



ES&H Section Procedures

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Formal Job ALARA Review Process

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Revision History

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Procedure

1.0 Purpose

The purpose of this procedure is to provide conditions, elements, and instructions for documenting a formal ALARA review.

2.0 Scope

This procedure defines the triggers for performing a formal ALARA review, and provides the tools required to complete a formal ALARA review. It also defines the controls such as required approvals to perform work that has been reviewed.

3.0 Summary

Fermilab takes a graded approach to the application of ALARA. The formal ALARA criteria are defined in Article 354 of the Fermilab Radiological Control Manual (FRCM) and are repeated here along with further instructions on how to complete the defined requirements. Lower thresholds for ALARA reviews are established in Appendix A of ESH-RPO-RWP-01, Radiological Work Permits. Therefore, a graded approach to formal ALARA reviews will be established to meet the listed requirements.

4.0 Definitions

ALARA	As Low As Reasonably Achievable - the approach to radiation protection to manage and control exposures (both individual and collective) to the work force and to the general public to as low as is reasonable, taking into account social, technical, economic, practical, and public policy considerations.
RPO	Radiation Physics Operations – ES&H staff members consisting of Radiation Control Technicians, Radiation Safety Officers, the Radiation Physics Operations Department Head, and the Senior Radiation Safety Officer.

5.0 Responsibilities

Participation in the ALARA program is required of all Divisions/Sections, and as such personnel of all levels throughout the Lab have responsibilities related to the ALARA program. These general responsibilities are outlined in the Fermilab ALARA Policy in Part 5 of the FRCM. The responsibilities described in this procedure are specific to the actual ALARA review process.

5.1 Radiation Safety Officer

- 5.1.1 Review alert list exposure investigations submitted by division/section radiation safety representatives.
- 5.1.2 Maintain a central file of division/section formal ALARA reviews and ALARA documentation.
- 5.1.3 Develop, document, review, and revise elements of the ALARA program based on division/section input.
- 5.1.4 As a part of the ALARA process, assigned RSOs should review exposure reports for personnel within their assigned areas. Any unusual or above normal exposures should be investigated and reported to the ES&H Section Dosimetry Program Manager as outlined in FRCM Articles 572 and 573.

- 5.1.5 Provide technical support and assistance to supervisors, planners, schedulers, and design engineers in the implementation of the radiological design and control elements of the ALARA program, and installation and use of shielding and containments.
 - 5.1.6 Develop, document, and review the radiological design and control elements of the ALARA program consistent with the ALARA policy and procedures.
 - 5.1.7 Review selected procedures involving radiological work, high dose/contamination jobs, and facility design changes for the purpose of recommending improvements to maintain dose, the spread of radioactive contamination, and the release of radioactive effluents at levels that are ALARA.
 - 5.1.8 Review and, if approved, provide prior oral approval before any individual undertake work which is likely to cause their dose for the week to exceed 100 mrem.
 - 5.1.9 Review and, if approved, provide prior written approval before any individual may undertake work which is likely to cause their dose for the week to exceed 200 mrem.
 - 5.1.10 Follow the steps of this procedure as outlined below.
- 5.2 Radiation Control Technician
- 5.2.1 As directed, conduct radiological surveillance, establish exposure and contamination controls, and prescribe protective requirements during radiological work to maintain dose, the spread of radioactive contamination, and the release of radioactive effluents at levels that are ALARA.
 - 5.2.2 Stop work when conditions and practices are unsafe and/or would violate DOE requirements or safety policies. See FRCM Article 348 and Fermilab ES&H Manual (FESHM) Chapter 1010.
 - 5.2.3 Report any radiological problems and concerns, along with any corrective actions, to the assigned RSO.
 - 5.2.4 May provide continuous supervision whenever any personnel are working in an area with accessible spaces having dose rates over 1 rem/hr.
 - 5.2.5 Periodically monitor collective dose accumulation during work and compare it with the pre-job dose estimate.
 - 5.2.6 Follow the steps of this procedure as outlined below.

6.0 Health and Safety Warnings

N/A

7.0 Prerequisites

Material & Equipment

- 7.1 N/A This is an administrative procedure.

Training Required

- 7.2 Radiological Worker Training (FN000470 and FN000471) or DOE Core Academics for RCTs (FN000277) and RCT Continuing Training and Requalification (FN000300)

8.0 Procedural Steps

8.1 Pre-Job Planning and Dose Assessment

8.1.1 All pre-job planning should include an estimate of the collective dose resulting from the job/task/experiment and a determination regarding whether the numerical criteria for an ALARA review is exceeded. The estimates may be based on actual or historical radiological monitoring results. If a review is required, the next step is to determine the appropriate level of review:

- A Work Plan from the Work Group
- A Formal ALARA Review

8.2 Trigger Levels Requiring a Work Plan from the Work Group

8.2.1 If a nonroutine or complex work activity is estimated to exceed any of the following trigger levels, a work plan from the work group is required:

- Estimated individual dose greater than 50 mrem for the task
- Collective doses estimated to be greater than 100 person-mrem for the task
- Work is to be done in radiation fields in excess of 100 mrem/hr
- Breaching any system or other work which has the potential to cause an Airborne Radiation Area of greater than 0.02 DAC or Contamination Area, including:
 - Cutting, grinding, welding, drilling, or other abrasive work on radioactive material
 - Accessing systems that may contain radioactive air or water
- Work in any Contamination Areas or work potentially generating contamination
- Remote handling of Class 3 material
- Movement of Class 2 or Class 3 material

8.2.2 If any of the above trigger levels are estimated, or as requested by the RSO, then Job Leader completes RP Form 071, Job and ALARA Plan Template.

8.3 Trigger Levels Requiring a Formal ALARA Review

8.3.1 If a non-routine or complex work activity is estimated to exceed any of the following trigger levels, a formal radiological review is required:

- Estimated individual dose greater than 100 mrem/week
- Collective doses estimated to be greater than 600 person-mrem for the task
 - Work above 1000 person-mrem requires SRSO approval
- Work is to be done in radiation fields in excess of 500 mrem/hr
 - Work in areas above 1000 mrem/hr fields requires SRSO Approval
- Entry into (or passing through) a posted Airborne Radiation Area
- Work in areas having removable contamination greater than 5 times the values in Table 2-2 of the FRCM
- Potential, unexpected, or expected radioactivity releases to the environment beyond those generated by existing machines or

experiments or increased dose rates in areas accessible by the public or the site boundary.

NOTE: See ESH-ERPP-004 – Environmental ALARA Program Plan for more information on environmental ALARA reviews.

- Handling or any movement of Class 4 or Class 5 material, including remote handling
- 8.3.2 If any of the above trigger levels are estimated, or at the discretion of RPO Staff, then RSO will request the RP Form 071, Job and ALARA Plan Template from the Job Leader and work with the Job Leader to complete RP Form to the Formal ALARA review level.

8.4 Elements of a Job-Plan and Formal ALARA Review

- 8.4.1 An ALARA review may include decisions to expend resources to reduce dose, contamination, and radioactive effluent releases. The review should include consideration of the costs and benefits in relation to social, technical, economic, practical, and public policy. For cost-benefit analysis, a value of \$2000/person-rem is used, unless otherwise specified. That is, if a dose reduction of at least 1.0 person-rem can be achieved with the expenditure of \$2000 or less, the reduction is reasonable and should be accomplished. If the cost exceeds \$2000/person-rem saved, a more detailed review will be required to determine if the expenditure is reasonable.
- 8.4.2 The assigned RSO will review the Job-Plan review documents and the Formal ALARA review documents. The Job-Plan review documents should consider, and the Formal ALARA review document shall perform the following applicable elements:
- Inclusion of Radiological Control Hold Points in the technical work documents or Radiological Work Permits (RWPs)
 - Surveys, contamination wipes, air monitoring, etc.
 - Potential presence of hard-to-detect radionuclides (^7Be , ^3H , etc.) and detection or PPE requirements
 - Consideration of tools and equipment being sequestered due to potential contamination
 - Elimination or reduction of radioactivity through application of shielding, decontamination, and fluid line flushing where applicable
 - Use of work processes and special tooling to reduce time in the work area
 - Use of engineered controls to minimize the spread of contamination and generation of airborne radioactivity
 - Review for need of respirators or internal dosimetry
 - Specification of special radiological training or monitoring requirements
 - Use of mock-ups for high exposure or complex tasks
 - Engineering, design, and use of temporary shielding to reduce radiation levels
 - Walkdown or dry-run of the activity using applicable procedures
 - Staging and preparation of necessary materials and special tools

- Radiological postings requirements
- Maximization of prefabrication and shop work
- Review of abnormal and emergency procedures and plans
- Review potential impacts to credited controls
- Identification of points where signatures and second party or independent verifications are required
- Establishment of success or completion criteria, with contingency plans to anticipate difficulties
- Development of a pre-job estimate of collective dose to be incurred for the job
- Provisions for waste minimization and proper waste disposal in accordance with other Fermilab policies
- Provisions for minimizing the release of radioactive material into the environment including airborne or liquid effluents and potential for groundwater impact or exposure to the onsite and offsite public

8.5 Implementation of Pre-Planned Tasks and Dose Tracking

8.5.1 During the performance of jobs for which a pre-job dose estimate was made, or at the request of the RSO, the Radiological Control Organization should periodically monitor collective dose accumulation and compare it with the pre-job dose estimate. Differences should be reviewed to identify causes and to assess the need for corrective actions as well as to identify successful dose reduction techniques.

- RCT should record the collective dose (individual and per step) on the job plan
- Assigned RSO should review this periodically

8.5.2 During performance of the pre-planned task, Radiological Control Technicians and their supervisors, line supervision, and any employee through their supervisor has the authority and responsibility to stop radiological work activities for any of the following reasons:

- Inadequate radiological controls
- Radiological controls not being implemented
- Radiological Control Hold Point not being satisfied
- Discovery of any non-radiological hazard which renders the operation unsafe
- Discovery of an off-normal condition not identified in the job plan

8.6 Post-Job Review

8.6.1 Upon completion of radiological work, a post-job review should be conducted if any of the following criteria are met:

- For work under a job-specific RWP or as required by the RSO
- Pre-job planning indicated that the job surpassed trigger levels for a job-plan ALARA review or a formal ALARA review
- Dose estimates in the job plan were exceeded

- Use of the Stop Radiological Work authority
 - A radiological occurrence / deficiency is reported
 - Identification of significant Lessons Learned
- 8.6.2 The post-job review performed by the assigned RCT should include:
- Gather maps and results from required surveys
 - Finalize individual and job-dose received
 - Complete summary of job
 - Update the job/formal ALARA plan with actual dose received for each step and noting any comments
 - Compile all documentation for the plan and submit to the RSO
- 8.6.3 The post-job review performed by the assigned RSO should include:
- A comparison of the actual person-rem with that of the pre-job review estimates,
 - An evaluation of the effectiveness of the pre-job plan, and
 - Documentation of Lessons Learned
 - Review survey results
 - Approve of any potential disposal or discharge of tools, PPE, waste, etc.
- 8.6.4 Post-job reviews may be used as a guide for planning future radiological work similar in nature to the work being reviewed. This review evaluates the performance of the work and may be conducted as a Post-Job ALARA Briefing. Post-Job ALARA Briefing are meetings of the personnel knowledgeable about an event (either a success or an abnormal event) to document a chronological listing of the facts. Post-Job ALARA Briefing meetings should be conducted as soon as practicable after the pre-planned task has been completed.
- This Post-Job ALARA Briefing is performed with the RSO, RCT, and Job Leader, as well as other applicable individuals.
 - Additional results from the Post-Job ALARA Briefing can be added to the Post-Job Review e.g. Lessons Learned, Dose Reduction Techniques, etc.
- 8.6.5 Lessons learned from the task should be evaluated and documented as a part of the post-job review.
- Fermilab's Lessons Learned Database: <https://www-esh.fnal.gov/pls/apex/f?p=127:34>
 - RP Form 071

9.0 Data and Records Management

Job-Plan Reviews and Formal ALARA Reviews are captured on RP Form 071 and are saved as attachments to job-specific RWPs in the Radiation Physics SharePoint.

10.0 Quality Assurance/Quality Control

This procedure is subject to a review frequency requirement of three (3) years, and is due March 2025.

11.0 References

Fermilab Radiological Control Manual
Chapter 3

Fermilab Environment, Safety, and Health Manual

RP Form 071, Job & ALARA Plan Template ([DocDB 1316](#))

“Doe G 441.1-1C CHG 1 (Admin CHG), Radiation Protection Programs Guide for Use with Title 10, Code of Federal Regulations, Part 835, Occupational Radiation Protection.” *Radiation Protection Programs Guide for Use with Title 10, Code of Federal Regulations, Part 835, Occupational Radiation Protection - DOE Directives, Guidance, and Delegations*, 26 May 2020, <https://www.directives.doe.gov/directives-documents/400-series/0441.1-EGuide-01c-admchg1>.

“DOE-STD-1098-2017, Radiological Control.” *DOE Technical Standards Program*, 2 Dec. 2021, <https://www.standards.doe.gov/standards-documents/1000/1098-AStd-2017>.

“Doe O 458.1 Chg 4 (LtdChg), Radiation Protection of the Public and the Environment.” *Radiation Protection of the Public and the Environment - DOE Directives, Guidance, and Delegations*, 8 Apr. 2021, <https://www.directives.doe.gov/directives-documents/400-series/0458.1-border-chg4-ltdchg>.

Name	Signature	Date	Department Head/Team Leader

Attachment A – Action Level Table

Trigger Levels	Dose Plan	Formal ALARA Review
Individual Dose	≥50 mrem/week	≥100 mrem/week
Task Dose	≥100 person-mrem	≥600 person-mrem; Work above 1000 person-mrem requires SRSO approval
Work in Radiation Fields	≥100 mrem/hr.	≥500 mrem/hr; Work in areas above 1000 mrem/hr fields requires SRSO approval
Airborne Radiation Area	Breaching any system with the potential to create an Airborne Area of greater than 0.02 DAC or Contamination Area, including:	Entry into or passing through a posted Airborne Radiation Area
	Cutting, grinding, welding, drilling, or other abrasive work on radioactive material	
	Accessing systems that may contain radioactive air	
Contamination Areas	Work in any potential Contamination Areas or work potentially generating contamination	≥5x values in FRCM Table 2-2
	Cutting, grinding, welding, drilling, or other abrasive work on radioactive material	
	Accessing systems that may contain radioactive water	
Environmental Releases		Potential, unexpected, or expected releases to the environment beyond those generated by existing machines or experiments or increased dose rates in areas accessible by the public or the site boundary
Handling or Movement of Material	Remote handling of Class 3; Movement of Class 2 or 3	Class 4 or Class 5 material, including remote handling