

ARR Report

I. Executive Summary

The Accelerator Readiness Review (ARR) Assessment Team judges that Fermi National Accelerator Laboratory (Fermilab) has appropriately updated their accelerator safety documentation in accordance with the changes implemented in the Department of Energy (DOE) Order 420.2D, *Safety of Accelerators*. However, the Assessment Team judges that the Fermilab accelerator safety documentation (i.e., the Safety Assessment Document (SAD) and Accelerator Safety Envelopes (ASE)) need significant improvement.

The SAD does not provide an adequate description of the facility and facility operations such that a reader can fully understand the hazards present in the facility. Furthermore, the SAD does not provide a sufficiently detailed hazard analysis to fully understand which are accelerator-specific hazards and which are non-accelerator specific hazards (NASH) that initiate accelerator-specific hazards. The hazard analysis should flow directly into a detailed description of the credited controls for the facility. Finally, the corresponding ASE should flow directly from the credited controls description in the SAD.

The Assessment Team is providing recommendations and opportunities for improvements in these documents for consistency with comparable accelerator facilities.

II. Charge Questions

- A. Pending FSO approval of updated programs and documents, is the Lab's updated approach appropriate for meeting the requirements of DOE O 420.2D and addressing the comments provided by FSO in the January 4, 2023 letter? Conditional YES
- a. The Assessment Team believes the Lab's approach to identify some facilities formerly categorized as radiation generating devices (RGDs) as accelerators is in accordance with DOE Order 420.2D.
 - b. The Lab approach to the SAD needs improvement to adequately describe the facilities, hazards and analyses to map credited controls into the ASE.
 - c. The ASE needs improvement to clarify the use of compensatory measures and approval authority for certain actions.
- B. Is the approach for use of Compensatory Measures appropriate? NO
- a. The Assessment Team finds that the implementation of compensatory measures in the ASE is not appropriate.
 - b. Any compensatory actions must be analyzed in the SAD with rigor comparable to the credited control, and the time during which compensatory actions can be employed should be identified.
- C. Is the methodology used for Risk Assessments appropriate? Conditional YES

- a. The Assessment Team judges the methodology used for risk assessments to be appropriate.
 - b. The controls credited to reduce the risk for specific hazards are not clearly defined in the risk assessments.
- D. Is the approach for instituting Credited Controls for ODH components within applicable accelerator facilities appropriate? Conditional YES
- a. The Assessment Team judges that the Lab used an appropriate approach for instituting credited controls for ODH components and exclusions areas.
 - b. Training for personnel working in each ODH classification area is judged to be appropriate.
 - c. The concept of when ODH systems must function should be evaluated to ensure that the process provides protection and does not create compliance traps.
 - d. Labeling of ODH credited controls should be consistent throughout the Fermilab site.
- E. Is the approach for implementing a consistent authorization operating limit appropriate? Conditional YES
- a. The Assessment Team judges that the approach for implementing authorization operating limits is consistent across the Lab machines.
 - b. However, operating limits that permit a +5% beam intensity variation are not adequately addressed in the Shielding Assessments.

III. Recommendations to Address Opportunities for Improvement

A. Focus Areas to Meet Expectations

1. SAD

- i. Fermilab should evaluate recent SADs from other facilities for ideas on structure and content.
- ii. Fermilab should establish contacts for reviews of interim work products.
- iii. The SAD should contain facility descriptions with sufficient detail to understand the source of the hazards.
- iv. The SAD should clearly describe the unmitigated accelerator specific hazards and non-accelerator specific hazards (NASH) that initiate accelerator-specific hazards.
- v. The SAD should specifically define the credited controls being applied to the hazard to reduce either the likelihood or consequences of the hazard to an acceptable risk level. Defense in depth measures should not be used to reduce risk.
- vi. Compensatory actions must be evaluated in the SAD with the same rigor as the credited controls in the SAD.
- vii. The SAD should present the final mitigated hazards.

- viii. The SAD should summarize the hazards evaluated in the risk tables.
- ix. Ensure that the SAD addresses the comments received from the Fermi Site Office (FSO) on the reviewed SAD and ASE.
- x. The applicability of ODH credited controls beyond exclusion areas should be evaluated and clarified in the SAD.
- xi. The controls used for fluorinert decomposition products (HF, perfluoroisobutylene) should be evaluated and clarified in the SAD.

2. ASE

- i. Credited Controls must be directly related to the hazard analysis documented in the SAD.
- ii. The ASE must be written to clearly define the limits and how they are measured.
- iii. Administrative Credited Controls that support multiple activities should be addressed in the SAD and identified in the ASE.
- iv. Direct reference to Shielding Assessments in the ASE is problematic. Instead, the Shielding Assessments should be referenced and described in the SAD, such that the ASE rolls up the required and credited shielding without directly referencing these documents.
- v. The ASE currently references longitudinal and transverse spreadsheets. These spreadsheets should instead be referenced and summarized in the SAD.
- vi. Some credited control sections in the ASE define the components that are required to be present. These lists are better placed in the SAD.
- vii. As a test, the ASE should be written such that any three individuals could evaluate a potential ASE violation and reach agreement.

3. USI

- 1. The USI process and forms should state how to properly determine if the activity/discovered condition is fully covered in the SAD or ASE, and therefore the necessary level of approval.
- 2. The initiator of the USI process must have a detailed understanding of the SAD and ASE. Consider implementing a screening process that does not require detailed knowledge of the SAD or ASE.
- 3. Update the training process for USI initiators and evaluators to incorporate the new process.

B. Some specific areas identified that merit additional consideration

- 1. Shielding Assessment
 - a. Update the shielding assessments when the SAD is updated
 - b. Provided structural delineation of shielding between accelerator segments for ease of review and confirmation of hazard protection.
 - c. Ensure the shielding assessment addresses the Maximum Operating intensity for the proposed experiment.

- d. If the Maximum Operating intensity is not the machine limit, a credited control is needed. Consider assessing the shielding at the maximum intensity of the machine.

2. Training

- a. Clarify the changes in Fermilab training that addresses the changed requirements in the modified SAD and ASE. Link the training requirements to the results of the hazards analyses. DOE O 426.2 is a useful guidance document.
- b. Develop guidance for training applicable personnel on updates to the ASE controls.

3. Emergency Response

The link between the hazard analyses, the mitigation actions, and the emergency response in the event of an incident should be evaluated; DOE O 151.1D is a useful guidance document.