DOE 2008 Occupational Radiation Exposure

October 2009

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Foreword

Foreword

A major priority of the U.S. Department of Energy (DOE) is to ensure the health, safety, and security of DOE employees, contractors, and subcontractors. The Office of Health, Safety and Security (HSS) provides the corporate-level leadership and strategic vision necessary to better coordinate and integrate health, safety, environment, security, enforcement, and independent oversight programs. One function that supports this mission is the DOE Corporate Operating Experience Program that provides collection, analysis, and dissemination of performance indicators, such as occupational radiation exposure information. This analysis supports corporate decision-making and synthesizes operational information to support continuous environment, safety, and health improvement across the DOE complex.

A key safety focus for DOE is to maintain radiation exposures of its workers below administrative control levels (ACL) and DOE limits and to further reduce these exposures to levels that are "as low as reasonably achievable (ALARA)." The annual *DOE 2008 Occupational Radiation Exposure Report* provides an evaluation of DOE-wide performance regarding compliance with DOE Part 835 dose limits and ALARA process requirements and an overview of the status of radiation exposures of the DOE workforce. In addition, this report provides data to DOE organizations responsible for developing policies for protection of individuals from the effects of radiation. This report is primarily a tool for managing radiological safety programs and provides useful information to epidemiologists, researchers, and national and international agencies involved in developing policies to protect individuals from harmful effects of radiation. The overall radiation dose decreased from 2007 to 2008 in terms of collective dose, although there were more individuals who received a measurable dose. The average measurable dose is calculated by dividing the collective dose by the number of individuals with a measurable dose. Since the collective total effective dose equivalent (TEDE) decreased by 108 person-rems and the number of individuals with a measurable dose increased slightly, the resultant average measurable dose decreased. In 2008, one individual received a dose to the bone surface in excess of the 50 rems (500 millisievert [mSv]) DOE annual organ dose limit.

One of the objectives of this report is to provide timely, useful, accurate, and complete information to the target audience. As part of a continuing improvement process, we would appreciate your response to the user survey included at the end of this report.

Glenn S. Podonsky
Chief Health, Safety and Security Officer
Office of Health, Safety and Security

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LIST OF ACRONYMS

ACL	Administrative Control Level
AEDE	Annual Effective Dose Equivalent
AEC	Atomic Energy Commission
ALARA	As Low As Reasonably Achievable
CDE	Committed Dose Equivalent
CEDE	Committed Effective Dose Equivalent
D&D	Decontamination and Decommissioning
DDE	Deep Dose Equivalent
DOE	U.S. Department of Energy
EM	Office of Environmental Management
EPA	U.S. Environmental Protection Agency
ETTP	East Tennessee Technology Park
HSS	Office of Health, Safety and Security
INTEC	Idaho Nuclear Technology and Engineering Center
LANL	Los Alamos National Laboratory
LDE	Lens (of the Eye) Dose Equivalent
LLNL	Lawrence Livermore National Laboratory
mSv	Millisievert
NE	Office of Nuclear Energy, Science and Technology
NNSA	National Nuclear Security Administration
ORISE	Oak Ridge Institute for Science and Education
ORNL	Oak Ridge National Laboratory
PFP	Plutonium Finishing Plant
REMS	Radiation Exposure Monitoring System
SC	Office of Science
SDE-ME	Shallow Dose Equivalent to the Maximally Exposed Extremity
SDE-WB	Shallow Dose Equivalent to the Skin of the Whole Body
SRS	Savannah River Site
Sv	Sieverts
TEDE	Total Effective Dose Equivalent
TODE	Total Organ Dose Equivalent
TVA	Tennessee Valley Authority
UNSCEAR	United Nations Scientific Committee on the Effects of Atomic Radiation
WIPP	Waste Isolation Pilot Plant
Y-12	Y-12 National Security Complex

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Executive Summary

The U.S. Department of Energy (DOE) Office of Corporate Safety Analysis (HS-30) within the Office of Health, Safety and Security (HSS) publishes the annual *DOE Occupational Radiation Exposure Report* to provide an overview of the status of radiation protection practices at DOE.* The *DOE 2008 Occupational Radiation Exposure Report* provides an evaluation of DOE-wide performance regarding compliance with DOE Part 835 dose limits and as low as reasonably achievable (ALARA) process requirements. In addition, the report provides data to DOE organizations responsible for developing policies for protection of individuals from the effects of radiation. This report provides a summary and an analysis of occupational radiation exposure information from the monitoring of individuals involved in DOE activities. The occupational radiation exposure information is analyzed in terms of aggregate data, dose to individuals, and dose by site over the past 5 years.

One of the report's features includes the collective total effective dose equivalent (TEDE)–an indicator of the overall amount of radiation dose received during the conduct of operations at DOE. Over the past 10-year period, 99.99% of the individuals receiving measurable dose have received doses below the 2 rems (20 mSv) TEDE administrative control level (ACL), which is well below the DOE regulatory limit of 5 rems (50 mSv) TEDE. The DOE collective TEDE decreased by 13% from 2007 to 2008, as shown in *Exhibit ES-1*. This is the fifth consecutive year that the collective TEDE has decreased. The decrease in 2008 was due primarily to the removal of radioactive materials, decreases in the amount of work performed that directly involves radioactive materials, and a safety-driven pause in operations at Los Alamos National Laboratory (LANL).

It should be noted that while 10 CFR 835 was revised as of June 2007, full implementation is not required until July of 2010. Some sites are still in the process of transition and therefore this report continues to use the previous dose terminology of 10 CFR 835, such as TEDE.

Sites that contributed to the decrease in the number of workers with measurable dose include Fermilab, Lawrence Livermore National Laboratory (LLNL), LANL, Sandia, the Office of River Protection, and Pantex, while increases occurred at Hanford, Oak Ridge National Laboratory (ORNL), Savannah River Site (SRS), Idaho, and Y-12 National Security Complex (Y-12 NSC). Overall from 2007 to 2008, there was an increase in the number of workers with measurable dose.

Exhibit ES-1:
Collective TEDE (person-rem), 2004–2008.

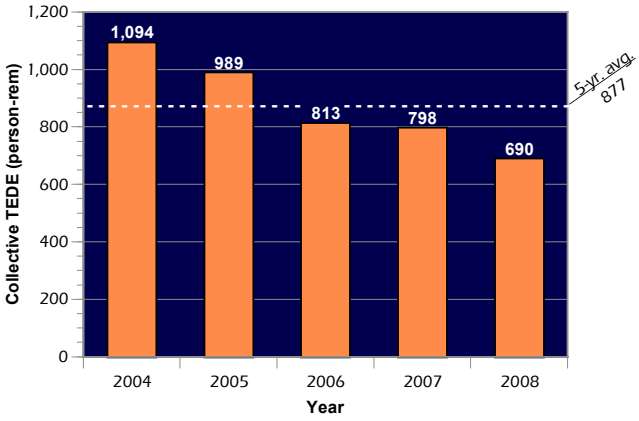
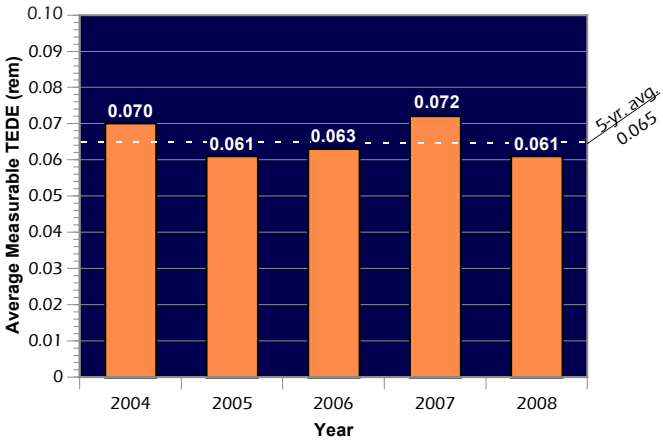


Exhibit ES-2:
Average Measurable TEDE (rem), 2004–2008.



* DOE is defined to include the National Nuclear Security Administration (NNSA) sites.

The TEDE is comprised of the external deep dose equivalent (DDE), which includes neutron and photon radiation, and the internal committed effective dose equivalent (CEDE), which results from the intake of radioactive material into the body. The photon, neutron and internal dose components of the collective TEDE decreased by 16%, 5% and 11% from 2007 to 2008, respectively.

Another primary indicator of the level of radiation exposure covered in this report is the average measurable dose, which normalizes the collective dose over the population of workers who actually received a measurable dose. The average measurable TEDE decreased by 15% from 2007 to 2008, as shown in *Exhibit ES-2.* The collective dose and the average measurable dose both decreased, while the number of individuals who received a measurable dose increased.

Additional analyses show that the dose distribution in 2008 was similar to the distribution in 2007 with the exception of the one individual that exceeded the 2 rems (20 millisievert [mSv]) DOE administrative control level (ACL) limit. Most of the reduction in monitored individuals occurred in the number of individuals with no measurable dose and the number of individuals receiving less than 0.1 rem (1 mSv). The number of individuals receiving doses between 0.1 rem (1 mSv) and 2 rems (20 mSv) in 2008 decreased by nearly 9% of the number in 2007.

In conclusion, the assessment of occupational radiation exposure for 2008 continues to show a decreasing trend in collective dose and the number of individuals with a measurable dose, while the average measurable dose decreased significantly. Primary factors in the decrease in collective dose for 2008 were a reduction in activities involving radiation at several DOE sites. The decrease in the average measurable dose was due to an increase in the number of individuals with measurable dose (particularly measurable doses below 0.1 rem). The one individual who received a dose above 2 rems (20 mSv) exceeding the ACL, also received 60 rems committed dose equivalent (CDE) to the bone surface exceeding the 50 rems DOE annual limit to an organ or tissue. With the exception of one incident, in 2008, all DOE operations complied with DOE Part 835 dose limits and the DOE-wide dose constraints. Only a small fraction of the DOE workforce received measurable doses and the average measurable dose was 1% of the DOE limit.

As DOE continues consolidation and remediation efforts, it is anticipated that the decreasing trend in collective dose and the number of individuals with measurable dose will continue over the next several years. At some sites where remediation activities are increased or accelerated, a temporary increase in dose may be observed at the site, but should decrease once the effects of the remediation result in lower dose rates and fewer opportunities for exposure. The average measurable dose may fluctuate as fewer individuals receive dose, but should remain low as radiation protection practices and ALARA principles continue to reduce dose to individuals.

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

http://www.hss.energy.gov

Select HSS Reporting Databases from the HSS Quick Reference and then select the Radiation Exposure Monitoring System (REMS).

Section One Introduction

1

Introduction

The *DOE 2008 Occupational Radiation Exposure Report* provides analyses of occupational radiation exposures incurred by individuals at the U.S. Department of Energy (DOE) facilities during 2008. This report includes occupational radiation exposure information for all DOE employees, contractors, and subcontractors, as well as members of the public who are monitored for exposure to radiation. The 92 DOE organizations submitting radiation exposure reports for 2008 have been grouped into 30 sites across the complex. This information has been analyzed and trended over time to provide a measure of DOE's performance in protecting its workers from radiation.

1.1 Report Organization

This report is organized into the five sections listed below. In an effort to further streamline the printed report, most of the supporting technical information, tables of data, and additional items that were previously provided in the report and the appendices will be available on the DOE web site for Information on Occupational Radiation Exposure. A User Survey form is included at the end of this report and users are encouraged to provide feedback to improve this report.

1.2 Report Availability

Requests for additional copies of this report, requests for access to the data files or individual dose records used to compile this report, and suggestions and comments should be directed to

Ms. Nirmala Rao, HS-30
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1000 Independence Avenue, SW
Washington, D.C. 20585-0270
E-mail: nimi.rao@hq.doe.gov

Visit the DOE web site at **http://www.hss.energy.gov** for more information on occupational radiation exposure, such as the following:

- Annual occupational radiation exposure reports in pdf files since 1974
- Guidance on reporting radiation exposure information to the DOE Headquarters Radiation Exposure Monitoring System (REMS)
- Guidance on how to request a dose history for an individual
- Statistical data since 1987 for analysis
- Applicable DOE orders and manuals for the record keeping and reporting of occupational radiation exposure at DOE
- "As low as reasonably achievable" (ALARA) activities at DOE

Section One	Provides a description of the content and organization of this report.
Section Two	Provides a discussion of the radiation protection and dose reporting requirements.
Section Three	Presents the occupational radiation dose data from monitored individuals at DOE facilities for 2008. The data are analyzed to show trends over the past five years.
Section Four	Includes instructions to submit successful ALARA projects within the DOE complex.
Section Five	Presents conclusions based on the analysis contained in this report.
Appendices	In an effort to streamline this publication, the appendices are now offered in color on the DOE Radiation Exposure Web site. Please visit **http://www.hss.energy.gov** and select HSS Reports and Occupational Radiation Exposure Reports to review.

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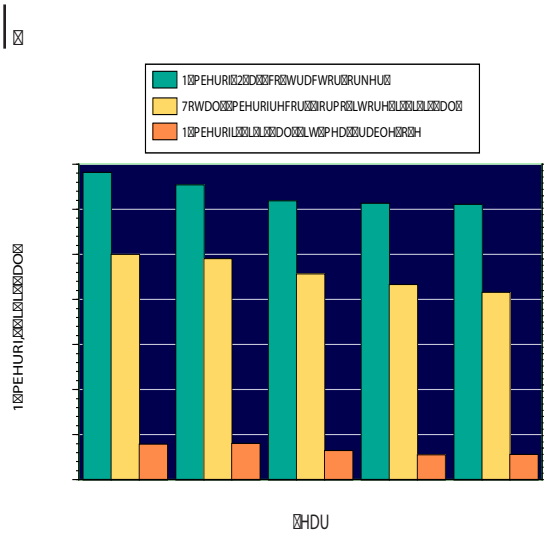
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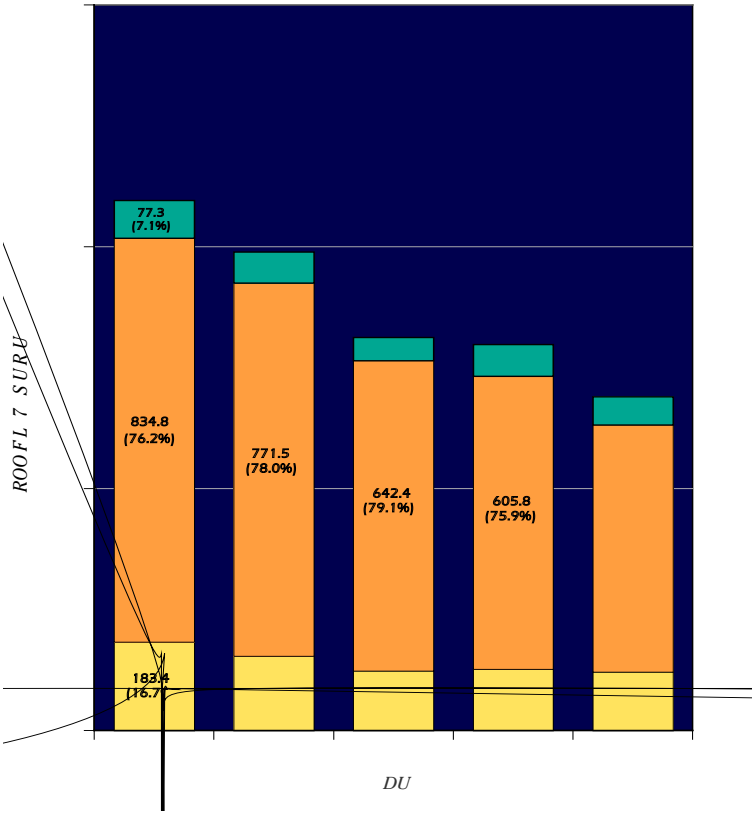
Year	DOE & Contractor Workforce	Number of Workers Monitored	Percent of Workers Monitored*	Number Monitored w/Measurable Dose	Percent Monitored w/Measurable Dose*
5-Year Average	**127,143**	**91,838**	**72%**	**13,443**	**15%**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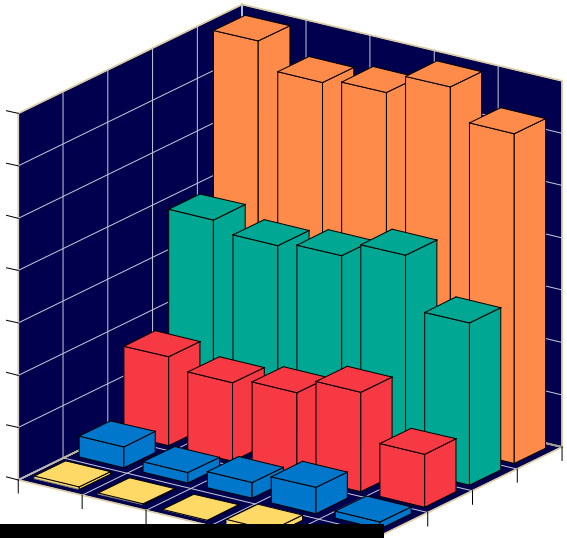

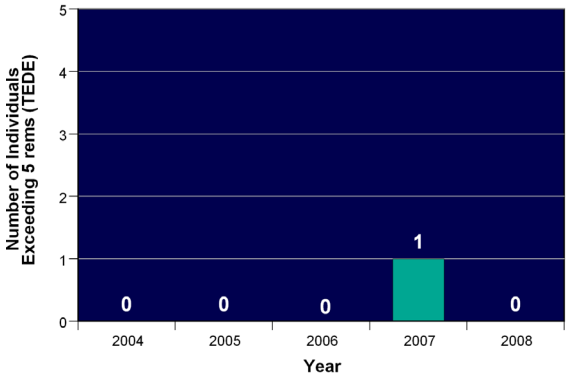

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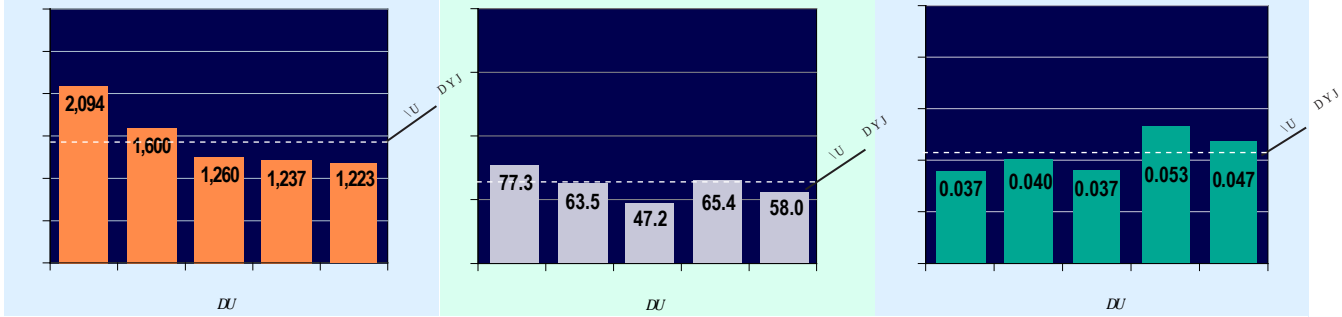

* The number of internal depositions represents the number of internal dose records with positive results reported for each individual. Individuals may have multiple intakes in a year and therefore may be counted more than once.

Year	Number of Individuals with CEDE in the Ranges (rem)*											Total No. of Indiv.**	Total Collective CEDE (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		
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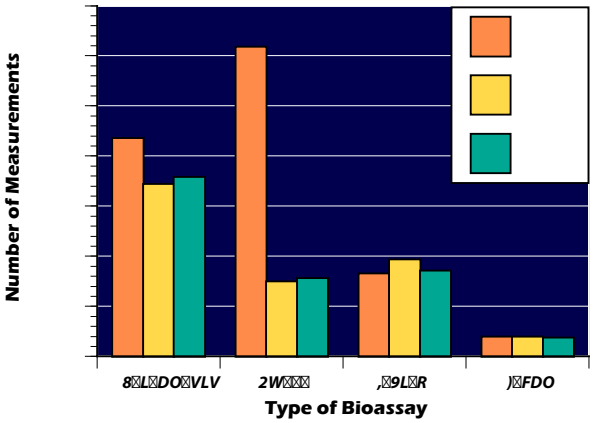

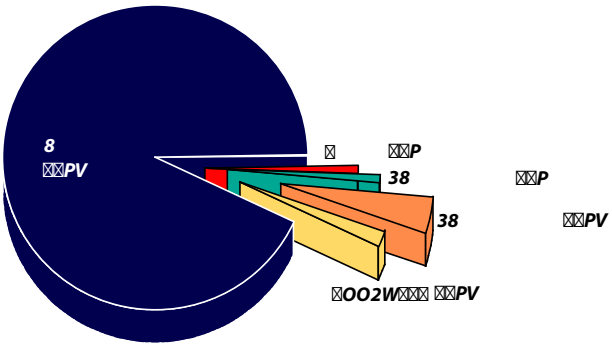

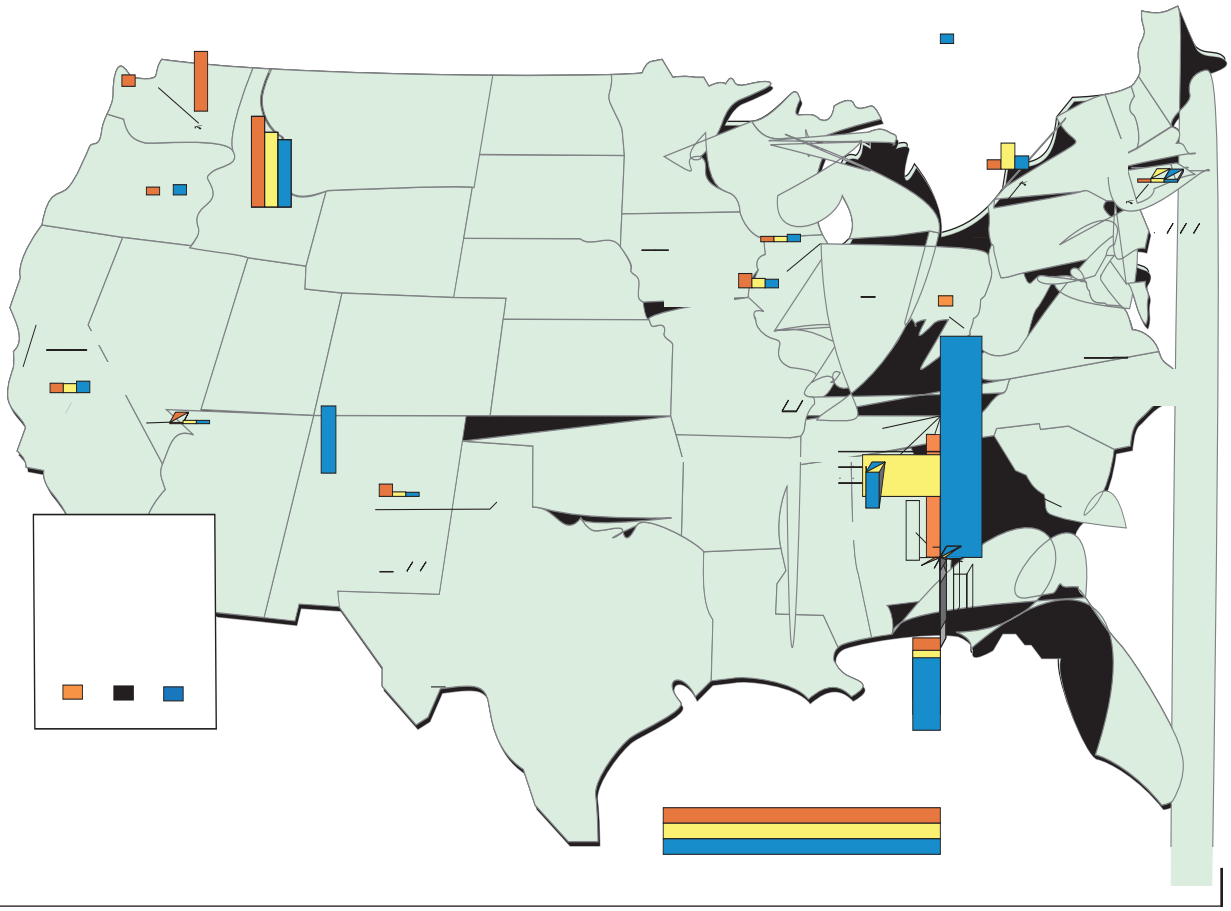

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[illegible]	[illegible]	[illegible] ▼	[illegible]	[illegible] ▼	[illegible]	[illegible] ▼		
[illegible]	[illegible]	[illegible] ▼	[illegible]	[illegible] ▲	[illegible]	[illegible] ▼		[illegible]
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[illegible]	127.1	[illegible] ▲	2,151	[illegible] ▲	[illegible]	[illegible] ▲	[illegible]	[illegible] ▼
[illegible]	[illegible]		[illegible]		[illegible]	[illegible] ▼		
[illegible]	[illegible]	[illegible] ▲	[illegible]	168% ▲	[illegible]	[illegible] ▼		
[illegible]	[illegible]	[illegible] ▼	[illegible]	[illegible] ▼	[illegible]	[illegible] ▼		
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		
[illegible]	[illegible]		[illegible]		[illegible]	[illegible] ▲	[illegible]	[illegible]
Totals [illegible]	**690.2**	**-13% ▼**	**11,287**	**2% ▲**	**0.061**	**-14% ▼**	**10%**	**-84% ▼**

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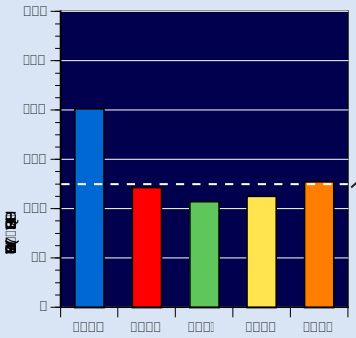
Savannah River Site	Percent Change*			Description of Activities at the Site
	2007 - 2008 (last yr.)	2006 - 2008 (3 yr.)	2004 - 2008 (5 yr.)	
				

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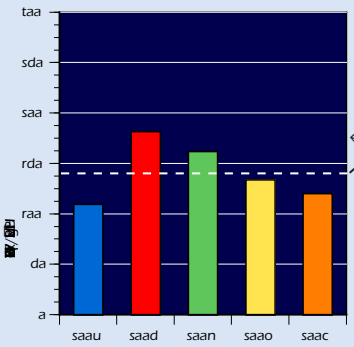
Idaho National Laboratory	Percent Chan- e*			Description of Activities at the Site
	2007 - 2008 (last	2006 - 2008 (3 yr.)	2004-2008 (5 yr.)	
	10% ↓	26% ↓	10% ↑	CH2MX WG Idaho LLC and Battelle Energy Alliance (Idaho National Laboratory Site) The primary Idaho Cleanup Project (ICP) activities, performed by CH2M-WG Idaho, LLC during CY-2008 leading to radiation exposure include the following: Waste Management Work - Inventory of legacy waste to be shipped off site in 2008 was less than 2007 due to reduction of inventory processed in 2007. RH-TRU waste handling/repack/shipping in 2008 decreased due to reduction of inventory processed in 2007 and a delay from WIPP. Idaho Nuclear Technology and Engineering Center (INTEC) - Decreased from 0.810 person-rem in 2007 to 0.002 person-rem in 2008 due to the significant reduction of number of hot samples that were processed in Remote Analytical Laboratory (RAL) and CPP-602. Liquid Waste - Decreased from 2.735 person-rems in 2007 to 1.730 person-rems in 2008 due to the video inspection of the Bin Sets, APS duct wrapping and associated RadCon Surveys in these areas in 2007. Lower dose grouting work was completed in Tank Farms during 2008. Nuclear Materials Disposition (NMD) - Decreased from 11.657 person-rems in 2007 to 1.530 person-rems in 2008. Battelle Energy Alliance The radiation exposure activities, performed by Battelle Energy Alliance during 2008 at the Idaho National Laboratory, included Reactor power operations and maintenance, i.e., loop maintenance and primary heat exchanger inspections and repair; research and development activities; hot cell and laboratory operations; and homeland security training and exercises. The increase in TEDE from 2007 (34,300 person-rems) to 2008, (48,000 person-rems) was due primarily to the following: • Analytical Laboratory ALP-7 cask loading and transfers, and repackaging/removal of radioactive material in the AL vault, resulting in a 1.250 person-rems increase.; • Two additional DTRA class exercises at MFC, resulting in a 0.325 person-rem increase; • Additional maintenance required in Nuclear Operations facilities, resulting in a 0.600 person-rem increase. • One additional Multi-Mission radioisotopes thermoelectric generator assembled in the Space & Security Power Systems (SSPS) facility, resulting in a 4,700 person-rems increase. Bechtel BWXT IdahoX LLC (Advanced Mixed Waste Treatment Project) The AMWTP work activities, performed by Bechtel BWXT Idaho, in 2008 continued the direct support of the 1995 Idaho/U.S. Navy/U.S. DOE Settlement Agreement requiring the removal of transuranic waste from the DOE"92s Idaho Operations area. The primary work activities at the AMWTP that contributed to workforce dose included TRU waste retrieval from burial, waste characterization, and waste handling operations in support of shipment of transuranic and by-product waste materials from Idaho to the DOE"92s WIPP facility and other commercial disposal sites. Increases in collective dose from 2007 can be attributed to increased retrieval and waste movement activities, initial receipt of offsite waste, and projects involving elevated dose rate waste drums. These activities lead to greater numbers of waste drums being stored at the AMWTP, which increases the dose producing source term for the worker population. While the collective total effective dose (TED) increased for the project there were significant decreases (~22%) in the maximum individual TED for 2008.

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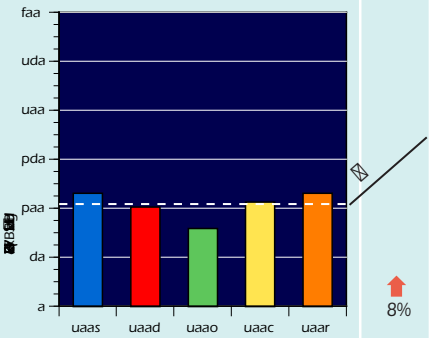
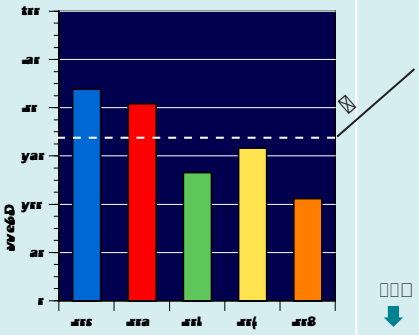
Oak Ridge Reservation	Percent Change* 2007 - 2008 (last	2006 - 2008 (3 yr.)	2004 - 2008 (5 yr.)	Description of Activities at the Site
	8%	45%	0%	The records for occupational radiation exposure monitoring conducted for BJC projects conducted during 2008 at three sites located in Oak Ridge, Tennessee: ETTP site (K25), ORNL, and Y-12 NSC. **ETTP** There were a total of 2,325 individuals monitored by BJC in 2008, resulting in a TEDE of 6.755 person-rems and a total CEDE of 0 person-rem for all BJC sites. The major activities performed at BJC sites consisted of environmental restoration work, removal or stabilization of buried hazardous wastes, decontamination of facilities, surveillance and maintenance tasks, stabilization of inactive facilities and demolition of surplus facilities. The decrease in TEDE for 2008 as compared with 2007 is attributed to a decrease in waste operations tasks at ORNL. The decreases in total neutron dose and total extremity dose for 2008 compared with 2007 were also due to the decrease in waste operations work at ORNL. There were no unusual events related to occupational radiation exposure at BJC facilities for 2008. **ORNL** The reported TEDE for ORNL for 2008 is higher than the 2007 reported TEDE. This increase can be attributed to the High Flux Isotope Reactor, Spallation Neutron Source, and Holifield Radioactive Ion Beam Facilities operating most of the year and maintenance and research activities associated with these facilities. There was also an increase in work associated with the processing of isotopes. **Y-12 National Security Complex** The collective TEDE decreased 3% from 2007 (74.3 person-rems) to 2008 (72.1 person-rems), while the total persons monitored increased by 6% from 4,862 to 5,168. Average TEDE decreased from 0.015 rem in 2007 to 0.014 rem in 2008. The number of workers receiving greater than 100 mrem is 212. The 2008 collective deep dose equivalent (DDE) for the Y-12 NSC decreased by 6.7% from 19.4 person-rems in 2007, to 18.1 person-rems in 2008. This decrease is the result of the conclusion of the Tennessee Valley Authority (TVA) Off-Spec Project and reduction in other operations. Average deep-dose equivalent remained the same at 0.004 rem. The collective CEDE decreased 1.6% from 54.9 person-rems in 2007 to 54.0 person-rems in 2008 while the average CEDE remained the same at 0.022 rem. There were 154 workers who received an internal dose in excess of 100 mrem (CEDE).

Hanford Site	Percent Change*			Description of Activities at the Site
	2007 - 2008 (last yr.)	2006 - 2008 (3 yr.)	2004- 2008 (5 yr.)	
				

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Program Office	Collective TEDE (person-rem)	Percent Change from 2007	Number with Meas. Dose	Percent Change from 2007	Avg. Meas. TEDE (rem)	Percent Change from 2007
[illegible]						
[illegible]	[illegible]		[illegible]		[illegible]	[illegible]▼
[illegible]	[illegible]		[illegible]		[illegible]	37%▲
[illegible]	[illegible]	[illegible]▼	[illegible]	[illegible]▲	[illegible]	[illegible]▼
[illegible]	[illegible]	[illegible]▲	[illegible]	[illegible]▲	[illegible]	[illegible]▼
[illegible]	[illegible]	[illegible]▲	[illegible]	[illegible]▼	[illegible]	[illegible]▲
[illegible]	[illegible]	[illegible]▼	[illegible]	[illegible]▼	[illegible]	[illegible]▼
[illegible]	[illegible]	[illegible]▼	[illegible]	[illegible]▲	[illegible]	[illegible]▼
[illegible]	[illegible]	[illegible]▼	[illegible]	100%▲	[illegible]	[illegible]▼
[illegible]	127.1	13%▲	2,151	[illegible]▲	[illegible]	[illegible]▲
[illegible]	[illegible]		[illegible]		[illegible]	[illegible]▲
[illegible]	[illegible]	[illegible]▼	[illegible]	[illegible]▼	0.141	[illegible]▼
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
EM Totals*	**304.2**	**-17%▼**	**5,532**	**5%▲**	**0.055**	**-21%▼**
[illegible]						
[illegible]	[illegible]		[illegible]		[illegible]	[illegible]▼
[illegible]	107.3	[illegible]▼	[illegible]	[illegible]▼	[illegible]	[illegible]▼
[illegible]	[illegible]	31%▲	[illegible]	[illegible]▼	0.158	39%▲
[illegible]	[illegible]	[illegible]▼	[illegible]	7%▲	[illegible]	[illegible]▼
[illegible]	[illegible]	[illegible]▼	[illegible]	[illegible]▼	[illegible]	[illegible]▼
[illegible]	[illegible]	[illegible]▼	[illegible]	[illegible]▼	[illegible]	[illegible]▲
[illegible]	[illegible]		[illegible]		[illegible]	
[illegible]	[illegible]	[illegible]▼	1,301	[illegible]▲	[illegible]	[illegible]▼
NNSA Totals*	**228.8**	**-17%▼**	**3,215**	**-4%▼**	**0.071**	**-14%▼**
[illegible]						
[illegible]	[illegible]	[illegible]▼	[illegible]	[illegible]▲	[illegible]	[illegible]▼
NE Totals*	**78.1**	**-10%▼**	**1,217**	**1%▲**	**0.064**	**-11%▼**
[illegible]						
[illegible]	[illegible]		[illegible]		[illegible]	[illegible]▼
[illegible]	[illegible]	[illegible]▲	[illegible]	[illegible]▼	0.103	63%▲
[illegible]	[illegible]	[illegible]▼	[illegible]	[illegible]▼	[illegible]	[illegible]▲
[illegible]	[illegible]	[illegible]▼	[illegible]	[illegible]▼	[illegible]	[illegible]▲
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[illegible]	[illegible]		[illegible]		[illegible]	[illegible]▲
[illegible]	[illegible]		[illegible]		[illegible]	[illegible]▼
[illegible]	29.2	[illegible]▲	353	[illegible]▲	[illegible]	[illegible]▲
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[illegible]	[illegible]	[illegible]▼	[illegible]	[illegible]▼	[illegible]	[illegible]▲
[illegible]	[illegible]		[illegible]		[illegible]	
[illegible]	[illegible]		[illegible]		[illegible]	[illegible]▼
[illegible]	[illegible]	97%▲	[illegible]	168%▲	[illegible]	[illegible]▼
SC Totals*	**78.9**	**20%▲**	**1,323**	**3%▲**	**0.060**	**17%▲**

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	Dose Ranges (TEDE in rem)	2004	2005	2006	2007	2008
Transients	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]		
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	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
All DOE	[illegible]					
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]					
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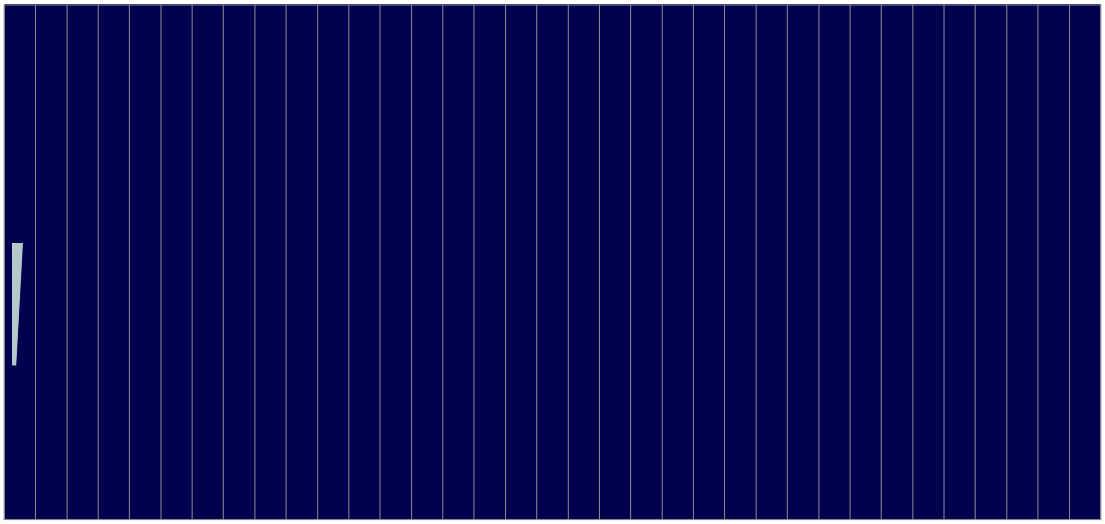

Section Four ALARA Activities at DOE

4

ALARA Activities at DOE

In past years, the published annual report has included descriptions of ALARA activities at DOE for the purposes of sharing strategies and techniques that have shown promise in the reduction of radiation exposure.

These ALARA activity descriptions are now provided on the HSS web site to facilitate the dissemination among DOE radiation protection managers and others interested in these project descriptions. Readers should be aware that the 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.

4.1 Submitting ALARA Project Descriptions for Future Annual Reports

Individual project descriptions may be submitted to the DOE Office of Corporate Safety Analysis through the REMS web site. The submittals 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)
- 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

http://www.hss.energy.gov/CSA/analysis/rems/rems/ALARA.cfm

4.2 Operating Experience Program

DOE has a mature operating experience program, which has been enhanced from the lessons-learned program that was initially developed in 1994. The current DOE operating experience program is described in DOE Order 210.2, *DOE Corporate Operating Experience Program* [9]. The objective is to institute a Department of Energy (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 purpose is to provide 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. The Headquarters corporate responsibility for identifying, analyzing, and sharing operating experience information, combined with the operating experience/lessons learned provided by DOE field sites, optimizes the knowledge gained and shared with others 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 openly disseminate such information so that not only DOE but also other external entities will have a source of information to improve the health and safety aspects of operations within their facilities, including reducing the number of accidents and injuries.

The specific operating experience web site address may be subject to change. Information services can be accessed through the HSS web site as follows:

http://www.hss.energy.gov/csa/analysis/II/

Section Five

Conclusions

5

Conclusions

The occupational radiation exposure records show that in 2008, with the exception of only one individual, DOE facilities continued to comply with DOE dose limits and ACLs and worked to minimize exposure to individuals. Only 14% of the monitored workers received a measurable dose and the average measurable dose was less than 2% of the DOE limit. Although the number of individuals with measurable dose increased, the collective dose decreased. See *Exhibit 5-1* for summary data.

Over the past 10 years, the collective dose and the size of the monitored workforce have remained at fairly stable levels. For the past 5 years, there has been a decrease in collective dose and the number of individuals with measurable dose.

The collective dose at DOE facilities has experienced a dramatic (90%) decrease since 1986. This decrease 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. Also during this time period, regulations have improved with an increased focus on ALARA practices and risk reduction.

Exhibit 5-1:
2008 Radiation Exposure Summary.

- There were no exposures in excess of the DOE 5 rems (50 mSv) annual TEDE limit, but there was one individual at LANL who received an organ dose in excess of the 50 rems (500 mSv) limit as a result of an intake of plutonium from a puncture wound during glove-box work.
- There was one exposure in excess of the DOE ACL of 2 rems (20 mSv) TEDE. This same individual exceeded the 50 rems (500 mSv) organ dose limit from an intake of plutonium.
- The collective TEDE decreased 13% from 798 person-rems (7.98 person-Sv) in 2007 to 690 person-rems (6.90 person-Sv) in 2008.
- Sites contributing significantly to collective dose were (in descending order of collective dose) Savannah River, Idaho, Oak Ridge, Los Alamos and Hanford. These sites accounted for 79% of the collective dose at DOE in 2008.
- Decreases in collective dose at three of the highest dose sites were attributed to a reduction in dose rates and work activities at Hanford, a safety-driven pause in operations at LANL, and a reduction in the number of samples processed and source term at Idaho.
- The collective internal dose (CEDE) decreased by 11% between 2007 and 2008 due to a reduction in the number of internal doses for 2008 and an upward adjustment to the 2007 internal doses at Y-12 NSC.
- Ninety-three percent of the collective CEDE at DOE was due to U-234, and over 99% of the CEDE at DOE from U-234 was accrued at Y-12 NSC.
- The collective dose for transient workers decreased by 3% from 22.1 person-rems (221 mSv) in 2007 to 21.4 person-rems (214 mSv) in 2008.
- The total number of bioassay measurements performed decreased by less than 1% from 72,861 in 2007 to 72,346 in 2008.

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Glossary

administrative control level (ACL)
A dose level that is established below the DOE dose limit in order to administratively control exposures. ACLs are multitiered, with increasing levels of authority required to approve a higher level of exposure.

ALARA
Acronym for "as low as reasonably achievable," which is the approach to radiation protection to manage and control exposures (both individual and collective) to the workforce and the general public to as low as is reasonable, taking into account social, technical, economic, practical, and public policy considerations. ALA A is not a dose limit but a process with the ob-ective of attaining doses as far below the applicable limits as is reasonably achievable.

average measurable dose
Dose obtained by dividing the collective dose by the number of individuals who received a measurable dose. This is the average most commonly used in this and other reports when examining trends and comparing doses received by workers, because it reflects the exclusion of those individuals receiving a less than measurable dose. Average measurable dose is calculated for TEDE, DDE, neutron dose, extremity dose, and other types of dose.

collective dose
The sum of the total annual effective dose equivalent or total effective dose equivalent values for all individuals in a specified population. Collective dose is expressed in units of person-rem.

committed dose equivalent (CDE) (H_T,50)
The dose equivalent 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. CDE is expressed in units of rem.

committed effective dose equivalent (CEDE) (H_E,50)
The sum of the committed dose equivalents to various tissues in the body (H_T,50), each multiplied by the appropriate weighting factor (w_T) (i.e., H_E

DOE site
A geographic location operated under the authority of the U.S. Department of Energy (DOE).

exposure
As used in this report, exposure refers to individuals sub-ected to, or in the presence of, radioactive materials that may or may not result in occupational radiation dose.

lens (of the eye) dose equivalent (LDE)
The radiation dose for the lens of the eye is taken as the external equivalent at a tissue depth of 0.3 cm.

members of the public
Individuals who are not occupationally exposed to radiation or radioactive material. This includes visitors and visiting dignitaries.

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 dose
An individual's ionizing radiation dose (external and internal) as a result of that individual's work assignment. Occupational dose does not include doses received as a medical patient or doses resulting from background radiation or participation as a sub-ect in medical research programs.

shallow dose equivalent (SDE)
The dose equivalent deriving from external radiation at a depth of 0.007 cm in tissue.

SR (formerly CR)
S is defined by United Nations Scientific Committee on the Effects of Atomic adiation (UNSCEA) as the ratio of the annual collective dose delivered at individual doses exceeding a specified dose value to the collective dose. UNSCEA uses a subscript to denote the dose value (in mSv) used in the calculation of the ratio. Therefore, S_{15} would be the ratio of the annual collective dose delivered at individual doses exceeding 1.5 rems (15 mSv) to the total annual collective dose.

total effective dose (TED)
The sum of the effective dose (for external exposures) and the committed effective dose.

total effective dose equivalent (TEDE)
The sum of the effective dose equivalent for external exposures and the committed effective dose equivalent (CEDE) for internal exposures. DDE to the whole body is typically used as effective dose equivalent for external exposures. The internal dose component of TEDE changed from the annual effective dose equivalent (AEDE) to the CEDE in 1993.

total number of records for monitored individuals
All individuals who are monitored and reported to the DOE Headquarters database system. This includes DOE employees, contractors, subcontractors, and members of the public monitored during a visit to a DOE site. 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.

transient individual
An individual who is monitored at more than one DOE site during the calendar year.

urinalysis
The technique of determining the radiation dose received by an individual from an intake by the measurement of the amount of radioactive material in the urine excreted from the body.

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User Survey

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User S rvey

DOE, striving to meet the needs of its stakeholders, is looking for suggestions on ways to improve the DOE 2008 Occupational Radiation Exposure Report. **Your feedback is important.** Constructive feedback will ensure the report can continue to meet user needs. Please fill out the attached survey form and return it to

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nimi.rao@hq.doe.gov
Fax: (301) 903-1257

Questions concerning this survey should be directed to Ms. Rao at (301) 903-2297.

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

Executive Summary	1	2	3	4	5
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Dose Distribution	1	2	3	4	5
Analysis of Individual Dose Data	1	2	3	4	5
Doses above 2 rems ACL	1	2	3	4	5
Doses in Excess of 5 rems	1	2	3	4	5
Internal Depositions of Radioactive Material	1	2	3	4	5
Analysis of Site Data	1	2	3	4	5
Collective Dose by Site	1	2	3	4	5
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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:

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Please provide any additional input or comments on the report.

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