Dose Standards

Contents

Dose Standards

Appendix 4E of this chapter (Guidance) presents the major criteria recommended for implementing the self-assessment.

Part 1 Introduction

411 General Requirements

Who	Shall
Division directors, program directors, office directors, and group leaders	Determine the need for a planned special exposure (PSE) and request a PSE when required.
Environment, Safety, and Health (ESH) Division director	Request DOE approval for the PSE.
Radiation Protection Program manager	Provide a technical merit review and recommendation to the ESH Division director regarding a PSE.
Safety- and environment-responsible line-management chain	Ensure that workers, minors, and on-site members of the public under their purview do not exceed specified dose limits.
Individual radiation workers and general employees	Monitor their doses throughout the calendar year and during radiological activities to ensure that specified dose limits are not exceeded. They shall also know what dose limits apply to them and where to obtain dose reports. (Go to http://eshdb.lanl.gov/cgi-bin/esh12/esh12menu.cgi).
Health Physics Operations (ESH-1)	Provide hazard analysis and field technical support for routine and planned special exposures.
Occupational Medicine (ESH-2)	Provide medical counseling for PSEs, authorized emergency exposures, and other exposures that warrant medical attention.
Radiation Protection Services (ESH-12)	• Provide dose history information. • Provide dose determinations and counseling. • Assist in ALARA (as low as reasonable achievable) analyses and radiological job reviews. • Maintain dose records.

Part 2 Dose Limits

Unless otherwise indicated, dose limits shall be stated in terms of the total effective dose equivalent (TEDE), which is the sum of the doses received from internal and external sources.

421 Lifetime Dose Limit

Guidance Note: The Laboratory has established a lifetime dose limit (cumulative TEDE) of N rem, in which N is the age of the individual in years. Article 443, chapter 4, discusses special control levels for radiological workers who have lifetime doses exceeding N rem.

To ensure implementation of the lifetime dose limit, efforts must be made to determine the lifetime occupational dose of individuals expected to receive more than 1 rem (0.01 sievert) in a year. The lifetime occupational dose shall be determined by summing all occupational internal and external doses received during the individual's lifetime at all facilities.

422 Occupational Dose Limits

1. Occupational dose limits are provided in Table 4-1 below and shall not be exceeded [see 835.202(a)(1)-(4)]. All occupational doses received during the current year (including off-site occupational dose), except the dose resulting from PSEs and authorized emergency exposures, shall be included when demonstrating compliance with Table 4-1 limits [see 835.202(b) and 702(d)]. **Guidance Note**: If formal records of an individual's previous occupational dose during the year cannot be obtained, a written estimate signed by the individual may be accepted [see 835.702(d)].
2. The occupational dose limits provided in Table 4-1 below shall apply to all workers performing radiological work. However, general employees who have not completed required training and examinations shall not be permitted unescorted access to any radiological area [see 835.901(b)].

Table 4-1 Summary of Occupational Dose Limits

Type of Exposure	Limit
Radiological worker: whole body (internal + external) (TEDE) [see 835.202(a)(1)]	5 rem/year (0.05 sievert/year)
Radiological worker: lens of the eye (external) [see 835.202(a)(3)]	15 rem/year (0.15 sievert/year)
Radiological worker: skin and extremities (external shallow dose) [see 835.202(a)(4)]	50 rem/year (0.5 sievert/year)
Radiological Worker: Any organ or tissue (other than lens of eye) (internal + external) [see 835.202(a)(2)]	50 rem/year (0.5 sievert/year)
Declared pregnant worker: embryo/fetus (internal + external) [see 835.206(a)]	0.5 rem/gestation period (5 mSv/gestation period)
Minors: whole body (internal + external) (TEDE) [see 835.207]	0.1 rem/year (1 mSv/year)
Minors: lens of the eye, skin, and extremities [see 835.207]	10% of radiological worker limits
General employee (nonradiological worker): whole body (internal + external) (TEDE)	0.1 rem/year (1 mSv/year)

Notes

1. The weighting factors in Appendix 4A shall be used in converting organ dose equivalent to effective dose equivalent for the whole body dose [see 835.203(b)].
2. The annual limit of dose to "any organ or tissue" shall be based on the committed dose equivalent to that organ or tissue resulting from internally deposited radionuclides over a 50-year period after intake plus any deep dose equivalent to that organ from external exposures during the year [see 835.202(a)(2)].
3. Exposures resulting from background radiation, as a patient undergoing therapeutic and diagnostic medical procedures, or participating as a subject in medical research programs, shall not be included in either personnel radiation dose records or assessment of dose against the limits in this Table [see 835.202(c)].
4. Whole-body dose (TEDE) shall be the effective dose equivalent from external exposures + committed effective dose equivalent from internal exposures [see 835.2(a)].
5. Lens-of-the-eye dose equivalent shall be the dose equivalent from external exposure determined at a tissue depth of 0.3 cm [see 835.2(a)].
6. Shallow dose equivalent shall be the equivalent from external exposure determined at a tissue depth of 0.007 cm [see 835.2(a)].

423 Dose Limits for Members of the Public

Members of the public permitted access to Radiological Controlled Areas (RCAs) at the Laboratory shall be limited to an annual radiation dose of 0.1 rem (1 mSv) from the sum of doses received from internal and external radiation sources [see 835.208].

424 Embryo/Fetus Dose Limits

After a female worker voluntarily notifies her employer in writing that she is pregnant, for the purposes of fetal/embryo protection, she shall be considered a declared pregnant worker. **Guidance Note**: This declaration may be revoked, in writing, at any time by the declared pregnant worker [see 835.2(a), Declared pregnant worker].

1. For a declared pregnant worker who chooses to continue work that involves occupational exposure, the following shall apply:

   a. The dose limit for the embryo/fetus from conception to birth (entire gestation period) as a result of the occupational exposure of the declared pregnant worker shall be 0.5 rem (5 mSv) [see 835.206(a)]. The dose to the embryo/fetus shall be equal to the sum of doses received from external doses, sources inside the mother, and sources inside the embryo/fetus.

   b. Measures shall be taken to avoid substantial variation above the uniform exposure rate necessary to meet the 0.5 rem (5 mSv) limit for the gestation period [see 835.206(b)]. **Guidance Note**: Avoid exceeding 0.05 rem (0.5 mSv) per month for the declared pregnant worker.

2. If the dose to the embryo/fetus is determined to have already exceeded 0.5 rem (5 mSv) when a worker notifies her employer of her pregnancy, the worker shall not be assigned to tasks in which additional occupational radiation exposure is likely during the remainder of the gestation period [see 835.206(c)].

3. The declaration of pregnancy shall be voluntary. However, an employee who wishes to declare her pregnancy must do so in writing to her supervisor, to ESH-12, or to ESH-2. The group or individual who first receives the written pregnancy notification shall send a copy to the persons in charge of fetal protection in the other groups. Once the pregnancy is declared, the Laboratory shall provide a radiation protection program that enables the declared pregnant worker to reduce the occupational exposure to her embryo/fetus. Once the employee has declared her pregnancy in writing, her supervisor must take an active role in participating in the more stringent radiation protection program for the pregnant worker.

   Guidance Note: The pregnant worker may at any time withdraw her declaration of pregnancy, thus terminating any workplace restrictions.

4. A withdrawal of declaration must be made in writing to ESH-2 or ESH-12.

Part 3 Planned Special Exposures (PSEs)

431 Introduction

Guidance Note: In an exceptional situation, a radiological worker can be authorized to receive a PSE that exceeds the values of the radiological worker limits specified in Table 4-1 above.

PSEs shall be accounted for separately from doses received under the Table 4-1 limits above [see 835.204].

432 PSE Limiting Conditions

1. A PSE shall be considered only in an exceptional situation, such as when alternatives that might prevent a radiological worker from exceeding the radiological worker limits in Table 4-1 above are unavailable or impractical [see 835.204(a)(1)].

2. The group leader or equivalent (and employer, if the direct employer is not UC) shall justify and request the PSE in writing (see Appendix 4B in this chapter) [see 835.204(a)(2)]. The group leader or equivalent shall forward the completed request to the next level of Laboratory line management.

433 PSE Dose Limits

1. Before assigning an individual to participate in an authorized PSE, the individual's dose from all previous PSEs and all doses in excess of the occupational dose limits shall be determined [see 835.204(b)]. The requester shall provide the individual's name, Z number, and anticipated PSE dose on the "Previous Doses and Dose Limits" section of the form in Appendix 4B. ESH-12 shall provide written records of all previous PSE doses and all doses in excess of the occupational dose limits by filling out the "Previous Doses and Dose Limits" section of the form. ESH-12 shall complete the "Dose Limits from PSEs" section of the form and shall indicate the eligibility of each individual.
2. An individual shall not receive a PSE that, in addition to the doses determined in Article 433.1 (this chapter), would result in a dose exceeding the following [see 835.204(c)(1)-(2)]:
   a. in a year, the numerical values of the radiological worker dose limits established in Table 4-1 above, and
   b. over the individual's lifetime, five times the numerical values of the radiological worker dose limits in Table 4-1 above.

434 PSE Consent

1. Before a PSE takes place, written consent shall be obtained from each individual involved. Each such written consent shall include the following [see 835.204(d)(1)-(3)]:
   a. the purpose of the planned operations and procedures to be used;
   b. the estimated doses and associated potential risks and specific radiological conditions and other hazards that might be involved in performing the operations; and
   c. instructions on the measures to be taken to keep the dose ALARA considering other risks that may be present.
2. The PSE Consent Form (Appendix 4C, this chapter) shall be used to document the instructions given to an individual. The employee's immediate supervisor and a radiation protection representative (for example, an ESH-1 team leader) shall verbally inform the individual of all items contained on the consent form. Any concerns **s**hall be resolved through counseling from ESH-2, ESH-12, or other organizations.

435 PSE Approvals

1. The PSE shall be approved by the next level safety- and environment-responsible line manager above the requesting manager. The next level of the safety- and environment-responsible line-management chain shall forward the approved PSE request to the Radiation Protection Program manager for review.
2. The Radiation Protection Program manager shall review the PSE for technical content and merit and recommend the PSE, if approved, to the ESH Division director and the requesting organization. The Radiation Protection Program manager shall consider consulting the ALARA Steering Committee on the appropriateness of the PSE.
3. The ESH Division director shall forward the request to the DOE Headquarters program office and the secretarial officer responsible for environment, safety, and health matters for approval [see 835.204(b)].
4. A copy of the written notification of DOE approval shall be provided by the ESH Division director to the Radiation Protection Program manager and requesting organizations.
5. The PSE must be approved as outlined above before the individual is allowed to receive the PSE exposure.

436 PSE Records and Reports

1. The dose from a PSE shall not be considered in controlling the future occupational dose of the individual under the Table 4-1 (above) radiological worker limits, but shall be included in records and reports as specified in chapter 20 [see 835.204(f)]. The ESH-12 Dose Assessment and Radiation Information Management teams shall ensure that this requirement is implemented.
2. Records of the execution of a PSE shall be maintained and a written report submitted to the DOE Headquarters program office and the secretarial officer who is responsible for environment, safety, and health matters within 30 days after the PSE [see 835.204(e)].
3. As specified above, the supervisor or group leader of the individual receiving the exposure shall forward the 30-day report to the Radiation Protection Program manager, the ESH-12 Radiation Information Management team, the next level of Laboratory management, and the DOE Headquarters program office and secretarial officer who is responsible for environment, safety, and health matters The following shall be included in the report:
   a. a copy of the written PSE form, including any cover pages used to forward the form to DOE;
   b. the "as accomplished" information and actual exposures received during the job (obtained from the ESH-12 Radiation Information Management team), entered on the PSE work form;
   c. a copy of the radiation work permit (RWP) (or other work control document) attached to the work form;
   d. an explanation for deviations from the plan;
   e. a copy of the worker's consent;
   f. the ALARA post-job review and actions, entered on the work form;
   g. a copy of the Radiation Protection Program manager's recommendation concerning approval with a copy of the DOE approval; and
   h. the requesting organization shall coordinate sending the 30-day report with the ESH-12 Radiation Information Management team so that they can fulfill the requirement specified in Article 436.3 (above).
4. The ESH-12 Radiation Information Management team shall maintain a file for the PSE that includes everything listed above, the dose assessment from Article 433.1 (above), and the planned exposure data sent to the individual in accordance with Article 436.5 (below).
5. When the Laboratory organization that initiated the PSE reports the results of the PSE to DOE, the ESH-12 Radiation Information Management Team shall also give the individual who received the PSE a report of his or her exposure data. Such a report shall be transmitted no later than the transmittal to DOE [see 835.801(e)]. The ESH-12 Radiation Information Management team shall report PSE data to the individual using the "PSE Report to Individual" form (Appendix 4D of this chapter).

Part 4 Dose Management

To achieve the Laboratory's objective of maintaining individual doses well below regulatory limits, numerical action levels and Laboratory performance goals shall be established below the regulatory limits to administratively control and help reduce individual and collective radiation dose.

441 Action Levels

1. An action level is a notification "flag" that shall be used to notify the worker, the safety- and environment-responsible line-management chain, the ESH-1 team leader, and the Radiation Protection Program manager that the worker has exceeded a predetermined external dose level and is possibly approaching an occupational dose limit. ESH-12 shall issue these notifications electronically after dosimetry data become available.

2. The action levels that shall be applied are shown below:

Dose Being Reported	Notification Action Level
Whole-body dose (EDE)	1 rem (0.01 sievert)
Lens of the eye	3 rem (0.03 sievert)
Extremities/organ/tissue	10 rem (0.1 sievert)
Embryo/fetus	0.1 rem (1 mSv)

3. Upon notification, the safety- and environment-responsible line-management chain and ESH-1 team leader shall review the worker's dose in conjunction with their tasks to identify areas of potential dose savings (ALARA).

4. The safety- and environment-responsible line-management chain shall determine a new notification level and shall communicate this new notification level to the Radiation Protection Program manager and ESH-12. ESH-12 shall notify the individuals specified in Article 441.1 above when this new notification level is reached. **Guidance Note**: The new EDE notification level should not be higher than the 2.0-rem performance goal specified in Article 442 below.

5. When requested, ESH-1 shall provide consultation on efforts to manage doses for workers who are approaching dose limits.

442 Laboratory Performance Goal

1. **Guidance Note**: The Laboratory has set a performance goal (part of Appendix F performance measures) of 2 rem (0.02 sievert) in a year external effective dose equivalent (EDE). This performance goal has been established to ensure that individuals do not exceed the 5-rem (0.05-sievert) TEDE limit. Inherent in controlling doses to below the 5-rem (0.05-sievert) TEDE limit is the expectation that intakes of radioactive material arising from operational incidents are also managed with the ultimate goal of zero intakes.

2. No individual shall be allowed to exceed the Laboratory performance goal without written approval from the Radiation Protection Program manager and the safety- and environment-responsible line-management chain.

3. **Guidance Note**: Organizations required to set annual ALARA goals (refer to Article 324 in chapter 3) may elect to set a maximum individual external dose goal that is lower than the 2 rem (0.02 sievert) annual performance goal set by the Laboratory.

443 Special Control Levels

Guidance Note: Certain situations may require lower individual exposure control levels.

In addition to considering recommendations from line management, the Radiation Protection Program manager shall consider using expertise from other disciplines, such as human resources and legal counsel, in establishing special control levels.

1. A dose management plan shall be established for each radiological worker with a lifetime occupational dose exceeding N rem, where N is the age of the individual in years. The dose management plan shall include a special control level. The special control level shall allow the individual's lifetime occupational dose to approach and, if practicable, fall below N rem during ensuing years as additional occupational dose is received.

2. Employees with special needs, such as those undergoing radiation therapy, shall be considered, and the Radiation Protection Program manager shall establish special control levels.

    2. Special controls on an individual dose shall not be implemented in a manner that interferes with that individual's right to work. If reasonable efforts to implement the special control level below 1 rem (0.01

3. sievert) per year threaten to restrict the individual's right to work or are otherwise unsuccessful, the Radiation Protection Program manager shall consider authorizing any dose in excess of the special control level, but not to exceed the regulatory dose limits.

Appendix 4A
[see 835.2(b), weighting factor]

Weighting Factors for Organs and Tissues

Organs or Tissues	Weighting Factor
Gonads	0.25
Breasts	0.15
Red bone marrow	0.12
Lungs	0.12
Thyroid	0.03
Bone surfaces	0.03
Remainder	0.30
Whole body	1.00

1. Weighting factors as defined in ICRP Publication 26 and NCRP Report 91 shall be used to convert organ or tissue dose equivalent to effective dose equivalent for the whole body. The effective dose equivalent shall be obtained by multiplying the organ dose by the weighting factor. For example, a 5-rem (0.05-sievert) dose to the thyroid would be multiplied by the weighting factor 0.03 to yield a contribution of 0.15 rem (1.5 mSv) to the total effective dose equivalent.
2. **Guidance Note**: "Remainder" means the five other organs or tissues with the highest dose (for example liver, kidney, spleen, thymus, adrenal, pancreas, stomach, small intestine, and upper large intestine). The weighting factor of 0.30 results from 0.06 for each of the five remainder organs [see 835.2(b), weighting factor, note 1].
3. **Guidance Note**: For the case of uniform external irradiation of the whole body, a weighting factor equal to 1 may be used in determining the effective dose equivalent [see 835.2(b), weighting factor, note 2].

Appendix 4B

Planned Special Exposure (PSE) Work Form

(To be completed by the requester in determining the need for a PSE)

Answer all questions below and attach supporting documentation, including a copy of the first page of the RWP.			
	Yes	No	NA
1. Is the proposed task vitally important to the Laboratory's mission?	☐	☐	☐
2. Is there another worker who meets the requirements of this job without the need for a PSE?	☐	☐	☐
3 Is not doing the task a viable alternative?	☐	☐	☐
4. Does an ALARA review indicate the need for a PSE? Contact ESH-12 for assistance in determining (1) if the PSE is necessary and (2) ALARA measures for the PSE if it is undertaken.	☐	☐	☐
5. Is there other decisive information?	☐	☐	☐
Summarize the reasons for request.			

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Previous Doses and Dose Limits Section PSE requester identifies the worker and provides the worker's anticipated PSE dose (a. and e.). ESH-12 provides all other dose information.				
Individual's Name:			Z Number	
	TEDE (*rem*)	**Lens of Eye (*rem*)**	**Skin or Extremities (*rem*)**	**Any Organ or Tissue (internal + external) (*rem*)**
a. Anticipated PSE in current year				
b. Previous PSEs in current year				
c. Doses in excess of radiological worker dose limits in current year				
d. Total (a+b+c)				
e. Anticipated PSE in current year				
f. Previous PSEs over worker lifetime (including current year)				
g. Doses in excess of radiological worker dose limits over worker lifetime (including current year)				
h. Total (e + f + g)				
If any of the totals (on line d.) exceed the numerical values of the radiological worker dose limits in Table 4-1 (page 3 of this chapter), the worker is not eligible to receive a PSE. If any of the totals (on line h.) exceed five times the numerical values of the radiological worker dose limits in Table 4-1, the worker is not eligible to receive a PSE.				
This worker is ☐ is not ☐ eligible.				
Signature, ESH-12 Dose Assessment team leader			Date	

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Appendix 4C

PSE Consent Form

1. Purpose of the operation				
2. Specific procedures to be used				
3. ALARA measures to be used (considering other risks that may be present)				
4. Potential risks that may be encountered				
5. Radiological conditions and other hazards that may be encountered (See the RWP and associated maps.)				
6. Your estimated doses from this job are as follows:				
7. When the estimated doses are added to your present doses, you will be exposed to the following doses and risks:				
I have read, asked questions about, and understand the information given above. I give my consent to the planned special exposure (PSE).				
Name (print)		Signature		Z Number
Group Leader or equivalent	Organization	Radiation Protection Representative	Organization	Date

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Appendix 4D

PSE Report to Individual

Name	Z Number
As a result of the planned special exposure (PSE) conducted under RWP or HCP _____ , you received the following doses: **Total effective dose equivalent (TEDE)**_____*rem* **Lens of eye dose**_____*rem* **Extremities**_____*rem* **Skin**_____*rem* **Organ or tissue**_____*rem*	
If you wish to discuss these doses or have any questions, please contact the ESH-12 Dose Assessment team at (phone) _____.	
Signature	Date
Date report submitted to worker_____	

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Appendix 4E
Recommended Major Implementation Criteria for Self-Assessment (Guidance)

Chapter Title	LIR Number
Dose Standards	LIR402-700-01.0

1. The most important criterion for assessing the implementation status of this chapter is knowing whether the requirements described in the chapter have been communicated to the individuals responsible for performing the work.

2. The recommended major implementation criteria for self-assessment in this chapter are the following. *Note: The article number is given with each bullet to help the reader find more information*

   - Radiological workers do not receive more than 5 rem/year (0.05 sievert/year) (TEDE); 15 rem/year (0.15 sievert) to the lens of the eye; 50 rem/year (0.5 sievert/year) (shallow dose equivalent to the skin or any extremity; 50 rem/year (0.5 sievert/year) (CDE and deep dose equivalent) to any organ or tissue other than the lens of the eye; or a lifetime dose equivalent (cumulative TEDE) exceeding their age in rem. (Article 422.1, Table 4-1) Radiological workers whose lifetime dose exceeds their age in rem (for any reason except a planned special exposure or authorized emergency exposure) have a dose management plan to realign their doses with the age limit. (Article 421)
   - Declared pregnant workers receive less than 0.5 rem (5 mSv) from declaration of pregnancy to birth of the child. Substantial variation above a uniform exposure rate that satisfies the 0.5-rem (5-mSv) limit is avoided. Workers who already received greater than 0.5 rem (5 mSv) by declaration are assigned tasks that limit additional exposure to the fetus. (Article 424)
   - Occupational dose limits do not include exposures from background radiation or therapeutic and diagnostic medical radiation. (Table 4-1, Note 3)
   - Planned special exposures (PSEs) are managed and limited as specified in Part 3 of this chapter. Authorized emergency exposures are managed and limited as specified in Chapter 2, Part 3, of this LIR.
   - Off-site occupational exposures are recorded in workers' dose records to ensure compliance with occupational dose limits. (Article 422.1)
   - General employees (nonradiological workers), members of the public, and minors receive less than 0.1-rem/year (1-mSv/year) TEDE from occupational sources. Minors are also limited to 10% of the radiological worker limits for lens of the eye, skin, and extremities. (Article 422.1 and Table 4-1)
   - Workers understand what their dose limits are, what their current doses are, and where to obtain dose reports. (Article 411)