Fermilab	ES&H Section Procedures	
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Radiological Release and Clearance of Materials and Equipment

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Revision History

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Carmen DuVall	Initial Release	0	03/18/2022

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Procedure

1.0 Purpose

This procedure describes the Fermilab process for the radiological release and clearance of personal property, commonly referred to as materials and equipment (M&E). Key steps of the process are shown in Figure 1.

2.0 Scope

This procedure implements Fermilab's overall release and clearance processes. The procedure applies to both surface and volumetric contamination. While the DOE Moratorium and Suspension remain in effect, metals designated as scrap while in a Radiological Area may not be cleared for unrestricted release for recycling. Clearance of real property is not included.

3.0 Summary

Fermilab has established a Radiation Protection Program (RPP) and an Environmental Radiation Protection Program (ERPP), documented in the *Fermilab Radiological Control Manual* (FRCM) and supported by a comprehensive set of procedures, as required by 10 CFR 835, *Occupational Radiation Protection* and DOE Order 458.1, *Radiation Protection of the Public and the Environment*. This procedure is intended to provide guidance for developing survey procedures that satisfy these requirements, to be performed only by Fermilab personnel. These requirements include the guidance that is provided in the *Multi-Agency Radiation Survey and Assessment of Materials and Equipment* (MARSAME) and DOE-STD-6004-2016, *Clearance and Release of Personal Property from Accelerator Facilities*.

At Fermilab, M&E is not eligible for clearance unless sufficient and approved process knowledge or a conforming radiological clearance survey has demonstrated that the potential residual radioactive material is indistinguishable from background (IFB). M&E that is not eligible for clearance may be eligible for restricted release if a radiological release survey demonstrates that the residual radioactive material is within predefined limits.

4.0 Definitions

Clearance: The removal of property that contains or may contain residual radioactive material from DOE radiological control under 10 CFR Part 835 and DOE Order 458.1 for unrestricted release.

Controlled Area: Any area to which access is managed by or for DOE to protect individuals from exposure to radiation and/or radioactive material as defined by 10 CFR Part 835.

Impacted: A reasonable potential exists for materials to have become activated or contaminated with radioactivity above background levels.

Materials and Equipment (M&E): A generic term for personal property that includes materials, equipment, apparatus, components, articles, etc.

Non-impacted: No reasonable potential exists for materials to have become activated or contaminated with radioactivity above background levels based on sufficient process knowledge.

Radiological Area: Any area within a Controlled Area defined as a Radiation Area, High Radiation Area, Very High Radiation Area, Contamination Area, High Contamination Area, or Airborne Radioactivity Area (see Articles 234, 235, 236, and Chapter 3 Part 3 of the FRCM).

Radiologically posted area: Any area that is posted for purposes of radiological protection, including Controlled Areas, Radioactive Material Areas, Radiological Buffer Areas, and Radiological Areas.

Release: A reduction in the level of radiological control, or a transfer of control to another party. Examples of release include clearance, recycle, reuse, disposal as waste, or transfer of control of radioactive M&E from one authorized user to another.

Restricted Release: A subset of release defined as a reduction in the level of radiological control, or transfer of control to another party, where restrictions are placed on how the released items will be used or transferred.

Unrestricted Release: The removal of radiological regulatory controls from materials and equipment.

5.0 Responsibilities

5.1 Senior Radiation Safety Officer (SRSO)

- Provide direction to the material release program
- Guide decisions that require coordination of external organizations
- Provide guidance on non-routine release projects
- Designate other members of the Radiological Control Organization (RCO) to review completed *Radiological Clearance Forms* and approve the clearance of property
- Designate additional qualified individuals to perform clearance surveys

5.2 Assigned Radiation Safety Officer (RSO) or designee

- Review completed *Radiological Clearance Forms* and approve the clearance of property
- Provide guidance to Radiological Control Technicians related to interpretation of release survey methods and procedures
- Prepare non-routine release survey plans
- Maintain records of items released from radiological control

5.3 Radiological Control Technician (RCT) or designee

- Perform clearance surveys according to ESH-RPO-MON-09 or non-routine release survey plans

5.4 Radiological Worker

- Perform restricted release surveys according to FRCM Chapter 4
- Complete the top portion of the *Radiological Clearance Form* (all fields above the "Survey Data" section)

6.0 Health and Safety Warnings

None

7.0 Prerequisites

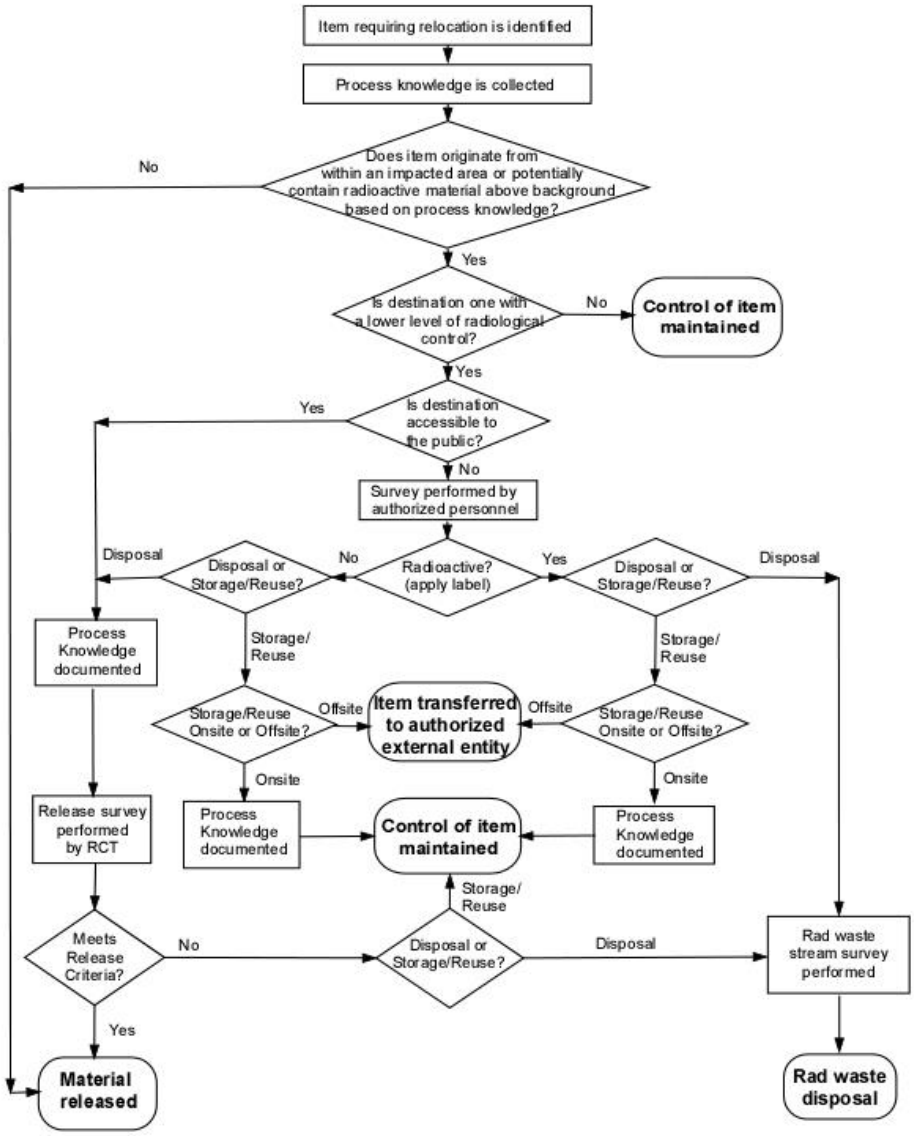
None

8.0 Procedural Steps

8.1 Release Overview

Figure 1 provides an overview of the release process. Consistent with the ERPP, a release is defined as "a reduction in the level of radiological control, or a transfer of control to another party." Radiological control under 10 CFR 835 consists of radiological posting, labeling, or other controls implemented under the Fermilab RPP. Radiological control under DOE O 458.1 applies to property potentially containing radioactivity not requiring 10 CFR 835 control but the clearance of which may exceed the dose constraints of DOE O 458.1, along with sufficient administrative or physical controls to ensure appropriate disposition. M&E under either type of control are subject to the release processes described in this procedure.

Figure 1 – M&E Release Overview



Personnel with General Employee Radiation Training (GERT) or higher may make an impact determination (described in Section 8.2) for unlabeled items in Controlled Areas.

- If any items are determined to be impacted, GERT employees cannot release the items—only the authorized personnel discussed in Section 5.0 may release impacted M&E. Employees must contact their assigned RSO for further instructions.
- Non-impacted M&E may be released without a survey if sufficient process knowledge exists to support this evaluation. If there is any uncertainty regarding item history, complicating whether an impact determination can be made, the assigned RSO must be contacted to provide guidance with the evaluation.

Radiological workers can make impact determinations from all radiologically posted areas. For clearance of impacted M&E, RSOs normally review completed *Radiological Clearance Forms* and approve the clearance of property prior to release. At SRSO discretion, other members of the RCO may be called upon to complete these tasks.

8.2 Determining what qualifies as impacted

Categorize the M&E being evaluated as impacted or non-impacted based on past or present location in a radiologically posted area, visual inspection, historical records and operating history, or other process knowledge.

- Non-impacted: If the evaluation process does not indicate that there is a potential for residual radioactive material or content, the M&E is classified as non-impacted and can be released without performing measurements. Examples of non-impacted M&E include:
  - Items located in a radiologically posted area with no potential for containing radioactivity above natural background levels based on process knowledge
  - Items located in a radiologically posted area with only sealed sources or radiation-generating devices (other than neutron generators) present
  - Items located outside of a radiologically posted area that have conforming survey results demonstrating they are IFB
  - Items known to contain only naturally-occurring radioactive material (NORM)
- Impacted: If the evaluation process indicates that there is a potential for residual radioactive material or content, the M&E is classified as impacted and cannot be released without performing a radiological release survey. M&E in any of the following conditions is considered impacted:
  - Labeled as being radioactive material
  - Resides within a posted Radiological Area
  - Identified on a survey form as potentially containing radioactive material
  - Has a Class 0 label or is otherwise considered potentially radioactive
  - Previously contained water, oil, or other liquid(s) that may have been activated

- From water systems previously containing tritium concentrations greater than 100 pCi/mL (e.g., Radioactive Water [RAW], some sections of Industrial Cooling Water [ICW], and NuMI condensate system)
- Has non-original paint or other surface covering that may conceal residual radioactive material
- Previously contained residual radioactive material that has been decontaminated, but has since been used in a manner or in areas that could have resulted in re-contamination of the property

8.3 Decide between clearance or restricted release

Clearance and restricted releases generally use different survey criteria. A clearance survey is normally performed as an IFB survey, while a survey supporting a restricted release would normally be performed using predefined release limits, such as those described in FRCM Chapter 4. IFB surveys use detection levels generated in accordance with Fermilab's *Technical Basis for Release of Materials from Radiological Control* (ESH-RP-ERPP-02).

A clearance survey is performed when the M&E is to be released without restrictions or without knowledge of final disposition. Examples include:

- Release to the general environment or community for unrestricted reuse or recycling
- Release for disposal or potential disposal to a landfill or facility at which radioactive material is prohibited

A restricted release survey may be performed when the destination of the M&E is known, and the recipient is known to be authorized to possess the M&E by an appropriate jurisdiction. Examples are:

- Onsite transfer from a Radiological Area to a Radioactive Materials Area (RMA) or Controlled Area.
- Transfer to another DOE facility which has an active 10 CFR 835 program. In this case, the survey may consist solely of external packaging shipping survey for compliance with transportation regulations.
- Transfer to a facility or individual licensed by an Agreement State or the Nuclear Regulatory Commission (NRC) to possess radioactive material. The transfer would require assurance that the radioactive material was within the recipient's license limits.
- Transfer to a radioactive waste disposal facility. The radioactive material would be characterized in accordance with the facility requirements. The packaging and conveyance would be surveyed for compliance with shipping regulations and the facility's requirements. In the absence of facility-specific requirements, applicable transportation regulations would be followed (e.g., CFR Title 49 issued by the U.S. Department of Transportation).

8.4 Routine Release

A routine release may be performed by any individual authorized and trained on the selected release survey procedure. The assigned RSO (or designee) should be consulted if any questions exist concerning the applicability of a procedure.

8.5 Non-Routine Release

If the release is non-routine, the assigned RSO (or designee) may prepare a survey plan that incorporates unique aspects of the release survey not covered in existing survey procedures. Conditions that may warrant a non-routine release survey plan include:

- M&E is requested to be cleared that differs significantly in its primary composition, beam exposure time, or decay time from the Technical Basis Document or Radiation Physics (RP) Notes, such as short irradiations or cool-downs. Requires collaboration with Radiation Physics staff to document the clearance basis and measurement requirements.
- M&E is requested to be cleared that does not require surface scans and can solely utilize fixed point measurements, such as concrete shielding that was located away from the primary beam and would not have a sharp activity gradient.
- M&E is requested to be cleared which could contain radionuclides requiring additional measurement methods (e.g., alpha emitters, activated graphite, or concrete decayed for more than twenty years).

8.6 Release Process

8.6.1 Restricted Release

If the impacted M&E requires a restricted release survey as determined in Section 8.3, follow FRCM Chapter 4 and complete the *Onsite Restricted Release Form* as follows:

8.6.1.1 Mark the box at the top of the form to indicate the intended disposition of the M&E. Contact a member of the RCO for any item(s) that need to be transferred to an area other than an RMA or Controlled Area.

8.6.1.2 List the Release ID and previous Release ID (if applicable). Record where the item is being removed from and select the area posting.

If M&E is being removed from a Contamination Area or High Contamination Area, the item(s) must be decontaminated or appropriately packaged prior to removal. (If activation is a concern, M&E may be kept in staged Contamination Areas located outside of enclosures.) Contact a member of the RCO to have the item decontaminated. Record the Batch ID or Work Request Number from the Radionuclide Analysis Facility (RAF) sample submission and attach the results.

8.6.1.3 Indicate whether the M&E was present during beam-on conditions and if contamination is possible.

8.6.1.4 Indicate if the M&E contains liquid as part of the item(s). If liquid is present, contact a member of the RCO for further instructions.

8.6.1.5 Describe the M&E, listing the material type(s) or composition(s), size of item(s), weight, etc. Attach additional documentation, if necessary.

8.6.1.6 Select the instrument to be used for the survey. Record the instrument ID and calibration due date.

8.6.1.7 Perform a source check to verify instrument response. Measure and record the Background CPM.

8.6.1.8 Survey the item(s) to be released and record the Gross CPM and Net CPM. If use of the Wallflower is necessary, record the instrument ID, calibration due date, and the exposure rate in mR/hr at one (1) foot.

8.6.1.9 Mark the appropriate Class Label applied to the item(s) or to the container for groups of similar items. For quick reference, the Radioactivity Class Label chart is on the back of the form.

NOTE 1: Class 0 labels do not require a radiation warning trefoil, as the friskers (Ludlum and Eberline) and Bicron Analyst can easily detect the radiation field generated from radioactivity present at less than 10% of the values specified in Appendix E to 10 CFR 835.

NOTE 2: Contact a member of the RCO for M&E labeled as Class 2 or above.

8.6.1.10 Sign and date the form. Place the completed form in the designated location.

8.6.2 Clearance

If the impacted M&E requires a clearance survey as determined in Section 8.3, a *Radiological Clearance Form* must be completed. Radiological Workers may complete the top portion of the form (above the "Survey Data" section). However, only RCTs or personnel authorized by the SRSO can complete the bottom portion of the form and perform the clearance survey according to ESH-RPO-MON-09.

8.6.2.1 Mark the box at the top of the form to indicate the intended disposition of the M&E. The final destination of the M&E being cleared may be unknown and can be released without restrictions.

8.6.2.2 List the Release ID and previous Release ID (if applicable). Describe the M&E, documenting the dimensions, complexity, accessibility, and composition of the M&E; include any special markings and serial, model, or property numbers. Attach additional documentation, if necessary.

8.6.2.3 From the available information, document the process knowledge for the M&E, including previous and current postings, and whether activation or contamination is possible. Use the following, as applicable:

- Previous survey data (e.g., from an *Onsite Restricted Release Form*)
- Current work authorization, such as Radiological Work Permits
- Discussions with any employees whose work may have affected the possibility of radioactive content
- Discussions with property owners (past/present)

NOTE: While the DOE Moratorium and Suspension remain in effect, metals designated as scrap while in a Radiological Area may not be cleared for unrestricted release for recycling.

8.6.2.4 If liquid is present or a part of the item(s), contact a member of the RCO before proceeding.

8.6.2.5 ***To be completed by the RCO.*** Based on available information, categorize the M&E according to its potential level for radioactivity and list the potential radionuclide distribution. The specified level for impacted M&E will dictate the scope of the survey processes:

- Level 1 – M&E from areas *known* to have or have had surface contamination or volumetric activation, based on process knowledge or previous radiological surveys, or both (e.g., items near normal beam loss points such as beam absorbers, septa, collimators, and targets)
- Level 2 – M&E from areas that have or have had at least a *potential* for surface contamination or volumetric activation, based on process knowledge, previous radiological surveys, or both (e.g., items adjacent to Level 1 areas and any area or system handling radioactive effluent)
- Level 3 – M&E from areas that have or have had a *minimal potential* for surface contamination or volumetric activation based on process knowledge or previous radiological surveys, or both (e.g., items far from beam losses or for which preliminary area surveys have shown no induced radioactivity)
- Level 4 – M&E from areas where ^{3}H or ^{7}Be contamination is suspected.

NOTE: Surveys that encompass a large variety of items may benefit from segregating M&E into categories of similar items. Categories could include similar materials, items with similar history or items with similar risk of contamination. Avoid mixing items with significantly differing history or risk, unless performing a 100% scan survey of the items. Segregation could include classifying different parts of a type of item in different levels, such as the exterior versus the interior of an experimental apparatus.

8.6.2.6 The survey is then performed according to ESH-RPO-MON-09 by Radiation Control Technicians (RCTs) or other trained individuals approved by the SRSO. Once completed, the *Radiological Clearance*

Form is given to the RSO (or designee) for decision determination and approval.

8.6.2.7 ***To be completed by the RSO (or designee).*** Applicable detection thresholds are shown on the back side of the *Radiological Clearance Form*. M&E that does not exceed the applicable survey level(s) meets criteria for clearance. M&E above these level(s) does not meet criteria for clearance and must be maintained under radiological control. Clearly indicate the release decision on the *Radiological Clearance Form*.

Individual items surveyed in a batch may be individually released if measured to be not greater than the applicable survey level(s).

NOTE: When calculating the total surface contamination and converting net CPM to dpm/100 cm^2, a conversion factor of 0.019 is used. This value represents the 2π beta efficiency of the 44-9 GM detector (38%), the conservative source efficiency accounting for the increased particle emission resulting from backscatter effects as well as the decreased particle emission because of self-absorption losses (25%), and correction of the physical probe area to account for an area of 100 cm^2 (20.3%). The selection of these values is discussed in Appendix C of ESH-RP-ERPP-02, *Technical Basis for Release of Materials from Radiological Control.*

8.6.2.8 The *Radiological Clearance Form* must be approved by the assigned RSO (or designee). M&E meeting criteria for clearance shall not be released until the *Radiological Clearance Form* is signed by the assigned RSO (or designee).

8.6.2.9 Results of radiological monitoring and surveys of cleared property, with type and quantity of property cleared, and independent verification results must be summarized in the *Annual Site Environmental Report*.

9.0 Data and Records Management

Radiation survey data is recorded on the *Onsite Restricted Release Form* and *Radiological Clearance Form* and maintained for 75 years. A summary of material cleared shall be reported in the *Annual Site Environmental Report.*

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 Environmental Radiation Protection Program (ERPP)
- Fermilab Radiation Protection Program (RPP)
- *Fermilab Radiological Control Manual* (FRCM)
- Fermilab R.P. Form #127 – *Onsite Restricted Release Form*
- Fermilab R.P. Form #128 – *Radiological Clearance Form*

- Fermilab, “Surveys for Release and Clearance of Materials and Equipment from Radiological Control”, ESH-RPO-MON-09.
- Fermilab, “Technical Basis for Release of Materials from Radiological Control”, ESH-RP-ERPP-02.
- *Multi-Agency Radiation Survey and Assessment of Materials and Equipment* (MARSAME)
- Title 10, Code of Federal Regulations, Part 835, *Occupational Radiation Protection*
- U.S. Department of Energy (DOE), “Clearance and Release of Personal Property from Accelerator Facilities”, DOE-STD-6004-2016, 5-19-2016.
- U.S. Department of Energy (DOE), “Radiation Protection of the Public and the Environment”, DOE Order 458.1, Chg. 4, 9-15-2020.

12.0 Attachments

None