Fermilab	ES&H Section Procedures	
Procedure Number/Name ESH-RPO-MON-05 – Water System Sampling		**Original Date:** 09/26/2000
Written by: Ben Russell	**Reviewed and Updated By:** Dale White	**Date:** 04/27/2022

Water System Sampling

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Maddie Schoell, RPO Department Manager

Revision History

Updated by	Description of Change	Revision Number	Revision Date
Date White	Initial Release (RSG-101-1)	0	9/26/2000
Dale White	Updated personnel titles after ESH reorganization, and Transferred to ESH-MON-07 format	1	8/16/2019
Ben Russell	Updated to ESH-RPO format, included DOE O 458.1 requirements	2	04/27/2022

Table of Contents

Table of Contents

Procedure

1.0 Purpose

Sump systems, Low Conductivity Water (LCW) systems, and Radioactive Water (RAW) systems are required to be surveyed (i.e., sampled) on a routine frequency as determined by the assigned RSO. This procedure details the specific aspects of the sampling program.

2.0 Scope

The Radiation Physics Operations (RPO) Department is responsible for collecting samples in the Beam Line Enclosures. The Environmental Protection Group (EPG) is responsible for collecting samples from the outdoor waterways from on-site locations i.e., lakes, ponds, creeks, ditches, etc. All samples are submitted to the Radionuclide Analysis Facility (RAF) for storage and analysis.

3.0 Summary

Radiation Physics Operations (RPO) Department, in consultation with the Environmental Protection Group, develops a yearly sampling plan. Sample sites are chosen by their proximity to target areas, closed loop (recirculating) cooling systems, and areas of soil radioactivation resulting from accelerator operations. The number of samples per year is dependent on the anticipated concentration or nuclides detected in the water.

Water samples are taken routinely from sumps, retention pits, and monitoring holes located within the accelerator rings and fixed target tunnel enclosures. The sample type in accordance with the sample schedule determines which accelerator-produced nuclides (H-3, Be-7, Na-22, Mn-54, Co-60, etc.) will be analyzed. The sample type will determine the amount of sample needed, necessary preservation, and whether on-site or off-site analysis will be used by the RAF.

Sumps located closest to maximum soil activation are sampled more frequently than ones further away. Other sumps are sampled less often based on low tritium (H-3) concentrations. Typically, retention pits are sampled 1-4 times per year depending on historic activation levels and storage capacities. A discharge from these does not occur automatically.

4.0 Definitions

None

5.0 Responsibilities

5.1 Radiation Safety Officer (RSO)

- Works with EPG and Environmental Radiological Protection Program (ERPP) Manager to determine yearly sampling plan
- May request additional samples
- Reviews completed samples

5.2 Environmental Radiation Protection Program (ERPP) Manager

- Works with EPG and RSO to determine yearly sampling plan
- May request additional samples
- Reviews completed samples

5.3 Radiation Control Technician (RCT)

- Responsible for the collection, submission, and distribution of samples and results

5.4 RAF Personnel

- Responsible for counting, reporting, and maintaining records of samples submitted for analysis

6.0 Health and Safety Warnings

Personnel will likely encounter hazards such as radiation exposure and radioactive contamination while performing the steps of this procedure.

During a controlled access into beamline enclosures, only the main dipole and quadrupoles with exposed conductors are de-energized by performing LOTO II on the applicable 13.8 kV Power Supply System. It is important that surveys avoid touching exposed terminals on terminations to avoid electric shock or electrocution. For enclosures with group LOTO boxes available, personnel performing this procedure should place their individual LOTO locks on the appropriate group LOTO boxes prior to accessing the enclosure. If it is necessary for the surveyor to touch or potentially touch any exposed conductors in any enclosure, the device specific LOTO procedure must be followed. Contact the DSO, EE Support, or Machine Coordinators for further instructions.

Additionally, some enclosures may have additional hazards such as ODH or confined space, or enclosure specific hazards that are addressed in enclosure specific trainings.

Personnel must comply with applicable radiological work permits (RWPs), Hazard Analysis (HAs) or other access requirements.

7.0 Prerequisites

Material & Equipment

- Dipstick – most locations can easily be sampled with the use of a dipstick. This method is the preferred method. Use a pump for locations with grates or that are too deep and that will not allow for use of a dipstick.
- AC/Battery-operated peristaltic pump with required tubing with weight for sample end (~20ft intake and 2ft discharge), pump adapter, and extension cord if necessary
- Equipment and PPE required under the Radiological Work Permit
- Polyethylene sample containers as required for sample type with blank labels attached
- Chain-of-Custody, labels, and pen or marker
- Kimwipes or similar disposable absorbent material
- Maps, if unfamiliar with the areas to be visited

Training Required

- Radiological Worker Training (FN000470 and FN000471) or DOE Core Academics for RCTs (FN000277) and RCT Continuing Training and Requalification (FN000300)
- Lockout/Tagout Level 2 (LOTO II) (FN000212)
- Fermilab Controlled Access (FN000311)
- O.D.H. Training (FN000029) and O.D.H. Medical Qualification, for applicable enclosures
- Confined Space (FN000003), for applicable enclosures
- Enclosure specific trainings (i.e., NuMI/MINOS Underground Safety Training, etc.)
- Other training as required by RWP or other entry requirements

8.0 Procedural Steps

8.1 Pre-Requisites

8.1.1 Call the Main Control Room (MCR) at x3721 before planning any sampling to coordinate access to beam enclosures.

8.1.2 Enter a work request in the Accelerator Division Electronic Worklist for the sampling, if occurring in an enclosure.

8.1.3 Any Confined Space area requiring entry into it to collect a sample will require filling out a Confined Space Permit or a reclassification form and following its associated steps to gain access.

8.1.4 If a sump lid is marked as Confined Space:

8.1.4.1 Because a person is not entering with any part of their body it is okay to place a dipstick into the water and collect a sample without performing normal confined space access entry procedures and permits.

8.1.5 An AD Worklist entry and/or IMPACT HA may need to be completed, depending on the location and hazards associated with the sampling.

8.2 Sampling Sumps and Retention Pits

8.2.1 If using a Dipstick:

NOTE: When handling/carrying a dipstick, cup end should be down towards the ground to avoid placing it near another individual's face or body. Having the cup end low to the ground prevents water from running down the handle while it is being carried.

8.2.1.1 Remove the Sump or Retention Pit cover

8.2.1.2 Lower the dipstick down until the end with the cup is fully submerged

8.2.1.3 Rinse the dipstick several times in the sump or retention pit by raising it and lowering it in the water. This can remove previous residual water on the dipstick from other locations and provides a more representative sample of the sump or retention pit being sampled.

8.2.1.4 Raise the dipstick out of the Sump or Retention Pit

8.2.1.5 Pour the sample into the appropriately labeled Polyethylene sample container, being careful to avoid spilling water in the area around the sample site

8.2.1.6 Seal the sample container

8.2.1.7 Wipe off any water on the outside of the dipstick and sample container with absorbent material

8.2.1.8 Replace the Sump or Retention Pit cover

8.2.2 If using a Pump:

8.2.2.1 Plug AC adapter into the pump to power the pump from an electrical outlet. The AC method will provide the greatest pumping power and speed over the battery method. If intending to use battery power place the peristaltic pump on charge the day before sampling to ensure a full charge is available.

8.2.2.2 Attach hosing: Connect both long pump section of hose and discharge end to appropriate head connection of pump. Ensure suction and

discharge ends are performing proper function by turning on pump temporarily. If the discharge end is sucking rather than pushing air, switch the hose end connections or reverse the direction of pump operation. The pump may be run in a Clockwise (CW) or Counterclockwise (CCW) direction allowing for thorough purging of lines before collecting sample.

8.2.2.3 At the sample site, remove the Sump or Retention Pit cover

8.2.2.4 Lower the weighted intake tube into the sump/retention pit/hole until the weight is just below the surface of the water.

8.2.2.5 Turn on the pump: Once sufficient flow has begun purge the lines by allowing the pump to run for about 30 seconds with the discharge running back into the sump/retention pit/hole. Repeat this step at the next location for each sample, thoroughly purging lines before collecting the sample.

8.2.2.6 Fill the required labeled Polyethylene Sample container(s) to a point just below the neck seam line.

8.2.2.7 Turn off the pump, switch the flow direction knob to the opposite setting (CCW or CW), and turn the pump back on allowing water in the tubing to completely run back into the sump/retention pit/hole. Wipe off the outside of the tubing with absorbent material while removing hose.

8.2.2.8 Close the Sump or Retention Pit cover.

8.3 LCW Samples

8.3.1 Fill the labeled Polyethylene sample container from the sample nozzle by opening the control valve.

8.3.2 Close the valve when the desired level is reached.

8.3.3 Wipe off the outside of the sample container with absorbent material.

8.4 RAW Samples

8.4.1 Locate the sample valve with the associated discharge hose/nozzle.

8.4.2 Fill sample container to desired level by gently opening the control valve and closing it when the fill is complete.

NOTE: NuMI RAW systems have a sample manifold located in the Power Supply room which allows for sampling remotely so that entry into the RAW room is not necessary. This requires an M-13 key to unlock.

8.4.3 Wipe off the outside of the sample container with absorbent material.

8.4.4 Perform a count of the absorbent material with a frisker to determine if the outside of the sample container has been contaminated. Contaminated sample containers should not be submitted to the RAF for analysis, as they could contaminate the counting equipment.

8.5 Sample Submission

8.5.1 Each sample should already be labeled, including Sample Identification Number, Location Description, and time sample was taken. This information is used to complete RP Form 33, Chain-of-Custody form.

8.5.2 Take samples with Chain of Custody form to the RAF

8.5.2.1 Depending on analysis type, samples will either be analyzed on-site or shipped to an off-site vendor.

8.5.3 Submit the sample(s) by signing off "Relinquished By" signature area of the Chain -of-Custody. RAF personnel will sign accepting possession of sample(s) in "Received By" portion. The original Chain-of-Custody remains with the sample(s).

8.5.4 RAF personnel will provide a pdf report of the results via email and will upload electronic results into the LocusEIM cloud database within 1 week of issuance of the pdf report.

8.5.5 RCT should send results to the assigned RSO and ERPP Manager for review.

8.6 RSO and ERPP Manager Review

8.6.1 The RSO and ERPP Manager will review the results once received from the RAF.

8.6.2 The ERPP Manager will trend the data to evaluate inputs into the *Annual Site Environmental Report.*

8.6.3 The RSO will evaluate tritium and other isotope levels to determine if the threshold for posting a contamination area is surpassed via the requirements of ESH-RPO-CONTAM-01.

9.0 Data and Records Management

This procedure's sampling includes information and data necessary to identify and characterize releases of radioactive material to the environment, their fate in the environment, and their probable impact on radiation dose to members of the public, and any impacts on ecological systems. These water sample records are maintained by the RAF for a minimum of 75 years.

10.0 Quality Assurance/Quality Control

This procedure is subject to a review frequency requirement of 3 years and is due 04/25/2025.

Data shall be reviewed by the assigned RSO and the ERPP Manager prior to being approved.

11.0 References

Fermilab's Environmental Monitoring Plan (EMP)

Fermilab's Environmental Radiological Protection Program (ERPP)

ESH-RPO-CONTAM-01 – Control of Contamination Areas and Program Management

12.0 SOP Signature Sheet

This table indicates all qualified personnel, and documents that they have read and understood this procedure and completed necessary On-the-Job Training (OJT) and Procedure Specific Training Checklist listed in Section 7.0 and tracked in Section 13.0. By signing below, the qualified individual agrees to adhere to the requirements and guidelines contained within this procedure along with all other applicable work authorization documents. Only persons who have signed below and have been authorized may perform work covered by this SOP.

Name	Signature	Date	Department Head/Team Leader

13.0 Procedure Specific Training Checklist

This table indicates all qualified personnel, and documents that they have completed necessary On-the-Job Training (OJT). Only persons who have signed below and have been authorized by the relevant department head or team leader may perform work covered by this SOP.

Topic	Name	Signature	Date	Department Head/Team Leader

14.0 Attachments

None