

LICENSEES AND CERTIFICATE HOLDERS
TO BE INCLUDED IN ANNUAL REPORT TO THE COMMISSION
ON PERFORMANCE IN THE MATERIALS AND WASTE ARENAS

WESTINGHOUSE COLUMBIA FUEL FABRICATION FACILITY

1. IDENTIFICATION

Location: Columbia, SC
License No.: SNM-1107
Docket No.: 70-1151
License Status: Active

2. STATUS SUMMARY

In May of 2016, Westinghouse discovered excessive amounts of uranium that had accumulated in process off-gas ventilation ducts and the S-1030 scrubber system. The uranium mass limit was exceeded by a factor of 3 in the inlet ducting, and 8 in the scrubber body; moderator was introduced from the scrubber spray nozzles and the clean out process; and the both the scrubber inlet ducting and body are unfavorable geometries. All items relied on for safety were found to be ineffective in preventing mass accumulation, and as a result, the safety margin available to preclude an inadvertent criticality was significantly degraded.

The condition met Criteria II of SECY 11-0132, a "Significant Issue or Event." Specifically, the condition will likely result in an Abnormal Occurrence (AO) report to Congress for AO Criteria III.A.2 because the condition revealed a major deficiency in design, construction, control, or operation having significant safety implications that require immediate remedial action. Specifically the condition called into question the licensee's controls for nuclear criticality safety associated with wet scrubbers and non-favorable geometry components and justified the immediate shut down of the conversion process. Additionally, following notification of the condition, an Augmented Inspection Team was chartered with inspection results documented in inspection report 70-1151/2016-007 (ML16301A001).

Increased regulatory oversight was required and a confirmatory action letter was issued documenting the licensee's commitment to remain shut down until corrective actions were implemented to address the following items:

- review Criticality Safety Evaluations (CSEs);
- validate assumptions;
- modify equipment;
- extent of condition;
- independent criticality safety expert, etc.; and
- safety culture and communications.

3. MAJOR TECHNICAL OR REGULATORY ISSUES

In 2002, the S-1030 scrubber was installed to replace the S-1056 scrubber. The scrubber is intended to remove uranium from process off-gas, which would be collected either in the packing (filter) or monitored and removed from a recirculated solution. The process off-gas air streams serviced by the original S-1056 scrubber were believed to be of low uranium concentration and either water soluble or particulate, and that scrubber had no known issues with uranium accumulation. However, during installation of the S-1030 scrubber, and on several occasions afterwards, changes were made from the original configuration which contributed to significant uranium buildup.

- Additional conversion process off-gas streams were ducted into the scrubber inlet. These changes were unanalyzed at the time, but the new off-gas streams have subsequently been determined to contribute significantly to the formation of an insoluble compound (AUF, ammonium uranyl fluoride) of high uranium concentration, which tends to accumulate in portions of the scrubber.
- The S-1030 scrubber utilizes a spray of recirculating water in the inlet, which is partially intended to remove uranium from the incoming airstream. However, the spray was found to be incorrectly directed, thereby significantly reducing its effectiveness and contributing to the formation of AUF.
- In 2005, filters servicing the “Blue M” ovens upstream of the S-1030 scrubber were removed, resulting in additional uranium particulate carryover into the S-1030 scrubber and thereby further contributing to the formation of AUF.
- In 2009, three additional changes were made to the S-1030 scrubber:
 - Removal of ammonium hydroxide additive to the scrubber recirculation spray. This resulted in a more acidic recirculation spray, thereby promoting the accumulation of AUF.
 - Removal of the continuous feed and bleed feature on the recirculation spray. This resulted in higher concentrations of uranium in the spray, aiding uranium accumulation inside the scrubber.
 - The Blue M oven exhaust plenum was expanded in an effort to reduce particulate carryover, however the supporting calculation was incorrect, thereby allowing uranium bearing particulates to enter the scrubber inlet.
- Annual scrubber inspections and cleanouts were credited with detecting and maintaining the scrubber clean of uranium buildup. However, both the inspections and cleanouts were ineffective. Staff and management continued to believe that any material accumulating in the scrubber was of low uranium concentration and water soluble, and were not aggressive in pursuing any noted buildup.

The major deficiencies in control and operation are:

- a. The licensee lacked a robust configuration management program to prevent and/or mitigate the chronic accumulation of uranium in the scrubber and ventilation systems. Over the course of many years, physical and operational changes were made to the scrubber, as well as the chemical composition of input airflows, however, the configuration management program was not adequate to detect or evaluate the impact these changes would have on uranium accumulation.

- b. The safety culture exhibited by management and some nuclear criticality safety staff did not include a questioning attitude, and lacked the conservative bias needed to identify weaknesses in criticality safety evaluations. In particular, numerous evaluations rested on un-validated and erroneous assumptions about the ability for uranium to accumulate inside the scrubber and ducting. Contributing to this, the management team did not ensure the organization had sufficient procedures and training to recognize and respond to deviations from the safety basis described in the criticality safety evaluation.
 - The licensee failed to effectively implement other management measures, such as existing operating experience, the corrective action program, and audits and assessments, to detect, estimate, and mitigate deposited uranium in the scrubber and ventilation ducting.

The major regulatory issues are:

- a. Failure to ensure criticality accident sequences remain highly unlikely. Specifically, the accumulation of uranium within the scrubber was a condition under which the performance requirements of Part 70, subpart H, for a high consequence event did not remain highly unlikely. This represents a failure to meet Title 10 of the *Code of Federal Regulations* (10 CFR) 70.61(b), and is currently an unresolved item (URI) (currently being evaluated for enforcement action).
- b. Failure to assure that under credible normal and abnormal conditions, all nuclear processes were subcritical including use of an approved margin of subcriticality. Specifically, the criticality safety evaluation performed to ensure safety within the scrubber, was inadequate since it did not appropriately account for the chronic buildup of uranium in the form of AUF. This represents a failure to meet 10 CFR 70.61(d), and is currently a URI (currently being evaluated for enforcement action).
- c. Failure to establish adequate management measures to ensure that items relied on for safety (IROFS) perform their function when needed. Specifically, the licensee did not establish adequate management measures (i.e., configuration management program, procedures, training, audits, and corrective actions) to ensure that IROFS related to ventilation systems were designed, implemented, and maintained such that they were available and reliable to perform their function when needed as required by 10 CFR 70.62(d). This potential violation of 10 CFR 70.62(d) is currently a URI (currently being evaluated for enforcement action).
- d. Failure to make a 1-hour report. Specifically, the licensee failed to report, within 1 hour, a condition such that no IROFS, as documented in the Integrated Safety Analysis summary, remained available and reliable, to perform their function, and which resulted in the failure to meet the performance requirements of 10 CFR 70.61. This represents a failure to meet 10 CFR 70, Appendix A (a)(4), and is currently a URI (currently being evaluated for enforcement action).