

Nuclear Reactor Facility

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August 23, 2022

ATTN: Document Control Desk
U.S. Nuclear Regulatory Commission
Washington, DC 20555-0001

SUBJECT: RESPONSE TO NOTIFICATION OF VIOLATION AND INSPECTION REPORT NO.
05000123/202202 FOR MISSOURI S&T REACTOR (R-79)

Dear Sirs:

The Missouri University of Science and Technology Reactor ("MSTR" with License R-79, Docket No. 50-123) is hereby submitting a written report required per 10 CFR 2.201 "Notice of Violation" in response to receiving the Nuclear Regulatory Commission Safety Inspection Report No. 05000123/202202 and associated Notice of Violation. The attached document details the reasons for the violations, corrective steps taken and results achieved, corrective steps that will be taken, and the date when full compliance will be achieved.

If you have any questions regarding this report, please contact either me, at 573-341-4291; or Dr. Joseph Graham, the Reactor Director, at 573-341-7759.

Sincerely,



Ethan Taber
Reactor Manager, MSTR



Joseph Graham, PhD
Reactor Director, MSTR

Enclosure

cc: Radiation Safety Committee (S&T)
Dr. Ayodeji Alajo, Interim Chair of NERS (S&T)
Ms. Paulette Torres, Project Manager (NRC)
Mr. Andrew Waugh, Facility Inspector (NRC)

MSTR Response to 202202 Notice of Violation

The Nuclear Regulatory Commission (NRC) identified two violations at the Missouri University of Science and Technology Reactor (MSTR) during the June 6-9, 2022, inspection. This report forms the basis of the required written response.

Background and Causes

Root and contributing causes were determined for the cited violations.

Operator Medical Qualifications

As cited, “Contrary to the requirements in 10 CFR 55.21, three operators licensed at the Missouri University of Science and Technology Research Reactor failed to meet the conditions of their license by not receiving a medical examination from a physician every two years.”

It is noted that the three operators who failed to meet the medical qualification requirement are suspended from performing licensed duties by the facility, due to leaves of absence preventing timely proficiency acknowledgements. These suspensions will remain in-place until their medical qualification requirements and all remaining obligations under the Missouri S&T Reactor Operator Requalification Program are met.

Cause 1: Staffing shortage

As defined by the Missouri S&T Reactor Operator Requalification Program, the Training Coordinator is responsible for nearly all facets of operator requalification at the MSTR. While maintaining and tracking the medical qualification records is not explicitly mentioned, these are considered to be part of the Training Coordinator’s work scope.

Current staffing levels at the MSTR consist of a single full-time staff member (the Reactor Manager), and several part-time student operators. The Reactor Director is a full-time faculty member. Therefore, the Training Coordinator role at MSTR is currently filled by the Reactor Manager. In performing training coordinator duties, operations, systems engineering (with respect to facility and control system modifications), lab instruction, and other responsibilities, the Reactor Manager role is task saturated. While assistants have helped

maintain the Training Program for operator candidates, such resources have not been previously assigned to support the Operator Requalification Program (see the contributing cause).

Cause 2: Absence of tracking framework

No formal system was in-place for tracking operator medical qualification status and some requalification requirements. Paper checklists have been utilized for on-the-job and most other requalification requirements but pose a challenge for a clear and regular review by the training coordinator for more than a handful of operators.

Contributing Cause: High operator turnover

Excluding the current operators, a significant majority of the nearly 100 operators licensed at the MSTR in the last 20 years have been licensed for less than a requalification cycle (two years). Nearly all these operators are undergraduate students, with typical four-to-six-year graduation rates. In combination with 12-18 months of operator training and typically 1-2 years unaffiliated with the reactor, this has previously limited the number of personnel that needed to have requalification activities tracked in detail.

Of the current student operators, all but three were licensed during or before their respective junior year, leading to at least one requalification cycle.

It is noted that the high turnover is not a resolvable issue in the context of a predominantly student-staffed reactor.

TS 4.1.1

Missouri S&T Reactor Technical Specification 4.1.1.2 states that “Following a change in core configuration... The excess reactivity of the core shall be measured... If the excess reactivity is found to be acceptable, then a) the control rod worths shall be measured, and b) the shutdown margin shall be determined.”

As cited, “Contrary to TS 4.1.1, the [sic, MSTR] changed the reactor core configuration multiple times without measuring excess reactivity, control rod worth, and shutdown margin afterwards.” These transitions occurred between the Core 130 and Core 131 configurations.

Contributing Cause: Operational reactivity needs

On initial loading (and at reference core conditions), Core 130 had an excess reactivity of 0.342% $\Delta k/k$ in T-mode (the most reactive configuration), while Core 131 had an excess reactivity of 0.755% $\Delta k/k$ in W-mode (the least reactive configuration). The difference between the two core configurations was the presence of an additional half fuel element at the core periphery for Core 131. Due to high facility usage, Core 130 excess reactivity was further reduced over time (as noted by gradually increasing critical rod positions).

Per MSTR TS 6.1.4, students and trainees can only operate the MSTR under the direct supervision of a licensed operator if the excess reactivity is less than 0.7% $\Delta k/k$, although trainees can operate the MSTR under the direct supervision of an SRO below the overall excess reactivity limit of 1.5% $\Delta k/k$. With these constraints, operational flexibility was severely limited in Core 131 (to the effect of eliminating student operations and greatly reducing training operations), but Core 130 did not provide adequate reactivity for extended high power operations.

Existing procedures, measurement hardware, and staffing levels effectively require two full days to perform core characterization/reactivity measurement efforts for both the W- and T-modes. The substantial downtime to alter the core loading from the shared Core 130/131 was not considered feasible, thus usage of Core 130 and Core 131 was alternated as needed by ongoing operations. As discussed in the following section, explicit reactivity measurements were not performed at these transitions.

Cause 1: Reliance on historical facility interpretation and procedure

The historical interpretation of TS 4.1.1 by the facility, as is understood by current facility management, was that loading to an established and previously measured core configuration did not require an additional measurement of excess reactivity, shutdown margin, and rod worths (the existing values were to be utilized). However, in reviewing facility records, no examples of this practice were observed outside of the NOV-cited events. Previous core unloads (partial or full) were performed for required surveillances and maintenance, but during reload the most recent core configuration was reused (thus no “change” in core configuration took place) or measurements were performed as required.

Cause 2: Operator shortage

Of the three Senior Reactor Operators (SRO) at the MSTR, only a single operator is a full-time employee. Procedurally (and depending on interpretations of MSTR TS 6.1.3.3), an SRO is required for some or all of the reactivity measurements. Additionally, the direct supervision of an SRO is required for trainees operating at or above of 0.7% $\Delta k/k$ excess reactivity. While there were approximately 10 licensed operators in addition to the SROs, overlapping class schedules reduce availability to one or no operators (excluding the full-time SRO) for extended periods during an operating week.

Corrective Actions

At or before the inspection exit meeting, the items were entered in the MSTR Corrective Action Program (CAP) as CAP-2022-004.

Corrective actions completed as of the writing of this report are listed with a date completed. For formally planned actions (i.e., those excluding the consideration of submitting license amendment requests) the facility an Estimated Time to Completion (ETC) is listed. The facility commits to completing these actions by the ETC unless otherwise supplemented in follow-up correspondence and notifications to the NRC.

As required by MSTR TS 6.2.3, the cited violations will be presented to and reviewed by the Missouri S&T Radiation Safety Committee (RSC, facility oversight committee). This review will take place at the next quarterly meeting (no later than [NLT] 9/30/2022).

Operator Medical Qualification – Restoration of Compliance (ETC 10/1/2022)

All licensed duties performed at the MSTR by or under the direct supervision of a licensed operator have been in compliance with respect to 10 CFR 55.21 since May 16, 2022.

The three operators will undergo their required medical evaluation unless their license is otherwise terminated (e.g., by the facility). This evaluation will be performed as soon as is practical and before the performance of any licensed duties.

It is noted that as of drafting this report, one of the three operators has undergone their medical evaluation and was determined to meet ANSI/ANS-15.4-2016 requirements.

Operator Medical Qualification – Prevention of Future Recurrence

Operator Medical Qualification - Staffing shortage (ETC 12/31/2022)

The MSTR has an ongoing search for employing a Reactor Engineer, with significant delays stemming from the COVID-19 Public Health Emergency. Most of the systems engineering and control system maintenance responsibilities will be transferred from the Reactor Manager on filling this position.

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An additional Assistant Training Coordinator will be dedicated towards the MSTR Operator Requalification Program. The Assistant Training Coordinator will assist the Training Coordinator in maintaining records and qualifications for the operators.

Operator Medical Qualification - Tracking framework (Completed 6/10/2022)

A tracking spreadsheet was implemented on June 10, 2022. This tracking spreadsheet stores and displays the longer interval items (calendar year or greater) for operator requalification, including the medical qualification, detector usage qualification, facility license qualification, requalification exam status, and emergency plan training status in addition to other information for all licensed operators. Approaching or exceeding the associated interval is clearly color-coded, such that operators who do not maintain a qualified status can be restricted from performing licensed duties.

Future versions of this tracking system may utilize a database or address additional requalification items.

TS 4.1.1 – Restoration of Compliance (Completed NLT 7/5/2022)

To support annual maintenance and surveillance requirements, the MSTR core was partially unloaded on July 5, 2022. If not already considered in compliance, this action formally restored compliance with TS 4.1.1.

TS 4.1.1 – Prevention of Future Recurrence

Historical interpretation and procedure (ETC 9/30/2022)

MSTR Standard Operating Procedure (SOP) 207 will be revised to incorporate the currently understood interpretation of TS 4.1.1. This revision will include an explicit requirement to measure excess reactivity, shutdown margin, and rod worths for all core configuration changes. The revision will be submitted to the RSC for review and approval at the next quarterly meeting.

The MSTR may consider seeking a regulatory interpretation or license/TS amendment to further clarify or simplify reactivity measurement requirements.

Operational reactivity needs (Completed 8/10/2022)

The MSTR loaded a new core configuration (Core 132) on August 10, 2022, which provides an excess reactivity of $\sim 0.65\% \Delta k/k$ (W-mode). This Core 132 configuration is anticipated to meet the facility's needs for at least the next year while remaining fully compliant with existing TS requirements.

The MSTR may consider seeking a license/TS amendment to address reactivity limits, especially for student/trainee operations.

Reactivity Measurement Procedures (ETC 9/30/2022)

The existing procedures for reactivity measurements (MSTR SOP 109, 110, and 111) will be reviewed to determine if revisions are warranted to improve their effectiveness and reduce their overhead. If warranted, revisions shall be prepared and submitted to the RSC for review and approval at the next quarterly meeting.

Operator shortage (ETC 12/31/2023)

The MSTR continues to expand the operator pool through focused efforts on the Operator Training Program. A net gain of approximately two Senior Reactor Operators and five Reactor Operators is anticipated over the next year. Note that the expansion is a target, and the facility commitment is to continue the Operator Training Program.

Conclusions

Causes and corrective actions of violations cited during the June 6-9, 2022 inspection of the Missouri S&T Reactor were discussed. Compliance was restored with MSTR TS 4.1.1 no later than July 5, 2022. Compliance with regards to operator medical requirements will be restored no later than October 1, 2022. Additional corrective actions have been and will be implemented to prevent recurrence.