Date Tue, 14 Dec 1999 162944 -0700
From Meredith Brown <racer@lanl.gov>

Subject: Red Alert- Sodium-Potassium Reaction Results in Injuries

TITLE: Red Alert- Sodium-Potassium (NaK) Reaction Results in Personnel Injuries

IDENTIFIER R-1999-OR-LMESY12-1201 DATE December 14, 1999

LESSON LEARNED STATEMENT: The purpose of this notice is to provide information pertaining to a violent chemical reaction that occurred at the Y-12 Plant on December 8, 1999 resulting in eleven (11) employees either being treated or observed. Additional information will be provided in a future update.

DISCUSSION OF ACTIVITIES: In November 1999, a decision was made to replace an arc melt crucible in the Depleted Uranium Operations (DUO), Building 9201-5, of the Y-12 Plant. The arc melt furnace contains a limited life crucible surrounded by a sodium potassium (NaK) filled coolant chamber. Maintenance and Operations personnel with crucible change-out experience developed a crucible change procedure to define and capture the details of the task, containing planned responses to potential events including a NaK release. Operations Safety Board review of the task and procedure included Industrial Safety, Industrial Hygiene, and Radiological Control. The integrated operations, maintenance, and technical support team performed extensive validation activities including reviews and walkdowns of the procedure. This crucible changeout process was initiated on December 1, 1999 where maintenance personnel who had conducted previous crucible changes performed the actions assisted by experienced operations personnel. The first step was to drain as much NaK as possible from the crucible assembly back into the system reservoir before removal. This was done by purging the furnace with argon (Ar) forcing the NaK out of the chamber. When the NaK was drained from the chamber, the level of NaK in the storage reservoir did not rise as high as expected. Operations Manager consulted with maintenance and decided to recirculate with the Ar, reheat the NaK, and redrain. At this time a quick-disconnect argon fitting was removed without closing the valve and some Ar and NaK sprayed back into the furnace. The NaK oxidized in air and smoke filled the area. Operations immediately stopped the process and responded to stabilize the furnace. The furnace lid and bottom door was closed and an Ar blanket was added to the furnace chamber. The isolation valve between the crucible and NaK reservoir was closed. The area was evacuated until the smoke had cleared. On December 2, 1999, a team of operational personnel and technical support began planning operations for removing the spilled NaK from the furnace. The removal was to be done by Operations and Industrial Hygiene support personnel with spill cleanup experience. After the plan was developed, reviewed, and approved by Operations, process engineering, and ES&H support, the cleanup was scheduled for December 8, 1999. Until that time, the furnace was sprayed with mineral oil, the oxygen level in furnace was checked, the Ar blanket was maintained, and the Ar pressure was checked. On December 8, 1999, at approximately 900 a.m., the NaK removal continued with an attempt to remove the free NaK from the furnace floor using a vacuum tool. No free NaK was found, therefore the vacuum rig was secured and a steel tube probe was used to break up the NaK crust on the furnace bottom. During this process, at approximately 930 a.m., a violent

reaction occurred. Eleven (11) employees were treated or observed. One of the employees was transported directly to the Methodist Medical Center in the City of Oak Ridge, via ambulance. He was later air-lifted to the Erlanger Burn Unit, in Chattanooga, Tennessee, and was listed in serious but stable condition. The employee received approximately twenty five percent (25%) total burns with 10% to 15% third degree burns. The employee also received contamination in his hair which was removed prior to transport to the Methodist Medical Center. Two employees were hospitalized in the Methodist Medical Center. The other injuries were not considered serious and the employees were treated or observed and released from the Y-12 Health Services. Building 9201-5 was evacuated while emergency responders cleared the facility of smoke, and responded to the chemical reaction. All personnel were promptly accounted for at their assembly stations. There was no indication of any radiological contamination outside the facility as a result of this event. Re-entry planning was started, and re-entry will take place following a thorough evaluation conducted by technical and operations SMEs. The area around the scene of the accident will remain secured pending evaluations by a Type A Accident Investigation Team.

ANALYSIS: Prior to starting the removal of the NaK, SMEs such as chemical operators, process engineers, industrial hygiene, industrial safety, and maintenance pipefitters were involved in the planning for the removal process. This process had been conducted in prior years, but not since 1993. Due to the long duration in actual conduct of this process, the job was planned and training conducted with all involved employees. Preliminary information received from the operators and SME's indicated that the only difference compared to the removals conducted in the past was the time duration. Previous cleanups occurred within one day, whereas this occurred over one week duration. Review of literature on hazards associated with NaK and the Material Safety Data Sheets (MSDS) supplied by the vendor resulted in concerns that need to be evaluated on use of mineral oil with NaK or NaK containing potassium superoxide (KO2).

RECOMMENDED ACTIONS: At this time, the Y-12 Plant is reviewing any process that utilizes highly reactive materials. SMEs from the chemical manufacturing company and ORNL are being consulted for theories as to why this type of reaction occurred. Further updates will be provided based on the completion of the Type A Investigation.

ORIGINATOR Lockheed Martin Energy Systems, Inc., Quality Services Organization, K. A. Hensley 865-574-3546, K. A. Fee 865-576-3606
VALIDATOR T. R. Butz, 865-576-0129
CONTACT K. A. Fee, 865-576-3606
PRIORITY DESCRIPTOR Red/Urgent
NAME OF AUTHORIZED DERIVATIVE CLASSIFIER P. A. Porter, 865-574-1563 and M. D. Trundle, 865-574-3836
NAME OF REVIEWING OFFICIAL P. A. Porter, 865-574-1563
KEYWORDS explosive, chemical, injury, maintenance, sodium potassium, NaK, violent, reaction
REFERENCES Occurrence Report Number ORO--LMES-Y12NUCLEAR-1999-071
DOE FUNCTIONAL CATEGORY(S) CO - Conduct of Operations, HF - Human Factors, MA - Maintenance, OP - Operations, OS - Occupational Safety & Health, SF -Safety
LMES FUNCTIONAL CATEGORY(S) MA - Maintenance, OP - Conduct of Operations, SH -

Safety & Health
HAZARDS CODES CN - Contamination, FE - Firearms & Explosives, HZ -Hazardous Materials, PP - Personnel Protection, RD - Radiological
WORK ACTIVITY FE - Facility Equipment, FM - Facility Maintenance, RD -Radiological, OT - Other