PHMC Lessons Learned Fluor Hanford Inc.

Information Bulletin

Title: Unexpected Sodium-Potassium Alloy (NaK) Reaction with Water

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Lessons Learned Summary: When systems or component parts of systems have not been operated for an extended timeframe conditions must be verified before again operating those systems or components.

Discussion of Activities: Event Summary - During preparation for cleaning the sodium-potassium alloy (NaK) residuals from the Fuel Storage Facility (FSF) In-Vessel NaK Cooler an unexpected NaK-water reaction resulted in two or three loud noises and a small flash fire at the exhaust stack of the scrubber.

Detailed Description - On November 6, 2005, preparation for cleaning the equipment group including the In-Vessel NaK Cooler was started. The initial inert gas purge of the supply lines was completed and the ambient temperature inert gas purge of the Cooler following the supply line connection was started. The inert gas flow rate was set at 5 standard cubic feet per minute (scfm). After a short period of time operating staff noticed that a pressure indicator was reading slightly lower than expected. They decided to increase the flow rate of the inert gas to 10 scfm, as allowed by the procedure, to investigate the lower than expected pressure.

When the inert gas flow was increased, an unexpected NaK-water reaction occurred. The reaction resulted in unexpected noises and a hydrogen gas release with combustion at the exhaust stack of the scrubber approximately 20 feet above ground level. The flame at the scrubber outlet was momentary. At no time was fire noted anywhere else in facility. A small amount of smoke released from a ¼ inch fitting in Room 912 through a valve that was inadvertently left open activated the facility fire alarm.

Analysis: When the In-Vessel NaK Cooler was drained in July, 2004, considerable effort was made to minimize the amount of NaK left in the Cooler. A flexible metal hose was inserted into the Cooler and approximately 60 gallons of NaK was transferred to the drain tank. Based on this information and mock-up testing results, and estimated 5 to 10 gallons of NaK remained in the Cooler. That would correspond to the horizontal portion of the piping being approximately 25% to 50% full. The presence of a gas space through the Cooler was confirmed by using highly sensitive pressure gauges.

Apparently during modifications to prepare the NaK Cooling System for cleaning, tank T-914 was pressurized relative to the In-Vessel NaK Cooler. That pressure pushed NaK through a nozzle very close to the bottom of the tank back into the Cooler. Engineering personnel discussed the need to re-verify the amount of NaK in the In-Vessel NaK Cooler but did not identify the possibility of reintroducing NaK back into the Cooler. A review of existing conditions in the In-Vessel NaK Cooler prior to starting the cleaning process was not

performed. The work package that was used to modify the system was reviewed but the specific time NaK was forced back into the Cooler could not be identified.

The smoke in Room 912 came from a small valve that was inadvertently left open after previously cleaning another equipment group. The In-Vessel NaK Cooler cleaning did not use this valve in its configuration so it was inadvertently left out of this group's Process and Instrumentation Diagram (P&ID) and valve line up. When the configuration was set for this group the valve was left open and went unnoticed.

Recommendations: The FFTF modified its cleaning process and equipment configurations to prevent water introduction into NaK equipment that has not been cleaned.

Other facilities with systems or equipment that has been idle for an extended period should perform a field verification of the equipment configuration and procedures to ensure conditions are satisfactory for resuming operation.

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References: Occurrence Report EM-RL-PHMC--FFTF-2005-0008;
FFTF-28579, Fuel Storage Facility Sodium-Potassium (NaK) Unexpected Reaction Report