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Subject: Yellow Alert: Equipment Failure Results in Flood

The following lessons learned alert has NOT been cleared for public release.

TITLE: Chilled Water System Failure Floods Building

IDENTIFIER: 1998-LA-LANL-ESH7-0001

DATE: February 26, 1998

LESSONS LEARNED: Facility operations and maintenance personnel need to have a clear understanding of system and equipment operating characteristics to ensure proper operation, and to ensure that abnormal operating conditions are recognized. Periodic operational surveillances that include notation of critical operating parameters provide trending and tracking data that can be used to identify changes in systems and equipment. Legacy systems that have the potential to adversely affect facility operations may need to be removed or disabled to prevent inadvertent operation.

DISCUSSION: During the weekend of November 15-16, 1997, serious flooding occurred at Technical Area 35, Building 27, resulting in an estimated \$3.2 million worth of property damage to facility and programmatic equipment. Freezing temperatures over the weekend contributed to the equipment failure that resulted in the flood. The occurrence was the subject of a DOE Type B investigation in December 1997, the results of which are being finalized.

The building, a three story structure with two stories below ground, was originally designed as a reactor research facility but never used for that purpose. A chilled water system provides cooling for a computer room and other non-critical process loads within the building. The system is a closed loop system consisting of two full-capacity, manually-operated, chilled water pumps that circulate the water through a cooling coil and out to the chilled water header. There are no automatic shifting features between the pumps. The chilled water is cooled in an evaporative water cooler consisting of a fan that draws outside air over the cooling coils, a set of mechanically interlocked dampers that are modulated through a single temperature control sensor to maintain the chill water at a set temperature within a preset operating band, and a recirculating spray system that sprays water from a reservoir over the cooling coils. The system also contains an automatic emergency "feed and bleed" mode of operation. This is a legacy feature that was installed for the facility's original mission. An electro-pneumatically operated valve, which is activated through a pressure switch located on the discharge side of the chilled water pumps, provides an emergency source of cooling water from the industrial water system when a low-pressure condition exists in the system.

The flooding was primarily caused by the freezing and subsequent rupturing of the cooling coils and actuation of the emergency "feed and bleed" mode of operation, which supplied an estimated flow of 250 gallons per minute through the ruptured coils. The leak originated on the ground floor and water flowed down into the subterranean levels. Security personnel responding to an alarm discovered five to six feet of water in the building basement, which contained computer

and analytical equipment. One hundred sixty three sealed radioactive sources were stored in the building for training and analysis purposes; 109 sources were found to be leaking as a result of being submerged under the flood waters.

Incident investigators found that a mechanical interference of the building sump-pump float switch prevented simultaneous operation of both sump pumps. Whether this condition was present during the incident is unclear, but it would have contributed to the seriousness of the flooding if it had been. The fact that the chill water pump capacity was severely reduced from aging, and the fact that the sump pump float switch was restricted were not discovered until after the flood occurred because facility personnel were not familiar with some of the legacy equipment and systems in the building.

RECOMMENDED ACTIONS: The term "legacy system or design" is used to describe facility system features that were installed to perform a specific function in support of a facility mission need that no longer exists. At Building 27, the presence of a legacy system contributed to the severity of the flooding and may have been a direct contributor to the initiating events that resulted in the coil freezing. This emergency cooling feature, which was installed to support the research reactor, is unnecessary for the current facility mission. Because of the age of facilities throughout the Department of Energy complex and their changing missions, there is a high probability that such legacy systems are still in place at other facilities. Facility managers should ensure that these systems are identified within their facilities and removed, disabled, or isolated to prevent unintended operation.

Freeze protection measures addressing testing and calibration of freeze-stats, and functional testing of all air intake systems controlled by dampers are essential to ensuring that temperature controllers are set properly and that equipment is functional. These actions would have corrected the improper setting of the temperature controller at Building 27, as well as uncovered the mechanical failure in the damper. Facility managers should review facility specific freeze protection programs to ensure that adequate measures are in place to monitor critical systems and equipment.

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FUNCTIONAL CATEGORY: Configuration Management

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REFERENCES: Occurrence Report ALO-LA-LANL-NUCSAFGRDS-1997-0005, Facility, Safeguards & Security Notice No. 0015

FOLLOW-UP ACTIONS: Information in this report is accurate to the best of our knowledge. As a means of measuring the effectiveness of this report, please contact the originator of any action taken as a result of this report or of any technical inaccuracies you find. Your feedback is appreciated.