Date: Wed, 25 Nov 1998 09:15:13 -0600
From: Meredith Brown <racer@lanl.gov>
Subject: **Yellow Alert: Condensate Induced Water Hammer**

Project Hanford Lessons Learned

Title: Winter Preps May Increase Susceptibility to Condensate Induced Water Hammer
Date: October 14, 1998
Identifier: 1998-RL-HNF-0028

Lessons Learned Statement: Winterization activities may result in abnormal system lineups that can lead to condensate induced water hammer (CIWH). Introducing steam into a line containing water can result in a water hammer even if that line is vented. The location of vent lines, amount and temperature of the water, velocity of the steam, and condition and grade of the pipe affect the probability of occurrence and severity of water hammer. Expeditious maintenance and repair of steam system components is necessary to maintain system control and eliminate the need for compensatory measures in the system operation. Inspect areas that have had maintenance performed on or around them for insulation in good repair, particularly on those lines associated with steam traps. Extra caution should be used when restoring systems to service to ensure that no condensate is present in any portion of the piping.

Discussion of Activities:
Summary: The 234-5Z Facility at the Plutonium Finishing Plant recently experienced a condensate induced water hammer while restoring steam after scheduled maintenance work. No injuries or system damage occurred.

Details: On Monday, July 20, 1998, Johnson Controls, Incorporated, (JCI) operators installed vent lines to #2 and #3 boilers during a planned steam outage. Upon completion of that maintenance activity, they coordinated restoring steam with PFP Operations. As pressure was building up in the system, a PFP Operator stationed nearby heard what he thought to be condensation induced water hammer coming from near the boiler annex. The JCI person restoring steam obtained a ladder and drained what appeared to be 20 to 30 gallons of water from a vertical mud leg on the steam line. Restoration of steam to the PFP continued without further incident.

Analysis: The direct cause of this event was that the boiler operator failed to ensure that all JCI owned steam lines were drained prior to introducing steam to the line. Operators must exercise extraordinary precautions to prevent condensate-induced water hammer because the resulting violent pressure excursions can cause serious equipment damage that could lead to personnel hazards.

This event might not have occurred if the following expectations of the Integrated Safety Management System had been more effectively implemented:

Identify Hazards and Requirements - Major Subcontractors ensure that hazard and environmental impact identification and analysis are performed and facility or project Hazard Classification are

identified and maintained.

Major Subcontractors are responsible for development of ES&H goals and objectives for improving safe operations and environmental protection. Work planning teams effectively communicate the identified hazards and environmental impacts and specified controls to all personnel performing the work activity.

Major Subcontractors operate industrial facilities in compliance with applicable operating procedures, permits, and consent orders and agreements (e.g., Tri-Party Agreement).

Major Subcontractors ensure that all personnel working on a project or at a facility are qualified and trained to conduct the work scope in a safe, environmentally protective, and efficient manner. Individual workers perform the work activity in accordance with the specified work instructions, work procedures, standard operating procedures, etc.

Recommended actions: Several Lessons Learned over the past five years have addressed condensate induced water hammer events, including a fatal accident in the 300 area in 1993. Thirteen safety principles for steam system operation are listed in lessons learned 95I048.txt, Condensation Induced Water Hammer Strikes Again. Facilities with steam should ensure that all steam system operators are following those principles.

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Functional Categories (Hanford specific): Mechanical/Structural
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