA AXILLA	LN(TH)	Lung	Lymphoma and multiple myeloma
200.15	LYMPHOSARCOMA INGUIN	Highest non-met org/tiss	Bladder	Lymphoma and multiple myeloma
200.16	LYMPHOSARCOMA PELVIC	Highest non-met org/tiss	Bladder	Lymphoma and multiple myeloma
200.17	LYMPHOSARCOMA SPLEEN	Spleen	Stomach	Lymphoma and multiple myeloma
200.18	LYMPHOSARCOMA MULT	LN(TH)	Thyroid	Lymphoma and multiple myeloma
200.2	BURKITT'S TUMOR/LYMPHOMA	LN(TH)	Lung	Lymphoma and multiple myeloma
200.20	BURKITT'S TUMOR UNSPEC EXT ORG	LN(TH)	Lung	Lymphoma and multiple myeloma
200.21	BURKITT'S TUMOR HEAD	LN(TH)	Lung	Lymphoma and multiple myeloma
200.22	BURKITT'S TUMOR THORAX	LN(TH)	Lung	Lymphoma and multiple myeloma
200.23	BURKITT'S TUMOR ABDOM	LN(TH)	Lung	Lymphoma and multiple myeloma
200.24	BURKITT'S TUMOR AXILLA	LN(TH)	Lung	Lymphoma and multiple myeloma
200.25	BURKITT'S TUMOR INGUIN	LN(TH)	Lung	Lymphoma and multiple myeloma
200.26	BURKITT'S TUMOR PELVIC	LN(TH)	Lung	Lymphoma and multiple myeloma
200.27	BURKITT'S TUMOR SPLEEN	LN(TH)	Lung	Lymphoma and multiple myeloma
200.28	BURKITT'S TUMOR MULT	LN(TH)	Lung	Lymphoma and multiple myeloma
200.8	MIXED LYMPHOSARCOMA	LN(TH)	Thyroid	Lymphoma and multiple myeloma
200.80	OTHER VARN UNSPEC EXT ORG	LN(TH)	Thyroid	Lymphoma and multiple myeloma
200.81	MIXED LYMPHOSARC HEAD	LN(ET)	Thyroid	Lymphoma and multiple myeloma
200.82	MIXED LYMPHOSARC THORAX	LN(TH)	Lung	Lymphoma and multiple myeloma
200.83	MIXED LYMPHOSARC ABDOM	Highest non-met org/tiss	Stomach	Lymphoma and multiple myeloma
200.84	MIXED LYMPHOSARC AXILLA	LN(TH)	Lung	Lymphoma and multiple myeloma
200.85	MIXED LYMPHOSARC INGUIN	Highest non-met org/tiss	Bladder	Lymphoma and multiple myeloma
200.86	MIXED LYMPHOSARC PELVIC	Highest non-met org/tiss	Bladder	Lymphoma and multiple myeloma
200.87	MIXED LYMPHOSARC SPLEEN	Spleen	Stomach	Lymphoma and multiple myeloma

Table 3-1 (Continued).

ICD-9 Code	Cancer code explanation	Internal Organ	External organ	IREP model
200.88	MIXED LYMPHOSARC MULT	LN(TH)	Thyroid	Lymphoma and multiple myeloma
201	HODGKIN'S DISEASE	LN(TH)	Thyroid	Lymphoma and multiple myeloma
201.0	HODGKIN'S PARAGRANULOMA	LN(TH)	Thyroid	Lymphoma and multiple myeloma
201.00	HODGKINS PARAGRANULOMA UNSPEC EXT ORG	LN(TH)	Thyroid	Lymphoma and multiple myeloma
201.01	HODGKINS PARAGRAN HEAD	LN(ET)	Thyroid	Lymphoma and multiple myeloma
201.02	HODGKINS PARAGRAN THORAX	LN(TH)	Lung	Lymphoma and multiple myeloma
201.03	HODGKINS PARAGRAN ABDOM	Highest non-met org/tiss	Stomach	Lymphoma and multiple myeloma
201.04	HODGKINS PARAGRAN AXILLA	LN(TH)	Lung	Lymphoma and multiple myeloma
201.05	HODGKINS PARAGRAN INGUIN	Highest non-met org/tiss	Bladder	Lymphoma and multiple myeloma
201.06	HODGKINS PARAGRAN PELVIC	Highest non-met org/tiss	Bladder	Lymphoma and multiple myeloma
201.07	HODGKINS PARAGRAN SPLEEN	Spleen	Stomach	Lymphoma and multiple myeloma
201.08	HODGKINS PARAGRAN MULT	LN(TH)	Thyroid	Lymphoma and multiple myeloma
201.1	HODGKIN'S GRANULOMA	LN(TH)	Thyroid	Lymphoma and multiple myeloma
201.10	HODGKINS GRANULOM UNSPEC EXT ORG	LN(TH)	Thyroid	Lymphoma and multiple myeloma
201.11	HODGKINS GRANULOM HEAD	LN(ET)	Thyroid	Lymphoma and multiple myeloma
201.12	HODGKINS GRANULOM THORAX	LN(TH)	Lung	Lymphoma and multiple myeloma
201.13	HODGKINS GRANULOM ABDOM	Highest non-met org/tiss	Stomach	Lymphoma and multiple myeloma
201.14	HODGKINS GRANULOM AXILLA	LN(TH)	Lung	Lymphoma and multiple myeloma
201.15	HODGKINS GRANULOM INGUIN	Highest non-met org/tiss	Bladder	Lymphoma and multiple myeloma
201.16	HODGKINS GRANULOM PELVIC	Highest non-met org/tiss	Bladder	Lymphoma and multiple myeloma
201.17	HODGKINS GRANULOM SPLEEN	Spleen	Stomach	Lymphoma and multiple myeloma
201.18	HODGKINS GRANULOM MULT	LN(TH)	Thyroid	Lymphoma and multiple myeloma
201.2	HODGKIN'S SARCOMA	LN(TH)	Thyroid	Lymphoma and multiple myeloma
201.20	HODGKINS SRC UNSPEC EXT ORG	LN(TH)	Thyroid	Lymphoma and multiple myeloma
201.21	HODGKINS SARCOMA HEAD	LN(ET)	Thyroid	Lymphoma and multiple myeloma
201.22	HODGKINS SARCOMA THORAX	LN(TH)	Lung	Lymphoma and multiple myeloma
201.23	HODGKINS SARCOMA ABDOM	Highest non-met org/tiss	Stomach	Lymphoma and multiple myeloma
201.24	HODGKINS SARCOMA AXILLA	LN(TH)	Lung	Lymphoma and multiple myeloma
201.25	HODGKINS SARCOMA INGUIN	Highest non-met org/tiss	Bladder	Lymphoma and multiple myeloma
201.26	HODGKINS SARCOMA PELVIC	Highest non-met org/tiss	Bladder	Lymphoma and multiple myeloma
201.27	HODGKINS SARCOMA SPLEEN	Spleen	Stomach	Lymphoma and multiple myeloma
201.28	HODGKINS SARCOMA MULT	LN(TH)	Thyroid	Lymphoma and multiple myeloma
201.4	HODGKINS LYMPH-HISTIOCYT	LN(TH)	Thyroid	Lymphoma and multiple myeloma
201.40	LYM-HST UNSPEC EXT ORGN	LN(TH)	Thyroid	Lymphoma and multiple myeloma
201.41	HODGKINS LYMPH-HISTIO HEAD	LN(ET)	Thyroid	Lymphoma and multiple myeloma
201.42	HODGKINS LYMPH-HISTIO THORAX	LN(TH)	Lung	Lymphoma and multiple myeloma

Table 3-1 (Continued).

ICD-9 Code	Cancer code explanation	Internal Organ	External organ	IREP model
201.43	HODGKINS LYMPH-HISTIO ABDOM	Highest non-met org/tiss	Stomach	Lymphoma and multiple myeloma
201.44	HODGKINS LYMPH-HISTIO AXILLA	LN(TH)	Lung	Lymphoma and multiple myeloma
201.45	HODGKINS LYMPH-HISTIO INGUIN	Highest non-met org/tiss	Bladder	Lymphoma and multiple myeloma
201.46	HODGKINS LYMPH-HISTIO PELVIC	Highest non-met org/tiss	Bladder	Lymphoma and multiple myeloma
201.47	HODGKINS LYMPH-HISTIO SPLEEN	Spleen	Stomach	Lymphoma and multiple myeloma
201.48	HODGKINS LYMPH-HISTIO MULT	LN(TH)	Thyroid	Lymphoma and multiple myeloma
201.5	HODGKINS NODULAR SCLEROS	LN(TH)	Thyroid	Lymphoma and multiple myeloma
201.50	NODULAR SCLEROS UNSPEC EXT ORG	LN(TH)	Thyroid	Lymphoma and multiple myeloma
201.51	HODGKINS NODUL SCLERO HEAD	LN(ET)	Thyroid	Lymphoma and multiple myeloma
201.52	HODGKINS NODUL SCLERO THORAX	LN(TH)	Lung	Lymphoma and multiple myeloma
201.53	HODGKINS NODUL SCLERO ABDOM	Highest non-met org/tiss	Stomach	Lymphoma and multiple myeloma
201.54	HODGKINS NODUL SCLERO AXILLA	LN(TH)	Lung	Lymphoma and multiple myeloma
201.55	HODGKINS NODUL SCLERO INGUIN	Highest non-met org/tiss	Bladder	Lymphoma and multiple myeloma
201.56	HODGKINS NODUL SCLERO PELVIC	Highest non-met org/tiss	Bladder	Lymphoma and multiple myeloma
201.57	HODGKINS NODUL SCLERO SPLEEN	Spleen	Stomach	Lymphoma and multiple myeloma
201.58	HODGKINS NODUL SCLERO MULT	LN(TH)	Thyroid	Lymphoma and multiple myeloma
201.6	HODGKINS MIX CELLULARITY	LN(TH)	Thyroid	Lymphoma and multiple myeloma
201.60	MXD CELR UNSPEC EXT ORG	LN(TH)	Thyroid	Lymphoma and multiple myeloma
201.61	HODGKINS MIX CELL HEAD	LN(ET)	Thyroid	Lymphoma and multiple myeloma
201.62	HODGKINS MIX CELL THORAX	LN(TH)	Lung	Lymphoma and multiple myeloma
201.63	HODGKINS MIX CELL ABDOM	Highest non-met org/tiss	Stomach	Lymphoma and multiple myeloma
201.64	HODGKINS MIX CELL AXILLA	LN(TH)	Lung	Lymphoma and multiple myeloma
201.65	HODGKINS MIX CELL INGUIN	Highest non-met org/tiss	Bladder	Lymphoma and multiple myeloma
201.66	HODGKINS MIX CELL PELVIC	Highest non-met org/tiss	Bladder	Lymphoma and multiple myeloma
201.67	HODGKINS MIX CELL SPLEEN	Spleen	Stomach	Lymphoma and multiple myeloma
201.68	HODGKINS MIX CELL MULT	LN(TH)	Thyroid	Lymphoma and multiple myeloma
201.7	HODG LYMPHOCYTIC DEPLET	Highest non-met org/tiss	Thyroid	Lymphoma and multiple myeloma
201.70	LYM DPLT UNSPEC EXT ORG	LN(TH)	Thyroid	Lymphoma and multiple myeloma
201.71	HODGKINS LYMPH DEPLET HEAD	LN(ET)	Thyroid	Lymphoma and multiple myeloma
201.72	HODGKINS LYMPH DEPLET THORAX	LN(TH)	Lung	Lymphoma and multiple myeloma
201.73	HODGKINS LYMPH DEPLET ABDOM	Highest non-met org/tiss	Stomach	Lymphoma and multiple myeloma
201.74	HODGKINS LYMPH DEPLET AXILLA	LN(TH)	Lung	Lymphoma and multiple myeloma
201.75	HODGKINS LYMPH DEPLET INGUIN	Highest non-met org/tiss	Bladder	Lymphoma and multiple myeloma
201.76	HODGKINS LYMPH DEPLET PELVIC	Highest non-met org/tiss	Bladder	Lymphoma and multiple myeloma
201.77	HODGKINS LYMPH DEPLET SPLEEN	Spleen	Stomach	Lymphoma and multiple myeloma
201.78	HODGKINS LYMPH DEPLET MULT	LN(TH)	Thyroid	Lymphoma and multiple myeloma
201.9	HODGKINS DISEASE NOS	LN(TH)	Thyroid	Lymphoma and multiple myeloma
201.90	HDGK DISEASE UNSPEC EXT ORG	LN(TH)	Thyroid	Lymphoma and multiple myeloma

Table 3-1 (Continued).

ICD-9 Code	Cancer code explanation	Internal Organ	External organ	IREP model
201.91	HODGKINS DISEASE NOS HEAD	LN(ET)	Thyroid	Lymphoma and multiple myeloma
201.92	HODGKINS DISEASE NOS THORAX	LN(TH)	Lung	Lymphoma and multiple myeloma
201.93	HODGKINS DISEASE NOS ABDOM	Highest non-met org/tiss	Stomach	Lymphoma and multiple myeloma
201.94	HODGKINS DISEASE NOS AXILLA	LN(TH)	Lung	Lymphoma and multiple myeloma
201.95	HODGKINS DISEASE NOS INGUIN	Highest non-met org/tiss	Bladder	Lymphoma and multiple myeloma
201.96	HODGKINS DISEASE NOS PELVIC	Highest non-met org/tiss	Bladder	Lymphoma and multiple myeloma
201.97	HODGKINS DISEASE NOS SPLEEN	Spleen	Stomach	Lymphoma and multiple myeloma
201.98	HODGKINS DISEASE NOS MULT	LN(TH)	Thyroid	Lymphoma and multiple myeloma
202	OTHER MALIG NEO LYMPH/HISTIO	LN(TH)	Thymus/Lung'	Lymphoma and multiple myeloma
202.0	NODULAR LYMPHOMA	LN(TH)	Thymus/Lung'	Lymphoma and multiple myeloma
202.00	NDLR LYM UNSPEC EXT ORG	LN(TH)	Thymus/Lung'	Lymphoma and multiple myeloma
202.01	NODULAR LYMPHOMA HEAD	LN(TH)	Thymus/Lung'	Lymphoma and multiple myeloma
202.02	NODULAR LYMPHOMA THORAX	LN(TH)	Thymus/Lung'	Lymphoma and multiple myeloma
202.03	NODULAR LYMPHOMA ABDOM	LN(TH)	Thymus/Lung'	Lymphoma and multiple myeloma
202.04	NODULAR LYMPHOMA AXILLA	LN(TH)	Thymus/Lung'	Lymphoma and multiple myeloma
202.05	NODULAR LYMPHOMA INGUIN	LN(TH)	Thymus/Lung'	Lymphoma and multiple myeloma
202.06	NODULAR LYMPHOMA PELVIC	LN(TH)	Thymus/Lung'	Lymphoma and multiple myeloma
202.07	NODULAR LYMPHOMA SPLEEN	LN(TH)	Thymus/Lung'	Lymphoma and multiple myeloma
202.08	NODULAR LYMPHOMA MULT	LN(TH)	Thymus/Lung'	Lymphoma and multiple myeloma
202.1	MYCOSIS FUNGOIDES	Skin	Skin	Lymphoma and multiple myeloma
202.10	MYCS FNG UNSPEC EXT ORG	Skin	Skin	Lymphoma and multiple myeloma
202.11	MYCOSIS FUNGOIDES HEAD	Skin	Skin	Lymphoma and multiple myeloma
202.12	MYCOSIS FUNGOIDES THORAX	Skin	Skin	Lymphoma and multiple myeloma
202.13	MYCOSIS FUNGOIDES ABDOM	Skin	Skin	Lymphoma and multiple myeloma
202.14	MYCOSIS FUNGOIDES AXILLA	Skin	Skin	Lymphoma and multiple myeloma
202.15	MYCOSIS FUNGOIDES INGUIN	Skin	Skin	Lymphoma and multiple myeloma
202.16	MYCOSIS FUNGOIDES PELVIC	Skin	Skin	Lymphoma and multiple myeloma
202.17	MYCOSIS FUNGOIDES SPLEEN	Skin	Skin	Lymphoma and multiple myeloma
202.18	MYCOSIS FUNGOIDES MULT	Skin	Skin	Lymphoma and multiple myeloma
202.2	SEZARY'S DISEASE	Skin	Skin	Lymphoma and multiple myeloma
202.20	SZRY DISEASE UNSPEC EXT ORG	Skin	Skin	Lymphoma and multiple myeloma
202.21	SEZARY'S DISEASE HEAD	Skin	Skin	Lymphoma and multiple myeloma
202.22	SEZARY'S DISEASE THORAX	Skin	Skin	Lymphoma and multiple myeloma
202.23	SEZARY'S DISEASE ABDOM	Skin	Skin	Lymphoma and multiple myeloma
202.24	SEZARY'S DISEASE AXILLA	Skin	Skin	Lymphoma and multiple myeloma
202.25	SEZARY'S DISEASE INGUIN	Skin	Skin	Lymphoma and multiple myeloma
202.26	SEZARY'S DISEASE PELVIC	Skin	Skin	Lymphoma and multiple myeloma
202.27	SEZARY'S DISEASE SPLEEN	Skin	Skin	Lymphoma and multiple myeloma

Table 3-1 (Continued).

ICD-9 Code	Cancer code explanation	Internal Organ	External organ	IREP model
202.28	SEZARY'S DISEASE MULT	Skin	Skin	Lymphoma and multiple myeloma
202.3	MALIG HISTIOCYTOSIS	LN(TH)	Thyroid	Lymphoma and multiple myeloma
202.30	MLG HIST UNSPEC EXT ORG	LN(TH)	Thyroid	Lymphoma and multiple myeloma
202.31	MALIG HISTIOCYTOSIS HEAD	LN(ET)	Thyroid	Lymphoma and multiple myeloma
202.32	MALIG HISTIOCYTOSIS THORAX	LN(TH)	Lung	Lymphoma and multiple myeloma
202.33	MALIG HISTIOCYTOSIS ABDOM	Highest non-met org/tiss	Stomach	Lymphoma and multiple myeloma
202.34	MALIG HISTIOCYTOSIS AXILLA	LN(TH)	Lung	Lymphoma and multiple myeloma
202.35	MALIG HISTIOCYTOSIS INGUIN	Highest non-met org/tiss	Bladder	Lymphoma and multiple myeloma
202.36	MALIG HISTIOCYTOSIS PELVIC	Highest non-met org/tiss	Bladder	Lymphoma and multiple myeloma
202.37	MALIG HISTIOCYTOSIS SPLEEN	Spleen	Stomach	Lymphoma and multiple myeloma
202.38	MALIG HISTIOCYTOSIS MULT	LN(TH)	Thyroid	Lymphoma and multiple myeloma
202.4	LEUKEM RETICULOENDOTHEL	Red Bone Marrow	Red Bone Marrow	Lymphoma and multiple myeloma
202.40	LK RTCTL UNSPEC EXT ORG	Red Bone Marrow	Red Bone Marrow	Lymphoma and multiple myeloma
202.41	HAIRY-CELL LEUKEM HEAD	Red Bone Marrow	Red Bone Marrow	Lymphoma and multiple myeloma
202.42	HAIRY-CELL LEUKEM THORAX	Red Bone Marrow	Red Bone Marrow	Lymphoma and multiple myeloma
202.43	HAIRY-CELL LEUKEM ABDOM	Red Bone Marrow	Red Bone Marrow	Lymphoma and multiple myeloma
202.44	HAIRY-CELL LEUKEM AXILLA	Red Bone Marrow	Red Bone Marrow	Lymphoma and multiple myeloma
202.45	HAIRY-CELL LEUKEM INGUIN	Red Bone Marrow	Red Bone Marrow	Lymphoma and multiple myeloma
202.46	HAIRY-CELL LEUKEM PELVIC	Red Bone Marrow	Red Bone Marrow	Lymphoma and multiple myeloma
202.47	HAIRY-CELL LEUKEM SPLEEN	Red Bone Marrow	Red Bone Marrow	Lymphoma and multiple myeloma
202.48	HAIRY-CELL LEUKEM MULT	Red Bone Marrow	Red Bone Marrow	Lymphoma and multiple myeloma
202.5	LETTERER-SIWE DISEASE	LN(TH)	Skin	Lymphoma and multiple myeloma
202.50	LTR-SIWE UNSPEC EXT ORG	LN(TH)	Skin	Lymphoma and multiple myeloma
202.51	LETTERER-SIWE DISEASE HEAD	LN(TH)	Skin	Lymphoma and multiple myeloma
202.52	LETTERER-SIWE DISEASE THORAX	LN(TH)	Skin	Lymphoma and multiple myeloma
202.53	LETTERER-SIWE DISEASE ABDOM	LN(TH)	Skin	Lymphoma and multiple myeloma
202.54	LETTERER-SIWE DISEASE AXILLA	LN(TH)	Skin	Lymphoma and multiple myeloma
202.55	LETTERER-SIWE DISEASE INGUIN	LN(TH)	Skin	Lymphoma and multiple myeloma
202.56	LETTERER-SIWE DISEASE PELVIC	LN(TH)	Skin	Lymphoma and multiple myeloma
202.57	LETTERER-SIWE DISEASE SPLEEN	LN(TH)	Skin	Lymphoma and multiple myeloma
202.58	LETTERER-SIWE DISEASE MULT	LN(TH)	Skin	Lymphoma and multiple myeloma
202.6	MALIG MAST CELL TUMORS	LN(TH)	Thyroid	Lymphoma and multiple myeloma
202.60	MALIG MAST UNSPEC EXT ORG	LN(TH)	Thyroid	Lymphoma and multiple myeloma
202.61	MALIG MASTOCYTOSIS HEAD	LN(ET)	Thyroid	Lymphoma and multiple myeloma
202.62	MALIG MASTOCYTOSIS THORAX	LN(TH)	Lung	Lymphoma and multiple myeloma
202.63	MALIG MASTOCYTOSIS ABDOM	Highest non-met org/tiss	Stomach	Lymphoma and multiple myeloma
202.64	MALIG MASTOCYTOSIS AXILLA	LN(TH)	Lung	Lymphoma and multiple myeloma
202.65	MALIG MASTOCYTOSIS INGUIN	Highest non-met org/tiss	Bladder	Lymphoma and multiple myeloma

Table 3-1 (Continued).

ICD-9 Code	Cancer code explanation	Internal Organ	External organ	IREP model
202.66	MALIG MASTOCYTOSIS PELVIC	Highest non-met org/tiss	Bladder	Lymphoma and multiple myeloma
202.67	MALIG MASTOCYTOSIS SPLEEN	Spleen	Stomach	Lymphoma and multiple myeloma
202.68	MALIG MASTOCYTOSIS MULT	LN(TH)	Thyroid	Lymphoma and multiple myeloma
202.8	LYMPHOMAS NEC	LN(TH)	Thymus/Lung[7]	Lymphoma and multiple myeloma
202.80	OTHER LYMP UNSPEC EXT ORG	LN(TH)	Thymus/Lung[7]	Lymphoma and multiple myeloma
202.81	LYMPHOMAS NEC HEAD	LN(TH)	Thymus/Lung[7]	Lymphoma and multiple myeloma
202.82	LYMPHOMAS NEC THORAX	LN(TH)	Thymus/Lung[7]	Lymphoma and multiple myeloma
202.83	LYMPHOMAS NEC ABDOM	LN(TH)	Thymus/Lung[7]	Lymphoma and multiple myeloma
202.84	LYMPHOMAS NEC AXILLA	LN(TH)	Thymus/Lung[7]	Lymphoma and multiple myeloma
202.85	LYMPHOMAS NEC INGUIN	LN(TH)	Thymus/Lung[7]	Lymphoma and multiple myeloma
202.86	LYMPHOMAS NEC PELVIC	LN(TH)	Thymus/Lung[7]	Lymphoma and multiple myeloma
202.87	LYMPHOMAS NEC SPLEEN	LN(TH)	Thymus/Lung[7]	Lymphoma and multiple myeloma
202.88	LYMPHOMAS NEC MULT	LN(TH)	Thymus/Lung[7]	Lymphoma and multiple myeloma
202.9	MALIG NEO LYM/HIST TIS NEC	LN(TH)	Thymus/Lung[7]	Lymphoma and multiple myeloma
202.90	UNSPEC LYM UNSPEC EXT ORG	LN(TH)	Thymus/Lung[7]	Lymphoma and multiple myeloma
202.91	LYMPHOID MALIG NEC HEAD	LN(TH)	Thymus/Lung[7]	Lymphoma and multiple myeloma
202.92	LYMPHOID MALIG NEC THORAX	LN(TH)	Thymus/Lung[7]	Lymphoma and multiple myeloma
202.93	LYMPHOID MALIG NEC ABDOM	LN(TH)	Thymus/Lung[7]	Lymphoma and multiple myeloma
202.94	LYMPHOID MALIG NEC AXILLA	LN(TH)	Thymus/Lung[7]	Lymphoma and multiple myeloma
202.95	LYMPHOID MALIG NEC INGUIN	LN(TH)	Thymus/Lung[7]	Lymphoma and multiple myeloma
202.96	LYMPHOID MALIG NEC PELVIC	LN(TH)	Thymus/Lung[7]	Lymphoma and multiple myeloma
202.97	LYMPHOID MALIG NEC SPLEEN	LN(TH)	Thymus/Lung[7]	Lymphoma and multiple myeloma
202.98	LYMPHOID MALIG NEC MULT	LN(TH)	Thymus/Lung[7]	Lymphoma and multiple myeloma
203	MULTIPLE MYELOMA ET AL	Red Bone Marrow	Red Bone Marrow	Lymphoma and multiple myeloma
203.0	MULTIPLE MYELOMA	Red Bone Marrow	Red Bone Marrow	Lymphoma and multiple myeloma
203.00	MULT MYELM W/O REMISSION	Red Bone Marrow	Red Bone Marrow	Lymphoma and multiple myeloma
203.01	MULT MYELM W/REMISSION	Red Bone Marrow	Red Bone Marrow	Lymphoma and multiple myeloma
203.1	PLASMA CELL LEUKEMIA	Red Bone Marrow	Red Bone Marrow	Lymphoma and multiple myeloma
203.10	PLSM CELL LEUK W/O REMISSON	Red Bone Marrow	Red Bone Marrow	Lymphoma and multiple myeloma
203.11	PLSM CELL LEUK W/REMISS	Red Bone Marrow	Red Bone Marrow	Lymphoma and multiple myeloma
203.8	IMMUNOPROLIFERAT NEOPLASM NEC	Red Bone Marrow	Red Bone Marrow	Lymphoma and multiple myeloma
203.80	OTHER IMNPRFL NPL W/O REMISS	Red Bone Marrow	Red Bone Marrow	Lymphoma and multiple myeloma
203.81	OTHER IMNPRFL NPL W/REMISS	Red Bone Marrow	Red Bone Marrow	Lymphoma and multiple myeloma
204	LYMPHOID LEUKEMIA	Red Bone Marrow	Red Bone Marrow	Acute lymphoid leukemia
204.0	ACUTE LYMPHOID LEUKEMIA	Red Bone Marrow	Red Bone Marrow	Acute lymphoid leukemia
204.00	ACT LYM LEUK W/O REMISS	Red Bone Marrow	Red Bone Marrow	Acute lymphoid leukemia
204.01	ACT LYM LEUK W/REMISS	Red Bone Marrow	Red Bone Marrow	Acute lymphoid leukemia
204.1	CHRONIC LYMPHOID LEUKEMIA	NA	NA	NA[4]

Table 3-1 (Continued).

ICD-9 Code	Cancer code explanation	Internal Organ	External organ	IREP model
204.10	CHRONIC LYM LEUK W/O REMISS	NA	NA	NA[4]
204.11	CHRONIC LYM LEUK W/REMISS	NA	NA	NA[4]
204.2	SUBACUTE LYMPHOID LEUKEMIA	Red Bone Marrow	Red Bone Marrow	Leukemia, less CLL
204.20	SBAC LYM LEUK W/O REMISS	Red Bone Marrow	Red Bone Marrow	Leukemia, less CLL
204.21	SBAC LYM LEUK W/REMISS	Red Bone Marrow	Red Bone Marrow	Leukemia, less CLL
204.8	LYMPHOID LEUKEMIA NEC	Red Bone Marrow	Red Bone Marrow	Leukemia, less CLL
204.80	OTHER LYM LEUK W/O REMISS	Red Bone Marrow	Red Bone Marrow	Leukemia, less CLL
204.81	OTHER LYM LEUK W/REMISS	Red Bone Marrow	Red Bone Marrow	Leukemia, less CLL
204.9	LYMPHOID LEUKEMIA NOS	Red Bone Marrow	Red Bone Marrow	Acute lymphoid leukemia
204.90	UNS LYM LEUK W/O REMISS	Red Bone Marrow	Red Bone Marrow	Acute lymphoid leukemia
204.91	UNS LYM LEUK W/REMISS	Red Bone Marrow	Red Bone Marrow	Acute lymphoid leukemia
205	MYELOID LEUKEMIA	Red Bone Marrow	Red Bone Marrow	Leukemia, less CLL AND Acute myeloid leukemia
205.0	ACUTE MYELOID LEUKEMIA	Red Bone Marrow	Red Bone Marrow	Leukemia, less CLL AND Acute myeloid leukemia
205.00	ACT MYL LEUK W/O REMISS	Red Bone Marrow	Red Bone Marrow	Leukemia, less CLL AND Acute myeloid leukemia
205.01	ACT MYL LEUK W/REMISS	Red Bone Marrow	Red Bone Marrow	Leukemia, less CLL AND Acute myeloid leukemia
205.1	CHRONIC MYELOID LEUKEMIA	Red Bone Marrow	Red Bone Marrow	Leukemia, less CLL AND Chronic myeloid leukemia
205.10	CHRONIC MYL LEUK W/O REMISS	Red Bone Marrow	Red Bone Marrow	Leukemia, less CLL AND Chronic myeloid leukemia
205.11	CHRONIC MYL LEUK W/REMISS	Red Bone Marrow	Red Bone Marrow	Leukemia, less CLL AND Chronic myeloid leukemia
205.2	SUBACUT MYELOID LEUKEMIA	Red Bone Marrow	Red Bone Marrow	Leukemia, less CLL
205.20	SBAC MYL LEUK W/O REMISS	Red Bone Marrow	Red Bone Marrow	Leukemia, less CLL
205.21	SBAC MYL LEUK W/REMISS	Red Bone Marrow	Red Bone Marrow	Leukemia, less CLL
205.3	MYELOID SARCOMA	Red Bone Marrow	Red Bone Marrow	Leukemia, less CLL
205.30	MYL SRCOMA W/O REMISS	Red Bone Marrow	Red Bone Marrow	Leukemia, less CLL
205.31	MYL SRCOMA W/REMISS	Red Bone Marrow	Red Bone Marrow	Leukemia, less CLL
205.8	MYELOID LEUKEMIA NEC	Red Bone Marrow	Red Bone Marrow	Leukemia, less CLL
205.80	OTHER MYL LEUK W/O REMISS	Red Bone Marrow	Red Bone Marrow	Leukemia, less CLL
205.81	OTHER MYL LEUK W/REMISS	Red Bone Marrow	Red Bone Marrow	Leukemia, less CLL
205.9	MYELOID LEUKEMIA NOS	Red Bone Marrow	Red Bone Marrow	Leukemia, less CLL AND Acute myeloid leukemia
205.90	UNS MYL LEUK W/O REMISS	Red Bone Marrow	Red Bone Marrow	Leukemia, less CLL AND Acute myeloid leukemia

Table 3-1 (Continued).

ICD-9 Code	Cancer code explanation	Internal Organ	External organ	IREP model
205.91	UNS MYL LEUK W/REMISS	Red Bone Marrow	Red Bone Marrow	Leukemia, less CLL AND Acute myeloid leukemia
206	MONOCYTIC LEUKEMIA	Red Bone Marrow	Red Bone Marrow	Leukemia, less CLL
206.0	ACUTE MONOCYTIC LEUKEMIA	Red Bone Marrow	Red Bone Marrow	Leukemia, less CLL
206.00	ACT MONO LEUK W/O REMISS	Red Bone Marrow	Red Bone Marrow	Leukemia, less CLL
206.01	ACT MONO LEUK W/REMISS	Red Bone Marrow	Red Bone Marrow	Leukemia, less CLL
206.1	CHRONIC MONOCYTIC LEUKEMIA	Red Bone Marrow	Red Bone Marrow	Leukemia, less CLL
206.10	CHRONIC MONO LEUK W/O REMISS	Red Bone Marrow	Red Bone Marrow	Leukemia, less CLL
206.11	CHRONIC MONO LEUK W/REMISS	Red Bone Marrow	Red Bone Marrow	Leukemia, less CLL
206.2	SUBAC MONOCYTIC LEUKEMIA	Red Bone Marrow	Red Bone Marrow	Leukemia, less CLL
206.20	SBACUTE MONO LEUK W/O REMISS	Red Bone Marrow	Red Bone Marrow	Leukemia, less CLL
206.21	SBACUTE MONO LEUK W/REMISS	Red Bone Marrow	Red Bone Marrow	Leukemia, less CLL
206.8	MONOCYTIC LEUKEMIA NEC	Red Bone Marrow	Red Bone Marrow	Leukemia, less CLL
206.80	OTHER MONO LEUK W/O REMISS	Red Bone Marrow	Red Bone Marrow	Leukemia, less CLL
206.81	OTHER MONO LEUK W/REMISS	Red Bone Marrow	Red Bone Marrow	Leukemia, less CLL
206.9	MONOCYTIC LEUKEMIA NOS	Red Bone Marrow	Red Bone Marrow	Leukemia, less CLL
206.90	UNS MONO LEUK W/O REMISS	Red Bone Marrow	Red Bone Marrow	Leukemia, less CLL
206.91	UNS MONO LEUK W/REMISS	Red Bone Marrow	Red Bone Marrow	Leukemia, less CLL
207	OTHER SPECIFIED LEUKEMIA	Red Bone Marrow	Red Bone Marrow	Leukemia, less CLL
207.0	ACUTE ERYTHREMIA	Red Bone Marrow	Red Bone Marrow	Leukemia, less CLL
207.00	ACT ERTH/ERYLK W/O REMISS	Red Bone Marrow	Red Bone Marrow	Leukemia, less CLL
207.01	ACT ERTH/ERYLK W/REMISS	Red Bone Marrow	Red Bone Marrow	Leukemia, less CLL
207.1	CHRONIC ERYTHREMIA	Red Bone Marrow	Red Bone Marrow	Leukemia, less CLL
207.10	CHRONIC ERYTHRM W/O REMISION	Red Bone Marrow	Red Bone Marrow	Leukemia, less CLL
207.11	CHRONIC ERYTHRM W/REMISION	Red Bone Marrow	Red Bone Marrow	Leukemia, less CLL
207.2	MEGAKARYOCYTIC LEUKEMIA	Red Bone Marrow	Red Bone Marrow	Leukemia, less CLL
207.20	MGKRYCYT LEUK W/O REMISS	Red Bone Marrow	Red Bone Marrow	Leukemia, less CLL
207.21	MGKRYCYT LEUK W/REMISS	Red Bone Marrow	Red Bone Marrow	Leukemia, less CLL
207.8	SPECIFIED LEUKEMIA NEC	Red Bone Marrow	Red Bone Marrow	Leukemia, less CLL
207.80	OTHER SPF LEUK W/O REMISS	Red Bone Marrow	Red Bone Marrow	Leukemia, less CLL
207.81	OTHER SPF LEUK W/REMSION	Red Bone Marrow	Red Bone Marrow	Leukemia, less CLL
208	LEUKEMIA-UNSPECIF CELL	Red Bone Marrow	Red Bone Marrow	Leukemia, less CLL AND Acute lymphoid leukemia AND Acute myeloid leukemia
208.0	ACT LEUK UNS CL W/O REMISS	Red Bone Marrow	Red Bone Marrow	Leukemia, less CLL AND Acute lymphoid leukemia AND Acute myeloid leukemia
208.00	ACT LEUK UNS CL W/O REMISS	Red Bone Marrow	Red Bone Marrow	Leukemia, less CLL AND

				Acute lymphoid leukemia AND Acute myeloid leukemia

Table 3-1 (Continued).

ICD-9 Code	Cancer code explanation	Internal Organ	External organ	IREP model
208.01	ACT LEUK UNS CL W/REMISS	Red Bone Marrow	Red Bone Marrow	Leukemia, less CLL AND Acute lymphoid leukemia AND Acute myeloid leukemia
208.1	CHRONIC LEUKEMIA NOS	Red Bone Marrow	Red Bone Marrow	Leukemia, less CLL AND Chronic myeloid leukemia
208.10	CHRONIC LEUK UNS CL W/O REMISS	Red Bone Marrow	Red Bone Marrow	Leukemia, less CLL AND Chronic myeloid leukemia
208.11	CHRONIC LEUK UNS CL W/REMISS	Red Bone Marrow	Red Bone Marrow	Leukemia, less CLL AND Chronic myeloid leukemia
208.2	SUBACUTE LEUKEMIA NOS	Red Bone Marrow	Red Bone Marrow	Leukemia, less CLL
208.20	SUBACUTE LEUKEMIA UNS CL W/O REMISSION	Red Bone Marrow	Red Bone Marrow	Leukemia, less CLL
208.21	SUBACUTE LEUKEMIA UNS CL W/REMISSION	Red Bone Marrow	Red Bone Marrow	Leukemia, less CLL
208.8	LEUKEMIA-UNSPEC CELL NEC	Red Bone Marrow	Red Bone Marrow	Leukemia, less CLL
208.80	OTHER LEUK UNS CL W/O REMISSION	Red Bone Marrow	Red Bone Marrow	Leukemia, less CLL
208.81	OTHER LEUK UNS CL W/REMISSION	Red Bone Marrow	Red Bone Marrow	Leukemia, less CLL
208.9	LEUKEMIA-UNSPEC CELL NOS	Red Bone Marrow	Red Bone Marrow	Leukemia, less CLL AND Acute lymphoid leukemia AND Acute myeloid leukemia AND Chronic myeloid leukemia
208.90	OTHER LEUK NOS W/O REMISSION	Red Bone Marrow	Red Bone Marrow	Leukemia, less CLL AND Acute lymphoid leukemia AND Acute myeloid leukemia AND Chronic myeloid leukemia
208.91	OTHER LEUK NOS W/REMISSION	Red Bone Marrow	Red Bone Marrow	Leukemia, less CLL AND Acute lymphoid leukemia AND Acute myeloid leukemia AND Chronic myeloid leukemia
230	CA IN SITU DIGESTIVE ORG			
230.0	CA IN SITU ORAL CAV/PHAR	Highest non-met org/tiss	Thyroid	Oral cav. and pharynx
230.1	CA IN SITU ESOPHAGUS	Esophagus	Esophagus	Esophagus
230.2	CA IN SITU STOMACH	Stomach	Stomach	Stomach
230.3	CA IN SITU COLON	Colon	Colon	Colon
230.4	CA IN SITU RECTUM	LLI	Colon	Rectum
230.5	CA IN SITU ANAL CANAL	LLI	Colon	Rectum
230.6	CA IN SITU ANUS NOS	LLI	Colon	Rectum

230.7	CA IN SITU BOWEL NEC/NOS	Colon	Colon	All digestive

Table 3-1 (Continued).

ICD-9 Code	Cancer code explanation	Internal Organ	External organ	IREP model
230.8	CA IN SITU LIVER/BILIARY	Liver	Liver	Liver
230.9	CA IN SITU GI NEC/NOS	Highest non-met org/tiss	Remainder[2]	All digestive
231	CA IN SITU RESPIRATORY			
231.0	CA IN SITU LARYNX	ET2	Esophagus	Other respiratory
231.1	CA IN SITU TRACHEA	BB	Thyroid	Lung
231.2	CA IN SITU BRONCHUS/LUNG	Lung	Lung	Lung
231.8	CA IN SITU RESP SYS NEC	Medical review	Medical review	Other respiratory
231.9	CA IN SITU RESP SYS NOS	Lung	Lung	Other respiratory
232	CARCINOMA IN SITU SKIN			
232.0	CA IN SITU SKIN LIP	Skin	Skin	Malignant melanoma AND Non-melanoma skin-Squamous cell[5]
232.1	CA IN SITU EYELID	Skin	Skin	Malignant melanoma AND Non-melanoma skin-Squamous cell[5]
232.2	CA IN SITU SKIN EAR	Skin	Skin	Malignant melanoma AND Non-melanoma skin-Squamous cell[5]
232.3	CA IN SITU SKIN FACE NEC	Skin	Skin	Malignant melanoma AND Non-melanoma skin-Squamous cell[5]
232.4	CA IN SITU SCALP	Skin	Skin	Malignant melanoma AND Non-melanoma skin-Squamous cell[5]
232.5	CA IN SITU SKIN TRUNK	Skin	Skin	Malignant melanoma AND Non-melanoma skin-Squamous cell[5]
232.6	CA IN SITU SKIN ARM	Skin	Skin	Malignant melanoma AND Non-melanoma skin-Squamous cell[5]
232.7	CA IN SITU SKIN LEG	Skin	Skin	Malignant melanoma AND Non-melanoma skin-Squamous cell[5]
232.8	CA IN SITU SKIN NEC	Skin	Skin	Malignant melanoma AND Non-melanoma skin-Squamous cell[5]
232.9	CA IN SITU SKIN NOS	Skin	Skin	Malignant melanoma AND Non-melanoma skin-Squamous cell[5]
233	CA IN SITU BREAST/GU			
233.0	CA IN SITU BREAST	Breast	Breast	Breast
233.1	CA IN SITU CERVIX UTERI	Uterus	Uterus	Female genitalia less ovary
233.2	CA IN SITU UTERUS NEC	Uterus	Uterus	Female genitalia less ovary
233.3	CA IN SITU FEM GEN NEC	Uterus	Uterus	Female genitalia less ovary AND Ovary
233.4	CA IN SITU PROSTATE	Highest non-met org/tiss	Bladder	All male genitalia
233.5	CA IN SITU PENIS	Testes	Testes	All male genitalia

233.6	CA IN SITU MALE GEN NEC	Testes	Testes	All male genitalia

Table 3-1 (Continued).

ICD-9 Code	Cancer code explanation	Internal Organ	External organ	IREP model
233.7	CA IN SITU BLADDER	Bladder	Bladder	Bladder
233.9	CA IN SITU URINARY NEC	Medical review	Liver	Urinary organs less bladder
234	CA IN SITU NEC/NOS			
234.0	CA IN SITU EYE	Brain	Eye Lens	Eye
234.8	CA IN SITU NEC	Highest non-met org/tiss	Remainder[2]	Other and ill-defined sites
234.9	CA IN SITU NOS	Highest non-met org/tiss	Remainder[2]	Other and ill-defined sites
235	UNCERT BEHAV NEOPLASM GI/RESP			
235.0	UNCERT BEHAV NEOPLASM SALIVARY	Highest non-met org/tiss	Thyroid/Remainder[1]	Oral cav. and pharynx
235.1	UNCERT BEHAV NEOPLASM ORAL/PHAR	Highest non-met org/tiss	Thyroid/Remainder[1]	Oral cav. and pharynx
235.2	UNCERT BEHAV NEOPLASM INTESTINE (stomach)	Stomach	Stomach	Stomach
235.2	UNCERT BEHAV NEOPLASM INTESTINE (colon)	Colon	Colon	Colon
235.2	UNCERT BEHAV NEOPLASM INTESTINE (rectum)	LLI	Colon	Rectum
235.3	UNCERT BEHAV NEOPLASM LIVER	Liver	Liver	Liver
235.4	UNCERT BEHAV NEOPLASM PERITONEUM	Highest non-met org/tiss	Colon	All digestive
235.5	UNCERT BEHAV NEOPLASM GI NEC	Colon	Colon	All digestive
235.6	UNCERT BEHAV NEOPLASM LARYNX	ET2	Esophagus	Other respiratory
235.7	UNCERT BEHAV NEOPLASM LUNG	Lung	Lung	Lung
235.8	UNCERT BEHAV NEOPLASM PLEURA	Medical review	Lung	Other respiratory
235.9	UNCERT BEHAV NEOPLASM RESP NEC	Medical review	Lung	Other respiratory
236	UNCERT BEHAV NEOPLASM GU			
236.0	UNCERT BEHAV NEOPLASM UTERUS	Uterus	Uterus	Female genitalia, less ovary
236.1	UNCERT BEHAV NEOPLASM PLACENTA	Uterus	Uterus	Female genitalia, less ovary
236.2	UNCERT BEHAV NEOPLASM OVARY	Ovaries	Ovaries	Ovary
236.3	UNCERT BEHAV NEOPLASM FEMALE NEC	Medical review	Uterus	Female genitalia, less ovary
236.4	UNCERT BEHAV NEOPLASM TESTIS	Testes	Testes	All male genitalia
236.5	UNCERT BEHAV NEOPLASM PROSTATE	Highest non-met org/tiss	Bladder	All male genitalia
236.6	UNCERT BEHAV NEOPLASM MALE NEC	Testes	Testes	All male genitalia
236.7	UNCERT BEHAV NEOPLASM BLADDER	Bladder	Bladder	Bladder
236.9	UNCERT BEHAV NEOPLASM OTHER URINAR	Medical review	Liver	Urinary organs less bladder
236.90	UNCERT BEHAV NEOPLASM URINAR NOS	Medical review	Liver	Urinary organs less bladder
236.91	UNCERT BEHAV NEOPLASM KIDNEY	Medical review	Liver	Urinary organs less bladder
236.99	UNCERT BEHAV NEOPLASM URINAR NEC	Medical review	Liver	Urinary organs less bladder
237	UNCER NEOPLASM ENDOCRINE/NERV			

237.0	UNCERT BEHAV NEOPLASM PITUITARY	Brain	Thyroid/Remainder[1]	Thyroid

Table 3-1 (Continued).

ICD-9 Code	Cancer code explanation	Internal Organ	External organ	IREP model
237.1	UNCERT BEHAV NEOPLASM PINEAL	Brain	Thyroid/Remainder[1]	Thyroid
237.2	UNCERT BEHAV NEOPLASM ADRENAL	Adrenal	Liver	Urinary organs less bladder
237.3	UNCERT BEHAV NEOPLASM PARAGANG	Brain	Thyroid/Remainder[1]	Nervous system
237.4	UNCER NEOPLASM ENDOCRINE NEC	Medical review	Remainder[2]	Thyroid
237.5	UNCERT BEH NEOPLASM BRAIN/SPINAL	Brain	Thyroid/Remainder[1]	Nervous system
237.6	UNCERT BEHAV NEOPLASM MENINGES	Brain	Thyroid/Remainder[1]	Nervous system
237.7	NEUROFIBROMATOSIS	Medical review	Remainder[2]	Nervous system
237.70	NEUROFIBROMATOSIS NOS	Medical review	Remainder[2]	Nervous system
237.71	NEUROFIBROMATOSIS TYPE I	Medical review	Remainder[2]	Nervous system
237.72	NEUROFIBROMATOSIS TYP II	Medical review	Remainder[2]	Nervous system
237.9	UNCERT BEH NEOPLASM NERV SYS NEC	Medical review	Remainder[2]	Nervous system
238	UNCERT BEHAV NEOPLASM NEC/NOS			
238.0	UNCERT BEHAV NEOPLASM BONE	Medical review	Red Bone Marrow	Bone
238.1	UNCERT BEHAV NEOPLASM SOFT TISSU	Medical review	Remainder[2]	Connective Tissue
238.2	UNCERT BEHAV NEOPLASM SKIN	Medical review	Skin	Malignant melanoma AND non-melanoma skin-Basal cell
238.3	UNCERT BEHAV NEOPLASM BREAST	Medical review	Breast	Breast
238.4	POLYCYTHEMIA	Red Bone Marrow	Red Bone Marrow	Bone
238.5	MASTOCYTOMA NOS	Red Bone Marrow	Red Bone Marrow	Lymphoma and multiple myeloma
238.6	PLASMACYTOMA NOS	Red Bone Marrow	Red Bone Marrow	Lymphoma and multiple myeloma
238.7	LYMPHOPROLIFERAT DISEASE NOS	Red Bone Marrow	Red Bone Marrow	Bone AND Lymphoma and multiple myeloma
238.8	UNCERT BEHAVIOR NEOPLASM NEC	Medical review	Remainder[2]	Other and ill-defined sites
238.9	UNCERT BEHAVIOR NEOPLASM NOS	Medical review	Remainder[2]	Other and ill-defined sites
239	UNSPECIFIED NEOPLASM			
239.0	DIGESTIVE NEOPLASM NOS	Medical review	Stomach	All digestive
239.1	RESPIRATORY NEOPLASM NOS	Medical review	Lung	Lung AND Other respiratory
239.2	BONE/SKIN NEOPLASM NOS (Bone)	Medical review	Red Bone Marrow	Bone
239.2	BONE/SKIN NEOPLASM NOS (Skin)	Medical review	skin	Non-melanoma skin-Basal cell
239.3	BREAST NEOPLASM NOS	Breast	Breast	Breast
239.4	BLADDER NEOPLASM NOS	Bladder	Bladder	Bladder
239.5	OTHER GU NEOPLASM NOS (Female)	Medical review	Bladder	Female genitalia less ovary AND Ovary AND All urinary organs
239.5	OTHER GU NEOPLASM NOS (Male)	Medical review	Testes	All male genitalia AND All urinary organs

239.6	BRAIN NEOPLASM NOS	Brain	Thyroid/Remainder[1]	Nervous system

Table 3-1 (Continued).

ICD-9 Code	Cancer code explanation	Internal Organ	External organ	IREP model
239.7	BRAIN/NERV NEOPLASM NOS	Medical review	Remainder[2]	Nervous system
239.7	ENDOCRINE NOS	Medical review	Remainder[2]	Thyroid AND Other endocrine glands
239.8	NEOPLASM NOS, SITE NEC	Medical review	Remainder[2]	Other and ill-defined sites
239.9	NEOPLASM NOS	Medical review	Remainder[2]	Other and ill-defined sites
273	DISORDERS OF PLASMA PROTEIN METABOLISM			
273.3	WALDENSTROM'S MACROGLOBULINEMIA	Red Bone Marrow	Red Bone Marrow	Lymphoma and multiple myeloma
289	OTHER SPECIFIED BLOOD DISORDER			
289.7	ESSENTIAL THROMBOCYTOSIS	Red Bone Marrow	Red Bone Marrow	Bone
289.8	OTHER SPECIFIED DISEASES OF BLOOD AND BLOOD-FORMING ORGANS	Red Bone Marrow	Red Bone Marrow	Bone
289.9	ESSENTIAL THROMBOCYTHEMIA	Red Bone Marrow	Red Bone Marrow	Bone

1. 1 - See discussion in Section 4.3
2. 2 - See discussion in Section 4.4
3. 3 – For secondary cancers, doses are assessed for the likely primary cancer site(s), which are selected using guidance in Table 3-2.
4. 4 - 42 CFR 81.30 states this cancer is non-radiogenic for the purposes of EEOICPA and assigns zero probability of causation.
5. 5 – For ICD-9 code 232, if the type of cancer is specified by DOL (Malignant melanoma or Non-melanoma skin-Squamous cell) use only the specified IREP model (note that Bowden's disease is another name for Squamous Cell Carcinoma in situ). If the cancer is not specified, run both IREP models as discussed in Section 4.6.
6. 6 – See discussion in Section 4.7
7. 7 - The external target organ should be lung if the lymphoma is known to be a B-cell variety, or thymus if the lymphoma is known to be a T-cell variety or if the variety is unknown.

Table 3-2.

Secondary cancer	ICD-9 code of likely primary cancers[1,2,3]
196.0 Lymph nodes of head, face, and neck	141, 142(M), 146(M), 149(F), 161(M), 162, 172, 173, 174(F), 193(F)
196.1 Intrathoracic lymph nodes	150(M), 162, 174(F)
196.2 Intra-abdominal lymph nodes	150(M), 151(M), 153, 157(F), 162, 174(F), 180(F), 185(M), 189, 202(F)
196.3 Lymph nodes of axilla and upper limb	162, 172, 174(F)
196.5 Inguinal and lower limb lymph nodes	154(M), 162, 172, 173(F), 187(M)
196.6 Intrapelvic lymph nodes	153(M), 154(F), 162(M), 180(F), 182(F), 185(M), 188
196.8 Lymph nodes of multiple sites	150(M), 151(M), 153(M), 162, 174(F)
196.9 Lymph nodes, site unspecified	150(M), 151, 153, 162, 172, 174(F), 185(M)
197.0 Lung	153, 162, 172(M), 174(F), 185(M), 188(M), 189
197.1 Mediastinum	150(M), 162, 174(F)
197.2 Pleura	150(M), 153(M), 162, 174(F), 183(F), 185(M), 189(M)
197.3 Other respiratory organs	150, 153(M), 161, 162, 173(M), 174(F), 185(M), 193(F)
197.4 Small intestine, including duodenum	152, 153, 157, 162, 171, 172(M), 174(F), 183(F), 189(M)
197.5 Large intestine and rectum	153, 154, 162, 174(F), 183(F), 185(M)
197.6 Retroperitoneum and peritoneum	151, 153, 154(M), 157, 162(M), 171, 174(F), 182(F), 183(F)
197.7 Liver, specified as secondary	151(M), 153, 154(M), 157, 162, 174(F)
197.8 Other digestive organs	150(M), 151, 153, 157, 162, 174(F), 185(M)
198.0 Kidney	153, 162, 174(F), 180(F), 185(M), 188, 189, 202(F)
198.1 Other urinary organs	153, 174(F), 180(F), 183(F), 185(M), 188, 189(F)
198.2 Skin	153, 162, 171(M), 172, 173(M), 174(F), 189(M)
198.3 Brain and spinal cord	162, 172(M), 174(F)
198.4 Other parts of nervous system	162, 172(M), 174(F), 185(M), 202
198.5 Bone and bone marrow	162, 174(F), 185(M)
198.6 Ovary	153(F), 174(F), 183(F)
198.7 Suprarenal gland	153(F), 162, 174(F)
198.8 Other specified sites	153, 162, 172(M), 174(F), 183(F), 185(M), 188(M)

1 – "M" indicates cancer site should be used for males only, and "F" indicates cancer site should be used for females only.
2 – For likely primary cancer sites that have multiple possible IMBA or external organs, see Section 4.8.
3 – Whenever "173" is indicated as a likely primary cancer, the "non-melanoma skin-basal cell (BCC)" model should be used.

If none of the likely primary cancer sites yield a probability of causation greater than or equal to 50%, the supporting documentation for all of them shall be submitted, demonstrating that all of them were less than 50%.

4.0 DISCUSSION

4.1 HIGHEST NON-METABOLIC ORGAN

The dose estimate for a number of tissues is based on the highest non-metabolic organ dose, designated as "Highest non-met org/tiss" in the table. Metabolic organs are those that are specifically modeled by the ICRP for a particular element. The biokinetic models are based on the behavior of the particular element in the body, so the metabolic organs vary with the element of interest. The metabolic organs also include the gastrointestinal tract (ICRP 30) and, in the case of inhalation, the respiratory tract (ICRP 66).

For radionuclides that primarily emit alpha or beta radiation, the soft tissue compartment becomes the primary recipient of dose. This compartment contains all the organs not specifically accounted for in the metabolic model. This compartment accounts for the dose delivered by material actually deposited in that tissue. An additional source of exposure to the tissue is known as photon cross-irradiation. This cross-irradiation is the exposure to a tissue from photons originating in other tissues.

When the energy emitted by a radionuclide is primarily alpha or beta radiation, the soft tissue compartment becomes the primary source of dose. Under this scenario most of the non-metabolic organs receive the same dose. For radionuclides where photon emissions are a major source of energy emitted, the non-metabolic organ doses can vary due to their relative proximity to the metabolic organs in which the radionuclides concentrate. IMBA calculates the dose from both means of irradiation and sums them. For many radionuclides (predominately alpha and beta emitters) this will cause only minor differences in doses to non-metabolic organs, so choosing the highest is a realistic assumption with only minor (if any) overestimation.

It is conceivable that a situation could arise where a photon emitting radionuclide causes a large difference in doses delivered to non-metabolic organs. In accordance with the Internal Dose Reconstruction Implementation Guideline, it is acceptable in these situations to base the dose on an organ that is not the highest non-metabolic organ. The choice in these cases should be based on the proximity of the model organ to the actual organ of interest.

4.2 MEDICAL REVIEW

Due to the complexity of determining the appropriate organ/tissue for some ICD-9 code cancers, a medical review by an ORAU team physician is required to determine the organ/tissue to use in IMBA for those cancers. These cancers have been designated in the table as "Medical review." The ORAU team physician will recommend to the dose reconstructor the appropriate organ/tissue for dose estimation purposes.

4.3 THYROID/REMAINDER SELECTION FOR EXTERNAL DOSE

For cancer sites where "Thyroid/Remainder" is listed for the external organ selection, there is no external dose model for the organ of interest and the organ is located in close proximity to the thyroid.. The thyroid has higher organ dose conversion factors than the remainder selection, thereby maximizing the dose. If a more realistic dose assessment is required rather than a maximizing dose assessment, then the remainder organ should be selected to calculate dose.

4.4 REMAINDER SELECTION FOR EXTERNAL DOSE

When there are cancers of multiple organs or the cancer site is unknown, the remainder organ should be selected as the model to apply dose. However, if the organ location can be determined through the medical records or a medical review, then an organ in close physical proximity should be selected. The remainder selection provides a claimant favorable estimate of dose.

4.5 BLADDER

When the term "Bladder" is used in the table with no modifier, this represents the urinary bladder. When the organ of interest is the gallbladder, "Gallbladder" is specified clearly in the table above.

4.6 MULTIPLE IREP MODELS

When multiple IREP models are listed for a given cancer type, the IREP model(s) to be run is determined based upon the use of the words "OR" and "AND" in the IREP Model column.

For multiple IREP models listed that are connected by the word "OR", only the model that best fits the actual cancer type should be selected and run in IREP. For example, ICD-9 code 173.0 has listed "Non-melanoma skin-Basal cell OR Non-melanoma skin-Squamous cell" in the IREP Model column.

The appropriate IREP model would be selected and run based on the type of skin cancer (Basal cell or Squamous cell) listed in the claim's NIOSH Referral Summary Document (NRSD).

For multiple IREP models listed that are connected by the word "AND", separate IREP runs are made for each of the listed models, and compensability is determined based on the claimant favorable model resulting in the highest probability of causation. For example, ICD-9 code 233.3 has listed "Female genitalia less ovary AND Ovary " in the IREP Model column. Separate IREP runs would be made using each model and compensability would be based upon the model that resulted in the highest probability of causation.

4.7 ADENOCARCINOMA OF THE DISTAL (LOWER THIRD) ESOPHAGUS

If adenocarcinoma is indicated in the distal esophagus (also known as the lower third, abdominal, lower thoracic esophagus, gastro-esophageal, cardio-esophageal junction, or esophageal cardia), the appropriate IMBA, external, and IREP organ model is the stomach. In order to use the stomach, both conditions MUST be met (adenocarcinoma AND correct location). If either condition is not met, the use of the esophagus for the IMBA, external, and IREP organ model is appropriate.

4.8 SECONDARY CANCERS - LIKELY PRIMARY CANCER SITES WITH MULTIPLE IMBA, EXTERNAL, AND IREP ORGAN MODEL OPTIONS

For secondary cancers with unknown primary cancers sites, the likely primary cancer sites are listed in Table 3-2. Since the likely primary cancer sites are listed only by ICD-9 code (three digit code with no extensions), it is possible for a single likely primary cancer site to have multiple options for IMBA, external, and IREP organ model selection. In this case, each possible option must be assessed and the option that yields the largest probability of causation shall be submitted.
For example, secondary cancer code 196.2 has a likely primary cancer site of ICD-9 code 153. ICD-9 code 153 has an Internal Dosimetry Organ selection of ULI, LLI, and colon, depending on the extension of the ICD-9 code. Since it is an unknown location, each of these organs must be run for internal dose purposes and the one yielding the largest dose over the exposure period would be selected for use in the IREP run.

4.9 MULTIPLE SECONDARY CANCERS WITH UNKNOWN PRIMARY CANCER SITE OR MULTIPLE PRIMARY AND SECONDARY CANCERS

In some claims, multiple secondary cancers with unknown primary cancer location may be indicated. In such cases, unless the DOL specifically states differently, each likely primary cancer site from each secondary cancer is to be treated separately, with individual IREP probability of causation determinations and combined as separate primary cancers.

For example, consider a claim has indicated separate secondary cancers of 196.0 (Lymph nodes of head, face, and neck) and 197.7 (Liver, specified as secondary), with no indication of the cancers being metastasized from a single unknown primary cancer site. When each of the likely primary cancer sites are assessed, ICD-9 code 162 (Lung) yields the largest probability of causation for each of 38.00% (for this example only). Since it is possible that each secondary cancer came from a separate likely primary lung cancer, the probability of causation results for each likely primary lung cancer would be combined to yield a final probability of causation of 61.56% (per multiple cancer calculation in IREP).

The same type of situation may occur when primary and secondary cancers are both indicated by DOL. The same logic applies that, unless specifically directed otherwise by DOL, each cancer will be

treated as a totally separate cancer for the determination of Probability of Causation and for combining them for the final Probability of Causation. It should not be assumed by the Dose Reconstructor that any listed secondary cancer has metastasized from another listed primary cancer.

REFERENCES

42 CFR § 81, *Guidelines for Determining the Probability of Causation Under the Energy Employees Occupational Illness Compensation Program Act of 2000*; Final Rule, Federal Register/Vol.67, No. 85/Thursday, May 2, 2002, p 22296

NIOSH, (2002) *Internal Dose Reconstruction Implementation Guideline, Rev 0*, OCAS-IG-002, National Institute for Occupational Safety and Health, Office of Compensation Analysis and Support, Cincinnati, Ohio, August 2002

NIOSH, (2002) *External Dose Reconstruction Implementation Guideline, Rev 1*, OCAS-IG-001, National Institute for Occupational Safety and Health, Office of Compensation Analysis and Support, Cincinnati, Ohio, August 2002

ACJ & Associates and the UK National Radiological Protection Board, Integrated Modules for Bioassay Analysis, (IMBA), Software produced for NIOSH-OCAS as part of the EEOICPA Program, UK, July 2003

NIOSH, NIOSH-Interactive RadioEpidemiological Program (NIOSH-IREP), Technical Documentation, Office of Compensation Analysis and Support, Cincinnati, Ohio, June 2002

Office of Compensation Analysis and Support, OCAS-TIB-012, Rev 1, *Selection of internal and external dosimetry target organs for lymphatic/hematopoietic cancers, February 10, 2006.*

Energy Employees Occupational Illness Compensation Program Act of 2000, EEOICPA Bulletin No. 03-32, *Clarification by NCI of Certain Primary Cancers*, August 27, 2003.

Appendix 2 – Definition of Terms

Term	Definition
Acute external exposures	Acute external exposures are short term exposures. Dose is delivered quickly (minutes to hours).
Alpha particle	A positively charged particle ejected spontaneously from the nuclei of some radioactive elements. It is identical to a helium nucleus that has a mass number of 4 and an electric charge of +2. It has low penetrating power and a short range (a few centimeters in air). The most energetic alpha particle will generally fail to penetrate the dead layers of cells covering the skin and can be easily stopped by a sheet of paper. Alpha particles represent much more of a health risk when emitted by radionuclides deposited inside the body.
Beta particle	A charged particle emitted from a nucleus during radioactive decay, with a mass equal to 1/1837 that of a proton. A negatively charged beta particle is identical to an electron. A positively charged beta particle is called a positron. Exposure to large amounts of beta radiation from external sources may cause skin burns (erythema). Beta emitters can also be harmful if they enter the body. Thin sheets of metal or plastic may stop beta particles.
Bioassay	The determination of kinds, quantities, or concentrations and, in some cases, the locations of radioactive material in the human body, whether by direct measurement (in vivo counting) or by analysis and evaluation of materials excreted or removed (*in vitro*) from the human body.
Chronic external exposures	Chronic external exposures are continuous exposures. Dose is delivered constantly over a period of time.
Dose, equivalent	The product of absorbed dose in tissue multiplied by a quality factor, and then sometimes multiplied by other necessary modifying factors, to account for the potential for a biological effect resulting from the absorbed dose. B18It is expressed numerically in rems (traditional units) or sieverts (SI units).
Dosimetry	Generic term for radiation exposure / dose measurement techniques.

Appendix 2: Definition of Terms

Term	Definition
Environmental Dose	Environmental dose (exposure) applies primarily to *internal* dose from radioactive materials on the site grounds. (chronic exposure)
External Dose	Radiation dose received from external exposure (or, from sources external to the body)
External Dosimetry	Film badges, Thermoluminescent Detectors (TLDs), Neutron detectors, Pocket (pencil) dosimeters. Results are in roentgen (R), rad, or rem depending on era and reporting practices
Gamma Radiation	High-energy, short wavelength, electromagnetic radiation emitted from the nucleus of an atom. Gamma radiation frequently accompanies the emission of alpha and beta particles and always accompanies fission
Glove Box	A **glovebox** (or **glove box**) is a sealed container that is designed to allow one to manipulate objects while being in a different atmosphere from the object. Built into the sides of the glovebox are two gloves arranged in such a way that the user can place his or her hands into the gloves and perform tasks inside the box without breaking the seal or allowing potential injury. Part or all of the box is usually transparent to allow the user to see what is being manipulated. Two types of glove boxes exist: one allows a person to work with hazardous substances, such as radioactive materials or infectious disease agents; the other allows manipulation of substances that must be contained within a very high purity inert atmosphere, such as argon or nitrogen. [4]
Internal dose	Radiation [exposure to / dose received from] radioactive materials entering the body (intake) via: inhalation, ingestion, absorption, or wound/injection.
Interactive RadioEpidemiological Program (IREP)	A special algorithm which uses the dose reconstruction returned by NIOSH to determine whether the diagnosed cancer was at least as likely as not (50% or greater probability) caused by radiation exposure on the job

[4] http://en.wikipedia.org/wiki/Glove_box

Appendix 2: Definition of Terms

Term	Definition
Internal dosimetry	Bioassays In-vivo: measure radioactivity in the body (lung counts, whole body counts, wound counting, etc.) In-vitro: measure bodily excretions (urine, fecal, nasal smears) for radioactivity
In-vivo (internal dosimetry)	measure radioactivity in the body (lung counts, whole body counts, wound counting, etc.)
In-vitro (internal dosimetry)	measure bodily excretions (urine, fecal, nasal smears) for radioactivity
Neutrons	An uncharged elementary particle with a mass slightly greater than that of the proton, and found in the nucleus of every atom heavier than hydrogen.
On-site Ambient Dose	On-site ambient dose is the *external* exposure (dose) measured on and around the facilities. This accounts for any external doses from stack releases or other radiation sources that may have been unmonitored at the site. The doses assigned based on an assumed 50-hour workweek and the maximum annual average on-site ambient dose for the site. (chronic exposure)
Particulate Radiation	alpha, beta (electron), gamma
Photon	A quantum (or packet) of energy emitted in the form of electromagnetic radiation. Gamma rays and x rays are examples of photons
Quality factor	The factor by which the absorbed dose (rad or gray) must be multiplied to obtain a quantity that expresses, on a common scale for all ionizing radiation, the biological damage (rem or sievert) to the exposed tissue. It is used because some types of radiation, such as alpha particles, are more biologically damaging to live tissue than other types of radiation when the absorbed dose from both is equal. The term, quality factor, has now been replaced by "radiation weighting factor" in the latest system of recommendations for radiation protection.

Appendix 2: Definition of Terms

Term	Definition
rad	The original unit developed for expressing absorbed dose, which is the amount of energy from any type of ionizing radiation (e.g., alpha, beta, gamma, neutrons, etc.) deposited in any medium (e.g., water, tissue, air). A dose of one rad is equivalent to the absorption of 100 ergs (a small but measurable amount of energy) per gram of absorbing tissue. The rad has been replaced by the gray in the SI system of units (1 gray = 100 rad).
Radiation	Energy emitted during the process of an unstable atom achieving stability. Radiation energy is defined in electron-volts (eV), e.g., kilo electron-volts (keV), mega electron-volts (MeV)
Radiation Dose	Term used to denote the amount of energy imparted (deposited) in the body, organ, tissue, etc. For EEOICPA, the dose to the affected organ is calculated.
Radiation Exposure (exposure)	Term used to signify that radiation is present. It does not indicate what type of radiation or how much is impinging.
rem (Roentgen Equivalent Man)	A unit in the traditional system of units that measures the effects of ionizing radiation on humans.
Residual Contamination	Contamination remaining after DOE or AEC activities have ended
Special Exposure Cohort (SEC)	Group of covered employees at a "facility" for which NIOSH cannot perform a dose reconstruction for every type of cancer. Potential radiation exposure/dose not known; insufficient data; primarily internal dose
IREP	Interactive Radio Epidemiological Program used to calculate the Probability of Causation (PoC) that radiation exposure caused a cancer

Appendix 3 – Acronyms

Acronym/ Symbol	Meaning
ά	alpha
ABRWH	Advisory Board on Radiation and Worker Health
AEC	Atomic Energy Commission
ANRSD	Amended NIOSH Referral Summary Document
AP	Anterior-Posterior (External Dose Exposure Geometry)
AWE	Atomic Weapons Employer
β	Beta
BCC	Basal Cell Carcinoma
CATI	Computer Assisted Telephone Interview - held by NIOSH for DRs
CDC	Centers for Disease Control
CF	Correction Factor
CFR	Code of Federal Regulations
CLL	Chronic Lymphocytic Leukemia
cSv	CentiSeivert (equal to 1 rem)
DAR	Document Acquisition Request
DCF	Dose Correction Factor
DoD	Department of Defense
DOE	Department of Energy
DOL	Department of Labor
DR	Dose Reconstruction
EE-1	Employee Claim for Benefits form
EE-2	Survivor Claim for Benefits form
EE-3	Employment History
EE-4	Employment History Affidavit
EEOICPA	Energy Employees' Occupational Illness Compensation Program Act (the Act)
ERDA	Energy Research and Development Administration (pre DOE)
eV	Electron-Volts
FWP	Former Worker Program
GDP	Gaseous Diffusion Plant

Appendix 3: Acronyms

Acronym/ Symbol	Meaning
>	Greater than
≥	Greater than or equal to
HHS	Health and Human Services
HP	Health Physicist
ICD-9	International Coding of Diseases
IREP	Interactive RadioEpidemiological Program
IREP-EE	IREP-EE- Enterprise Edition used for POCs between 45 and 50%
keV	Kilo Electron-Volts
<	Less than
LOD	Limit of Detection (Dosimeter Detection Limit)
MeV	Mega Electron-Volts
mrem	Millirem
mSv	MilliSievert
NCI	National Cancer Institute
NIOSH	National Institute for Occupational Safety and Health
NRSD	NIOSH Referral Summary Document
OCAS	NIOSH's Office of Compensation Analysis and Support (OCAS)
OCAS-1	NIOSH form to be signed by claimant after DR
OHQ	Occupational History Questionnaire
ORAU	Oak Ridge Associated Universities
ORISE	Oak Ridge Institute for Science and Education
OWCP	Office of Workers' Compensation Programs
PA	Privacy Act
PEP	Program Evaluation Plan
PER	Program Evaluation Report
PII	Personally Identifiable Information
PM	Procedure Manual
PoC	Probability of Causation
Pu-238	Plutonium 238
R	Roentgen
Rad	Radiation absorbed dose
RC	Resource Center

Appendix 3: Acronyms

Acronym/ Symbol	Meaning
RD	Recommended Decision
REFs	Radiation Effectiveness Factors
Rem	Roentgen Equivalent Man
§	Section
SCC	Squamous Cell Carcinoma
SEC	Special Exposure Cohort
SEM	Site Exposure Matrices
SOAF	Statement of Accepted Facts
SOL	Office of the Solicitor
SSA	Social Security Administration
SRS	Savannah River Site
Super S	Super Slow Plutonium (solubility)
Sv	Sievert (equals 100 rem)
TBD	Technical Basis Documents
TIB	Technical Information Bulletins
TLD	Thermoluminescent Detectors
γ	Gamma