Document Title: **Occupational Onsite Ambient Dose Reconstruction for DOE Sites**	Document Number: ORAUT-PROC-0060 Revision: 01 Effective Date: 06/28/2006 Type of Document: Procedure Supersedes: Revision 00

Subject Expert: Robert C. Winslow

Document Owner
Approval: Signature on File — James P. Griffin, Deputy Project Director — Approval Date: 05/11/2006

Concurrence: Signature on File — Kate Kimpan, Project Director — Concurrence Date: 05/22/2006

Approval: Signature on File — Stuart L. Hinnefeld, Health Science Administrator — Approval Date: 06/28/2006

☐ New ☒ Total Rewrite ☐ Revision ☐ Page Change

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

PUBLICATION RECORD

EFFECTIVE DATE	REVISION NUMBER	DESCRIPTION
03/07/2005	00	New document to provide direction for external onsite ambient dose reconstruction for DOE sites. Incorporates internal and NIOSH formal review comments. First approved issue. Initiated by Steven E. Merwin.
06/28/2006	01	Revised document to include additional DOE sites. Incorporates formal internal and NIOSH review comments. Constitutes a total rewrite of the document. Training required: as determined by the Task Manager. Initiated by Robert C. Winslow.

TABLE OF CONTENTS

1.0 PURPOSE

The purpose of this procedure is to provide direction to the Oak Ridge Associated Universities (ORAU) Team Dose Reconstructors for the assignment of external dose from onsite ambient radiation for the National Institute for Occupational Safety and Health (NIOSH) Energy Employees Occupational Illness Compensation Program Act (EEOICPA) dose reconstruction project. This procedure relies upon information contained in site technical basis documents (TBDs), and it supersedes the instructions pertaining to external onsite ambient dose reconstruction in ORAUT-PROC-0006.

2.0 SCOPE

This procedure applies to NIOSH technical support contractors involved in performing dose reconstruction for covered employees of the U.S. Department of Energy (DOE), its predecessor agencies, and certain of its contractors and subcontractors.

3.0 REFERENCES

OCAS-IG-001, External Dose Reconstruction Implementation Guideline

ORAUT-PROC-0006, External Dose Reconstruction

ORAUT-TKBS-0003, Savannah River Site

ORAUT-TKBS-0006-4, Technical Basis Document for the Hanford Site – Occupational Environmental Dose

ORAUT-TKBS-0007-4, Technical Basis Document for the Idaho National Engineering and Environmental Laboratory (INEEL) – Occupational Environmental Dose

ORAUT-TKBS-0008-4, Technical Basis Document for the Nevada Test Site – Occupational Environmental Dose

ORAUT-TKBS-0009-4, Technical Basis Document for the K-25 Site – Occupational Environmental Dose

ORAUT-TKBS-0010-4, Technical Basis Document for the Los Alamos National Laboratory – Occupational Environmental Dose

ORAUT-TKBS-0011-4, Technical Basis Document for the Rocky Flats Plant – Occupational Environmental Dose

ORAUT-TKBS-0012-4, Technical Basis Document for the Oak Ridge National Laboratory – Occupational Environmental Dose

ORAUT-TKBS-0013-4, Technical Basis Document for the Pantex Plant – Occupational Environmental Dose

ORAUT-TKBS-0014-4, Technical Basis Document for the Y-12 National Security Complex – Occupational Environmental Dose

ORAUT-TKBS-0015-4, Technical Basis Document for the Portsmouth Gaseous Diffusion Plant – Occupational Environmental Dose

ORAUT-TKBS-0016-4, Technical Basis Document for the Mound Site – Occupational Environmental Dose

ORAUT-TKBS-0017-4, Technical Basis Document for the Fernald Environmental Management Project (FEMP) – Occupational Environmental Dose

ORAUT-TKBS-0019-4, Technical Basis Document for the Paducah Gaseous Diffusion Plant – Occupational Environmental Dose

ORAUT-TKBS-0026-6, Technical Basis Document for the Argonne National Laboratory – West – Occupational External Dose

ORAUT-TKBS-0029-4, Pinellas Plant – Occupational Environmental Dose

ORAUT-TKBS-0031, Site Profile for the Kansas City Plant

ORAUT-TKBS-0035-4, Lawrence Livermore National Laboratory – Occupational Environmental Dose

Crystal Ball, Decisioneering Inc., Denver, CO.

4.0 RESPONSIBILITIES

Principal External Dosimetrist – As the Subject Expert, revises this procedure as necessary based on revised or new information in TBDs.

Task 3 Manager – Advises the Principal External Dosimetrist of impending revisions to the TBDs or issues that might render information inaccurate in approved TBDs.

Task 5 Group Leaders – Inform the Principal External Dosimetrist of issues with implementation of this procedure identified by Dose Reconstructors or Peer Reviewers.

Dose Reconstructors – Inform their Task Group Leader of issues with implementation of this procedure identified during the course of performing dose reconstructions.

Peer Reviewers – Inform their Task Group Leader of issues with implementation of this procedure identified during the course of performing peer reviews.

5.0 GENERAL

As described in OCAS-IG-001, doses from elevated background radiation must be included in dose reconstructions performed under this program. This requirement is complicated by site reporting practices, fallout from atmospheric weapons testing, and worker location in relation to the site monitoring data. Since these exposures are a concern for energy employees who were not monitored or who worked at a site where elevated background radiation might have been subtracted from dosimeter results, reconstruction of doses must rely upon information

provided in site-specific TBDs, technical information bulletins, and other published health physics resources.

External dosimeters using film or thermoluminescent dosimeters (TLDs) have been used for occupational radiation monitoring since the 1940s. To account for background radiation levels, which are not traditionally included in occupational radiation dose records, control dosimeters have been used from the outset. Good radiation protection practice dictates that, during shipment, a control dosimeter accompany each batch of dosimeters issued to workers. Between manufacture (or annealing) and issuance, and between retrieval and processing, each shipment of dosimeters is irradiated by natural cosmic and terrestrial radiation sources, and potentially inadvertently irradiated by other sources. The function of the control dosimeter is to measure all nonoccupational radiation exposure to the batch of dosimeters. On processing, the reading from the control dosimeter is subtracted from the reading of each of the other dosimeters in the batch, yielding a result for each dosimeter that is uniquely due to occupational radiation exposure. Note that the subtraction could occur with raw data, such as optical density readings for film or glow curves, or with transformed data, such as exposures in roentgens, absorbed doses in rads or grays, or dose equivalents in rems or sieverts.

Determination as to whether control dosimeters were exposed to elevated ambient levels of external radiation (EALER) is generally associated with where the control dosimeters were stored. From the intended use of control dosimeters, it is clear that controls should be subjected to exactly the same *nonoccupational* radiation exposure as the issued dosimeters, and differ only in the *occupational* component. The implementation of this intention, that is, procedures for issuance and retrieval of dosimeters, likely differed over time within a given facility and certainly differed among various DOE and Atomic Weapons Employer (AWE) sites. For example, at large facilities like Hanford, the Idaho National Engineering and Environmental Laboratory (INEEL), Los Alamos National Laboratory (LANL), and Savannah River Site (SRS), controls might have been kept at a central dosimeter location, or distributed with batches of dosimeters to remote identification (ID) badge/dosimeter exchange buildings such as guard stations near reactors, reprocessing facilities, or manufacturing facilities. During some periods, dosimeters were incorporated into ID badges to ensure that no one entered without a dosimeter, and these ID badges were picked up at the entrance station at the beginning of each shift, and turned in there at the end of each shift. If control dosimeters were kept at remote exchange facilities, they would have recorded elevated ambient levels of external radiation at those facilities. Such doses from EALER recorded by the controls would subsequently have been subtracted from each worker's dosimeter reading. However, if control dosimeters were kept at a distant, central badging facility where ambient radiation levels were lower than in the work areas, each worker's dosimeter would have recorded not only his or her occupational exposure, but also his or her exposure to elevated ambient radiation levels. In the latter case, no adjustment for occupational environmental radiation levels is needed, since they would have been included in the worker's occupational measurements.

One important component of external environmental dose arose from submersion in, or irradiation at a distance from, a plume containing ^{41}Ar (with a radiological half-life of 1.83 hours), formed when naturally occurring ^{40}Ar nuclei absorb neutrons near operating reactor facilities in the early days. The emissions from ^{41}Ar are primarily a 1.2-MeV (maximum) β particle and a 1.3-MeV γ photon. A wooden badge exchange building would likely provide very little shielding or attenuation of the γ emission and, if air exchange rates at the control dosimeter storage point were high, even the β component could have approached outdoor

levels. Besides radiation from airborne releases of radioactive materials, other components of EALER could arise from:

1. Scattered radiation from waste trenches, storage facilities, etc.,

2. Terrestrial contamination, and

3. Skyshine (radiation scattered to the ground from air over nuclear or high-energy accelerator facilities).

However, these components are unlikely to have been the same at dosimeter exchange facilities as on the rest of the site, so control dosimeters stored at remote exchange facilities would not have recorded this component.

Processes with potential for significant EALER include those with

- Operating production reactors,
- Fuel reprocessing,
- Other radiochemical processing facilities,
- Atmospheric nuclear weapons testing,
- Underground nuclear weapons testing with significant venting of fission gasses,
- Accidental airborne releases of radioactive materials, and
- Certain high-energy accelerators (in the early years).

Large sites might have had inhomogeneous EALER, and a need for distributing control dosimeters with batches intended for particular areas might have had potential for significant EALER that the Energy Employee's dosimeter might not have measured.

In general, there will be a point in time, probably no later than 1970, after which there will be no need to assess a specific EALER to add to claimants' dose histories, because (1) levels were so low they would not significantly impact probability of causation, and (2) control dosimeters were kept out of harm's way and EALER would not have been subtracted. As environmental monitoring programs matured, environmental TLD measurements rule out significant EALER values. This can only be established for a particular site by reviewing site activities.

External dosimetry results account for both occupational and environmental penetrating radiation exposures if control dosimeters were not exposed to elevated environmental radiation due to weapons production operations. All DOE and AWE sites might not have experienced the problem of missed EALER.

It is concluded that for the years 1980 and later, except for the sites noted in Attachment A, environmental (onsite ambient) doses need not be considered when evaluating occupational doses because they would have been accounted for by personnel dosimeters. For extremely small environmental doses that were received but not reported due to dosimeter detection limits or reporting practices (i.e., in cases in which the reported dose is zero for a particular badge cycle), the assignment of missed doses according to procedures developed for this Project ensures that such environmental doses have been accounted for.

All external ambient doses are assigned in the Interactive RadioEpidemiological Program (IREP) as follows:

Exposure Rate: **Chronic**

Radiation Type: **Photons E = 30–250 keV**.

NOTE: The energy range prescribed above differs from that recommended in OCAS-IG-001. Other IREP parameters not listed above depend on the specific analysis being performed.

The attachments to this procedure provide direction for assigning external ambient dose for employees from specific sites based on approved TBDs.

NOTE: In this procedure, reference to a TBD pertains to the environmental dose TBD, typically Part 4, of the site profile.

If the relevant site-specific TBD has not been issued, the Dose Reconstructor should review TBDs from other sites performing similar functions within the DOE complex, as well as other published health physics resources, to determine whether the case can be completed or needs to be placed on HOLD pending approval of the relevant site-specific TBD.

Due to the variations in site geography, monitoring practices, reporting practices, and facilities and operations at the different sites, a best estimate cannot be generated for a site that does not have a completed TBD. To assess doses in recent years (e.g., 2003 to the present) that might not be covered in the TBDs, the most recent onsite ambient doses listed can be assumed to apply.

6.0 PROCEDURE

Dose Reconstructors

6.1 Review the Information Provided in the Case File

Determine the methodology (Maximize, Best Estimate, or Minimize) that will be applied to reconstruct the dose. The Dose Reconstructor must then consult the appropriate attachment to this procedure for specific instructions on reconstructing the onsite ambient dose for that site. As described in OCAS-IG-001, onsite ambient doses apply both to unmonitored employees who were not likely to have been exposed to workplace radiation and to monitored employees whose monitoring results could have reflected a subtraction of elevated onsite ambient radiation doses. Attachment A provides site-specific information regarding the need to assign onsite ambient doses for monitored employees.

6.2 Maximizing Methodology

Attachment B provides maximizing external ambient doses that can be assigned by a Dose Reconstructor to ensure claimant favorability. Background radiation not related to site operations has generally been included in the values listed, unless unequivocal background-subtracted values were provided in the TBD. Site-specific notes to the table are provided describing the sources of the values listed.

As a claimant-favorable assumption, the maximizing approach assumes that the employee worked 50 hours per week for 52 weeks per year, or 2,600 hours per year, and that he/she worked continuously in the area with the highest external onsite ambient dose rate. Unless otherwise noted, the values should be assigned in IREP as a constant, and they include a multiplication factor of 1.3 (or other appropriate factor based on the TBD) to account for any potential under-response by the ambient radiation measurement devices. A claimant-favorable organ dose conversion factor (DCF) of 1 can be assumed. These factors combined with the maximum ambient values assumed when applying this methodology ensure that the ambient doses received by a worker have been overestimated.

For some sites, this approach significantly overestimates the external ambient dose for most employees. If necessary, the Dose Reconstructor can use more realistic, yet still claimant-favorable, assumptions to process clearly noncompensable cases.

Prior to assigning the doses listed in Attachment B for an unmonitored employee, the Dose Reconstructor must review the claim files provided by DOE to verify that the employee would not have been likely to have received doses exceeding the values listed and that there was not a potential for the employee to spend more than 50 hours/ week on the site over the course of his/her employment. In some cases, an employee for whom monitoring data were not available could have received doses from radiation sources that exceed the onsite ambient levels, in which case the assignment of unmonitored dose is appropriate.

6.3 Best Estimate Methodology

Attachment C provides information for the assignment of a best estimate of external onsite ambient dose. A best estimate must take into account all available records pertinent to determination of work location. For employees who worked in multiple areas of the site, if the employee records and claimant interview do not provide enough information to determine specific work locations, values representing a “site average” are appropriate as a best estimate. Otherwise, the annual dose should be calculated according to the fraction of time spent in different areas of the site.

Consistent with the precedent established in the SRS TBD, the assumption should be made that the energy employee worked 50 hours per week. In addition, 50 weeks of work per year should be assumed (to reasonably account for holiday and/or vacation time), for a total of 2,500 work-hours per year as a best estimate. Partial years of employment should be scaled accordingly. In addition, if the claimant interview or other available information indicates definitively that fewer or more hours were worked than the default assumption, this information should be used accordingly. For example, if it is indicated that the employee spent half of his/her time at offsite locations where only natural background radiation levels existed, only 25 hours of exposure per week should be assumed.

The calculated annual dose should be multiplied by the appropriate exposure (R)-to-organ DCF documented in OCAS-IG-001 for an isotropic exposure geometry.

If the supporting documentation for all of the elements necessary for a best estimate dose reconstruction does not exist, conservative assumptions should be applied related to work location and area conditions, erring in favor of the claimant.

Attachment C provides information that describes how best estimate ambient doses are calculated from the site-specific TBDs, including information on the treatment of uncertainty. If appropriate, the attachment describes best estimate values that include subtraction of background radiation from the doses reported in the TBDs, although this calculation was often complicated by the site monitoring and reporting practices and the paucity of pertinent information in the TBDs. The numbers calculated in the manner described in Attachment C are available to the Dose Reconstructor either in the site-specific calculational workbooks or on the network. (Contact the Task 5 Tools Manager for assistance.)

6.4 Minimizing Methodology

The general philosophy for a minimizing approach is to assign dose from external ambient radiation only if the dose is necessary to generate a probability of causation (POC) greater than 50%. Doses should be assigned only for periods during which the employee was employed at the site and known to be present in conditions during which above-background onsite ambient doses might have been received. For many sites, this excludes time spent indoors and in areas near the perimeter of the site. If the work location is unknown, doses from the area with the lowest external ambient dose should be applied. A best estimate approach (see Section 6.3) is warranted if records are not available to indicate the energy employee's work location or if the employment area was not monitored for ambient dose rates and the inclusion of external ambient dose is necessary to raise the calculated POC to 50% or greater.

7.0 RECORDS

No records are generated as a result of this procedure.

8.0 APPLICABLE DOCUMENTS

8.1 Drivers

42 U.S.C. §§ 7384-7385, Energy Employees Occupational Illness Compensation Program Act (EEOICPA) of 2000, As Amended

Contract No. 200-2002-00593, Radiation Dose Estimation, Dose Reconstruction, and Evaluation of SEC Petitions Under EEOICPA

ORAUT-PLAN-0001, Quality Assurance Program Plan

8.2 Forms

None

9.0 DEFINITIONS AND ACRONYMS

ANL-W – Argonne National Laboratory-West.

AWE – Atomic Weapons Employer.

DCF – dose conversion factor.

DOE – U.S. Department of Energy.

EALER – Elevated Ambient Levels of External Radiation.

EEOICPA – Energy Employees Occupational Illness Compensation Program Act of 2000.

FEMP – Fernald Environmental Management Project.

FFTF – Fast Flux Test Facility.

GSD – geometric standard deviation.

ID – Identification.

INEL – Idaho National Engineering Laboratory (later changed to Idaho National Engineering and Environmental Laboratory (INEEL).

INEEL – Idaho National Engineering and Environmental Laboratory.

IREP – Interactive RadioEpidemiological Program.

KCP – Kansas City Plant.

keV – kilo-electron volt.

LANL – Los Alamos National Laboratory.

LLNL – Lawrence Livermore National Laboratory.

MeV – mega-electron volt.

mrem – millirem.

NIOSH – National Institute for Occupational Safety and Health.

NTS – Nevada Test Site.

OCAS – Office of Compensation Analysis and Support.

ORAU – Oak Ridge Associated Universities.

ORNL – Oak Ridge National Laboratory.

POC – probability of causation.

rem – roentgen equivalent man.

RFP – Rocky Flats Plant.

SRS – Savannah River Site.

TBD(s) – technical basis document(s).

TLD – thermoluminescent dosimeter.

β – beta radiation.

γ – gamma radiation.

ATTACHMENTS

The information contained in the following attachments is derived from the approved site Occupational Environmental Dose TBDs. All tables, figures, etc., referred to in these attachments pertain to the official revision number of the approved TBD for that site in place at the time the attachment was drafted. Although revisions to the TBDs will be reviewed by the Principal External Dosimetrist and any necessary modifications will be subsequently incorporated in a modification to this procedure, the Dose Reconstructor should be aware that this process could experience delays and, thus, should carefully review any revised TBDs with dates later than the effective date of this procedure.

These attachments include interpretation of sometimes unclear or inconsistent information contained in the TBDs. The Dose Reconstructor and Peer Reviewer have the authority to overrule these interpretations on a case-specific basis if all available information indicates that a different approach is warranted. However, the Dose Reconstructor and Peer Reviewer shall notify the Principal External Dosimetrist of any changes of interpretation or new information obtained that could affect other cases so that such information can be incorporated into subsequent revisions to this procedure.

ATTACHMENT A
EXTERNAL ONSITE AMBIENT DOSE ASSIGNMENT FOR MONITORED SITE EMPLOYEES

The following table lists rules for assigning external onsite ambient dose for monitored employees at the DOE sites addressed in Attachments B and C of this procedure. These rules have been derived from an evaluation of information provided in site profiles and communications with the site profile authors. Despite these rules, it is always acceptable with a noncompensable case to include onsite ambient dose for all years of employment to ensure claimant favorability.

Site	Assign external onsite ambient dose for monitored employees?
ANL-W	Yes.
Fernald	No (prior to 1985). Yes (1985–present, pending study of elevated ambient doses at badge storage locations).
Hanford	Yes (prior to 1972). No (1972–later).
INEEL	Yes.
KCP	No. There is little likelihood of significant occupational environmental exposure. The TBD directs assignment of unmonitored dose for unmonitored workers.
K-25	No.
LANL	No.
LLNL	No.
Mound	No.
NTS	No.
PNNL	Yes (prior to 1972). No (1972–later).
Paducah	No. (Although information on the control dosimeter storage practices at the site is unavailable, background levels were present at most areas of the site that indicate it is likely that above-background radiation was not inappropriately excluded from the monitored doses.)
Pantex	No.
Pinellas	No.
Portsmouth	No. (Although information on the control dosimeter storage practices at the site is unavailable, background levels were present at most areas of the site that indicate it is likely that above-background radiation was not inappropriately excluded from the monitored doses.)
Rocky Flats	Yes (prior to 1977, since control badges were stored on boards and could have been exposed to elevated ambient doses). No (1977–1999). Yes (2000–present).
SRS	Yes through 1979. No (1980–present).
Weldon Spring	No.
X-10	No.
Y-12	No.

ATTACHMENT B
MAXIMIZING DOSE SUMMARY

Maximizing external ambient dose (rem)

	Site name																	
Year	ANL-W	Fernald	Hanford	INEEL	K-25	LLNL	LANL	Mound	NTS	PNNL	PADGDP	Pantex	Pinellas	PORGDP	RFP	Weldon Spring	ORNL (X-10)	Y-12
1940																		
1941																		
1942																		
1943																		
1944			0.252		0.130			2.500		0.252							0.473	0.315
1945			0.252		0.130			15.000		0.252							0.473	0.315
1946			0.159		0.130			15.000		0.159							0.473	0.315
1947			0.157		0.130			15.000		0.157							0.473	0.315
1948			0.150		0.130			15.000		0.150							0.980	0.315
1949			0.205		0.130			0.723		0.205							1.555	0.315
1950			0.072		0.130			0.640		0.072							0.270	0.315
1951		0.032	0.072		0.130			0.640		0.072		0.030					0.372	0.315
1952		0.032	0.125	0.159	0.130	0.130		0.640		0.125	0.260	0.030					0.946	0.315
1953		0.032	0.082	0.159	0.130	0.130		0.640		0.082	0.260	0.030			0.073		0.710	0.315
1954		0.389	0.282	0.159	0.130	0.130		0.640		0.282	0.260	0.030		0.452	0.073		0.473	0.315
1955		0.389	0.345	0.159	0.130	0.130		0.356		0.345	0.260	0.030		0.452	0.073		0.406	0.315
1956		0.646	0.451	0.159	0.130	0.130		0.356		0.451	0.260	0.030		0.452	0.073		0.473	0.315
1957		0.646	0.350	0.159	0.130	0.130		0.356		0.350	0.260	0.030		0.452	0.073	0.646	0.372	0.315
1958		0.646	0.415	0.159	0.130	0.130		0.356		0.415	0.260	0.030		0.452	0.073	0.646	0.439	0.315
1959		0.646	0.225	0.159	0.130	0.130		0.356		0.225	0.260	0.030		0.452	0.073	0.646	0.642	0.315
1960		0.646	0.186	0.159	0.130	0.130		0.207		0.186	0.260	0.030		0.452	0.073	0.646	0.439	0.315
1961		0.646	0.186	0.159	0.130	0.130		0.207		0.186	0.260	0.030		0.452	0.073	0.646	0.338	0.315
1962		0.646	0.186	0.159	0.130	0.130		0.207		0.186	0.260	0.030		0.452	0.073	0.646	0.359	0.315
1963		0.646	0.153	0.159	0.130	0.130		0.207	0.123	0.153	0.260	0.030	0.001	0.452	0.073	0.646	0.351	0.315
1964		0.646	0.153	0.159	0.130	0.130		0.207	0.123	0.153	0.260	0.030	0.001	0.452	0.073	0.646	0.274	0.315
1965	0.021	0.646	0.153	0.159	0.130	0.130	0.126	0.127	0.123	0.153	0.260	0.030	0.001	0.452	0.073	0.646	0.243	0.315
1966	0.021	0.646	0.140	0.159	0.130	0.130	0.105	0.127	0.123	0.140	0.260	0.030	0.001	0.452	0.073	0.646	0.254	0.315
1967	0.021	0.646	0.163	0.159	0.130	0.130	0.090	0.127	0.123	0.163	0.260	0.030	0.001	0.452	0.073	0.646	0.241	0.315
1968	0.021	0.646	0.204	0.159	0.130	0.130	0.090	0.127	0.110	0.204	0.260	0.030	0.001	0.452	0.073		0.257	0.315
1969	0.021	0.646	0.163	0.159	0.130	0.130	0.090	0.127	0.123	0.163	0.260	0.030	0.001	0.452	0.073		0.283	0.315
1970	0.021	0.646	0.096	0.159	0.130	0.130	0.039	0.085	0.123	0.096	0.260	0.030	0.001	0.452	0.073		0.243	0.315
1971	0.021	0.291	0.040	0.159	0.130	0.117	0.082	0.085	0.123	0.040	0.260	0.030	0.001	0.452	0.073		0.237	0.315
1972	0.021	0.291	0.044	0.159	0.130	0.130	0.067	0.085	0.123	0.044	0.260	0.030	0.001	0.452	0.073		0.237	0.315
1973	0.013	0.291	0.048	0.144	0.130	0.130	0.102	0.085	0.123	0.048	0.260	0.030	0.001	0.452	0.073		0.237	0.315
1974	0.132	0.291	0.043	0.223	0.130	0.130	0.102	0.085	0.123	0.043	0.260	0.030	0.001	0.452	0.073		0.237	0.315
1975	0.094	0.291	0.040	0.127	0.130	0.130	0.113	0.061	0.123	0.040	0.260	0.015	0.001	0.452	0.073	0.077	0.237	0.315
1976	0.055	0.291	0.035	0.111	0.130	0.121	0.077	0.061	0.123	0.035	0.260	0.015	0.001	0.452	0.073	0.077	0.190	0.315
1977	0.067	0.227	0.035	0.113	0.130	0.130	0.081	0.061	0.123	0.035	0.260	0.015	0.001	0.452	0.073	0.077	0.142	0.315
1978	0.038	0.287	0.029	0.089	0.130	0.130	0.069	0.061	0.123	0.029	0.260	0.015	0.001	0.452	0.073	0.077	0.125	0.315
1979	0.023	0.000	0.029	0.084	0.130	0.125	0.075	0.061	0.074	0.029	0.260	0.015	0.001	0.452	0.073	0.077	0.112	0.315
1980	0.020	0.323	0.029	0.089	0.130	0.130	0.090	0.048	0.080	0.029	0.260	0.015	0.001	0.452	0.073	0.077	0.108	0.315

Maximizing external ambient dose (rem) (continued)

	Site name																	
Year	ANL-W	Fernald	Hanford	INEEL	K-25	LLNL	LANL	Mound	NTS	PNNL	PADGDP	Pantex	Pinellas	PORGDP	RFP	Weldon Spring	ORNL (X-10)	Y-12
1981	0.015	0.500	0.038	0.091	0.130	0.130	0.052	0.048	0.084	0.038	0.260	0.015	0.001	0.452	0.073	0.077	0.098	0.315
1982	0.015	0.510	0.058	0.157	0.130	0.130	0.048	0.048	0.081	0.058	0.260	0.015	0.001	0.452	0.073	0.077	0.101	0.315
1983	0.018	0.521	0.062	0.127	0.130	0.130	0.056	0.048	0.079	0.062	0.260	0.015	0.001	0.452	0.073	0.077	0.098	0.315
1984	0.017	0.385	0.073	0.027	0.130	0.130	0.054	0.048	0.126	0.073	0.260	0.015	0.001	0.452	0.073	0.091	0.105	0.315
1985	0.017	0.406	0.073	0.025	0.130	0.104	0.056	0.041	0.134	0.073	0.260	0.015	0.001	0.452	0.073	0.086	0.101	0.315
1986	0.017	0.385	0.073	0.027	0.130	0.090	0.054	0.041	0.123	0.073	0.260	0.015	0.001	0.404	0.073	0.071	0.101	0.315
1987	0.017	0.100	0.073	0.027	0.130	0.092	0.049	0.041	0.095	0.073	0.260	0.015	0.001	0.452	0.073	0.056	0.101	0.315
1988	0.017	0.175	0.073	0.027	0.130	0.090	0.056	0.041	0.086	0.073	0.260	0.015	0.001	0.440	0.073	0.049	0.101	0.315
1989	0.017	0.202	0.073	0.030	0.130	0.130	0.044	0.041	0.084	0.073	0.260	0.015	0.001	0.435	0.073	0.054	0.101	0.315
1990	0.010	0.116	0.028	0.027	0.130	0.130	0.053	0.037	0.074	0.028	0.260	0.015	0.001	0.424	0.073	0.051	0.101	0.315
1991	0.010	0.128	0.028	0.035	0.130	0.101	0.053	0.037	0.075	0.028	0.260	0.015	0.001	0.441	0.073	0.058	0.101	0.315
1992	0.010	0.136	0.028	0.031	0.130	0.099	0.070	0.037	0.073	0.028	0.260	0.015	0.001	0.417	0.073	0.053	0.101	0.315
1993	0.010	0.149	0.027	0.030	0.130	0.096	0.044	0.037	0.082	0.027	0.260	0.015	0.001	0.254	0.073	0.965	0.101	0.315
1994	0.009	0.149	0.025	0.036	0.130	0.103	0.047	0.037	0.055	0.025	0.260	0.015	0.001	0.061	0.073	0.965	0.101	0.315
1995	0.015	0.137	0.032	0.026	0.130	0.087	0.112	0.037	0.082	0.032	0.260	0.015	0.001	0.152	0.073	0.965	0.101	0.315
1996	0.014	0.050	0.019	0.026		0.078	0.072	0.037	0.087	0.019	0.260	0.015		0.189	0.073	0.064	0.101	0.315
1997	0.006	0.051	0.016	0.026		0.083	0.137	0.037	0.066	0.016	0.260	0.015		0.222	0.073	0.071	0.101	0.315
1998	0.007	0.045	0.027	0.022		0.086	0.126	0.037	0.078	0.027	0.260	0.015		0.228	0.073	0.054	0.101	0.315
1999	0.008	0.045	0.029	0.017		0.082	0.072	0.037	0.074	0.029	0.260	0.015		0.222	0.073	0.048	0.101	0.315
2000	0.022	0.049	0.029	0.022		0.085	0.080	0.037	0.084	0.029	0.260	0.015		0.252	0.073	0.044	0.101	0.315
2001	0.009	0.049	0.029	0.011		0.130	0.169	0.037	0.115	0.029	0.260			0.254	0.073	0.044	0.101	0.315
2002	0.014	0.048	0.029	0.019			0.070	0.037		0.029				0.241	0.073	0.044	0.101	0.315
2003			0.029					0.037		0.029				0.241	0.073	0.044	0.101	

Notes Supporting the Calculation and Use of Maximum External Ambient Doses

General Notes

Unless otherwise indicated in the site-specific notes below, maximum values provided in the above table were derived from the reported TBD values without background subtraction by adjusting for a 2,600-hour work year and multiplying by 1.3 to account for uncertainty. These values should be assigned in IREP as a constant. All tables or other data sources cited in the notes below refer to the Occupational Environmental Dose TBD (typically Part 4) of the site profile.

Site-Specific Notes

ANL-W: The maximum annual dose is based on the maximum values listed for each year from Tables 4-6 and 6-1 of the TBDs, multiplied by 1.2 to account for a 20% uncertainty in the TLD readings suggested in the TBD. The 20% uncertainty also applies to

the early (film-badge) years because the reported values are based on back-extrapolation from TLD readings. These values reflect background-subtracted doses.

Fernald: Based on information provided in the TBD, some areas of the site had the potential to deliver an annual dose greater than 3 rem/year during certain periods of site operation. However, the TBD also provides an FEMP site average as a more realistic value that excludes the K-65 silos since that area has the highest dose rate and was occupied infrequently. For the purpose of assigning a maximized external ambient dose to a typical unmonitored employee, the FEMP site average dose rates provided in Table 4-17 of the TBD were used.

Hanford: The maximum annual dose is based on the maximum value for each year listed in Table 4.3.1-1 of the TBD, adjusted for a 2,600-hour year. The value for 1944 was assumed to be equal to the value for 1945; this is likely to be a claimant-favorable assumption because the operations at the site were limited in 1944 compared to 1945. For 1943, only very limited operations occurred, so no onsite ambient doses should be assigned. (The few employees involved in radiological operations that year should instead be assigned unmonitored doses.)

INEEL: The maximum annual dose is based on the maximum values listed for each year from Table 4-13 of the TBD, multiplied by 1.2 to account for a 20% uncertainty in the TLD readings suggested in the TBD. The 20% uncertainty also applies to the early (film-badge) years at the site because the reported values are based on back-extrapolation from TLD readings. These values reflect background-subtracted doses.

KCP: According to Section 4.0 of the site profile, KCP routinely handles hazardous chemicals, but there is limited handling of radioactive materials and thus essentially little likelihood of a significant occupational environmental exposure associated with releases. The site profile provides guidance for assignment of unmonitored dose in the case of unmonitored workers. No onsite ambient dose is provided.

K-25: A maximum annual dose of 0.130 rem is the result of adding the highest dose rate provided in Table 4D-4 (10.5 μR/hr for 1976) after application of the provided geometric standard deviation (GSD) of 1.07 to determine the 95th-percentile dose and adding the dose rate from the parking area near the cylinder yards. The dose rates were then multiplied by 2,600 hours per year. A multiplication factor of 1.3 has NOT been applied.

LLNL: The maximum annual dose is based on the maximum values listed in Table 4-9 of the TBD, adjusted for 2,600 hours per year. Based on this being a maximum, a multiplication factor of 1.3 has NOT been applied.

LANL: The maximum annual dose for 1965 through 2002 is based on the maximum values listed in Tables 4-25 and 4-30 of the TBD and has been adjusted to 2,600 hours to calculate the maximum doses in this procedure. For 1943 through 1964, the highest value for any year (2001) was used to estimate the onsite ambient dose since no value is provided in the TBD.

Mound: The maximum onsite ambient doses are based on the maximum values listed for each year in Tables 4-9 and 4-29 of the TBD. For 1945 through 1948, the maximum is the permissible level of 15 rem per year. For 1944, based on ^{210}Po production being performed for 8 weeks, the maximum of 15 rem per year was multiplied by a factor of 0.16 based on the mean doses provided in the TBD. For 1949 through 2003, the maximum provided in Table 4-29 was adjusted by a factor of 1.3 to account for an assumed 2,600 hours on the site.

NTS: The maximum onsite ambient doses are based on the maximum values listed for each year in Table 4.3.1-2 of the TBD. The TBD states that, prior to 1967, the dose rates for 1967 can be applied for the years 1963–1966 as a maximizing assumption. Years prior to 1963 have been omitted due to substantial releases from above-ground testing.

PNNL: See Hanford above.

Paducah: The TBD states that 200 mrem should be assigned for a 2,000-hour year. Adjusting for a 2,600-hour work year, the maximum onsite ambient dose is 260 mrem (0.260 rem) per year. Since this value is claimant-favorable according to the TBD, a multiplication factor of 1.3 has NOT been applied.

Pantex: Section 4.3.1 of the TBD recommends that ambient external dose should be applied as 0.100 rem for the years from 1951 to 1974, and 0.050 rem for the years from 1975 to 2000. These values represent a full year, so they have been adjusted to reflect a 2,600-hour work year. Since it is stated in the TBD that these values are claimant-favorable, they have NOT been multiplied by 1.3.

Pinellas: The primary environmental release was tritium, which does not contribute to external dose. The external dose was determined based on ^{14}C and ^{85}Kr emissions. Note that from 1957 through 1962, there were no external doses due to stack emissions because neither ^{14}C nor ^{85}Kr was emitted during these years. The doses provided in Table 4.3.1-1 are assumed to be for 2,600 working hours per year. A maximizing onsite ambient dose of 0.001 rem per year is a very claimant-favorable assumption.

Portsmouth: The doses included in the above table significantly overestimate the average unmonitored employee's external onsite ambient dose. The values were derived from the TBD Table 4.3.1-1 values at the "Power Pole 874" location at the northwest corner of the cylinder storage areas, where it is unlikely an unmonitored employee would have been present and where the dose rates are significantly higher than both the dose rates found on the rest of the site and the median dose to a monitored employee. Note that in 2000 and 2001, dose rates at the X-744G Building were higher than the "Power Pole 874" doses. For the period between 1954 and 1985, the maximum ambient dose has been assumed to equal the value for 1987 at "Power Pole 874," as this is the highest value

listed for that location. If it can be determined that the employee did not work in this location, the TBD stipulates that the maximum value of 35.9 mrem from Table 4.3.1-1 can be used as the basis for a maximizing assessment; this value converts to an annual dose of 0.061 rem under the assumptions stated in the "General Notes" above.

RFP: To ensure claimant favorability, the maximum mean yearly dose from Table 4-3 of the TBD, combined with the maximum standard deviation recommended in the TBD, was applied to all years. This results in a recommended maximum value of 73 mrem, calculated as follows:

$$(2600 / 8760)(\text{Mean}_{\text{Max}} + 2\sigma_{\text{Max}}) = .297\ (167 + (2 * 39)) = 73 \text{ mrem}.$$

This value clearly provides a claimant-favorable assessment of onsite ambient dose for administrative work or work in outside locations because, as described in both the TBD and Attachment C of this procedure, the external onsite ambient doses at the site exceed natural background by only 9%.

SRS: The maximum values for application are provided in Table 3.4-1 of the SRS TBD.

Weldon Spring: The plant was shut down at the end of 1966. Shutdown procedures began in 1967 and only a few pounds of pure compounds were present in any single piece of equipment. The bulk of the remaining radiological materials that remained on the site were in building sumps and secondary pieces of process equipment without routine access ports. Monitoring and maintenance was performed from 1975 to 1985 with site remediation beginning in 1986.

X-10: See 'Best Estimate' section for X-10.

Y-12: The maximum annual dose is based on the 95th-percentile dose rate (excluding background) from Table D-7 of the TBD. Because the 95th-percentile value was used, a multiplication factor of 1.3 has NOT been applied.

ATTACHMENT C
METHODS FOR ASSIGNING SITE-SPECIFIC BEST ESTIMATES OF EXTERNAL ONSITE AMBIENT DOSES

Best estimates incorporate a 2,500-hour work year (which the Dose Reconstructor has the discretion to modify, as discussed in Section 6.3). The reported values are not multiplied by a factor to ensure claimant favorability, but are typically treated as normal or lognormal distributions depending on the TBD information regarding uncertainty. If uncertainty is not discussed in the TBD, a default assumption of a normal distribution and 30% standard deviation is applied. Background is excluded from the reported values unless the TBD does not provide reliable information that supports background subtraction.

ANL-W: For the best estimate approach, the area-specific values provided in Table 4-6 of the environmental TBD are applied. Additional fenceline direct gamma values for the EBR-1 and Radioactive Waste Management Complex are provided in Table 6-1 of the external dose TBD. These values should be applied in IREP as a normal distribution with a standard deviation of 20%. If the employee's work location was unknown or included many areas of the site with no apparent location frequented more than others, the following values should be used:

NOTE: The Parameter 1 and Parameter 2 values should be multiplied by an appropriate factor to account for the fact that the TBD values are relevant to a full year, e.g., 0.285 for 2,500 hours per year.

ANL-W Best Estimate Doses (rem)			
Year(s)	**Distribution type**	**IREP Param. 1**	**IREP Param. 2**
1952-72	Normal	0.047	0.006
1973	Normal	0.029	0.004
1974	Normal	0.140	0.025
1975	Normal	0.102	0.018
1976	Normal	0.087	0.012
1977	Normal	0.070	0.013
1978	Normal	0.055	0.008
1979	Normal	0.043	0.006
1980	Normal	0.040	0.005
1981	Normal	0.026	0.003
1982	Normal	0.025	0.003
1983	Normal	0.028	0.004
1984	Normal	0.031	0.004
1985	Normal	0.031	0.004
1986	Normal	0.031	0.004
1987	Normal	0.031	0.004
1988	Normal	0.031	0.004
1989	Normal	0.031	0.002
1990	Normal	0.020	0.002
1991	Normal	0.020	0.002
1992	Normal	0.020	0.003
1993	Normal	0.023	0.002
1994	Normal	0.014	0.003
1995	Normal	0.022	0.003
1996	Normal	0.028	0.002
1997	Normal	0.016	0.002
1998	Normal	0.010	0.002
1999	Normal	0.016	2.039
2000	Normal	0.037	0.005
2001	Normal	0.009	0.002
2002	Normal	0.030	0.004

ATTACHMENT C
METHODS FOR ASSIGNING SITE-SPECIFIC BEST ESTIMATES OF EXTERNAL ONSITE AMBIENT DOSES

Fernald: For the best estimate approach, the area-specific "Net above background" values from Table 4-17 are applied. If the employee's work location was unknown or included many areas of the site, the FEMP site average values should be used. These values should be applied in IREP as a normal distribution with a standard deviation of 30%.

Hanford: The areas listed in Table 4.3.1-1 have been grouped in the table below to simplify the assignment of external onsite ambient dose. The doses represent an average value for the area and have been modified for a 2,500-hour work year. These values reflect a subtraction of 20 mrem, which represents a claimant-favorable interpretation of background radiation from the TBD data. Any negative value resulting from this subtraction has been changed to zero. The values should be treated in IREP as a normal distribution with a standard deviation of 30%.

If the specific work locations within the area are known, the Dose Reconstructor should use the appropriate values from Table 4.3.1-1 of the TBD (adjusted to a 2,500-hour work year). As an inherently claimant-favorable assumption, values for 1944 can be assumed to be equal to the 1945 values. For 1943, unmonitored doses (as opposed to onsite ambient doses) should be assigned if applicable. In the 100 and 300 Areas from 1957 to 1959 if values were not reported, the claimant-favorable assumption was made to use the previously listed value for that area. For 1960 to 1965, the values for "Perimeter Locations/FFTF" represent the site-wide average excluding the 100, 200, and 300 Areas. In the 100, 200, and 300 Areas from 1960 to 1962, ambient dose rates were based on the average gamma levels for all three locations from 1952 to 1956. Similarly, the values listed for 1963 to 1965 for the 100, 200, and 300 Areas were based on the average values for 1966 to 1970. In 1969, the value from 1968 was used for the perimeter areas.

Hanford Best Estimate Doses (rem)				
Year	300 Area	100 Area	200 Area	Perimeter locations/FFTF
1945	0.193	0.140	0.217	0.166
1946	0.066	0.029	0.088	0.031
1947	0.131	0.058	0.088	0.090
1948	0.075	0.043	0.041	0.124
1949	0.055	0.015	0.003	0.178
1950	0.041	0.035	0.031	0.020
1951	0.041	0.035	0.031	0.020
1952	0.100	0.017	0.011	0.000
1953	0.024	0.028	0.050	0.009
1954	0.010	0.108	0.160	0.019
1955	0.085	0.107	0.257	0.075
1956	0.180	0.248	0.275	0.138
1957	0.316	0.248	0.163	0.138
1958	0.316	0.248	0.379	0.138
1959	0.316	0.248	0.196	0.138
1960	0.080	0.100	0.131	0.018
1961	0.080	0.100	0.131	0.018
1962	0.080	0.100	0.131	0.029
1963	0.038	0.055	0.038	0.027
1964	0.038	0.055	0.038	0.022

ATTACHMENT C
METHODS FOR ASSIGNING SITE-SPECIFIC BEST ESTIMATES OF EXTERNAL ONSITE AMBIENT DOSES
Page 3 of 7

Hanford Best Estimate Doses (rem)				
Year	300 Area	100 Area	200 Area	Perimeter locations/FFTF
1965	0.038	0.055	0.038	0.014
1966	0.029	0.048	0.043	0.019
1967	0.030	0.069	0.049	0.041
1968	0.029	0.075	0.032	0.024
1969	0.080	0.079	0.080	0.024
1970	0.019	0.029	0.024	0.004
1971	0.001	0.005	0.009	0.001
1972	0.006	0.009	0.012	0.003
1973	0.003	0.007	0.016	0.001
1974	0.001	0.003	0.014	0.001
1975	0.001	0.003	0.013	0.001
1976	0.000	0.001	0.008	0.000
1977	0.000	0.000	0.009	0.000
1978	0.000	0.002	0.006	0.000
1979	0.000	0.002	0.007	0.001
1980	0.004	0.001	0.005	0.000
1981	0.016	0.002	0.004	0.001
1982	0.131	0.002	0.004	0.001
1983	0.103	0.002	0.002	0.001
1984	0.006	0.003	0.000	0.001
1985	0.004	0.000	0.000	0.000
1986	0.006	0.000	0.000	0.000
1987	0.006	0.003	0.004	0.003
1988	0.004	0.004	0.004	0.004
1989	0.005	0.004	0.005	0.005
1990	0.004	0.004	0.003	0.004
1991	0.008	0.009	0.006	0.006
1992	0.008	0.007	0.008	0.007
1993	0.006	0.007	0.008	0.006
1994	0.010	0.011	0.011	0.009
1995	0.004	0.003	0.004	0.003
1996	0.003	0.003	0.004	0.003
1997	0.003	0.003	0.004	0.003
1998	0.004	0.003	0.005	0.004
1999	0.004	0.003	0.006	0.005
2000	0.004	0.003	0.005	0.004
2001	0.004	0.004	0.005	0.005

INEEL: For the best estimate approach, the area-specific values from Table 4-13 are applied. These values should be applied in IREP as a normal distribution with a standard deviation of 20%. If the employee's work location was unknown or included many areas of the site with no apparent location frequented more than others, the following values should be used (NOTE: the Parameter 1 values should be multiplied by an appropriate factor to account for the fact that the TBD values are relevant to a full year, e.g., 0.285 for 2,500 hours per year; the Parameter 2 values should not be changed):

ATTACHMENT C
METHODS FOR ASSIGNING SITE-SPECIFIC BEST ESTIMATES OF EXTERNAL ONSITE AMBIENT DOSES

INEEL Best Estimate Doses (rem)			
Year(s)	**Distribution type**	**IREP Param. 1**	**IREP Param. 2**
1952-72	Lognormal	0.048	3.947
1973	Lognormal	0.047	3.058
1974	Lognormal	0.064	4.767
1975	Lognormal	0.039	4.111
1976	Lognormal	0.047	2.798
1977	Lognormal	0.020	7.173
1978	Lognormal	0.019	5.452
1979	Lognormal	0.029	3.481
1980	Lognormal	0.034	3.090
1981	Lognormal	0.029	3.301
1982	Lognormal	0.023	3.019
1983	Lognormal	0.034	2.471
1984-92	Lognormal	0.032	2.846
1993	Lognormal	0.025	1.671
1994	Lognormal	0.019	2.695
1995	Lognormal	0.013	3.114
1996	Lognormal	0.021	2.183
1997	Lognormal	0.015	2.255
1998	Lognormal	0.016	2.184
1999	Lognormal	0.016	2.039
2000	Lognormal	0.022	1.980
2001	Lognormal	0.013	3.045
2002	Lognormal	0.025	1.888

Each of the 11 area-specific data points in Table 4-13 of the TBD were used to generate the annual distributions to represent the site-wide ambient doses shown above. The values were calculated using the Crystal Ball code (Decisioneering Inc., Denver, CO) based on the assumption that the data fit a lognormal distribution. An analysis of the data indicated that they fit a lognormal distribution better than a normal distribution for most years; thus, a lognormal distribution was assumed for all years to ensure consistency and claimant favorability.

KCP: According to Section 4.0 of the TBD, KCP routinely handles hazardous chemicals, but there is limited handling of radioactive materials and thus essentially little likelihood of a significant occupational environmental exposure associated with releases. The TBD provides guidance for assignment of unmonitored dose in the case of unmonitored workers. No onsite ambient dose is provided.

K-25: The best estimates should be based on the average levels provided in Table 4D-4 of the TBD. The dose rates should be multiplied by an assumed 2,500 working hours per year and entered into Parameter 1. The GSD should be entered as Parameter 2 and a lognormal distribution applied. If there is indication that the Energy Employee spent time in proximity to the cylinder yards, the dose rate given in the TBD should be scaled based on the assumed hours in that location.

LLNL: The best estimate values should be based on the site average values provided in Table 4-9 of the TBD. The values provided in the TBD are based on 2,000 hours per year and should be adjusted

ATTACHMENT C
METHODS FOR ASSIGNING SITE-SPECIFIC BEST ESTIMATES
OF EXTERNAL ONSITE AMBIENT DOSES

for an assumed 2,500 working hours per year and entered into Parameter 1. Parameter 2 is determined by multiplying the dose for Parameter 1 by 0.20 (20% uncertainty). The calculated dose and uncertainty should be entered into IREP as a normal distribution.

LANL: The best estimates should be applied as a lognormal distribution based on the Geometric Mean, adjusted for 2,500 hours, provided in Table 4-25 of the LANL TBD as Parameter 1 and the provided GSD provided in Table 4-25 as Parameter 2.

Mound: The best estimates should be based on the mean site-wide values from Tables 4-9 and 4-29 in the TBD. The values provided in the TBD are based on 2,000 working hours per year and should be adjusted for an assumed 2,500 working hours per year. A GSD of 3.6 should be applied for 1944 through 1948 and a GSD of 3.12 applied starting in 1949. The calculated dose and GSD should be entered into IREP as a lognormal distribution.

NTS: The best estimates are based on the values from Table 4.3.1-2 minus the background radiation from Table 4.3.1-1. (If the resultant value is negative, the onsite ambient dose is considered zero.) (NOTE: The values provided in the tables are based on 8,760 hours per year). If the employee's work location was unknown or included many areas of the site, the average of the area-specific values should be used. The background for years listed in the TBD as "Not Reported" is assumed to be 95 mrem. For periods where there are no data, the site maximum should be applied as suggested by the TBD. Based on information in Section 4.3.1 of the TBD, the values should be applied in IREP as a lognormal distribution with a GSD of 1.52.

PNNL: See Hanford.

Paducah: Similar to Portsmouth, the monitoring locations around the cylinder storage yards show an ambient background rate that is clearly elevated over the rest of the site. At other areas of the site, it appears that the ambient dose rates might not have been elevated over the background rates. In addition, the ambient dose rates in the cylinder yards are proportional to the amount of material stored there, which grew over time. Therefore, as stated in the TBD, in the early periods of operation when it was more likely an unmonitored employee might have been present in the cylinder yards, the dose rates were lower, while in the modern era it is unlikely an unmonitored employee would spend a significant amount of time in the cylinder yards. Thus, consistent with the approach for the Portsmouth site, for employees not near the cylinder storage yards, the best estimate of the background-subtracted external onsite ambient dose rate is 0 mrem. For employees near the cylinder storage yards, the average values presented in the TBD, when adjusted for a 2,500-hour work year, lead to a geometric mean of 0.131 rem. These values should be applied in IREP as a lognormal distribution with a GSD of 1.43. Because these values are based on limited data, mostly from the modern era (when the cylinder yard inventories were the highest), they are, by necessity due to the paucity of data, claimant-favorable for employees in the early years at the site.

Pantex: The linear regression method discussed in the TBD was used to generate an annual dose. The values were then adjusted from a full year (8,760 hours) to a 2,500-hour year. The calculated annual values are consistent with the 5-year values presented in Table 4-6 of the TBD. The yearly standard deviation was calculated assuming that the 95th percentile is twice the value at the mean.

ATTACHMENT C
METHODS FOR ASSIGNING SITE-SPECIFIC BEST ESTIMATES OF EXTERNAL ONSITE AMBIENT DOSES
Page 6 of 7

The values in the table below should be applied in IREP as a normal distribution together with values listed for Parameter 2 based on the calculated standard deviation.

Pantex Best Estimate External Ambient Doses (rem)						
Year	**Dose (Parameter 1)**	**σ (Parameter 2)**		**Year**	**Dose (Parameter 1)**	**σ (Parameter 2)**
1950	0.0311	0.0189		1976	0.0147	0.0090
1951	0.0305	0.0185		1977	0.0141	0.0086
1952	0.0298	0.0181		1978	0.0135	0.0082
1953	0.0292	0.0178		1979	0.0128	0.0078
1954	0.0286	0.0174		1980	0.0122	0.0074
1955	0.0280	0.0170		1981	0.0116	0.0070
1956	0.0273	0.0166		1982	0.0109	0.0067
1957	0.0267	0.0162		1983	0.0103	0.0063
1958	0.0261	0.0158		1984	0.0097	0.0059
1959	0.0254	0.0155		1985	0.0091	0.0055
1960	0.0248	0.0151		1986	0.0084	0.0051
1961	0.0242	0.0147		1987	0.0078	0.0047
1962	0.0235	0.0143		1988	0.0072	0.0044
1963	0.0229	0.0139		1989	0.0065	0.0040
1964	0.0223	0.0136		1990	0.0059	0.0036
1965	0.0217	0.0132		1991	0.0053	0.0032
1966	0.0210	0.0128		1992	0.0047	0.0028
1967	0.0204	0.0124		1993	0.0040	0.0024
1968	0.0198	0.0120		1994	0.0034	0.0021
1969	0.0191	0.0116		1995	0.0028	0.0017
1970	0.0185	0.0113		1996	0.0021	0.0013
1971	0.0179	0.0109		1997	0.0015	0.0009
1972	0.0172	0.0105		1998	0.0010	0.0005
1973	0.0166	0.0101		1999	0.0010	0.0001
1974	0.0160	0.0097		2000	0.0010	0.0001
1975	0.0154	0.0093				

Pinellas: The information provided in the maximizing section is adequate for all dose reconstructions when external onsite ambient dose needs to be applied.

Portsmouth: The TBD states that for employees not near the UF_6 cylinder storage yards (i.e., the guard gates, switchyards, warehouses, process buildings, and wastewater facility), the background-subtracted external onsite ambient dose rate is 0 mrem. For employees near either the UF_6 cylinder storage yards or the X-744G Bulk Storage Building, the values from the appropriate columns in Table 4.3.1-1 or 4.3-3, respectively, should be used after adjusting for a 2,500-hour work year. The values should be applied in IREP as a normal distribution with a standard deviation of 30%.

RFP: The TBD states that the ambient radiation at the site is elevated approximately 9% above the natural background radiation. Thus, an annual external ambient dose of 4 mrem can be considered a best estimate for work in outside areas or for administrative workers not potentially exposed to workplace radiation sources. This value should be applied in IREP as a constant. The TBD information does not support a best estimate of onsite ambient dose that could have been

ATTACHMENT C
METHODS FOR ASSIGNING SITE-SPECIFIC BEST ESTIMATES OF EXTERNAL ONSITE AMBIENT DOSES

inappropriately subtracted from a worker's dosimeter readings due to the storage of control badges in areas with elevated ambient dose rates.

SRS: The best estimate for external onsite ambient dose can be calculated using the tool that incorporates the Crystal Ball program to perform best estimate dose reconstructions.

Weldon Spring: The best estimate for claims should be assigned the values provided below for the appropriate area as a normal distribution with a standard deviation of 30% applied as Parameter 2 in the IREP input sheet

Weldon Spring Best Estimate Doses (mrem)			
Year	**WSRP**	**WSCP**	**WSQ**
1957-1967		478	
1975-1979	57		28
1980	57		28
1981	57		28
1982	57		24
1983	57		27
1984	67		36
1985	64	57	35
1986	53	44	27
1987	40	41	27
1988	36	34	21
1989	40	37	23
1990	38	38	22
1991	43	40	24
1992	39	39	21
1993	36	34	713
1994	34	34	713
1995	40	41	713
1996	39	47	18
1997	39	53	17
1998	36	40	16
1999	35	35	16
2000	17	32	14
2001	17	32	14
2002	17	32	14
2003	17	32	14
2004	17	32	14

X-10: The TBD does not contain sufficient information regarding natural background radiation or fallout from atmospheric weapons testing to allow their subtraction from the rates reported in Attachment 4C of the TBD. Also, the TBD does not provide sufficient information to permit area-specific assessments of ambient dose. Thus, the Attachment 4C values (combined with a 2,500-hour work week and assigned as lognormal with a GSD of 3.0) can be considered best estimates.

Y-12: For a best estimate approach, the geometric mean (13 µrem/hr) of the background subtracted dose reported in Table D-7 of the TBD translates to a dose of 0.0325 rem. This value should be applied in IREP as a lognormal distribution, with a GSD of 4.0 based on the TBD information (revised upward to account for the uncertainty associated with background subtraction).