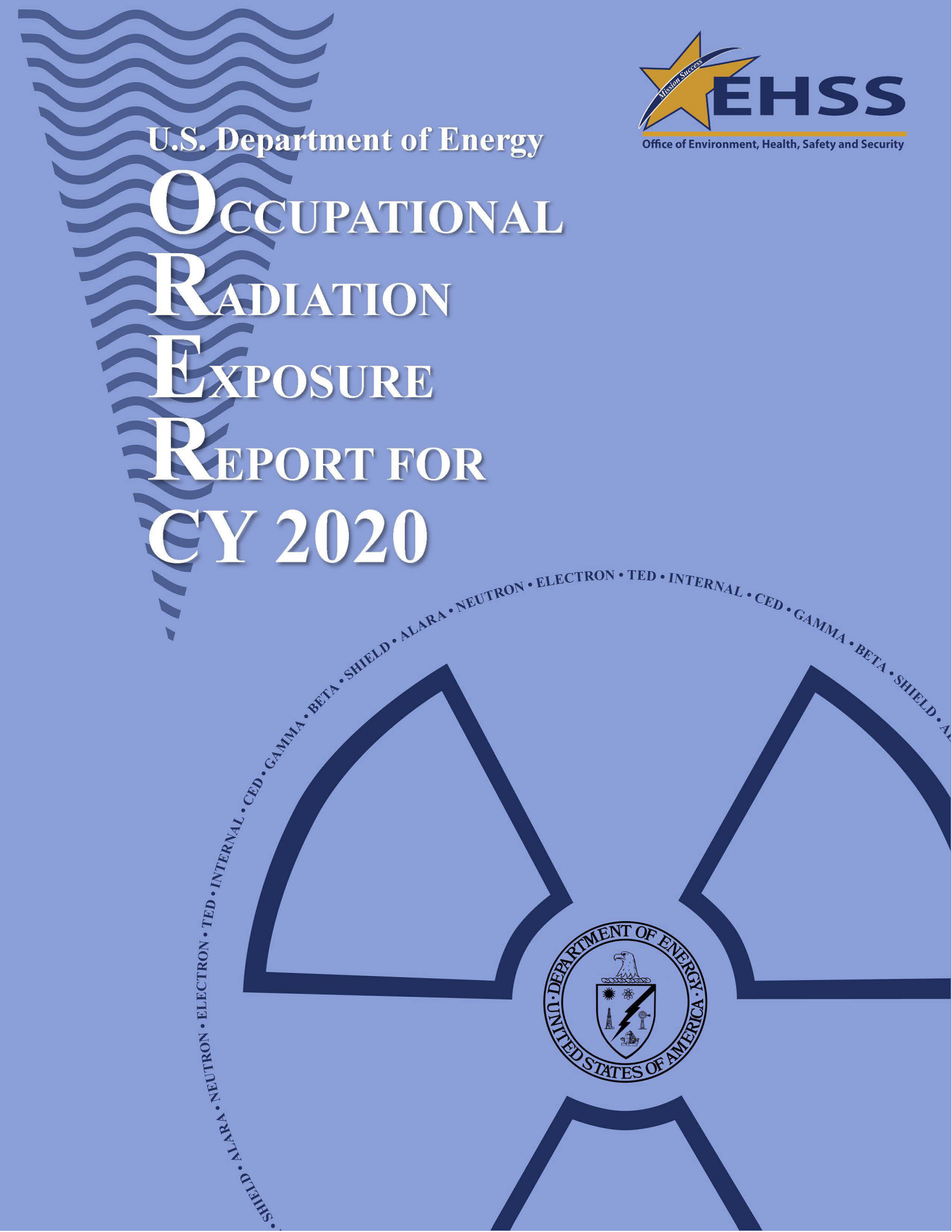
EHSS

Office of Environment, Health, Safety and Security

U.S. Department of Energy

Occupational Radiation Exposure Report for CY 2020



This document is available on the U.S. Department of Energy
Radiation Exposure Monitoring System Program Web Site at:
https://energy.gov/ehss/occupational-radiation-exposure

U.S. Department of Energy

Occupational Radiation Exposure Report for Calendar Year 2020

Manuscript Completed:
Date Published:

Prepared by:
Katharine McLellan
U.S. Department of Energy
Office of Environment, Safety, and Health Reporting and Analysis (AU-23)

D.A. Hagemeyer
D.B. Holcomb
Oak Ridge Institute for Science and Education (ORISE)

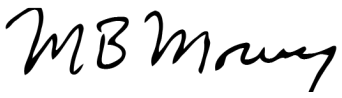
Foreword

The *U.S. Department of Energy Occupational Radiation Exposure Report for Calendar Year 2020* presents the results of analyses of occupational radiation exposures at the Department of Energy (DOE), including the National Nuclear Security Administration operations, during calendar year 2020. This report includes occupational radiation exposure data for over 64,000 DOE Federal employees, contractors, and subcontractors, as well as members of the public who have worked in or entered controlled areas monitored for exposure to radiation.

DOE publishes this annual report to provide DOE Management, Program Offices, workers, health physicists and other stakeholders an evaluation of DOE-wide performance regarding compliance with Title 10 of the *Code of Federal Regulations* (CFR), Part 835, *Occupational Radiation Protection* (10 CFR 835) radiation exposure limits and adherence to as low as reasonably achievable principles.

This report provides a discussion regarding radiation protection and exposure reporting requirements as well as information and analyses regarding aggregate, individual, site, DOE Program, transient workers, and a 46-year historical review of DOE exposure data. DOE continues to be diligent in protecting its workers and the public from exposure to radiation as proven by the results contained in this report.

As part of our continual improvement process, you, the reader, are encouraged to provide comments and suggestions regarding this report via the User Survey included at the end of this report.



MATTHEW B. MOURY
ASSOCIATE UNDER SECRETARY FOR ENVIRONMENT,
HEALTH, SAFETY AND SECURITY

This page intentionally left blank.

Table of Contents

APPENDICES*

Appendix A

Appendix B

* Appendices for this annual report are located at: https://www.energy.gov/ehss/listings/annual-doe-occupational-radiation-exposure-reports

LIST OF EXHIBITS

LIST OF ABBREVIATIONS AND ACRONYMS

ACL	Administrative Control Level
AEC	U.S. Atomic Energy Commission
AEDE	Annual Effective Dose Equivalent
ALARA	As Low As Reasonably Achievable
AMWTP	Advanced Mixed Waste Treatment Project
ANL	Argonne National Laboratory
ATR	Advanced Test Reactor
AU	Office of the Associate Under Secretary for Environment, Health, Safety and Security
AU-23	Office of Environment, Safety, and Health Reporting and Analysis
BNL	Brookhaven National Laboratory
CEBAF	Continuous Electron Beam Accelerator Facility
CED	Committed Effective Dose
CEDE	Committed Effective Dose Equivalent
CEqD	Committed Equivalent Dose
CEqD-SK	Committed Equivalent Dose to the Skin
CFR	Code of Federal Regulations
CY	Calendar Year
D&D	Decontamination and Decommissioning
DAC	Derived Air Concentration
DOE	U.S. Department of Energy
DOELAP	DOE Laboratory Accreditation Program
ED	Effective Dose
EqD	Equivalent Dose
EqD-Fetus	Equivalent Dose to the Fetus
EqD-ME	Equivalent Dose to the Skin of the Maximally Exposed Extremity
EqD-SKWB	Equivalent Dose to the Skin of the Whole Body
EqD-WB	Equivalent Dose to the Whole Body
EE	Office of Energy Efficiency and Renewable Energy
EM	Office of Environmental Management
EPA	U.S. Environmental Protection Agency
ERDA	Energy Research and Development Administration
ES&H	Environment, Safety, & Health
ETEC	Energy Technology Engineering Center
ETTP	East Tennessee Technology Park
Fermilab	Fermi National Accelerator Laboratory
ICP	Idaho Cleanup Project
ICRP	International Commission on Radiological Protection
INL	Idaho National Laboratory
KC-NSC	Kansas City National Security Campus
LANL	Los Alamos National Laboratory
LBNL	Lawrence Berkeley National Laboratory
LINAC	Linear Accelerator
LCLS	LINAC Coherent Light Source
LLNL	Lawrence Livermore National Laboratory
LM	Office of Legacy Management
MPPB	Main Plant Process Building
mSv	Millisievert

NCRP	National Council on Radiation Protection and Measurements
NE	Office of Nuclear Energy
NNSA	National Nuclear Security Administration
NNSS	Nevada National Security Site
NRC	U.S. Nuclear Regulatory Commission
NREL	National Renewable Energy Laboratory
NYSERDA	New York State Energy Research and Development Authority
O	Order
OEP	Operating Experience Program
ORISE	Oak Ridge Institute for Science and Education
ORNL	Oak Ridge National Laboratory
ORP	Office of River Protection
OST	Office of Secure Transportation
PGDP	Paducah Gaseous Diffusion Plant
PNNL	Pacific Northwest National Laboratory
PORTS	Portsmouth Gaseous Diffusion Plant
PPPL	Princeton Plasma Physics Laboratory
rem	Roentgen equivalent man
REMS	Radiation Exposure Monitoring System
Rh-102	Rhodium-102
Rh-102m	Rhodium-102m
SC	Office of Science
SLAC	SLAC National Accelerator Laboratory
SNM	Special Nuclear Material
SNL	Sandia National Laboratories
SPRU	Separations Process Research Unit
SPEAR3	Stanford Positron-Electron Asymmetric Ring
SRNL	Savannah River National Laboratory
SRS	Savannah River Site
STD	Standard
Sv	Sievert
TED	Total Effective Dose
TJNAF	Thomas Jefferson National Accelerator Facility
TLD	Thermoluminescent Dosimeter
TOD	Total Organ Dose
TRU	Transuranic
TSS	Transportation Safeguards System
U	Uranium
U-234	Uranium-234
UMTRA	Uranium Mill Tailings Remedial Action Project
USEC	United States Enrichment Corporation
WIPP	Waste Isolation Pilot Plant
WTP	Waste Treatment Plant
WVDP	West Valley Demonstration Project
Y-12	Y-12 National Security Complex

This page intentionally left blank.

Executive Summary

The U.S. Department of Energy (DOE) Office of Environment, Safety, and Health Reporting and Analysis within the Office of the Associate Under Secretary for Environment, Health, Safety and Security publishes annual occupational radiation exposure reports to provide DOE Management, Program Offices, workers, health physicists, and other stakeholders an evaluation of DOE-wide performance regarding compliance with Title 10 of the Code of Federal Regulations (CFR) Part 835, *Occupational Radiation Protection* (10 CFR 835) radiation exposure limits and adherence to as low as reasonably achievable (ALARA) principles.

This report presents the results of analyses of occupational radiation exposures at DOE operations, including the National Nuclear Security Administration, during calendar year (CY) 2020. The report includes occupational radiation exposure information for over 64,000 DOE Federal employees, contractors, and subcontractors, and members of the public monitored for radiation exposure. The 96 DOE organizations that submitted radiation exposure reports in CY 2020 have been grouped into 35 sites. The information has been analyzed to provide a measure of DOE's performance in protecting workers and individuals who have entered controlled areas.

Individuals who have the potential to be exposed to radiation at a DOE facility are required to be monitored in accordance with 10 CFR 835, Subpart E. The exposure monitoring data are used to determine the radiation dose received by the individual, which is reported to DOE through the DOE Radiation Exposure Monitoring System (REMS) in accordance with DOE Order 231.1B, *Environment, Safety and Health Reporting*.

Unless otherwise specified, the term "dose" used in this report refers to the total effective dose (TED) and is measured in units of "rem" (Roentgen equivalent man). The sievert (Sv) is the international unit of effective dose where 1 Sv is equal to 100 rem and 1 rem is, therefore, equal to 10 millisieverts (mSv). The TED is the summation of the effective dose from sources of radiation that are external and internal to the body. The committed effective dose (CED) is the dose resulting from radioactive material taken into the body and is commonly referred to as internal dose. The term "collective dose" is the sum of the individual doses received by a group of individuals and is shown in units of "person-rem."

Analysis of the collected exposure data for CY 2020 indicate that:

- DOE operations were in compliance with regulatory radiation protection requirements as no exposures were reported to have exceeded the occupational dose limit of 5 rem (50 mSv) TED.
- One exposure over the ACL of 2 rem (20 mSv) was reported at LANL.
- Only 27 percent of the monitored individuals received a measurable dose, and the average measurable dose received was less than 1 percent of the 5 rem (50 mSv) TED limit.

In addition, from CY 2019 to CY 2020 the:

- The collective TED dose decreased by less than 1 percent, although the number of individuals with measurable dose increased by 25 percent.
- The majority (62 percent) of facilities cited the COVID-19 pandemic as limiting operational activities;
- Collective CED (internal exposure to U-234) increased by 10 percent to 56.1 person-rem (561 person-mSv); and
- Collective TED for transient workers decreased by 66 percent to 7.6 person-rem (76 person-mSv).

The collective dose at DOE facilities has decreased by 91 percent since CY 1986. This coincides with the end of the Cold War era, which shifted the DOE mission from weapons production to stabilization, waste management, and environmental remediation activities, along with the consolidation and remediation of facilities across the complex to meet the new mission.

In alignment with the change in mission, regulations and requirements have been modified (see Section 2) that reinforce DOE's focus on ALARA practices and risk reduction to lowering occupational radiation dose.

Over the past 5 years, only two monitored individuals, both at LANL, received a dose above the 2 rem (20 mSv) TED ACL.

- In CY 2018, an individual received a TED of 3.8 rem (38 mSv) when a technician breached his glove while performing glovebox maintenance. A survey of the worker detected alpha contamination on two fingers of the worker's hand and the results of a diagnostic bioassay confirmed that an intake had occurred.
- In CY 2020, an individual received a TED of 3.0 rem (30 mSv) after an airborne release. The individual received an internal dose during the incident in which skin contamination and positive nasal smears were detected. The source of the contamination was determined to be a breach in a glovebox glove.
- Details of these incidents are available in the occurrence reports NA-LASO-LANL-TA55-2018-0013 and NA--LASO-LANL-TA55-2020, respectively.

The collective dose at DOE facilities has decreased by 91 percent since CY 1986. This coincides with the end of the Cold War era, which largely shifted the DOE mission from weapons production to stabilization, waste management, and environmental remediation activities, along with the consolidation and remediation of facilities across the complex to meet the new mission. In alignment with the change in mission, regulations and requirements have been modified (see Section 2) to reinforce DOE's focus on ALARA practices and risk reduction to lowering occupational radiation dose.

This report and other information regarding DOE occupational radiation exposure may be accessed at:

https://energy.gov/ehss/occupational-radiation-exposure

Introduction

The *U.S. Department of Energy Occupational Radiation Exposure Report for Calendar Year 2020* presents the results of analyses of occupational radiation exposures at Department of Energy (DOE), including the National Nuclear Security Administration (NNSA), operations during calendar year (CY) 2020. This report includes occupational radiation exposure information for DOE Federal employees, contractors, and subcontractors, and members of the public monitored for radiation exposure. The 96 DOE organizations that submitted radiation exposure reports for CY 2020 have been grouped into 35 sites.* The information has been analyzed and trended to provide a measure of DOE's performance in protecting workers and individuals who have entered controlled areas.

This report is published by the DOE Office of Environment, Safety, and Health (ES&H) Reporting and Analysis (AU-23) within the Office of the Associate Under Secretary for Environment, Health, Safety and Security (AU). The purpose of this report is to provide DOE Management, Program Offices, workers, health physicists and other stakeholders an evaluation of DOE-wide performance regarding compliance with Title 10 of the *Code of Federal Regulations* (CFR) Part 835, *Occupational Radiation Protection* (10 CFR 835) radiation exposure limits and adherence to as low as reasonably achievable (ALARA) principles.

Individuals who have the potential to be exposed to radiation at a DOE facility are required to be monitored in accordance with 10 CFR 835, Subpart E. The exposure monitoring data are used to determine the radiation dose received by the individual, which is reported to DOE in accordance with DOE Order (O) 231.1B, *Environment, Safety and Health Reporting*. Unless otherwise specified, the term "dose" used in this report refers to the total effective dose (TED) and is measured in units of "rem" (Roentgen equivalent man). The TED is the summation of the effective dose from sources of radiation that are external and internal to the body. The committed effective dose (CED) is the dose resulting from radioactive material taken into the body and is commonly referred to as internal dose. The term "collective dose" is the sum of the individual doses received by a group of individuals and is shown in units of "person-rem."

1.1 Report Organization

This report is organized into five sections. Section 1 describes the content and organization of this report. Section 2 discusses radiation protection, radiation dose limits, and reporting requirements. Section 3 presents the CY 2020 occupational dose data along with trends over the past 5 years and includes information and analyses regarding aggregate, individual, site, DOE Program, and transient worker exposure data; a historical review; and a DOE occurrence report review. Section 4 provides instructions to submit successful ALARA projects, and Section 5 discusses conclusions. A user survey form is included at the end of this report, and users are encouraged to provide feedback.

1.2 Report Availability

This report, the appendices, and all other associated information are available on the DOE Radiation Exposure Monitoring System (REMS) web site at:

https://www.energy.gov/ehss/corporate-reporting-analysis/databases/occupational-radiation-exposure

The REMS web site contains additional information on occupational radiation exposure, such as:

- Annual occupational radiation exposure reports and associated Appendices in pdf since CY 1974;
- Guidance on reporting radiation exposure information to the DOE REMS;
- Updated REMS-Online Query Tool;
- Guidance on how to request a dose history for an individual;

* For the purposes of this report, the sites and facilities are grouped by geographic location. When reported separately, the data for individual facilities at the sites are provided separately. See Section 3.4 for more information.

- Statistical data since CY 1987 for analysis;
- Applicable DOE orders and manuals for the recordkeeping and reporting of occupational radiation exposure at DOE;
- Occupational Exposure Dashboard—interactive data explorer;
- Ten Year Summary—graphical comprehensive overview of past 10 years of radiation exposure data; and
- ALARA activities at DOE.

Requests for access to the data files, or for individual dose records used to compile this report, as well as suggestions and comments, should be directed to:

Ms. Katharine McLellan
DOE REMS Program Manager
Office of ES&H Reporting and Analysis (AU-23)
U.S. Department of Energy
1000 Independence Avenue, SW
Washington, D.C. 20585-1290
E-mail: katharine.mclellan@hq.doe.gov

Standards and Requirements

It is DOE's mission to provide a safe and healthy workplace for all DOE Federal employees, contractors, and subcontractors, as well as, members of the public that visit DOE facilities. To meet this mission, the Office of the Associate Under Secretary for Environment, Health, Safety and Security (AU) establishes comprehensive and integrated programs for the protection of workers from hazards in the workplace, including ionizing radiation. The DOE standards for occupational radiation protection include radiation exposure limits to workers. In addition, DOE is required to maintain radiation exposures as far below the limits as is reasonable through application of the ALARA process, which incorporates pre-job planning, engineering controls, and worker training.

This section identifies the radiation protection standards and requirements applicable to DOE operations in CY 2020.

2.1 Radiation Protection Requirements

DOE radiation protection standards are based on Federal guidance for protection against occupational radiation exposure promulgated by the U.S. Environmental Protection Agency (EPA) in CY 1987 [1]. The guidance, initially implemented by DOE in CY 1989, was based on the CY 1977 recommendations of the International Commission on Radiological Protection (ICRP) Publication 26 [2] and the CY 1987 recommendations of the National Council on Radiation Protection and Measurements (NCRP) Publication 91 [3]. EPA recommends that internal dose be added to the external whole-body dose to determine the TED equivalent. The laws and requirements for occupational radiation protection pertaining to the information collected and presented in this report are summarized in *Exhibit 2-1*.

2.2 Radiation Dose Limits

Radiation dose limits are codified in 10 CFR 835, Sections 202, 206, 207, and 208 [4] and are summarized in *Exhibit 2-2*.

2.3 Reporting Requirements

DOE O 231.1B, *Environment, Safety and Health Reporting* [5] contains the requirements for reporting annual individual radiation exposure records to the REMS repository. Exposure records for the monitoring year are required to be reported by March 31 of the following calendar year. Specific instructions for preparing occupational exposure data for submittal to the REMS repository are contained in the REMS Data Reporting Guide [6] available online at:

https://www.energy.gov/ehss/downloads/radiation-exposure-monitoring-systems-data-reporting-guide

Exhibit 2-1:
Regulations and Requirements Pertaining to the Collection and Reporting of Radiation Exposures.

Title	Date	Description
10 CFR 835, Occupational Radiation Protection [4]	Issued 12/14/93 Amended 11/4/98 Amended 6/8/07 Amended 4/13/11 Amended 8/11/17	Establishes radiation protection standards, exposure limits, and program requirements for protecting individuals from ionizing radiation that results from the conduct of DOE activities.
DOE O 231.1B, Environment, Safety and Health Reporting [5]	Approved 6/27/11 Amended 11/28/12	Requires the annual reporting of occupational radiation exposure records to the DOE REMS repository.
REMS Reporting Guide [6]	Issued 2/23/12	Specifies the current format and content of the reports required by DOE O 231.1B.

Exhibit 2-2:
DOE Dose Limits from 10 CFR 835.

Personnel Category	Section of 10 CFR 835	Type of Exposure	Acronym	Annual Limit
General employees	835.202	Total effective dose. The sum of the effective dose (for external exposures) and the committed effective dose.	TED	5 rem (50 mSv)
		The sum of the equivalent dose to the whole body for external exposures and the committed equivalent dose to any organ or tissue other than the skin or the lens of the eye.	EqD-WB + CEqD (TOD)	50 rem (500 mSv)
		Equivalent dose to the lens of the eye	EqD-Eye	15 rem (150 mSv)
		The sum of the equivalent dose to the skin or to any extremity for external exposures and the committed equivalent dose to the skin or to any extremity	EqD-SkWB + CEqD-SK and EqD-ME + CEqD-SK	50 rem (500 mSv)
Declared pregnant workers*	835.206	The equivalent dose to the embryo/fetus from the period of conception to birth as a result of occupational exposure of a declared pregnant worker.	EqD-Fetus	0.500 rem (5 mSv) from the period of conception to birth
Minors	835.207	Total effective dose	TED	0.100 rem (1 mSv)
Members of the public in a controlled area	835.208	Total effective dose	TED	0.100 rem (1 mSv)

* Limit applies to the embryo/fetus.

2.4 Amendments to 10 CFR 835

In August 2006, DOE published a proposed amendment to 10 CFR 835 in the *Federal Register*, and in June 2007, the amended rule was published. The amendment:

- Specified new dosimetric terminology and quantities based on ICRP 60/68 in place of ICRP 26/30;
- Specified ICRP 60 tissue weighting factors in place of ICRP 26 weighting factors;
- Specified ICRP 60 radiation weighting factors in place of ICRP 26 quality factors;
- Amended other parts of the regulation that changed as a result of adopting ICRP 60 dosimetry system;
- Used the ICRP 68 dose conversion factors to determine values for the derived air concentrations; and
- Adopted other changes intended to enhance radiation protection.

The amended rule became effective on July 9, 2007 and was required to be fully implemented by DOE sites by July 9, 2010. All terminology used in this annual report reflects that of the amendment. In addition, 10 CFR 835 was revised in April 2011 when Appendix C (Derived Air Concentration [DAC] for Workers) was updated. On August 11, 2017, Appendices C and E were amended. The amendment to Appendix C corrected the air immersion DAC for any single radionuclide not listed in the Appendix C table with a decay mode other than alpha emission or spontaneous fission and with radioactive half-life less than two hours, adjusted for an 8-hr work day. The amendment to Appendix E corrected the activity information of two radioisotopes of rhodium (Rh-102 and Rh-102m).

Occupational Radiation Dose at DOE

3.1 Analysis of the Data

The following key indicators are analyzed to identify and correlate parameters that impact occupational radiation doses at DOE:

- Number of records for monitored individuals;
- Individuals who received a measurable dose;
- Collective dose;
- Average measurable dose; and
- Dose distribution.

The analysis of key indicators for individual dose data includes:

- Doses exceeding the 5 rem (50 millisievert [mSv]) DOE regulatory limit; and
- Doses exceeding the 2 rem (20 mSv) DOE administrative control level (ACL).

Additional information is provided in this report concerning activities at sites contributing to the majority of the collective dose.

The data for prior years contained in this report are subject to change as sites may submit corrections for previous years as required by DOE O 231.1-1B(1)(b). Corrected or updated records received after the annual March 31 deadline are included in the following year's annual report.

3.2 Analysis of Aggregate Data

3.2.1 Number of Monitored Individuals

The data in the REMS repository are reported by each facility in the form of a record for a monitoring period for each individual. An individual may have been monitored more than once at the same facility (e.g., multiple short-term assignments) or may have been monitored at more than one facility during the year. This can result in more than one record for an individual during the year in the REMS repository. However, the impact of multiple records per person on the annual trends and aggregate analysis of the data in this report is not significant as it occurs consistently from year to year. An analysis of the number of individuals who are monitored at more than one location during the year is provided in Section 3.5 which supports this assertion. The term "number of monitored individuals" will be used herein with the understanding that it is determined by the number of records for monitored individuals.

3.2.2 Number of Individuals with Measurable Dose

DOE uses the number of individuals with measurable dose to represent the exposed workforce size. In this context, "with measurable dose" means that a detectable value was reported for the individual.

Over the past 5-year period, measurable doses to all monitored individuals were well below the annual DOE regulatory limit of 5 rem (50 mSv) TED; however, one monitored individual received an annual TED of 3.8 rem (38 mSv) in CY 2018, and another individual received a single dose of 3.0 rem (30 mSv) TED in CY 2020. Both of these doses exceeded the 2 rem (20 mSv) DOE ACL.

Exhibit 3-1a and *Exhibit 3-1b* show the number of DOE Federal and contract workers, the total number of individuals monitored for radiation dose, the number of individuals with a measurable dose, and the relative percentages of individuals with measurable dose for the past five years. The number of DOE Federal and contract employees was calculated by dividing the total hours worked per year by the average number of work hours per year. It is, therefore, not a true count of individuals, but is a representation of the total size of the DOE workforce as full-time equivalents (FTE) and is included here to compare it to the number of workers monitored.

As shown in *Exhibit 3-1b*, the number of monitored individuals decreased by 15 percent from a value of 76,143 in CY 2019 to a value of 64,688 in CY 2020. This is the first time since individual records began being compiled in 1987 where the number of monitored individuals has been lower than 70,000. The decrease is due to many DOE employees and contractors moving to a "work from home" status in

response to the COVID-19 pandemic during CY 2020, and, therefore, not requiring radiation exposure monitoring.

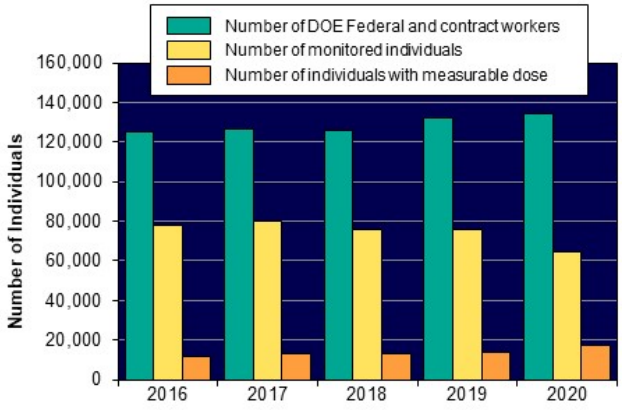
However, the number of individuals with measurable dose increased by 25 percent from a value of 13,824 in CY 2019 to a value of 17,329 in CY 2020. This increase was due to two factors.

1. Individuals that tend to receive measurable doses at DOE sites work in areas involving radioactive materials as part of DOE's core mission activities. These core mission activities continued during CY 2020 at most sites. Therefore, the number of individuals with the potential to receive a measurable dose did not decrease.
2. In addition, the Pantex Plant experienced a significant increase in the number of individuals with measurable dose as the result of a failure of the site dosimetry processing equipment. In response to this failure, a backup system from another site was used to process the dosimeters, which required the doses to be recalculated. As a conservative measure and to ensure that all dose was accounted for, the recalculation tended to elevate the individual dose values. This resulted in an increase in the number of individuals with measurable dose, as well as an increase in the overall collective dose. See *Exhibit 3-14* for more information on the dosimetry issue at the Pantex Plant during CY 2020.

3.2.3 Collective Dose

The collective dose is the sum of the dose received by all individuals with a measurable dose and is measured in units of person-rem and person-mSv.

Exhibit 3-1a:
Monitoring of the DOE Workforce, CY 2016 – 2020.



DOE monitors the collective dose as one measure of the overall performance of radiation protection programs to keep individual exposures and collective exposures ALARA.

In this report, the term "collective dose" is also applied to various types of radiation dose, such as external or internal, and will be specified in conjunction with the term "collective" to clarify the intended meaning.

As shown in *Exhibit 3-2*, the collective TED decreased at DOE by less than 1 percent from 752.3 person-rem (7,523 person-mSv) in CY 2019 to 750.8 person-rem (7,508 person-mSv) in CY 2020. The internal dose is based on the 50-year CED methodology. Under this methodology, the cumulative dose received from the intake of radioactive material over the next 50 years is assigned to the individual as a one-time dose in the year of intake. In other words, the CED is the effective dose from radionuclides taken into the body during the reporting year integrated over the next 50 years.

The internal dose component of the collective TED increased by 10.4 percent from 50.8 person-rem (508 person-mSv) in CY 2019 to 56.1 person-rem (561 person-mSv) in CY 2020, due to increases at Los Alamos National Laboratory (LANL) and Y-12 National Security Complex (Y-12). The collective photon dose decreased by 3 percent from 548.2 person-rem (5,482 person-mSv) in CY 2019 to 529.6 person-rem (5,296 person-mSv) in CY 2020.

The neutron component of the collective TED increased by 8 percent from 153.4 person-rem (1,534 person-mSv) in CY 2019 to 165.1 person-rem (1,651 person-mSv) in CY 2020. The increase resulted primarily from increases in collective neutron dose at the Pantex Plant.

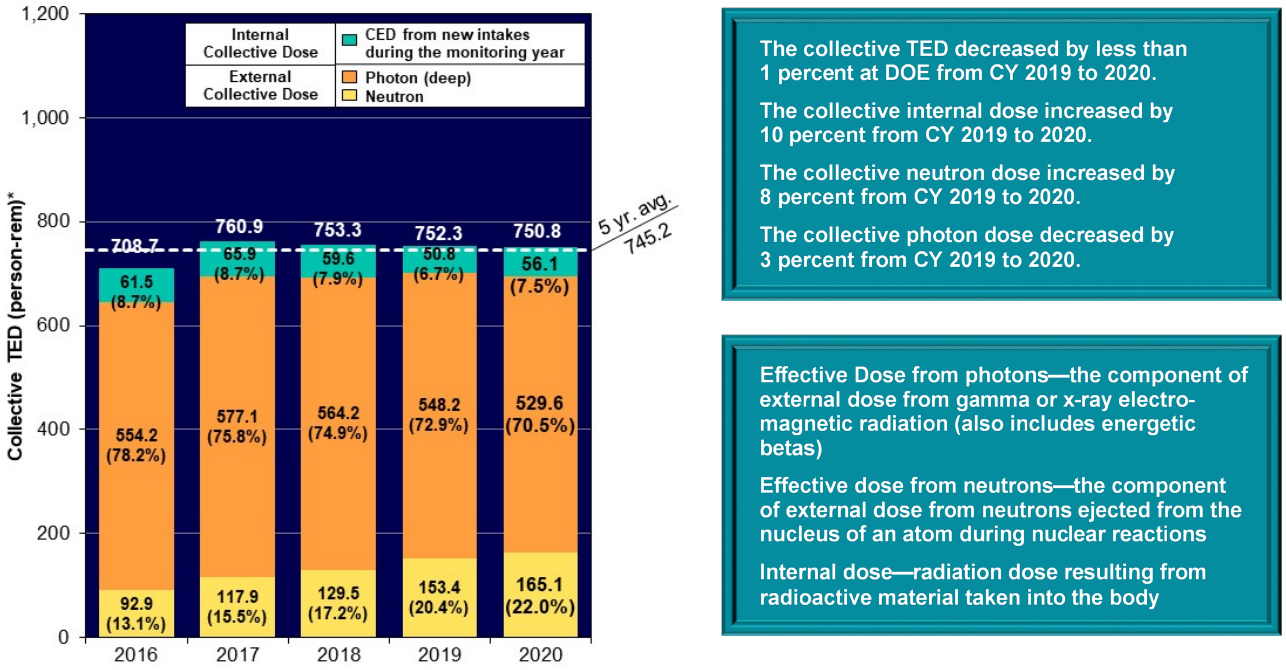
For CY 2020, 48 percent of the DOE workforce was monitored for radiation dose, and 27 percent of monitored individuals received a measurable dose.

Exhibit 3-1b:
Monitoring of the DOE Workforce, CY 2016 – 2020.

Year	DOE Federal & Contractor Workforce*	Number of Monitored Individuals	Percent of Monitored Individuals**	Number of Individuals with Measurable Dose	Percent of Individuals with Measurable Dose**
2016	125,324	77,848	62% ▲	11,983	15% ▲
2017	126,268	79,906	63% ▲	13,019	16% ▲
2018	125,969	75,634	60% ▼	13,335	18% ▲
2019	131,895	76,143	58% ▼	13,824	18%
2020	134,468	64,688	48% ▼	17,329	27% ▲
5-Year Average	**128,785**	**74,844**	**58%**	**13,898**	**19%**

* The number of DOE and contractor workers was determined from the total annual work hours at DOE [7] converted to FTEs.
** Up arrows indicate an increase from the previous year's value. Down arrows indicate a decrease from the previous year's value.

Exhibit 3-2:
Components of TED, CY 2016-2020.



The collective TED decreased by less than 1 percent at DOE from CY 2019 to 2020.

The collective internal dose increased by 10 percent from CY 2019 to 2020.

The collective neutron dose increased by 8 percent from CY 2019 to 2020.

The collective photon dose decreased by 3 percent from CY 2019 to 2020.

Effective Dose from photons—the component of external dose from gamma or x-ray electro-magnetic radiation (also includes energetic betas)

Effective dose from neutrons—the component of external dose from neutrons ejected from the nucleus of an atom during nuclear reactions

Internal dose—radiation dose resulting from radioactive material taken into the body

* The percentages in parentheses represent the percentage of each dose component to the collective TED.

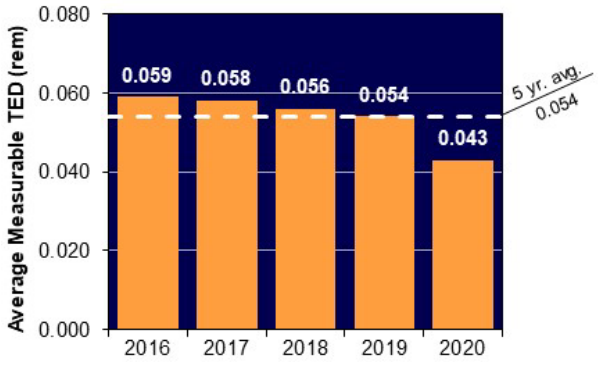
Five DOE sites contributed 88 percent of the collective TED in CY 2020. In descending order of collective TED, these were: LANL, Savannah River, Pantex Plant, Idaho, and Oak Ridge. LANL, Pantex Plant, and Idaho had increases in collective TED in CY 2020 while Savannah River and Oak Ridge reported decreases in collective TED. (See section 3.4.3.)

3.2.4 Average Measurable Dose

The average measurable dose to DOE workers, a key radiation dose indicator, is calculated by dividing the collective TED by the number of individuals with measurable dose. This is the average most commonly used by radiation exposure research organizations when examining trends and comparing doses received by workers, because it excludes those individuals receiving a less than measurable dose.

Exhibit 3-3 illustrates that the average measurable TED decreased by 20 percent from 0.054 rem (0.540 mSv) in CY 2019 to 0.043 rem (0.430 mSv) in CY 2020.

Exhibit 3-3:
Average Measurable TED, CY 2016 – 2020.



While the collective dose and average measurable dose serve as measures of the magnitude of the dose accrued by DOE workers, they do not depict the distribution of doses among the worker population.

3.2.5 Dose Distribution

Exposure data are commonly analyzed in terms of dose intervals to depict the TED distribution among the worker population. *Exhibit 3-4* shows the number of individuals in each of 11 different dose ranges. The number of individuals receiving doses above 0.100 rem (1 mSv) is included to show the number of individuals with doses above the monitoring threshold specified in 10 CFR 835.402(a) and (c) [4].

Even though the number of individuals monitored decreased by 15 percent in CY 2020, *Exhibit 3-4* shows that the dose distribution in the 1.0-2.0 rem (10-20 mSv) range remained the same. In addition, one individual received a dose in the 3.0-4.0 rem (30-40 mSv) range in CY 2020.

Exhibit 3-5 presents the dose distribution of those individuals with measurable doses, in terms of the percentage of individuals with measurable TED in each range. The doses received by the ninety-one percent of monitored individuals who received a measurable dose, were below the required monitoring threshold of 0.100 rem (1 mSv) specified in 10 CFR 835.402 (a) and (c).

These results reflect DOE's conservative practice of monitoring more individuals than are required to ensure adequate protection of the worker and that ALARA principles are being effectively implemented at reducing radiation exposure.

Exhibit 3-4:
Distribution of TED by Dose Range, CY 2016 – 2020.

	TED Range (rem)*	2016	2017	2018	2019	2020
Number of Individuals in Each Dose Range	Less than measurable	65,865	66,887	62,299	62,319	47,359
	Measurable to 0.100	10,138	11,006	11,418	11,946	15,760
	0.100 – 0.250	1,246	1,397	1,336	1,311	1,155
	0.250 – 0.500	451	480	429	424	313
	0.500 – 0.750	90	102	97	90	67
	0.750 – 1.000	38	13	39	42	22
	1.0 – 2.0	20	21	15	11	11
	2.0 – 3.0	0	0	0	0	0
	3.0 – 4.0	0	0	1	0	1
	4.0 – 5.0					
	>5.0					
Total number of records for monitored individuals		77,848	79,906	75,634	76,143	64,688
Number with measurable dose		11,983	13,019	13,335	13,824	17,329
Number with dose >0.100 rem		1,845	2,013	1,917	1,878	1,569
Collective TED (person-rem)		708.656	760.859	753.322	752.315	750.842
Average measurable TED (rem)		0.059	0.058	0.056	0.054	0.043

* Individuals with doses equal to the dose value separating the dose ranges are included in the next higher dose range.

Exhibit 3-5:
Percentage of Individuals with Measurable TED by Dose Range, CY 2016 – 2020.

	TED Range (rem)*	2016	2017	2018	2019	2020
Percentage of Individuals with Measurable TED	Measurable <0.100	84.60%	84.54%	85.62%	86.41%	90.95%
	0.100 – 0.250	10.40%	10.73%	10.02%	9.48%	6.67%
	0.250 – 0.500	3.76%	3.69%	3.22%	3.07%	1.81%
	0.500 – 0.750	0.75%	0.78%	0.73%	0.65%	0.39%
	0.750 – 1.000	0.32%	0.10%	0.29%	0.30%	0.13%
	1.0 – 2.0	0.17%	0.16%	0.11%	0.08%	0.06%
	2.0 – 3.0	0.00%	0.00%	0.00%	0.00%	0.00%
	>3.0	0.00%	0.00%	0.01%	0.00%	0.01%
% of monitored individuals with measurable dose		15%	15%	16%	18%	27%
% of monitored individuals with dose > 0.100 rem		2%	2%	3%	3%	2%

* Individuals with doses equal to the dose value separating the dose ranges are included in the next higher dose range.

3.3 Analysis of Individual Dose Data

The previous section's analysis is based on aggregate data for DOE. From both individual worker and regulatory perspectives, it is important to examine the doses received by individuals in the elevated dose ranges to understand the circumstances that led to these exposures and reduce or eliminate these types of exposures in the future.

3.3.1 Doses in Excess of the Regulatory Limit

No individual was reported to have exceeded the TED regulatory limit (5 rem [50 mSv]) from CY 2016 – 2020.

In CY 2018, one individual exceeded the 10 CFR 835.202 total organ dose (TOD) limit of 50 rem (500 mSv) from a plutonium-238 intake at LANL which resulted in a TOD to the bone surfaces of 118.5 rem (1,185 mSv). Details of the incident are available in the occurrence report NA--LASO-LANL-TA55-2018-0013.

Ninety-one percent of monitored individuals who received a measurable dose in CY 2020, received doses below the required monitoring threshold of 0.100 rem (1 mSv) specified in 10 CFR 835.402 (a) and (c).

3.3.2 Doses in Excess of the DOE Administrative Control Level

DOE Standard (STD)-1098-2017, *Radiological Control* [8] establishes a 2 rem (20 mSv) ACL for TED per year per person for all DOE activities. The STD states that each DOE site should establish an annual facility ACL based on historical and projected exposures and that no individual should be allowed to exceed this value without prior facility management approval.

One individual was reported to have exceeded the TED ACL (2 rem [20 mSv]) in CY 2020.

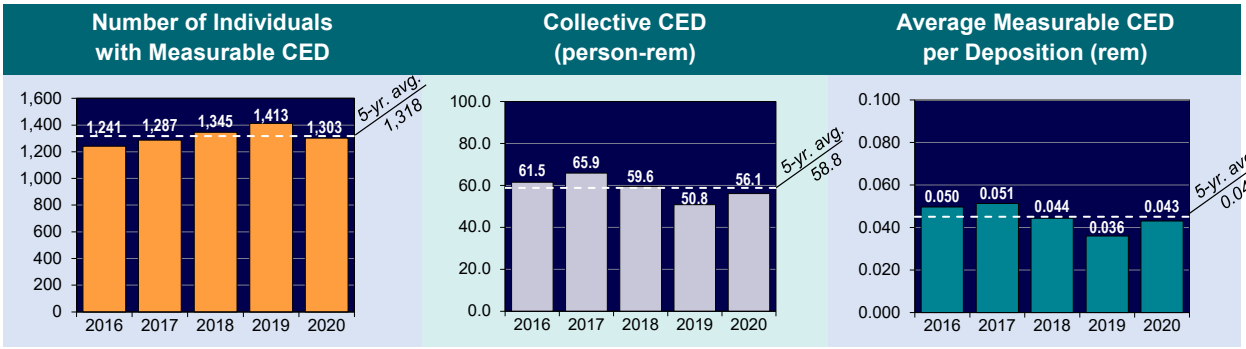
In June of CY 2020, skin contamination and positive nasal smears were detected on one employee after an airborne release at LANL's Plutonium Processing and Handling Facility. The source of the contamination was determined to be a breach in a glovebox glove. The individual received a CED of 2.4 rem (24 mSv) from Plutonium-238, resulting in a TED of 3.0 rem (30 mSv) for the year. Details of the incident are available in the occurrence report NA--LASO-LANL-TA55-2020.

3.3.3 Intakes of Radioactive Material

DOE tracks the number of radionuclide intakes as a performance measure in this report. DOE emphasizes the importance of implementing measures to avoid intakes and maintain doses as low as reasonable through the ALARA principle. Intakes involving certain radionuclides can take significant time to analyze and determine final dose. This can result in changes to prior year dose totals if the updates are received after the March 31 annual reporting deadline.

Exhibit 3-6 shows the number of individuals with measurable CED, collective CED, and average measurable CED for CY 2016 – 2020. The number of individuals with measurable CED decreased by 8 percent from 1,413 in CY 2019 to 1,303 in CY 2020, while the collective CED increased by 10 percent. The average measurable CED increased from 0.036 rem (0.360 mSv) in CY 2019 to 0.043 rem (0.430 mSv) in CY 2020, but remained below the 5-year average measurable CED.

Exhibit 3-6:
Number of Individuals with Measurable CED, Collective CED, and Average Measurable CED, CY 2016 – 2020.



Note: The number of internal depositions represents the number of internal dose records with positive results reported foreach individual.

Ninety-one percent of the collective CED in CY 2020 was from uranium intakes at Y-12 during the operation and management of Enriched Uranium Operations facilities at the site. Compared with external doses, few individuals at DOE receive measurable internal doses. Larger fluctuations may occur from year to year in the number of workers and the collective CED compared to other components of TED.

Exhibit 3-7 shows the distribution of the CED from CY 2016 – 2020. The total number of individuals with measurable CED in each dose range is the sum of the number of individuals receiving a CED in the dose range. Individuals may have had more than one intake of radioactive material, but the site would report one CED value from these intakes.

Doses below 0.020 rem (0.200 mSv) are shown as a separate dose range, to show the large number of individuals in this low dose range.

The internal dose records indicate that the majority of the intakes resulted in very low doses.

In CY 2020, 44 percent of the internal dose records were for doses below 0.020 rem (0.200 mSv). Over the 5-year period, internal doses accounted for 8 percent of the collective TED; although only 11 percent of the individuals who received internal doses had estimated doses above the monitoring threshold (0.100 rem [1 mSv]) specified in 10 CFR 835.402(c) [4]. It is noted that the CED is a dose received over a 50-year period after the intake that is all credited to the worker in the year of intake so the actual annual dose is lower. As noted previously, one individual received a CED of 2.4 rem (24 mSv) from an intake of Plutonium-238 at LANL.

3.3.4 Bioassay and Intake Summary Information

Exhibit 3-8 shows the breakdown of bioassay measurements by measurement type and number of measurements. For the monitoring year CY 2020, bioassay and intake summary information were required to be reported under the REMS Reporting Guide [6].

During the past 5 years, "Urinalysis" has been reported as the most common method of bioassay measurement used to determine internal doses to the individuals.

LANL had the largest percentage increase (1,221 percent) in the number of "Urinalysis" measurements in CY 2020, increasing from 473 in CY 2019 to 6,251 in CY 2020. Seventy-four percent of the "Urinalysis" measurements in CY 2020 were performed at four sites: Y-12, LANL, SRS, and Hanford Site.

The measurements reported as "In Vivo" include direct measurements of the radioactive material in the body of the monitored person. Examples of "In Vivo" measurements include whole-body counts and lung or thyroid counts. Three sites—Hanford, SRS, and Oak Ridge—accounted for 85 percent of the "In Vivo" measurements.

Exhibit 3.8 also indicates the number of "Fecal" bioassay measurements taken. Y-12 accounted for 80 percent of the measurements in CY 2020.

Exhibit 3-9 shows the reported "Air Sampling" measurements, which are used to calculate the amount of airborne radioactive material taken into the body and the resultant internal dose. The values shown are based on the number of measurements taken and not the number of individuals monitored. Individuals may have measurements taken more than once during the year.

Exhibit 3-7:
Internal Dose Distribution from Intakes, CY 2016 – 2020.

Year	Number of Individuals with CED in the Ranges (rem)*											Total No. of Indiv.	Total Collective CED (person-rem)
	Meas. <0.020	0.020–0.100	0.100–0.250	0.250–0.500	0.500–0.750	0.750–1.000	1.0–2.0	2.0–3.0	3.0–4.0	4.0–5.0	>5.0		
2016	546	522	135	36	2	0	0	0	0	0	0	1,241	61.544
2017	554	544	148	38	3							1,287	65.923
2018	629	559	141	14	1	0	0	0	1	0	0	1,345	59.556
2019	683	612	116	2								1,413	50.761
2020	574	583	139	6	0	0	0	1	0	0	0	1,303	56.078

* Individuals with doses equal to the dose value separating the dose ranges are included in the next higher dose range.

Exhibit 3-8:
Bioassay Measurements, CY 2016 – 2020.

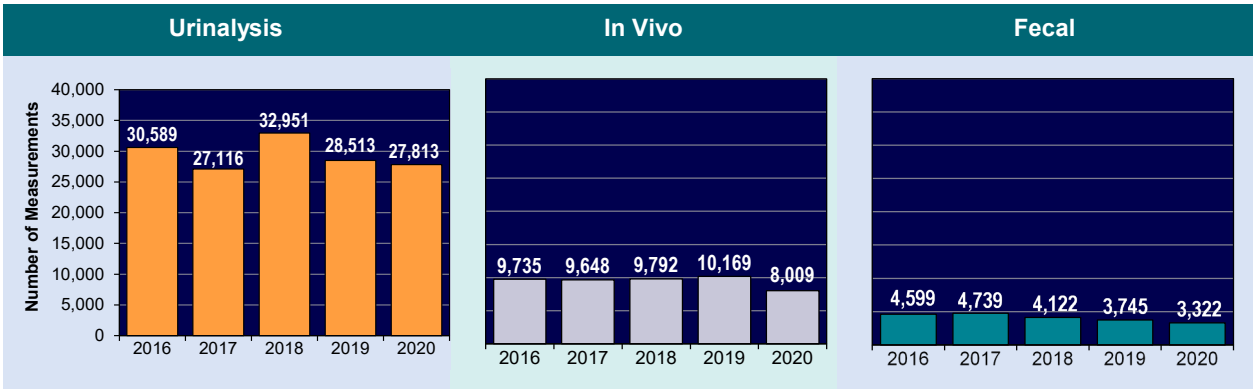
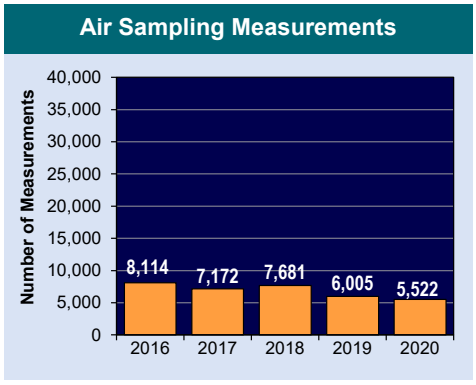


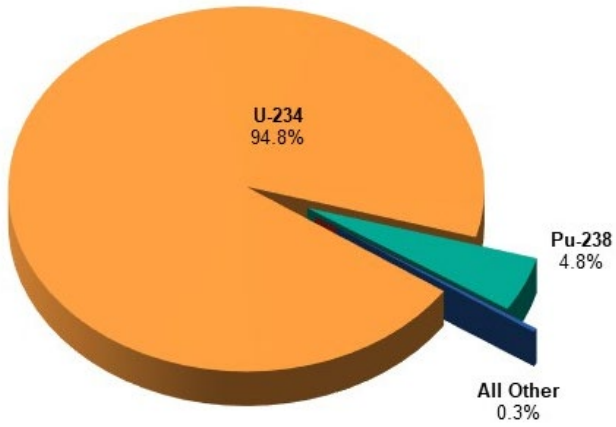
Exhibit 3-9:
Air Sampling Measurements, CY 2016 – 2020.



Y-12 performed the largest number of bioassay and air sampling measurements combined, comprising 32 percent of the total measurements taken.

Exhibit 3-10 shows the breakdown of the collective CED by radionuclide for CY 2020. Uranium-234 (U-234) accounted for the largest percentage of the collective CED, with 95 percent of this dose accrued at Y-12.

Exhibit 3-10:
Collective CED by Radionuclide from Internal Exposure, CY 2020.



The majority of the measurements reported as "Air Sampling" accounted for 15 percent of the total measurements. SRS had the largest percentage decrease in the number of "Air Sampling" measurements, decreasing from 6,005 in CY 2019 to 5,017 in CY 2020 (see *Exhibit 3-14* for additional information).

Appendix B contains additional information on intake data such as: Exhibits B-4, Internal Dose by Site; B-17, Internal Dose by Facility Type and Nuclide; B-19, Internal Dose by Labor Category; and B-21, Internal Dose Distribution by Site and Nuclide.

3.4 Analysis of Site Data

3.4.1 Collective TED by Site and Other Facilities

The collective TED values for CY 2018 – 2020 for the major DOE sites and operations/field offices are shown graphically in *Exhibit 3-11*. A list of the collective TED and number of individuals with measurable TED by DOE sites is shown in *Exhibit 3-12*. For the purposes of this report, the sites and facilities are grouped by geographic location as shown in these exhibits. When reported separately, the data for individual facilities at the sites are provided separately, such as at Hanford, Oak Ridge, and Savannah River. The data for Idaho is not provided separately and includes the Idaho National Laboratory (INL), Idaho Cleanup Project (ICP), and the Advanced Mixed Waste Treatment Project (AMWTP).

The collective TED decreased less than 1 percent from 752 person-rem (7,520 person-mSv) in CY 2019 to 751 person-rem (7,510 person-mSv) in CY 2020, with LANL, Savannah River, Pantex Plant, Idaho, and Oak Ridge contributing 88 percent of the total DOE collective TED.

Exhibit 3-11:
Collective TED by DOE Site for CY 2018 – 2020.

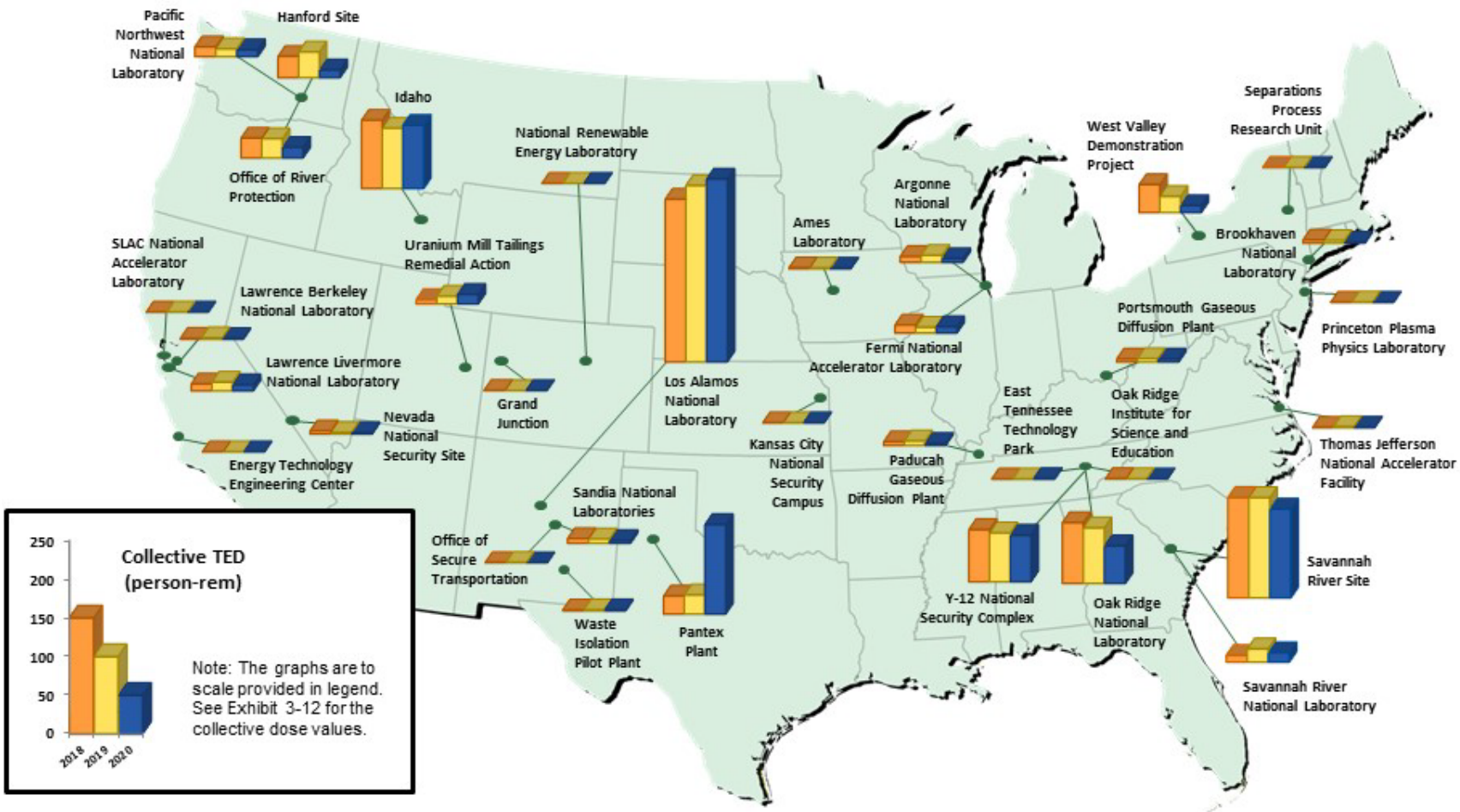


Exhibit 3-12:
Collective TED and Number of Individuals with Measurable TED by DOE Site, CY 2018 – 2020.

Site	2018		2019		2020	
	Collective TED (person-rem)	Number with Meas. TED	Collective TED (person-rem)	Number with Meas. TED	Collective TED (person-rem)	Number with Meas. TED
Ames Laboratory	0.935	33	0.837	31	0.777	30
Argonne National Laboratory	7.174	77	8.650	83	4.609	65
Brookhaven National Laboratory	3.924	125	3.191	137	1.161	111
Energy Technology Engineering Center	0.059	3	0.009	2	0.045	8
Fermi National Accelerator Laboratory	9.980	188	7.060	154	7.850	168
Grand Junction Site	0.336	22	0.041	13	0.043	14
Hanford:						
Hanford Site	27.008	565	32.673	822	9.797	485
Office of River Protection	24.926	570	24.153	671	13.291	461
Pacific Northwest National Laboratory	12.225	494	9.717	446	8.523	408
Hanford Totals:	*64.159*	*1,629*	*66.543*	*1,939*	*31.611*	*1,354*
Idaho	86.799	1,373	76.511	1,203	80.518	1,664
Kansas City National Security Campus	0.428	58	0.364	66	0.493	93
Lawrence Berkeley National Laboratory	1.014	22	1.810	23	0.834	14
Lawrence Livermore National Laboratory	8.691	145	11.003	153	7.494	128
Los Alamos National Laboratory	**207.051**	1,953	**224.472**	1,983	**232.736**	2,523
National Renewable Energy Laboratory	0.006	1	0.001	1	0.030	4
Nevada National Security Site	3.893	74	1.940	50	1.800	72
Oak Ridge:						
East Tennessee Technology Park	0.147	18	0.186	19	0.751	102
Oak Ridge Institute for Science and Education	0.317	20	0.237	22	0.000	0
Oak Ridge National Laboratory	76.833	615	70.245	539	47.666	610
Y-12 National Security Complex	65.917	1,524	61.751	1,665	58.768	1,409
Oak Ridge Totals:	*143.214*	*2,177*	*132.419*	*2,245*	*107.185*	*2,121*
Office of Secure Transportation	0.288	14	0.448	13	0.025	2
Paducah Gaseous Diffusion Plant	4.593	110	5.554	100	2.654	116
Pantex Plant	22.927	312	24.248	758	113.909	3,563
Portsmouth Gaseous Diffusion Plant	3.588	69	4.289	71	3.712	139
Princeton Plasma Physics Laboratory	0.239	38	0.391	72	0.234	54
Sandia National Laboratories	5.819	175	5.323	154	3.287	89
Savannah River:						
Savannah River National Laboratory	8.463	314	16.631	547	11.717	445
Savannah River Site	126.869	**4,101**	126.763	**3,651**	112.247	**4,220**
Savannah River Totals:	*135.332*	*4,415*	*143.394*	*4,198*	123.964	4,665
Separations Process Research Unit	0.208	10	0.029	2	0.000	0
SLAC National Accelerator Laboratory	0.047	3	0.206	11	0.146	2
Thomas Jefferson National Accelerator Facility	0.526	26	1.266	52	0.607	22
Uranium Mill Tailings Remedial Action Project	5.485	77	9.748	95	12.004	95
Waste Isolation Pilot Plant	0.909	42	1.113	54	1.130	67
West Valley Demonstration Project	35.549	160	20.459	139	8.868	112
Service Center Personnel *	0.149	4	0.996	22	3.116	34
Totals	**753.322**	**13,335**	**752.315**	**13,824**	**750.842**	**17,329**

Note: Bold and boxed values indicate the greatest value in each column.
* Includes personnel at National Energy Technology Laboratory (NETL), NNSA Albuquerque complex, Oak Ridge, and Waste Isolation Pilot Plant (WIPP) in addition to several smaller facilities not associated with a DOE site.

3.4.2 Changes by Site from CY 2019 to 2020

Exhibit 3-13 shows the collective TED, the number monitored, the number with a measurable TED, and the average measurable TED, as well as the percentage change in these values from the previous year. Some of the largest percentage changes occurred at relatively small facilities, where conditions may fluctuate from year to year due to changes in workload and tasks conducted.

Changes that have the most impact in the overall values at DOE typically occur at sites with large collective TED. For example, the collective TED at the Pantex Plant increased from 24.248 person-rem (242.48 person-mSv) in CY 2019 to 113.9 person-rem (1,139 person-mSv) in CY 2020. (See section 3.4.3.)

Twenty-three of the 35 DOE sites reported decreases in the collective TED from the CY 2019 values, and 12 of the 35 DOE sites reported increases in the collective TED from the CY 2019 values.

Sixteen of the 35 reporting sites experienced increases in the number of workers with a measurable TED from CY 2019 to 2020. The largest increase in total number of workers with a measurable TED occurred at the Pantex Plant with an increase of 370 percent, or 2,805 workers (see *Exhibit 3-14)*. The second largest increase in total number of workers with a measurable TED occurred at the Portsmouth Gaseous Diffusion Plant with an increase of 68 workers, or 96 percent.

Eighteen of the 35 reporting sites experienced decreases in the number of workers with a measurable TED from CY 2019 to 2020. The largest decrease in the number of workers receiving a measurable TED occurred at Hanford Site with a decrease of 337 workers. One site (Uranium Mill Tailings Remedial Action Project [UMTRA]) experienced no change. A discussion of activities at the highest dose facilities is included in section 3.4.3.

3.4.3 Activities Significantly Contributing to Collective Dose in CY 2020

In an effort to identify the reasons for changes in the collective dose at DOE, the sites provided information on activities that significantly contributed to the collective dose for CY 2020 as instructed in the REMS Reporting Guide, Item 1. In *Exhibit 3-14*, these sites are presented in descending order of collective TED with a dotted line representing the site's 5-year average TED. Sites that have reported less than 5 person-rem (50 person-mSv) for CY 2020 can be found in *Exhibit 3-15*. Due to the low doses and small number of individuals with measurable dose, wider variation can occur from year to year.

Exhibit 3-14 Site Listing > 5 Person-Rem

Exhibit 3-15 Site Listing < 5 Person-Rem

Exhibit 3-13:
Site Dose Data, CY 2020.

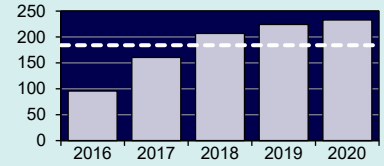
Site	2020							
	Collective TED (person-rem)	Percent Change from 2019	Number of Monitored Individuals	Percent Change from 2019	Number with Meas. TED	Percent Change from 2019	Avg. Meas. TED (person-rem)	Percent Change from 2019
Ames Laboratory	0.777	◊	126	◊	30	◊	0.026	◊
Argonne National Laboratory	4.609	-47% ▼	1,529	-17% ▼	65	-22% ▼	0.071	-32% ▼
Brookhaven National Laboratory	1.161	-64% ▼	1,845	-23% ▼	111	-19% ▼	0.010	-55% ▼
Energy Technology Engineering Center	0.045	◊	11	◊	8	◊	0.006	◊
Fermi National Accelerator Laboratory	7.850	11% ▲	1,268	-15% ▼	168	9% ▲	0.047	2% ▲
Grand Junction Site	0.043	◊	22	◊	14	◊	0.003	◊
Hanford:								
Hanford Site	9.797	-70% ▼	3,443	-8% ▼	485	-41% ▼	0.020	-49% ▼
Office of River Protection	13.291	-45% ▼	2,796	-3% ▼	461	-31% ▼	0.029	-20% ▼
Pacific Northwest National Laboratory	8.523	-12% ▼	1,935	-29% ▼	408	-9% ▼	0.021	-4% ▼
Hanford Totals:	*31.611*	*-52%* ▼	*8,174*	-13% ▼	*1,354*	*-30%* ▼	*0.023*	*-32%* ▼
Idaho	80.518	5% ▲	5,397	-29% ▼	1,664	38% ▲	0.048	-24% ▼
Kansas City National Security Campus	0.493	◊	239	◊	93	◊	0.005	◊
Lawrence Berkeley National Laboratory	0.834	◊	785	◊	14	◊	0.060	◊
Lawrence Livermore National Laboratory	7.494	-32% ▼	3,393	-12% ▼	128	-16% ▼	0.059	-19% ▼
Los Alamos National Laboratory	**232.736**	4% ▲	**9,487**	-21% ▼	2,523	27% ▲	0.092	-19% ▼
National Renewable Energy Laboratory	0.030	◊	7	◊	4	◊	0.008	◊
Nevada National Security Site	1.800	-7% ▼	753	-17% ▼	72	44% ▲	0.025	-36% ▼
Oak Ridge:								
East Tennessee Technology Park	0.751	◊	408	◊	102	◊	0.007	◊
Oak Ridge Institute for Science and Education	0.000	◊	60	◊	0	◊	0.000	◊
Oak Ridge National Laboratory	47.666	-32% ▼	3,890	-11% ▼	610	13% ▲	0.078	-40% ▼
Y-12 National Security Complex	58.768	-5% ▼	5,708	-10% ▼	1,409	-15% ▼	0.042	12% ▲
Oak Ridge Totals:	107.185	-19% ▼	10,066	-10% ▼	2,121	-6% ▼	0.051	-14% ▼
Office of Secure Transportation	0.025	◊	327	◊	2	◊	0.013	◊
Paducah Gaseous Diffusion Plant	2.654	-52% ▼	1,388	4% ▲	116	16% ▲	0.023	-59% ▼
Pantex Plant	113.909	**335%** ▲	3,808	-35% ▼	3,563	**370%** ▲	0.032	0% ▼
Portsmouth Gaseous Diffusion Plant	3.712	-13% ▼	2,155	-13% ▼	139	96% ▲	0.027	-56% ▼
Princeton Plasma Physics Laboratory	0.234	◊	352	◊	54	◊	0.004	◊
Sandia National Laboratories	3.287	-38% ▼	1,886	-8% ▼	89	-42% ▼	0.037	7% ▲
Savannah River:								
Savannah River National Laboratory	11.717	-30% ▼	632	-9% ▼	445	-19% ▼	0.026	-13% ▼
Savannah River Site	112.247	-11% ▼	6,477	-2% ▼	**4,220**	16% ▲	0.027	-23% ▼
Savannah River Totals:	123.964	-14% ▼	7,109	-2% ▼	4,665	11% ▲	0.027	-22% ▼
Separations Process Research Unit	0.000	◊	11	◊	0	◊	0.000	◊
SLAC National Accelerator Laboratory	0.146	◊	2,055	◊	2	◊	0.073	◊
Thomas Jefferson National Accelerator Facility	0.607	◊	1,317	◊	22	◊	0.028	◊
Uranium Mill Tailings Remedial Action Project	12.004	23% ▲	135	-2% ▼	95	0% ▼	**0.126**	23% ▲
Waste Isolation Pilot Plant	1.130	2% ▲	398	-7% ▼	67	24% ▲	0.017	-18% ▼
West Valley Demonstration Project	8.868	-57% ▼	361	-4% ▼	112	-19% ▼	0.079	-46% ▼
Service Center Personnel*	3.116	**213%** ▲	284	**68%** ▲	34	55% ▲	0.092	**102%** ▲
Totals	**742.291**	**-1%** ▼	**64,190**	**-16%** ▼	**16,864**	**22%** ▲	**0.044**	**-19%** ▼

Note: Bold and boxed values indicate the greatest value in each column.
◊ The percentage change from the previous year is not shown because it is not meaningful when the site collective dose is less than 1 person-rem (10 person-mSv).
* Includes personnel at NETL, NNSA Albuquerque complex, Oak Ridge, and WIPP in addition to several smaller facilities not associated with a DOE site.

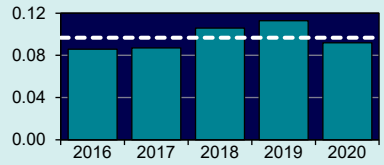
Exhibit 3-14:
Activities Significantly Contributing to Collective TED in CY 2020, in Descending Order of Collective Dose.

Los Alamos National Laboratory (LANL)

Collective TED (person-rem)



Average Measurable TED (rem)



Site Description

LANL conducts radiological operations in active facilities, storage facilities, facilities with legacy radiological concerns, in addition to operations in inactive facilities and areas destined for decommissioning. Radiological activities include programmatic and production work; facility construction, modification, and maintenance; and research, development, and testing.

Activities Involving Radiation Exposure

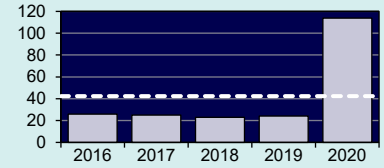
- Weapons manufacturing and related work at the TA-55 plutonium facility;
- Plutonium-238 work;
- Retrieval, repackaging, and shipping of radioactive waste; and
- Infrastructure support for radiological work and facility maintenance.

Changes in Dose

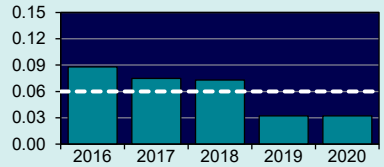
- A primary contributor to dose in CY 2020 was work with Pu-238, producing general purpose heat sources for use individually and in radioisotope thermoelectric generators; and
- A significant portion of LANL dose was accrued by workers commensurate with programmatic and maintenance work at the TA-53 Los Alamos Neutron Science Center.

Pantex Plant

Collective TED (person-rem)



Average Measurable TED (rem)



Site Description

The DOE/NNSA Pantex Plant is the nation's primary facility for the final assembly, disassembly, and maintenance of nuclear weapons. The last new nuclear weapon was completed in CY 1991. Since then, the Pantex Plant has safely dismantled thousands of weapons retired from the stockpile by the military and placed the resulting plutonium pits in interim storage. The Pantex Plant has approximately 650 buildings, including specialized facilities in which maintenance, modification, disassembly, and assembly operations are conducted.

Activities Involving Radiation Exposure

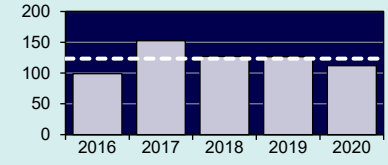
- Operations that expose workers to large numbers of bare weapon pits containing significant quantities of special nuclear material (SNM); and
- Nuclear explosive assembly/disassembly operations, weapon dismantlement programs, life-extension programs, SNM Component Re-qualification, and SNM staging.

Changes in Dose

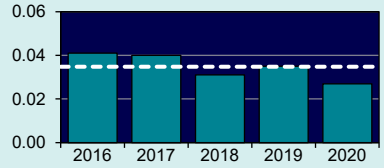
- In CY 2020, the Pantex Plant's Dosimetry program experienced a failure of the thermoluminescent (e.g., TLD) reading equipment, resulting in the first 3 quarters of dosimeter readings in CY 2020 being processed at the Nevada National Security Site. Due to differences between the thermoluminescent dosimeter readers used, dose calculations were corrected for the reader differences, and a very conservative approach was utilized to ensure all dose was captured. As a result, the dose for Pantex Plant personnel was elevated compared to prior years. Effective Quarter 4 of CY 2020, the Pantex Plant addressed the problems associated with dosimetry equipment by having the dosimeters processed at the Y-12 facility in Oak Ridge.

Savannah River Site (SRS)

Collective TED (person-rem)



Average Measurable TED (rem)



Site Description

SRS was constructed during the early 1950s to produce the basic materials used in the fabrication of nuclear weapons, primarily tritium and plutonium-239, in support of our nation's defense programs. Five reactors were built to produce these materials. Also built were a number of support facilities including two chemical separations plants, a heavy water extraction plant, a nuclear fuel and target fabrication facility, a tritium extraction facility, and waste management facilities.

Activities Involving Radiation Exposure

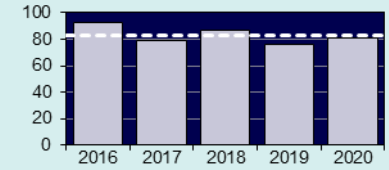
- Continued processing Canadian Target Residue Material;
- Finished decommissioning a former nuclear radiological facility;
- Post-closure care at closed reactor facilities; and
- Plutonium down blending.

Changes in Dose

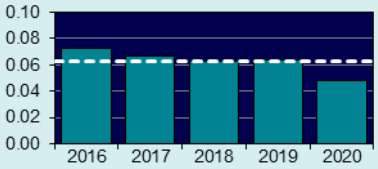
- CY 2020 dose decreased in comparison with CY 2019. Innovations such as using drones in post closure areas and optimization process projects in support of K area plutonium down blend helped to reduce radiological exposure.

Idaho

Collective TED (person-rem)



Average Measurable TED (rem)



Site Description

The primary focus of activities at INL is nuclear energy research and development. The DOE Idaho Operations Office oversees three major contracts to ensure that operations and research activities are carried out safely, and in compliance with laws, regulations, and contract provisions. The Idaho Cleanup Project (ICP) focuses on addressing legacy wastes resulting from decades of widely-varied work including conventional weapons testing, government-owned research and power reactor development and testing, spent nuclear fuel reprocessing, laboratory research, and defense missions.

Activities Involving Radiation Exposure

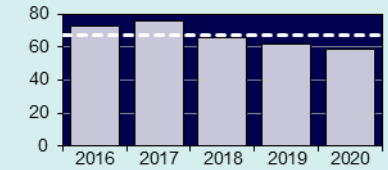
- Work at the Advanced Test Reactor (ATR) Complex, including experiment system operations, plant maintenance and modifications, routine ATR power and outage operations, and Research and Development Operations/Laboratory support;
- Activities at the Materials and Fuel Complex including maintenance and upgrades, treatment and storage for waste repackaging, benchtop and glovebox operations, decontamination efforts; and
- Waste handling, consolidation and shipment, decontamination work, and radiography operations.

Changes in Dose

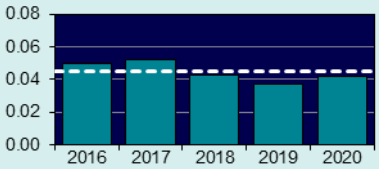
- Dose increased in CY 2020 with increased high-dose work at the ATR;
- A very small portion of the increase in collective TED was attributed to changing from a quarterly to a semi-annual dosimeter exchange period; and
- The reduction in monitored individuals was attributed to implementation of a dosimeter reduction campaign and Site access restrictions due to the COVID-19 pandemic.

Oak Ridge: Y-12 National Security Complex (Y-12)

Collective TED (person-rem)



Average Measurable TED (rem)



Site Description

Y-12 is one of four production facilities in the NNSA Nuclear Security Enterprise. The facility's emphasis is the processing and storage of uranium and development of technologies associated with those activities. Y-12 maintains the safety, security, and effectiveness of the U.S. nuclear weapons stockpile and processes highly enriched uranium for the Naval Nuclear Propulsion Program.

Activities Involving Radiation Exposure

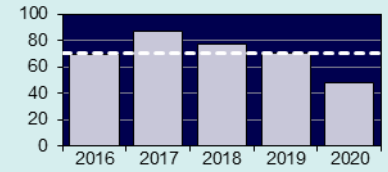
- Manufacture, processing, and storage of special nuclear materials;
- Characterization and hazardous waste removal at Y-12 Biology Complex; and
- Maintenance of equipment and facilities.

Changes in Dose

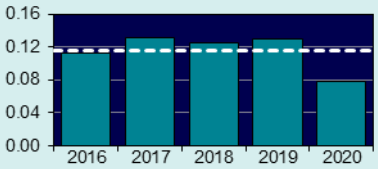
- In CY 2020, pauses were enacted across the site due to COVID-19 protocols that reduced activities involving radiation exposure which subsequently resulted in a decrease in collective dose; and
- Sampling protocols were impacted because the length of time between the requested appointment date and the actual sample submission date was increased for some bioassay participants and because of the nature of the chronic exposure scenario resulted in a corresponding increase in internal dose.

Oak Ridge: Oak Ridge National Laboratory (ORNL)

Collective TED (person-rem)



Average Measurable TED (rem)



Site Description

ORNL is a multiprogramming science and technology laboratory. ORNL's mission is to deliver scientific discoveries and technical breakthroughs that will accelerate the development and deployment of solutions in clean energy and global security, and in doing so create economic opportunity for the nation. ORNL also performs other work for the DOE, including isotope production, information management, and technical program management, and provides research and technical assistance to other organizations.

Activities Involving Radiation Exposure

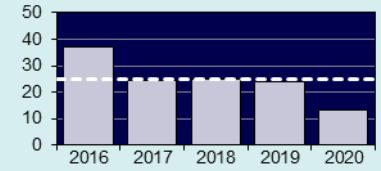
- Medical radioisotope production
- Processing low level and transuranic waste at the TRU Waste Processing Center
- Providing materials for NASA; and
- Facility maintenance.

Changes in Dose

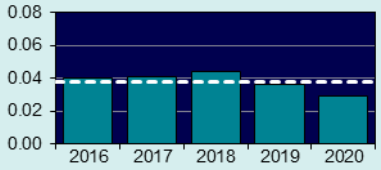
- Two projects involving high dose work (heavy element radiochemistry that resulted in the production of Tennessine and significant hot cell maintenance) were completed.
- COVID-19 prevention measures interrupted some irradiated materials characterization and radiochemical work that typically comprised a larger fraction of the collective dose.

Hanford: Office of River Protection (ORP)

Collective TED (person-rem)



Average Measurable TED (rem)



Site Description

The DOE ORP mission is to retrieve and treat Hanford's waste and close the tank farms to protect the Columbia River. Chemical and radioactive waste, resulting from more than four decades of plutonium production, is currently stored in 177 large underground tanks. ORP is responsible for the retrieval, treatment, and disposal of this waste. The cornerstone of the tank waste cleanup project is the Waste Treatment Plant (WTP). The WTP will use a technology called vitrification to immobilize chemical and radioactive waste in an exceptionally sturdy form of glass to isolate it from the environment.

Activities Involving Radiation Exposure

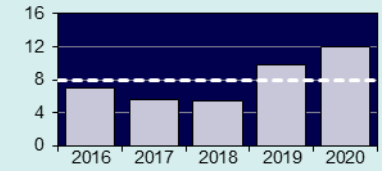
- Removal and transfer of waste from older single-shell tanks to newer double-shell tanks;
- Maintenance and support of the evaporator which reduces the volume of stored liquid waste by concentrating radioactive waste solutions;
- Work at the 222-S laboratory; and
- Well logging activities using an AmBe source.

Changes in Dose

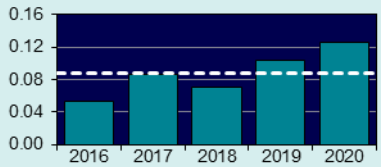
- The decrease in collective TED was attributed to the curtailment of radiological work in CY 2020 due to the COVID-19 pandemic.

Uranium Mill Tailings Remedial Action Project (UMTRA)

Collective TED (person-rem)



Average Measurable TED (rem)



Site Description

The UMTRA site is located approximately 3 miles northwest of Moab in Grand County, Utah, and includes a former uranium-ore processing facility. The site encompasses 480 acres, of which approximately 130 acres are covered by a uranium mill tailings pile. The UMTRA Project ships four trainloads of tailings to the Crescent Junction Disposal Site each week. The trains contain 144 containers of approximately 40 tons each, or a total of 23,040 tons of tailings per week. Tailing shipments began in April 2009 and are expected to continue through CY 2034.

Activities Involving Radiation Exposure

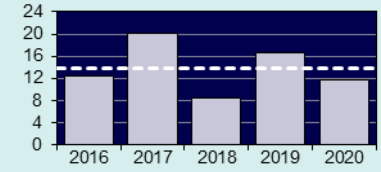
- Maintenance;
- Erosion control measures;
- Tailings excavation and conditioning;
- Loading tailings into containers and transporting to the rail beach;
- Ground water remediation; and
- Health and safety oversight.

Changes in Dose

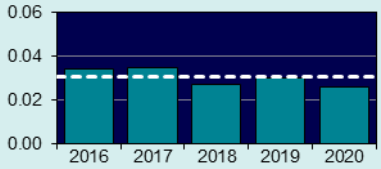
- The increase in dose was attributed to a 50 percent greater (on average) concentration of radium-226 in the excavated mill tailings and additional time spent in the contamination area training new employees.

Savannah River National Laboratory (SRNL)

Collective TED (person-rem)



Average Measurable TED (rem)



Site Description

SRNL began reporting separately from Savannah River Site (SRS) effective CY 2016. SRNL supports DOE in its environmental management and nuclear security missions. SRNL applies its expertise in nuclear chemical manufacturing to assist DOE in meeting its objectives in areas, such as nuclear waste cleanup and defense nonproliferation.

Activities Involving Radiation Exposure

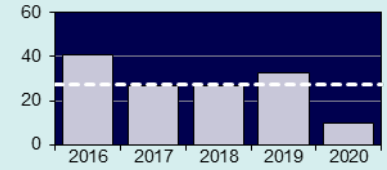
- Currently, most SRNL programs support the SRS tritium mission. This includes applying hydrogen technologies used in processing tritium; extraction, purification, and storage of tritium;
- Execution of the Mark-1A plutonium-244 recovery program

Changes in Dose

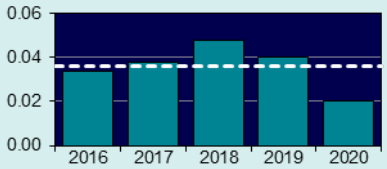
- Renovations were completed with the clean out of 20 gloveboxes and radiohoods as part of the SRS's laboratory consolidation efforts.

Hanford: Hanford Site

Collective TED (person-rem)



Average Measurable TED (rem)



Site Description

DOE's Hanford Site sits on 586 square miles in the desert of southeastern Washington State. The area is home to nine former nuclear reactors and their associated processing facilities that were built beginning in CY 1943. Hanford reactors produced plutonium from CY 1944 until 1987. Today, Hanford workers are involved in an environmental cleanup project and remediation of the site.

Activities Involving Radiation Exposure

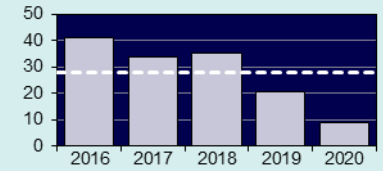
- Work activities at the plutonium finishing plant facility;
- Material handling and waste transfer; and
- Facility demolition and site remediation.

Changes in Dose

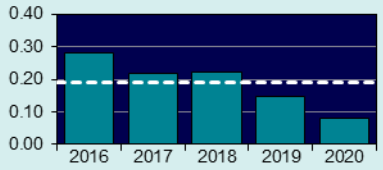
- Dose decreased in CY 2020 due to COVID-19 partial stop work.

West Valley Demonstration Project (WVDP)

Collective TED (person-rem)



Average Measurable TED (rem)



Site Description

WVDP is a unique operation within DOE and came into being through the WVDP Act of 1980. The Act requires DOE to be responsible for solidifying the high-level waste and disposing of waste created by the solidification and decommissioning of the facilities used in the process. The land and facilities are not owned by DOE; rather, the project premises are the property of the New York State Energy Research and Development Authority (NYSERDA) and represent only 200 acres of the larger Western New York Service Center, which is approximately 3,300 acres, also owned by NYSERDA. After DOE's responsibilities under the Act are complete, the Act requires that the premises be returned to New York State.

Activities Involving Radiation Exposure

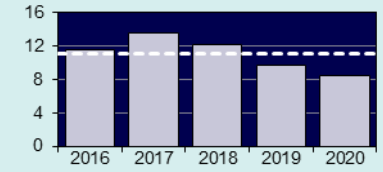
- Facility Disposition;
- Deactivation work in the Main Plant Process Building (MPPB); and
- Radiological Control Technicians providing support for facility disposition activities.

Changes in Dose

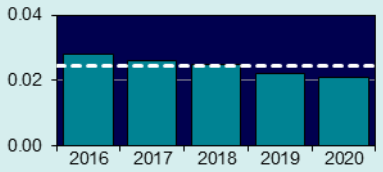
- The CY 2020 overall dose decreased from the previous year due primarily to fewer activities performed in high dose rate areas in the MPPB because of COVID-19-imposed restrictions on operations.

Hanford: Pacific Northwest National Laboratory (PNNL)

Collective TED (person-rem)



Average Measurable TED (rem)



Site Description

Located in Richland, Washington, PNNL is 1 of 10 national laboratories managed by DOE's Office of Science (SC). The laboratory provides the facilities, unique scientific equipment, and world-renowned scientists and engineers to strengthen U.S. scientific foundations through fundamental research and innovation. The lab also supports Hanford site cleanup efforts by performing scientific and technical evaluations and reviews, and developing and advancing new technologies to address site cleanup challenges.

Activities Involving Radiation Exposure

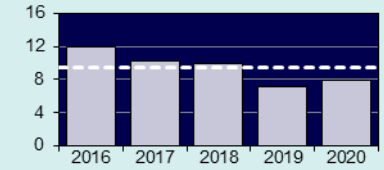
- Work at the Radiochemical Processing Laboratory;
- Radiation detection research; and
- Implementation of security measures for radiological materials of concern.

Changes in Dose

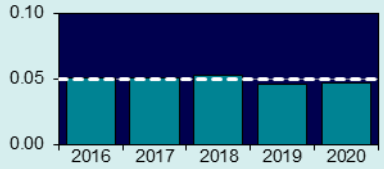
- The decrease in dose was attributed to the curtailment of radiological work in CY 2020 due to the COVID-19 pandemic.

Fermi National Accelerator Laboratory (Fermilab)

Collective TED (person-rem)



Average Measurable TED (rem)



Site Description

Fermilab provides leadership and resources for qualified researchers to conduct basic research at the frontiers of high-energy particle physics and related disciplines. The primary features of the site include the accelerator complex and associated building infrastructure, an interconnected industrial cooling water system, a housing complex for visiting researchers, row crop agriculture, and natural areas in various states of restoration.

Activities Involving Radiation Exposure

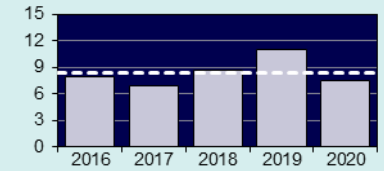
- Upgrade and repair activities of the Fermilab accelerator complex;
- Installation of new NuMi target, upgrade of water piping, replacement of pre- and HEPA filters, ion pump replacement; and
- Management and disposal of radioactive waste.

Changes in Dose

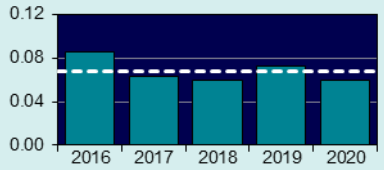
- Fermilab's CY 2020 shutdown began on 15 June 2020, and the accelerators were restarted between 13 October 2020 and 14 December 2020. This was a longer shutdown duration than was initially planned at the start of the year; plans were adjusted to extend the shutdown due to the COVID-19 pandemic.

Lawrence Livermore National Laboratory (LLNL)

Collective TED (person-rem)



Average Measurable TED (rem)



Site Description

LLNL is a DOE facility operated by the Lawrence Livermore National Security, LLC management team, which includes Bechtel, the University of California, BWX Technologies, Washington Group, and Battelle. The site serves as a national resource of scientific, technical, and engineering capability with a special focus on national security. LLNL's mission encompasses such areas as: strategic defense, energy, the environment, biomedicine, technology transfer, education, counter-terrorism, and emergency response. The types of radioactive materials range from tritium to transuranic (TRU); the quantities of each range from nanocuries (i.e., normal environmental background values) to kilocuries.

Activities Involving Radiation Exposure

- Radiation producing devices, such as x-ray machines, accelerators, and electron-beam welders; and
- Handling a wide range and quantity of radioactive materials.

Changes in Dose

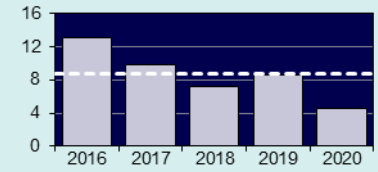
- The decrease in collective dose was due to a reduction in work posed by COVID conditions.

As seen in *Exhibit 3-11*, the majority of the collective TED is associated with just a few DOE sites. For sites with relatively low collective dose or with fewer monitored individuals, wider variation can occur from year to year. These year-to-year variations are often due to changes in funding or mission priorities that can significantly impact the relatively small amount of work involving radiation exposure. In CY 2020, 20 DOE sites reported less than 5 person-rem (50 person-mSv) collective TED for their respective site. These sites and the activities contributing to collective TED can be found in *Exhibit 3-15*.

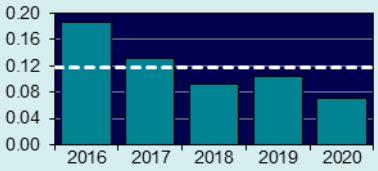
Exhibit 3-15:
Activities Significantly Contributing to Collective TED in CY 2020, for Sites Reporting Less Than 5 Person-Rem, in Descending Order of Collective Dose.

Argonne National Laboratory (ANL)

Collective TED (person-rem)



Average Measurable TED (rem)



Site Description

ANL is one of DOE's largest national laboratories for scientific and engineering research. The lab's mission is to apply a unique mix of world-class science, engineering, and user facilities to deliver innovative research and technologies. The principal radiological facilities at Argonne are the Advanced Photon Source, a superconducting heavy-ion linear accelerator (LINAC), a 22-MeV pulsed electron LINAC, and several other charged-particle accelerators.

Activities Involving Radiation Exposure

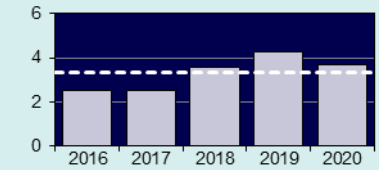
- Work supporting the lab's radiological facilities;
- Programmatic activities resulting primarily from research activities in the Irradiated Materials Laboratory; and
- Material handling, management, storage, and disposition activities associated with the Alpha Gamma Hot Cell Facility, the Waste Management Operations Facility, and the Radioactive Waste Storage Facility.

Changes in Dose

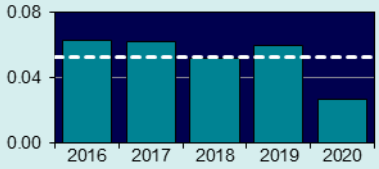
- Decreased presence of workers on-site and work performed because of COVID-19 restrictions related to Minimum Safe Status and Limited Status Operations.

Portsmouth Gaseous Diffusion Plant (PORTS)

Collective TED (person-rem)



Average Measurable TED (rem)



Site Description

PORTS is located in Pike County, Ohio. PORTS was one of three large gaseous diffusion plants initially constructed to produce enriched uranium to support the nation's nuclear weapons program and later enrich uranium for commercial nuclear reactors. The plant has been shut down and is currently undergoing decontamination and decommissioning (D&D).

Activities Involving Radiation Exposure

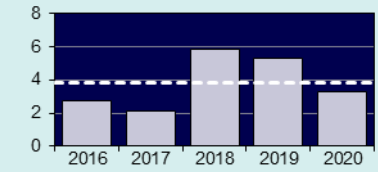
- Site deactivation, decommissioning, and demolition activities;
- Waste handling, processing, and shipment of uranium-bearing materials;
- Processing of uranium hexafluoride cylinders;
- Facility decontamination; and
- Uranium barter transfers.

Changes in Dose

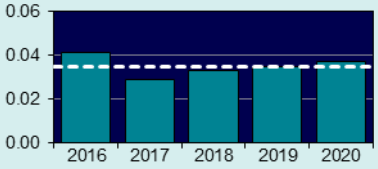
- PORTS began issuing new TLDs that have a greater sensitivity at low levels of radiation resulting in a greater number of positive readings above the minimum reportable dose; and
- Plant staffing was reduced to essential personnel March through September 2020 due to the COVID-19 partial stop work. Work was subsequently refined to a significantly reduced work level.

Sandia National Laboratories (SNL)

Collective TED (person-rem)



Average Measurable TED (rem)



Site Description

SNL's primary mission is ensuring the U.S. nuclear arsenal is safe, secure, and reliable, and can fully support our nation's deterrence policy. SNL is the engineering arm of the U.S. nuclear weapons enterprise. SNL's foundation is science-based engineering, in which fundamental science, computer models, and unique experimental facilities come together so researchers can understand, predict, and verify weapon systems performance.

Activities Involving Radiation Exposure

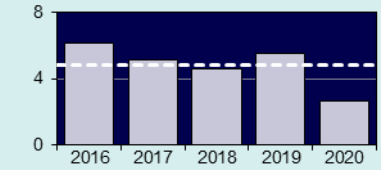
- Operation of a research reactor, gamma irradiation facility, hot cell facility, and several pulsed-power accelerators;
- Conducting light laboratory work involving x-ray machines and tracer radionuclides; and
- Waste operations.

Changes in Dose

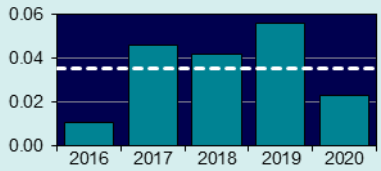
- Decreases are attributed to the COVID-19 pandemic and associated work-from-home order, with no radiological work significantly changing between CY 2019 and CY 2020, only the volume of work being performed onsite decreasing overall.

Paducah Gaseous Diffusion Plant (PGDP)

Collective TED (person-rem)



Average Measurable TED (rem)



Site Description

PGDP is located 3 miles south of the Ohio River and is 12 miles west of Paducah, Kentucky. The plant began enriching uranium in CY 1952, first for the nation's nuclear weapons program and then for nuclear fuel for commercial power plants. In CY 1994, the enrichment facilities were leased to United States Enrichment Corporation (USEC). In August 2013, USEC notified DOE that they were discontinuing enrichment operations and planning to de-lease the enrichment facilities.

Activities Involving Radiation Exposure

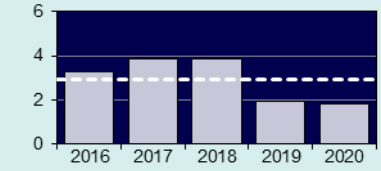
- Continued support of plant operations and maintenance of the Depleted Uranium Hexafluoride project as a nuclear facility;
- Environmental remediation and cleanup activities;
- Waste disposition; and
- Decontamination and decommissioning of inactive facilities.

Changes in Dose

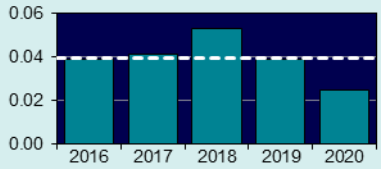
- Plant staffing was reduced to essential personnel March through September 2020 due to the COVID-19 partial stop work. A large number of staff were able to return to the site after September 2020, but the work scope was refined to a significantly reduced work level.

Nevada National Security Site (NNSS)

Collective TED (person-rem)



Average Measurable TED (rem)



Site Description

NNSS is located approximately 65 miles northwest of Las Vegas. It is a remote facility that covers approximately 1,375 square miles of land. The NNSS has been the primary location for testing nuclear experiments in the continental United States since CY 1951.

Activities Involving Radiation Exposure

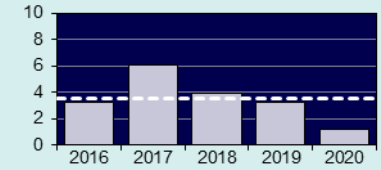
- Operation of low-level radioactive and mixed waste disposal facilities;
- Assembly and execution of subcritical experiments, confined critical experiments;
- Assembly/disassembly of special experiments;
- Operation of pulsed x-ray machines, linear accelerators, and neutron generators;
- Development, testing, and evaluation of radiation detectors;
- Surface cleanup and site characterization of contaminated land areas; and
- Managing environmental activity for the University of Nevada system.

Changes in Dose

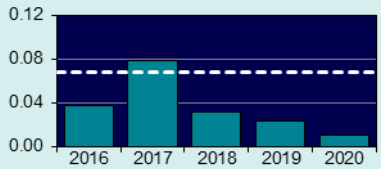
- The decrease in dose was attributed to the curtailment of activities associated with critical and special national laboratories experiments which resulted from a change in operational status during the Covid-19 pandemic.

Brookhaven National Laboratory (BNL)

Collective TED (person-rem)



Average Measurable TED (rem)



Site Description

BNL conducts research in the physical, biomedical, and environmental sciences, as well as in energy technologies and national security. BNL also builds and operates major scientific facilities which are available to university, industry, and government researchers.

Activities Involving Radiation Exposure

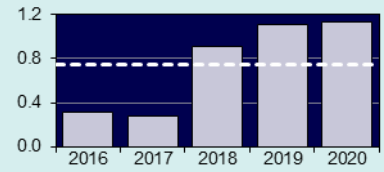
- Research involving nuclear and particle physics, accelerator science, and biological systems research;
- Facility maintenance and source replacement; and
- Support for the National Aeronautics and Space Administration Space Radiation Laboratory.

Changes in Dose

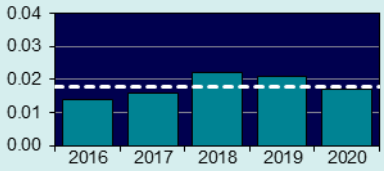
- The decrease in total dose was primarily due to restricted access to the BNL site and most of the personnel teleworking in response to the COVID-19 pandemic.

Waste Isolation Pilot Plant (WIPP)

Collective TED (person-rem)



Average Measurable TED (rem)



Site Description

WIPP is located in the Chihuahuan Desert near Carlsbad, New Mexico. This DOE facility safely disposes of the nation's defense-related TRU radioactive waste. WIPP began disposal operations in March 1999.

Activities Involving Radiation Exposure

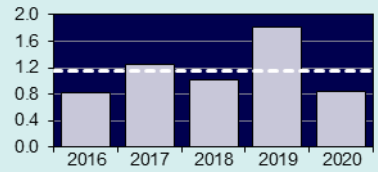
- Handling and processing of TRU waste for storage; and
- Managing long-term repository operations.

Changes in Dose

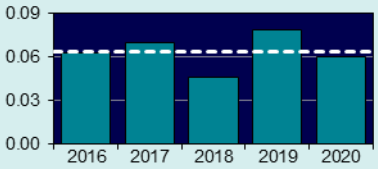
- All doses received were from routine activities associated with the disposal of TRU waste.

Lawrence Berkeley National Laboratory (LBNL)

Collective TED (person-rem)



Average Measurable TED (rem)



Site Description

LBNL is a member of the national laboratory system supported by DOE through its Office of Science and is charged with conducting unclassified research across a wide range of scientific disciplines. LBNL employs approximately 4,200 scientists, engineers, support staff, and students.

Activities Involving Radiation Exposure

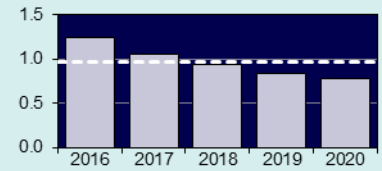
- Fluorine-18 research;
- Antineutrino research and experiments; and
- Site inventory of radioactive and nuclear material activities.

Changes in Dose

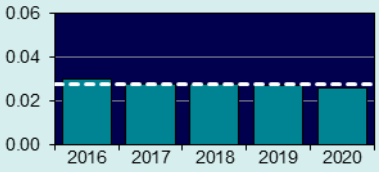
- The decrease in the collective TED was due to less radiation work having been performed onsite due to regional COVID-19 stay at home orders and less dose to workers performing maintenance tasks at the 88-inch Cyclotron facility.

Ames Laboratory

Collective TED (person-rem)



Average Measurable TED (rem)



Site Description

Ames Laboratory is a government-owned, contractor-operated research facility of the DOE. For over 65 years, the Ames Laboratory has sought solutions to energy-related problems through the exploration of chemical, engineering, materials, mathematical, and physical sciences.

Activities Involving Radiation Exposure

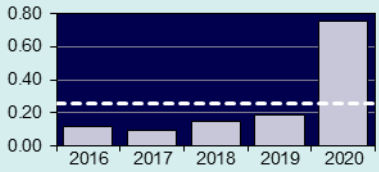
- Remediation of radiological legacy contamination; and
- Operation of 23 x-ray systems and 1 Mossbauer spectroscopy system.

Changes in Dose

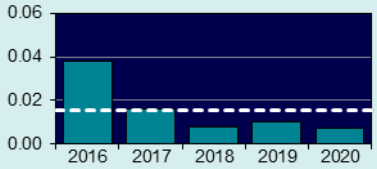
- The decrease in the collective TED was due to less radiation work having been performed onsite due to regional COVID-19 stay at home orders.

Oak Ridge: East Tennessee Technology Park (ETTP)

Collective TED (person-rem)



Average Measurable TED (rem)



Site Description

ETTP was originally named the Oak Ridge Gaseous Diffusion Plant. As part of the Manhattan Project, the plant was designed to produce enriched uranium for use in atomic weapons operations during World War II. After the war, this Plant was renamed the Oak Ridge K-25 Site and produced enriched uranium for the commercial nuclear power industry from CY 1945 to 1985. In CY 1987, DOE renamed the site ETTP and began a major environmental cleanup project with the long-term goal of converting ETTP into a private industrial park.

Activities Involving Radiation Exposure

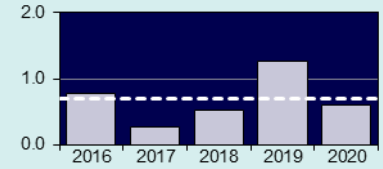
- Continuation of ongoing cleanup activities.

Changes in Dose

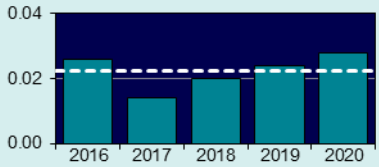
- Dose increased in CY2020 as work focused on shifting to cleanup and demolition at the Oak Ridge National Laboratory.

Thomas Jefferson National Accelerator Facility (TJNAF)

Collective TED (person-rem)



Average Measurable TED (rem)



Site Description

TJNAF is one of 17 national laboratories funded by DOE. TJNAF's primary mission is to conduct basic research of the atom's nucleus using the unique particle accelerator known as the Continuous Electron Beam Accelerator Facility (CEBAF).

Activities Involving Radiation Exposure

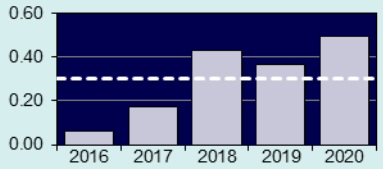
- Maintenance, modification, and repair of activated components associated with the CEBAF and other ancillary activities (e.g., transport, storage, and disposal of radioactive materials).

Changes in Dose

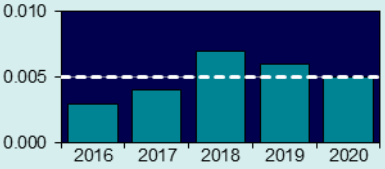
- The closure of TJNAF for several months due to the COVID-19 pandemic caused some reduction in dose.

Kansas City National Security Campus (KC-NSC)

Collective TED (person-rem)



Average Measurable TED (rem)



Site Description

The KC-NSC is responsible for manufacturing and procuring non-nuclear components for nuclear weapons, including electronic, mechanical, and engineered material components. It supports national laboratories, universities, and U.S. industry and is located in Kansas City, Missouri.

Activities Involving Radiation Exposure

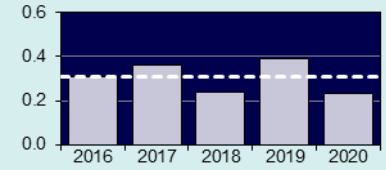
- Non-destructive testing, telemetry (neutron generators);
- Security operations, depleted uranium operations;
- Full production of weapons Life Extension Program; and
- Legacy part refurbishment and waste management.

Changes in Dose

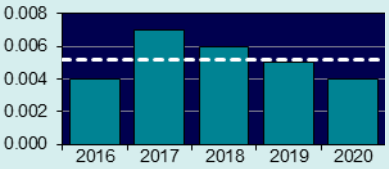
- The number of radiation workers increased five percent at KC-NSC.

Princeton Plasma Physics Laboratory (PPPL)

Collective TED (person-rem)



Average Measurable TED (rem)



Site Description

PPPL is a collaborative national center for fusion energy research. The laboratory advances the coupled fields of fusion energy and plasma physics research and enhances the scientific understanding and key innovations needed to realize fusion as an energy source for the world.

Activities Involving Radiation Exposure

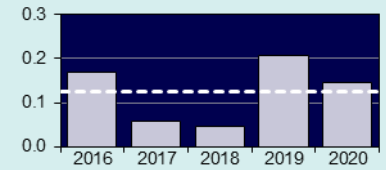
- Experimental and theoretical fusion research; and
- Plasma research and experiments involving radioactive sources and x-ray generating devices.

Changes in Dose

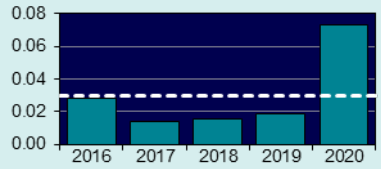
- The decrease in dose was attributed to COVID-19 decreased work duties.

SLAC National Accelerator Laboratory (SLAC)

Collective TED (person-rem)



Average Measurable TED (rem)



Site Description

SLAC, which opened in CY 1962, is 1 of 10 DOE Office of Science laboratories and is operated by Stanford University on behalf of DOE. Originally a premier high-energy particle accelerator laboratory, SLAC has grown into a state-of-the-art photon science laboratory. SLAC's scientific mission has diversified from an original focus on particle physics and accelerator science to include cosmology, materials and environmental sciences, biology, chemistry, and alternative energy research.

Activities Involving Radiation Exposure

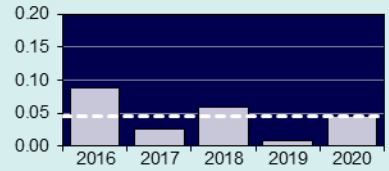
- Operation of the LINAC Coherent Light Source (LCLS) – the world's first hard x-ray free electron laser;
- Operation of the Stanford Synchrotron Radiation Lightsource – a pioneering synchrotron radiation facility; and
- Operation of the Stanford Positron-Electron Asymmetric Ring (SPEAR3), and a separate, shorter linear accelerator (LINAC), and a booster ring for injecting accelerated beams of electrons into SPEAR3.

Changes in Dose

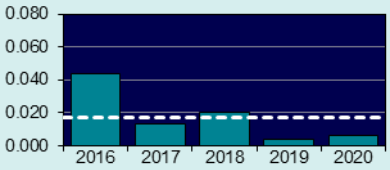
- The collective dose reflects normal routine operations and normal variations given the limited number of individuals with measurable dose and the very low doses.

Energy Technology Engineering Center (ETEC)

Collective TED (person-rem)



Average Measurable TED (rem)



Site Description

ETEC is located within area IV of the Santa Susana Field Laboratory. The laboratory comprises four discrete operational areas with two adjacent undeveloped properties. In CY 1988, DOE decided to close the remaining ETEC operations. ETEC is currently in a safe shutdown mode, pending the completion of the Environmental Impact Statement.

Activities Involving Radiation Exposure

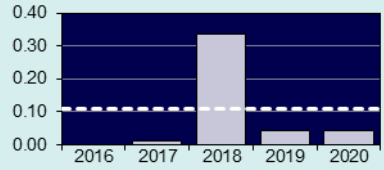
- Disposition of government property;
- Cleanup of facilities, demolition of facilities, and site restoration;
- Area IV is undergoing characterization for cleanup of the area; and
- Investigation and remediation of soil and groundwater.

Changes in Dose

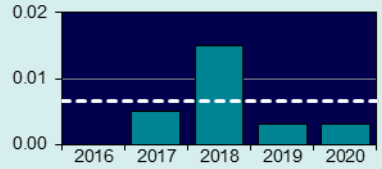
- The CY 2020 dose stems from the fact that the ETEC facility is not operational and employees are only performing monitoring and maintenance functions, along with abatement activities.

Grand Junction Site

Collective TED (person-rem)



Average Measurable TED (rem)



Site Description

The Grand Junction disposal site was transferred to the Office of Legacy Management in CY 2003. Legacy Management manages the site according to a site-specific Long-Term Surveillance and Maintenance Plan.

Activities Involving Radiation Exposure

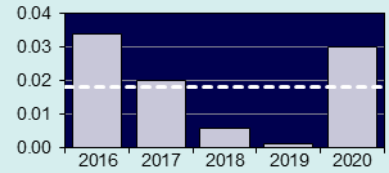
- Conducting annual sampling of groundwater and surface water, validating the analytical data generated from the annual sampling event;
- Conducting an annual site inspection and preparing an inspection report;
- Abandoned mine site inspections; and
- Monitoring well maintenance.

Changes in Dose

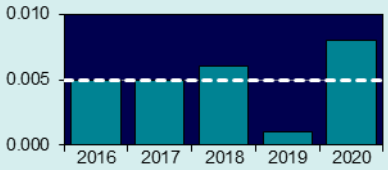
- All doses received were from routine field activities performed by Legacy Management personnel and were very low.

National Renewable Energy Laboratory (NREL)

Collective TED (person-rem)



Average Measurable TED (rem)



Site Description

NREL focuses on creative answers to today's energy challenges. From fundamental science and energy analysis to validating new products for the commercial market, NREL researchers are dedicated to transforming the way the world uses energy. With more than 35 years of successful innovation in energy efficiency and renewable energy, NREL discoveries provide sustainable alternatives for powering homes, businesses, and transportation systems.

Activities Involving Radiation Exposure

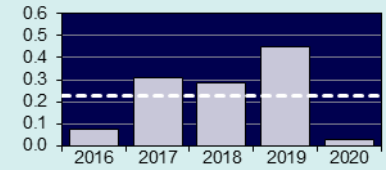
- Electron microscopy staining; and
- Operation of analytical and process equipment containing sealed sources.

Changes in Dose

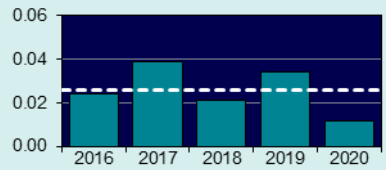
- The increase in dose for CY 2020 was due to an increase in work involving radiation exposure and the completion of decontamination activities. Due to the small number of individuals with measurable dose, these small differences are within normal variations.

Office of Secure Transportation (OST)

Collective TED (person-rem)



Average Measurable TED (rem)



Site Description

OST is the NNSA organization tasked to provide secure ground transportation of nuclear weapons, special nuclear material (SNM), nuclear weapon components, and nuclear explosive-like assemblies. OST operates both secure ground transporters and Federal aircraft, which make up the Transportation Safeguards System (TSS). The TSS Federal Agent and vehicle maintenance facilities are located in Oak Ridge, Tennessee, Amarillo, Texas, and Albuquerque, New Mexico. The OST Administrative Headquarters are located at Kirtland Air Force Base in Albuquerque, New Mexico.

Activities Involving Radiation Exposure

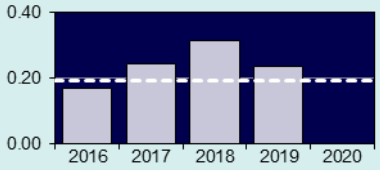
- Providing secure ground transportation of nuclear weapons, SNM, nuclear weapon components, and nuclear explosive-like assemblies; and
- Tracking and directing cargo loading revisions to minimize radiation exposure.

Changes in Dose

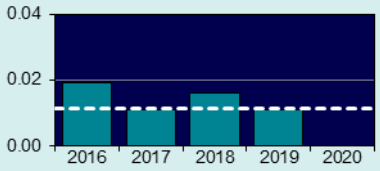
- Differences may be attributed to the small number of individuals (less than 10 for each year).
- Due to COVID-19 impacts, the overall level of activity decreased.

Oak Ridge: Oak Ridge Institute for Science and Education (ORISE)

Collective TED (person-rem)



Average Measurable TED (rem)



Site Description

ORISE is a DOE institute focusing on scientific initiatives to research health risks from occupational hazards, assess environmental cleanup, respond to radiation medical emergencies, support national security and emergency preparedness, and educate the next generation of scientists.

Activities Involving Radiation Exposure

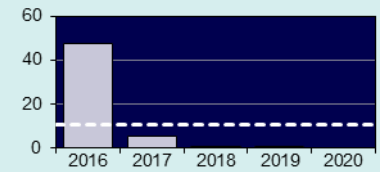
- Independent verification activities involving radiological surveys at sites undergoing decommissioning; and
- Environmental sample processing and radiological protection.

Changes in Dose

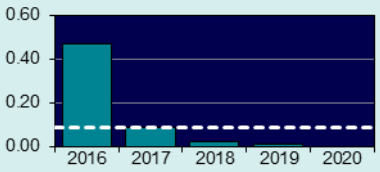
- Due to COVID-19 restrictions, no radiological site work was performed during the period.

Separations Process Research Unit (SPRU)

Collective TED (person-rem)



Average Measurable TED (rem)



Site Description

SPRU is located at Knolls Atomic Power Laboratory based in upstate New York. Built in the 1940s, the buildings supported the SPRU mission to research the chemical process to extract plutonium from irradiated materials. Although the equipment was flushed and drained, and bulk waste was removed following the shutdown of the facilities in CY 1953, residual materials are present in the tanks, buildings H2 and G2, and interconnecting pipe tunnels. The site is currently undergoing a variety of cleanup activities, including demolition, decontamination, and remediation.

Activities Involving Radiation Exposure

- Repackaging TRU waste;
- Processing and shipping low activity water and waste; and
- Surveillance and maintenance of site condition activities.

Changes in Dose

- Collective dose decreased due to maintaining proper as low as reasonably achievable controls during quarterly inspections of the TRU waste storage area.

3.4.4 Summary by Program Office

DOE has divided the responsibility of managing its missions among specific program offices. A site may include facilities or project areas that perform work in support of the mission of multiple program offices. In these cases, the dose records are separated by the reporting organization and assigned to the corresponding program office. For this reason, some sites will have portions of the collective dose shown under more than one program office.

Exhibit 3-16 shows the collective TED, number of individuals with measurable TED, and the average measurable TED by DOE program office. The NNSA and the Office of Environmental Management (EM) account for 84 percent of the collective TED (61 and 23 percent, respectively).

The primary sites contributing to the collective TED within EM are SRS and Idaho. For NNSA, the primary contributors are LANL and the Pantex Plant.

A more detailed breakdown of the exposure information by site, program office, and contractor is included in the Appendices of this report.

Exhibit 3-16:
Program Office Dose Data, CY 2020.

Program Office	Collective TED (person-rem)	Percent Change from 2019	Number with Meas. Dose (TED)	Percent Change from 2019	Avg. Meas. TED (rem)	Percent Change from 2019
Office of Energy Efficiency and Renewable Energy (EE)					**Total Monitored =**	**7***
National Renewable Energy Laboratory	0.030	◊	4	◊	0.008	◊
EE Totals	**0.030**	◊	**4**	◊	**0.008**	◊
Office of Environmental Management (EM)					**Total Monitored =**	**18,980***
East Tennessee Technology Park	0.751	◊	102	◊	0.007	◊
Energy Technology Engineering Center	0.045	◊	8	◊	0.006	◊
Hanford Site	9.797	-70% ▼	485	-41% ▼	0.020	-49% ▼
Idaho (ICP, AMWTP and DOE IOO)	27.501	-25% ▼	645	8% ▲	0.043	-30% ▼
Los Alamos National Laboratory	1.311	-17% ▼	28	-3% ▼	0.047	-14% ▼
Nevada National Security Site	0.000	◊	0	◊	0.000	◊
Oak Ridge National Laboratory	6.035	-67% ▼	276	57% ▲	0.022	-79% ▼
Office of River Protection	13.291	-45% ▼	461	-31% ▼	0.029	-20% ▼
Paducah Gaseous Diffusion Plant	2.654	-52% ▼	116	16% ▲	0.023	-59% ▼
Portsmouth Gaseous Diffusion Plant	3.712	-13% ▼	139	**96%** ▲	0.027	-56% ▼
Savannah River National Laboratory	11.717	-30% ▼	445	-19% ▼	0.026	-13% ▼
Savannah River Site	**72.451**	-17% ▼	**2,663**	15% ▲	0.027	-28% ▼
Separations Process Research Unit	0.000	◊	0	◊	0.000	◊
Service Center Personnel*	3.096	**218%** ▲	32	52% ▲	0.097	**109%** ▲
Uranium Mill Tailings Remedial Action Project	12.004	23% ▲	95	0%	**0.126**	23% ▲
Waste Isolation Pilot Plant	1.130	2% ▲	67	24% ▲	0.017	-18% ▼
West Valley Demonstration Project	8.868	-57% ▼	112	-19% ▼	0.079	-46% ▼
EM Totals	**174.363**	**-33%** ▼	**5,674**	**0%**	**0.031**	**-33%** ▼
Office of Fossil Entergy (FE)					**Total Monitored =**	**103***
Service Center Personnel*	0.020	◊	2	◊	0.010	◊
FE Totals	**0.020**	◊	**2**	◊	**0.010**	◊
Office of Legacy Management (LM)					**Total Monitored =**	**22***
Grand Junction Site	0.043	◊	14	◊	0.003	◊
LM Totals	**0.043**	◊	**14**	◊	**0.003**	◊
National Nuclear Security Administration (NNSA)					**Total Monitored =**	**27,356***
Kansas City National Security Campus	0.493	◊	93	◊	0.005	◊
Lawrence Livermore National Laboratory	7.494	-32% ▼	128	-16% ▼	0.059	-19% ▼
Los Alamos National Laboratory	**231.425**	4% ▲	2,495	28% ▲	**0.093**	-19% ▼
Nevada National Security Site	1.800	-6% ▼	72	50% ▲	0.025	-37% ▼
Office of Secure Transportation	0.025	◊	2	◊	0.013	◊
Pantex Plant	113.809	**369%** ▲	**3,559**	**370%** ▲	0.032	0% ▼
Sandia National Laboratories	3.287	-38% ▼	89	-42% ▼	0.037	7% ▲
Savannah River Site	39.796	1% ▲	1,557	17% ▲	0.026	-14% ▼
Y-12 National Security Complex	58.768	-5% ▼	1,409	-15% ▼	0.042	**12%** ▲
NNSA Totals	**448.346**	**22%** ▲	**8,939**	**46%** ▲	**0.050**	**-16%** ▼
Office of Nuclear Energy (NE)					**Total Monitored =**	**3,469***
Idaho National Laboratory	53.017	33% ▲	1,019	68% ▲	0.052	-21% ▼
NE Totals	**53.017**	**33%** ▲	**1,019**	**68%** ▲	**0.052**	**-21%** ▼
Office of Science (SC)					**Total Monitored =**	**14,242***
Ames Laboratory	0.777	◊	30	◊	0.026	◊
Argonne National Laboratory	4.609	-47% ▼	65	-22% ▼	0.071	-32% ▼
Brookhaven National Laboratory	1.161	-64% ▼	111	-19% ▼	0.010	-55% ▼
Fermi National Accelerator Laboratory	7.850	**11%** ▲	168	**9%** ▲	0.047	**2%** ▲
Lawrence Berkeley National Laboratory	0.834	◊	14	◊	0.060	◊
Oak Ridge Institute for Science and Education	0.000	◊	0	◊	0.000	◊
Oak Ridge National Laboratory	**41.631**	-20% ▼	334	-8% ▼	**0.125**	-13% ▼
Pacific Northwest National Laboratory	8.523	-12% ▼	**408**	-9% ▼	0.021	-4% ▼
Princeton Plasma Physics Laboratory	0.234	◊	54	◊	0.004	◊
SLAC National Accelerator Laboratory	0.146	◊	2	◊	0.073	◊
Thomas Jefferson National Accelerator Facility	0.607	◊	22	◊	0.028	◊
SC Totals	**66.372**	**-22%** ▼	**1,208**	**-13%** ▼	**0.055**	**-10%** ▼

Note: Bold and boxed values indicate the greatest value in each category.
◊ The percentage change from the previous year is not shown because it is not meaningful when the site collective dose is less than 1 person-rem (10 person-mSv).
* Individuals who worked at more than one program office are represented within each grouping; therefore, the total monitored values will not match the annual number of workers monitored.

3.5 Transient Individuals

For the purpose of this report, a DOE site is defined as a geographic location. Transient individuals, or transients, are defined as individuals who are monitored at more than one DOE site during the calendar year and, therefore, had more than one monitoring record reported to the REMS repository. This section presents information on transient individuals to determine the extent to which individuals traveled from site to site and to examine the doses received by these individuals.

The tracking and analysis of transient workers are important aspects of the REMS Program. While each site is responsible for monitoring individuals during their work at that site, the REMS Program collects dose records from all sites and verifies that individuals do not exceed regulatory limits by accruing doses at multiple facilities. Although the number of transient individuals and average doses have been low, the examination of these records remains an important function in assessing performance of DOE radiation protection programs.

Exhibit 3-17 shows the dose distribution and total number of transient individuals from CY 2016 to 2020. Over the past five years, the records of transient individuals have averaged almost three percent of the total records for all monitored individuals. These individuals received, on an average, two and one half percent of the collective TED. The collective TED for transients decreased from 22.2 person rem (222 person-mSv) in CY 2019 to 7.6 person-rem (76 person-mSv) in CY 2020. The average measurable TED decreased from 0.042 rem (0.420 mSv) in CY 2019 to 0.029 in CY 2020. The 67 percent decrease in the collective TED in CY 2020 is the result of the decreased travel due to the COVID-19 pandemic.

3.6 Historical Data

To provide historical context for radiation exposure data at DOE, it is useful to include information prior to the past 5 years. *Exhibit 3-18* and *Exhibit 3-19* show a summary of occupational exposures starting in CY 1974, when the Atomic Energy Commission (AEC) split into the U.S. Nuclear Regulatory Commission (NRC) and the Energy Research and Development Administration (ERDA), which subsequently became DOE. *Exhibit 3-18* and *Exhibit 3-19* show the collective dose, average measurable dose, and number of workers with a measurable dose from CY 1974 to 2020. All three parameters decreased dramatically between CY 1986 and 1993 due to the shutdown of facilities within the weapons complex and the end of the Cold War era. After this time, the DOE mission shifted from weapons production to shutdown, stabilization, and decontamination and decommissioning activities.

Exhibit 3-17:
Dose Distribution of Transient Individuals, CY 2016 – 2020.

	Dose Ranges (TED in rem)*	2016	2017	2018	2019	2020
Transients	Less than measurable	2,016	2,035	2,291	2,144	522
	Measurable <0.100	420	432	404	475	324
	0.100 – 0.250	47	24	23	31	12
	0.250 – 0.500	14	12	13	12	2
	0.500 – 0.750	1	3	1	2	0
	0.750 – 1.000	1	1	2	2	0
	1.0 – 2.0					
	>2.0					
	Total number of individuals monitored**	2,499	2,507	2,734	2,666	860
	Number with measurable dose	483	472	443	522	338
	% with measurable dose	19%	19%	16%	20%	39%
	Collective TED (person-rem)	23.363	20.069	18.934	22.169	10.370
	Average measurable TED (rem)	0.048	0.043	0.043	0.042	0.031
All DOE	Total number of records for monitored individuals	77,848	79,906	75,634	76,143	64,688
	Number of individuals with measurable dose	11,983	13,019	13,335	13,824	17,329
	% of total monitored individuals who are transient	3.2%	3.1%	3.6%	3.5%	1.3%
	% of the number of individuals with measurable dose who are transient	4.0%	3.6%	3.3%	3.8%	2.0%

*Individuals with doses equal to the dose value separating the dose ranges are included in the next higher dose range.
** Total number of individuals represents the number of individuals monitored and not the number of records.

Exhibit 3-18:
Collective Dose and Average Measurable Dose, CY 1974 – 2020.

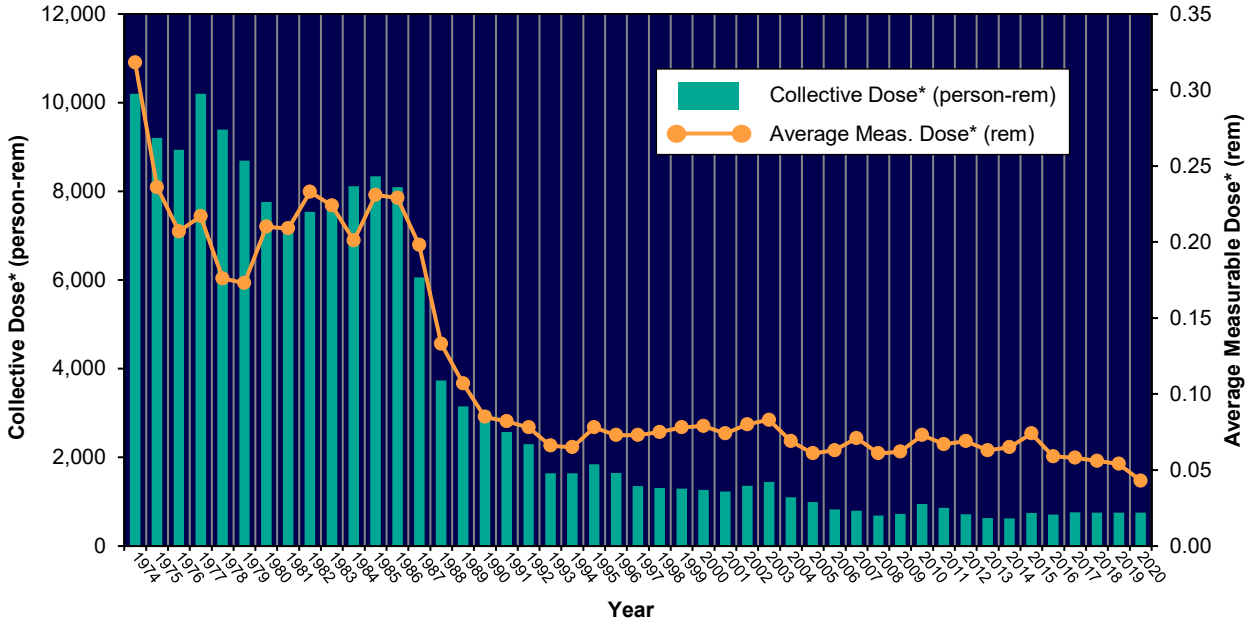
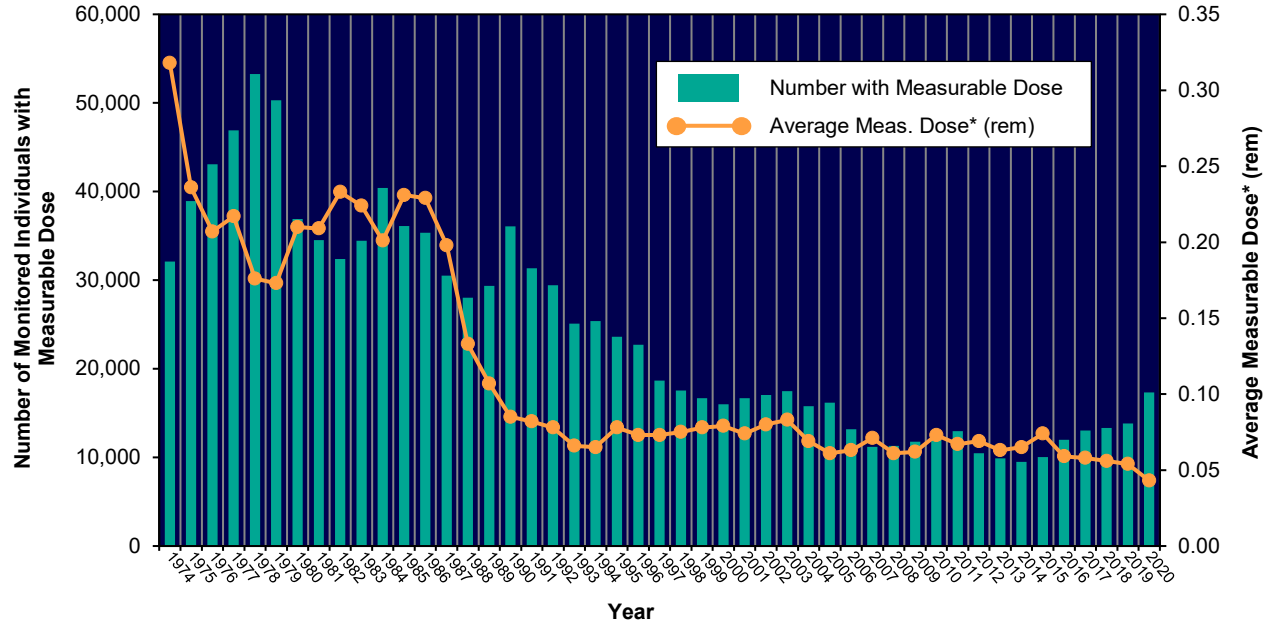


Exhibit 3-19:
Number of Workers with Measurable Dose and Average Measurable Dose, CY 1974 – 2020.



* 1974 – 1989 collective dose = DDE
1990 – 1992 collective dose = DDE + AEDE
1993 – 2009 collective dose = DDE + CEDE
2010 – 2020 collective dose = ED + CED

1946 – 1974 Atomic Energy Commission (AEC)
1974 – 1977 Energy Research and Development Administration (ERDA)
1977 – Present Department of Energy (DOE)

This page intentionally left blank

ALARA and Operating Experience Programs

Two EHSS Programs that are closely related to the collection and analysis of occupational radiation exposure are the ALARA and Operating Experience Programs. A description of these Programs are provided here as well as access information.

4.1 ALARA Program

Descriptions of ALARA activities that have shown promise in reducing the radiation exposure at DOE are collected for the purpose of sharing strategies and techniques among DOE radiation protection managers. Project descriptions are voluntarily submitted from the sites and are not independently verified or endorsed by DOE. Program and site offices and contractors who are interested in benchmarks of success and continuous improvement in the context of integrated safety management and quality are encouraged to provide input.

Descriptions of ALARA activities are provided on the DOE web site:

https://www.energy.gov/ehss/occupational-radiation-exposure-publications

Individual project descriptions may be submitted to the DOE Office of ES&H Reporting and Analysis (AU-23) through the REMS web site. The submissions should describe the process in sufficient detail to provide a basic understanding of the project, the radiological concerns, and the activities initiated to reduce dose. The web site provides a form to collect the following information about the project:

- Mission statement;
- Project description;
- Radiological concerns;
- Total collective dose for the project;
- Dose rate to exposed workers before and after exposure controls were implemented;
- Information on how the process implemented ALARA techniques in an innovative or unique manner;
- Estimated dose avoided;
- Project staff involved;
- Approximate cost of the ALARA effort;
- Impact on work processes, in person-hours if possible (may be negative or positive);
- Figures and/or photos of the project or equipment (electronic images if available); and
- Point of contact for follow-up by interested professionals.

The REMS web page for submitting ALARA project descriptions can be accessed on the internet at:

https://www.energy.gov/ehss/downloads/line-alara-project-submittal-form-report-alara-project-descriptions-rems

4.2 Operating Experience Program

DOE has a mature Operating Experience Program (OEP), which has been enhanced from the lessons learned program that was initially developed in CY 1994. The OEP is described in DOE O 210.2A, *DOE Corporate Operating Experience Program* [9]. The objectives of the OEP are to institute a DOE-wide program for the management of operating experience to prevent adverse operating incidents and to expand the sharing of good work practices among DOE sites. The program provides a systematic review, identification, collection, screening, evaluation, and dissemination of operating experience from U.S. and foreign government agencies and industry, professional societies, trade associations, national academies, universities, and DOE and its contractors. DOE Headquarters takes corporate responsibility for identifying, analyzing, and sharing operating experience information. Operating experience/lessons learned provided by DOE field sites optimize the

knowledge gained by communicating through various products, including a corporate database.

DOE posts operating experience information and links to other operating experience resources on the internet. DOE uses the internet to disseminate information so that DOE and external entities may improve the health and safety aspects of operations within their facilities, including reducing the number of accidents and injuries.

For further information contact:

Ms. Colette Broussard
Office of ES&H Reporting and Analysis (AU-23)
U.S. Department of Energy
1000 Independence Avenue, SW
Washington, D.C. 20585-1290
E-mail: colette.broussard@hq.doe.gov

https://www.energy.gov/ehss/corporate-operating-experience-program

Conclusions

Analysis of the collected exposure data for CY 2020 indicate that:

- DOE operations were in compliance with regulatory radiation protection requirements as no exposures were reported to have exceeded the occupational dose limit of 5 rem (50 mSv) TED.
- One exposure over the ACL of 2 rem (20 mSv) was reported at LANL.
- Only 27 percent of the monitored individuals received a measurable dose, and the average measurable dose received was less than 1 percent of the 5 rem (50 mSv) TED limit.

In addition, from CY 2019 to CY 2020 the:

- The collective TED at DOE decreased by less than 1 percent, although the number of individuals with measurable dose increased by 25 percent. The majority (62 percent) of facilities cited the COVID-19 pandemic as limiting operational activities;
- Collective CED (internal exposure to U-234) increased by 10 percent to 56.1 person-rem (561 person-mSv); and
- Collective TED for transient workers decreased by 66 percent to 7.6 person-rem (76 person-mSv).

The collective dose at DOE facilities has decreased by 91 percent since CY 1986. This coincides with the end of the Cold War era, which shifted the DOE mission from weapons production to stabilization, waste management, and environmental remediation activities, along with the consolidation and remediation of facilities across the complex to meet the new mission.

In alignment with the change in mission, regulations and requirements have been modified (see Section 2) that reinforce DOE's focus on ALARA practices and risk reduction to lowering occupational radiation dose.

This page intentionally left blank.

Glossary

Administrative Control Level (ACL)
A dose level that is established below the DOE dose limit to administratively control exposures. ACLs are multi-tiered, with increasing levels of authority required to approve a higher level of exposure.

As Low As Reasonably Achievable (ALARA)
The approach to radiation protection to manage and control exposures (both individual and collective) to the work force and to the general public to as low as is reasonable, taking into account social, technical, economic, practical, and public policy considerations. As used in this part, ALARA is not a dose limit but a process which has the objective of attaining doses as far below the applicable limits of this part as is reasonably achievable. [10 CFR 835.2]

Average Measurable Dose
The dose obtained by dividing the collective dose by the number of individuals who received a measurable dose. This is the average most commonly used when examining trends and comparing doses received by workers, because it reflects the exclusion of those individuals receiving a less than measurable dose. In this report, average measurable dose is calculated for total effective dose (TED) and committed effective dose (CED).

Bioassay Measurements
As presented in Section 3.3.4, the number of bioassay measurements is the number of measurements taken to determine the kinds, quantities, or concentrations of radioactive material in the human body, whether by direct measurement or by analysis and evaluation of materials excreted or removed from the human body. Types of bioassay include:

- In Vivo bioassay: From the Latin for "in one that is living," occurring within the living. The direct measurement of radioactive material in the human body. The number of in vivo measurements represents the number of measurements performed for all individuals during the year.
- Fecal bioassay: The evaluation of radioactive material excreted in feces from the human body. The number of fecal bioassay measurements is the number of fecal samples analyzed for all individuals during the year.
- Urinalysis bioassay: The evaluation of radioactive material excreted in urine from the human body. The number of urinalysis bioassay measurements is the number of fecal samples analyzed for all individuals during the year.

Collective Dose
The sum of doses to all individuals in a population for a period of time and is used whenever the dose may refer to more than one type of dose. In cases where the type of dose is specified, the term “collective” is followed by the type of dose such as the TED, CED, or photon. In all cases, the population is the group of DOE workers that were monitored for occupational radiation exposure, and the period of time is the monitoring year. Collective dose is expressed in units of person-rem.

Committed Effective Dose (CED) or (E_{50})
Means the sum of the committed equivalent doses to various tissues or organs in the body ($H_{T,50}$), each multiplied by the appropriate tissue weighting factor (w_T)—that is, $E_{50} = \Sigma w_T H_{T,50} + w_{Remainder} H_{Remainder,50}$. Where $w_{Remainder}$ is the tissue weighting factor assigned to the remainder organs and tissues and $H_{Remainder,50}$ is the committed equivalent dose to the remainder organs and tissues. Committed effective dose is expressed in units of rem (or Sv). [10 CFR 835.2]

Committed Equivalent Dose (CEqD) or ($H_{T,50}$)
Means the equivalent dose calculated to be received by a tissue or organ over a 50-year period after the intake of a radionuclide into the body. It does not include contributions from radiation sources external to the body. Committed equivalent dose is expressed in units of rem (or Sv). [10 CFR 835.2]

Dose
A general term for absorbed dose, equivalent dose, effective dose, committed equivalent dose, committed effective dose, or total effective dose as defined in this part. [10 CFR 835.2]

Effective Dose
Means the summation of the products of the equivalent dose received by specified tissues or organs of the body (H_T) and the appropriate tissue weighting factor (w_T)—that is, $E = \Sigma w_T H_T$. It includes the dose from radiation sources internal and/or external to the body. For purposes of compliance with this part, equivalent dose to the whole body may be used as effective dose for external exposures. The effective dose is expressed in units of rem (or Sv). [10 CFR 835.2]

Equivalent Dose (EqD)
Means the product of average absorbed dose ($D_{T,R}$) in rad (or gray) in a tissue or organ (T) and a radiation (R) weighting factor (w_R). For external dose, the equivalent dose to the whole body is assessed at a depth of 1 cm in tissue; the equivalent dose to the lens of the eye is assessed at a depth of 0.3 cm in tissue, and the equivalent dose to the extremity and skin is assessed at a depth of 0.007 cm in tissue. Equivalent dose is expressed in units of rem (or Sv). [10 CFR 835.2]

Measurable Dose
A dose greater than zero rem (not including doses reported as "not detectable").

Member of the Public
Means an individual who is not a general employee. An individual is not a "member of the public" during any period in which the individual receives an occupational dose. [10 CFR 835.2] The definition of general employee is specified in 10 CFR 835.

Number of Individuals with Measurable Dose
The subset of all monitored individuals who receive a measurable dose (greater than the limit of detection for the monitoring system). Many personnel are monitored as a matter of prudence and may not receive a measurable dose. For this reason, the number of individuals with measurable dose is presented in this report as a more accurate indicator of the exposed workforce. The number of individuals represents the number of dose records reported. Some individuals may be counted more than once if multiple dose records are reported for the individual during the year.

Occupational Exposure
An individual's exposure to ionizing radiation (external and internal) as a result of that individual's work assignment. Occupational exposure does not include planned special exposures, exposure received as a medical patient, background radiation, or voluntary participation in medical research programs.

Person-rem
The unit of measurement used for the collective dose to all DOE Federal, contractor, and subcontractor employees.

Rem
A unit of dose derived from the phrase roentgen equivalent man. The rem is equal to 0.010 Sv, which is the international unit of measurement for radiation exposure.

Total Effective Dose (TED)
Means the sum of the effective dose (for external exposures) and the committed effective dose. [10 CFR 835.2]

Total Organ Dose (TOD)
The sum of the equivalent dose to the whole body for external exposures and the committed equivalent dose to any organ or tissue other than the skin or the lens of the eye.

Transient Individual
As used in this report, a transient individual is an individual monitored for radiation exposure at more than one DOE site during the calendar year.

This page intentionally left blank.

References

1. EPA (U.S. Environmental Protection Agency), 1987. "Radiation Protection Guidance to Federal Agencies for Occupational Exposure," *Federal Register* 52, No. 17, 2822; with corrections published in the *Federal Registers* of Friday, January 30, and Wednesday, February 4, 1987.

2. ICRP (International Commission on Radiological Protection), 1977. "Recommendations of the International Commission on Radiological Protection," ICRP Publication 26, *Annals of the ICRP, Vol. 1, No. 3* (Pergamon Press, New York).

3. NCRP (National Council on Radiation Protection and Measurements), 1987. "Recommendations on Limits for Exposure to Ionizing Radiation," NCRP 91; superseded by NCRP Report No. 116.

4. 10 CFR 835, 1998, "Occupational Radiation Protection." Rule; DOE *Federal Register*, November 4, 1998. Amended August 11, 2017.

5. DOE O 231.1B, 2011, "Environment, Safety and Health Reporting," June 27, 2011.

6. REMS Data Reporting Guide, issued February 23, 2012. Online at: https://www.energy.gov/ehss/downloads/radiation-exposure-monitoring-systems-data-reporting-guide.

7. Computerized Accident Incident Reporting System (CAIRS), "DOE and Contractor Injury and Illness Data by Year by Quarter" report. Online at: https://www.energy.gov/ehss/policy-guidance-reports/databases/computerized-accident-incident-reporting-system.

8. DOE Standard, DOE-STD-1098-2017, "Radiological Control," January 2017. Online at: https://www.standards.doe.gov/standards-documents/1000/1098-AStd-2017/@@images/file.

9. DOE O 210.2A, "DOE Corporate Operating Experience Program," April 8, 2011. Online at: https://www.directives.doe.gov/directives-documents/200-series/0210.2-BOrder-a/@@images/file.

This page intentionally left blank.

User Survey

U.S. Department of Energy Occupational Radiation Exposure Report for Calendar Year 2020 User Survey

DOE, striving to meet the needs of its stakeholders, is looking for suggestions on ways to improve the *U.S. Department of Energy Occupational Radiation Exposure Report for Calendar Year 2020*. **Your feedback is important**. Constructive feedback will ensure this report can continue to meet user needs. Please fill out the attached survey form and return it to:

Ms. Katharine McLellan
Office of ES&H Reporting and Analysis (AU-23)
DOE REMS Program Manager
U.S. Department of Energy
1000 Independence Avenue, SW
Washington, D.C. 20585-1290
katharine.mclellan@hq.doe.gov
Fax: (301) 903-1257

Questions concerning this survey should be directed to Ms. McLellan at (202) 586-0183.

1. Identification:

   Name: _____

   Title: _____

   Mailing Address: _____

   _____

   _____

   _____

2. Distribution:

   2.1 Do you wish to remain on the distribution for this report? _____ yes _____ no

   2.2 Do you wish to be added to the distribution? _____ yes _____ no

(continued on back)

Please circle one.

	Not Useful				Very Useful
Please rate the usefulness of this report overall:	1	2	3	4	5

Please rate the usefulness of the analysis presented in the following sections:

Executive Summary	1	2	3	4	5
Analysis of Aggregate Data	1	2	3	4	5
Collective Dose	1	2	3	4	5
Average Measurable Dose	1	2	3	4	5
Dose Distribution	1	2	3	4	5
Analysis of Individual Dose Data	1	2	3	4	5
Doses in Excess of DOE limit (5 rem)	1	2	3	4	5
Doses in Excess of ACL limit (2 rem)	1	2	3	4	5
Intakes of Radioactive Material	1	2	3	4	5
Bioassay and Intake Summary Information	1	2	3	4	5
Analysis of Site Data	1	2	3	4	5
Collective TED by Site and Other Facilities	1	2	3	4	5
Activities Significantly Contributing to Collective Dose	1	2	3	4	5
Additional Site Descriptions	1	2	3	4	5
Summary by Program Office	1	2	3	4	5
Transient Individuals	1	2	3	4	5
Historical Data	1	2	3	4	5
ALARA Activities at DOE	1	2	3	4	5
Conclusions	1	2	3	4	5

Please rate the importance of the timeliness of the publication of this report as it relates to your professional need for the information on occupational radiation exposure at DOE:

Not important				Critical
1	2	3	4	5

Please provide any additional input or comments on this report.

Appendix A

DOE Reporting Sites and Reporting Codes

DOE Occupational Radiation Exposure Report for CY 2020

Exhibit A-1. Labor Categories and Occupation Codes.

The following is a list of the Occupation Codes that are reported with each individual's dose record to the DOE Radiation Exposure Monitoring System (REMS) in accordance with Order 231.1B. Occupation Codes are grouped into Labor Categories for the purposes of analysis and summary in this report. The occupation codes are listed in the REMS Reporting Guide, Table G-7, and represent a subset of the occupations listed in the Department of Commerce's Standard Occupational Classification (SOC) Manual (1980).

Labor Category	Occupation Code	Occupation Name
Agriculture	562	Groundskeepers
	570	Forest Workers
	580	Misc. Agriculture
Construction/Repair	610	Mechanics/Repairers
	641	Masons
	642	Carpenters
	643	Electricians
	644	Painters
	645	Pipe Fitter
	650	Miners/Drillers
	660	Misc. Repair/Construction
Laborers	850	Handlers/Laborers/Helpers
Management	110	Manager - Adminstrator
	400	Sales
	450	Admin. Support and Clerical
Misc.	910	Military
	990	Miscellaneous
Production	681	Machinists
	682	Sheet Metal Workers
	690	Operators, Plant/System/Utility
	710	Machine Setup/Operators
	771	Welders and Solderers
	780	Misc. Precision/Production
Professional	160	Engineer
	170	Scientist
	184	Health Physicist
	200	Misc. Professional
	260	Doctors and Nurses
Service Workers	512	Firefighters
	513	Security Guards
	521	Food Service Employees
	524	Janitors
	525	Misc. Service
Technicians	350	Technicians
	360	Health Technicians
	370	Engineering Technicians
	380	Science Technicians
	383	Radiation Monitors/Techs.
	390	Misc. Technicians
Transport Workers	820	Truck Drivers
	821	Bus Drivers
	825	Pilots
	830	Equipment Operators
	840	Misc. Transport
Unknown	001	Unknown

DOE Occupational Radiation Exposure Report for CY 2020

Exhibit A-2. Organizations Reporting to DOE REMS, CY 2016–2020.

The following is a list of all organizations reporting to the DOE REMS from CY 2016–2020.
The list provides the Site groupings used in this report as well as the organization reporting code and name.

Site	Org. Code	Organization Name	2016	2017	2018	2019	2020
Albuquerque	OST3100	Office of Secure Transportation	●	●	●	●	●
Ames Laboratory	1000503	Ames Laboratory (Iowa State)	●	●	●	●	●
Argonne National Laboratory (ANL)	1000703	Argonne National Laboratory	●	●	●	●	●
	1004031	New Brunswick Laboratory	●	–	–	–	–
Brookhaven National Laboratory (BNL)	1001003	Brookhaven National Laboratory	●	●	●	●	●
DOE Headquarters	1504001	DOE Headquarters	●	●	●	●	●
Energy Technology Engineering Center	8002001	Cabrera Services	●	●	●	●	●
Fermi National Accelerator Lab. (FERMI)	1002503	Fermilab	●	●	●	●	●
Grand Junction Site	3260615	Navarro Research and Engineering	–	●	●	●	●
Hanford	4700805	Bechtel National Corporation	●	●	●	●	●
	4701001	DOE, Office of River Protection	●	●	●	●	●
	4702004	Advance Technology Laboratories	●	–	–	–	–
	4702005	Wastren Advantage, Inc.	●	●	●	●	●
	4707104	Washington River Protection Solutions, LLC	●	●	●	●	●
	NA-2000	NNSA - Visitors	●	●	●	●	●
	NA-2100	NNSA - Management and Support Personnel	●	●	●	●	●
	NA-2101	NNSA - Mgmt. & Support Personnel: MELE Assoc.	●	●	●	●	●
	NA-2110	NNSA - North and South America	●	●	●	●	●
	NA-2120	NNSA - Europe, Africa and the Middle East	●	●	●	●	●
	NA-2130	NNSA - Asia and Members of the Former Soviet	●	–	–	–	–
	7500503	Battelle - PNNL	●	●	●	●	●
	7500504	Battelle -PNNL- Subs	●	●	●	●	●
	7500521	Pacific Northwest Site Office	●	●	●	●	●
	7500605	Washington Closure Hanford	●	–	–	–	–
	7502504	HPMC Occupational Medical Services	●	●	●	●	●
	7505214	Mission Support Alliance (MSA)	●	●	●	●	●
	7505304	CH2M Hill Plateau Remediation Company	●	●	●	●	●
	7506001	DOE-Richland Field Office	●	●	●	●	●
Idaho	3004001	Idaho Field Office	●	●	●	●	●
	3005003	INL - BEA, LLC - Research	●	●	●	●	●
	3005004	INL - BEA, LLC - Services	●	●	●	●	●
	3005009	INL - BEA, LLC - Security	●	●	●	●	●
	3005012	INL - BEA, LLC - Production	●	●	●	●	●
	3006002	INL - Fluor- Projects	●	●	●	●	●
	3006004	ICP - Fluor - Subcontractors	●	●	●	●	●
	3006005	ICP - Fluor - Support	●	●	●	●	●
	3006016	ICP - Fluor - Construction Subs	●	–	–	–	–
Kansas City National Security Campus	0531002	Honeywell FM & T	●	●	●	●	●
Lawrence Berkeley National Lab. (LBNL)	8003003	Lawrence Berkeley National Laboratory	●	●	●	●	●
Lawrence Livermore National Lab. (LLNL)	0580403	Lawrence Livermore National Laboratory	●	●	●	●	●
	0580416	LLNL - Construction Subcontractors	–	–	●	●	●
	0580503	LLNL - Nevada	●	●	●	●	●
	0580701	LLNL - DOE Site Office	●	●	●	●	●
Los Alamos National Lab. (LANL)	0540001	NNSA Los Alamos Site Office	●	●	●	●	●
	0544003	Los Alamos National Laboratory	●	●	●	●	●
	0544006	Los Alamos National Lab Construction Subs	–	●	●	●	●
	0544809	Protection Technologies Los Alamos	●	●	–	–	–
	0544904	Johnson Controls, Inc.	●	●	●	–	–
	1530001	Newport News Nuclear BWXT Los Alamos (N3B)	–	–	●	●	●
National Renewable Energy Laboratory	2806003	National Renewable Energy Laboratory	●	●	●	●	●
Nevada National Security Site	0501001	NNSA Service Center	●	●	●	–	–
	0520001	NNSA Nevada Site Office	●	●	●	●	●
	0521104	Bechtel Nevada - Amador Valley	●	–	–	–	–
	0521104	MSTS - Livermore Operations	–	●	●	●	●
	0521204	Bechtel Nevada - Las Vegas	●	–	–	–	–

Site	Org. Code	Organization Name	2016	2017	2018	2019	2020
	0521204	MSTS - Las Vegas	–	●	●	●	●
	0521304	Bechtel Nevada - Los Alamos	●	–	–	–	–
	0521304	MSTS - Los Alamos	–	●	●	●	●
	0521314	NSTec - Sandia	–	●	–	●	–
	0521405	Bechtel Nevada - NTS	●	–	–	–	–
	0521405	MSTS - NTS	–	●	●	●	●
	0521416	Bechtel Nevada - NTS - subcontractors	●	–	–	–	–
	0521416	MSTS - NTS subcontractors	–	●	●	●	●
	0521503	Bechtel Nevada - Special Tech Lab.	●	–	–	–	–
	0521503	MSTS - Special Tech. Lab	–	●	●	●	●
	0528002	Centerra-Nevada	●	–	–	–	–
	0528004	Centerra-Nevada Subcontractors Lockheed	●	–	–	–	–
	0529004	Nevada	–	●	●	●	–
	0529009	Wackenhut Services Inc. - NV	–	●	●	●	●
	3505104	Navarro-Intera LLC	●	●	●	●	●
	3508004	Nye County Sheriff - NSTec	●	●	–	–	–
	3508703	SAIC - NV	–	●	–	–	–
	9708001	USGS - Yucca	–	●	●	–	–
New Brunswick Laboratory	1004031	New Brunswick Laboratory - Research	●	–	–	–	–
Oak Ridge Site	4003602	UT-Battelle: ORNL-Isotek	●	●	●	–	–
	4004203	Oak Ridge Inst. For Science & Educ. (ORISE)	●	●	●	●	●
	4004602	Tru Waste Processing Center - ORNL	●	●	●	●	●
	4005104	USEC: Oak Ridge, K25	●	–	–	–	–
	4006002	UCOR - ETTP	●	●	●	●	●
	4006503	UT-Battelle - ORNL	●	●	●	●	●
	4006510	UCOR - ORNL	●	●	●	●	●
	4007509	National Strategic Protective Services	●	●	●	–	–
	4008010	UCOR- Y-12	●	●	●	●	●
	4018102	CNS, LLC, Y-12	●	●	●	●	●
Paducah Gaseous Diff. Plant (PGDP)	4007002	Swift & Staley Team	●	●	●	●	●
	6203106	DUF6 Paducah Construction Subs - MACS	●	●	●	●	●
	6503304	Fluor Paducah Deactivation Project	●	–	–	–	–
	6503304	Four Rivers Nuclear Partnership	–	●	●	●	●
Pantex Plant (PP)	0510001	CNS Pantex - NNSA and DOE Couriers	●	●	●	●	●
	0514004	Battelle - Pantex	●	●	●	●	●
	0515002	CNS Pantex	●	●	●	●	●
	0515006	CNS Pantex - Construction Subs	●	●	●	●	●
	0515009	CNS Pantex - Security	●	–	●	●	–
Portsmouth Gaseous Diff. Plant (PORTS)	6202106	Mid-America Conversion Services (MCS)	●	●	●	●	●
	6202204	Portsmouth Mission Alliance (PMA)	●	●	●	●	●
	6202304	Fluor B & W Portsmouth	●	●	●	●	●
Princeton Plasma Physics Laboratory	1005003	Princeton Plasma Physics Laboratory	●	●	●	●	●
Sandia National Laboratories (SNL)	0578003	Sandia National Laboratories	●	●	●	●	●
Savannah River	0595112	Tritium Extractopm Facility	●	●	●	●	●
	8500505	Bechtel Construction - SR	●	●	●	–	–
	8500516	Miscellaneous SRS Construction Subs	●	●	●	●	●
	8501042	SRR Operations	●	●	●	●	●
	8501044	SRR Service Subs	●	●	●	●	●
	8505501	Savannah River Field Office	●	●	●	●	●
	8505504	Misc. DOE Contractors - SR	●	●	●	●	●
	8505525	Savannah River Nuclear Solutions, Inc.	●	●	●	●	–
	8505526	SR Construction - Parsons Subcontractors	●	●	●	●	●
	8509003	Univ. of Georgia Ecology Laboratories	●	●	●	●	●
	8509509	Wackenhut Services, Inc. - SRNS	●	–	–	–	–
	8509509	Centerra - SR	–	●	●	●	●
	8511002	Savannah River Nuclear Solutions, Inc.	●	●	●	●	●
	8511003	Savannah River National Laboratory	●	●	●	●	●
	8511004	SRNS Service Subs	●	●	●	●	●
	8511005	SRNS Construction	●	●	●	●	●
	8511006	SRNS Construction Subs	●	●	●	●	●
Separations Process Research Unit	1523016	NY SPRU	●	●	●	●	●
Service Center Personnel	0501001	NNSA Albuquerque Complex	●	●	●	●	●

Site	Org. Code	Organization Name	2016	2017	2018	2019	2020
	0701001	Carlsbad Field Office	●	●	●	●	●
	0702003	Los Alamos National Lab - WIPP	●	●	●	●	●
	1504001	DOE Headquarters	●	●	●	●	●
	2041001	NETL Morgantown	-	-	-	-	●
	2042001	NETL Pittsburgh	-	-	-	-	●
	2045001	NETL Albany	-	-	-	-	●
	4003602	Isotek (Bldg 3019)	●	●	●	●	●
SLAC National Accelerator Facility	8008003	Stanford Linear Accelerator Center	●	●	●	●	●
Thomas Jefferson National Accelerator Facility	1509503	Thomas Jefferson National Accelerator Facility	●	●	●	●	●
	1509521	Jefferson Laboratory - DOE Employees	●	●	●	●	-
Uranium Mill Tailings Remediation Action Project	3260645	Uranium Mill Tailings Remedial Action - Moab	●	●	●	●	●
Waste Isolation Pilot Plant	0701001	Carlsbad Field Office	●	●	●	-	-
	0702003	LANL - WIPP	●	●	●	-	-
	0703104	Washington TRU Solutions LLC-WIPP	●	●	●	●	●
	0703109	Santa Fe Protective Services - WIPP	●	●	●	●	●
	0703114	WTS Subcontractors - WIPP	●	●	●	●	●
	0704003	Sandia National Laboratories - WIPP	●	-	-	-	-
West Valley Project	4539004	West Valley Nuclear Services, Inc. (WVNS)	●	●	●	●	●
Pittsburg Naval Reactor Office	6007504	PNR - BAPL & BPMI-P	●	●	●	●	●
	6008003	PNR - BAPL & BPMI-P	●	●	●	●	●
	6009003	Naval Reactors - Idaho	●	●	●	●	●
Schenectady Naval Reactor Office	9004003	Knolls Atomic Power Laboratory	●	-	●	●	●
	9005003	Knolls Atomic Power Laboratory	●	●	●	●	●
	9005004	Knolls Atomic Power Laboratory	●	-	●	●	●

DOE Occupational Radiation Exposure Report for CY 2020

Exhibit A-3. Facility Type Codes.

The following is a list of Facility Type Codes reported to REMS in accordance with the REMS Reporting Guide. A facility type code is reported with each individual's dose record and indicates the facility type where the majority of the individual's dose was accrued during the monitoring year.

Facility Type Code	Description
10	Accelerator
21	Fuel/Uranium Enrichment
22	Fuel Fabrication
23	Fuel Processing
40	Maintenance and Support (Site-Wide)
50	Reactor
61	Research, General
62	Research, Fusion
70	Waste Processing/Mgmt.
80	Weapons Fab. and Testing
99	Other

Appendix B
Additional Data

DOE Occupational Radiation Exposure Report for CY 2020

Exhibit B-1. Site Dose Data, CY 2018.

Site	Collective TED (person-rem)	Percent Change - Coll. TED		Number with Meas. Dose	Percent Change - # with Meas. Dose		Avg. Meas. TED (rem)	Percent Change - Avg. Meas. TED		Percentage of Coll. TED above 0.500 rem	Percent Change - Coll. TED above 0.500 rem	
Ames Laboratory	0.935	–	–	33	–	–	0.028	–	–	–	–	–
Argonne National Laboratory	7.174	-28%	▼	77	–	–	0.095	-28%	▼	26%	-48%	▼
Brookhaven National Laboratory	3.924	-35%	▼	125	62%	▲	0.031	-60%	▼	–	–	–
Energy Technology Engineering Center	0.059	–	–	3	–	–	0.020	–	–	–	–	–
Fermi National Accelerator Laboratory	9.980	-2%	▼	188	-6%	▼	0.053	5%	▲	–	–	–
Grand Junction Site	0.336	–	–	22	–	–	0.015	–	–	–	–	–
Hanford: Hanford Site	27.008	1%	▲	565	-21%	▼	0.048	27%	▲	18%	0%	-
Hanford: Office of River Protection	24.926	2%	▲	570	-5%	▼	0.044	7%	▲	–	–	–
Hanford: Pacific Northwest National Laboratory	12.225	-10%	▼	494	-4%	▼	0.025	-6%	▼	–	–	–
Idaho	86.799	9%	▲	1,373	16%	▲	0.063	-6%	▼	1%	**88%**	▲
Kansas City National Security Campus	0.428	–	–	58	–	–	0.007	–	–	–	–	–
Lawrence Berkeley National Laboratory	1.014	-19%	▼	22	22%	▲	0.046	-34%	▼	–	–	–
Lawrence Livermore National Laboratory	8.691	22%	▲	145	26%	▲	0.060	-3%	▼	14%	-51%	▼
Los Alamos National Laboratory	**207.051**	29%	▲	1,953	6%	▲	0.106	22%	▲	28%	20%	▲
National Renewable Energy Laboratory	0.006	–	–	1	–	–	0.006	–	–	–	–	–
Nevada National Security Site	3.893	1%	▲	74	-21%	▼	0.053	**28%**	▲	–	–	–
Oak Ridge: East Tennessee Technology Park	0.147	–	–	18	–	–	0.008	–	–	–	–	–
Oak Ridge: Oak Ridge Institute for Science and Education	0.317	–	–	20	–	–	0.016	–	–	–	–	–
Oak Ridge: Oak Ridge National Laboratory	76.833	-12%	▼	615	-7%	▼	0.125	-6%	▼	34%	4%	▲
Oak Ridge: Y-12 National Security Complex	65.917	-13%	▼	1,524	4%	▲	0.043	-17%	▼	1%	-56%	▼
Office of Secure Transportation	0.288	–	–	14	–	–	0.021	–	–	–	–	–
Paducah Gaseous Diffusion Plant	4.593	-11%	▼	110	-4%	▼	0.043	-8%	▼	–	–	–
Pantex Plant	22.927	-8%	▼	312	-6%	▼	0.073	-2%	▼	8%	1%	▲
Portsmouth Gaseous Diffusion Plant	3.588	41%	▲	69	68%	▲	0.052	-16%	▼	–	–	–
Princeton Plasma Physics Laboratory	0.239	–	–	38	–	–	0.006	–	–	–	–	–
Sandia National Laboratories	5.819	**171%**	▲	175	**140%**	▲	0.033	13%	▲	–	–	–
Savannah River National Lab	8.463	-58%	▼	314	-45%	▼	0.027	-23%	▼	–	–	–
Savannah River Site	126.869	-17%	▼	**4,101**	7%	▲	0.031	-22%	▼	–	–	–
Separations Process Research Unit	0.208	–	–	10	–	–	0.021	–	–	–	–	–
SLAC National Accelerator Laboratory	0.047	–	–	3	–	–	0.016	–	–	–	–	–
Thomas Jefferson National Accelerator Facility	0.526	–	–	26	–	–	0.020	–	–	–	–	–
Uranium Mill Tailings Remedial Action Project	5.485	-3%	▼	77	17%	▲	0.071	-17%	▼	–	–	–
Waste Isolation Pilot Plant	0.909	–	–	42	–	–	0.022	–	–	–	–	–
West Valley Demonstration Project	35.549	6%	▲	160	4%	▲	**0.222**	2%	▲	**48%**	21%	▲
Service Center Personnel*	0.149	–	–	4	–	–	0.037	–	–	–	–	–
Totals	**753.322**	**-1%**	▼	**13,335**	**2%**	▲	**0.056**	**-4%**	▼	**15%**	**13%**	▲

Note: Boxed values (gray background) indicate the greatest value in each column.

* Includes personnel at NNSA Albuquerque complex, Oak Ridge, and WIPP, in addition to several smaller facilities not associated with a DOE site.

DOE Occupational Radiation Exposure Report for CY 2020

Exhibit B-2. Site Dose Data, CY 2019.

Site	Collective TED (person–rem)	Percent Change – Coll. TED		Number with Meas. Dose	Percent Change – # with Meas. Dose		Avg. Meas. TED (rem)	Percent Change – Avg. Meas. TED		Percentage of Coll. TED above 0.500 rem	Percent Change – Coll. TED above 0.500 rem	
Ames Laboratory	0.837	–	–	31	–	–	0.027	–	–	–	–	–
Argonne National Laboratory	8.650	21%	▲	83	8%	▲	0.104	12%	▲	**39%**	52%	▲
Brookhaven National Laboratory	3.191	–18.6%	▼	137	10%	▲	0.002	–25.8%	▼	–	–	–
Energy Technology Engineering Center	0.009	–	–	2	–	–	0.005	–	–	–	–	–
Fermi National Accelerator Laboratory	7.060	–29%	▼	154	–18%	▼	0.045	–13.6%	▼	–	–	–
Grand Junction Site	0.041	–	–	13	–	–	0.003	–	–	–	–	–
Hanford: Hanford Site	32.673	21%	▲	822	**45%**	▲	0.040	4%	▲	3%	–81.3%	▼
Hanford: Office of River Protection	24.153	–3.1%	▼	671	18%	▲	0.035	4%	▲	–	–	–
Hanford: Pacific Northwest National Laboratory	9.717	–20.5%	▼	446	–9.7%	▼	0.021	2%	▲	–	–	–
Idaho	76.511	–11.8%	▼	1,203	–12%	▼	0.063	6%	▲	3%	**129%**	▲
Kansas City National Security Campus	0.364	–	–	66	–	–	0.005	–	–	–	–	–
Lawrence Berkeley National Laboratory	1.810	78%	▲	23	5%	▲	0.078	**71%**	▲	–	–	–
Lawrence Livermore National Laboratory	11.003	27%	▲	153	6%	▲	0.072	20%	▲	14%	–3%	▼
Los Alamos National Laboratory	**224.472**	8%	▲	1,983	2%	▲	0.113	7%	▲	31%	9%	▲
National Renewable Energy Laboratory	0.001	–	–	1	–	–	0.001	–	–	–	–	–
Nevada National Security Site	1.940	–50.1%	▼	50	–32%	▼	0.039	–26%	▼	–	–	–
Oak Ridge: East Tennessee Technology Park	0.186	–	–	19	–	–	0.010	–	–	–	–	–
Oak Ridge: Oak Ridge Institute for Science and Education	0.237	–	–	22	–	–	0.011	–	–	–	–	–
Oak Ridge: Oak Ridge National Laboratory	70.245	–9%	▼	539	–12%	▼	0.130	4%	▲	29%	–12%	▼
Oak Ridge: Y–12 National Security Complex	61.751	–6%	▼	1,665	9%	▲	0.037	–14%	▼	–	–	–
Office of Secure Transportation	0.448	–	–	13	–	–	0.034	–	–	–	–	–
Paducah Gaseous Diffusion Plant	5.554	21%	▲	100	–9%	▼	0.055	33%	▲	–	–	–
Pantex Plant	24.248	6%	▲	758	1%	▲	0.032	–56%	▼	–	–	–
Portsmouth Gaseous Diffusion Plant	4.289	20%	▲	71	3%	▲	0.060	16%	▲	–	–	–
Princeton Plasma Physics Laboratory	0.391	–	–	72	–	–	0.005	–	–	–	–	–
Sandia National Laboratories	5.323	–8.5%	▼	154	–12%	▼	0.035	4%	▲	–	–	–
Savannah River National Lab	16.631	97%	▲	547	74%	▲	0.030	13%	▲	4%	–	–
Savannah River Site	126.763	–1%	▼	**3,651**	–10.9%	▼	0.035	12%	▲	1%	–	–
Separations Process Research Unit	0.029	–	–	2	–	–	0.015	–	–	–	–	–
SLAC National Accelerator Laboratory	0.206	–	–	11	–	–	0.019	–	–	–	–	–
Thomas Jefferson National Accelerator Facility	1.266	**141%**	▲	52	**100%**	▲	0.024	20%	▲	–	–	–
Uranium Mill Tailings Remedial Action Project	9.748	78%	▲	95	23%	▲	0.103	44%	▲	–	–	–
Waste Isolation Pilot Plant	1.113	22%	▲	54	29%	▲	0.021	–4%	▼	–	–	–
West Valley Demonstration Project	20.459	–42%	▼	139	–13%	▼	**0.147**	–33.7%	▼	11%	–76%	▼
Service Center Personnel*	0.996	–	–	22	–	–	0.045	–	–	–	–	–
Totals	**752.315**	**0%**	–	**13,824**	**4%**	▲	**0.054**	**–3.65%**	▼	**14%**	**–9%**	▼

Note: Boxed values (gray background) indicate the greatest value in each column.

* Includes personnel at NNSA Albuquerque complex, Oak Ridge, and WIPP, in addition to several smaller facilities not associated with a DOE site.

DOE Occupational Radiation Exposure Report for CY 2020

Exhibit B-3. Site Dose Data, CY 2020.

Site	Collective TED (person–rem)	Percent Change – Coll. TED		Number with Meas. Dose	Percent Change – # with Meas. Dose		Avg. Meas. TED (rem)	Percent Change – Avg. Meas. TED		Percentage of Coll. TED above 0.500 rem	Percent Change – Coll. TED above 0.500 rem	
Ames Laboratory	0.777	–	–	30	–	–	0.026	–	–	–	–	–
Argonne National Laboratory	4.609	–47%	▼	65	–22%	▼	0.071	–32%	▼	–	–	–
Brookhaven National Laboratory	1.161	–64%	▼	111	–19%	▼	0.010	–55%	▼	–	–	–
Energy Technology Engineering Center	0.045	–	–	8	–	–	0.006	–	–	–	–	–
Fermi National Accelerator Laboratory	7.850	11%	▲	168	9%	▲	0.047	2%	▲	6%	–	–
Grand Junction Site	0.043	–	–	14	–	–	0.003	–	–	–	–	–
Hanford: Hanford Site	9.797	–70%	▼	485	–41%	▼	0.020	–49%	▼	–	–	–
Hanford: Office of River Protection	13.291	–45%	▼	461	–31%	▼	0.029	–20%	▼	–	–	–
Hanford: Pacific Northwest National Laboratory	8.523	–12%	▼	408	–9%	▼	0.021	–4%	▼	–	–	–
Idaho	80.518	5%	▲	1,664	38%	▲	0.048	–24%	▼	4%	**47%**	▲
Kansas City National Security Campus	0.493	–	–	93	–	–	0.005	–	–	–	–	–
Lawrence Berkeley National Laboratory	0.834	–	–	14	–	–	0.060	–	–	–	–	–
Lawrence Livermore National Laboratory	7.494	–32%	▼	128	–16%	▼	0.059	–19%	▼	14%	5%	▲
Los Alamos National Laboratory	**232.736**	4%	▲	2,523	27%	▲	0.092	–19%	▼	25%	–21%	▼
National Renewable Energy Laboratory	0.030	–	–	4	–	–	0.008	–	–	–	–	–
Nevada National Security Site	1.800	–7%	▼	72	44%	▲	0.025	–36%	▼	–	–	–
Oak Ridge: East Tennessee Technology Park	0.751	–	–	102	–	–	0.007	–	–	–	–	–
Oak Ridge: Oak Ridge Institute for Science and Education	0.000	–	–	-	-	–	0.000	–	–	–	–	–
Oak Ridge: Oak Ridge National Laboratory	47.666	–32%	▼	610	13%	▲	0.078	–40%	▼	**24%**	–19%	▼
Oak Ridge: Y–12 National Security Complex	58.768	–5%	▼	1,409	–15%	▼	0.042	12%	▲	–	–	–
Office of Secure Transportation	0.025	–	–	2	–	–	0.012	–	–	–	–	–
Paducah Gaseous Diffusion Plant	2.654	–52%	▼	116	16%	▲	0.023	–59%	▼	–	–	–
Pantex Plant	113.909	**370%**	▲	3,563	**370%**	▲	0.032	6%	▲	–	–	–
Portsmouth Gaseous Diffusion Plant	3.712	–13%	▼	139	96%	▲	0.027	–56%	▼	–	–	–
Princeton Plasma Physics Laboratory	0.234	–	–	54	–	–	0.004	–	–	–	–	–
Sandia National Laboratories	3.287	–38%	▼	89	–42%	▼	0.037	7%	▲	–	–	–
Savannah River National Lab	11.717	–30%	▼	445	–19%	▼	0.026	–13%	▼	–	–	–
Savannah River Site	112.247	–11%	▼	**4,220**	16%	▲	0.027	–23%	▼	–	–	–
Separations Process Research Unit	0.000	–	–	-	–	–	0.000	–	–	–	–	–
SLAC National Accelerator Laboratory	0.146	–	–	2	–	–	0.073	–	–	–	–	–
Thomas Jefferson National Accelerator Facility	0.607	–	–	22	–	–	0.028	–	–	–	–	–
Uranium Mill Tailings Remedial Action Project	12.004	23%	▲	95	–	–	**0.126**	23%	▲	18%	–	–
Waste Isolation Pilot Plant	1.130	2%	▲	67	24%	▲	0.017	–18%	▼	–	–	–
West Valley Demonstration Project	8.868	–57%	▼	112	–19%	▼	0.079	–46%	▼	–	–	–
Service Center Personnel*	3.116	211%	▲	34	45%	▲	0.107	**114%**	▲	–	–	–
Totals	**750.842**	**–1%**	▼	**17,329**	**25%**	▲	**0.043**	**–20%**	▼	**10%**	**–26%**	▼

Note: Boxed values (gray background) indicate the greatest value in each column.

* Includes personnel at NETL, NNSA Albuquerque complex, Oak Ridge, and WIPP, in addition to several smaller facilities not associated with a DOE site.

DOE Occupational Radiation Exposure Report for CY 2020

Exhibit B-4. Internal Dose by Site, CY 2018–2020.

Site	No. of Individuals with Measurable CED* 2018	No. of Individuals with Measurable CED* 2019	No. of Individuals with Measurable CED* 2020	Collective CED Dose (person–rem) 2018	Collective CED Dose (person–rem) 2019	Collective CED Dose (person–rem) 2020	Average Measurable CED 2018	Average Measurable CED 2019	Average Measurable CED 2020
Argonne National Laboratory	2	–	–	0.062	–	–	0.031	–	–
Hanford: Hanford Site	–	2	–	–	0.003	–	–	0.002	–
Hanford: Pacific Northwest National Laboratory	4	4	1	0.007	0.006	0.014	0.002	0.002	0.014
Idaho	2	2	3	0.171	0.093	0.037	0.086	0.047	0.012
Lawrence Livermore National Laboratory	3	2	1	0.045	0.115	0.056	0.015	0.058	0.056
Los Alamos National Laboratory	15	22	26	3.649	0.081	2.640	**0.243** ◀	0.004	**0.102** ◀
Oak Ridge: Oak Ridge National Laboratory	3	1	–	0.045	0.010	–	0.015	0.010	–
Oak Ridge: Y–12 National Security Complex	**1,273** ◀	**1,313** ◀	**1,202** ◀	**54.619** ◀	**48.104** ◀	**50.821** ◀	0.043	0.037	0.042
Paducah Gaseous Diffusion Plant	5	3	5	0.089	0.044	0.096	0.018	0.015	0.019
Pantex Plant	–	–	–	–	–	–	–	–	–
Sandia National Laboratories	7	10	8	0.034	0.036	0.051	0.005	0.004	0.006
Savannah River Site	2	2	9	0.007	0.007	0.034	0.004	0.004	0.004
Uranium Mill Tailings Remedial Action Project	29	51	48	0.828	2.179	2.329	0.029	0.043	0.049
Service Center Personnel**	–	1	–	–	0.083	–	–	**0.083** ◀	–
Totals	**1,345**	**1,413**	**1,303**	**59.556**	**50.761**	**56.078**	**0.044**	**0.036**	**0.043**

Note: Boxed values (gray background) indicate the greatest value in each column.

* The number of internal depositions represents the number of internal dose records with positive results reported for each individual.

** Includes personnel at NETL, NNSA Albuquerque complex, Oak Ridge, and WIPP, in addition to several smaller facilities not associated with a DOE site.

DOE Occupational Radiation Exposure Report for CY 2020

Exhibit B-5. Neutron Dose Distribution by Site, CY 2020.

Site	No. Meas. Dose	Meas. < 0.100	0.100–0.250	0.250–0.500	0.500–0.750	0.750–1.00	1.0–2.0	>2.0	Total Monitored *	No. of Individuals with Meas. Dose	% of Individuals with Meas. Dose	Collective Neutron Dose (person–rem)	Avg. Meas. Neutron Dose (rem)
Ames Laboratory	126	–	–	–	–	–	–	–	126	–	–	–	–
Argonne National Laboratory	1,529	–	–	–	–	–	–	–	1,529	–	–	–	–
Brookhaven National Laboratory	1,845	–	–	–	–	–	–	–	1,845	–	–	–	–
Energy Technology Engineering Center	11	–	–	–	–	–	–	–	11	–	–	–	–
Fermi National Accelerator Laboratory	1,268	–	–	–	–	–	–	–	1,268	–	–	–	–
Grand Junction Site	22	–	–	–	–	–	–	–	22	–	–	–	–
Hanford: Hanford Site	3,220	223	–	–	–	–	–	–	3,443	223	6%	2.218	0.010
Hanford: Office of River Protection	2,776	20	–	–	–	–	–	–	2,796	20	1%	0.428	0.021
Hanford: Pacific Northwest National Laboratory	1,935	–	–	–	–	–	–	–	1,935	–	–	–	–
Idaho	5,322	74	1	–	–	–	–	–	5,397	75	1%	2.100	0.028
Kansas City Security Campus	238	1	–	–	–	–	–	–	239	1	0%	0.020	0.020
Lawrence Berkeley National Laboratory	785	–	–	–	–	–	–	–	785	–	–	–	–
Lawrence Livermore National Laboratory	3,340	46	2	5	–	–	–	–	3,393	53	2%	3.033	0.057
Los Alamos National Laboratory	7,771	1,383	226	83	17	3	4	–	**9,487** ◀	**1,716** ◀	**18%** ◀	**113.91** ◀	0.066
National Renewable Energy Laboratory	7	–	–	–	–	–	–	–	7	–	–	–	–
Nevada National Security Site	753	–	–	–	–	–	–	–	753	–	–	–	–
Oak Ridge: East Tennessee Technology Park	407	1	–	–	–	–	–	–	408	1	0%	0.030	0.030
Oak Ridge: Oak Ridge Institute for Science and Education	60	–	–	–	–	–	–	–	60	–	–	–	–
Oak Ridge: Oak Ridge National Laboratory	3,770	93	23	4	–	–	–	–	3,890	120	3%	8.336	**0.069** ◀
Oak Ridge: Y–12 National Security Complex	5,702	5	1	–	–	–	–	–	5,708	6	0%	0.295	0.049
Office of Secure Transportation	327	–	–	–	–	–	–	–	327	–	–	–	–
Paducah Gaseous Diffusion Plant	1,388	–	–	–	–	–	–	–	1,388	–	–	–	–
Pantex Plant	3,361	438	9	–	–	–	–	–	3,808	447	12%	15.295	0.034
Portsmouth Gaseous Diffusion Plant	2,151	4	–	–	–	–	–	–	2,155	4	0%	0.063	0.016
Princeton Plasma Physics Laboratory	352	–	–	–	–	–	–	–	352	–	–	–	–
Sandia National Laboratories	1,881	5	–	–	–	–	–	–	1,886	5	0%	0.113	0.023
Savannah River National Lab	618	14	–	–	–	–	–	–	632	14	2%	0.490	0.035
Savannah River Site	6,001	466	10	–	–	–	–	–	6,477	476	7%	18.807	0.040
Separations Process Research Unit	11	–	–	–	–	–	–	–	11	–	–	–	–
SLAC National Accelerator Facility	2,055	–	–	–	–	–	–	–	2,055	–	–	–	–
Thomas Jefferson National Accelerator Facility	1,322	–	–	–	–	–	–	–	1,322	–	–	–	–
Uranium Mill Tailings Remediation Action Project	135	–	–	–	–	–	–	–	135	–	–	–	–
Waste Isolation Pilot Plant	398	–	–	–	–	–	–	–	398	–	–	–	–
West Valley Project	361	–	–	–	–	–	–	–	361	–	–	–	–
Service Center Personnel**	279	–	–	–	–	–	–	–	279	–	–	–	–
Totals	**61,527**	**2,773**	**272**	**92**	**17**	**3**	**4**	–	**64,688**	**3,161**	**5%**	**165.138**	**0.052**

Note: Boxed values (gray background) indicate the greatest value in each column.

*Represents the total number of monitoring records. The number of individuals specifically monitored for neutron radiation cannot be determined.

**Includes personnel at NETL, NNSA Albuquerque complex, Oak Ridge, and WIPP, in addition to several smaller facilities not associated with a DOE site.

DOE Occupational Radiation Exposure Report for CY 2020

Exhibit B-6a. Distribution of TED by Facility Type, CY 2018.

TOTAL EFFECTIVE DOSE (TED)

Number of Individuals Receiving Radiation Doses in Each Dose Range (rem)

Facility Type	Less than Meas.	Meas. to 0.100	0.100–0.250	0.250–0.500	0.500–0.750	0.750–1.000	1.0–2.0	2.0–3.0	3.0–4.0	4.0–5.0	>5.0	Total Monitored	Percent of Monitored with Meas. TED	No. with Meas. TED	Collective TED (Person-rem)	Avg. Meas. TED (rem)
Accelerator	9,398	417	67	12	3	–	–	–	–	–	–	9,897	5%	499	26.049	0.052
Fuel Processing	342	436	18	–	–	–	–	–	–	–	–	796	**57%** ◀	454	12.000	0.026
Fuel/Uranium Enrichment	341	18	–	–	–	–	–	–	–	–	–	359	5%	18	0.147	0.008
Maintenance and Support	5,880	831	91	23	2	–	–	–	–	–	–	6,827	14%	947	42.329	0.045
Other	5,504	807	56	21	7	1	–	–	–	–	–	6,396	14%	892	36.662	0.041
Reactor	84	17	4	–	–	–	–	–	–	–	–	105	20%	21	1.163	0.055
Research, Fusion	377	46	–	–	–	–	–	–	–	–	–	423	11%	46	0.507	0.011
Research, General	25,405	3,417	376	132	17	15	1	–	–	–	–	**29,363** ◀	13%	**3,958** ◀	213.352	0.054
Waste Processing/Management	3,846	2,965	295	95	30	6	–	–	–	–	–	7,237	47%	3,391	177.419	0.052
Weapons Fabrication and Testing	11,122	2,464	429	146	38	17	14	–	1	–	–	14,231	22%	3,109	**243.694** ◀	**0.078** ◀
Totals	**62,299**	**11,418**	**1,336**	**429**	**97**	**39**	**15**	**–**	**1**	**–**	**–**	**75,634**	**18%**	**13,335**	**753.322**	**0.056**

Note: Boxed values (gray background) indicate the greatest value in each column.

DOE Occupational Radiation Exposure Report for CY 2020

Exhibit B-6b. Distribution of TED by Facility Type, CY 2019.

TOTAL EFFECTIVE DOSE (TED)

Number of Individuals Receiving Radiation Doses in Each Dose Range (rem)

Facility Type	Less than Meas.	Meas. to 0.100	0.100–0.250	0.250–0.500	0.500–0.750	0.750–1.000	1.0–2.0	2.0–3.0	3.0–4.0	4.0–5.0	>5.0	Total Monitored	Percent of Monitored with Meas. TED	No. with Meas. TED	Collective TED (Person-rem)	Avg. Meas. TED (rem)
Accelerator	7,863	431	45	11	1	–	–	–	–	–	–	8,351	6%	488	20.840	0.043
Fuel Processing	417	402	11	2	–	–	–	–	–	–	–	832	**50%** ◀	415	11.189	0.027
Fuel/Uranium Enrichment	2,823	79	10	1	–	–	–	–	–	–	–	2,913	3%	90	4.475	0.050
Maintenance and Support	5,446	977	78	16	–	–	–	–	–	–	–	6,517	16%	1,071	41.174	0.038
Other	5,273	788	65	14	2	–	–	–	–	–	–	6,142	14%	869	33.154	0.038
Reactor	127	23	5	1	–	–	–	–	–	–	–	156	19%	29	1.593	0.055
Research, Fusion	345	77	–	–	–	–	–	–	–	–	–	422	18%	77	0.467	0.006
Research, General	24,392	3,089	361	100	24	14	4	–	–	–	–	**27,984** ◀	13%	3,592	200.307	0.056
Waste Processing/Management	4,417	2,996	347	122	6			–	–	–	–	7,888	44%	3,471	174.997	0.050
Weapons Fabrication and Testing	11,216	3,084	389	157	57	28	7	–	–	–	–	14,938	25%	**3,722** ◀	**264.119** ◀	**0.071** ◀
Totals	**62,319**	**11,946**	**1,311**	**424**	**90**	**42**	**11**	**–**	**–**	**–**	**–**	**76,143**	**18%**	**13,824**	**752.315**	**0.054**

Note: Boxed values (gray background) indicate the greatest value in each column.

DOE Occupational Radiation Exposure Report for CY 2020

Exhibit B-6c. Distribution of TED by Facility Type, CY 2020.

TOTAL EFFECTIVE DOSE (TED)

Number of Individuals Receiving Radiation Doses in Each Dose Range (rem)

Facility Type	Less than Meas.	Meas. to 0.100	0.100–0.250	0.250–0.500	0.500–0.750	0.750–1.000	1.0–2.0	2.0–3.0	3.0–4.0	4.0–5.0	>5.0	Total Monitored	Percent of Monitored with Meas. TED	No. with Meas. TED	Collective TED (Person-rem)	Avg. Meas. TED (rem)
Accelerator	6,785	386	34	7	1	–	–	–	–	–	–	7,213	6%	428	16.819	0.039
Fuel Processing	238	385	9	1	–	–	–	–	–	–	–	633	**62%**	395	11.052	0.028
Fuel/Uranium Enrichment	2,322	240	1	–	–	–	–	–	–	–	–	2,563	9%	241	4.463	0.019
Maintenance and Support	5,008	889	25	3	–	–	–	–	–	–	–	5,925	15%	917	23.633	0.026
Other	3,920	722	38	3	1	–	–	–	–	–	–	4,684	16%	764	23.608	0.031
Reactor	115	10	2	–	–	–	–	–	–	–	–	127	9%	12	0.497	0.041
Research, Fusion	366	54	–	1	–	–	–	–	–	–	–	421	13%	55	0.497	0.009
Research, General	17,882	3,813	317	92	15	4	3	–	–	–	–	**22,126**	19%	4,244	189.998	0.045
Waste Processing/Management	4,266	3,635	164	46	5	–	–	–	–	–	–	8,116	47%	3,850	129.690	0.034
Weapons Fabrication and Testing	6,457	5,626	565	160	45	18	8	–	1	–	–	12,880	50%	**6,423**	**350.585**	**0.055**
Totals	**47,359**	**15,760**	**1,155**	**313**	**67**	**22**	**11**	–	**1**	**–**	**–**	**64,688**	**27%**	**17,329**	**750.842**	**0.043**

Note: Boxed values (gray background) indicate the greatest value in each column.

DOE Occupational Radiation Exposure Report for CY 2020

Exhibit B-7a. Collective TED by Site and Facility Type, CY 2018.

Site	Accelerator	Fuel/Uranium Enrichment	Fuel Processing	Maintenance and Support	Reactor	Research, General	Research, Fusion	Waste Processing/ Management	Weapons Fabrication and Testing	Other	Totals
Ames Laboratory	–	–	–	–	–	0.935	–	–	–	–	0.935
Argonne National Laboratory	–	–	–	–	–	7.174	–	–	–	–	7.174
Brookhaven National Laboratory	3.372	–	–	0.454	–	–	–	0.098	–	–	3.924
Energy Technology Engineering Center	–	–	–	–	–	0.059	–	–	–	–	0.059
Fermi National Accelerator Laboratory	9.980	–	–	–	–	–	–	–	–	–	9.980
Grand Junction Site	–	–	–	–	–	–	–	–	–	0.336	0.336
Hanford: Hanford Site	–	–	–	**18.863**	–	–	–	–	–	8.145	27.008
Hanford: Office of River Protection	–	–	–	–	–	–	–	12.931	–	**11.995**	24.926
Hanford: Pacific Northwest National Laboratory	–	–	–	–	–	12.225	–	–	–	–	12.225
Idaho	–	–	–	–	–	**86.799**	–	–	–	–	86.799
Kansas City National Security Campus	–	–	–	–	–	–	–	–	0.428	–	0.428
Lawrence Berkeley National Laboratory	–	–	–	–	–	1.014	–	–	–	–	1.014
Lawrence Livermore National Laboratory	–	–	–	1.286	–	7.405	–	–	–	–	8.691
Los Alamos National Laboratory	**11.149**	–	–	7.169	–	26.627	–	3.230	**150.241**	8.635	**207.051**
National Renewable Energy Laboratory	–	–	–	–	–	0.006	–	–	–	–	0.006
Nevada National Security Site	–	–	–	3.893	–	–	–	–	–	–	3.893
Oak Ridge: East Tennessee Technology Park	–	**0.147**	–	–	–	–	–	–	–	–	0.147
Oak Ridge: Oak Ridge Institute for Science and Education	–	–	–	–	–	0.317	–	–	–	–	0.317
Oak Ridge: Oak Ridge National Laboratory	–	–	–	–	–	48.647	–	28.186	–	–	76.833
Oak Ridge: Y-12 National Security Complex	–	–	–	–	–	–	–	–	65.917	–	65.917
Office of Secure Transportation	–	–	–	–	–	–	–	–	0.260	0.028	0.288
Paducah Gaseous Diffusion Plant	–	–	–	0.051	–	0.100	–	4.442	–	–	4.593
Pantex Plant	–	–	–	–	–	–	–	–	22.927	–	22.927
Portsmouth Gaseous Diffusion Plant	–	–	–	–	–	3.588	–	–	–	–	3.588
Princeton Plasma Physics Laboratory	–	–	–	–	–	–	0.239	–	–	–	0.239
Sandia National Laboratories	0.975	–	–	0.627	**1.163**	1.437	**0.268**	0.541	0.132	0.676	5.819
Savannah River National Laboratory	–	–	0.027	1.007	–	7.117	–	0.156	0.040	0.116	8.463
Savannah River Site	–	–	**11.973**	8.979	–	9.753	–	**85.684**	3.749	6.731	126.869
Separations Process Research Unit	–	–	–	–	–	–	–	0.208	–	–	0.208
SLAC National Accelerator Laboratory	0.047	–	–	–	–	–	–	–	–	–	0.047
Thomas Jefferson National Accelerator Facility	0.526	–	–	–	–	–	–	–	–	–	0.526
Uranium Mill Tailings Remedial Action Project	–	–	–	–	–	–	–	5.485	–	–	5.485
Waste Isolation Pilot Plant	–	–	–	–	–	–	–	0.909	–	–	0.909
West Valley Demonstration Project	–	–	–	–	–	–	–	35.549	–	–	35.549
Service Center Personnel*	–	–	–	–	–	0.149	–	–	–	–	0.149
Totals	**26.049**	**0.147**	**12.000**	**42.329**	**1.163**	**213.352**	**0.507**	**177.419**	**243.694**	**36.662**	**753.322**

Note: Boxed values (gray background) indicate the greatest value in each column.

* Includes personnel at NNSA Albuquerque complex, Oak Ridge, and WIPP.

DOE Occupational Radiation Exposure Report for CY 2020

Exhibit B-7b. Collective TED by Site and Facility Type, CY 2019.

Site	Accelerator	Fuel/Uranium Enrichment	Fuel Processing	Maintenance and Support	Reactor	Research, General	Research, Fusion	Waste Processing/ Management	Weapons Fabrication and Testing	Other	Totals
Ames Laboratory	–	–	–	–	–	0.837	–	–	–	–	0.837
Argonne National Laboratory	–	–	–	–	–	8.650	–	–	–	–	8.650
Brookhaven National Laboratory	2.720	–	–	0.392	–	–	–	0.079	–	–	3.191
Energy Technology Engineering Center	–	–	–	–	–	0.009	–	–	–	–	0.009
Fermi National Accelerator Laboratory	7.060	–	–	–	–	–	–	–	–	–	7.060
Grand Junction Site	–	–	–	–	–	–	–	–	–	0.041	0.041
Hanford: Hanford Site	–	–	–	**20.406**	–	–	–	–	–	**12.267**	32.673
Hanford: Office of River Protection	–	–	–	–	–	–	–	15.045	–	9.108	24.153
Hanford: Pacific Northwest National Laboratory	–	–	–	–	–	9.717	–	–	–	–	9.717
Idaho	–	–	–	–	–	**76.511**	–	–	–	–	76.511
Kansas City National Security Campus	–	–	–	–	–	–	–	–	0.364	–	0.364
Lawrence Berkeley National Laboratory	–	–	–	–	–	1.810	–	–	–	–	1.810
Lawrence Livermore National Laboratory	–	–	–	1.573	–	9.430	–	–	–	–	11.003
Los Alamos National Laboratory	**8.749**	–	–	6.245	–	24.333	–	4.278	**174.284**	6.583	**224.472**
National Renewable Energy Laboratory	–	–	–	–	–	0.001	–	–	–	–	0.001
Nevada National Security Site	–	–	–	1.940	–	–	–	–	–	–	1.940
Oak Ridge: East Tennessee Technology Park	–	0.186	–	–	–	–	–	–	–	–	0.186
Oak Ridge: Oak Ridge Institute for Science and Education	–	–	–	–	–	0.237	–	–	–	–	0.237
Oak Ridge: Oak Ridge National Laboratory	–	–	–	–	–	52.789	–	17.456	–	–	70.245
Oak Ridge: Y-12 National Security Complex	–	–	–	–	–	–	–	–	61.751	–	61.751
Office of Secure Transportation	–	–	–	–	–	–	–	–	0.448	–	0.448
Paducah Gaseous Diffusion Plant	–	–	–	–	–	0.044	–	5.510	–	–	5.554
Pantex Plant	–	–	–	–	–	–	–	–	24.248	–	24.248
Portsmouth Gaseous Diffusion Plant	–	**4.289**	–	–	–	–	–	–	–	–	4.289
Princeton Plasma Physics Laboratory	–	–	–	–	–	–	**0.391**	–	–	–	0.391
Sandia National Laboratories	0.839	–	–	0.224	**1.593**	1.014	0.076	0.124	0.636	0.817	5.323
Savannah River National Laboratory	–	–	0.005	4.609		11.543		0.385	0.024	0.065	16.631
Savannah River Site	–	–	**11.184**	5.762	–	3.382	–	**100.757**	2.364	3.314	126.763
Separations Process Research Unit	–	–	–	–	–	–	–	0.029	–	–	0.029
SLAC National Accelerator Laboratory	0.206	–	–	–	–	–	–	–	–	–	0.996
Thomas Jefferson National Accelerator Facility	1.266	–	–	–	–	–	–	–	–	–	0.206
Uranium Mill Tailings Remedial Action Project	–	–	–	–	–	–	–	9.748	–	–	1.266
Waste Isolation Pilot Plant	–	–	–	–	–	–	–	1.113	–	–	9.748
West Valley Demonstration Project	–	–	–	–	–	–	–	20.459	–	–	1.113
Service Center Personnel*	–	–	–	0.023	–	–	–	0.014	–	0.959	20.459
Totals	**20.840**	**4.475**	**11.189**	**41.174**	**1.593**	**200.307**	**0.467**	**174.997**	**264.119**	**33.154**	**752.315**

Note: Boxed values (gray background) indicate the greatest value in each column.

* Includes personnel at NNSA Albuquerque complex, Oak Ridge, and WIPP.

DOE Occupational Radiation Exposure Report for CY 2020

Exhibit B-7c. Collective TED by Site and Facility Type, CY 2020.

Site	Accelerator	Fuel/Uranium Enrichment	Fuel Processing	Maintenance and Support	Reactor	Research, General	Research, Fusion	Waste Processing/ Management	Weapons Fabrication and Testing	Other	Totals
Ames Laboratory	–	–	–	–	–	0.777	–	–	–	–	0.777
Argonne National Laboratory	0.246	–	–	0.383	–	2.047	–	1.851	–	0.082	4.609
Brookhaven National Laboratory	0.806	–	–	0.282	–	–	–	0.073	–	–	1.161
Energy Technology Engineering Center	–	–	–	–	–	0.045	–	–	–	–	0.045
Fermi National Accelerator Laboratory	**7.850**	–	–	–	–	–	–	–	–	–	7.850
Grand Junction Site	–	–	–	–	–	–	–	–	–	0.043	0.043
Hanford: Hanford Site	–	–	–	**8.071**	–	–	–	–	–	1.726	9.797
Hanford: Office of River Protection	–	–	–	0.015	–	–	–	8.099	–	5.177	13.291
Hanford: Pacific Northwest National Laboratory	–	–	–	–	–	8.523	–	–	–	–	8.523
Idaho	–	–	–	–	–	**80.518**	–	–	–	–	80.518
Kansas City National Security Campus	–	–	–	–	–	–	–	–	0.493	–	0.493
Lawrence Berkeley National Laboratory	–	–	–	–	–	0.834	–	–	–	–	0.834
Lawrence Livermore National Laboratory	–	–	–	0.608	–	6.886	–	–	–	–	7.494
Los Alamos National Laboratory	6.819	–	–	4.231	–	31.775	–	6.981	**175.509**	**7.421**	**232.736**
National Renewable Energy Laboratory	–	–	–	–	–	0.030	–	–	–	–	0.030
Nevada National Security Site	–	–	–	1.800	–	–	–	–	–	–	1.800
Oak Ridge: East Tennessee Technology Park	–	0.751	–	–	–	–	–	–	–	–	0.751
Oak Ridge: Oak Ridge Institute for Science and Education	–	–	–	–	–	–	–	–	–	–	–
Oak Ridge: Oak Ridge National Laboratory	–	–	–	–	–	45.162	–	2.504	–	–	47.666
Oak Ridge: Y-12 National Security Complex	–	–	–	–	–	–	–	–	58.768	–	58.768
Office of Secure Transportation	–	–	–	–	–	–	–	–	0.014	0.011	0.025
Paducah Gaseous Diffusion Plant	–	–	–	0.011	–	0.096	–	2.547	–	–	2.654
Pantex Plant	–	–	–	0.100	–	–	–	–	113.809	–	113.909
Portsmouth Gaseous Diffusion Plant	–	**3.712**	–	–	–	–	–	–	–	–	3.712
Princeton Plasma Physics Laboratory	–	–	–	–	–	–	0.234	–	–	–	0.234
Sandia National Laboratories	0.345	–	–	0.787	**0.497**	0.766	**0.263**	0.271	0.143	0.215	3.287
Savannah River National Laboratory	–	–	0.104	2.575	–	8.679	–	0.169	0.183	113.909	11.717
Savannah River Site	–	–	**10.948**	4.770	–	3.840	–	**85.193**	1.666	5.830	112.247
Separations Process Research Unit	–	–	–	–	–	–	–	–	–	–	–
SLAC National Accelerator Laboratory	0.146	–	–	–	–	–	–	–	–	–	0.146
Thomas Jefferson National Accelerator Facility	0.607	–	–	–	–	–	–	–	–	–	0.607
Uranium Mill Tailings Remedial Action Project	–	–	–	–	–	–	–	12.004	–	–	12.004
Waste Isolation Pilot Plant	–	–	–	–	–	–	–	1.130	–	–	1.130
West Valley Demonstration Project	–	–	–	–	–	–	–	8.868	–	–	8.868
Service Center Personnel*	–	–	–	–	–	0.020	–	–	–	3.096	3.116
Totals	**16.819**	**4.463**	**11.052**	**23.633**	**0.497**	**189.998**	**0.497**	**129.690**	**350.585**	**23.608**	**750.842**

Note: Boxed values (gray background) indicate the greatest value in each column.

* Includes personnel at NETL, NNSA Albuquerque complex, Oak Ridge, and WIPP.

DOE Occupational Radiation Exposure Report for CY 2020

Exhibit B-8. Distribution of TED by Facility Type Listed in Descending Order of Average Measurable TED for Accelerator Facilities, CY 2020.

ACCELERATORS

Number of Individuals Receiving Radiation Doses in Each Dose Range (rem)

Site/Contractor	Less than Meas.	Meas. to 0.100	0.100–0.250	0.250–0.500	0.500–0.750	0.750–1.000	1.0–2.0	2.0–3.0	3.0–4.0	4.0–5.0	>5.0	Total Monitored	Percent of Monitored with Meas. TED	No. with Meas. TED	Collective TED (Person-rem)	Avg. Meas. TED (rem)
Argonne National Laboratory	358	2	1	–	–	–	–	–	–	–	–	361	1%	3	0.246	**0.082**
SLAC National Accelerator Laboratory	2,053	1	1	–	–	–	–	–	–	–	–	**2,055**	0%	2	0.146	0.073
Los Alamos National Laboratory	416	121	14	3	–	–	–	–	–	–	–	554	**25%**	138	6.819	0.049
Fermi National Accelerator Lab	1,100	146	17	4	1	–	–	–	–	–	–	1,268	13%	**168**	**7.850**	0.047
Sandia National Laboratories	409	10	1	–	–	–	–	–	–	–	–	420	3%	11	0.345	0.031
Thomas Jefferson Natl. Accel. Facil.	1,295	22	–	–	–	–	–	–	–	–	–	1,317	2%	22	0.607	0.028
Brookhaven National Laboratory	1,148	84	–	–	–	–	–	–	–	–	–	1,232	7%	84	0.806	0.010
CH2M Hill Plateau Remediation Company (CHPRC)	1	–	–	–	–	–	–	–	–	–	–	1	0%	0	0.000	0.000
Thomas Jefferson Site Office-DOE Employees	5	–	–	–	–	–	–	–	–	–	–	5	0%	0	0.000	0.000
Totals	**6,785**	**386**	**34**	**7**	**1**	**–**	**–**	**–**	**–**	**–**	**–**	**7,213**	**6%**	**428**	**16.819**	**0.039**

Note: Boxed values (gray background) indicate the greatest value in each column.

DOE Occupational Radiation Exposure Report for CY 2020

Exhibit B-9. Distribution of TED by Facility Type Listed in Descending Order of Average Measurable TED for Fuel Facilities, CY 2020.

FUEL FACILITIES

Number of Individuals Receiving Radiation Doses in Each Dose Range (rem)

Site/Contractor	Less than Meas.	Meas. to 0.100	0.100–0.250	0.250–0.500	0.500–0.750	0.750–1.000	1.0–2.0	2.0–3.0	3.0–4.0	4.0–5.0	>5.0	Total Monitored	Percent of Monitored with Meas. TED	No. with Meas. TED	Collective TED (Person-rem)	Avg. Meas. TED (rem)
ENRICHMENT																
Mid-America Conversion Services (MCS)	179	44	1	–	–	–	–	–	–	–	–	224	20%	45	1.660	**0.037**
Fluor/B&W - Portsmouth	1,694	92	–	–	–	–	–	–	–	–	–	**1,786**	5%	92	**2.026**	0.022
Portsmouth Mission Alliance (PMA)	143	2	–	–	–	–	–	–	–	–	–	145	1%	2	0.026	0.013
URS/CH2MHill - Oak Ridge (UCOR): ETTP	306	102	–	–	–	–	–	–	–	–	–	408	**25%**	**102**	0.751	0.007
Totals	**2,322**	**240**	**1**	–	–	–	–	–	–	–	–	**2,563**	**9%**	**241**	**4.463**	**0.019**
PROCESSING																
Savannah River Nuclear Solutions	205	319	8	1	–	–	–	–	–	–	–	**533**	62%	**328**	**9.557**	**0.029**
SRNS Construction	19	43	1	–	–	–	–	–	–	–	–	63	70%	44	1.014	0.023
SRNS Service Subs	4	3	–	–	–	–	–	–	–	–	–	7	43%	3	0.038	0.013
Savannah River National Laboratory	1	3	–	–	–	–	–	–	–	–	–	4	75%	3	0.104	0.035
Savannah River Field Office	4	5	–	–	–	–	–	–	–	–	–	9	56%	5	0.190	0.038
SRS Tritium Facilities	1	1	–	–	–	–	–	–	–	–	–	2	50%	1	0.006	0.006
Centerra Services Inc. - SR	3	11	–	–	–	–	–	–	–	–	–	14	**79%**	11	0.143	0.013
SRR Operations	1	–	–	–	–	–	–	–	–	–	–	1	0%	0	0.000	0.000
Totals	**238**	**385**	**9**	**1**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**633**	**62%**	**395**	**11.052**	**0.028**

Note: Boxed values (gray background) indicate the greatest value in each column.

DOE Occupational Radiation Exposure Report for CY 2020

Exhibit B-10. Distribution of TED by Facility Type Listed in Descending Order of Average Measurable TED for Maintenance and Support, CY 2020.

MAINTENANCE AND SUPPORT

Number of Individuals Receiving Radiation Doses in Each Dose Range (rem)

Site/Contractor	Less than Meas.	Meas. to 0.100	0.100–0.250	0.250–0.500	0.500–0.750	0.750–1.000	1.0–2.0	2.0–3.0	3.0–4.0	4.0–5.0	>5.0	Total Monitored	Percent of Monitored with Meas. TED	No. with Meas. TED	Collective TED (Person–rem)	Avg. Meas. TED (rem)
Savannah River National Laboratory	5	27	10	1	–	–	–	–	–	–	–	43	88%	38	2.575	**0.068**
Argonne National Laboratory	261	7	1	–	–	–	–	–	–	–	–	269	3%	8	0.383	0.048
Sandia National Laboratories	334	19	–	1	–	–	–	–	–	–	–	354	6%	20	0.787	0.039
SRR Operations	1	15	1	–	–	–	–	–	–	–	–	17	94%	16	0.605	0.038
Centerra Services Inc. – SR	1	4	–	–	–	–	–	–	–	–	–	5	80%	4	0.131	0.033
Los Alamos National Laboratory	607	123	4	1	–	–	–	–	–	–	–	735	17%	128	**4.231**	0.033
MSTS – Las Vegas	91	6	–	–	–	–	–	–	–	–	–	97	6%	6	0.198	0.033
Savannah River Nuclear Solutions	53	138	–	–	–	–	–	–	–	–	–	191	72%	138	3.620	0.026
Battelle – Pantex	13	4	–	–	–	–	–	–	–	–	–	17	24%	4	0.100	0.025
MSTS – NTS	503	54	1	–	–	–	–	–	–	–	–	558	10%	55	1.390	0.025
CH2M Hill Plateau Remediation Company (CHPRC)	1,108	252	8	–	–	–	–	–	–	–	–	**1,368**	19%	**260**	6.352	0.024
SRNS Construction	17	11	–	–	–	–	–	–	–	–	–	28	39%	11	0.236	0.021
Lawrence Livermore National Laboratory Nevada	52	32	–	–	–	–	–	–	–	–	–	84	38%	32	0.608	0.019
MSTS – NTS subcontractors	13	11	–	–	–	–	–	–	–	–	–	24	46%	11	0.212	0.019
Washington River Protection Solutions LLC (W	3	1	–	–	–	–	–	–	–	–	–	4	25%	1	0.015	0.015
SRNS Service Subs	4	8	–	–	–	–	–	–	–	–	–	12	67%	8	0.115	0.014
Mission Support Alliance	1,062	145	–	–	–	–	–	–	–	–	–	1,207	12%	145	1.719	0.012
Savannah River Field Office	3	3	–	–	–	–	–	–	–	–	–	6	50%	3	0.036	0.012
Brookhaven National Laboratory	544	25	–	–	–	–	–	–	–	–	–	569	4%	25	0.282	0.011
Swift and Staley Team	226	1	–	–	–	–	–	–	–	–	–	227	0%	1	0.011	0.011
SRR Service Subs	–	2	–	–	–	–	–	–	–	–	–	2	**100%**	2	0.019	0.010
SRNS Construction Subs	1	1	–	–	–	–	–	–	–	–	–	2	50%	1	0.008	0.008
Batelle – PNNL	1	–	–	–	–	–	–	–	–	–	–	1	0%	–	0.000	0.000
DOE Headquarters	11	–	–	–	–	–	–	–	–	–	–	11	0%	-	0.000	0.000
DOE–Richland Field Office	3	–	–	–	–	–	–	–	–	–	–	3	0%	–	0.000	0.000
LLNL Service Subcontractors	1	–	–	–	–	–	–	–	–	–	–	1	0%	-	0.000	0.000
Los Alamos National Lab Construction Subs	6	–	–	–	–	–	–	–	–	–	–	6	0%	-	0.000	0.000
MSTS – Livermore Operations	6	–	–	–	–	–	–	–	–	–	–	6	0%	-	0.000	0.000
MSTS – Los Alamos	2	–	–	–	–	–	–	–	–	–	–	2	0%	–	0.000	0.000
MSTS – Special Tech. Lab	7	–	–	–	–	–	–	–	–	–	–	7	0%	-	0.000	0.000
N3B	5	–	–	–	–	–	–	–	–	–	–	5	0%	-	0.000	0.000
Navarro–Intera LLC	7	–	–	–	–	–	–	–	–	–	–	7	0%	-	0.000	0.000
NNSA Albuquerque Complex	3	–	–	–	–	–	–	–	–	–	–	3	0%	–	0.000	0.000
NNSA Nevada Site Office	42	–	–	–	–	–	–	–	–	–	–	42	0%	-	0.000	0.000
Office of Secure Transportation	1	–	–	–	–	–	–	–	–	–	–	1	0%	-	0.000	0.000
UT–Batelle ORNL	1	–	–	–	–	–	–	–	–	–	–	1	0%	-	0.000	0.000
Wackenhut Services Inc. – NV	10	–	–	–	–	–	–	–	–	–	–	10	0%	-	0.000	0.000
Totals	**5,008**	**889**	**25**	**3**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**5,925**	**15%**	**917**	**23.633**	**0.026**

Note: Boxed values (gray background) indicate the greatest value in each column.

DOE Occupational Radiation Exposure Report for CY 2020

Exhibit B-11. Distribution of TED by Facility Type Listed in Descending Order of Average Measurable TED for Reactor Facilities, CY 2020.

REACTOR FACILITIES

Number of Individuals Receiving Radiation Doses in Each Dose Range (rem)

Site/Contractor	Less than Meas.	Meas. to 0.100	0.100–0.250	0.250–0.500	0.500–0.750	0.750–1.000	1.0–2.0	2.0–3.0	3.0–4.0	4.0–5.0	>5.0	Total Monitored	Percent of Monitored with Meas. TED	No. with Meas. TED	Collective TED (Person-rem)	Avg. Meas. TED (rem)
Sandia National Laboratories	109	10	2	–	–	–	–	–	–	–	–	**121**	**10%**	**12**	**0.497**	**0.041**
Brookhaven National Laboratory	6	–	–	–	–	–	–	–	–	–	–	6	0%	–	–	0.000
Totals	**115**	**10**	**2**	–	–	–	–	–	–	–	–	**127**	**9%**	**12**	**0.497**	**0.041**

Note: Boxed values (gray background) indicate the greatest value in each column.

DOE Occupational Radiation Exposure Report for CY 2020

Exhibit B-12. Distribution of TED by Facility Type Listed in Descending Order of Average Measurable TED for Research, General, CY 2020.

RESEARCH, GENERAL

Number of Individuals Receiving Radiation Doses in Each Dose Range (rem)

Site/Contractor	Less than Meas.	Meas. to 0.100	0.100–0.250	0.250–0.500	0.500–0.750	0.750–1.000	1.0–2.0	2.0–3.0	3.0–4.0	4.0–5.0	>5.0	Total Monitored	Percent of Monitored with Meas. TED	No. with Meas. TED	Collective TED (Person-rem)	Avg. Meas. TED (rem)
UT-Batelle ORNL	2,630	226	59	34	9	3	3	–	–	–	–	2,964	11%	334	41.631	**0.125**
Lawrence Livermore National Laboratory	3,145	82	7	5	2	–	–	–	–	–	–	**3,241**	3%	96	6.886	0.072
Argonne National Laboratory	747	28	4	2	–	–	–	–	–	–	–	781	4%	34	2.047	0.060
INL - BEA LLC - Security	32	15	–	2	–	–	–	–	–	–	–	49	35%	17	1.021	0.060
Lawrence Berkeley Laboratory	771	12	2	–	–	–	–	–	–	–	–	785	2%	14	0.834	0.060
INL - BEA LLC - Research	127	37	4	3	–	–	–	–	–	–	–	171	26%	44	2.548	0.058
INL - BEA LLC - Services	2,088	735	85	28	4	1	–	–	–	–	–	2,941	29%	**853**	**46.455**	0.054
ICP - Fluor - Support	21	13	2	–	–	–	–	–	–	–	–	36	42%	15	0.720	0.048
ICP - Fluor Service Subcontractors ICP/AMWTP	733	367	41	2	–	–	–	–	–	–	–	1,143	36%	410	18.001	0.044
Los Alamos National Laboratory	2,949	674	57	13	–	–	–	–	–	–	–	3,693	20%	744	31.595	0.042
ICP - Fluor Projects (ICP and AMWTP)	415	193	17	–	–	–	–	–	–	–	–	625	34%	210	8.635	0.041
Sandia National Laboratories	366	23	1	–	–	–	–	–	–	–	–	390	6%	24	0.766	0.032
INL - BEA LLC - Production	203	101	4	–	–	–	–	–	–	–	–	308	34%	105	2.993	0.029
NNSA Los Alamos Site Office	50	6	–	–	–	–	–	–	–	–	–	56	11%	6	0.174	0.029
SRS Tritium Facilities	3	2	–	–	–	–	–	–	–	–	–	5	40%	2	0.057	0.029
Ames Laboratory (Iowa State)	96	30	–	–	–	–	–	–	–	–	–	126	24%	30	0.777	0.026
Batelle - PNNL	1,368	362	16	2	–	–	–	–	–	–	–	1,748	22%	380	8.287	0.022
Savannah River National Laboratory	158	376	13	–	–	–	–	–	–	–	–	547	71%	389	8.679	0.022
Four Rivers Nuclear Partnership (FRNP)	850	5	–	–	–	–	–	–	–	–	–	855	1%	5	0.096	0.019
Savannah River Field Office	4	12	–	–	–	–	–	–	–	–	–	16	75%	12	0.229	0.019
Centerra Services Inc. - SR	26	37	–	–	–	–	–	–	–	–	–	63	59%	37	0.621	0.017
SRNS Construction	24	61	1	–	–	–	–	–	–	–	–	86	72%	62	0.988	0.016
Idaho Field Office	114	10	–	–	–	–	–	–	–	–	–	124	8%	10	0.145	0.015
Savannah River Nuclear Solutions	59	83	–	–	–	–	–	–	–	–	–	142	58%	83	1.260	0.015
SRNS Construction Subs	4	4	–	–	–	–	–	–	–	–	–	8	50%	4	0.061	0.015
UCOR: ORNL	460	225	4	1	–	–	–	–	–	–	–	690	33%	230	3.531	0.015
SRNS Service Subs	12	37	–	–	–	–	–	–	–	–	–	49	76%	37	0.486	0.013
SRR Operations	1	2	–	–	–	–	–	–	–	–	–	3	67%	2	0.023	0.012
NETL Morgantown	31	2	–	–	–	–	–	–	–	–	–	33	6%	2	0.020	0.010
Univ. of Georgia Ecology Laboratory	7	10	–	–	–	–	–	–	–	–	–	17	59%	10	0.100	0.010
Pacific Northwest Site Office	11	14	–	–	–	–	–	–	–	–	–	25	56%	14	0.126	0.009
Battelle -PNNL- Subs	147	14	–	–	–	–	–	–	–	–	–	161	9%	14	0.110	0.008
Misc. DOE Contractors - SR	–	1	–	–	–	–	–	–	–	–	–	1	**100%**	1	0.008	0.008
National Renewable Energy Laboratory	3	4	–	–	–	–	–	–	–	–	–	7	57%	4	0.030	0.008
SRR Service Subs	–	1	–	–	–	–	–	–	–	–	–	1	**100%**	1	0.007	0.007
Cabrera Services	3	8	–	–	–	–	–	–	–	–	–	11	73%	8	0.045	0.006
N3B	26	1	–	–	–	–	–	–	–	–	–	27	4%	1	0.006	0.006
Brookhaven National Laboratory	1	–	–	–	–	–	–	–	–	–	–	1	0%	-	0.000	0.000
Lawrence Livermore National Laboratories	67	–	–	–	–	–	–	–	–	–	–	67	0%	-	0.000	0.000
NETL Albany	40	–	–	–	–	–	–	–	–	–	–	40	0%	-	0.000	0.000
NETL Pittsburgh	30	–	–	–	–	–	–	–	–	–	–	30	0%	-	0.000	0.000
Oak Ridge Institute for Science & Education	60	–	–	–	–	–	–	–	–	–	–	60	0%	-	0.000	0.000
Totals	**17,882**	**3,813**	**317**	**92**	**15**	**4**	**3**	**–**	**–**	**–**	**–**	**22,126**	**19%**	**4,244**	**189.998**	**0.045**

Note: Boxed values (gray background) indicate the greatest value in each column.

DOE Occupational Radiation Exposure Report for CY 2020

Exhibit B-13. Distribution of TED by Facility Type Listed in Descending Order of Average Measurable TED for Research, Fusion, CY 2020.

RESEARCH, FUSION

Number of Individuals Receiving Radiation Doses in Each Dose Range (rem)

Site/Contractor	Less than Meas.	Meas. to 0.100	0.100–0.250	0.250–0.500	0.500–0.750	0.750–1.000	1.0–2.0	2.0–3.0	3.0–4.0	4.0–5.0	>5.0	Total Monitored	Percent of Monitored with Meas. TED	No. with Meas. TED	Collective TED (Person-rem)	Avg. Meas. TED (rem)
Sandia National Laboratories	68	–	–	1	–	–	–	–	–	–	–	69	1%	1	**0.263**	0.263
Princeton Plasma Physics Laboratory	298	54	–	–	–	–	–	–	–	–	–	**352**	**15%**	**54**	0.234	0.004
Totals	**366**	**54**	**–**	**1**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**422**	**13%**	**55**	**0.497**	**0.009**

Note: Boxed values (gray background) indicate the greatest value in each column.

Exhibit B-14. Distribution of TED by Facility Type Listed in Descending Order of Average Measurable TED for Waste Processing, CY 2020.

WASTE PROCESSING

Number of Individuals Receiving Radiation Doses in Each Dose Range (rem)

Site/Contractor	Less than Meas.	Meas. to 0.100	0.100–0.250	0.250–0.500	0.500–0.750	0.750–1.000	1.0–2.0	2.0–3.0	3.0–4.0	4.0–5.0	>5.0	Total Monitored	Percent of Monitored with Meas. TED	No. with Meas. TED	Collective TED (Person-rem)	Avg. Meas. TED (rem)
Sandia National Laboratories	42	1	–	1	–	–	–	–	–	–	–	44	5%	2	0.271	**0.136**
Northwind Portage - UMTRA Project - Moab	40	65	9	17	4	–	–	–	–	–	–	135	70%	95	12.004	0.126
Argonne National Laboratory	59	12	3	3	–	–	–	–	–	–	–	77	23%	18	1.851	0.103
West Valley Nuclear Services Inc.	249	83	22	7	–	–	–	–	–	–	–	361	31%	112	8.868	0.079
TRU WASTE PROCESSING CENTER - ORNL	189	38	8	–	–	–	–	–	–	–	–	235	20%	46	2.504	0.054
Los Alamos National Laboratory	156	116	15	1	1	–	–	–	–	–	–	289	46%	133	6.981	0.052
Brookhaven National Laboratory	35	2	–	–	–	–	–	–	–	–	–	37	5%	2	0.073	0.037
SRR Operations	592	1,717	59	17	–	–	–	–	–	–	–	**2,385**	75%	**1,793**	**55.390**	0.031
Santa Fe Protective Services (WIPP)	–	1	–	–	–	–	–	–	–	–	–	1	**100%**	1	0.030	0.030
Savannah River Nuclear Solutions	384	646	38	–	–	–	–	–	–	–	–	1,068	64%	684	20.492	0.03
Washington River Protection Solutions LLC (W	1,678	291	10	–	–	–	–	–	–	–	–	1,979	15%	301	8.099	0.027
Centerra Services Inc. - SR	110	209	–	–	–	–	–	–	–	–	–	319	66%	209	4.859	0.023
DUF6 Conversion Project - Paducah Subs	196	110	–	–	–	–	–	–	–	–	–	306	36%	110	2.547	0.023
SRNL	4	8	–	–	–	–	–	–	–	–	–	12	67%	8	0.169	0.021
SRNS Construction	63	98	–	–	–	–	–	–	–	–	–	161	61%	98	1.902	0.019
Misc. DOE Contractors - SR	11	40	–	–	–	–	–	–	–	–	–	51	78%	40	0.733	0.018
Savannah River Field Office	29	40	–	–	–	–	–	–	–	–	–	69	58%	40	0.719	0.018
Washington TRU Solutions LLC-WIPP	298	60	–	–	–	–	–	–	–	–	–	358	17%	60	1.035	0.017
SRS Tritium Facilities	4	6	–	–	–	–	–	–	–	–	–	10	60%	6	0.084	0.014
SRNS Service Subs	41	68	–	–	–	–	–	–	–	–	–	109	62%	68	0.856	0.013
WTS Subcontractors - WIPP	33	6	–	–	–	–	–	–	–	–	–	39	15%	6	0.065	0.011
SRR Service Subs	17	14	–	–	–	–	–	–	–	–	–	31	45%	14	0.136	0.010
Misc. S.R.S. Const. Subcontractors	3	1	–	–	–	–	–	–	–	–	–	4	25%	1	0.006	0.006
SRNS Construction Subs	–	1	–	–	–	–	–	–	–	–	–	1	**100%**	1	0.006	0.006
Parsons Subcontractors	1	1	–	–	–	–	–	–	–	–	–	2	50%	1	0.005	0.005
Univ. of Georgia Ecology Laboratory	–	1	–	–	–	–	–	–	–	–	–	1	**100%**	1	0.005	0.005
Carlsbad Field Office	11	–	–	–	–	–	–	–	–	–	–	11	0%	–	0.000	0.000
Los Alamos National Lab - WIPP	3	–	–	–	–	–	–	–	–	–	–	3	0%	–	0.000	0.000
N3B	3	–	–	–	–	–	–	–	–	–	–	3	0%	–	0.000	0.000
NNSA Los Alamos Site Office	2	–	–	–	–	–	–	–	–	–	–	2	0%	–	0.000	0.000
SPRU-NY (Building remediation)	11	–	–	–	–	–	–	–	–	–	–	11	0%	–	0.000	0.000
Wastren Advantage, Inc.	2	–	–	–	–	–	–	–	–	–	–	2	0%	–	0.000	0.000
Totals	**4,266**	**3,635**	**164**	**46**	**5**	**–**	**–**	**–**	**–**	**–**	**–**	**8,116**	**47%**	**3,850**	**129.690**	**0.034**

Note: Boxed values (gray background) indicate the greatest value in each column.

DOE Occupational Radiation Exposure Report for CY 2020

Exhibit B-15. Distribution of TED by Facility Type Listed in Descending Order of Average Measurable TED for Weapons Fabrication, CY 2020.

WEAPONS FABRICATION

Number of Individuals Receiving Radiation Doses in Each Dose Range (rem)

Site/Contractor	Less than Meas.	Meas. to 0.100	0.100–0.250	0.250–0.500	0.500–0.750	0.750–1.000	1.0–2.0	2.0–3.0	3.0–4.0	4.0–5.0	>5.0	Total Monitored	Percent of Monitored with Meas. TED	No. with Meas. TED	Collective TED (Person-rem)	Avg. Meas. TED (rem)
Los Alamos National Laboratory	1,055	691	273	145	45	18	8		1	–	–	2,236	53%	1,181	**175.414**	**0.149**
N3B	5	1	–	–	–	–	–	–	–	–	–	6	17%	1	0.071	0.071
CNS, LLC - Y-12	4,199	1,224	147	7	–	–	–	–	–	–	–	**5,577**	25%	1,378	58.409	0.042
CNS, LLC - Pantex	169	2,837	145	8	–	–	–	–	–	–	–	3,159	95%	**2,990**	107.782	0.036
SRNL	17	6	–	–	–	–	–	–	–	–	–	23	26%	6	0.183	0.031
Pantex Plant (CNS) Construction Sub	5	34	–	–	–	–	–	–	–	–	–	39	87%	34	1.046	0.031
NNSA Production Office - Pantex Site	1	37	–	–	–	–	–	–	–	–	–	38	97%	37	0.881	0.024
SRNS Service Subs	–	4	–	–	–	–	–	–	–	–	–	4	**100%**	4	0.085	0.021
Office of Secure Transportation	291	1	–	–	–	–	–	–	–	–	–	292	0%	1	0.014	0.014
Sandia National Laboratories	143	11	–	–	–	–	–	–	–	–	–	154	7%	11	0.143	0.013
NNSA Los Alamos Site Office	3	2	–	–	–	–	–	–	–	–	–	5	40%	2	0.024	0.012
URS/CH2MHill - Oak Ridge (UCOR): Y-12	100	31	–	–	–	–	–	–	–	–	–	131	24%	31	0.359	0.012
SRS Tritium Facilities	217	135	–	–	–	–	–	–	–	–	–	352	38%	135	1.404	0.010
Savannah River Field Office	5	5	–	–	–	–	–	–	–	–	–	10	50%	5	0.046	0.009
SRNS Construction	25	12	–	–	–	–	–	–	–	–	–	37	32%	12	0.108	0.009
CNS, LLC - Security	57	498	–	–	–	–	–	–	–	–	–	555	90%	498	4.100	0.008
SRR Operations	–	1	–	–	–	–	–	–	–	–	–	1	100%	1	0.007	0.007
Kansas City National Security Campus	146	93	–	–	–	–	–	–	–	–	–	239	39%	93	0.493	0.005
Savannah River Nuclear Solutions	19	3	–	–	–	–	–	–	–	–	–	22	14%	3	0.016	0.005
Totals	**6,457**	**5,626**	**565**	**160**	**45**	**18**	**8**	**–**	**1**	**–**	**–**	**12,880**	**50%**	**6423**	**350.585**	**0.055**

Note: Boxed values (gray background) indicate the greatest value in each column.

DOE Occupational Radiation Exposure Report for CY 2020

Exhibit B-16. Distribution of TED by Facility Type Listed in Descending Order of Average Measurable TED for Other, CY 2020.

OTHER

Number of Individuals Receiving Radiation Doses in Each Dose Range (rem)

Site/Contractor	Less than Meas.	Meas. to 0.100	0.100–0.250	0.250–0.500	0.500–0.750	0.750–1.000	1.0–2.0	2.0–3.0	3.0–4.0	4.0–5.0	>5.0	Total Monitored	Percent of Monitored with Meas. TED	No. with Meas. TED	Collective TED (Person-rem)	Avg. Meas. TED (rem)
Isotek (Bldg 3019)	116	21	9	2	–	–	–	–	–	–	–	148	22%	32	3.096	**0.097**
N3B	373	21	5	–	–	–	–	–	–	–	–	399	7%	26	1.234	0.047
Argonne National Laboratory	39	2	–	–	–	–	–	–	–	–	–	41	5%	2	0.082	0.041
Los Alamos National Laboratory	1,273	147	12	1	1	–	–	–	–	–	–	**1,434**	11%	161	**6.148**	0.038
Misc. DOE Contractors - SR	–	2	–	–	–	–	–	–	–	–	–	2	**100%**	2	0.068	0.034
SRNS Service Subs	9	34	2	–	–	–	–	–	–	–	–	45	80%	36	1.188	0.033
Washington River Protection Solutions LLC (W	485	131	8	–	–	–	–	–	–	–	–	624	22%	139	4.550	0.033
Wastren Advantage, Inc.	64	19	–	–	–	–	–	–	–	–	–	83	23%	19	0.616	0.032
Sandia National Laboratories	326	8	–	–	–	–	–	–	–	–	–	334	2%	8	0.215	0.027
CH2M Hill Plateau Remediation Company (CHPRC)	404	54	2	–	–	–	–	–	–	–	–	460	12%	56	1.401	0.025
Mission Support Alliance	51	2	–	–	–	–	–	–	–	–	–	53	4%	2	0.044	0.022
SRNS Construction	21	28	–	–	–	–	–	–	–	–	–	49	57%	28	0.583	0.021
SRNS Construction Subs	3	2	–	–	–	–	–	–	–	–	–	5	40%	2	0.042	0.021
Centerra Services Inc. - SR	18	18	–	–	–	–	–	–	–	–	–	36	50%	18	0.354	0.020
NNSA Los Alamos Site Office	35	2	–	–	–	–	–	–	–	–	–	37	5%	2	0.039	0.020
Savannah River Field Office	14	13	–	–	–	–	–	–	–	–	–	27	48%	13	0.264	0.020
Savannah River Nuclear Solutions	211	177	–	–	–	–	–	–	–	–	–	388	46%	**177**	3.300	0.019
Univ. of Georgia Ecology Laboratory	1	2	–	–	–	–	–	–	–	–	–	3	67%	2	0.031	0.016
DOE-Richland Field Office	322	22	–	–	–	–	–	–	–	–	–	344	6%	22	0.281	0.013
BECHTEL NATIONAL CORPORATION	23	1	–	–	–	–	–	–	–	–	–	24	4%	1	0.011	0.011
OFFICE OF SECURE TRANSPORTATION	33	1	–	–	–	–	–	–	–	–	–	34	3%	1	0.011	0.011
SRNL	2	1	–	–	–	–	–	–	–	–	–	3	33%	1	0.007	0.007
Navarro Research & Engineering	8	14	–	–	–	–	–	–	–	–	–	22	64%	14	0.043	0.003
HPMC Occupational Medical Services	7	–	–	–	–	–	–	–	–	–	–	7	0%	–	0.000	0.000
Office of River Protection	80	–	–	–	–	–	–	–	–	–	–	80	0%	–	0.000	0.000
SRR Operations	1	–	–	–	–	–	–	–	–	–	–	1	0%	–	0.000	0.000
SRS Tritium Facilities	1	–	–	–	–	–	–	–	–	–	–	1	0%	–	0.000	0.000
Totals	**3,920**	**722**	**38**	**3**	**1**	**–**	**–**	**–**	**–**	**–**	**–**	**4,684**	**16%**	**764**	**23.608**	**0.031**

Note: Boxed values (gray background) indicate the greatest value in each column.

DOE Occupational Radiation Exposure Report for CY 2020

Exhibit B-17. Internal Dose by Facility Type and Nuclide, CY 2018–2020.

Facility Type	Nuclide*	No. of Individuals with Measurable CED** 2018	No. of Individuals with Measurable CED** 2019	No. of Individuals with Measurable CED** 2020	Collective CED Dose (person-rem) 2018	Collective CED Dose (person-rem) 2019	Collective CED Dose (person-rem) 2020	Average Measurable CED (rem) 2018	Average Measurable CED (rem) 2019	Average Measurable CED (rem) 2020
Accelerator	Hydrogen-3	–	1	–	–	0.001	–	–	0.001	–
	Total	–	1	–	–	0.001	–	–	0.001	–
Fuel Fabrication	Total	–	–	–	–	–	–	–	–	–
Fuel Processing	Hydrogen-3	–	–	1	–	0.004	–	–	–	0.004
	Total	–	–	1	–	0.004	–	–	–	0.004
Fuel/Uranium Enrichment	Total	–	–	–	–	–	–	–	–	–
Maintenance and Support	Americium	–	1	–	–	0.002	–	–	0.002	–
	Hydrogen-3	–	1	–	–	0.004	–	–	0.004	–
	Other	1	2	3	0.007	0.002	0.007	0.007	0.001	0.002
	Plutonium	–	1	–	–	0.001	–	–	0.001	–
	Uranium	–	–	–	–	–	–	–	–	–
	Total	1	5	3	0.007	0.009	0.007	0.007	0.002	0.002
Other	Other	1	4	4	0.001	0.026	0.043	0.001	0.007	0.011
	Uranium	–	1	–	–	0.083	–	–	**0.083** ◀	–
	Total	1	5	4	0.001	0.109	0.043	0.001	0.022	0.011
Reactor	Total	–	–	–	–	–	–	–	–	–
Research, Fusion	Total	–	–	–	–	–	–	–	–	–
Research, General	Americium	2	–	3	0.062	–	0.040	0.031	–	0.013
	Hydrogen-3	7	6	–	0.052	0.121	–	0.007	0.020	–
	Mixed	1	–	1	0.087	–	0.056	0.087	–	0.056
	Other	1	1	–	0.019	0.010	–	0.019	0.010	–
	Plutonium	–	2	2	–	0.093	0.019	–	0.047	0.010
	Uranium	20	9	10	0.232	0.056	0.106	0.012	0.006	0.011
	Total	33	18	16	0.486	0.280	0.221	0.015	0.016	0.014
Waste Processing/Mgmt.	Other	4	4	–	0.007	0.008	–	0.002	0.002	–
	Uranium	29	51	48	0.828	2.179	2.329	0.029	0.043	0.049
	Total	33	55	48	0.835	2.187	2.329	0.025	0.040	0.049
Weapons Fab. and Testing	Hydrogen-3	3	16	20	0.008	0.071	0.067	0.003	0.004	0.003
	Mixed	15	6	–	0.233	0.093	–	0.016	0.016	–
	Other	–	–	1	–	–	0.001	–	–	0.001
	Plutonium	1	–	8	3.600	–	2.585	**3.600** ◀	–	**0.323** ◀
	Uranium	**1,258** ◀	**1,307** ◀	**1,202** ◀	**54.386** ◀	**48.011** ◀	**50.821** ◀	0.043	0.037	0.042
	Total	1,277	1,329	1,231	58.227	48.175	53.474	0.046	0.036	0.043
	Totals	**1,343**	**1,413**	**1,303**	**59.522**	**50.761**	**56.078**	**0.044**	**0.036**	**0.043**

Note: Boxed values (gray background) indicate the greatest value in each column.

*Intakes grouped by nuclide. Intakes involving multiple nuclides were grouped into "mixed." Nuclides where fewer than 10 individuals had intakes were grouped as "other."

**The number of internal depositions represents the number of internal dose records with positive results reported for each individual.

DOE Occupational Radiation Exposure Report for CY 2020

Exhibit B-18a. Distribution of TED by Labor Category, CY 2018.

TOTAL EFFECTIVE DOSE (TED)

Number of Individuals Receiving Radiation Doses in Each Dose Range (rem)

Labor Category	Less than Meas.	Meas. to 0.100	0.100–0.250	0.250–0.500	0.500–0.750	0.750–1.000	1.0–2.0	2.0–3.0	3.0–4.0	4.0–5.0	>5.0	Total Monitored	Percent of Monitored with Meas. TED	No. with Meas. TED	Collective TED (Person-rem)	Avg. Meas. TED (rem)
Agriculture	59	–	–	–	–	–	–	–	–	–	–	59	–	–	–	–
Construction/Repair	3,175	1,363	158	37	2	–	–	–	–	–	–	4,735	33%	1,560	72.434	0.046
Laborers	928	285	62	22	5	1	–	–	–	–	–	1,303	29%	375	29.060	0.077
Management	5,412	1,064	61	10	2	–	–	–	–	–	–	6,549	17%	1,137	34.641	0.030
Miscellaneous	8,229	1,282	121	31	1	1	–	–	–	–	–	9,665	15%	1,436	61.968	0.043
Production	2,305	1,123	237	95	37	7	–	–	–	–	–	3,804	**39%** ◀	1,499	134.876	0.090
Professional/Scientists	18,257	3,140	210	55	12	5	–	–	–	–	–	**21,679** ◀	16%	**3,422** ◀	130.532	0.038
Service Workers	5,677	829	55	18	–	–	–	–	–	–	–	6,579	14%	902	33.161	0.037
Technicians	5,733	1,705	383	148	35	25	15	–	1	–	–	8,045	29%	2,312	**227.088** ◀	**0.098** ◀
Transport Workers	845	110	15	5	1	–	–	–	–	–	–	976	13%	131	8.523	0.065
Unknown	11,679	517	34	8	2	–	–	–	–	–	–	12,240	5%	561	21.039	0.038
Totals	**62,299**	**11,418**	**1,336**	**429**	**97**	**39**	**15**	–	**1**	–	–	**75,634**	**18%**	**13,335**	**753.322**	**0.056**

Note: Boxed values (gray background) indicate the greatest value in each column.

DOE Occupational Radiation Exposure Report for CY 2020

Exhibit B-18b. Distribution of TED by Labor Category, CY 2019.

TOTAL EFFECTIVE DOSE (TED)

Number of Individuals Receiving Radiation Doses in Each Dose Range (rem)

Labor Category	Less than Meas.	Meas. to 0.100	0.100–0.250	0.250–0.500	0.500–0.750	0.750–1.000	1.0–2.0	2.0–3.0	3.0–4.0	4.0–5.0	>5.0	Total Monitored	Percent of Monitored with Meas. TED	No. with Meas. TED	Collective TED (Person-rem)	Avg. Meas. TED (rem)
Agriculture	51	1	–	–	–	–	–	–	–	–	–	52	2%	1	0.010	0.010
Construction/Repair	3,364	1,521	181	56	3	–	–	–	–	–	–	5,125	34%	1,761	87.509	0.050
Laborers	1,041	350	48	19	1	–	–	–	–	–	–	1,459	29%	418	25.589	0.061
Management	5,533	1,170	46	9	–	–	–	–	–	–	–	6,758	18%	1,225	32.398	0.026
Miscellaneous	7,714	754	100	10	–	3	–	–	–	–	–	8,581	10%	867	39.188	0.045
Production	2,338	1,325	253	82	11	–	–	–	–	–	–	4,009	**42%** ◀	1,671	115.868	0.069
Professional/Scientists	17,898	3,328	208	62	12	7	1	–	–	–	–	**21,516** ◀	17%	**3,618** ◀	134.077	0.037
Service Workers	5,940	838	72	12	2	–	–	–	–	–	–	6,864	13%	924	35.171	0.038
Technicians	6,095	2,020	345	148	58	32	10	–	–	–	–	8,708	30%	2,613	**246.304** ◀	**0.094** ◀
Transport Workers	839	133	15	13	2	–	–	–	–	–	–	1,002	16%	163	11.900	0.073
Unknown	11,506	506	43	13	1	–	–	–	–	–	–	12,069	5%	563	24.301	0.043
Totals	**62,319**	**11,946**	**1,311**	**424**	**90**	**42**	**11**	**–**	**–**	**–**	**–**	**76,143**	**18%**	**13,824**	**752.315**	**0.054**

Note: Boxed values (gray background) indicate the greatest value in each column.

DOE Occupational Radiation Exposure Report for CY 2020

Exhibit B-18c. Distribution of TED by Labor Category, CY 2020.

TOTAL EFFECTIVE DOSE (TED)

Number of Individuals Receiving Radiation Doses in Each Dose Range (rem)

Labor Category	Less than Meas.	Meas. to 0.100	0.100–0.250	0.250–0.500	0.500–0.750	0.750–1.000	1.0–2.0	2.0–3.0	3.0–4.0	4.0–5.0	>5.0	Total Monitored	Percent of Monitored with Meas. TED	No. with Meas. TED	Collective TED (Person-rem)	Avg. Meas. TED (rem)
Agriculture	37	5	–	–	–	–	–	–	–	–	–	42	12%	5	0.043	0.009
Construction/Repair	3,181	1,803	136	25	2	–	–	–	–	–	–	5,147	38%	1,966	75.908	0.039
Laborers	995	391	43	4	–	–	–	–	–	–	–	1,433	31%	438	19.885	0.045
Management	4,565	1,642	51	8	1	–	–	–	–	–	–	6,267	27%	1,702	47.199	0.028
Miscellaneous	4,212	766	59	5	–	–	–	–	–	–	–	5,042	16%	830	28.421	0.034
Production	1,942	1,635	231	43	1	–	–	–	–	–	–	3,852	**50%** ◀	1,910	103.743	0.054
Professional/Scientists	15,281	4,384	223	50	11	6	2	–	–	–	–	**19,957** ◀	23%	**4,676** ◀	160.174	0.034
Service Workers	3,322	1,736	63	20	3	1	–	–	–	–	–	5,145	35%	1,823	54.271	0.030
Technicians	5,733	2,253	319	142	45	15	9	–	1	–	–	8,517	33%	2,784	**223.325** ◀	**0.080** ◀
Transport Workers	796	139	7	15	4	–	–	–	–	–	–	961	17%	165	12.661	0.077
Unknown	7,295	1,006	23	1	–	–	–	–	–	–	–	8,325	12%	1,030	25.212	0.025
Totals	**47,359**	**15,760**	**1,155**	**313**	**67**	**22**	**11**	–	**1**	–	–	**64,688**	**27%**	**17,329**	**750.842**	**0.043**

Note: Boxed values (gray background) indicate the greatest value in each column.

DOE Occupational Radiation Exposure Report for CY 2020

Exhibit B-19. Internal Dose by Labor Category, CY 2018–2020.

Labor Category	No. of Individuals with Measurable CED* 2018	No. of Individuals with Measurable CED* 2019	No. of Individuals with Measurable CED* 2020	Collective CED Dose (person-rem) 2018	Collective CED Dose (person-rem) 2019	Collective CED Dose (person-rem) 2020	Average Measurable CED (rem) 2018	Average Measurable CED (rem) 2019	Average Measurable CED (rem) 2020
Construction/Repair	267	314	263	9.633	11.624	11.752	0.036	0.037	0.045
Laborers	80	70	66	5.172	3.641	3.282	**0.065**	**0.052**	**0.050**
Management	102	98	102	5.944	3.231	4.226	0.058	0.033	0.041
Miscellaneous	10	11	7	0.195	0.289	0.155	0.020	0.026	0.022
Production	**375**	**363**	**355**	**18.214**	**14.619**	**14.993**	0.049	0.040	0.042
Professional/Scientists	196	213	194	6.106	6.091	6.643	0.031	0.029	0.034
Service Workers	38	31	32	1.554	1.302	1.200	0.041	0.042	0.038
Technicians	108	111	118	7.382	3.660	6.653	0.068	0.033	0.056
Transport Workers	20	34	34	0.647	1.563	1.630	0.032	0.046	0.048
Unknown	149	168	132	4.709	4.741	5.544	0.032	0.028	0.042
Totals	**1,345**	**1,413**	**1,303**	**59.556**	**50.761**	**56.078**	**0.044**	**0.036**	**0.043**

Note: Boxed values (gray background) indicate the greatest value in each column.
*The number of internal depositions represents the number of internal dose records with positive results reported for each individual.

DOE Occupational Radiation Exposure Report for CY 2020

Exhibit B-20. Dose Distribution by Labor Category and Occupation, CY 2020.

Labor Category	Occupation	Less than Meas.	Meas. to 0.100	0.100–0.250	0.250–0.500	0.500–0.750	0.750–1.000	1.0–2.0	2.0–3.0	3.0–4.0	4.0–5.0	>5.0	Total Monitored	Percent of Monitored with Meas. TED	No. with Meas. TED	Collective TED (Person-rem)	Avg. Meas. TED (rem)
Agriculture	Groundskeepers	34	5	–	–	–	–	–	–	–	–	–	39	13%	5	0.043	0.009
	Misc. Agriculture	3	–	–	–	–	–	–	–	–	–	–	3	–	–	–	–
Construction/Repair	Carpenters	272	181	14	5	–	–	–	–	–	–	–	472	42%	200	9.030	0.045
	Electricians	1,102	434	40	6	–	–	–	–	–	–	–	1,582	30%	480	18.813	0.039
	Masons	19	20	–	–	–	–	–	–	–	–	–	39	51%	20	0.355	0.018
	Mechanics/Repairers	450	290	17	2	–	–	–	–	–	–	–	759	41%	309	11.233	0.036
	Miners/Drillers	42	8	–	–	–	–	–	–	–	–	–	50	16%	8	0.075	0.009
	Misc. Repair/Construction	765	556	33	3	–	–	–	–	–	–	–	1,357	44%	592	19.549	0.033
	Painters	136	83	6	–	–	–	–	–	–	–	–	225	40%	89	2.436	0.027
	Pipe Fitter	395	231	26	9	2	–	–	–	–	–	–	663	40%	268	14.417	0.054
Laborers	Handlers/Laborers/Helpers	995	391	43	4	–	–	–	–	–	–	–	1,433	31%	438	19.885	0.045
Management	Admin. Support & Clerical Sec.	542	128	–	–	–	–	–	–	–	–	–	670	19%	128	2.871	0.022
	Manager - Administrator	4,010	1,514	51	8	1	–	–	–	–	–	–	5,584	28%	1,574	44.328	0.028
	Sales	13	–	–	–	–	–	–	–	–	–	–	13	–	–	–	–
Miscellaneous	Military	28	1	–	–	–	–	–	–	–	–	–	29	3%	1	0.008	0.008
	Miscellaneous	4,184	765	59	5	–	–	–	–	–	–	–	5,013	17%	829	28.413	0.034
Production	Machine Setup/Operators	139	184	23	–	–	–	–	–	–	–	–	346	60%	207	9.514	0.046
	Machinists	101	27	6	6	–	–	–	–	–	–	–	140	28%	39	3.894	0.100
	Misc. Precision/Production	357	272	32	11	–	–	–	–	–	–	–	672	47%	319	16.598	0.053
	Operators, Plant/ System/Util.	1,052	1,031	144	21	1	–	–	–	–	–	–	2,249	53%	1,201	63.992	0.053
	Sheet Metal Workers	265	117	25	5	–	–	–	–	–	–	–	412	36%	147	9.594	0.065
	Welders and Solderers	28	4	1	–	–	–	–	–	–	–	–	33	15%	5	0.151	0.030
Professional/Scientists	Doctors and Nurses	13	2	–	–	–	–	–	–	–	–	–	15	13%	2	0.095	0.048
	Engineer	5,126	1,461	84	19	2	4	–	–	–	–	–	6,696	23%	1,570	55.804	0.035
	Health Physicist	329	79	6	2	–	–	–	–	–	–	–	416	21%	87	3.776	0.043
	Misc. Professional	6,403	2,301	111	19	2	2	–	–	–	–	–	**8,843** ◀	28%	**2,440** ◀	75.006	0.031
	Scientist	3,410	539	22	10	7	–	2	–	–	–	–	3,987	14%	577	25.493	0.044
Service Workers	Firefighters	372	119	1	–	–	–	–	–	–	–	–	492	24%	120	1.803	0.015
	Food Service Employees	1	2	–	–	–	–	–	–	–	–	–	3	**67%** ◀	2	0.098	0.049
	Janitors	224	27	1	–	–	–	–	–	–	–	–	252	11%	28	0.827	0.030
	Misc. Service	1,686	710	59	20	3	1	–	–	–	–	–	2,479	32%	793	38.547	0.049
	Security Guards	1,039	878	2	–	–	–	–	–	–	–	–	1,919	46%	880	12.996	0.015
Technicians	Engineering Technicians	1,492	305	54	7	3	–	–	–	–	–	–	1,861	20%	369	22.180	0.060
	Health Technicians	140	31	1	2	–	–	–	–	–	–	–	174	20%	34	1.558	0.046
	Misc. Technicians	1,460	577	66	31	8	1	3	–	–	–	–	2,146	32%	686	46.630	0.068
	Radiation Monitors/Techs.	1,089	877	110	39	7	4	1	–	–	–	–	2,127	49%	1,038	68.354	0.066
	Science Technicians	585	315	83	58	27	10	5	–	1	–	–	1,084	46%	499	**78.648** ◀	**0.158** ◀
	Technicians	967	148	5	5	–	–	–	–	–	–	–	1,125	14%	158	5.955	0.037
Transport Workers	Bus Drivers	1	–	–	–	–	–	–	–	–	–	–	1	–	–	–	–
	Equipment Operators	103	76	5	8	1	–	–	–	–	–	–	193	47%	90	6.543	0.073
	Misc. Transport	313	37	1	–	–	–	–	–	–	–	–	351	11%	38	1.284	0.035
	Pilots	7	–	–	–	–	–	–	–	–	–	–	7	–	–	–	–
	Truck Drivers	372	26	1	7	3	–	–	–	–	–	–	409	9%	37	4.834	0.131
Unknown	Unknown	7,295	1,006	23	1	–	–	–	–	–	–	–	8,325	12%	1,030	25.212	0.024
Totals		**47,359**	**15,760**	**1,155**	**313**	**67**	**22**	**11**	–	1	–	–	**64,688**	**27%**	**17,329**	**750.842**	**0.043**

Note: Boxed values (gray background) indicate the greatest value in each column.

DOE Occupational Radiation Exposure Report for CY 2020

Exhibit B-21. Internal Dose Distribution by Site and Nuclide, CY 2020.

Number of Individuals Receiving Radiation Doses in Each Dose Range (rem)															
Site	Nuclide*	Meas. to 0.020	0.020–0.100	0.100–0.250	0.250–0.500	0.500–0.750	0.750–1.000	1.0-2.0	2.0-3.0	3.0-4.0	4.0-5.0	>5.0	Total Indiv. with Meas. CED	Collective CED (person-rem)	Avg. CED (rem)
Hanford: Pacific Northwest National Laboratory	Americium	1	–	–	–	–	–	–	–	–	–	–	1	0.014	0.014
Idaho	Plutonium	1	–	–	–	–	–	–	–	–	–	–	1	0.011	0.011
Idaho	Americium	2	–	–	–	–	–	–	–	–	–	–	2	0.026	0.013
Lawrence Livermore National Laboratory	Mixed	–	1	–	–	–	–	–	–	–	–	–	1	0.056	0.056
Los Alamos National Laboratory	Uranium	5	–	–	–	–	–	–	–	–	–	–	5	0.010	0.002
Los Alamos National Laboratory	Plutonium	5	3	–	–	–	–	–	1	–	–	–	9	2.593	**0.288** ◀
Los Alamos National Laboratory	Hydrogen-3	12	–	–	–	–	–	–	–	–	–	–	12	0.037	0.003
Oak Ridge: Y-12 National Security Complex	Uranium	513	554	129	6	–	–	–	–	–	–	–	**1,202** ◀	**50.821** ◀	0.042
Paducah Gaseous Diffusion Plant	Uranium	4	1	–	–	–	–	–	–	–	–	–	5	0.096	0.019
Sandia National Laboratories	Other	8	–	–	–	–	–	–	–	–	–	–	8	0.051	0.006
Savannah River Site	Hydrogen-3	9	–	–	–	–	–	–	–	–	–	–	9	0.034	0.004
Uranium Mill Tailings Remedial Action Project	Uranium	14	24	10	–	–	–	–	–	–	–	–	48	2.329	0.049
Totals		**574**	**583**	**139**	**6**	–	–	–	**1**	–	–	–	**1,303**	**56.078**	**0.043**

Note: Boxed values (gray background) indicate the greatest value in each column.

*Intakes grouped by nuclide. Intakes involving multiple nuclides were grouped into "mixed." Nuclides where fewer than 10 individuals had intakes were grouped as "other."

DOE Occupational Radiation Exposure Report for CY 2020

Exhibit B-22. Extremity Dose Distribution by Site, CY 2020.

Site	No. Meas. Dose	Meas. to 0.100	0.100–1.0	1.0–5.0	5.0–10.0	10.0–20.0	20.0–30.0	>30.0	Total Monitored*	No. with Meas.	No. Above Monitoring Threshold (5 rems)**	Collective Extremity Dose (person-rem)	Avg. Meas. Extremity Dose (rem)
Ames Laboratory	32	94	–	–	–	–	–	–	126	94	–	3.741	0.040
Argonne National Laboratory	1,433	75	14	6	1	–	–	–	1,529	96	1	24.434	0.255
Brookhaven National Laboratory	1,835	9	1	–	–	–	–	–	1,845	10	–	0.565	0.056
Energy Technology Engineering Center	11	–	–	–	–	–	–	–	11	–	–	–	–
Fermi National Accelerator Laboratory	1,264	4	–	–	–	–	–	–	1,268	4	–	0.090	0.022
Grand Junction Site	22	–	–	–	–	–	–	–	22	–	–	–	–
Hanford: Hanford Site	3,431	12	–	–	–	–	–	–	3,443	12	–	0.804	0.067
Hanford: Office of River Protection	2,379	239	166	12	–	–	–	–	2,796	417	–	79.868	0.192
Hanford: Pacific Northwest National Laboratory	1,476	408	48	3	–	–	–	–	1,935	459	–	23.763	0.052
Idaho National Laboratory	3,635	1,413	309	36	4	–	–	–	5,397	1,762	4	224.067	0.127
Kansas City National Security Plant	142	97	–	–	–	–	–	–	239	97	–	2.961	0.031
Lawrence Berkeley National Laboratory	738	31	13	3	–	–	–	–	785	47	–	11.362	0.242
Lawrence Livermore National Laboratory	3,361	8	16	6	2	–	–	–	3,393	32	2	29.603	0.925
Los Alamos National Laboratory	6,830	1,825	653	162	15	2	–	–	**9,487** ◀	**2,657** ◀	17	**755.282** ◀	0.284
National Renewable Energy Laboratory	7	–	–	–	–	–	–	–	7	–	–	–	–
Nevada National Security Site	746	7	–	–	–	–	–	–	753	7	–	0.165	0.024
Oak Ridge: East Tennessee Technology Park	408	–	–	–	–	–	–	–	408	–	–	–	–
Oak Ridge: Oak Ridge Institute for Science and Education	60	–	–	–	–	–	–	–	60	–	–	–	–
Oak Ridge: Oak Ridge National Laboratory	3,749	39	58	24	17	1	2		3,890	141	**20** ◀	253.454	**1.798** ◀
Oak Ridge: Y-12 National Security Complex	5,623	39	37	9	–	–	–	–	5,708	85	–	25.768	0.303
Office of Secure Transportation	327	–	–	–	–	–	–	–	327	–	–	–	–
Paducah Gaseous Diffusion Plant	1,388	–	–	–	–	–	–	–	1388	–	–	–	–
Pantex Plant	3,808	–	–	–	–	–	–	–	3,808	–	–	–	–
Portsmouth Gaseous Diffusion Plant	2,155	–	–	–	–	–	–	–	2,155	–	–	–	–
Princeton Plasma Physics Laboratory	352	–	–	–	–	–	–	–	352	–	–	–	–
Sandia National Laboratories	1,886	–	–	–	–	–	–	–	1,886	–	–	–	–
Savannah River National Laboratory	503	67	59	3	–	–	–	–	632	129	–	25.198	0.195
Savannah River Site	5,861	351	235	30	–	–	–	–	6,477	616	–	133.009	0.216
Separations Process Research Unit	11	–	–	–	–	–	–	–	11	–	–	–	–
SLAC National Accelerator Laboratory	2,055	–	–	–	–	–	–	–	2,055	–	–	–	–
Thomas Jefferson National Accelerator Facility	1,322	–	–	–	–	–	–	–	1,322	–	–	–	–
Uranium Mill Tailings Remedial Action Project	135	–	–	–	–	–	–	–	135	–	–	–	–
Waste Isolation Pilot Plant	398	–	–	–	–	–	–	–	398	–	–	–	–
West Valley Demonstration Project	346	15	–	–	–	–	–	–	361	15	–	0.443	0.030
Service Center Personnel***	242	27	3	7	–	–	–	–	279	37	–	17.539	0.474
Totals	**57,971**	**4,760**	**1,612**	**301**	**39**	**3**	**2**	–	**64,688**	**6,717**	**44**	**1,612.116**	**0.240**

Note: Boxed values (gray background) indicate the greatest value in each column.

* Represents the total number of monitoring records. The number of individuals provided extremity monitoring cannot be determined.

** All extremity doses above 5 rems were for the upper extremities (hands and forearms). DOE annual limit for extremities is 50 rems.

10 CFR 835.402(a)(1)(ii) requires extremity monitoring for a shallow dose equivalent to the skin or extremity of 5 rems or more in a year.

*** Includes personnel at NETL, NNSA Albuquerque complex, Oak Ridge, and WIPP.

Prepared for the Office of Environment, Health, Safety and Security
by ORISE, P.O. Box 117 • Oak Ridge, TN 37831-0117