

OES 2023-02

April 2023

## DOE Occupational Radiation Exposure Monitoring for CY 2021

### Purpose

This Operating Experience Summary (OES) document provides an overview of occupational radiation doses at Department of Energy (DOE) sites, including the National Nuclear Security Administration (NNSA), for calendar year (CY) 2021. The *U.S. Department of Energy (DOE) Occupational Radiation Exposure Report for CY 2021* provides an analysis of the collective total effective dose (TED), including the effective dose from external radiation sources and the committed effective dose (CED) from the internal intake of radiation during work activities. It contains a description of work activities in relation to occupational radiation doses for each DOE facility.

The purpose of the OES is to provide DOE line managers with key highlights from the CY 2021 report for awareness, evaluation, and potential site-specific action. The OES provides high-level DOE-wide summary information. Line managers are encouraged to review the CY 2021 report for detailed information about the distribution of radiological dose across DOE, including at a program- and site-specific level.

### Background

DOE Order 231.1B, *Environment Safety and Health Reporting*, requires the DOE sites report annually on radiation exposure monitoring data to the Radiation Exposure Monitoring System (REMS) database before March 31 of the following year. From this data, the Office of Environment, Safety and Health (ES&H) Reporting and Analysis develops an annual report. The *U.S. Department of Energy Occupational Radiation Exposure Report for CY 2021* provides a detailed evaluation of DOE-wide performance in compliance with Title 10, Code of Federal Regulations, Part 835, *Occupational Radiation*

*Protection.* The regulation includes occupational dose limits, as well as the principle of reducing radiation doses to levels *as low as reasonably achievable* (ALARA). The report provides data to DOE organizations responsible for developing policies for protecting individuals from the adverse health effects of radiation. The occupational radiation dose information over the past 5-year period is analyzed in terms of dose to individuals, dose by site, and aggregate data. The data in this analysis represent the data reported to REMS as of July 31, 2022.

### Discussion

The occupational radiation dose records for CY 2021 show that DOE facilities complied with DOE dose limits and administrative control levels (ACLs), and worked to minimize doses to individuals.

Information on collective TED is an indicator of the overall amount of radiation dose received during the conduct of work activities at DOE. The TED is comprised of the effective dose from external sources (which includes neutron and photon radiation) and the internal CED, which results from the intake of radioactive material into the body.

Highlights between CY 2020 and CY 2021:

- The collective TED increased at DOE by 11 percent from 749 person-rem (7,490 person-mSv) in CY 2020 to 828 person-rem (8,280 person-mSv) in CY 2021.
- The number of individuals with measurable TED decreased by less than 1 percent from 17,252 in CY 2020 to 17,130 in CY 2021.

- The average measurable TED increased by 11 percent from 0.043 rem (0.430 mSv) in CY 2020 to 0.048 rem (0.480 mSv) in CY 2021.
- The collective CED (internal dose from U-234) decreased by 23 percent from 56.9 person-rem (569 person-mSv) in CY 2020 to 43.8 person-rem (438 person-mSv) in CY 2021.
- The number of individuals with measurable CED decreased by 6 percent from 1,324 in CY 2020 to 1,240 in CY 2021.
- No individual was reported to have exceeded the TED regulatory limit (5 rem [50 mSv]) from CY 2017 through 2021.
- No individual was reported to have exceeded the TED ACL (2 rem [20 mSv]) in CY 2021. Previously, 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.
- The collective photon dose increased by 16 percent from 527.1 person-rem (5,271 person mSv) in CY 2020 to 611.4 person-rem (6,114 person mSv) in CY 2021.
- The neutron component of the collective TED increased by 5 percent from 165.1 person-rem (1,651 person mSv) in CY 2020 to 172.8 person-rem (1,728 person mSv) in CY 2021.

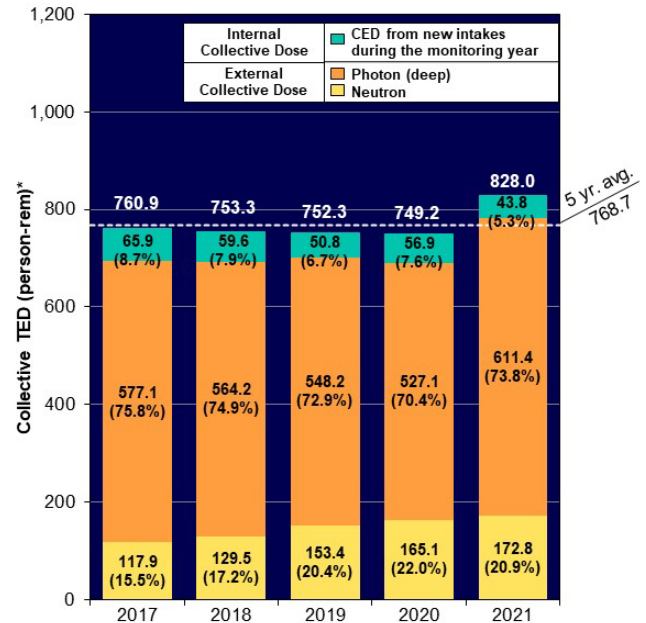
Figure 1 shows the components of the collective TED from CY 2017–2021, including the external dose contributions from photon and neutron, as well as the internal dose from intakes.

Figure 2 shows the average measurable TED, which normalizes the collective dose over the population of workers who received a measurable dose from CY 2017–2021. The average measurable TED increased by 11 percent from 0.043 rem (0.430 mSv) in CY 2020 to 0.048 rem (0.480 mSv) in CY 2021.

In CY 2021, the five sites that contributed significantly (89 percent) to the collective TED in descending order were Los Alamos National

Laboratory (LANL), Savannah River, Idaho, Oak Ridge, and Hanford.

Figure 1. Components of TED, CY 2017–2021.



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

Figure 2. Average Measurable TED, CY 2017–2021



The collective TED increased at four of the five sites with the largest collective TED: LANL, Savannah River, Idaho, and Hanford. Change in collective TED at Oak Ridge was negligible.

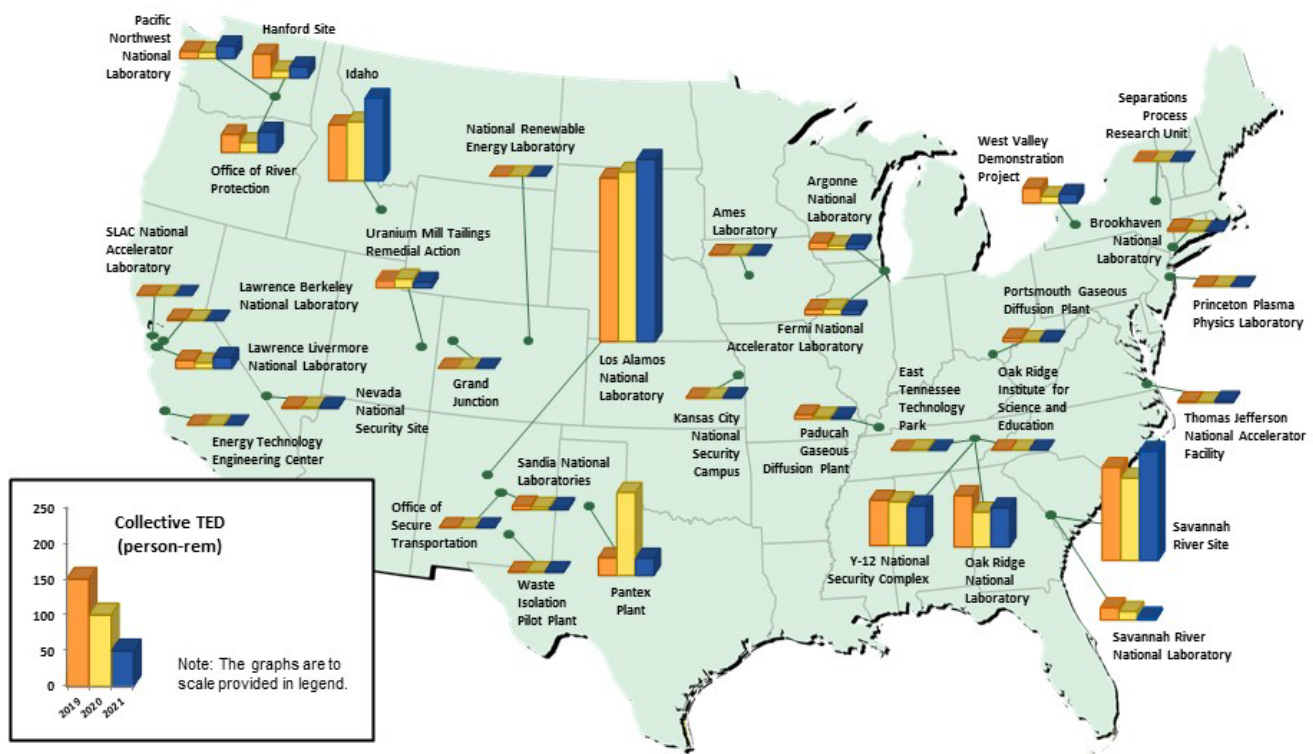
At LANL, a primary contributor to dose in CY 2021 was work with Pu-238, producing general purpose

heat sources, and other infrastructure support for radiological work at the TA-55 plutonium facility. In addition, increased work at TA-55 led to an increase in the number of personnel, and subsequently, an increase in collective dose. The dose at Savannah River increased in comparison with CY 2020 as workers safely removed failed vessels from the Hot Canyon and began the process of deactivating 235-F. For Idaho, the change in CY 2021 was due to increased characterization of waste drums at CPP-659, increased entries in the Integrated Fuel Storage Facility to repair canister lid clamps, and the completion of several significant tasks in high dose rate areas. The increased dose at Hanford was

attributed to the resumption of operations in CY 2021 as compared with CY 2020 when radiological work was curtailed due to the COVID-19 pandemic. Oak Ridge saw a negligible increase in collective TED even though the number of monitored individuals increased along with the level of work activities after COVID-19 restrictions were relaxed.

Figure 3 illustrates the collective TED at DOE sites that are required to report the results of occupational radiation monitoring to the DOE REMS Program.

**Figure 3.** Collective TED by DOE Site for CY 2019 – 2021



## Conclusion

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 doses exceeded the 2 rem (20 mSv) DOE ACL.

Only 25 percent of the monitored individuals received a measurable dose, and of those, the average measurable dose received was less than 1 percent of the 5 rem (50 mSv) TED limit.

Additionally, the number of facilities citing the COVID-19 pandemic as limiting operational activities decreased from 62 percent to 53 percent.

## Reference

The *U.S. Department of Energy Occupational Radiation Exposure Report for CY 2021* contains a description of work activities in relation to occupational radiation dose for each DOE facility. The annual report is located at:

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

## Additional Sources of Information

REMS System Tools: REMS includes a database with over 4 million dose records. REMS system tools below provide access to summary data for research and interactive data visualization products.

- [Occupational Exposure Dashboard](#) - Provides an Illustrated and Interactive Overview of Radiation Exposure at DOE Sites.
- [REMS Query Tool](#) - Provides access to REMS summary data for analysis.
- [10 Year Summary](#) - Provides descriptions and trends of dose data over the last 10 years.

To access annual reports from CY 1974 to CY 2021, ALARA activities at DOE, REMS Query Tool, and other information on occupational radiation doses at DOE, visit the DOE ES&H website at:

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

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The Office of Environment, Health, Safety and Security, Office of ES&H Reporting and Analysis publishes OESs to promote safety throughout the DOE complex by encouraging the exchange of lessons learned information among DOE facilities.

For further information or assistance related to this OES, please contact Katharine McLellan, REMS Program Manager, at (202) 586-0183 or by email at [katharine.mclellan@hq.doe.gov](mailto:katharine.mclellan@hq.doe.gov).