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ATTN: Document Control Desk,
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Washington, DC 20555-0001

Subject: Follow-up report to Event Notification 58063, MURR Licensee Event Report 25-01

References: 1. Docket No. 50-186; University of Missouri – Columbia Research Reactor; Renewed Facility Operating License No. R-103

2. Event Notification 58063, submitted November 26, 2025

The enclosed document provides the University of Missouri-Columbia Research Reactor (MURR) Licensee Event Report (LER) for an event that was discovered on November 26, 2024, and resulted in a deviation from MURR Technical Specifications 3.8.b and 4.8.b.

If you have any questions regarding this report, please contact Russell W. Gibson, Associate Director of Reactor Operations and Acting Reactor Manager, at (573) 882-0342.

Sincerely,

Matt Sanford

Matthew R. Sanford
Facility Director

MRS:tjf

Enclosure: University of Missouri Research Reactor Licensee Event Report No. 25-01

cc: Reactor Advisory Committee
Reactor Safety Subcommittee
Ms. Paulette Torres, U.S. Nuclear Regulatory Commission
Mr. Edward Helvenston, U.S. Nuclear Regulatory Commission
Mr. Andrew Waugh, U.S. Nuclear Regulatory Commission

University of Missouri Research Reactor Licensee Event Report No. 25-01

Introduction

On November 26, 2025, during a review of past flux trap loadings, it was identified that during the period from July 24, 2024, through August 4, 2024, the University of Missouri Research Reactor (MURR) exceeded the requirements of Technical Specification (TS) 3.8, "Experiments." Specifically, TS 3.8.b requires that "The absolute value of the reactivity worth of all experiments in the center test hole shall be limited to 0.006 Δk/k." A review of the center test hole flux trap loading for those two weeks determined that the reactivity worth of experiments exceeded the 0.006 Δk/k, and has been re-estimated to have been approximately between 0.0061 and 0.0063 Δk/k. This underestimation of flux trap worth occurred due to inadequate programmatic controls applied to TS 4.8, "Experiments," specification b, which requires that "The reactivity worth of an experiment shall be estimated or measured, as appropriate, before reactor operation with said experiment." Specifically, a limited set of flux trap irradiation samples were run without adequate prior reactivity worth measurement or estimation.

This error does not impact any current operation or flux trap loading. This issue is being reported under TS 6.6.c(1) as it meets the TS 1.1.b and TS 1.1.f definitions for an Abnormal Occurrence. Specifically, TS 1.1.b defines an Abnormal Occurrence as an "Operation in violation of Limiting Conditions for Operations established in Section 3.0," and TS 1.1.f defines Abnormal Occurrence as "An observed inadequacy in the implementation of an administrative or procedural controls such that the inadequacy causes or could have caused the existence or development of an unsafe condition involving operation of the reactor."

Description of the Flux Trap Scheduling Program

MURR procedure IRR-PSO-100, "Scheduling Flux Trap Tubes," describes the process by which the center test hole flux trap is evaluated and configured for loading and irradiation of experimental samples. This process describes the means by which MURR intends to fulfill TS 4.8. At a high level, this process requires that prior to loading a new irradiation sample, the sample's reactivity worth impact is to be measured or estimated based on measurements taken from previous similar irradiation samples. Once an irradiation sample is assigned a reactivity worth, typically following multiple measurements or after applying a conservative estimate from similar past measurements, the sample type is added as a selectable option within the spreadsheet used to calculate weekly flux trap reactivity values. The spreadsheet is run each flux trap loading and undergoes reviews from multiple personnel and groups to confirm that the loading complies with all TS requirements. Once the loading is ensured to comply with TS requirements and is approved, the flux trap loading can be used in the center test hole of the reactor. The process also includes administrative limits below the TS limits, to reduce the impact of errors in loading or non-conservative estimations for irradiation samples.

Detailed Event Description

During review of planned flux trap loadings and as part of the flux trap optimization efforts documented within Corrective Action Program (CAP) entry 25-0444, written November 7, 2025, Reactor Physics identified that for some irradiation samples, non-conservative reactivity values had been selected. The

non-conservative reactivity values identified all involved samples of identical materials to previously measured samples, but having different masses.

The loading of revised sample configurations or masses typically requires additional reactivity worth measurements to ensure an appropriate reactivity worth can be assigned. In some cases, for new samples that were similar to previously irradiated samples, rather than taking multiple reactivity worth measurements and updating the associated Reactor Utilization Request (RUR) Summary Sheet and the Material Lookup Table (used with the flux trap loading spreadsheets for the IRR-PSO-100 process), fewer than expected reactivity worth measurements were taken and relied upon to determine reactivity worth estimations. Ideally, three or more measurements are used for each sample to determine the final value used in revision of the RUR summary sheet and material lookup table. However, in some cases only one or two measurements were used to select a reactivity worth for samples that were similar to those previously measured, but differing in sample mass or sample host canister configuration.

Specifically, the undermeasured samples include 4.5-gram Yttrium-89 canisters, and 0.2-to-0.8-gram capsules or canisters of Iridium-191. Previous flux trap measurements for 3.0 grams of Y-89 resulted in a reactivity worth value of 2.5E-5 Δk/k and previous measurements of 1.5 gram capsules of Ir-191 resulted in a reactivity worth values of either -1.0E-5 Δk/k or -1.8E-5 Δk/k depending on the host canister configuration and the number of capsules present in the host canister (between 1 and 5 capsules per canister). When 4.5-gram Y-89 sample and 0.2-to-0.8-gram Ir-191 samples were re-measured, their reactivity worth values were all determined to be more positive than was previously estimated. Each of these sample types have been loaded into the flux trap and irradiated on multiple occasions using the non-conservative reactivity worth measurements applicable to the previously measured sample masses.

On October 16, 2024, CAP entry 24-0391 was written to recognize one of these errors, specifically, a 0.8-gram Ir-191 sample using the reactivity worth applicable to 1.5-gram Ir-191 samples during the week of October 14, 2024. At the time of the writing of that CAP entry, the non-conservative sample reactivity worth was only identified to have been used a single time, and on a single sample, which did not result in exceeding the TS 3.8.b reactivity worth limit for the center test hole. However, in November of 2025, a similar Ir-191 sample was requested to be loaded, causing a broad review of past flux trap loadings and measurements for Ir-191 samples having less than 1.5-gram masses. This review resulted in the generation of CAP entry 25-0450 on November 18, 2025, to document the potential impact of the undermeasured samples. As part of the evaluation of this CAP, additional instances were identified in which Ir-191 samples of less than 1.5 grams were loaded using non-conservative reactivity worth values. Specifically, for the two weeks between July 24, 2024, and August 4, 2024, two 0.8-gram Ir-191 irradiation samples were loaded in the flux trap using reactivity worth values for 1.5-gram Ir-191 samples. The impact of this is that the samples were collectively assigned a reactivity worth of -3.6E-5, where their actual reactivity worth should have been assigned a value closer to 3.8E-5. (Based on the most representative sample measurement that MURR has validated, for an Aluminum host canister.) This error results in a change in the overall flux trap loading reactivity worth from the initial estimations of between 0.0046 Δk/k and 0.0048 Δk/k to approximately 0.0061 Δk/k and 0.0063 Δk/k.

In review of this issue, it was discovered that the requirement to determine reactivity worth values for new or revised samples has sometimes been overlooked in the flux trap loading sheet review and approval process. Changes in sample weight and configuration are not always clearly communicated

through the existing process controls, leading to a weakness where sample weights or configurations may change, and not all reviewers of the flux trap loading sheet would be aware of the difference. Additionally, the current process, IRR-PSO-100, does not specify the minimum measurements required to determine a new reactivity worth value, or acceptable bounds for estimating reactivity worth using similar, past measured samples. When new or revised samples are identified, the appropriate path has been largely dependent on the judgement of the individuals fulfilling the roles at the time. Based on MURR's current understanding of TS 4.8.b, the practice of estimating sample reactivity worth based on two or fewer measurements does not meet the intended implementation of MURR's process for fulfilling the requirements of this TS.

Safety Analysis

While the TS 3.8.b limit is 0.006 Δk/k, the analytical limit of the supporting safety analysis is 0.007 Δk/k. This limitation is based upon the step insertion limits evaluated within the MURR Safety Analysis Report, Section 13.2.6.2 and Hazard Summary Report, Addendum 3, Section 3.5. As a result, exceeding the 0.006 Δk/k TS limitation by less than 0.001 Δk/k does not result in an impact to reactor safety.

Corrective Actions

MURR is performing additional sample measurements to support revision of associated RUR summaries and the flux trap irradiations lookup table (used in the IRR-PSO-100 process). These measurements will be completed prior to loading any of the samples identified in this event report.

Using the results of the additional sample measurements, MURR will review the extent of condition of this issue to determine the impact on the recent history of flux trap loadings and ensure the scope of the issue is fully understood.

MURR will revise IRR-PSO-100, and associated irradiations spreadsheets as necessary to: clarify the means of determining whether a sample meets the previously measured lookup table samples, specify minimum reactivity worth measurements/locations necessary to determine reliable RUR summary sheet reactivity worth values, and clarify the required communications when new or changed sample types are requested to be irradiated.