

OE-3: 2018-01

January 2018

## DOE Occupational Radiation Exposures for 2016

### PURPOSE

This Operating Experience Level 3 (OE-3) document is issued to provide an overview summary of the status of radiation protection practices at the Department of Energy (DOE) (including the National Nuclear Security Administration [NNSA]) for the year 2016.

### BACKGROUND

The Office of Environment, Health, Safety and Security (AU) provides the corporate-level leadership and strategic vision necessary to establish clear expectations and provide assistance regarding health, safety, environment, and security programs. In support of this mission, the Office of Environment, Safety and Health (ES&H) Reporting and Analysis (AU-23) provides for the collection, analysis, and dissemination of data and performance indicators, such as occupational radiation exposure information.

DOE Order 231.1B *“Environment Safety and Health Reporting”* requires the reporting of radiation exposure data to the Radiation Exposure Monitoring System database before March 31, of the year following the exposure monitoring. The DOE annual report on occupational exposure provides a detailed evaluation of DOE-wide performance regarding compliance with Title 10, Code of Federal Regulations (CFR), Part 835, *Occupational Radiation Protection* which includes requirements on occupational dose limits, as well as the principle of reducing radiation exposure to levels as low as reasonably achievable (ALARA). In addition, the report provides data to DOE organizations responsible for developing policies for protection of individuals from the adverse health

effects of radiation. The occupational radiation exposure information over the past 5-year period is analyzed in terms of dose to individuals, dose by site, and aggregate data.

### DISCUSSION

The occupational radiation exposure records show that in 2016, DOE facilities continued to comply with DOE dose limits and administrative control levels and worked to minimize exposure to individuals.

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

Highlights between 2015 and 2016:

- The collective TED decreased 5 percent from 745.3 person-rem (7,453 person-mSv) in 2015 to 709.4 person-rem (7,094 person-mSv) in 2016.
- The collective CED (internal exposure) increased by 19 percent from 51.7 person-rem (517 person-mSv) in 2015 to 61.5 person-rem (615 person-mSv) in 2016.
- The number of individuals with measurable CED increased by 8 percent from 1,147 in 2015 to 1,241 in 2016.
- The collective photon dose decreased by 8 percent from 601.8 person-rem (6,018 person-mSv) in 2015 to 555.0 person-rem (5,550 person-mSv) in 2016.

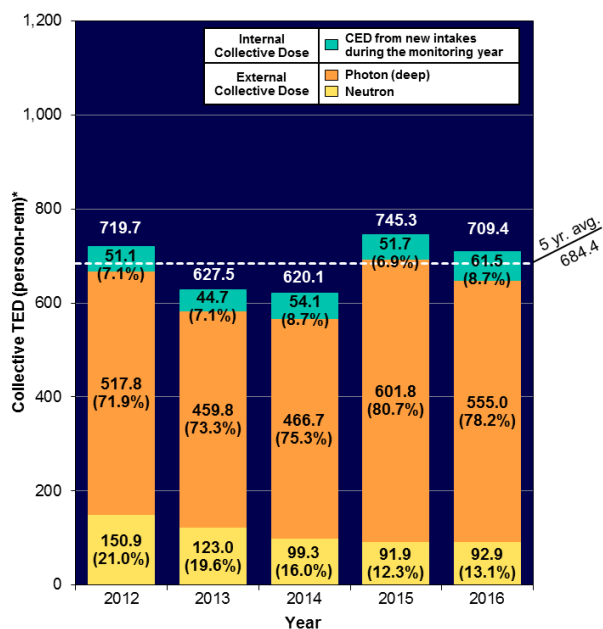
- The neutron component of the collective TED increased by 1 percent from 91.9 person-rem (919 person-mSv) in 2015 to 92.9 person-rem (929 person-mSv) in 2016.
- The average measurable TED decreased by 20 percent from 0.074 rem (0.740 mSv) in 2015 to 0.059 rem (0.590 mSv) in 2016.
- The number of workers with measurable TED increased by 20 percent from 10,024 in 2015 to 12,005 in 2016.

*Exhibit 1* shows the components of the collective TED from 2012-2016 including the external dose contributions from photon and neutron, as well as the internal dose from intakes.

*Exhibit 2* shows the average measurable TED, which normalizes the collective dose over the population of workers who actually received a measurable dose from 2012-2016. This value has remained within 11 percent of the 5-year average of 0.066 rem (0.66 mSv) over this time period.

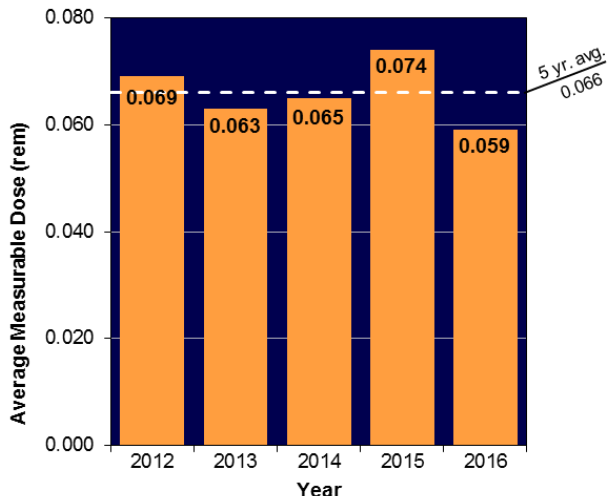
In 2016, the five sites that contributed significantly (75 percent) to the collective TED are: Oak Ridge, Savannah River Site (SRS), the Los Alamos National Laboratory (LANL), Idaho, and Hanford.

**Exhibit 1:**  
**Components of TED, 2012-2016.**



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

**Exhibit 2:**  
**Average Measurable TED, 2012-2016.**



*Exhibit 3* illustrates the collective TED at all DOE sites.

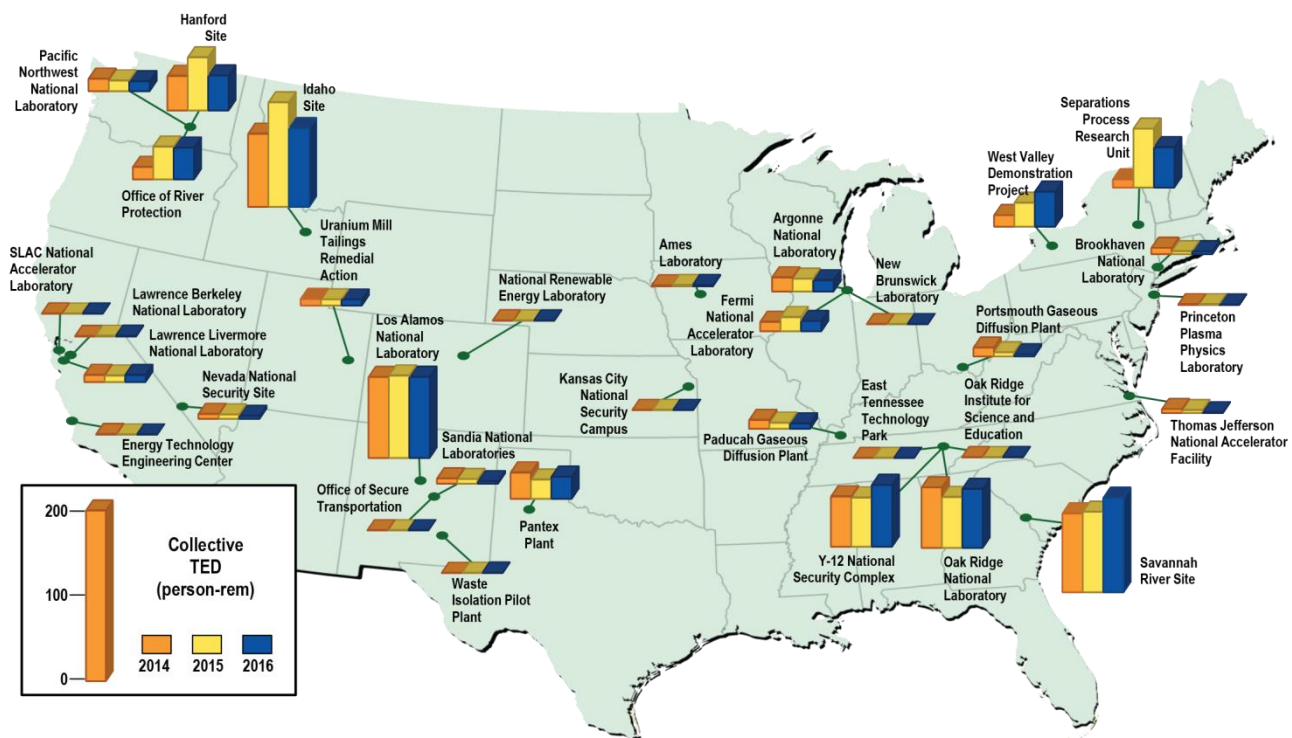
The collective TED increased at two of the five sites with the largest collective TED (Oak Ridge and SRS).

At the Oak Ridge National Laboratory (ORNL), dose increased due to increased work activities at hot cell and radiochemistry facilities, in addition to increased maintenance and waste handling activities at neutron research and radiochemistry facilities. The increase at SRS was attributed to the remediation of a 1950s era underground liquid waste storage tank, completion of the K Area complex battery change, and beginning the down-blend operations for plutonium.

The collective TED decreased at LANL, Idaho and Hanford in 2016. At LANL, a work pause that began in 2013 associated with the Criticality Safety Program for operations at the Plutonium Production Facility (TA-55) was ongoing which resulted in a lower occupational dose for work at TA-55 and subsequently lowered the collective TED for LANL in 2016. The main decrease of dose at the Idaho cleanup project was the reduction in hands-on cleaning of the knife gate valve and maintenance work on the sodium distillation system. The Hanford decrease was associated with a change in work activities at the plutonium finishing plant facility and a decrease in work activity with materials requiring extremity monitoring.



**Exhibit 3:**  
**Collective TED by DOE Site for 2014-2016**



## CONCLUSION

Over the past 5-year period, no DOE worker received measurable TED at or above the 2 rem (20 mSv) TED ACL and all doses were below the annual 5 rem (50 mSv) TED DOE regulatory limit.

*Exhibit 4* illustrates the general decreasing trend for collective dose and average measurable dose from 1974 through 2016.

The *DOE 2016 Occupational Radiation Exposure Report* contains a description of work activities in relation to occupational radiation exposure for each DOE facility. The annual report is located: <http://energy.gov/ehss/policy-guidance-reports/databases/occupational-radiation-exposure>.

In addition, descriptions of ALARA activities at DOE are voluntarily submitted and compiled to illustrate improvement in radiation exposure reduction. DOE emphasizes the importance to maintain doses ALARA.

The DOE query tool contains annual occupational radiation exposure dose records from 1987 through 2016 and is located at:

<https://apps.orau.gov/CER/REMSQueryTool>.

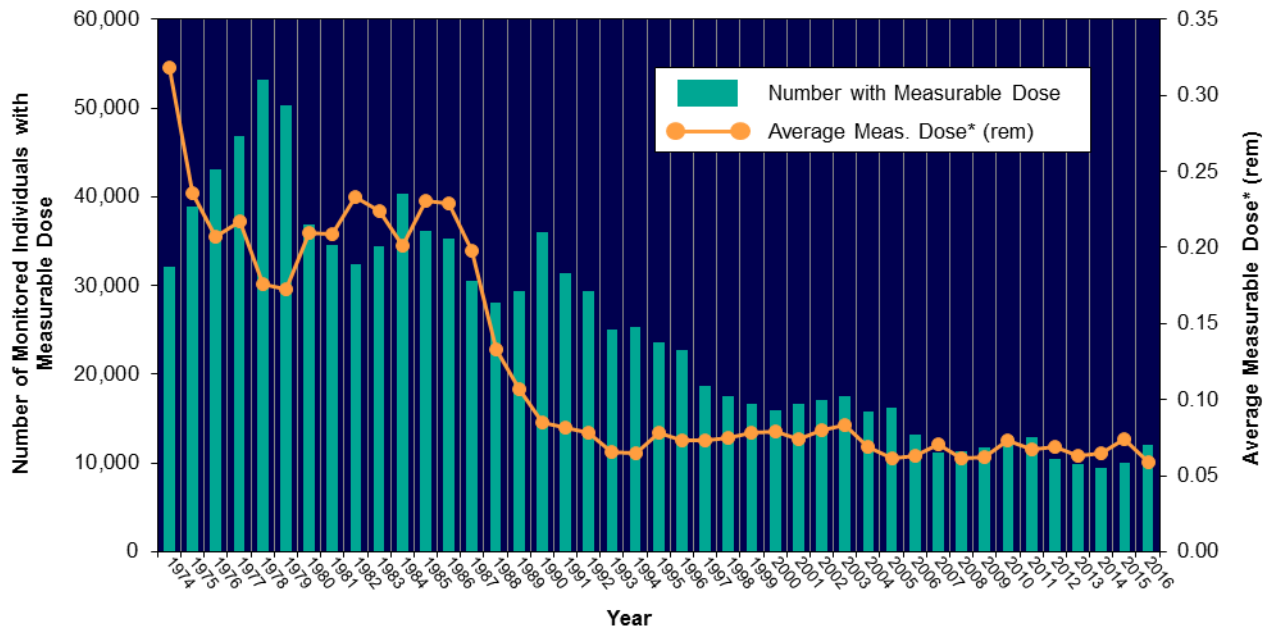
Additional information regarding the query tool is provided as *Attachment 1* to this document.

## REFERENCE

[\*DOE 2016 Occupational Radiation Exposure, November 2017\*](#)



**Exhibit 4:**  
**Number of Workers with Measurable Dose and Average Measurable Dose, 1974–2016**



* 1974–1989	collective dose = DDE	1946–1974	Atomic Energy Commission (AEC)
1990–1992	collective dose = DDE + AEDE	1974–1977	Energy Research and Development Administration (ERDA)
1993–2009	collective dose = DDE + CEDE	1977–Present	Department of Energy (DOE)
2010–2016	collective dose = ED + CED		

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This OE-3 document requires no follow-up report or written response.

Josh Silverman  
 Acting Director  
 Office of Environmental Protection and ES&H Reporting  
 Office of Environment, Health, Safety and Security



# REMS QUERY TOOL

## Exploration of the REMS Summary Data

The REMS Query Tool is a web application designed to provide summary data compiled from occupational radiation exposure records submitted to the REMS database by DOE facilities and contractors under DOE Order 231.1B. Users are able to obtain customized results by selecting the dose component of interest, data filters, and how the data is to be grouped. Once these selections are complete, the user can view the results on-screen in a table format, or export the data file to Excel. During on-screen viewing, the user can sort the data by any column for quick analysis of minimum and maximum values. Exporting to Excel gives the user additional capabilities such as graphing and statistical functions. The combination of these features allows users to quickly obtain summary information to answer the vast majority of inquiries about radiation exposure across the DOE complex.

**Dose components recently added:**

- Effective Dose, Photon (ED Photon)
- Effective Dose, Neutron (ED Neutron)
- Equivalent Dose, Skin Whole Body (EqD-SkWB)
- Equivalent Dose, Maximum Extremity (EqD-ME)
- Equivalent Dose, Eye (EqD-Eye)

**Dose data of interest:**

- Number with Measurable Dose
- Collective Dose
- Average Measurable Dose
- Number of Individuals by Dose Range (i.e. dose distributions)

Select Data ✕ Clear Data

DOSE		Number with Measurable Dose	Collective Dose (person-mrem)	Average Measurable Dose (mrem)	Number of Individuals by Dose Range (mrem)
Total Effective Dose (TED)	→	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Effective Dose, Photon (ED Photon)	→	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Effective Dose, Neutron (ED Neutron)	→	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Equivalent Dose, Skin Whole Body (EqD-SkWB)	→	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Equivalent Dose, Maximum Extremity (EqD-ME)	→	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Equivalent Dose, Eye (EqD-Eye)	→	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Committed Effective Dose (CED) from Intakes	→	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

With a total of 28 available selections, we moved to a simple matrix design to make selecting the values easier for the user. Each row and column of the new selection matrix is selectable/un-selectable by clicking the green buttons with arrows.

**Selections for Filtering and Grouping:**

- Year (1986 – 2016)
- Program Office
- Operations Office
- Site
- Reporting Organization
- Facility Type
- Labor Category
- Occupation
- Monitoring Status

Select Data Filters ✕ Clear Filters

<b>Year</b>	<div style="border: 1px solid blue; padding: 2px;">All</div> <div style="border: 1px solid gray; padding: 2px;">2016</div> <div style="border: 1px solid gray; padding: 2px;">2015</div> <div style="border: 1px solid gray; padding: 2px;">2014</div> <div style="border: 1px solid gray; padding: 2px;">2013</div> <div style="border: 1px solid gray; padding: 2px;">2012</div>	→
<b>Program Office</b>	<div style="border: 1px solid blue; padding: 2px;">All</div> <div style="border: 1px solid gray; padding: 2px;">Energy Efficiency and Renewable Energy</div> <div style="border: 1px solid gray; padding: 2px;">National Nuclear Security Administration</div> <div style="border: 1px solid gray; padding: 2px;">Office of Civilian Radioactive Waste Management</div> <div style="border: 1px solid gray; padding: 2px;">Office of Environmental Management</div> <div style="border: 1px solid gray; padding: 2px;">Office of Fossil Energy</div>	→
<b>Operations Office</b>	<div style="border: 1px solid blue; padding: 2px;">All</div> <div style="border: 1px solid gray; padding: 2px;">ALBUQUERQUE</div> <div style="border: 1px solid gray; padding: 2px;">CHICAGO</div> <div style="border: 1px solid gray; padding: 2px;">DOE HQ</div> <div style="border: 1px solid gray; padding: 2px;">FERNALD</div> <div style="border: 1px solid gray; padding: 2px;">IDAHO</div>	→
<b>Site</b>	<div style="border: 1px solid blue; padding: 2px;">All</div> <div style="border: 1px solid gray; padding: 2px;">Ames Laboratory</div> <div style="border: 1px solid gray; padding: 2px;">Argonne National Laboratory</div>	→



# Attachment 1

## We added new features to the REMS Query Tool this year to make it more user-friendly and intuitive:

- We updated the Help buttons (blue question marks) with additional content.
- We added “Clear” buttons for each of the three selection areas. These buttons add convenience of being able to reset your selections for a specific area (Data, Filters, or Groups), without affecting the others.
- We added color-coding to the headers of the output page to visually group the dose data.

Selected Data	TED Dose		ED Photon Dose		ED Neutron Dose	
▲ Monitoring Year	▲ Collective TED (person-mrem)	▲ Average Meas. TED (mrem)	▲ Collective ED Photon (person-mrem)	▲ Average Meas. ED Photon (mrem)	▲ Collective ED Neutron (person-mrem)	▲ Average Meas. ED Neutron (mrem)
2013	627549	63	459860	55	123002	61
2014	620103	65	466699	58	99322	54
2015	745127	74	601812	70	91700	56