April 16, 2008

UNITED STATES
NUCLEAR REGULATORY COMMISSION
OFFICE OF NUCLEAR MATERIAL SAFETY AND SAFEGUARDS
WASHINGTON, D.C. 20555

NRC INFORMATION NOTICE 2008-08: MAINTENANCE PROCEDURES COMPROMISE DOUBLE-CONTINGENCY OF UO_2 POWDER-HANDLING EQUIPMENT AT FUEL CYCLE FACILITY

ADDRESSEES

All licensees authorized to possess a critical mass of special nuclear material.

PURPOSE

The U.S. Nuclear Regulatory Commission (NRC) is issuing this information notice (IN) to inform addressees of a criticality safety concern about performance of maintenance on process equipment while the equipment contains fissile material. NRC expects that licensees will review this information and consider actions, as appropriate, to avoid similar problems. Suggestions contained in this IN are not NRC requirements; therefore, no specific action nor written response is required.

DESCRIPTION OF CIRCUMSTANCES

An NRC licensee operates a fuel cycle facility that processes low-enriched uranium into uranium dioxide (UO_2) powder, using a dry-conversion process. The licensee dry-conversion process consists of exposing uranium hexafluoride (UF_6) gas to steam and hydrogen in a reactor chamber and then passing the resulting uranyl fluoride (UO_2F_2) through a kiln, where it is converted to UO_2 powder. The UO_2 powder is collected in a powder outlet at the end of the kiln and then transferred out of the powder outlet, through two in-line hatch valves, to a Y junction, which passes the powder to one of two available nonfavorable-geometry powder cooling-hoppers below the kiln (see **Figure 1**). The cooling-hoppers are covered with a nitrogen (N_2)-gas blanket that keeps moist air out of the hopper.

A criticality related hazard of the dry-conversion process is the possibility that steam, used in the conversion process, could flow into the cooling-hoppers during normal operations. The licensee provides double-contingency protection to ensure that a criticality accident is prevented by precluding the intrusion of significant quantity of steam into the cooling-hoppers. The first double-contingency control consists of the hatch valves being configured so that both valves cannot be open at the same time, which limits the rate at which steam can enter the hopper under normal operating conditions.

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The second double-contingency control consists of moisture detectors on the cooling-hopper nitrogen purge. The nitrogen purge lines from cooling-hoppers A and B flow past moisture sensors that, on detection of moisture above the set point in the nitrogen purge gas, trip an alarm. After an alarm is tripped for a period of 5 minutes, the sensors lock out the steam and UF_6 supply to the reactor chamber.

The licensee was performing maintenance consisting of rebuilding the conversion reactor/kiln on one of the dry-conversion lines. The maintenance included replacing the two in-line hatch valves leading to the cooling-hoppers. During the maintenance, one of the two hatch valves was incorrectly connected to its actuator, which resulted in the valve not being able to fully close. After completion of the maintenance, the licensee performed startup testing of the rebuilt equipment, which included sending steam to the reactor/kiln and cycling the hatch valves, to ensure that both hatch valves were properly seating. Hatch valve cycling consists of opening and closing one valve at a time and then pressure checking between the valves, while both are closed, to ensure that there is no direct path for steam to enter the hoppers. Pressure conditions between the two closed hatch valves could not be achieved and the licensee halted the start-up testing. To troubleshoot the condition, the licensee placed the equipment in hot-maintenance standby, which included shutting off the steam to the reactor/kiln.

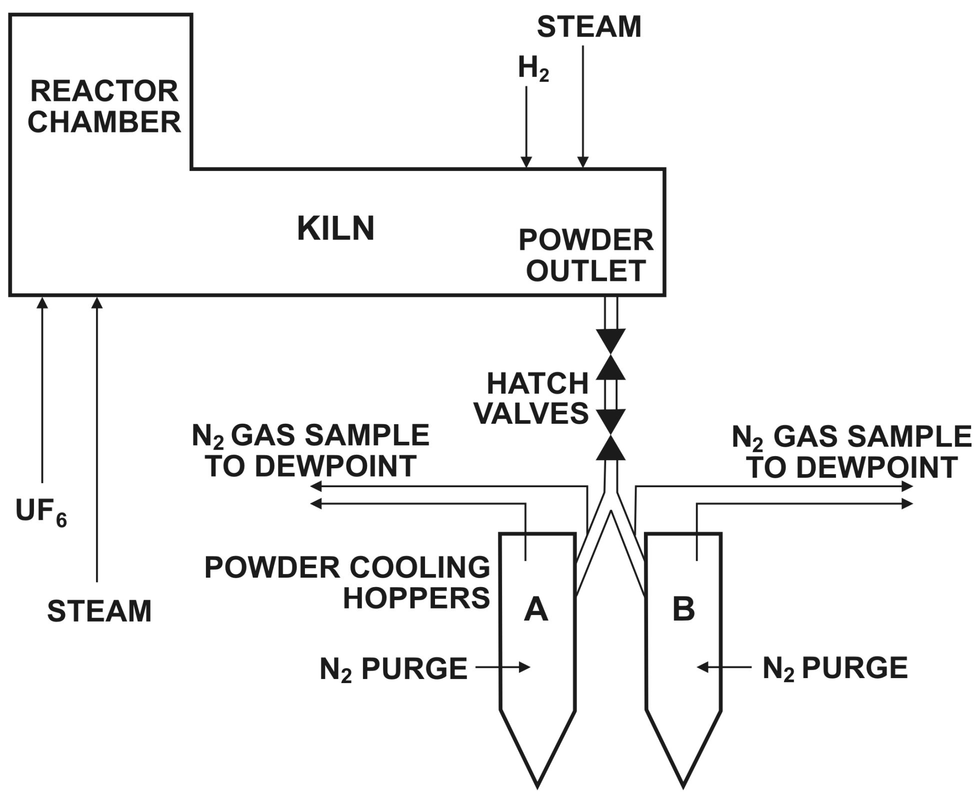

Figure 1
Conversion Reactor/Kiln and Cooling-Hopper Equipment Arrangement

During the specific troubleshooting of the condition, licensee maintenance personnel secure nitrogen flow to the cooling-hoppers to reduce the likelihood of airborne contamination. Licensee personnel anticipated that moisture sensors would trip the appropriate alarms and interlocks because of the intrusion of ambient air when the nitrogen was shut off. Maintenance personnel informed the dry-conversion area control room of the nitrogen flow being secured. As the troubleshooting progressed, the moisture sensors alarmed and then interlocked, which triggered the steam/UF_6 cutoff. Licensee operators acknowledged the moisture alarm, but failed to notice the interlock status.

Dry-conversion process operators beginning a subsequent shift in the facility noticed the activated cooling-hopper moisture interlock and observed that cooling-hopper A contained approximately 36 kilograms of UO_2 powder. Licensee management, unaware that the interlock had occurred during troubleshooting, decided that the moisture interlock possibly resulted from steam introduced during startup testing. Because the cooling-hoppers are a nonfavorable geometry and the amount of uranium involved appeared to be over the licensee's 31 kilogram safety limit for uncontrolled powder, licensee staff initiated an alert.

Subsequently, the powder in cooling-hopper A was determined to be dry. The licensee investigation concluded that the moisture detector tripped the interlock because of ambient air intrusion during troubleshooting, and that the maintenance staff had not passed on the information because they had not noticed the interlock status.

DISCUSSION

Double-contingency may be compromised if maintenance affecting criticality controls is performed on nonfavorable-geometry equipment containing fissile material. The event revealed that, although the licensee maintenance procedure required fissile material to be absent from equipment that was being worked on, the procedure did not clearly specify boundaries. Licensee staff failed to recognize that the hatch valves were criticality safety controls for the nonfavorable-geometry powder cooling-hoppers. Thus, the hatch valves were replaced during the maintenance without first emptying the hoppers of UO_2 powder thereby compromising the first double-contingency control against water intrusion into the cooling-hoppers.

Because the licensee criticality safety staff thought that no fissile material would be present in equipment during maintenance, this staff did not normally review maintenance procedures. NRC expects licensees to provide for double-contingency protection during all phases of operations at their facilities, including maintenance. To this end, fuel cycle licensee criticality safety staff members are expected to be familiar with the conduct of process equipment maintenance, in particular, how maintenance procedures affect criticality-related controls.

The failure to review or otherwise be familiar with in-plant maintenance procedures and the condition and status of equipment during all phases of operations and maintenance can result in the compromise of established criticality safety controls. NRC criticality safety inspections routinely review licensee facility operations, to ensure that credible accident sequences have been identified, analyzed, and controlled. NRC criticality safety inspections include review of licensee criticality analyses and related criticality controls, to ensure that analytical assumptions are adequate and not compromised after implementation.

CONTACT

This information notice does not require any specific action nor written response. Please direct any questions about this matter to the technical contact below.

/RA/

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