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U.S. Nuclear Regulatory Commission
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Subject: **Report Regarding Loss of Building Exhaust Fan on February 14, 2022, while operating The Ohio State University Research Reactor (OSURR, License R-75, Docket 50-150)**

Enclosed with this cover letter is the report required by OSURR Technical Specification 6.5.2 in response to the OSURR being operated for at least 58 minutes without operation of the building exhaust fan on February 14, 2022. While there were no safety implications for the reactor, the staff, or the public, OSURR Technical Specifications 3.4 and TS 3.5.1, which require operation of the fan during reactor operations, were violated. In response to this, the requirements of OSURR Technical Specifications 6.5.2 and 6.6.2 have been satisfied, including required notifications and reports. The attached report covers the cause, corrective actions, and the recommended measures being investigated to reduce the chance for recurrence.

Sincerely,

Lei Raymond Cao

Lei Raymond Cao, Director
OSU Nuclear Reactor Lab
The Ohio State University
(License R-75, Docket 50-150)

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NRR

Loss of OSURR (License R-75, Docket 50-150) building exhaust fan on 2022-02-14 while operating

Introduction

While performing the OSU Research Reactor (OSURR) pre-operation checkout on 2022-02-15, the SRO performing the checkout discovered that the building exhaust fan was not operating. This fan is required to be operating during reactor operations, and it is typically left running all the time. Troubleshooting determined that the cause of the fan loss was power loss from a conduit being cut the previous day (2022-02-14) when a small area of the cement floor in the janitor closet was being removed for replacing the sink. The concrete work was performed between 12:00 and 14:53 on 2022-02-14, which are the times at which the contractor signed in and out. The reactor was shut down at 15:51 that day, so the reactor was operated for at least 58 minutes on 2022-02-14 without the fan operating. The reactor was not operated on 2022-02-15 since the fan had been discovered to not be operating.

Safety implications:

There were no safety implications for the reactor, the staff, or the public. The purpose of the fan is to provide building confinement to "prevent the exposure of the public to airborne radioactivity exceeding the limits of 10 CFR Part 20 and the ALARA principle." Operation of the fan has nothing to do with safety of the reactor. Rather, the fan provides a defined stream out of the building such that the concentration of Ar-41 exiting the building can be quantified to show that Ar-41 effluent limits are not exceeded. In addition, it reduces the buildup of Ar-41 inside the building to minimize exposure to persons inside. Exposure of persons inside is monitored using the effluent monitor and area radiation monitors (ARMs). Both systems remained operating for the duration of the reactor operations on 2022-02-14.

Per safety analysis in Section 8.4.4 of the SAR, the leakage fraction from the building in hr^{-1} is about a factor of 200 less with the exhaust fan off than with it on. Therefore, with the exhaust fan off, the amount of Ar-41 released from the building was significantly less than it would have been with the fan operating, so there are no safety implications for the public. (This is particularly true given that the OSU-NRL only releases a small fraction of the effluent limit in any year, and Ar-41 decays quickly.) However, without the fan operating, the Ar-41 released from the building was not characterized using the effluent monitor. This was not a problem for the afternoon of 2022-02-14, as the Ar-41 concentration measured with the effluent monitor, which samples near the building exhaust point, provided a very conservative bound on the Ar-41 released when the fan was off. For annual reporting purposes, we will use this concentration measured on the effluent monitor for 2022-02-14.

Regarding exposure of personnel in the building, the readings on the effluent monitor system and on the ARMs were similar to typical values when operating at full power all day,

and the Ar-41 concentration never reached the limit requiring posting the bay as an airborne radiation hazard. Therefore, there were no safety implications for those in the bay.

License implications and requirements; notifications and corrective actions:

Because the exhaust fan power was cut while the reactor was operating on 2022-02-14 without being noticed, the reactor was operated for up to a few hours without this fan. Per both OSURR Technical Specifications (TSs) 3.4 and TS 3.5.1, which are Limiting Conditions for Operation (LCOs), the exhaust fan must be operating when the reactor is operating, and per TS 6.5.2(2), operating in violation of an LCO is a Reportable Occurrence. TSs 6.5.2 and 6.6.2 list the actions that must be taken in the event of a Reportable Occurrence, and the staff ensured that these were addressed. The four actions listed are:

1) *The reactor conditions shall be returned to normal, or the reactor shall be shutdown, to correct the occurrence.*

The reactor was shut down at the end of the operation on 2022-02-14, and it was not operated following problem discovery until after the problem was fixed.

2) *The director of the reactor laboratory shall be notified as soon as possible, and corrective action shall be taken before resuming the operation involved.*

The director was promptly notified, and the power feed to the fan was restored on 2022-02-15. In addition, the exhaust fan's emergency shutoff functionality via a switch in the control room was verified to still be operational prior to resuming reactor operations on 2022-02-16.

3) *A written report of the occurrence shall be made which shall include an analysis of the cause of the occurrence, the corrective action taken, and the recommendations for measures to preclude or reduce the probability of recurrence. This report shall be submitted to the director and the ROC for review and approval.*

A report was written and sent to the director and the ROC on 2022-02-15, and the ROC reviewed the occurrence and approved recommendations for reducing the probability of recurrence during an already-scheduled meeting the following day. Recommendations for reducing the probability of recurrence are discussed below.

4) *A report shall be submitted to the NRC in accordance with Section 6.6.2 of these specifications.*
    a. *Notifying the NRC by telephone no later than the next working day*
    b. *A written report within 14 days*

A timely phone notification was made to the NRC on 2022-02-15 (EN # 55739), and this document is the required written report.

Measures to reduce the probability of recurrence:

Because the OSURR pre-operation checkout includes checking the exhaust fan, the only way for the reactor to be operated without the fan operating is for the fan to stop running during the operation. To the best of the knowledge of the staff, this is the first time in the history of the laboratory that the exhaust fan has stopped during operation of the reactor, excluding building power losses that simultaneously shut down the reactor. At a minimum, it is the first time in at least the past few decades that such an occurrence happened. Given this and the fact that cutting or drilling into the bay floor happens only very rarely, particularly if the reactor is planned to be operated, there is very little chance of this recurring even without any new measures implemented. Nonetheless, in consultation with and recommendation of the reactor safety committee, the staff has planned the following:

1) Investigate adding an indication in the control room for exhaust fan operating status. The staff is presently investigating an electric current pickup device that would sense current flow through the power line to the fan motor and actuate an electric relay based on this. In the event of power loss to the fan, or if the fan motor stopped pulling current, the relay would change state to indicate a non-operating fan. The desired design will have both visible and audible indication, but the details are not set, as potential parts to be used have been ordered but not received, so a design cannot yet be tested. If it is determined that this design will not work, the staff will investigate other options for adding a control-room indication.

2) Add a precaution to the procedure for reactor operations discouraging cutting or drilling into the bay floor during operation of the reactor.

Conclusion:

Loss of power to the building exhaust fan on 2022-02-14 while the reactor was operating led to the OSURR being operated for at least 58 minutes without the fan operating. While there were no safety implications for the reactor, the staff, or the public, OSURR Technical Specifications 3.4 and TS 3.5.1 were violated. In response to this, the requirements of OSURR Technical Specifications TSs 6.5.2 and 6.6.2 have been satisfied. Even though there is very little chance of this recurring, the staff will continue working on the two items listed in the section above.