

DOE O 420.2D Phased Reviews: IRR #1a – Common, Support, Linac & MTA Internal Readiness Review November 29-December 1, 2023

Charge

Background

Over the past several months, several updates have been made to the Fermilab accelerator safety documentation to align with new requirements in DOE O 420.2D, *Safety of Accelerators*, and address comments and recommendations provided by the Fermilab Site Office (FSO), the August 2023 Accelerator Readiness Review (ARR), and the September 2023 DOE Assist Visit. Fermilab will be conducting a series of reviews from November 2023 through March 2024 to ensure all aspects of accelerator safety are in place and meet the requirements and expectation to allow for safe operations of all accelerators under DOE O 420.2D.

In general, the following updates have been made:

- Fermilab SAD and ASE structure and layout has been updated,
- Incorporated updated methodology for analyzing non-accelerator specific hazards, generated a common risk matrix table in the SAD Appendix,
- Incorporated updated methodology for analyzing the Maximum Credible Incident (MCI) for the prompt ionizing radiation accelerator-specific hazard, and utilizing this methodology for determining Credited Controls,
- Identified Oxygen Deficiency Hazard (ODH) as an accelerator-specific hazard for applicable accelerator facilities,
- Incorporated ODH Controls, Radiation Monitors, and Search & Secure process as Credited Controls, and
- Developed an updated Unreviewed Safety Issue (USI) Program.

Fermilab had two accelerators operating under DOE O 420.2C. With the updated Order, three additional devices previously managed as Radiation Generating Devices (RGDs) will now be managed as accelerators. Each accelerator will conduct an Internal Readiness Review (IRR) that will focus on the updated Safety Assessment Document (SAD) Chapter and Accelerator Safety Envelope (ASE) specific to that facility. Following the IRR, each accelerator will conduct an External Readiness Review (ARR) that will review all other aspects of accelerator safety required by DOE O 420.2D. The full review schedule is as follows:

- IRR #1a – SAD/ASE Review for Fermilab Main Accelerator Common Chapters, Support Areas, and Linac & MTA Accelerator Segments
- IRR #1b – SAD/ASE Review for Fermilab Main Accelerator Booster, 8 GeV, Booster Neutrino Beam (BNB), Main Injector, Recycler and Neutrinos from the Main Injector (NuMI) Accelerator Segments and the BNB & NuMI Experimental Areas
- IRR #1c/d – SAD/ASE Review for Fermilab Main Accelerator Muon Campus, Switchyard, Meson, and Neutrino Accelerator Segments and the Meson and Neutrino Experimental Areas
- ARR #1 – Full ARR for the Fermilab Main Accelerator
- IRR #2 – SAD/ASE Review for the FAST Accelerator
- ARR #2 – Full ARR for the FAST Accelerator
- IRR #3 – SAD/ASE Review for the Test Stand Accelerators (CMTS1, PIP2IT, and VTS)
- ARR #3 – Full ARR for the Test Stand Accelerators (CMTS1, PIP2IT, and VTS)

Review Charge

This review is: IRR #1a – SAD/ASE Review for Fermilab Main Accelerator Common Chapters, Support Areas, and Linac & MTA Accelerator Segments

This IRR is a limited scope review focusing on the applicable SAD and ASE documents. This review will encompass the SAD Chapters that provide an overview of the Fermilab facilities, the SAD Chapters that address accelerator support facilities, and specific SAD Chapters and ASE for Linac and 400 MeV Test Area (MTA). The following is a list of applicable Chapters:

- SAD Section I – Overview of Fermilab Facilities
 - I-1 *Executive Summary*
 - I-2 *Introduction*
 - I-3 *Site, Facility Design Criteria and Operations*
 - I-4 *Safety Assessment*
 - I-5 *Accelerator Safety Envelope Basis*
 - I-6 *Environmental Monitoring*
 - I-7 *Quality Assurance*
 - I-8 *Post-Operations Planning*
 - I-9 *Acronyms*
 - I-10 *References*
- SAD Section II – Support Facilities
 - II-1 *Railhead*
 - II-2 *Radiation Protection Calibration Facility (RPCF)*
 - II-3 *Radionuclide Analysis Facility (RAF)*
 - II-4 *Waste Handling Facilities*
 - II-5 *Applied Physics & Superconducting Technology Facilities*
 - II-6 *Shipping and Receiving Operations*
 - II-7 *Other Radioactive Material Storage Areas*
- SAD Section III – Fermilab Main Accelerator – Accelerator Segments
 - III-1 *Linac*
 - III-2 *400 MeV Test Area (MTA)*
- SAD Appendix A – Accelerator Safety Envelopes
 - VII-A.1 *Accelerator Safety Envelope – Fermilab Main Accelerator*
 - *Linac and MTA portions only
- SAD Appendix B – Fermilab Accelerator Safety Policies & Programs

- VII-B.1 *Fermilab Shielding Policy*
- VII-B.2 *Fermilab Unreviewed Safety Issue (USI) Process*
- SAD Appendix C – Non-Accelerator Specific Hazard (NASH) Risk Matrix Tables
 - VII-C.1 *Non-Ionizing Radiation*
 - VII-C.2 *Toxic Materials*
 - VII-C.3 *Flammable and Combustible Materials*
 - VII-C.4 *Electrical Energy*
 - VII-C.5 *Thermal Energy*
 - VII-C.6 *Kinetic Energy*
 - VII-C.7 *Potential Energy*
 - VII-C.8 *Magnetic Fields*
 - VII-C.9 *Other Hazards*
 - VII-C.10 *Access & Egress*
 - VII-C.11 *Environmental*

The Overview of Fermilab Facilities Section of the Fermilab SAD has been updated to describe the updated assessment methodology for the non-accelerator specific hazards, Maximum Credible Incident (MCI) analysis for the prompt ionizing radiation accelerator-specific hazard, and include descriptions for the new Credited Controls for radiation monitors, ODH safety system components, and the Search and Secure process.

The Unreviewed Safety Issue (USI) Process has been updated to meet requirements from DOE O 420.2D CRD § 2.f, and has been submitted for Lab and Site Office approval.

Following the updates to risk assessment methodology for non-accelerator specific hazards, there is no change to management of the Support Facilities, and changes to these facilities is entirely within the updated SAD Chapter documentation.

There have been no changes to the beamline or facility configuration of either the Linac or 400 MeV Test Area (MTA) accelerator segments. Following the updated MCI analysis for MTA, additional radiation monitors have been identified as Credited Controls, however use of radiation monitors as Credited Controls has been in place for previous MTA operations.

This committee is asked to review the updated documents noted above to verify they have addressed requirements in DOE O 420.2D and comments/recommendations from FSO, the August ARR, and the September DOE Assist visit. This committee is asked to verify that once the ASE has been approved by the Fermilab Site Office Manager, the Linac and MTA segments of the Fermilab Main Accelerator are ready for operations under DOE O 420.2D. The committee should present findings, comments, noteworthy practices, recommendations, and specific answers to the charge questions at a closeout meeting with Fermilab's management. A final written report is requested within two (2) weeks after the conclusion of the review.

Charge Questions

1. Have the Safety Assessment Document (SAD) Chapters and the Accelerator Safety Envelope (ASE) supporting Linac and MTA Operations been updated to meet the requirements in DOE O 420.2D and address the recommendations from FSO, the ARR review team, and the DOE Assist team?
2. Is the methodology for determining the Maximum Credible Incident (MCI) appropriate, and is it clear in our updated documentation?
3. Is our updated strategy to use the MCI analysis to determine Credited Controls, and Shielding Assessment analysis to determine Defense-in-Depth controls, appropriate and is it clear in our updated documentation?
4. Have the performance elements for active engineered Credited Controls been appropriately incorporated into the SAD Section I?
5. Have the performance elements for active engineered Credited Controls applicable to Linac and MTA (RSIS and radiation monitors) been appropriately detailed into their respective SAD Chapters and flowed-down into the Fermilab Main Accelerator ASE?
6. Does the content of the updated Unreviewed Safety Issue (USI) Program meet the requirements in DOE O 420.2D CRD § 2.f.(1) through 2.f.(5)?