

INES Event Rating Form (ERF)

Version 2

Sender's Name:	Patricia Milligan
Sender's Organization:	Nuclear Regulatory Commission (NRC) (United States of America)
Event Title:	Uranium accumulation in a glove box air purification system
Event Date:	2017-07-04
Location / Facility:	Lynchburg, Virginia / BWX Technologies, INC.
Event Country:	United States of America
Event Type:	Fuel Fabrication
INES Rating:	2 - Incident (Final)
Rating Date:	2017-11-17

Impact on people and the environment

Release beyond authorized limits?	No
Overexposure of a member of the public?	No
Overexposure of a worker?	No

Impact on the radiological barriers and controls at facilities

Contamination spread within the facility?	No
Damage to radiological barriers (incl. fuel damage) within the facility?	No

Degradation of Defence In-Depth? Yes

Other information

Person injured physically or casualty?	No
Is there a continuing problem?	No

Event Description

At a fuel fabrication facility (BWX Technologies, Inc.), unanticipated deposits of high-enriched uranium were discovered in two unfavorable geometry containers. Prior to discovery, the containers were assumed to be non-uranium bearing and were not included in the licensee's safety analysis.

BWX Technologies is authorized to use high-enriched uranium to fabricate research and test reactor nuclear fuel assemblies. Unexpected deposits of uranium-bearing material were found in two desiccant containers serving a dry air purification system on a uranium processing glove box line in the research and test reactors area. The two containers were located within close proximity to one another and initial surveys indicated that they may have contained a combined total of approximately 1 kilogram U-235 in the form of a powder aluminum uranium compound. The function of the desiccant is to remove oxygen and moisture from the process. The air purification system for the glove box was considered to be non-uranium bearing, and therefore had no documented controls in the Integrated Safety Analysis to prevent accumulations and was not routinely surveyed for uranium accumulations. There were no documented controls implemented to prevent criticality. (NRC EN52840)

The containers were unfavorable geometries. Uranium mass and moderation were the only parameters required for criticality to occur. A glove box pre-filter served to limit the accumulation rate; however, it was not effective at preventing all accumulation mechanisms as demonstrated by the event. The containers were not included in routine surveys to identify any accumulation. Therefore, mass was not effectively controlled, and the potential for an unsafe mass to accumulate undetected still existed. The containers were located in a moderator controlled area and the desiccant material did not possess any appreciable moderating characteristics; however, there were credible sources of moderation present, including a potential leak from two nearby heat exchangers. The water servicing the heat exchangers contained boron (a neutron absorber). However, there was no requirement that the heat exchangers be serviced by borated water or this particular water line. The licensee identified that a barrier did exist which limited the likelihood of an introduction of moderation. The design of the heat exchangers utilized an indirect heat transfer such that in order to introduce moderator into the desiccant containers, a breach of either heat exchanger's double wall would be required. Although not specifically established for NCS purposes, the design and physical integrity of the heat exchangers served to keep moderation within safe limits. Therefore, a barrier was in place which served to limit the likelihood of an introduction of moderation to the desiccant containers.

Given the unfavorable geometry of the containers and the potential for mass and moderation to be present, only slightly different conditions would have been required for criticality to occur, such as an upset involving a leak from either of two nearby heat exchangers. The likelihood of a moderation introduction, however, was limited by the design and physical integrity of the heat exchangers.

Rating Justification

This event is rated Level 2 based on Table 11 in Section 6 (Assessment of Impact on Defense in Depth) of the INES handbook. The maximum potential consequences were Level 3/4 (acute worker health effect/worker death) and only one effective control (design and physical integrity of the heat exchangers) was in place to prevent criticality.

Actual Consequences:

No actual consequence was experienced.

Maximum Potential Consequences:

The off-site impact of a potential criticality event would be minimal. The on-site impacts of a criticality event could have maximum potential consequences of acute worker health effects or worker death. Acute worker health effects or worker death corresponds to an INES Level 4 consequence rating.

Identification of Number of Safety Layers and Assessment of the Basic Rating:

Per the INES User's Manual, an event where a criticality would have occurred had there been one further failure in the safety provisions or had conditions been slightly different should be rated at Level 2 for facilities with maximum potential consequences of Levels 3 or 4. Given the unfavorable geometry of the containers and the potential for mass and moderation to be present, only slightly different conditions would have been required for criticality to occur, such as an upset involving a leak from either of two nearby heat exchangers.

Furthermore, per the INES User's Manual Table 11, if the maximum potential consequence is a Level 4 consequence rating, then 1 or 0 remaining controls corresponds to a Level 2 rating. The number of remaining safety layers was one (design and physical integrity of the heat exchangers). Therefore, this event is rated a Level 2.

Additional Factors:

The facility declared an alert, and remained in that status, until they could establish adequate criticality controls on the containers and reasonably demonstrate that criticality was not imminent.

Press Release Attached: No

Technical Document Attached: No

Further Information on Web:

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