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Control of Contamination Areas and Program Management

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Procedure

1.0 Purpose

Fermilab continues to diligently manage a Radiation Protection Program, under the requirements of 10CFR835, as part of integrated safety management (ISM) to control contamination, radiation doses to personnel and keep occupational radiation exposures as low as reasonably achievable (ALARA).

2.0 Scope

This document summarizes the planned and systematic aspects associated with contamination control, all of which have been incorporated procedurally into the Radiological Control Program.

3.0 Summary

Management of contamination areas and personnel exposures are addressed in all pertinent standard operating procedures to ensure that activities are organized, controlled and meet all regulatory requirements. This summary, and associated procedures and policies provides documented verifiable evidence to support the reliability and effectiveness of the Fermilab contamination control program and ensures compliance with 10CFR835. The Fermilab Radiological Control Manual (FRCM) flows directly down from the regulations set forth by the Department of Energy.

All procedures, written work authorizations and policies are documented, maintained and revised as necessary by the Radiation Physics Operations (RPO) Department within the Environment, Safety & Health (ES&H) Section. Radiation Safety Officers (RSOs) and Radiological Control Technicians (RCTs), have the appropriate training, education and experience to manage all aspects of the contamination control program. And in consultation with the Senior Radiation Safety Officer (SRSO) are responsible for the implementation of the contamination control program. Regulations and guidance can be found in the following documents,

- 10CFR835 Occupational Radiation Protection (see Section 11.0)
- The Fermilab Radiological Control Manual (FRCM) (see Section 11.0)
- DOE G 441.1-1C, Radiation Protection Programs Guide (see Section 11.0)

4.0 Definitions

See FRCM glossary of terms for radiological area posting definitions.

5.0 Responsibilities

Fermilab radiological control organization (RCO) personnel are responsible to follow contamination control requirements as stated in 10 CFR Part 835, the FRCM, and FESHM. The Fermilab Senior Radiation Safety Officer (SRSO) and RPO Department Head are responsible to ensure the requirements of this procedure are followed.

5.1 Assigned RSOs and RCTs are responsible for ensuring that contamination controls are implemented in accordance with 10 CFR Part 835, FRCM, and this procedure.

6.0 Health and Safety Warnings

Personnel performing steps of this procedure may come into contact with contaminated and/or potentially contaminated surfaces or radioactive water or airborne radioactivity. As such, proper precautions should be taken to reduce the spread of these types of contamination to other areas.

Regarding release of accelerator produced radionuclides to the sanitary sewer system, it has been calculated that at 1,000 net cpm flushing more than one-half gallon of water down the sink after decontamination will prevent contaminant levels above surface water derived concentration limits. Therefore, no significant environmental hazard exists as a result decontaminating a person using soap and water at a sink.

7.0 Material, Equipment & Training Needed

7.1 List of Materials – N/A

7.2 Training Required

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

7.2.2 Contamination Controls and Airborne Radioactivity Controls (FN000281)

8.0 Procedural Steps

8.1 Contamination Areas

In the course of operating the accelerator complex, radioactivation of the beamline, all beamline components, air and water, must always be given consideration. With increasing beam intensities and power, it is imperative that radiation safety personnel continuously evaluate the current and potential levels of air and water activation, as well as particulate contamination in water and residing on surfaces within the enclosures.

When beam strikes the collimators, or other beamline components, deliberately or incidentally, air activation products are created. Specifically, and most abundantly, Be-7 is created due to spallation of oxygen. Other radionuclides, of course can be created, including tritium, Na-22, Mn-54 and Co-60.

8.1.1 The RPO Department has identified several areas of the accelerator complex where surface contamination levels may exceed the contamination levels documented in Table 2-2 of the FRCM and must be posted as a Contamination Area. Inside beam enclosures, these contamination areas are consistently associated with high dose rate areas where beam is deliberately lost, such as collimator and absorber regions. While beam can be incidentally lost, collimators are utilized in multiple areas of the Fermilab accelerator complex and are designed to eliminate beam that does not meet spatial and timing parameters, therefore reducing incidental beam loss throughout the rest of the accelerator, helping lower residual dose rates, for personnel working on these components and contamination in other areas. These areas have been identified and are controlled and posted by the RPO Department.

8.1.2 All Contamination Areas are either roped off or behind a locked door/gate, are clearly posted, require additional radiation safety controls and coverage to perform work in the area.

8.1.3 In addition, opening up surveys are performed at the beginning of each shutdown, and during Controlled Accesses, as beam losses can occur at any point, creating areas of new elevated dose rates and possible contamination.

8.1.4 The 10 CFR 835 limit for posting a contamination area is 1000 dpm/100cm^2 (450 pCi/ml) for beta/gamma emitters. These radioisotopes can then build up on beamline components, under beamline components and in the aisleways. The radionuclides commonly found on aisleway surfaces in the accelerator enclosures are Be-7, Na-22, Na-24 and Mn-54. Other radioisotopes can be found on beamlines and beamline components. The 10CFR835 limit for Tritium is 10,000 dpm/100cm^2 (4500 pCi/mi). See FRCM Chapter 2 for additional information.

8.1.5 It should be emphasized that all high energy protons traveling through or hitting materials produce tritium. Upon exposure to air, the tritium atoms combine with oxygen to make tritiated water. The 10 CFR Part 835 limit for tritium is 10,000 dpm/100cm^2 (4500 pCi/mi). See FRCM Chapter 2 for additional information.

8.1.6 For tritiated water, Radiation Physics Note 165, Evaluation of the Radiological Hazards from Use of Industrial Cooling Water (ICW) in the Fermilab Fire Suppression Sprinkler Systems, Appendix 1, Analysis of Possible Puddle Heights H, states that a surface contamination level of 10,000 disintegrations per minute (dpm) per 100 cm^2 corresponds to 4,505 picoCuries (pCi) per 100 cm^2. Pertaining to the situation of water in the liquid state on solid horizontal surfaces, calculations of water on various surfaces were computed.

8.1.7 Based on the calculations described above, Fermilab uses a value of 100 pCi/ml as the threshold for posting Contamination Areas resulting from tritiated water puddles in beamline enclosures and other areas.

8.2 Contamination Build-Up

8.2.1 To assist in determining the frequency of necessary decontamination, a study has been conducted to determine how quickly these radioisotopes build up in MI-30 and MI-8 collimator regions and exceed FRCM limits. The specific wipe locations are documented on special survey maps.

8.2.2 Experience and data indicate that after two months of accelerating beam, the levels of Be-7 can exceed the limits in the FRCM, and decontamination should be considered whenever personnel are making accesses to the area after that time. This decontamination may relax some of the personal protective equipment (PPE) and access requirements discussed in section. But that decision still ultimately lies with the assigned RSO.

8.2.3 An evaluation of the data collected to date does not indicate that radioisotopes residing on the floor are readily spendable in water. It seems to require mechanical agitation to mix with water, therefore it is not easily spread by water running across the floor.

8.3 Contamination Monitoring Program

8.3.1 The RPO Department utilizes a Routine Area Monitoring Program throughout the site, although it is well known that most of the focus should be on the accelerator enclosures and associated facilities. The frequency of routine monitoring for a given area is commensurate with the expected dose rates, the type of work being conducted, and the risk of potential contamination that could be encountered. The contamination monitoring program includes wipes, water samples, and air filters. Wipes, water samples, and air filters are submitted to the Radionuclide Analysis Facility (RAF).

8.3.2 In addition to routine area monitoring, opening up (initial entry) surveys are conducted at the beginning of each Summer shutdown, and other maintenance periods requiring Supervised Access mode, which include taking contamination wipes. Also, individual jobs are evaluated as they are entered into the Accelerator Division (AD) work list to consider contamination levels prior to the beginning of a job. Once a job plan is created, RCTs review the most recent initial entry surveys and wipe results for that area, or as specified by assigned RSO. Based upon this evaluation, the job plan may develop into an ALARA plan, and a job specific RWP may be needed. For further information, please refer to the following procedures:

- ESH-RPE-001, ESH&Q RPE Routine Monitoring Programs (see Section 11.0)
- ADDP-SH-1200, Accelerator Division Initial Entry Survey Procedure (see Section 11.0)
- Snoop Survey Archive (see Section 9.0)

8.4 Be-7 Contamination

8.4.1 Considering the radiological characteristics of Be-7, specifically, the 10 percent gamma branching ratio, levels of Be-7 above FRCM limits may not be detectable with a Frisker, especially at levels as low as 50 cpm (threshold that PPE are considered contaminated). Even though Be-7 is not readily detectable with hand-held instruments, this radioisotope does not significantly contribute to an internal or external exposure as shown by a very low specific gamma ray constant of 0.0344 mrem/hr/mCi at one meter (0.37 mrem/hr/mCi at one foot). Calculations show that it would take 2.7E11 pCi (270 mCi) to receive a dose of 100 mrem in a year. The highest level of surface contamination measured on the MI-30 collimator is 8,000 pCi/100cm^2. To be conservative, a value of 10,000 pCi/100cm^2 is used. This level of surface contamination equates to a dose rate of 3.7E-6 mrem/hr at one foot. A radiological worker working in these conditions for one year (2000 hours) would receive a total effective dose of 7.4E-3 mrem. These calculations illustrate that Be-7 surface contamination poses no significant radiological hazard or potential exposure to workers.

8.4.2 Even though Be-7 poses no radiological hazard at high loss beamline areas, Fermilab is pursuing the possibility of implementation of instrumentation and associated procedures that will allow quicker turnaround time for Be-7 contamination wipe results rather than waiting for RAF results. Until such a time that Fermilab implements a precise instrumentation system with rapid turnaround time for Be-7 results, all contamination wipes are submitted to RAF for analysis.

8.4.3 In high loss areas where Be-7 is likely to occur in posted Contamination Areas, all PPE should be disposed of as radioactive waste by placing it in radioactive waste bags/containers.

8.5 Air Monitoring

Technical papers have shown that continuous air monitoring is needed at a few locations around the accelerator complex (as described in their shielding assessments) because these areas have the highest potential for the production of radionuclides in air. However, these isotopes have short half-lives and once the beam is turned off, they decay quickly. While most radioisotopes produced in air have decayed before it is physically possible for personnel to enter the enclosure, it is prudent to ensure the correct cool off time is imposed before allowing personnel to enter the enclosure. Cool off periods, when required, are noted on the applicable Running Condition. Since this cool off period is imposed where necessary, it is extremely unlikely that personnel will encounter areas exceeding one DAC, as a result, Fermilab has no areas posted as an Airborne Radioactivity Areas. For more information see ESH-RPO-006, Operation of the AMS-3 Air Monitor.

8.6 Water Monitoring and Sampling

The accelerator beamlines require a lot of water for cooling various components. Low conductivity water (LCW) is used to cool components such as magnets and RF cavities, while RAW systems are installed for cooling target stations or beam absorbers, both are closed loop systems. It is possible for this water to become radioactive, again through the spallation of oxygen, or pick up radioactive particles during cooling of beamline components. Typical radioisotopes of interest in these systems are H-3, Be-7, Na-22, Na-24, and Co-60.

8.6.1 The LCW and RAW systems are routinely monitored by the RPO Department. This information helps the RSO determine any necessary controls that may be needed for work on these systems, as well as how to properly dispose of the water, if necessary. Monitoring these levels will prevent an accidental release of tritium with levels approaching 1900 pCi/ml. For example, a "feed and bleed" method is used for NuMI water systems to prevent buildup of tritium.

8.6.2 Sump systems are installed and designed to prevent water from collecting under buildings and to carry this water out to one of the cooling ponds. All sumps are also sampled to ensure those levels stay below the Derived Concentration Standard limits outlined in the FRCM. See FRCM Table 11-1 Derived Concentration Standards* for Accelerator-produced Radionuclides in Water.

8.6.3 While the radionuclide levels are monitored in the cooling water to be sure systems are properly labeled and work on these systems is properly controlled and monitored, this does lead to other situations to consider. Occasionally a sump pump may fail, or an LCW hose could leak. This could lead to flooding in a contamination area. In these events, additional restrictions and controls will be established for walking through or working in water that has flowed through a posted Contamination Area. General RWPs for enclosures with posted Contamination Areas require individuals to turn back and notify the assigned RSO if water is found on the floor in areas around the posted Contamination Area. Rubber boots are always required when coming into contact with water that has been in contamination or high beam loss areas, and Job Specific RWPs will be generated if work needs to occur, specifically stating this requirement.

8.6.4 Additional consideration must be given to standing water in high loss areas such as collimator regions. In these high loss areas, concrete and beam line components become activated. Water standing on the floor for long periods of time leaches tritium and Na-22 from concrete. Indeed, almost all tritium produced at Fermilab originates from activation of beamline components. As mentioned in section 8.1.5, tritium atoms created as a result of beam hitting iron, concrete, carbon, air, water etc. will combine with oxygen or moisture in the air is also a contributing factor to tritiated water concentrations. Standing water on the floor that has been sitting for long periods of time in these high loss areas results in higher tritiated water concentrations than would be contained in the LCW alone. Therefore, LCW sampling results alone will not necessarily reflect contamination levels in standing water. For this reason, these high loss areas needs to be routinely monitored for standing water. Water that is found should cleaned up promptly and the area should be decontaminated as necessary. More information can be found in the following documents,

- ESH-RPO-007, Routine Sump, LCW, and RAW Sample Program (see Section 11.0)
- FRCM Chapter 11, Environmental Radiation Monitoring and Control (see Section 11.0)

8.7 Area Decontamination

8.7.1 The RPO Department has evaluated areas and developed controls, procedures, and technical basis documents to prevent the spread of contamination outside of area controlled for radiological purposes and to reduce internal exposures to personnel working in these areas. The enclosure aisleways are of particular concern with respect to the spread of contamination. As a result, RPO has developed a method to decontaminate the aisleways as necessary, but at a minimum at the beginning of each Summer shutdown.

8.7.2 The beamlines and beamline components are also considered for decontamination based on the type of work being performed in the area.

8.7.3 Decontamination of beamline components, at the discretion of the assigned RSO is still also considered based on the specific job requirements. Job plans from the accelerator departments are required to be submitted to the RPO Department before working in contamination areas. More information can be found in the following documents:

- ESH 003 ESH-RPO-003, Decontamination Using RPO Floor Cleaner (see Section 11.0)
- MI-30 Aisle Decontamination Technical Basis Document (see Section 11.0)

8.8 Internal Exposure to Personnel

8.8.1 An evaluation of potential internal exposures due to airborne radioactivity, radioactivated water, radioactivated materials, and surface contamination was conducted. Radioactive materials of most concern are those produced in the course of accelerator operations and maintenance activities. The primary exposure pathways evaluated were ingestion and inhalation. The most common accelerator-produced radionuclides present at Fermilab are Co-57, Co-60, Mn-54, Be-7, Na-22, Na-24, and tritium. These radionuclides can be present in the form of dust deposited on surfaces.

8.8.2 Though highly unlikely, these radionuclides could be resuspended in the air as a result of work activities. It has been determined that resuspension of these particulate radionuclides is minimal. Typical resuspension factor regularly used for resuspension of surface contamination into air is 1E-6 which poses no internal hazard for personnel working in these areas without respiratory protection. However, special consideration is given when work activities involve dismantling of absorbers or work on collimators due to the potential for high levels of contamination. For more information see the following documents listed below:

- Working on Contaminated Beamline Components in the Main Injector, Memo from S. McGimpsey to M. Quinn, M. Schoell dated July 16, 2019 (see Section 11.0)
- Radiation Physics Note 116, Guidelines for Employing Internal Exposure Controls During the Cutting of Activated Material at FNAL (see Section 11.0)
- Radiation Physics Note #128 (Title) Radiation Physics Note 128, Airborne Radioactivity in Accelerator Division (see Section 11.0)
- Radiation Physics Note 158, Review of Control of Occupational Exposure to Radioactivity at Fermilab (see Section 11.0)
- Binder from Los Alamos on resuspension factors Los Alamos National Laboratory LA-4558-MS, Surface Contamination: Decision Levels (see Section 11.0)

8.9 Internal Dosimetry Program

The estimated internal annual dose from each pathway as described above determines the need for a routine internal dosimetry program. 10 CFR Part 835 requires a routine internal monitoring program for internal dose of 100 mrem/year or greater. An extensive study was performed based on the types and levels of contamination that may be present and it has been determined that the threshold levels for which a routine internal dosimetry program would be needed cannot realistically be reached, even using extremely conservative assumptions. However, Fermilab will employ all appropriate measures and controls to avoid personnel contamination and continue to evaluate the need for a routine internal dosimetry program. Contamination monitoring is covered in the next sections. For further information see Fermilab Internal Dosimetry Technical Basis Document (R.P. Note #7).

8.10 Engineered and Administrative Controls

The Radiological Work Permit (RWP) is the main document that authorizes work in radiological areas or work with radioactive materials. An RWP and RCT coverage is always required when working in posted Contamination Areas. The RWP will clearly indicate the level of PPE and other requirements for entering and exiting the area, such as training, dosimetry, doffing PPE & frisking. RWP should also clearly state that “potential contamination” is the hazard/concern in the area. Other hazards should be identified as well.

Work in contamination areas also requires a job specific RWP, indicating additional necessary controls and RCT coverage. The RCT covering the job will create a post job write up, including post-job wipe of work location, adjacent aisles, entry/exit points that were used during the course of the work. This is documented to verify there was no contamination found on workers nor was there any spread of contamination outside of the posted areas.

8.11 Access Modes and Controls

Control of removable radioactive contamination at Fermilab is achieved, first and foremost, by containing contamination at the source. One method to keep contamination from spreading is prohibiting carts from going through the posted contamination areas of beamline enclosures once the contamination levels in the aisles exceed the FRCM limits for beta/gamma emitters. As previously mentioned, contamination levels can be assumed to be above the FRCM limits after two months of running beam. Therefore, carts are excluded from these areas until the aisleway decontamination has been completed. RCTs will conduct decontamination and perform surveys at the beginning of an extended shutdown. A general RWP for each type of access with the current requirements can always be found in the MCR or electronically.

All personnel entering the accelerator enclosures must obtain a key from the MCR. The MCR maintains a keylogger that ensures that everyone obtaining a key and entering an accelerator enclosure is a trained radiological worker. All training requirements for entering an area are also clearly stated on the RWP.

8.12 Posting

It is important to note that the beamline in high loss collimator regions within Booster and MI are permanently posted as Contamination Areas. This allows for deposting of the aisleway in these areas after decontamination is complete. For more information, see ESHS-RPO-POST-01, Radiological Posting dated November 2020 for posting of Contamination Areas.

8.13 Personal Protective Equipment (PPE)

While it is important to understand the type of access that is being made, decisions on the appropriate types of PPE are always made by the assigned RSO and documented on the RWP, or as directed by an RCT. PPE is always commensurate with the contamination potential, job activities, and location.

8.13.1 The level of PPE depends on the type of access that is being made. For example, for general enclosure entry during a Controlled access, if personnel are touring the area or just performing an inspection, only gloves and shoe covers are required. For personnel doing work, in addition to gloves and shoe covers, lab coats or coveralls may be appropriate. A hood may be prudent if any overhead work is involved. Some jobs may require additional RCT coverage and/or job specific RWPs. In any case, the assigned RSO is familiar with the area and the RCT is familiar with the work activities, so the correct PPE will be chosen and worn by personnel. For RCTs covering these jobs, gloves, shoe covers, and coveralls will likely be worn.

8.13.2 For the most part, a Controlled Access will always involve, at a minimum, gloves and shoe covers. This is because a radiation survey and wipes have not been performed after running beam. As a result, radiation and contamination levels are unknown. Under a

Supervised Access, when an initial entry survey has been performed by RCTs, it is possible to relax the PPE requirements, unless the area being entered is a posted Contamination Area.

8.13.3 At a minimum, personnel are required to wear additional shoe covers to enter Contamination Areas (i.e., double shoe covers if in Controlled Access mode, single shoe covers if in Supervised Access mode). Upon exiting the area, the shoe cover, or just the outer shoe cover for Controlled Accesses, is removed and disposed of as radioactive waste.

8.13.4 For all personnel, other hazards are considered such as heat stress or performing work above ground level. These other factors may require PPE (or lack of PPE) in direct contradiction to the PPE documented on the RWP. Meaning, it could be that a compromise is needed so that radiation safety and conventional safety are both given full consideration. For example, the Industrial Hygiene Group may require frequent breaks when specific PPE is worn, or a waiver for wearing shoe covers is granted when working on a ladder. In these cases, the assigned RSO is in direct communication with other subject matter experts to ensure worker safety.

8.13.5 Working in water in a posted Contamination Area also has special considerations, such as rubber boots, and these jobs must also have a job specific RWP and RCT coverage. Respirators are not required when working in areas where the surface contamination levels are less than 45,000 pCi/100cm^2. However, there are jobs where it is prudent to consider having personnel wear respirators or Personal Air Monitors (PAMs). All jobs are reviewed on a case-by-case basis and assigned appropriate PPE, monitoring, and controls.

9.0 Data and Records Management

Snoop Survey Archive,
https://fermipoint.fnal.gov/org/eshq/rp/Snoop%20Survey%20Program/Forms/AllItems.aspx?id=%2Forg%2Feshq%2Frp%2FSnoop%20Survey%20Program%2FSurvey%20Archive

Opening Up Surveys,
https://fermipoint.fnal.gov/org/eshq/rp/Snoop%20Survey%20Program/Forms/AllItems.aspx?id=%2Forg%2Feshq%2Frp%2FSnoop%20Survey%20Program%2FSurvey%20Archive%2FOpening%20Up%20Surveys

ALARA Plan Surveys,
https://fermipoint.fnal.gov/org/eshq/rp/Snoop%20Survey%20Program/Forms/AllItems.aspx?id=%2Forg%2Feshq%2Frp%2FSnoop%20Survey%20Program%2FSurvey%20Archive%2FALARA%20Plan%20Surveys

Miscellaneous Surveys,
https://fermipoint.fnal.gov/org/eshq/rp/Snoop%20Survey%20Program/Forms/AllItems.aspx?id=%2Forg%2Feshq%2Frp%2FSnoop%20Survey%20Program%2FSurvey%20Archive%2FMisc%2E%20Surveys

RAF Results, https://fermipoint.fnal.gov/org/eshq/rp/RAF%20Results/Forms/AllItems.aspx

RP Forms, Public_RPG(\\eshserver1\ESH_SECTION) (P:)

10.0 Quality Assurance/Quality Control

This procedure is subject to a review/update frequency requirement of five years and is due 11/30/2025.

11.0 References

ADDP-SH-1200, Accelerator Division Initial Entry Survey Procedure, G. Lauten, September 2013

ESH-RPE-001, ESH&Q RPE Routine Monitoring Programs, G. Lauten, May 2017

ESH-RPO-003, Decontamination Using RPO Floor Cleaner, J. Fulgham, May 2019

ESH-RPO-006, Operation of the AMS-3 Air Monitor, J. Fulgham, March 2020

ESH-RPO-007, Routine Sump, LCW, and RAW Sample Program, D. White, March 2020

ESH-RPO-MON-01, Fermilab ESH RPO Routine Monitoring Programs, M. Schoell, November 2020

ESH-RPO-POST-01, Radiological Posting, K. Graden, November 2020 https://esh-docdb.fnal.gov/cgi-bin/sso/ShowDocument?docid=6123

Fermilab Radiological Control Manual, https://eshq.fnal.gov/manuals/frcm/

Los Alamos National Laboratory LA-4558-MS, Surface Contamination: Decision Levels, J. W. Healy, September 1971

MI-30 Aisle Decontamination Technical Basis Document, M. Quinn, April 2019

Radiation Physics Note 7, Fermilab Internal Dosimetry Technical Basis Document, S. McGimpsey, February 2013, https://esh-docdb.fnal.gov/cgi-bin/sso/ShowDocument?docid=2192

Radiation Physics Note 116, Guidelines for Employing Internal Exposure Controls During the Cutting of Activated Material at FNAL, E. Marshall, August 1995, https://esh-docdb.fnal.gov/cgi-bin/sso/ShowDocument?docid=2203

Radiation Physics Note 128, Airborne Radioactivity in Accelerator Division, G Lautenschlager, T. Leveling, November 1996, https://esh-docdb.fnal.gov/cgi-bin/sso/ShowDocument?docid=2204

Radiation Physics Note 158, Review of Control of Occupational Exposure to Radioactivity at Fermilab, M. Quinn, J.D. Cossairt, M. Schoell, N. Chelidze, K. Graden, S. McGimpsey, D. Reitzner, W. Schmitt, K. Vaziri, December 2018, https://esh-docdb.fnal.gov/cgi-bin/sso/ShowDocument?docid=2208

Radiation Physics Note 165, Evaluation of the Radiological Hazards from Use of Industrial Cooling Water in the Fermilab Fire Suppression Sprinkler Systems, J.D. Cossairt and M. Quinn, May 2019, https://esh-docdb.fnal.gov/cgi-bin/sso/RetrieveFile?docid=3290&filename=RP%20Note%20No%20165%20Rev%201.pdf&version=7

Removable Contamination, DOE Radiological Control Guide, DOE G 441.1-10, dated 05-24-99, https://www.directives.doe.gov/terms_definitions/removable-contamination

Snoop Survey Schedules, https://fermipoint.fnal.gov/org/eshq/rp/Snoop%20Survey%20Program/Forms/AllItems.aspx?id=%2Forg%2Feshq%2Frp%2FSnoop%20Survey%20Program%2FSchedules

Title 10 Code of Federal Regulations Part 835, Occupational Radiation Protection, December 1993, https://ecfr.io/Title-10/Part-835

Working on Contaminated Beamline Components in the Main Injector, Memo from S. McGimpsey to M. Quinn, M. Schoell dated July 16, 2019 https://esh-docdb.fnal.gov/cgi-bin/sso/ShowDocument?docid=6161

12.0 SOP Signature Sheet

N/A - Procedure review and training specified in section 7.2 is tracked in TRAIN.

13.0 Procedure Specific Training Checklist

N/A - Procedure review and training specified in section 7.2 is tracked in TRAIN.

14.0 Attachments

N/A