DEFENSE NUCLEAR FACILITIES SAFETY BOARD

March 27, 1998

MEMORANDUM FOR: G. W. Cunningham, Technical Director
FROM: J. Kent Fortenberry / Joe Sanders
SUBJECT: SRS Report for Week Ending March 27, 1998

Pu Storage at K-Reactor - One potential scenario for receiving Pu from RFETS is to ship and subsequently store the oxide at K-Reactor in shipping containers prior to packaging per the DOE-STD-3013-96 long term storage standard. To assess the impact of storage at K-Reactor, the 9975 shipping container requirements were compared with those of DOE-STD-3013-96, looking especially at time dependent effects. The maximum internal pressure reported in the 9975 Safety Analysis Report for Packages (SARP) is not significantly affected by storage time. The maximum pressure (110 psia) is based on a 2 year storage time, but the time dependent contributors (radiolytic production of H_2 and alpha decay production of He) account for less than 2% of this pressure. Increasing the storage time to 20 years increases the maximum internal pressure to only 118 psia. However, applying the 3013 methodology to the 9975 container results in a maximum internal pressure of almost 500 psia. Although the Schedule 40 (about 0.25" thick) 304L stainless of the 9975 primary containment vessel is capable of containing substantial internal pressure, the design pressure is only 150 psig at 500F for Normal Conditions of Transport and 300 psig at 500F for Hypothetical Accident Conditions.

The DOE-STD-3013-96 methodology does not consider radiolysis. Experiments have shown that a reaction of plutonium oxide with residual water occurs instead of radiolysis. Due to the inability to predict the kinetics of this reaction, the 3013 methodology assumes complete reaction of residual water. The only time dependent source of internal pressure considered in the 3013 methodology is the alpha decay production of He, which does not significantly increase the internal pressure for several decades.

In addition to peak pressure, the 9975 shipping container limits maximum hydrogen concentration to prevent an explosive atmosphere inside the shipping container. As presented in the 9975 SARP, the maximum H_2 concentration is strongly affected by storage time. Doubling the storage time doubles the H_2 concentration. Bounding calculations in the 9975 SARP for packages with the maximum Am-241 content predict a H_2 concentration that exceeds 4% after 2 years. Shipping this limiting material requires that shipping and storage time be limited to 18 months. Packages with less that 5% Am-241 are not quite so limiting. Applying the DOE-STD-3013-96 methodology to the 9975 container results in very high H_2 concentration independent of storage time. Due to a lack of understanding of the kinetics involved, the 3013 methodology simply reacts all of the residual water, releasing the hydrogen. At 1.5% moisture, the H_2 concentration within the package can exceed 90%. Unlike the 3013 package, the 9975 shipping container does not require an inert environment and so has a supply of oxygen to potentially provide an explosive atmosphere when significant H_2 is present.

Discussions have been initiated to explore these issues further with DOE-SR and WSRC.