

OE-3: 2017-01

February 2017

DOE Occupational Radiation Exposures for 2015

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 2015.

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 oversight and enforcement 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 2015, 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 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 2014 and 2015:

- The collective TED increased 20 percent from 620 person-rem (6,200 person-mSv) in 2014 to 745 person-rem (7,450 person-mSv) in 2015.
- The collective photon dose increased by 29 percent from 466.7 person-rem (4,667 person-mSv) in 2014 to 601.6 person-rem (6,016 person-mSv) in 2015.
- The neutron component of the collective TED decreased by 8 percent from 99.3 person-rem (993 person-mSv) in 2014 to 91.7 person-rem (917 person-mSv) in 2015.

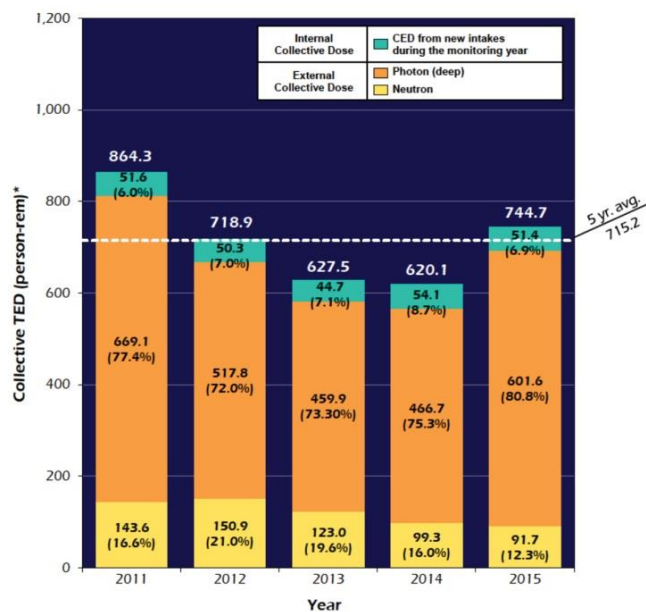
- The average measurable TED increased by 14 percent from 0.065 rem (0.65 mSv) in 2014 to 0.074 rem (0.74 mSv) in 2015.
- The number of workers with measurable TED increased by 5 percent from 9,501 in 2014 to 10,023 in 2015.
- The collective CED (internal exposure) decreased by 5 percent from 54.1 person-rem (541 person-mSv) in 2014 to 51.4 person-rem (514 person-mSv) in 2015.

The number of individuals with measurable CED decreased by 5 percent from 1,200 in 2014 to 1,146 in 2015.

Exhibit 1 shows the components of the collective TED from 2011-2015 including the external dose contributions from photon and neutron, as well as the internal dose from intakes.

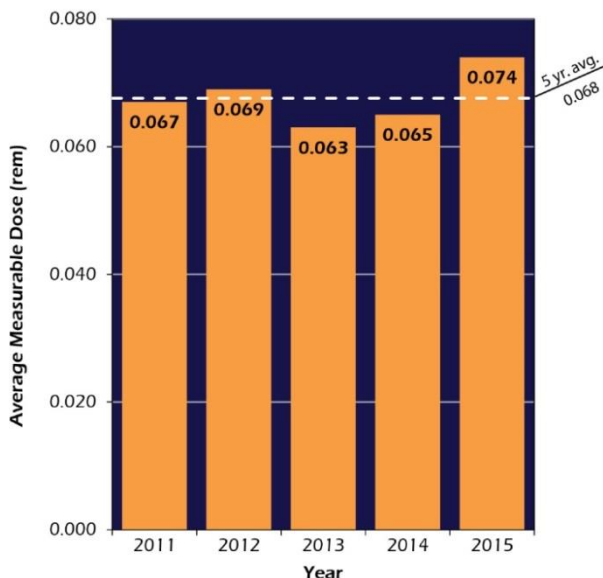
Exhibit 2 shows the average measurable TED, which normalizes the collective dose over the population of workers who actually received a measurable dose from 2011-2015. This value has remained within 10 percent of the 5-year average of 0.068 rem (0.68 mSv) over this time period.

Exhibit 1:
Components of TED, 2011-2015.



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

Exhibit 2:
Average Measurable TED, 2011-2015.



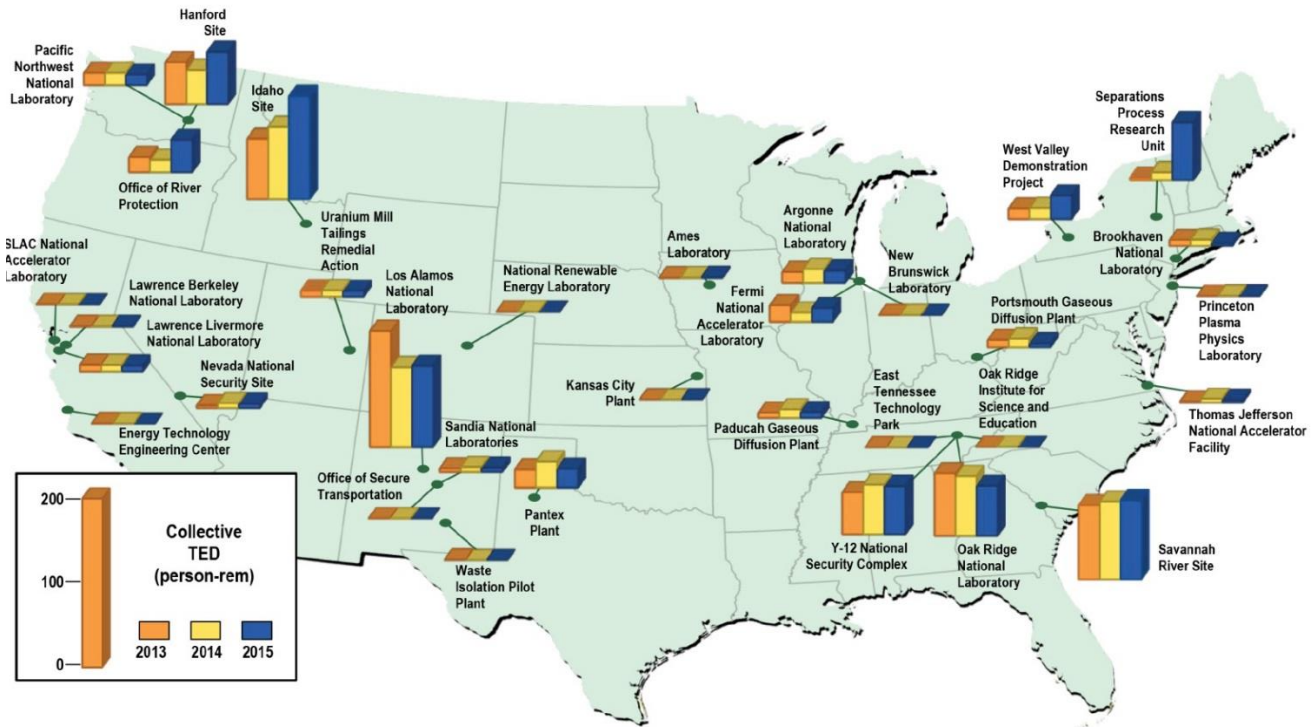
In 2015, the five sites that contributed most significantly (73 percent) to the collective TED in descending order were the Idaho Site, Oak Ridge Site, Hanford Site, the Los Alamos National Laboratory (LANL), and Savannah River Site (SRS). *Exhibit 3* illustrates the collective TED at all DOE sites.

The collective TED decreased for one of the five largest contributors (Oak Ridge Site).

For the other four sites, the increase in collective TED in 2015 was attributed to an increase in Homeland Security training exercises, maintenance at the analytical and radiochemistry laboratories, spent fuel treatment product handling, TRU waste retrieval and characterization, and maintenance and upgrade of the sodium distillation system at Idaho. At Hanford, the increase was due to work at the plutonium finishing plant facility. This work included the dismantlement of two large glove boxes in the process lines and the cleanout of the plutonium recovery facility canyon. The slight increase at LANL was due to the TA-55 plutonium facility operations. Occupational dose was accrued from weapons manufacturing, Pu-238 work, and repackaging materials. At SRS, a minor increase of occupational dose was attributed to resuming process operations in portions of the H Canyon to allow for continued spent nuclear fuel dissolution.



Exhibit 3:
Collective TED by DOE Site for 2013-2015



U-234 accounted for the largest percentage of the collective CED, with over 99 percent of the U-234 collective CED is accrued at Y-12.

CONCLUSION

Over the past 5-year period, only one individual exceeded the 5 rem (50 mSv) TED regulatory limit, and no other individual exceeded the 2 rem (20 mSv) TED administrative control limit (other than the one who exceeded 5 rem.)

Exhibit 4 illustrates the general decreasing trend for collective dose and average measurable dose from 1974 through 2015.

The *DOE 2015 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 at: <http://energy.gov/ehss/policy-guidance-reports/databases/occupational-radiation-exposure>.

The descriptions of As Low As is Reasonably Achievable (ALARA) activities are voluntarily submitted and compiled to illustrate improvement in radiation exposure reduction. DOE emphasizes the importance of ALARA programs to maintain dose as low as is reasonable.

The DOE REMS Query Tool contains summarized annual occupational radiation exposure data from 1987 through 2015 and is located at: <https://apps.ornl.gov/CER/REMSQueryTool>. The query tool does not require a login or password, as the data are aggregated and de-identified. Additional information regarding the query tool is provided as *Attachment 1* to this document.

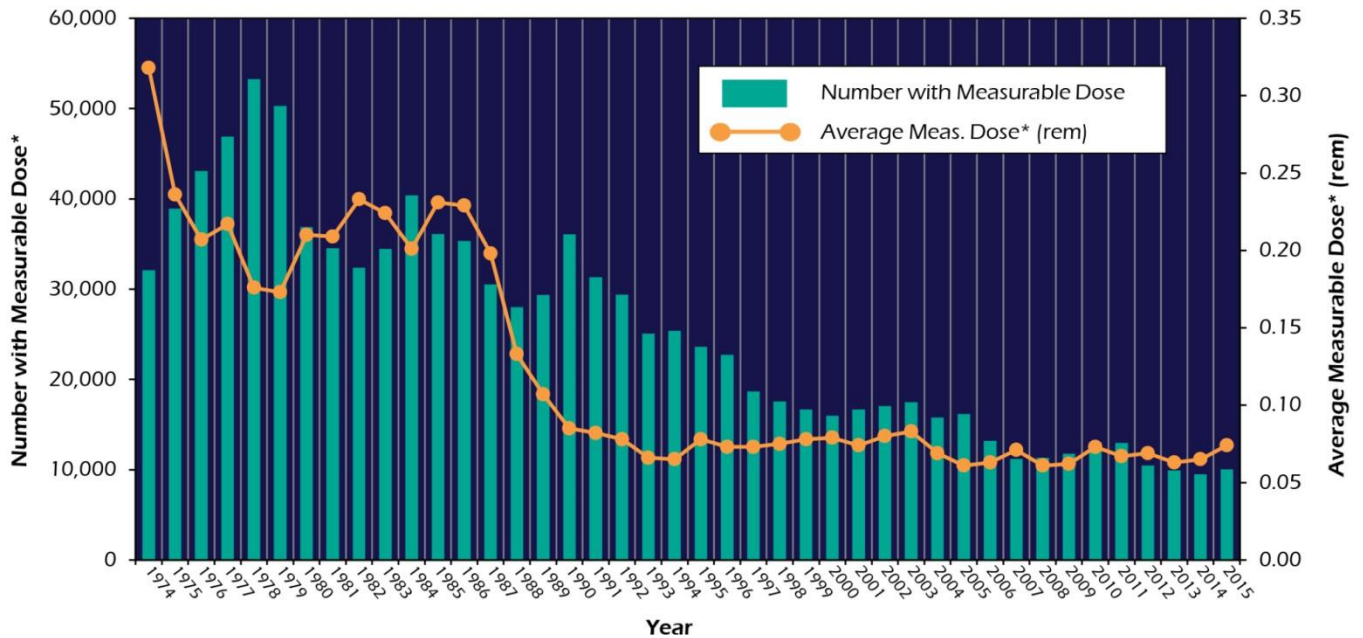
REFERENCES

To access this report and other information on occupational radiation exposure at DOE, visit the DOE AU web site at:

<https://energy.gov/ehss/policy-guidance-reports/databases/occupational-radiation-exposure>



Exhibit 4:
Number of Workers with Measurable Dose and Average Measurable Dose, 1974–2015



* 1974–1989 collective dose = DDE
 1990–1992 collective dose = DDE + AEDE
 1993–2009 collective dose = DDE + CEDE
 2010–2015 collective dose = ED + CED

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

ADDITIONAL SOURCES OF INFORMATION

The Computerized Accident and Incident Reporting System contains information on accidents and incidents, including the size of the DOE workforce that is used in this report.

<http://energy.gov/ehss/policy-guidance-reports/databases/computerized-accident-incident-reporting-system>

The Occurrence Reporting and Processing System contains information on occurrences including radiation exposures in excess of DOE limits, personnel contaminations, and other occurrences involving radiation that is used as a valuable reference in this report.

<http://energy.gov/ehss/policy-guidance-reports/databases/occurrence-reporting-and-processing-system>

Questions regarding this OE-3 report can be directed to Nimi Rao at (301) 903-2297 or e-mail nimi.rao@hq.doe.gov.

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

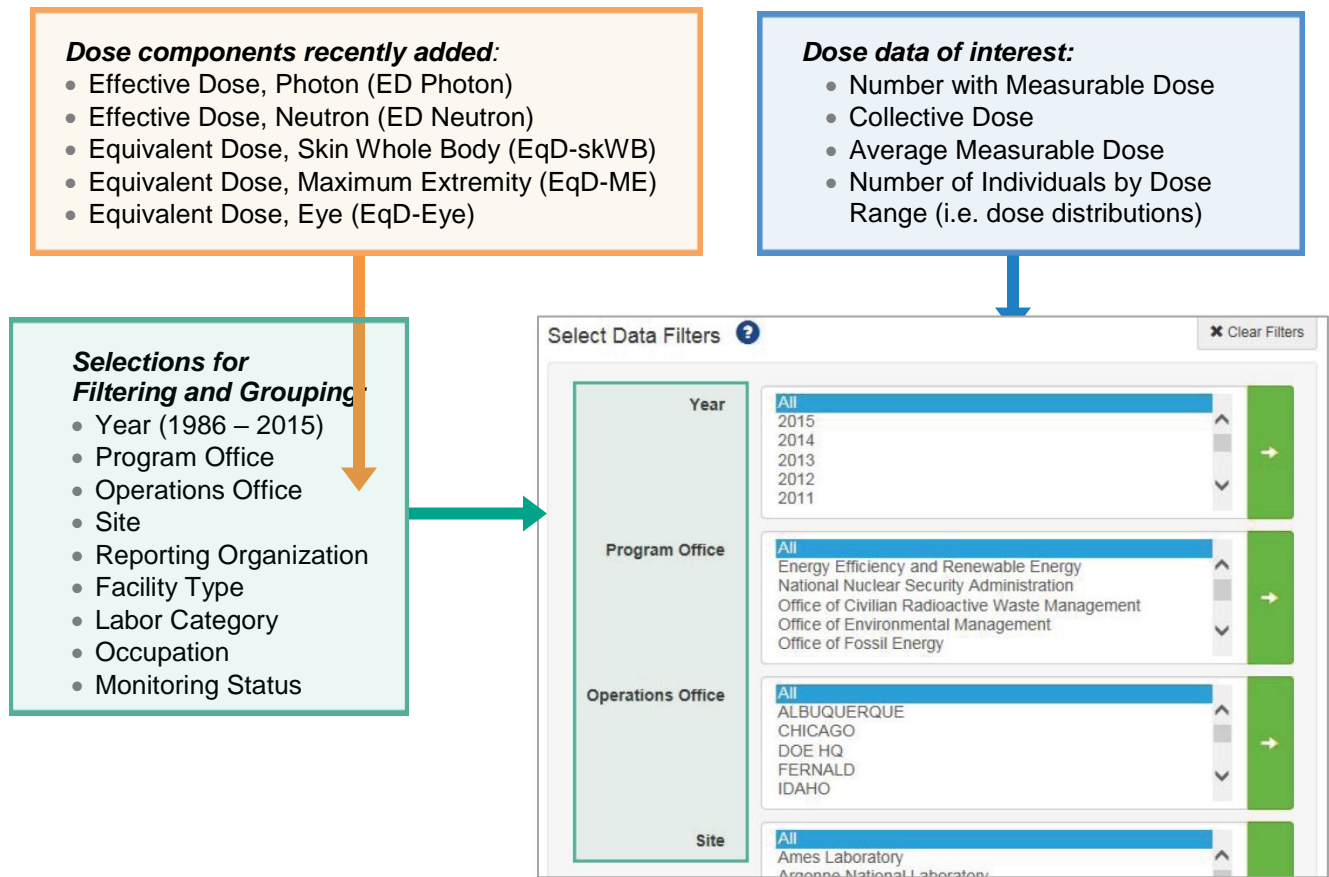
Josh Silverman
 Acting Director
 Office of Environmental Protection and ES&H Reporting
 Office of Environment, Health, Safety and Security



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 – 2015)
- Program Office
- Operations Office
- Site
- Reporting Organization
- Facility Type
- Labor Category
- Occupation
- Monitoring Status

Select Data Filters ? ✕ Clear Filters

Year	All 2015 2014 2013 2012 2011	→
Program Office	All Energy Efficiency and Renewable Energy National Nuclear Security Administration Office of Civilian Radioactive Waste Management Office of Environmental Management Office of Fossil Energy	→
Operations Office	All ALBUQUERQUE CHICAGO DOE HQ FERNALD IDAHO	→
Site	All Ames Laboratory Argonne National Laboratory	→



Recently added features that 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

What can users do with this tool?

An example of the use of the REMS Query Tool would be to answer a question that may be otherwise difficult to find or extract from other data sources. For instance, it has been discussed in the REMS Annual Report that almost all (99%) of the collective internal dose is accrued at the Enriched Uranium Operations at the Oak Ridge Y-12 National Security Complex. A user may be interested in the other sites where internal dose is accrued and which sites have the highest “Average Meas. CED”. By using the REMS Query Tool, a user could select the following items.

The screenshot displays the REMS Query Tool interface with several key elements highlighted by red circles:

- Select Data:** A table with columns for DOSE, Number with Measurable Dose, Collective Dose (person-mrem), Average Measurable Dose (mrem), and Number of Individuals by Dose Range (mrem). Checkmarks are visible in the 'Collective Dose' and 'Average Measurable Dose' columns for 'Total Effective Dose (TED)' and 'Committed Effective Dose (CED) from Intakes'.
- Select Data Filters:** A dropdown menu for 'Year' with '2015' selected.
- Select Data Groupings:** A list of selected filters including 'Year' and 'Site', each with a red 'X' icon to remove it.



Attachment 1

By selecting **View**, the results for 2015 are as follows:

Selected Data		TED Dose		CED Dose	
Monitoring Year	Site	Collective TED (person-mrem)	Average Meas. TED (mrem)	Average Meas. CED (mrem)	Collective CED (person-mrem)
2015	Oak Ridge: Oak Ridge National Laboratory	57269	107	93	186
2015	Oak Ridge: Y-12 National Security Complex	58010	48	47	48720
2015	Uranium Mill Tailings Remedial Action Project	7177	83	47	2104
2015	Argonne National Laboratory	14767	180	43	129
2015	Separations Process Research Unit	69291	468	28	84
2015	Paducah Gaseous Diffusion Plant	7058	21	22	86
2015	Idaho Site	123232	93	20	61
2015	Lawrence Livermore National Laboratory	7573	72	17	51

While it is clear from the above results that the Y-12 National Security Complex has the highest “*Collective CED*”, it is interesting to note that the Oak Ridge National Laboratory (ORNL) actually has the highest “*Average Meas. CED*”, and that the “*Average Meas. CED*” for Y-12 is equivalent to that of the Uranium Mill Tailings Remedial Action (UMTRA) Project. This example shows that a relatively larger collective dose does not always mean that individuals are receiving higher average doses. Additional information, such as how the dose is distributed to the worker population is available using the REMS Query Tool to further refine a user’s question and compare to other sites, or provide historical perspective by including data for prior years.

To access the DOE REMS Query Tool visit <https://apps.orau.gov/CER/REMSQueryTool>

