UNITED STATES
NUCLEAR REGULATORY COMMISSION
OFFICE OF NUCLEAR REACTOR REGULATION
OFFICE OF NEW REACTORS
WASHINGTON, DC 20555-0001

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NRC INFORMATION NOTICE 2010-27: VENTILATION SYSTEM PREVENTIVE MAINTENANCE AND DESIGN ISSUES

ADDRESSEES

All holders of an operating license or construction permit for a nuclear power reactor issued under Title 10 of the *Code of Federal Regulations* (10 CFR) Part 50, "Domestic Licensing of Production and Utilization Facilities," except those who have permanently ceased operations and have certified that fuel has been permanently removed from the reactor vessel.

All holders of, or applicants for, an early site permit, standard design certification, standard design approval, manufacturing license, or combined license issued under 10 CFR Part 52, "Licenses, Certifications, and Approvals for Nuclear Power Plants."

PURPOSE

The U.S. Nuclear Regulatory Commission (NRC) is issuing this information notice (IN) to inform addressees of recent operating experience concerning ventilation system preventive maintenance and design issues, including instances involving the control room habitability system. The NRC expects recipients to review the information for applicability to their facilities and consider actions, as appropriate, to avoid similar problems. The suggestions that appear in this IN are not NRC requirements; therefore, no specific action or written response is required.

DESCRIPTION OF CIRCUMSTANCES

Krümmel Nuclear Power Plant (Germany)

On June 28, 2007, a short circuit in one of two main generator transformers at Krümmel Nuclear Power Plant in northern Germany caused a reactor trip and transformer fire. Winds blew the heavy smoke from the fire towards the switchgear building, which shares its ventilation system with the conjoined main control room. Smoke detectors in the ventilation supply line sensed the smoke and automatically shifted the ventilation lineup to the smoke removal mode, closing the recirculation line and drawing all ventilation air in from the outside, which is typically expected to be free of smoke. The control logic of the ventilation system recognized the smoke removal mode as the highest priority, and operators discovered that they were unable to shift the ventilation system back to recirculation mode from the control room. Although filters in the ventilation system retained the smoke particles, fire gases passed through the filters and

entered the control room. Approximately 15 minutes elapsed before the operators manually realigned the ventilation system to recirculation mode from the local ventilation control panel.

The utility identified two major issues that led to the presence of excessive smoke in the control room during the transformer fire. It was determined that the effects of a fire outside of the building (as opposed to outside the control room but inside the building) were not considered during the design phase. The detection of smoke in the ventilation system led to the automatic shift of the system to smoke removal mode with no consideration for where the smoke originated. The control logic that sets the priority for the ventilation system prevented operators in the control room from overriding the automatic signal and placing the ventilation into recirculation mode.

In response to the event, the licensee disabled the automatic ventilation shift feature of the control room ventilation system for smoke detection and replaced it with a control room alarm. In addition, the licensee installed pushbuttons, both in the control room and at the remote shutdown panel, to allow operators to either isolate the ventilation system or place it in smoke removal mode, as the situation required.

Maanshan Nuclear Power Station (Taiwan)

On December 26, 2006, two Magnitude 7 earthquakes occurred near Maanshan Nuclear Power Station in Taiwan. In addition to causing a small amount of spillage from the spent fuel pool and minor damage to the cable duct connections of the reactor coolant pump, the earthquake caused a release of dust into the control room; the dust had accumulated in the outlet ducts of the control room ventilation system. The operators in the control room experienced a large shaking movement of the ground such that they could not stand firmly on the floor. Following the actuation of the reactor coolant pump and main turbine high-vibration alarms and numerous tank water level alarms, operators for Unit 2 made a conservative decision to initiate a manual scram of the reactor. This decision may also have been influenced by the large amount of falling dust from above the ceiling. In response, the licensee has incorporated ventilation ducts into the maintenance program to ensure a regular cleaning schedule.

Grand Gulf Nuclear Station

While measuring the airflow through the standby service water pump house with the ventilation fans running on January 14, 2009, the licensee at the Grand Gulf Nuclear Station noted that the airflow was significantly lower than expected in normal mode and higher than expected in cold weather recirculation mode. The results of an inspection that the licensee performed on the air intake showed that the station had not inspected or performed maintenance on the intake screens and damper assemblies for both divisional ventilation trains in approximately 20 years. The inspection showed that debris had accumulated and resulted in large differential pressures and low flow across the intake screens. Inadequate lubrication of the damper blade bearings resulted in damage to the intake dampers and operating mechanisms that resulted in significantly reduced flow control.

The reason no maintenance had been performed on this ventilation system was that during its preventive maintenance (PM) optimization initiative, the licensee decided that functional checks and inspections would be performed “as required” using observations from operator rounds and

engineering walkdowns instead of performing them at the periodic interval the licensee had established for dampers and ducting. This decision was based on an incorrect assumption the intake screens and dampers are visible during routine, non-invasive rounds and walkdowns.

After the licensee cleaned the screens and reworked the damaged dampers in August 2009, normal airflow through the ventilation system improved from 30,000 to 48,000 standard cubic feet per minute, and flow control was established to maintain the design flow in both normal and recirculation modes of operation. The licensee created preventive maintenance tasks to perform nonintrusive airflow testing on a 2-year frequency. The licensee also added maintenance procedures to lubricate the damper blade bearings and to inspect the intake dampers, operating mechanisms, and intake screens on a 2-year frequency. Additional information appears in Grand Gulf Nuclear Station—NRC Integrated Inspection Report 05000416/2009004, dated October 29, 2009, on the NRC's public website in the Agencywide Documents Access and Management System (ADAMS) under Accession No. ML093050016.

DISCUSSION

Criterion 19, "Control Room," of Appendix A, "General Design Criteria for Nuclear Power Plants," to 10 CFR Part 50 requires that "a control room shall be provided from which actions can be taken to operate the nuclear power unit safely under normal conditions and to maintain it in a safe condition…." Some plants are designed with control room smoke control systems that automatically align to a smoke purge mode that, as at Krümmel Nuclear Power Plant, will isolate the control room from the adjacent areas and purge it with a large quantity of outdoor air upon actuation of a smoke detection signal. Licensees are responsible for meeting fire protection and license condition commitments made during the establishment of their fire protection program. The NRC has evaluated plants licensed to operate after January 1, 1979, against Section 9.5.1, "Fire Protection Program," of NUREG-0800, "Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants," which has always specified that, "The outside air intake(s) for the control room ventilation system should be provided with smoke detection capability to alarm in the control room to enable manual isolation of the control room ventilation system and thus prevent smoke from entering the control room."

No specific requirement to periodically clean the inside of the control room ventilation ducts exists. However, such cleaning can prevent the introduction of dust into the control room following a seismic event; operators at the Maanshan Nuclear Power Station were distracted by dust in addition to being challenged in their response to a seismic event.

Criterion V, "Instructions, Procedures, and Drawings," of Appendix B, "Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Plants," to 10 CFR Part 50 requires licensees to prescribe and accomplish procedures for activities affecting quality, including procedures to ensure the operability of safety-related ventilation systems. In the example above, the licensee at Grand Gulf Nuclear Station had no procedures or PM schedules for the ventilation system of the standby service water pump house, which left the ventilation system in a degraded condition that caused significantly reduced ventilation flow.

CONTACT

This IN requires no specific action or written response. Please direct any questions about this matter to the technical contacts listed below or to the appropriate Office of Nuclear Reactor Regulation (NRR) project manager.

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Note: NRC generic communications may be found on the NRC public website, http://www.nrc.gov, under Electronic Reading Room/Document Collections.

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