

DEFENSE NUCLEAR FACILITIES SAFETY BOARD

May 25, 1995

MEMORANDUM FOR: G. W. Cunningham, Technical Director

COPIES: Board Members

FROM: H. W. Massie

SUBJECT: Trip Report - Workshop on Combustible Residues and Meeting on Residue Drum Safety, April 19-20, 1995

1. **Purpose:** This memorandum provides observations of two meetings by the Defense Nuclear Facilities Safety Board (Board) staff member, H. Massie, and outside experts, J. Cleveland and T. Clark, on April 19-20, 1995, of (1) a workshop held to develop a method for the selection of treatment alternatives for combustible residues at Rocky Flats, and (2) a meeting to review the safety of residue drum handling and venting practices.
2. **Summary:** Based on this review, the Board's staff notes the following:
 - a. Stabilization of the combustible residues at Rocky Flats is a critical path activity for meeting the requirements of Board Recommendation 94-1 for processing of higher risk residues.
 - b. The Department of Energy (DOE) Rocky Flats Field Office (RFFO) stated that the incineration option can not meet the schedule requirements (i.e., 3 years) for residue processing required by Recommendation 94-1. Incineration requires an Environmental Impact Statement and a Clean Air Act permit, which DOE said would require several years to obtain. Hence, the purpose of the workshop was to select an alternative to incineration. DOE RFFO informally favors only venting and repacking for most of the combustible residues; this alternative does not, however, satisfy Recommendation 94-1.
 - c. A DOE consultant proposed several improvements for protecting worker health and safety during drum venting and handling; they include implementing remote drum venting capability or having all workers near the drum venting operation wear full-face respirators until after the drum is vented. The EG&G 'worst case' drum flammability calculation in response to an accidentally punctured drum during handling does not appear to be conservative. The staff believes that drum venting should continue so that overall safety risks are reduced and that safety improvements, such as incorporation of a remote drum punching operation, should be expedited. It may also be prudent to provide special handling (e.g., safety nets) for drums suspected of having high levels (>4%) of hydrogen such as the residue sludge and incinerator ash drums.

3. **Background:** Board Recommendation 94-1 recommends "that preparations be expedited to process the containers of possibly unstable residues at the Rocky Flats Plant and to convert constituent plutonium to a form suitable for safe interim storage [within 3 years]." DOE has committed to process the higher risk residues within three years in the DOE Implementation Plan, except for the combustible residues which are to be processed within four and one half years. Currently, there is no viable treatment alternative for combustible residues at Rocky Flats.

DOE and the contractor (EG&G) committed to vent 2045 residues drums which are suspected to contain elevated levels of hydrogen. EG&G has found high hydrogen levels (e.g., 25-60 percent) in samples of gas obtained from the drum headspace.

4. **Discussion/Observations:**

- a. The combustibles residue workshop was a follow-up to a previous workshop held at Rocky Flats in January 1995; this workshop included DOE RFFO, EG&G, Savannah River Site, Lawrence Livermore National Laboratory and Los Alamos National Laboratory participants. The consensus of the workshop was that incineration was the best technical alternative, but it did not receive support from DOE and the stakeholders at Rocky Flats at the recent meeting. The scope of the April 1995 workshop was to discuss and reach consensus on three items: 1) definition of the "end state," (i.e., if the combustible residues are treated what should the final product be?), 2) definition of evaluation criteria which could be used as a methodology for selecting a final treatment alternative to incineration, and 3) selection of a criteria ranking process.
- b. EG&G stated that there are 17.5 metric tons of combustible residues containing about 0.5 metric tons of plutonium. The total plutonium inventory of all residues at Rocky Flats is 3.1 metric tons. The combustible residues consist primarily of paper, cloth, filters, resins, wood and various plastics along with small amounts of oils, greases and solvent. Potential hazards in the combustibles include radiolytic generation of hydrogen and other flammable gases, nitrated organic compounds which could be flammable or shock sensitive, plutonium metal in contact with chlorinated organic compounds that could result in violent reactions, packaging degradation due to chemical and/or radiolytic effects, and radiation exposure to workers. Rocky Flats committed in the Implementation Plan for Recommendation 94-1 to treat the higher risk residues by 1998 and the remainder by May 2002. EG&G stated this schedule requires initiation of facility modifications in FY96. Incineration of residues requires an Environmental Impact Statement by DOE regulation 10 CFR 1021.
- c. The workshop failed to reach a consensus on end-state criteria. The primary issue is the criterion for having no hydrogenous matrix material. Elimination of hydrogenous material eliminates the possibility of hydrogen generation. The other option is to allow

some hydrogen generation but limit hydrogen accumulation. This issue remains unresolved at Rocky Flats.

At the end of the workshop, a path forward was developed which entails revising the end-state criteria, refining the evaluation criteria with weighing factors, providing a treatment fact sheet describing the options in Attachment 1, and developing a public participation program for greater stakeholder involvement.

- d. Recent findings of high hydrogen levels (e.g., 25 percent, 60 percent) in several types of residue drums led the Board's staff to question the safety of workers while handling and venting these drums. Venting of drums is necessary to eliminate the buildup of hydrogen in a large number of residue drums at Rocky Flats.

The drums are taken to the Building 776 size reduction vault airlock and vented by a manual drum punching operation. In viewing videotapes of this operation the staff noted that the two workers who conduct the venting and removal of drum lids wear full-face respirators. Approximately six other people were also involved in venting operations, but they did not wear respirators, including several who were in the vicinity of the drums. The staff also notes that the drum is placed under restraining devices to protect the workers in case the lid is blown off. The staff believes that use of a "remote" punching operation would result in improvement in worker safety by reducing the consequences in the event of a plutonium contamination. DOE Safety Notice 93-1 entitled, "*Fire, Explosion, and High-Pressure Hazards Associated with Waste Drums and Containers,*" also proposes remotely operated drum punches.

- e. EG&G has made calculations to evaluate the possibility of a drum explosion. In all drums with high hydrogen levels (e.g., 25 percent, 60 percent), the oxygen is depleted to near zero percent; this phenomenon is believed to be due to reaction of the oxygen in the drum with carbon-containing species formed by radiolysis. The most probable way to get a hydrogen deflagration is by accidental punching of a hole in the drum. EG&G fire protection personnel performed a 'worst case' calculation assuming a pressurized (4.5 psig) drum with 60 percent hydrogen and 1/5 full (i.e., 4/5 volume of hydrogen). If a drum is punctured and because of the pressure differential, the resulting escape velocity of the hydrogen is high. This results in a jet flame with no flashback to the interior; hence a detonation of hydrogen would not occur. However, the 25 percent hydrogen drum, may be a more bounding case since it was not pressurized and the resulting escape velocity of the hydrogen is very low. Depending on the size of the hole in the drum, a deflagration could occur. Hence, EG&G's calculation does not appear to be conservative. It may be prudent to provide special handling (e.g., safety nets) for drums suspected of having high levels of hydrogen.

- f. EG&G improved its material handling procedures in January 1995 so that if a drum does not have a carbon filter vent, the worker must notify supervision. Supervision requests that a visual inspection be performed prior to moving the drum. If the drum shows no sign of pressurization, the drum is moved. If a drum is pressurized, then emergency response procedures would be utilized.
 - g. In response to Board staff concerns, DOE RFFO had Science Applications International Corporation (SAIC) perform an independent technical review of safety issues related to drum venting, handling, and sampling. SAIC concluded that there was no imminent hazard to the health and safety of the workers. The following key safety improvements are proposed by SAIC: 1) Expedite the installation of a 'remotely' operated drum punching apparatus, and 2) Revise respiratory protection requirements for workers in proximity to the drum punching operation to assure that they are consistent.
 - h. EG&G has concluded in a white paper that its drum handling and venting practices are safe and is proceeding with drum venting. The other major concern is handling of drums (i.e., movement of drums from storage locations to the venting location) which may contain high levels of hydrogen. The staff believes that EG&G has prudently drawn a balance between reducing the safety risks of collocated site workers by venting of all residue drums versus the elimination of all risk to an individual worker in the actual drum venting operation. The staff believes that venting of drums should continue as planned, but safety improvements such as incorporation of a remote drum punching operation for worker safety improvement should be expedited. Another option is to build a ventilated hood enclosure (e.g., tent) with video monitoring equipment inside the enclosure. Two workers would conduct the drum punching operation inside the enclosure. The need for wearing respirators for all workers is eliminated. DOE RFFO has requested EG&G to implement a remotely operated punch in a few weeks.
5. **Future Staff Actions:** The staff will continue to follow closely DOE RFFO and EG&G efforts for selecting alternative treatment processes for stabilizing of combustible residues; this will be done in periodic review meetings. Implementation of safety improvements in the drum venting and handling practices will be closely monitored and further discussions will be held with DOE RFFO.

SUGGESTED TREATMENT ALTERNATIVES

INCINERATION:	Rotary Kiln Controlled Air Fixed Hearth Multiple Chamber	Fluidized Bed Multiple Hearth Cyclone Drum Fluid Wall
NEAR-INCINERATION:	Pyrolysis Molten Salt Molten Metal Calcination Silent Discharge Plasma	Solar Thermal Electron Beam Plasma Arc Microwave
AQUEOUS OXIDATION:	Acid Digestion Electrochemical Oxidation Wet Air Oxidation Wet Chemical Oxidation Supercritical Water Oxidation UV-Oxidation	
DECONTAMINATION:	Chelation Sonic Electrochemical	Leaching Washing FOOF
IMMOBILIZATION:	Microwave Melt Polymer Sulfur Polymer Cement	Cement Glass
LIQUIFACTION:	Alkaline Digestion Hydrogenation	Dehalogenation Steam Gasification
BIODEGRADATION:	Fermentation Depolymerization	Digestion Fluidized Bed
NON-TREATMENT:	Repackage For Repository Underground Test Ship To DOE/DOD Site Do Nothing	