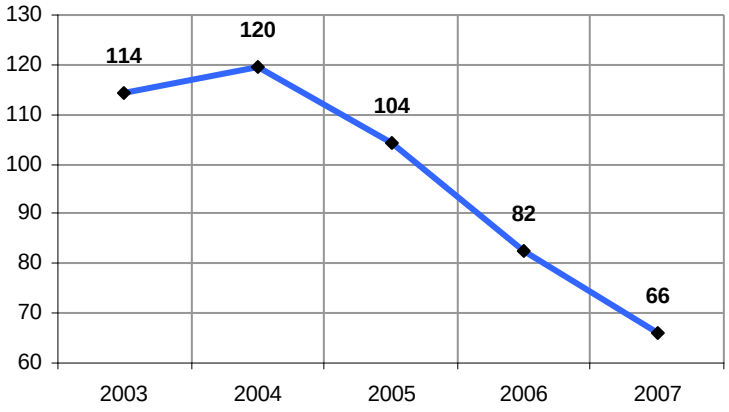
Radiological Control Profile for the Office of Science Laboratories 2003-2007

Collective Dose from all SC Laboratories (Person-Rem)



Office of Safety, Security and Infrastructure (SC-31)
Office of Science
U.S. Department of Energy

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Executive Summary

Looking back at the trend over the past five years, the collective dose from all SC laboratories has dropped by about 42 percent overall, from 114 person-rem in 2003 to 66 person-rem in 2007. By comparison, the collective dose at all Department of Energy (DOE) laboratories dropped by about 45 percent in the same period, from 1,445 to 792 person-rem.

During 2007, the collective occupational radiation dose for all SC laboratories dropped by about 20 percent to 66 person-rem, down from 82 person-rem in 2006. A large part of this decrease was at Fermi National Accelerator Laboratory (Fermilab), where the collective dose dropped to 16.6 person-rem, down from 25.7 person-rem the previous year. The drop in collective dose is attributable to the fact that there were no major shutdowns or maintenance work during the year. In 2006, Fermilab conducted a major 12 week shutdown for upgrades, maintenance and repair work, which brought the collective dose up to 25.7 person-rem for the year. For comparison, the collective dose was 16.1 person-rem in 2005, when there were no major shutdowns.

In 2007, the collective dose at Oak Ridge National Laboratory (ORNL) dropped to 18.3 person-rem, down from 21.5 person-rem the previous year. The major contribution to the collective dose at ORNL is the work at the Radiochemical Engineering Development Center and the High Flux Isotope Reactor.

At Pacific Northwest National Laboratory (PNNL), the collective dose was 11 person-rem in 2007, down from 13.3 person-rem the previous year. More than 75 percent of the collective dose is from operations at the Radiochemical Processing Laboratory (RPL), PNNL's category II nuclear facility.

In 2007, for the third year in a row, there were no workers with an annual dose exceeding 1,000 millirem. In 2004, there were two workers in this category, both at the Alpha Gamma Hot Cell Facility (AGHCF) at Argonne National Laboratory (ANL).

Most workers who were monitored for radiation exposure at SC laboratories received no measurable dose at all. Of those who did, more than 80 percent received less than 100 millirem per year (the threshold for when a dosimeter must be issued). More than 99 percent of those with a measurable dose received an annual dose under 500 millirem, which is one-tenth of the DOE annual limit of 5,000 millirem (5 rem).

Reportable occurrences for personnel contamination, loss of control of radioactive material, spread of contamination or unplanned radiation exposures do not show any clear trend, although they generally correspond to the amount of work performed. Off-site doses to members of the public from releases of radionuclides to the environment are all well within regulatory limits.

Introduction

This is a current assessment of the performance of SC laboratories with respect to radiological control. It provides a five-year retrospective look at occupational radiation exposures and radionuclide releases to the environment at all SC laboratories, including results for all DOE employees, contractors, subcontractors, and visitors. The scope of the report includes occupational doses for all workers at each facility and is not limited to just those funded by SC.

The occupational exposure data in this report is taken from the DOE Radiation Exposure Monitoring System (REMS), which serves as the central repository of radiation exposure information for DOE Headquarters. The REMS data is available on the web at http://www.hss.energy.gov/csa/analysis/rems/rems/ri.htm and is also published annually in the *DOE Occupational Radiation Exposure Report*.

Excellence in Radiological Control

The Department strives to maintain radiation exposures to its workers and the public below administrative control levels and regulatory limits and to further reduce these exposures to levels that are "As Low As Reasonably Achievable" (ALARA). The ALARA methodology considers both individual and group doses and involves a cost/benefit analysis that considers social, technical, economic, practical, and public policy aspects of the overall goal of dose reduction.

To evaluate how well ALARA is being implemented for workers at SC laboratories, it is necessary to look at several different measures of occupational dose. The analysis in this report considers the total number of individuals who are monitored for dose, the number of those who actually receive a measurable dose, the collective dose for all monitored individuals, and the average dose.

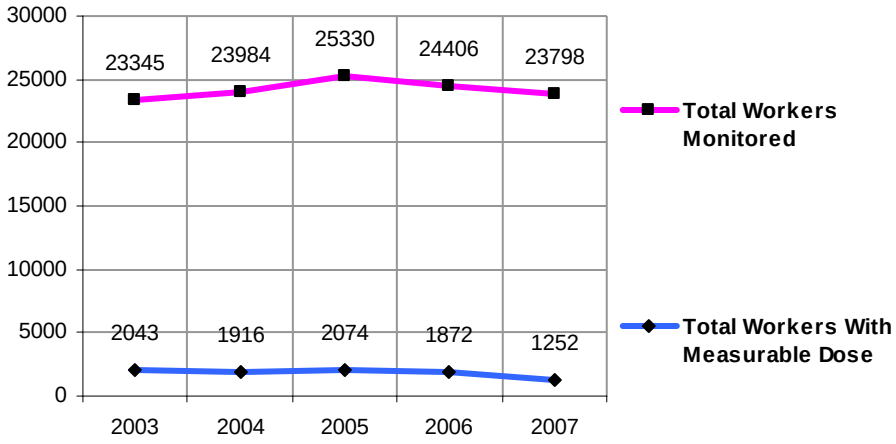
One characteristic of a good ALARA program is that the majority of worker dose should be at relatively low levels, with only a small percentage of workers receiving doses approaching administrative control levels. For this reason, this report also includes a frequency distribution for the total number of exposed workers at selected ranges of dose.

Another characteristic of a robust radiological safety program is that, for a constant workload, both individual and group doses should drop over time, as experience and lessons learned combine to improve radiological work practices. This analysis provides a five-year retrospective of occupational and environmental radiation exposures to evaluate where reductions have occurred. It is important to note that an increase in dose does not necessarily indicate a problem if it can be attributed to increased work activity rather than a decrease in radiation control practices.

Number of Monitored Workers

The total number of monitored workers at all SC laboratories has increased slightly, from 23,345 in 2003 to 23,798 in 2007 (see Figure 1.) However, only a fraction of those monitored actually received a measurable dose. The number of workers with a measurable dose decreased from 2,043 in 2003 to 1,252 in 2007.

Figure 1: Number of Monitored Workers at SC Laboratories

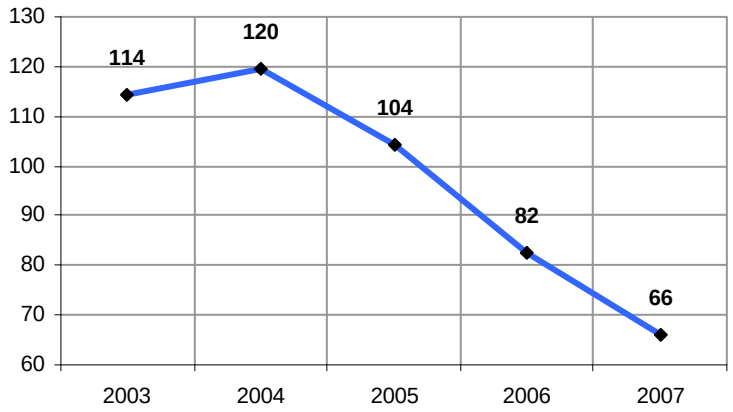


Personnel dosimetry is required for DOE workers who are likely to receive a dose greater than 100 millirem per year. Also, visitors are monitored at half that limit (50 millirem per year) if they are members of the public and not employees.

Collective Occupational Dose

Looking back at the trend over the past five years, the collective dose from all SC laboratories has dropped by about 42 percent overall, from 114 person-rem in 2003 to 66 person-rem in 2007 (see Figure 2.) By comparison, the collective dose at all Department of Energy (DOE) laboratories dropped by about 45 percent in the same period, from 1,445 to 792 person-rem.

Figure 2: Collective Dose from all SC laboratories (Person-Rem)



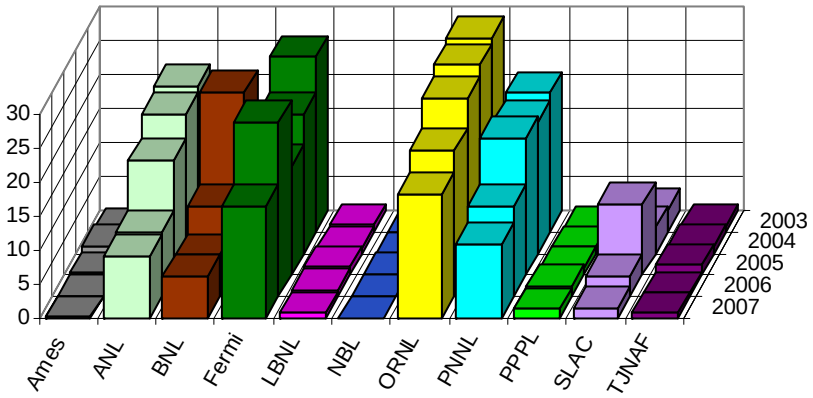
During 2007, the collective occupational radiation dose for all SC laboratories dropped by about 20 percent to 66 person-rem, down from 82 person-rem in 2006. A large part of this decrease was at Fermi National Accelerator Laboratory (Fermilab), where the collective dose dropped to 16.6 person-rem, down from 25.7 person-rem the previous year (see Figure 3). The drop in collective dose is attributable to the fact that there were no major shutdowns or maintenance work during the year. In 2006, Fermilab conducted a major 12 week shutdown for upgrades, maintenance and repair work, which brought the collective dose up to 25.7 person-rem for the year. For comparison, the collective dose was 16.1 person-rem in 2005, when there were no major shutdowns.

In 2007, the collective dose at Oak Ridge National Laboratory (ORNL) dropped to 18.3 person-rem, down from 21.5 person-rem the previous year. The major contribution to the collective dose at ORNL is the work at the Radiochemical Engineering Development Center and the High Flux Isotope Reactor.

At Pacific Northwest National Laboratory (PNNL), the collective dose was 11 person-rem in 2007, down from 13.3 person-rem the previous year. More than 75 percent of the collective dose is from operations at the Radiochemical Processing Laboratory (RPL), PNNL's category II nuclear facility. The PNNL collective dose was significantly below the anticipated level of 12.5 person-rem for 2007 due to three factors. The first and primary cause was from dose reductions realized in the Tritium Target Program-Post Irradiation Examination activities in the RPL. A second cause was an overall reduction in higher source term and Shielded Facility Operations (SFO) work scope in the RPL. The third and final cause was significantly less than anticipated Physical Science Facility (PSF) transitional activities with high-activity sources and radioactive material based on

an extension of PNNL occupancy for both the 326 and 329 buildings. The amount of radiological work, as measured by the number of RWP entries, increased slightly in 2007 (21,053 RWP entries in 2007 vs. 20,802 in 2006) though the dose per entry was significantly lower (0.52 mrem per entry in 2007 vs. 0.64 mrem per entry in 2006).

Figure 3: Collective Dose at SC Laboratories (Person-Rem)



Year	Ames	ANL	BNL	Fermi	LBNL	NBL	ORNL	PNNL	PPPL	SLAC	TJNAF
2003	0.448	21.379	12.183	25.670	1.037	0.045	28.591	20.407	0.552	3.127	0.992
2004	1.152	20.514	23.678	20.570	0.739	0.035	27.675	19.340	0.972	3.916	1.074
2005	0.339	16.984	10.216	16.130	1.180	0.160	26.122	20.073	1.164	10.370	1.519
2006	0.182	9.526	6.107	25.740	0.937	0.085	21.493	13.272	1.544	3.046	0.536
2007	0.158	9.242	6.277	16.560	0.770	0.027	18.309	10.991	1.380	1.453	0.773

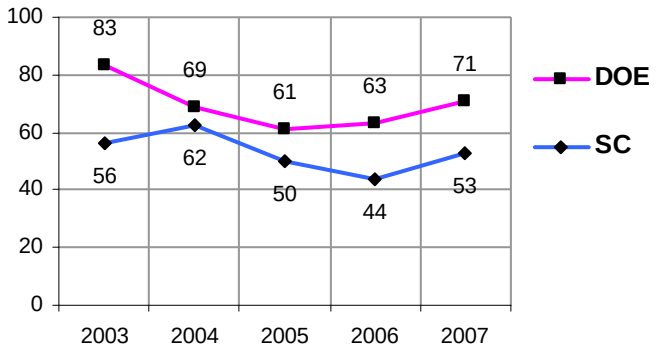
The collective dose at Stanford Linear Accelerator Center (SLAC) dropped to 1.5 person-rem in 2007, down from 3.0 person-rem the previous year. The decrease in collective dose was attributable to a corresponding decrease in maintenance activities conducted inside Radiological Control Areas where activated accelerator components are present.

At Argonne National Laboratory (ANL), the collective dose dropped to 9.2 person-rem in 2007, down from 9.5 person-rem the previous year. The two major dose contributors in 2007 were the Intense Pulsed Neutron Source (IPNS) and nuclear facility operations. The latter included the Alpha Gamma Hot Cell Facility (AGHCF), Building 205 G-Wing gloveboxes, and radioactive waste processing. The collective dose accrued for each of the two major contributors was approximately the same, and accounted for close to half the total collective dose for the Laboratory. IPNS and nuclear facility doses were received primarily during maintenance periods.

Average Measurable Occupational Dose

The average measurable dose for all SC facilities has ranged between 44 to 62 millirem during the last five years. By comparison, the average measurable dose for all DOE sites has ranged between 61 to 83 millirem (see Figure 4).

Figure 4: Average Measurable Dose - DOE and SC compared (mrem/yr)



The average measurable dose is calculated by dividing the collective dose by the total number of individuals with a measurable dose. While the average measurable dose is one useful indicator for dose to workers (and visitors) at SC laboratories, it can be misunderstood if taken out of context. For example, the average measurable dose can drop if there is an overall increase in the number of workers who receive very low levels of measurable dose. This may give a mistaken impression that doses are dropping, when in fact they are rising.

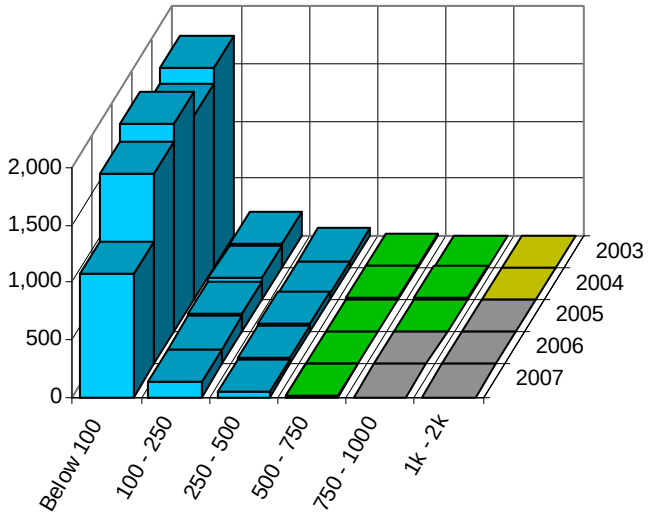
Also, since the average is calculated by dividing by the total number of workers with a measurable dose, the average may not be very sensitive to increases in dose to small numbers of workers, which may also be of concern.

In order to provide a more complete picture of radiation exposures, the following section presents a frequency distribution showing the number of workers at selected intervals of annual dose with trends over the past five years.

Occupational Dose Distribution

Of all SC laboratory workers who receive a measurable dose, the majority received an annual dose of less than 100 millirem, which is the DOE threshold for requiring dosimetry (see Figure 5). For the last five years, at least 80 percent of all workers at SC laboratories fell into this category.

Figure 5: Dose Distribution for SC Laboratories: Total Number of Workers in Each Dose Range



Dose Range (millirem/year)

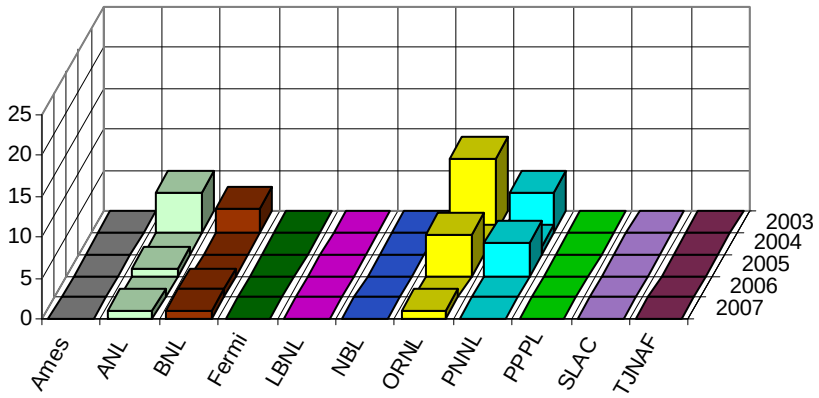
Year	Below 100	100 - 250	250 - 500	500 - 750	750 - 1000	1k - 2k
2003	1,744	212	65	17	4	1
2004	1,615	204	64	17	14	2
2005	1,823	164	72	12	3	0
2006	1,671	138	57	6	0	0
2007	1,070	133	45	4	0	0

In 2007, for the third year in a row, there were no workers with an annual dose exceeding 1,000 millirem. In 2004, there were two workers in this category, both at the AGHCF at ANL.

Personnel Contamination

There were three reported occurrences of personnel contamination in 2007. Over the past five years, there were 38 occurrences, as compared to 348 for all of DOE. These occurrences were predominately at the multi-program laboratories (see Figure 6). These occurrences do not show any clear trend, although they generally correspond to the amount of work performed.

Figure 6: Occurrences at SC Laboratories for Personnel Contamination



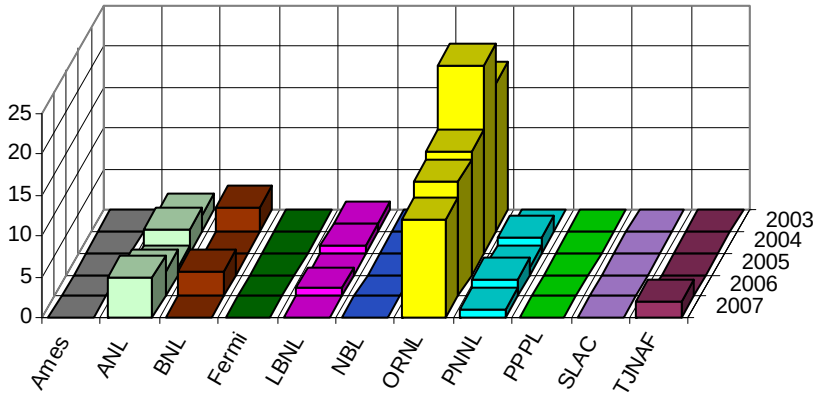
Year	Ames	ANL	BNL	Fermi	LBNL	NBL	ORNL	PNNL	PPPL	SLAC	TJNAF
2003	0	5	3	0	0	0	9	5	0	0	0
2004	0	0	0	0	0	0	1	1	0	0	0
2005	0	1	0	0	0	0	5	4	0	0	0
2006	0	0	1	0	0	0	0	0	0	0	0
2007	0	1	1	0	0	0	1	0	0	0	0

Although occurrences of personnel contamination do not cause any significant dose, they are tracked as a performance indicator for conduct of operations. An increase in the number of personnel contaminations may indicate a degradation in radiological control practices, if not otherwise attributable to a change in work activities. The threshold for reporting personnel contamination occurrences was raised in mid-2003, which generally decreased the total number reported, as compared to previous years.

Loss of Control of Radioactive Material and Spread of Contamination

In 2007, there were 20 reported occurrences for loss of control of radioactive material and spread of contamination. Over the past five years, there were 113 occurrences, as compared to 711 for all of DOE. These occurrences were predominately at ORNL, which are mostly due to the legacy contamination found during movement of personnel from old buildings to newer facilities (see Figure 7).

Figure 7: Occurrences at SC Laboratories for Loss of Control of Radioactive Material and Spread of Contamination



Year	Ames	ANL	BNL	Fermi	LBNL	NBL	ORNL	PNNL	PPPL	SLAC	TJNAF
2003	0	2	3	0	1	0	18	0	0	0	0
2004	0	3	0	0	1	0	23	2	0	0	0
2005	0	1	0	0	0	0	15	1	0	0	0
2006	0	3	3	0	1	0	14	2	0	0	0
2007	0	5	0	0	0	0	12	1	0	0	2

Like personnel contamination, these occurrences do not cause any significant dose, but are used as a performance indicator for conduct of operations. The threshold for reporting these contamination occurrences was raised in mid-2003, which generally decreased the total number reported, as compared to previous years.

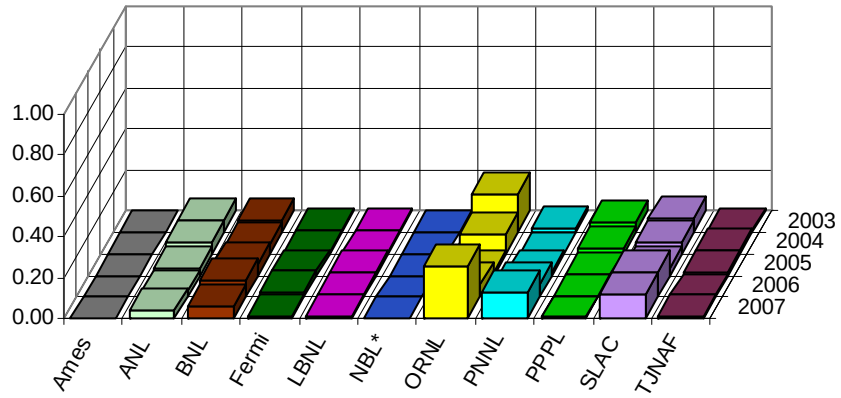
Unplanned Radiation Exposures

There were no occurrences of unplanned radiation exposures at SC laboratories in 2007. During the past five years, there was only one of these types of occurrences at SC laboratories, as compared to 36 for all of DOE.

Environmental Releases of Radionuclides

All DOE facilities are required to demonstrate to the Environmental Protection Agency (EPA) that radionuclides released to air do not cause a dose greater than 10 millirem per year to any member of the public. This standard is found in the National Emission Standards for Hazardous Air Pollutants (NESHAPS) standard 40 CFR 61, Subpart H. This dose of 10 millirem per year is too small to measure because of the much higher natural background radiation (around 300 millirem per year) and must be calculated annually, using EPA-approved computer codes.

Figure 8: NESHAPS dose at SC Laboratories (mrem/yr)



Year	Ames	ANL	BNL	Fermi	LBNL	NBL*	ORNL	PNNL	PPPL	SLAC	TJNAF
2003	0.000	0.057	0.060	0.007	0.010	0.000	0.189	0.021	0.047	0.070	0.013
2004	0.000	0.054	0.044	0.008	0.010	0.000	0.100	0.000	0.029	0.060	0.019
2005	0.000	0.034	0.053	0.022	0.019	0.000	0.020	0.017	0.007	0.040	0.014
2006	0.000	0.029	0.081	0.025	0.013	0.000	0.060	0.065	0.008	0.120	0.010
2007	0.000	0.045	0.059	0.016	0.012	0.000	0.260	0.133	0.008	0.120	0.012

** The NESHAPS dose for NBL is included in the total for ANL.*

Over the past five years, the dose to the maximally exposed individual has remained substantially less than one millirem per year at all SC laboratories (see Figure 8). In 2007, the largest dose was at ORNL (0.260 millirem, or 2.6 percent of the limit).

In addition to complying with the NESHAPS standard for releases to air, DOE facilities must also comply with the DOE dose limit of 100 millirem per year for members of the public from all pathways (DOE O 5400.5, *Radiation Protection of the Public and the Environment*). Important pathways which are evaluated include releases to both groundwater and surface waters (e.g., drinking water, eating fish, swimming, wading, and shoreline use). Off-site doses to members of the public from releases of radionuclides to the environment are all well within regulatory limits.

Laboratory Profiles

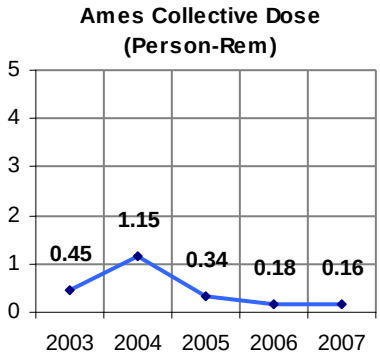
The following section is one-page synopses for each of the SC laboratories, briefly discussing their radiological operations and a summary of the occupational radiation doses for the past five years. Performance measures for radiological control are also noted, including both dose and contamination control, as applicable.

The occupational dose distribution tables are highlighted in color for easier reading and to help facilitate comparison of one laboratory with another. The highlight colors for the dose distributions are the same as those used in Figure 5, "Dose Distribution for SC Laboratories", where 0-500 mrem is blue, 500-1000 mrem is green, and 1000-2000 mrem is yellow.

Ames Laboratory (Ames)

Radiological Control Profile

In 2007, the collective dose at Ames Laboratory dropped to 0.16 person-rem, down from 0.18 person-rem the previous year. There were only six workers who had a measurable dose, and all of the measurable doses were less than 100 millirem.



The radiological work at Ames includes use of x-ray devices, remediation of legacy contamination, stewardship of radioactive materials, and intermittent research involving small amounts of radioactive materials. There are currently 17 x-ray systems and approximately 90 trained x-ray workers.

Radioactive materials work has been minimal over the past five years, with primary use consisting of sealed source materials and irradiated metals. Ames Laboratory radiological activities are subject to a readiness review process and ALARA committee review.

Occupational Radiation Dose Distribution 2003-2007

Year	Total Workers In Each Dose Range (mrem) > Below 100	100- 250	250- 500	500- 750	750- 1000	1k- 2k
2003	21	0	0	0	0	0
2004	40	0	0	0	0	0
2005	14	0	0	0	0	0
2006	8	0	0	0	0	0
2007	6	0	0	0	0	0

Performance Measures for Radiological Control

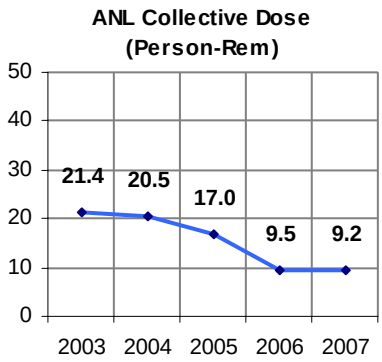
Ames uses the average total effective dose equivalent (TEDE) to measure the effectiveness of management commitments to ALARA. The rating is based on the average TEDE per person who received a measurable dose, as follows:

Outstanding = less than 30 millirem
Excellent = 30-42 millirem
Good = more than 42 and less than 79 millirem
Marginal = between 79-91 millirem
Unsatisfactory = more than 91 millirem

Argonne National Laboratory (ANL)

Radiological Control Profile

The collective dose at ANL dropped to 9.2 person-rem in 2007, down from 9.5 person-rem the previous year. For the third year in a row, there were no workers with an annual dose exceeding 750 millirem.



The two major dose contributors in 2007 were the Intense Pulsed Neutron Source (IPNS) and nuclear facility operations. The latter included the Alpha Gamma Hot Cell Facility (AGHCF), Building 205 G-Wing gloveboxes, and radioactive waste processing. The collective dose accrued for each of the two major contributors was approximately the same, and accounted for close to half the total collective dose for the Laboratory. IPNS and nuclear facility doses were received primarily during maintenance periods.

Occupational Radiation Dose Distribution 2003-2007

Year	Total Workers In Each Dose Range (mrem) >					
	Below 100	100- 250	250- 500	500- 750	750- 1000	1k- 2k
2003	159	51	18	3	0	0
2004	122	28	12	3	5	2
2005	222	27	14	4	0	0
2006	129	23	5	1	0	0
2007	115	24	5	2	0	0

Performance Measures for Radiological Control

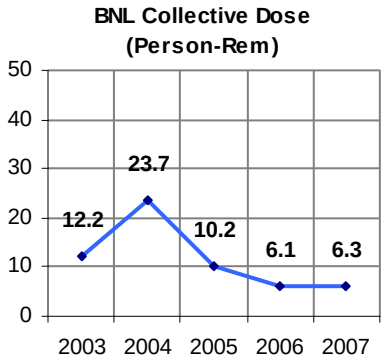
A new leading performance indicator replaced collective dose equivalent in October 2006. It is based on the number of ALARA reviews conducted and extra credit is given for improvements in the management of radiation exposures. Other performance measures were the number of radioactive contaminations and contaminated individuals, and the number of criticality safety infractions meeting ORPS reportability criteria. The contract provides that a joint committee of Argonne Site Office (ASO) and ANL representatives will review the occupational radiation protection performance measures quarterly and agree on adjustments to performance expectations as necessary to account for changes in the scope of radiological work. ASO awarded extra credit in 2007 for the innovations or improvements associated with the extremity dose reduction in cutting of radioactive fuel cladding samples.

Brookhaven National Laboratory (BNL)

Radiological Control Profile

In 2007, the collective dose at BNL increased slightly to 6.3 person-rem, from 6.1 person-rem in 2006. There were no workers with a dose exceeding 250 mrem.

The low collective dose is mainly attributed to a decrease in high dose work activities at the Environmental Restoration Projects (ERP). While a lot of the ERP work will be done remotely, the dose is expected to increase when the graphite pile removal begins at the Brookhaven Graphite Research Reactor.



Occupational Radiation Dose Distribution 2003-2007

Year	Total Workers In Each Dose Range (mrem) > Below 100	100- 250	250- 500	500- 750	750- 1000	1k- 2k
2003	273	29	3	1	0	0
2004	246	36	8	5	6	0
2005	189	16	11	0	0	0
2006	130	15	2	0	0	0
2007	180	11	0	0	0	0

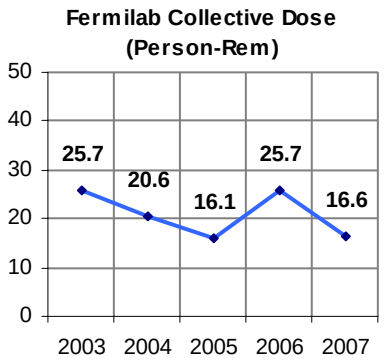
Performance Measures for Radiological Control

The performance measures define an effective ALARA program as comprised of dose goals and administrative control levels that are challenging and consider both historical exposures and planned operations; supportive of changes to those goals when operating assumptions change; communicates ALARA initiatives that help to optimize radiological exposures, and ensures dose is shared among all qualified workers.

Fermi National Accelerator Laboratory (Fermilab)

Radiological Control Profile

In 2007, the collective dose dropped to 16.6 person-rem, down from 25.7 person-rem the previous year. The drop in collective dose is attributable to the fact that there were no major shutdowns or maintenance work during the year. In 2006, Fermilab conducted a major 12 week shutdown for upgrades, maintenance and repair work, which brought the collective dose up to 25.7 person-rem for the year. For comparison, the collective dose was 16.1 person-rem in 2005, when there were no major shutdowns.



The 12 week shutdown included upgrades and component replacement in the Booster, replacement of the Main Injector Quadrupole Magnet and repairing leaks in the Neutrinos at the Main Injector (NuMI) horns. All of the shutdown tasks were necessary to achieve the challenging goals of the physics research program, while at the same time were aimed at reducing beam losses, which is an essential ingredient in improving performance and increasing deliverable proton intensities. Reducing beam losses also reduces radioactivation of beam line components and potential radiation dose to personnel who must maintain the accelerators in the future. The work during the shutdown was performed by workers who were fully trained in radiological work procedures and were thoroughly briefed in the specifics of each job task.

Occupational Radiation Dose Distribution 2003-2007

Year	Total Workers In Each Dose Range (mrem) > Below 100	100- 250	250- 500	500- 750	750- 1000	1k- 2k
2003	556	43	10	3	0	0
2004	451	34	13	0	0	0
2005	385	29	11	0	0	0
2006	720	36	19	1	0	0
2007	160	36	15	2	0	0

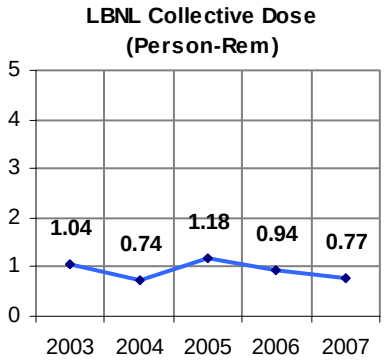
Performance Measures for Radiological Control

The ES&H Section Radiation Protection Group led formal reviews to identify both significant innovations recently made and opportunities for further improvement. For this measure, an identified innovation or opportunity for improvement that credibly can improve the control of radiation exposures is considered to be "significant." The measure was evaluated based on the number of reviews conducted and the number of significant actions identified and documented.

Lawrence Berkeley National Laboratory (LBNL)

Radiological Control Profile

In 2007, LBNL had a collective dose of 0.77 person-rem, down slightly from 0.94 person-rem the previous year. There were only two workers with a dose exceeding 100 millirem, and there were no workers with a dose exceeding 250 millirem.



Radiological work includes research in life sciences and physical sciences involving small amounts of radioactive materials, operation of the Advanced Light Source and 88-inch Cyclotron, and closure activities at the former Bevatron accelerator. Radiopharmaceutical development and functional imaging with positron emission tomography represent areas of growth in radiological work.

The Laboratory has a number of policies within the framework of Integrated Safety Management that contribute to maintaining occupational radiation doses ALARA. Radiation safety professionals perform a "walk down" on any operation that yields a dosimeter reading exceeding 50 millirem to any worker. Also, the LBNL Radiation Safety Committee (RSC) meets quarterly, evaluates dose trends for each building, and reviews the "top 5" worker doses ensure that the doses are commensurate with the work.

Occupational Radiation Dose Distribution 2003-2007

Year	Total Workers In Each Dose Range (mrem) >					
	Below 100	100- 250	250- 500	500- 750	750- 1000	1k- 2k
2003	17	2	1	0	0	0
2004	17	1	0	0	0	0
2005	19	3	0	0	0	0
2006	15	1	0	0	0	0
2007	15	2	0	0	0	0

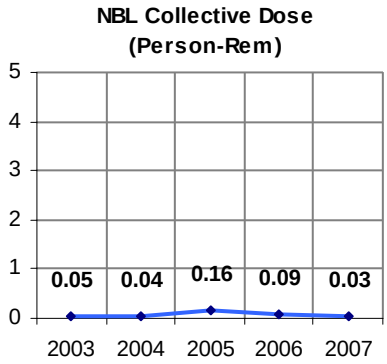
Performance Measures for Radiological Control

An Outstanding rating requires that the number of individual exposures exceeding 100 millirem must be less than or equal to the control level of 10, plus the average individual positive dose is less than the control level of 50 millirem, all without an increase in workload. The LBNL performance measure for reportable occurrences of personnel contamination provides an Outstanding rating for a weighted number of contaminated individuals less than or equal to 4.0 (with unusual occurrences having a weighting factor of 1.5, and off-normal at 1.0). The performance measure for control of radioactive material and spread of contamination provides an Outstanding rating for 2.0 or less weighted occurrences. Unusual occurrences use a weighted factor of 1.5 and off-normals 1.0.

New Brunswick Laboratory (NBL)

Radiological Control Profile

In 2007, the collective dose at NBL remained very low at 0.03 person-rem, down from 0.09 person-rem the previous year. There were no individuals with an annual dose exceeding 100 millirem. In 1997, there was one individual at NBL with a dose that exceeded 100 millirem, and no individuals have exceeded that value since that time.



The Laboratory's mission deals with handling and use of various nuclear materials. This work is the sole source of radiation exposure to Laboratory staff. This work has historically been conducted using ALARA principles.

Occupational Radiation Dose Distribution 2003-2007

Year	Total Workers In Each Dose Range (mrem) > Below 100	100- 250	250- 500	500- 750	750- 1000	1k- 2k
2003	2	0	0	0	0	0
2004	1	0	0	0	0	0
2005	4	0	0	0	0	0
2006	2	0	0	0	0	0
2007	2	0	0	0	0	0

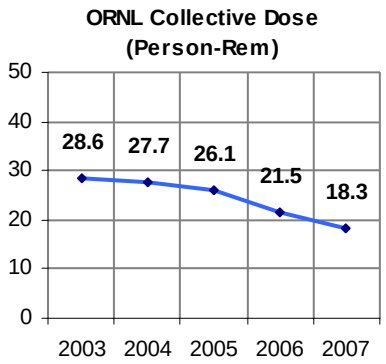
Performance Measures for Radiological Control

Due to the low exposure levels at NBL, the primary performance measure used by the Laboratory is total person-mrem received.

Oak Ridge National Laboratory (ORNL)

Radiological Control Profile

In 2007, the collective dose at ORNL dropped to 18.3 person-rem, down from 21.5 person-rem the previous year. For the first time since 2003, there were no workers with a dose exceeding 500 millirem.



The major contribution to the collective dose at ORNL is the work at the Radiochemical Engineering Development Center and the High Flux Isotope Reactor. The collective dose at ORNL will remain a challenge because of future projects and activities, including the consolidation of hot cell facilities, continued cleanup of legacy radioactive materials, and the operation of the Spallation Neutron Source. There is an ALARA Steering Committee and an ALARA Working Committee which discusses ongoing projects and share lessons learned on dose reductions. ALARA awards are routinely presented to employees who develop methods of reducing dose for particular jobs.

Occupational Radiation Dose Distribution 2003-2007

Year	Total Workers In Each Dose Range (mrem) > Below 100	100- 250	250- 500	500- 750	750- 1000	1k- 2k
2003	296	52	22	4	0	1
2004	262	55	19	3	3	0
2005	294	47	21	2	1	0
2006	239	37	17	4	0	0
2007	233	34	16	0	0	0

Performance Measures for Radiological Control

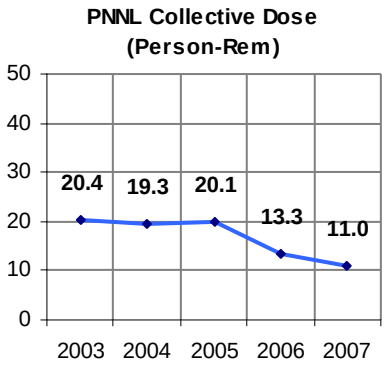
Performance measures are in place for both worker radiation dose and radiological control. The measures include:

- No unplanned dose.
- Average measurable dose to workers for individuals with measurable dose is less than the dose allowable to the public; i.e., less than 100 millirem.
- Effective radiological and chemical contamination control.

Pacific Northwest National Laboratory (PNNL)

Radiological Control Profile

In 2007, the collective dose at PNNL was 11 person-rem, down from 13.3 person-rem the previous year. For the second time since 2003, there were no workers with a dose exceeding 500 millirem.



More than 75 percent of the collective dose is from operations at the Radiochemical Processing Laboratory (RPL), PNNL's category II nuclear facility. The PNNL collective dose was significantly below the anticipated level of 12.5 person-rem for 2007 due to three factors. The first and primary cause was from dose reductions realized in the Tritium Target Program-Post Irradiation Examination activities in the RPL. A second cause was an overall reduction in higher source term and Shielded Facility Operations (SFO) work scope in the RPL. The third and final cause was significantly less than anticipated Physical Science Facility (PSF) transitional activities with high-activity sources and radioactive material based on an extension of PNNL occupancy for both the 326 and 329 buildings. The amount of radiological work, as measured by the number of RWP entries, increased slightly in 2007 (21,053 RWP entries in 2007 vs. 20,802 in 2006) though the dose per entry was significantly lower (0.52 mrem per entry in 2007 vs. 0.64 mrem per entry in 2006).

Occupational Radiation Dose Distribution 2003-2007

Year	Total Workers In Each Dose Range (mrem) >					
	Below 100	100- 250	250- 500	500- 750	750- 1000	1k- 2k
2003	166	31	11	6	4	0
2004	170	41	12	6	0	0
2005	141	30	15	6	2	0
2006	144	24	14	0	0	0
2007	150	22	9	0	0	0

Performance Measures for Radiological Control

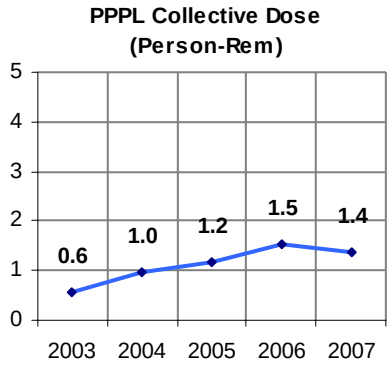
The PNNL radiological control management system continues to demonstrate mature performance through effective use of self assessments and Radiological Problem Report (RPR) and ALARA Tracking and Trending. Review of the RPR/ALARA tracking and trending data identified general improvements in contamination control which has resulted in an overall decrease in the number of RPRs (normalized to the amount of radiological work performed). Results from programmatic assessments performed in 2007 indicated stable or improved performance in all areas assessed. The Laboratory implemented a number of improvements in the radioactive source control program in response to a spread of contamination incident resulting from a leaking sealed source.

Princeton Plasma Physics Laboratory (PPPL)

Radiological Control Profile

The collective dose at PPPL was 1.4 person-rem in 2007, down slightly from 1.5 person-rem in 2006. There were no workers with a dose that exceeded 100 millirem.

Most of the dose received on site is due to activated components in the vicinity of the National Compact Stellarator Experiment Coil Winding Facility. This area contains components and materials that were activated during Tokamak Fusion Test Reactor operations.



Occupational Radiation Dose Distribution 2003-2007

Year	Total Workers In Each Dose Range (mrem) > Below 100	100- 250	250- 500	500- 750	750- 1000	1k- 2k
2003	110	0	0	0	0	0
2004	123	0	0	0	0	0
2005	136	0	0	0	0	0
2006	155	0	0	0	0	0
2007	153	0	0	0	0	0

Performance Measures for Radiological Control

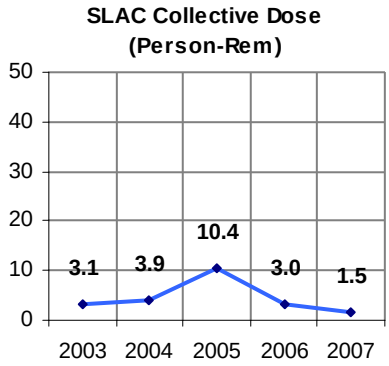
Performance measures are in place for collective dose. A TEDE that is 15 percent below the annual radiological goal established per the PPPL ALARA Plan is rated as Outstanding.

Stanford Linear Accelerator Center (SLAC)

Radiological Control Profile

The collective dose at SLAC dropped to 1.5 person-rem in 2007, down from 3.0 person-rem the previous year. There were only two workers who had an annual dose that exceeded 100 millirem.

The decrease in collective dose was attributable to a corresponding decrease in maintenance activities conducted inside Radiological Control Areas where activated accelerator components are present.



Occupational Radiation Dose Distribution 2003-2007

Year	Total Workers In Each Dose Range (mrem) >					
	Below 100	100- 250	250- 500	500- 750	750- 1000	1k- 2k
2003	106	3	0	0	0	0
2004	141	8	0	0	0	0
2005	349	10	0	0	0	0
2006	100	2	0	0	0	0
2007	39	2	0	0	0	0

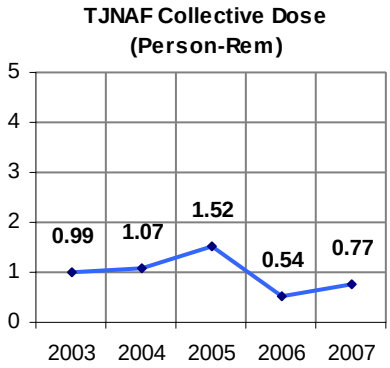
Performance Measures for Radiological Control

Performance measures are in place for unplanned radiation exposures and personnel contamination control. An Outstanding rating requires no occurrences of ORPS-reportable radiation doses or contamination. An unplanned radiation exposure includes a dose in excess of 100 millirem/year to non-radiological workers.

Thomas Jefferson National Accelerator Facility (TJNAF)

Radiological Control Profile

The collective dose at TJNAF was 0.77 person-rem in 2007, up slightly from 0.54 person-rem the previous year. There were only two workers with a dose exceeding 100 millirem. The collective dose is attributable to maintenance, repairs, and disassembly associated with a unique experimental set up involving separated electron and photon beams in one of the high power experimental halls in the Continuous Electron Beam Accelerator Facility.



There is an Exposure Alert Level of 250 millirem per year; any individual dose exceeding this level triggers an ALARA review. Additionally, any individual who receives a total dose exceeding 120 mrem in a six month period, either through Thermo Luminscent Dosimeter (TLD) badge readings, or Self Reading Pocket Dosimeter (SRPD) readings is placed on a monthly TLD badge frequency for the remainder of the monitoring year. This enables closer monitoring for individuals who may be approaching administrative alert levels.

Occupational Radiation Dose Distribution 2003-2007

Year	Total Workers In Each Dose Range (mrem) >					
	Below 100	100- 250	250- 500	500- 750	750- 1000	1k- 2k
2003	38	1	0	0	0	0
2004	42	1	0	0	0	0
2005	70	2	0	0	0	0
2006	29	0	0	0	0	0
2007	17	2	0	0	0	0

Performance Measures for Radiological Control

The Performance Evaluation and Measurement Plan (PEMP) incentivizes the percentage of pre and post Radiation Work Permit (RWP) reviews that are conducted by a Radiological Engineer, when the projected cumulative dose for the RWP exceeds 100 mrem.