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REPLACEMENT PAGES AND RESPONSES TO U. S. ENVIRONMENTAL PROTECTION AGENCY COMMENTS ON THE REMOVAL ACTION 9 FINAL REPORT FOR THORIUM NITRATE TANK T-2

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REPORT

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EXECUTIVE SUMMARY

Removal Action (RA) No. 9, Removal of Waste Inventories, was identified in the September 1991, Amended Consent Agreement (ACA) to address inventories of thorium and low-level radioactive waste (LLRW) remaining at the Fernald Environmental Management Project (FEMP). LLRW includes wastes containing constituents regulated under the Resource Conservation and Recovery Act (RCRA), as amended, and the Ohio Environmental Protection Agency (OEPA) Hazardous Waste Management Program. The ACA, as negotiated, requires the Department of Energy (DOE) to submit an annual compendium of existing procedures and documentation for the LLRW and Thorium Management Program, in lieu of a Removal Action Work Plan (RAWP). Additionally, Project Specific Plans (PSPs) for projects involving mixed waste treatment and disposition, including the Thorium Nitrate Solidification Project (TNSP), were submitted as specified in Removal Action Memorandum Addendum No. 1 (March 10, 1995). The Thorium Nitrate Tank T-2, Hazardous Waste Management Unit (HWMU) No. 54, contained mixed waste and fell within the scope and administration of RA No. 9.

The objectives of the TNSP encompassed safely removing the waste from Tank T-2, treating the waste for disposal, and decontaminating the tank to meet the clean closure requirements of the HWMU, while maintaining radiation exposures to personnel As Low As Reasonably Achievable (ALARA). All objectives of the TNSP were met. The following information summarizes the project results and conclusions.

- There was an outstanding safety record during this project. Radiologic controls were implemented and all safety issues listed in the PSP were complied with. There were no lost workday injuries (29 CFR 1904.12), no first aid cases, or personnel contaminations associated with the project. The TNSP was controlled, well-planned, and safe.

- The thorium nitrate was safely removed from Tank T-2. Small, nonreportable spills that occurred during this operation were contained and safely cleaned to background levels.

- The thorium nitrate and rinse water were solidified. Minor changes in the original solidification formulation, developed during bench-scale testing, were required. All drums of solidified waste hardened completely and contained no free liquids.

2.1.3 Process Equipment

The solidification process tanks, equipment, and layout used during this project are described in Section 2.2 of the PSP. The process equipment was pressure tested at the CNSI facility. Equipment that contacted the thorium nitrate during this project was new and was evaluated for compatibility with thorium nitrate. The equipment was set up at the FEMP and leak tested with water. After completing the leak test, a system Operational Readiness Assessment was conducted prior to beginning thorium nitrate processing. Figure 2-1 shows the TNSP work area. Figure 2-2 shows the TNSP neutralization tanks and associated equipment (the hose outside secondary containment is a process water line).

2.1.4 Safety

One safety issue concerned the radiological contents of the waste being processed. A Safety Assessment for the TNSP evaluated the radiological contents of Tank T-2 to assess system and worker safety. The safety basis for this project was documented in an Auditable Safety Record (ASR). Worker safety and personal protective equipment (PPE) requirements were addressed in the Project Specific Health and Safety Plan prepared for the TNSP. This ensured worker protection from the hazards of the process. There was an outstanding safety record during this project. Radiologic controls were implemented and all safety issues listed in the PSP were complied with. There were no lost workday injuries (29 CFR 1904.12), no first aid cases, or personnel contaminations.

2.1.5 Secondary Containment Analyses

The drain in the concrete secondary containment around Tank T-2 was closed for the duration of the TNSP. Stormwater was periodically emptied from the secondary containment and placed in portable dumpsters and analyzed for the Tank T-2 HWMU No. 54 constituents of concern (COC). The COC data from this stormwater, found in Table 2-1, shows the secondary containment area is below RCRA rinse standards as stated in the September 1993, Interim Final, Closure Plan Review Guidance for RCRA Facilities for HWMU No. 54 COCs. The stormwater effectively rinsed the entire secondary containment. Therefore, this secondary containment achieves OEPA closure requirements[1] and requires no further rinsing.

1/ Tank T-2's secondary containment also contains Tanks T-5 (HWMU No. 31) and T-6 (HWMU No. 32). The secondary containment was previously shown to meet the clean standards for the COCs for HWMUs 31 and 32 in the amendment to the closure plan for these HWMUs submitted to OEPA in November 1993.

to raise the pH of the solution to between 1.8 and 3. The maximum solution temperature encountered during neutralization was 99° F, which was below the PSP established control limit of 110° F. Activation of the chiller was never required because the liquid never exceeded 110° F during neutralization.

Transfer of Neutralized Thorium Nitrate to the Drumming Station

A 55-gallon drum with mixing blades was placed in the drumming station and secured to the drum fill head. The partially neutralized thorium nitrate was transferred to the drum by a chemical resistant hose and variable speed pump through an inlet on the fill head. The drumming station was enclosed by a temporary tent structure with secondary containment and maintained at a negative pressure by a high efficiency particulate air (HEPA) exhaust system.

Addition and Mixing of Solidification Dry Chemicals

The fill head contained a mixer drive unit, dry chemical inlet, waste inlet, and ventilation outlet, connected to the HEPA exhaust system. The mixing unit was attached to a disposal shaft and mixing blades that remained in the drum with the solidified material for disposal. With the mixer and ventilation system operating, approximately 170-190 pounds of dry chemicals were gradually added to each drum. The dry chemicals were supplied by an enclosed screw conveyor from a dry chemical hopper. The contents of the drum were mixed continuously during the addition of the dry chemicals and for approximately 5-10 minutes after the dry chemical addition was complete.

Transfer of Drums to the Staging Area

After mixing was complete, the drum fill head was removed and a curing lid was installed on the drum. The curing lid consisted of a modified shipping lid with a charcoal filtered vent to release the heat of the exothermic curing reaction. The filled drums of slurried waste were manually pushed along a conveyor to a staging area to cure for approximately 12 hours. Figure 2-3 shows TNSP workers inspecting the cured waste. After this initial curing, the drums were weighed and then moved to an interim staging area. The drums remained in this area for approximately two to three days (until the exothermic reaction had peaked). After inspection to ensure that the material had hardened, permanent shipping lids were installed. The drums were palletized and transferred to the Plant 1 Pad storage area on-site for interim storage, in accordance with the Plant 1 Pad waste storage permit. The drums will be stored until approval of the waste stream application by the proposed receiving facility. Application approval is anticipated in late FY96 or FY97.

sampling procedure used is provided in Attachment B of the PSP. Documentation for waste acceptance at NTS is ongoing.

UTS Results

The RCRA Land Disposal Restriction (LDR) rules (40 CFR 268; OAC 3754-59) specify treatment standards for hazardous waste to be land disposed. For corrosive wastes, the treatment standard is deactivation (treatment of the waste until it is no longer corrosive [i.e., pH above 2]). For TC wastes, the treatment standards are expressed as maximum concentrations that cannot be exceeded. Waste must be treated to meet all applicable standards before it can be land disposed.

Under a rule promulgated May 24, 1993 (58 FR 29860), corrosive wastes must be treated to meet the treatment standards for any "underlying hazardous constituents" besides being treated to remove the corrosive characteristic. A rule promulgated September 19, 1994 (59 FR 47982), established new treatment standards called UTS. This rule defines an underlying hazardous constituent as any constituent listed in the UTS rules that can reasonably be expected to be present in the waste (before treatment) at levels above the UTS.

Based on analytical data and process knowledge, underlying hazardous constituents for the thorium nitrate are chromium and cadmium. The UTS limits are 860 μg/l for chromium and 190 μg/l for cadmium. All drums of solidified thorium nitrate were below these limits (Table 2-2).

2.3.2 *Container Disposition Summary*

371 drums of solidified material, along with 150 drums of PPE waste and 6 white metal boxes of non-thorium concrete waste, were generated from the TNSP. The drums are stored on the Plant 1 Pad storage area in accordance with the Plant 1 Pad waste storage permit. The drums are shielded to reduce radiation exposure to workers. The drums will be stored until approval of the waste stream application by the proposed receiving facility. Application approval is anticipated in late FY96 or FY97.

2.3.3 Other Waste Streams

Incidental waste

Equipment used in the thorium nitrate solidification process that was not economically feasible to decontaminate and reuse, was disposed of consistent with FEMP site procedures. Waste, such as PPE, secondary containments, hoses, and other wastes generated throughout the operations of the TNSP were disposed of consistent with FEMP site procedures.

2.4.2 Nonreportable Spills

The following information describes minor nonreportable spills that occurred during the TNSP. These spills were safely cleaned to background levels and no personnel contamination events occurred. A nonreportable release is a spill that does not exceed the reportable quantity as specified in 40 CFR 355, Appendix A.

- Operations were stopped on September 16, 1995, due a problem with the siphon break line. A very small amount of thorium nitrate or thorium nitrate acid vapor corroded through a brass fitting and broke the vacuum for the suction side of the pump. Less than 20 ml of thorium nitrate or condensed thorium nitrate vapor dripped into the secondary containment for Tank T-2. The material was cleaned up using an absorbent pad. Radiological levels after clean up did not exceed background levels. There were no lost workday injuries to any site personnel from this problem.

- On September 30, 1995, after transferring 200 gallons of thorium nitrate from Tank T-2, a very small leak was noticed at the Kam-lock fitting for valve WS-6. Less than 30 ml of thorium nitrate dripped into the secondary containment pan. The material was cleaned up and the plastic wrap around the Kam-lock fitting was reinstalled.

- On October 9, 1995, CNSI found a small quantity of neutralized thorium nitrate (less than 10 ml) had stained the outside of the Kam-lock fittings of the mixer and chiller pumps. The two peristaltic pumps were replaced with double diaphragm pumps. The pumps were located between the neutralization tanks where radiation levels were 16 mrem per hour. To ensure worker safety and reduce radiation exposures, the leaking joint was wrapped and contained and both neutralization tanks were emptied. The pumps were replaced on October 11, 1995, with dose rates less than 4 mrem per hour.

- On October 25, 1995, approximately 700 milliliters (ml) of thorium nitrate was released (600 ml into secondary containment, 100 ml outside secondary containment onto pavement) as a result of an error in valve alignment and the use of an aluminum cap to blank off the end of a two inch stainless steel leg on the valve manifold. The partially neutralized thorium nitrate corroded through the aluminum cap, resulting in the small nonreportable spill. The nonreportable spill was immediately contained, cleaned up, and the area was decontaminated.

- On October 26, 1995, due to a cumulative error in a flow meter, a neutralization tank overflowed into its secondary containment vessel. 25 - 50 gallons of partially neutralized thorium nitrate was contained in the secondary containment vessel.

3.0 CONCLUSIONS

All objectives specified in the PSP were met. The following summarizes the TNSP results and conclusions.

- The entire TNSP had an outstanding safety record. Radiologic controls were implemented and all safety issues listed in the PSP were complied with. There were no lost workday injuries (29 CFR 1904.12), no first aid cases, or personnel contaminations. The TNSP was controlled, well-planned, and safe.

- The thorium nitrate was safely removed from Tank T-2. Minor nonreportable spills occurred during this operation. However, these spills were safely cleaned to background levels and no personnel contamination events occurred.

- The thorium nitrate and rinse water were solidified. Minor changes in the original solidification formulation, developed during bench-scale testing, were required. 371 drums of solidified waste hardened completely and contained no free liquids. In addition, the 150 85-gallon drums of PPE and 6 boxes of non-thorium concrete waste generated by the project also did not contain any free liquids.

- Based on analytical data and process knowledge, underlying hazardous constituents for the thorium nitrate were chromium and cadmium. The UTS limits are 860 μg/l for chromium and 190 μg/l for cadmium. Analytical results indicated that the drums of solidified thorium nitrate were below regulatory limits. The solidified waste is not corrosive and meets the criteria for land disposal.

- Tank T-2 and its treatment system piping were decontaminated by flushing the entire system with water to meet OEPA Closure Standards. Clean closure of Tank T-2 was achieved after four rinses. Tank T-2 was rinsed an additional four times to reduce ALARA concerns with the thorium residue in the tank.

- Results from air and radiological monitoring indicate no control levels were exceeded. The cumulative exposure received by project personnel was well below 1.9 man-rems. Contact dose-rates on the drums of final product are in the range of 10-15 mrem/hour on contact, with dose rates less than 5

mrem/hour at 30 centimeters. General area dose-rates in the project area were typically less than 5 mrem/hour. The DAC for Thorium-232 (Class W soluble) was applied for radiation protection purposes on this project. In addition, a DAC of 1.0 WL was applied for thoron progeny. Average concentrations on the project perimeter were less than ten percent for each DAC.