Radiation Physics Calibration Facility

Section V - Chapter 3

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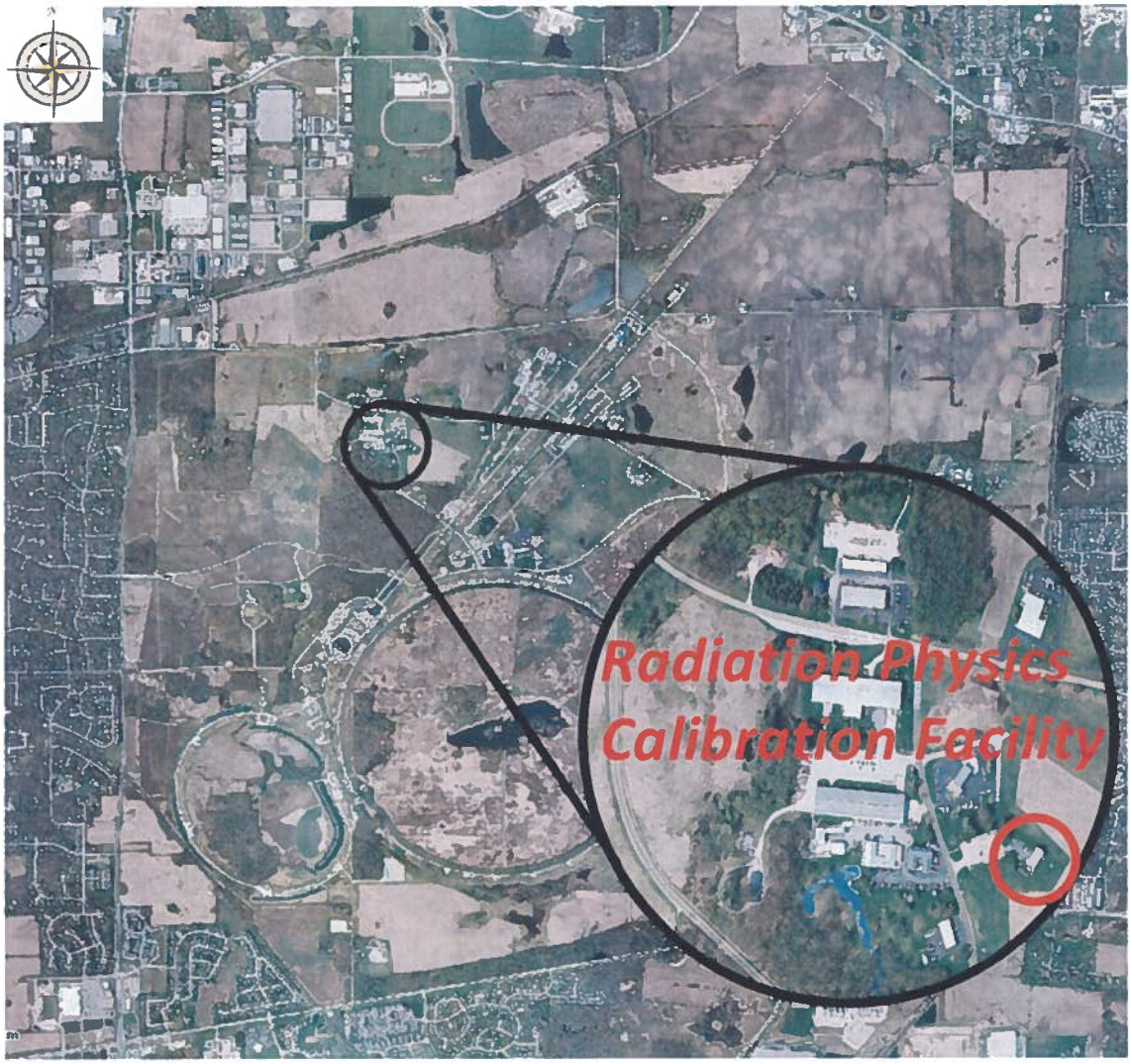
V- 3 Radiation Physics Calibration Facility (RPCF)

V - 3.1 RPCF Location on Fermi National Accelerator (Fermilab) Site

The RPCF is operated by the Environment, Safety, Health, & Quality (ESH&Q) Section Radiation Protection Group. The following aerial photograph shows the location of the RPCF on the Fermilab site.



V - 3.2 Inventory of Hazards

The following table lists the identified radiological hazards found at the RPCF. Conventional hazards are not addressed in Section V chapters.

Radiation Ionizing radiation Radioactive sources	**Nuclear Materials** Americium-241 Beryllium sealed neutron sources Californium-252 sealed neutron sources

V - 3.3 Introduction

This Section V, Chapter 3 of the Fermi National Accelerator Laboratory (Fermilab) Safety Assessment Document (SAD) covers the RPCF.

V - 3.3.1 Purpose of the RPCF

The purpose of the RPCF is to repair, modify, and calibrate radiation and industrial hygiene instruments. The ESH&Q Section Instrumentation Team conducts research, designs, develops, constructs, and calibrates radiation instrumentation for Fermilab, and performs related studies.

V - 3.3-2 Description of the RPCF

The RPCF is a two-story building located in the eastern-most section of the Site 38 area of Fermilab. There are three caves at the RPCF which serve as radiation instrument calibration facilities, neutron source storage, radioactive source storage, and instrumentation storage. Cave # 1 houses various radioactive sources that are used for instrument calibrations. Cave # 1 is the storage location for nuclear materials in the form of sealed neutron sources. All sealed neutron sources are stored in a concrete container called the neutron storage cave. The neutron storage cave is part of the poured concrete walls of cave # 1. The High Level Calibration Facility (HLCF) is located in cave # 2. This cave is constructed of concrete and consists of an outer control room and an inner irradiation room. Radioactive source projectors are used to project high intensity radiation beams into the inner irradiation room for various radiation instrument

calibrations. Three projectors are located in and operated from the outer (control) room where operators are stationed during irradiation.

The Low Level Calibration Facility (LLCF) is located in cave # 3. The cave is constructed of concrete and consists of an outer room and an inner irradiation room. The radioactive source projector is located in and operated from the inner irradiation room.

V - 3.4 Safety Assessment

The unique radiological hazards at the RPCF are described in this section.

V - 3.4.1 Radiological Hazards

Various types of sealed radioactive sources and nuclear material are located at the RPCF that present radiological hazards. This section identifies the types of radiological materials, radioactivated material, sealed radioactive sources, nuclear materials, radioactive waste, and their respective safety controls. Safety controls at Fermilab are in the form of prescribed procedures and protective measures detailed in the following guidance documents: Fermilab Environment, Safety and Health Manual[1] (FESHM); Fermilab Radiological Control Manual[2]; Fermilab Sealed Radioactive Source Control and Accountability Program[3]; Fermilab Nuclear Materials Control and Accountability (MC&A) Plan[4]; Fermilab Site Security Plan[5]; and Low-Level Waste Certification Program[6].

V - 3.4.1.1 Residual Activation

The RPCF is not physically connected to the accelerator complex, so there is no residual activation produced at the RPCF. Radiological hazards at the RPCF are not directly associated with accelerator operations and are managed in accordance with the requirements of FRCM Chapter 4, *Radioactive Materials*, that implement Title 10 of the Code of Regulations Part 835, "Occupational Radiation Protection" (10 CFR 835).

V - 3.4.1.2 Sealed Radioactive Sources

Various types of radioactive sources are located at the RPCF for instrument calibrations and related studies. These radioactive sources are stored and used in accordance with FRCM

Chapter 4, *Radioactive Materials*, Part 3, *Radioactive Source Controls*, and the Fermilab Sealed Source Control and Accountability Program policies.

The physical description of the High Level Calibration Facility (HLCF), including the safety features, personnel authorization requirements, and facility operating procedures are contained in the Fermilab ESH&Q Section High Level Calibration Facility Operating Procedures[7]. The HLCF houses six high activity radioactive sources which are contained within J.L. Shepherd source projectors. Three radioactive sources are mounted in a triple-source projector. Two radioactive sources are mounted in a dual-source projector. A sixth radioactive source is mounted in a single large projector. Each of these projectors is activated by rolling the projector positioning carriage to the desired position and selecting the desired radioactive source to be used for the irradiation. Dose rates in the HLCF range from 0.03 mrem/hour at 4 meters up to 1,500 rads/hour at 20 centimeters. Radioactive sources located in the HLCF in cave # 2 are:

- Cesium-137 radioactive source identified as 137-3.2-12
- Cesium-137 radioactive source identified as 137-4.2-3
- Cesium-137 radioactive source identified as 137-5.2-1
- Cesium-137 radioactive source identified as 137-6.2-1
- Cesium-137 radioactive source identified as 137-7.2-1
- Cesium-137 radioactive source identified as 137-8.2-1

The HLCF outer room door is locked. The doors to the irradiation (inner) room are locked by an interlock key. As described in the Fermilab High Level Calibration Facility Operating Procedures, the interlock/warning system provides multiple functions for the controlled use of the J.L. Shepherd source projectors. Daily preoperational interlock/warning test checks are performed in accordance with the Fermilab High Level Calibration Facility Operating Procedures. These keys are controlled by the operator(s) when the facility is in operation. The source projectors are locked with Sesamee™ combination locks while these sources are not in use. Only authorized ESH&Q Section personnel know the combinations to the locks. Padlock and other combination locks are changed in the event of termination or transfer of any person authorized to have access to these combinations.

The physical description of the Low Level Calibration Facility (HLCF), including the safety features, personnel authorization requirements, and facility operating procedures are contained in the Fermilab ESH&Q Section Low Level Calibration Facility Operating Procedures[8]. The LLCF houses four lower activity radioactive sources than those in the HLCF.

These four radioactive sources are installed in a horizontally mounted quad radioactive source projector. The source projector is located in and operated from the inner irradiation room. The detectors to be tested are placed in the inner irradiation room for exposure. Dose rates in the LLCF range from 0.01 mrem/hour at 4 meters to approximately 5 rads/hr at about 20 centimeters. Radioactive sources located in the LLCF in cave # 3 are:

- Cesium-137 radioactive source identified as 137-2.4-2
- Cesium-137 radioactive source identified as 137-3.4-3
- Cesium-137 radioactive source identified as 137-4.5-1
- Cesium-137 radioactive source identified as 137-5.6-3

The Low Level Calibration Facility outer room door is locked. This projector is not interlocked (warning device only) and is manually activated by moving the source rod to the desired source position. The projector is deactivated by manually returning the source rod to the off position.

V - 3.4.1.3 Nuclear Materials

Nuclear materials located at the RPCF are stored and used in accordance with requirements set forth in DOE Order 410.2, *Management of Nuclear Material*, DOE Order 474.2, *Nuclear Material Control and Accountability*, FRCM Chapter 4, *Radioactive Materials*, and the Fermilab MC&A Plan requirements. The ESH&Q Section Nuclear Materials Representative (NMR) is responsible for control and accountability of nuclear materials at Fermilab.

The following sealed neutron sources are located in the neutron storage cave located in cave # 1:

- Americium-241 Beryllium neutron source identified as 241Be-5.2-1
- Americium-241 Beryllium neutron source identified as 241Be-6.7-1
- Americium-241 Beryllium neutron source identified as 241Be-7.2-1
- Americium-241 Beryllium neutron source identified as 241Be-7.6-1
- Calfornium-252 neutron source identified as 252-7.2-1
- Calfornium-252 neutron source identified as 252-7.2-2

Fermilab has a graded program for controlling personnel access to nuclear materials in storage. The RPCF is locked with a limited issued key. The building is protected by an access encoded security system connected via Fire Incident Reporting and Utility System (FIRUS) to the Security Department.

Access controls for nuclear materials are described in the Fermilab Site Security Plan. Access to the neutron storage vault is controlled by use of a combination lock. Only a limited number of people are authorized access to the neutron source storage cave. Any person removing a neutron source from the vault is required to verify that the inventory is intact and to log that fact in accordance with the Fermilab Sealed Radioactive Source Control and Accountability Program. If the sources are to be used elsewhere, not in the constant possession of authorized personnel, Fermilab Security Department and the Department of Energy are notified by the ESH&Q Section Head or designee so that additional security arrangements can be made as deemed necessary.

An intrusion alarm system is installed at the RPCF which, upon unauthorized entry, sets off a FIRUS alarm at the Communication Center. An emergency power system, with a lifetime of approximately 12 hours, is used in the event of power outages. During system failures, Fermilab Security provides guard inspections of the RPCF integrity at two-hour intervals. Door locks at the RPCF are controlled through the Laboratory's key system. Fermilab Security provides exterior site inspection at least twice per 8-hour shift.

V - 3.5 Assessment of Potential Credited Controls

V – 3.5.1 Passive Controls

There are no passive credited controls that qualify for inclusion in the Accelerator Safety Envelope (ASE).

V - 3.5.2 Active Controls

There are no active controls that qualify for inclusion in the ASE.

V - 3.5.3 Administrative Controls

Fermilab has implemented material access controls to ensure that only authorized personnel gain access to nuclear materials. Locked buildings, fences, gates, and padlocks prevent unauthorized access to nuclear materials.

There are no administrative controls that qualify for inclusion in the ASE.

V - 3.6 Summary & Conclusion

This chapter of the Fermilab SAD identifies specific radiological hazards associated with the RPCF operations. The chapter describes designs, controls, and procedures that mitigate specific radiological hazards and enhance safety security at the RPCF. In addition to these specific safety considerations, the RPCF is subject to the global and more generic safety requirements, controls, and procedures outlined in Section 1 of this Fermilab SAD.

The RPCF can be operated with a level of safety that will protect people and property and is equal to or exceeding that currently prescribed by DOE orders and Fermilab regulations as put forth in the FESHM and the FRCM.

V - 3.7 Glossary, Acronyms

ASE	Accelerator Safety Envelope
DOE	Department of Energy
ESH&Q	Environment, Safety, Health and Quality
FESHM	Fermilab Environment, Safety, and Health Manual
FIRUS	Fire Incident Reporting and Utility System
FRCM	Fermilab Radiological Control Manual
HLCF	High Level Calibration Facility
LLCF	Low Level Calibration Facility
MC&A	Materials Control and Accountability
PIN	Personal Identification Number
RPCF	Radiation Physics Calibration Facility
SAD	Safety Assessment Document
SSP	Site Security Plan

V - 3.8 References

[1]Fermilab Environment, Safety, and Health Manual, March, 2015. ESHQ DocBD link: http://esh.fnal.gov/xms/FESHM

[2]Fermilab Radiological Control Manual, March, 2015. ESHQ DocBD link: http://esh.fnal.gov/xms/FRCM

[3]Fermilab Sealed Source Control and Accountability Program, February, 2013. ESHQ DocBD link: https://esh-docdb.fnal.gov:440/cgi-bin/ShowDocument?docid=156

[4]Fermilab Nuclear Materials Control and Accountability Plan, February, 2015. ESHQ DocBD link: https://esh-docdb.fnal.gov:440/cgi-bin/ShowDocument?docid=2024

[5]Fermilab Site Security Plan, July, 2014. ESHQ DocBD link: https://esh-docdb.fnal.gov:440/cgi-bin/ShowDocument?docid=2761

[6]Low-Level Waste Certification Program, March, 2015. ESHQ DocBD link: https://esh-docdb.fnal.gov:440/cgi-bin/ShowDocument?docid=3046

[7]Fermilab High Level Calibration Facility Operating Procedures, April, 2015. ESHQ DocBD link: https://esh-docdb.fnal.gov:440/cgi-bin/ShowDocument?docid=1644

[8]Fermilab Low Level Calibration Facility Operating Procedures, April, 2015. ESHQ DocBD link: https://esh-docdb.fnal.gov:440/cgi-bin/ShowDocument?docid=1645