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THE EXCAVATION AND REMEDIATION OF THE SANDIA NATIONAL LABORATORY CHEMICAL WASTE LANDFILL

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ABSTRACT

The Chemical Waste Landfill (CWL) at Sandia National Laboratories/New Mexico (SNL/NM) is a 1.9-acre disposal site that was used for the disposal of chemical wastes generated by many of SNL/NM research laboratories from 1962 until 1985. These laboratories were primarily involved in the design, research and development of non-nuclear components of nuclear weapons and the waste generated by these labs included small quantities of a wide assortment of chemical products.

A Resource Conservation and Recovery Act (RCRA) Closure Plan for the Chemical Waste Landfill was approved by the New Mexico Environment Department (NMED) in 1992. Subsequent site characterization activities identified the presence of significant amounts of chromium in the soil as far as 80 feet below ground surface (fbgs) and the delineation of a solvent plume in the vadose zone that extends to groundwater approximately 500 fbgs. Trichlorethylene (TCE) was detected in some groundwater samples at concentrations slightly above the drinking water limit of 5 parts per billion. In 1997 an active vapor extraction system reduced the size of the TCE vapor plume and for the last six quarterly sampling events groundwater samples have not detected TCE above the drinking water standard.

A source term removal, being conducted as a Voluntary Corrective Measure (VCM), began in September 1998 and is expected to take up to two years. Four distinct disposal areas were identified from historical data and the contents of disposal pits and trenches in these areas, in addition to much of the highly contaminated soil surrounding the disposal cells, are currently being excavated. Buried waste and debris are expected to extend to a depth of 12 to 15 fbgs. Excavation will focus on the removal of buried debris and contaminated soil in a sequential, area by area manner and will proceed to whatever depth is required in order to remove all pit contents.

Up to 50,000 cubic yards of soil and debris will be removed and managed during the excavation of the CWL. As part of the excavation process, soil is being separated from the buried debris using a 2-inch mechanical screen. After separation from the soil, debris items are further segregated by matrix into the following categories: wood, scrap metal, concrete/aggregates, resins, compactible debris, intact chemical containers, radioactive and mixed waste, and high hazard items. One of the greatest sources of hazards throughout the excavation process is the removal of numerous intact chemical containers with unknown contents.

A large portion of the excavated soil is contaminated with metals and/or solvents. Polychlorinated biphenyls (PCBs) are also known to be present. Most of the contaminated soils being excavated will be taken to the nearby Corrective Action Management Unit (CAMU) for treatment and management while a majority of the containers will be taken to the Hazardous Waste Management Facility or the Radioactive and Mixed Waste Management Facility for proper treatment and/or disposal at permitted offsite facilities.

INTRODUCTION

As part of a Voluntary Corrective Measure (VCM), Sandia National Laboratories (SNL/NM) Environmental Restoration (ER) Project is conducting a remedial excavation of Site 74, the Chemical Waste Landfill (CWL), located in the southeastern corner of Technical Area (TA) III in Albuquerque, New Mexico. The CWL occupies approximately 1.9-acres of level terrain with sparse, desert vegetation. The objectives of the ER CWL Landfill Excavation (LE) VCM project are as follows:

- To mitigate risks posed by the landfill,
- To provide for proper management and/or disposal of landfill contents, and
- To perform these activities with minimal risk to the health and safety of the workers and to the environment.

Site Disposal History and Characterization Results

Disposal of waste at the CWL began in 1962 and continued until 1985. The collection and disposal history of operations at the CWL is difficult to re-create before 1975 because written records of these activities were not kept between 1962 and 1975. This has resulted in a fair degree of uncertainty concerning the actual locations of waste pits and the types of wastes disposed of in the pits at the site.

Liquids and solid wastes were typically disposed of in unlined pits at the CWL. Separate pits were allegedly used for the disposal of acids, oxidizers, reducers, organics, reactives, bulky materials, metal, neutral compounds, and salts. Waste was to have been separated by type and placed in the appropriate pits. However, adherence to this procedure was not followed while the landfill was in operation.

Typically, a waste pit was excavated using a backhoe and ranged from 8-feet (ft.) to 12-ft. deep by at least 2-ft. wide. After a waste pit had been filled with waste, a new one was excavated and given the same number as the original trench. The number of each waste pit corresponded to a specific chemical type. Trench markers, used for identifying trench locations, were subsequently destroyed or buried through grading activities.

In addition to pits, an unlined surface impoundment, approximately 23-ft. by 66-ft. by 7-ft. deep was used to store chromic acid wastes from the early 1970 to 1978. A lined surface impoundment approximately 15-ft. by 15-ft. by 5-ft. deep was used between 1979 and 1982 for the disposal of liquid chromic acid and ferric chloride wastes.

In 1981, all liquid waste disposal in unlined trenches was discontinued. Liquid waste was stored in containers next to the appropriate trench and was later packaged into 55-gallon drums. Wastes with similar characteristics such as oils and solvents were consolidated and were subsequently disposed of off-site at an approved hazardous waste disposal facility by a hazardous waste management contractor.

In 1985 all pits were covered with soil backfill, and the CWL operated under the Resource Conservation and Recovery Act (RCRA) interim status as a hazardous waste drum storage facility until 1989. The lined chromic acid surface impoundment was used for disposal until April 1991.

Numerous site characterization studies have been conducted at the CWL over the last 16 years to determine the nature and extent of contaminants in the soil and groundwater, or contaminants occurring in a vapor phase as soil gas. Investigations conducted to delineate disposal area, contents of disposal pits, and contaminants occurring in the soil include the following:

- Geophysical surveys conducted in 1984, 1991, and 1998;
- Borehole sampling conducted in 1981, 1983, 1985, 1987, 1992, 1993, 1995, and 1996/1997;
- Trenching investigations conducted in 1985.

EXCAVATION APPROACH

The CWL has been subdivided into four areas: the East-Central, Southeast, Southwest, and North Areas. Excavation of the CWL began in September 1998 in the East-Central area. Excavation operations have focused on the removal of buried debris and contaminated soil in a sequential, area by area manner.

The initial excavation approach was a very cautious and labor intensive approach to excavating. Each trackhoe bucket of excavated material was placed on a 2-inch (in.) mesh screen top which was used to separate debris (all material >2-in.) from soil (all materials <2-in.). Debris collected on the top of the screen while soil collected beneath the screen. The debris was then manually picked off the mesh screen and segregated into similar waste matrices. While this approach was successful in recovering many intact containers, it became apparent that in order to complete the excavation portion of the CWL and transport the excavated soils and debris to the CAMU in a timeframe consistent with the CAMU treatment permit schedule, the technical approach to the excavation needed to be revised.

In September 1999 a revised technical approach to the excavation process was implemented at the CWL. The revised approach included the implementation of commercially available mechanical sorting screen for the segregation of debris and soil. Using this device, soil (all material <2 inches) is collected under the machine on the non-excavation side, while debris (all material >2 inches) is deposited on the excavation side of the machine. As excavation continues, these two types of materials build up and are removed as needed by a wheel loader, or similar heavy equipment. Debris is relocated from the area of excavation to the Waste Management (WM) area located to the east within the site operational boundary for further segregation and characterization. Soils are staged in soil piles of on operationally efficient size, nominally 100 cubic yards, within the site operational boundary until analytical results have been received from the on-site mobile laboratory.

SEGREGATION OF WASTE MATERIALS

For the CWL, a distinction is made between debris, which includes everything that does not pass through the 2-in. screen, and soil, which includes everything that does pass through the 2-in. screen. The use of a commercially available mechanical sorting screen is used for initial segregation of soil from debris. The mechanical screen has reduced material handling and worker exposure while increasing productivity. Figure 1 gives an overview of the materials segregation process.

Due to the great variety of materials being encountered the segregation process is complex. A standardized, field tested approach to this process is presented and transforms a very complex mixture of wastes into a manageable process that can be implemented in the field.

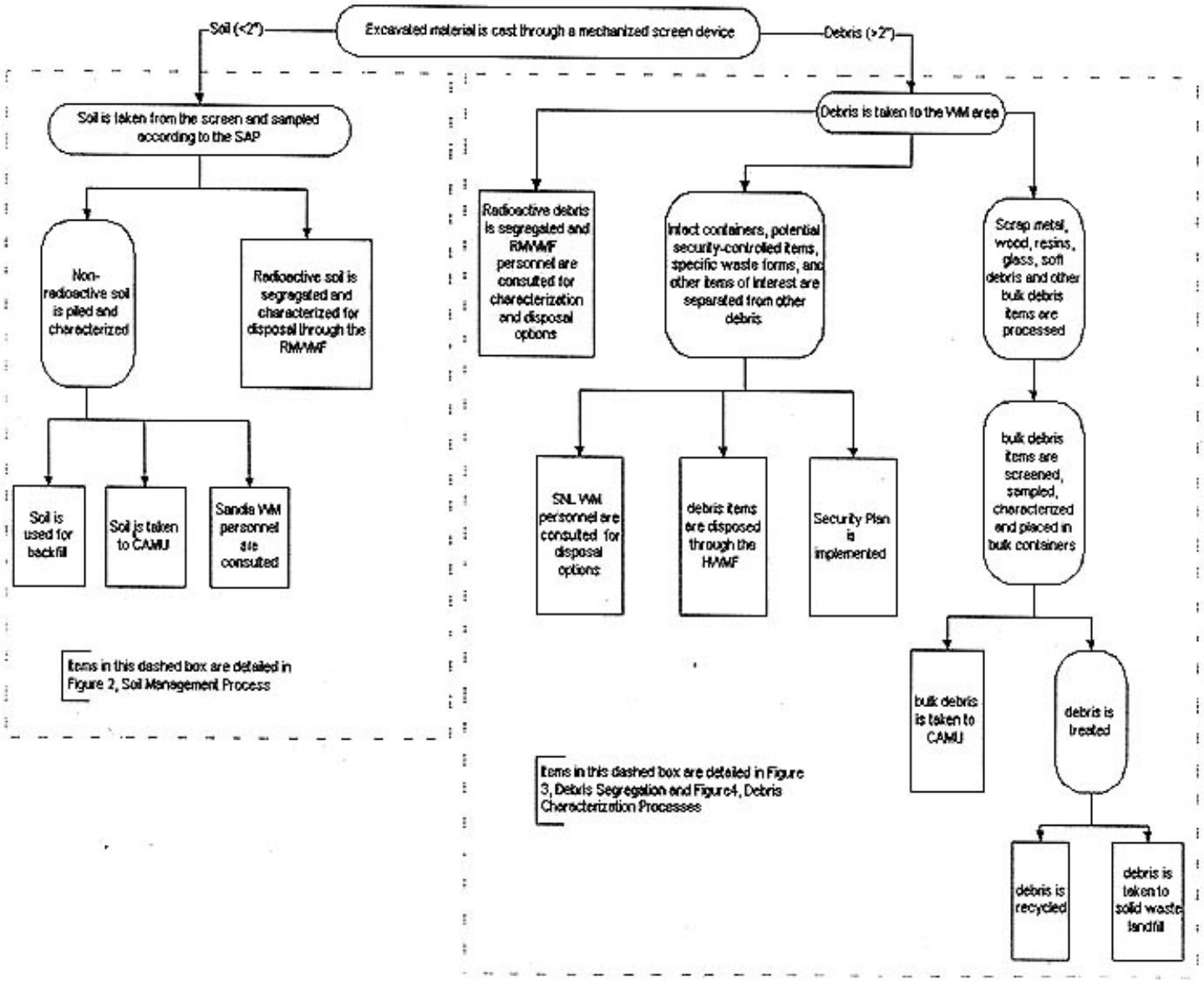

Figure 1. Generalized Material Segregation Process

Soils

Figure 2 depicts the overall soil management process at the CWL. Soils are hauled from the mechanical screening device to a designated sampling area using a front-end loader, or similar equipment, and then hauled to designated soil staging areas. Each loader bucket of soil is radiologically screened and sampled prior to being dumped into a stockpile. Soils are stockpiled within the site operational boundary while awaiting analytical results. The soil stockpiles are of an operationally efficient size, nominally 100 cubic yards. Each soil stockpile is clearly marked with a unique identifier and managed in compliance with the CWL Waste Management (WM) Plan. In the event that a soil stockpile must be moved or re-located within the site operational boundary, the integrity of the soil stockpile is maintained.

Upon review of the soil pile characterization results, the piles may be taken to the CAMU for treatment and disposal. If the soils contain PCBs above 50 parts per million (ppm) the soils will be protectively managed in accordance with the Toxic Substance Control Act (TSCA) and/or TSCA/RCRA guidance until a treatment and/or disposal option is identified. Should the soils meet the "replaceable soils criteria" the soil piles will be staged and used as backfill material upon completion of the excavation. Soils containing radioactive contamination are being protectively managed in separate piles. Upon completion of the excavation, the soil will be laid out in 8-in. lifts in an effort to segregate out the radioactive contamination. Any radioactive material will be containerized and the remaining soil will then be stockpiled for characterization and treatment at the CAMU. Any remaining radioactive contaminated soils will be containerized for shipment to an off-site facility for disposal.

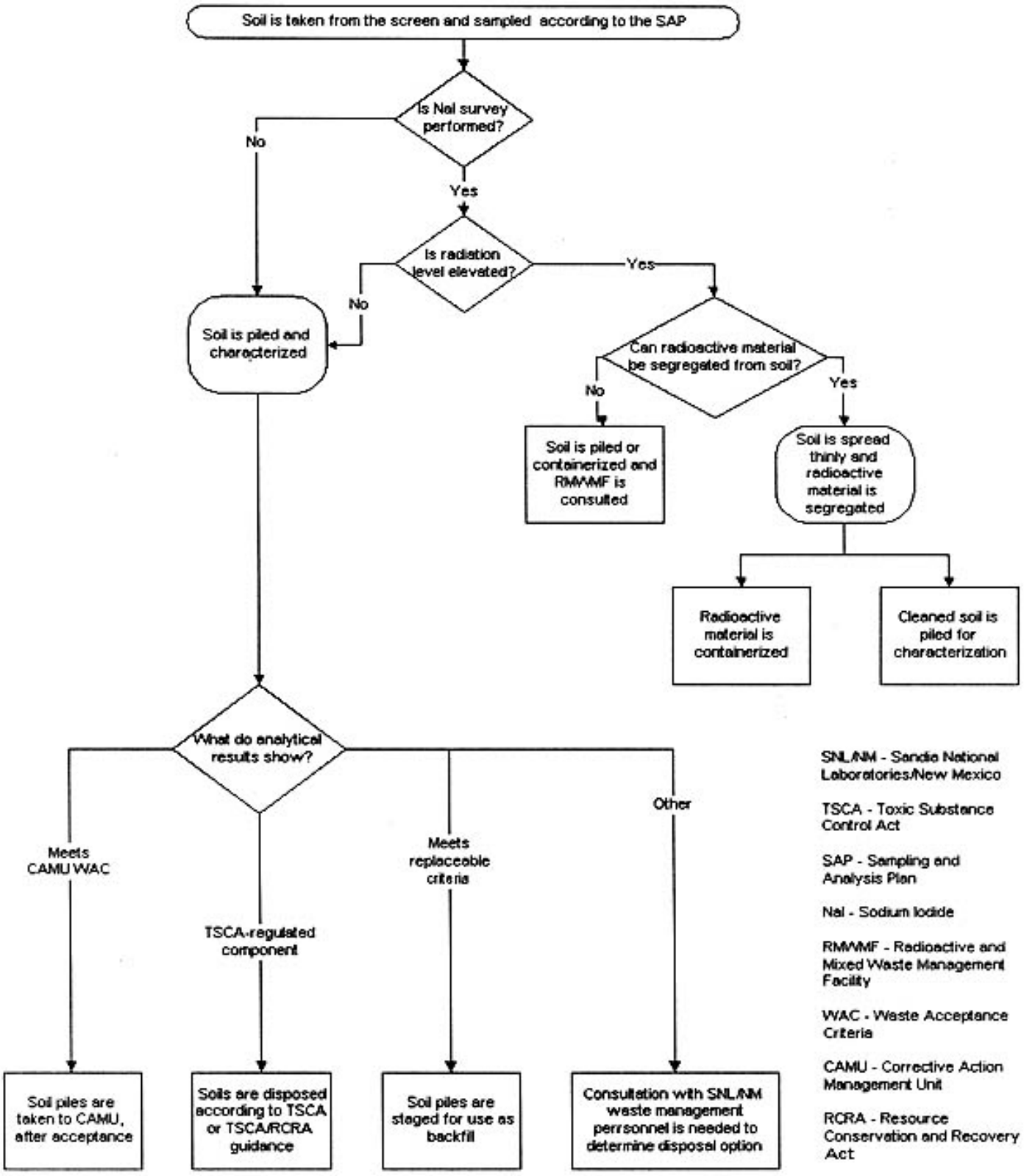

Figure 2. Soil Management Process

Debris

Segregation of debris is detailed in Figure 3. Excavated debris is relocated from the mechanical screen device to the WM area located in the southeast portion of the site operational boundary. The debris is then placed on a conveyor system within the WM tent using a front-end loader or similar equipment. Screening of debris for radiological contamination is conducted using a sodium iodide detector before the debris is placed on the conveyor and personnel come in contact with the waste. Any debris exhibiting elevated levels of radiation is segregated immediately and placed in an enclosed container. Initial segregation within the WM tent consists of separating materials by matrix directly from the conveyor system. All materials are divided into the following matrices:

- Soft debris (cardboard, plastic, etc.);
- Solid debris (metal, wood, concrete, batteries, and resins);
- Rocks;
- Intact non-empty chemical containers; and
- Other materials.

Soft debris is placed in 55-gallon drum liners and full liners are placed in a designated area. One hundred percent (100%) of the debris within the liners are surveyed with a pancake probe for radiological contamination and swipe samples are collected from a representative portion (i.e., 5%) of the debris. As appropriate, the debris is then marked with a radiological screening identification number. Once the debris in the bags has been surveyed and swiped, the full drum liners are placed in a separate designated area. When a sufficient volume of liners have been accumulated, they are moved to a specified container (e.g., roll-off box or wrangler bag) near the tent.

Solid debris is placed in a wheelbarrow. Following this initial segregation at the conveyor system, the debris are further segregated into the following categories:

- Ferrous metals;
- Non-ferrous metals;
- Metal;
- Resins;
- Batteries;
- Wood; and
- Concrete.

These materials are placed in separate, labeled self-dumping hoppers or other appropriate containers. Once a hopper is full, the materials are surveyed with a pancake probe and swiped for radiological constituents. If radiological contamination is not detected, the contents of the containers are transferred into larger containers near the tent. A container is designated for each category listed above, with the exception of batteries. Batteries are placed in 20-gallon poly totes and treated the same as intact containers. Any potentially classified material is placed in a separate 20-gallon tote (or other appropriate container, depending on the size of the material) and handled in accordance with the SNL/NM Chemical Waste Landfill Security Plan.

Rocks are left on the conveyor system and are deposited in a hopper at the end of the conveyor belt. Rocks are then stockpiled in operationally efficient volumes outside the WM tent. When an area of excavation is being backfilled, the rocks are decontaminated with a power wash and included as a marker layer with the backfill.

Intact containers include glass and plastic bottles, plastic bags, and metal containers. Intact, non-empty, chemical containers are placed in 20-gallon poly totes or 55-gallon drums. If the container is an intact 55-gallon drum it is staged separately. If the container is a leaking 55-gallon drum, the contents are transferred to an appropriate container or the entire drum is contained in an 85-gallon drum. When the secondary container is full, the contents are surveyed

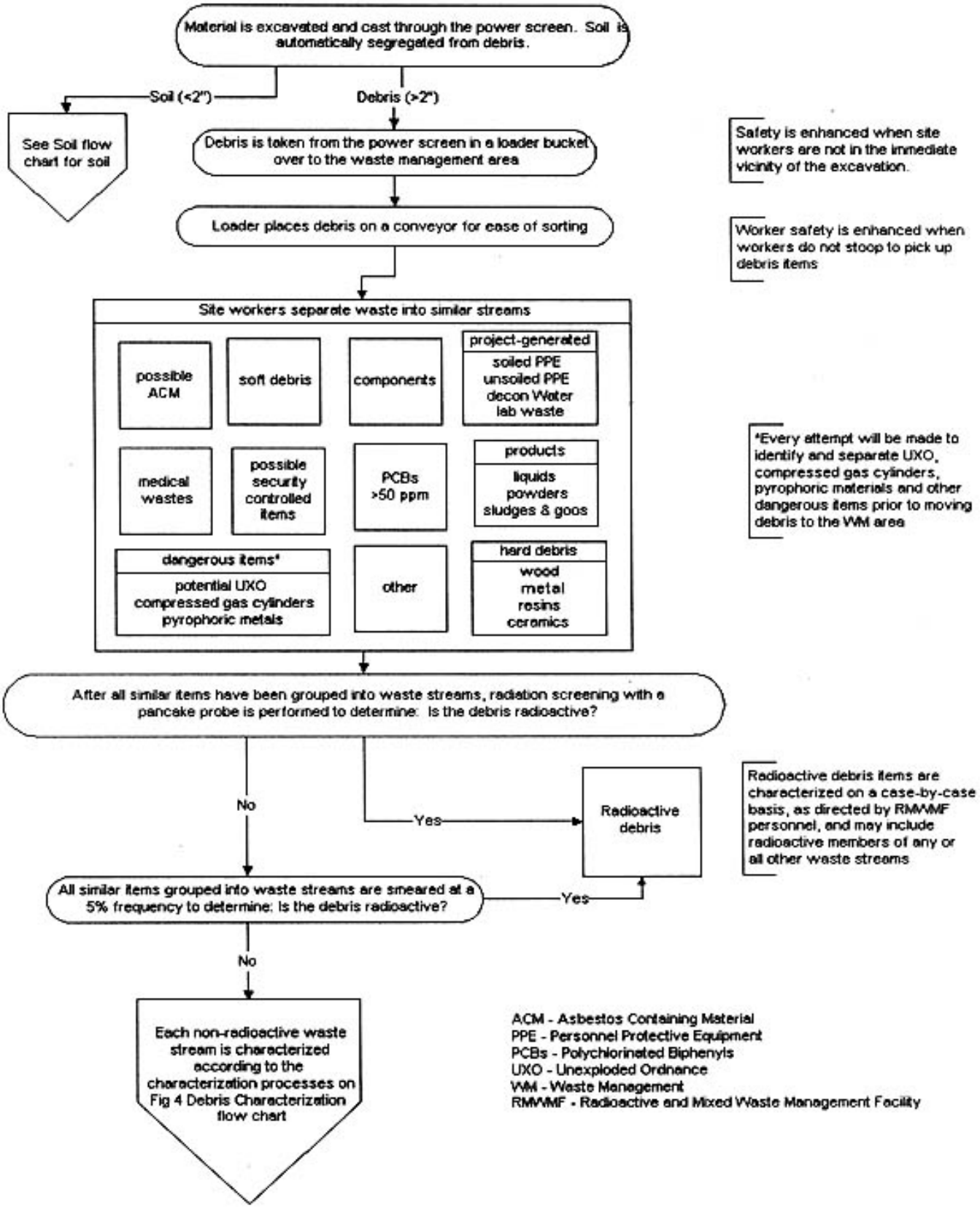

Figure 3. Debris Segregation Process

using a pancake probe. Once surveyed, the containers are segregated into radiologically contaminated and non-radiologically contaminated solids and liquids. The secondary containers are staged on designated pallets (spill pallets for liquids). When a pallet is full, it is moved near the waste characterization laboratory trailer.

"Other" materials include all materials that do not fit into any of the waste matrices listed above. These are expected to be small volumes of specific waste (intact compressed gas cylinders, potential explosives, semi-solids, etc). Proper staging and segregation requirements for "other" materials are conducted on a case-by-case basis. Dangerous items are removed from the debris waste steam by the Site Safety Officer (SSO) at the excavation and staged separately from the "other" materials.

The characterization process for each type of debris is, likewise complex. All recovered products will be characterized by Haz-Cat methods, on-site mobile laboratory analysis, or by off-site laboratory analysis for acceptance at the SNL/NM Hazardous Waste Management Facility (HWMF) or the Radioactive and Mixed Waste Management Facility (RMWMF). Debris that cannot be decontaminated and all porous debris will be characterized for acceptance at the CAMU. The characterization approach is depicted in Figure 4 and has resulted in waste streams that have been and are currently being accepted by waste management personnel at SNL/NM

CONCLUSION

Upon removal of all the debris within the CWL, verification samples will be collected within the excavated areas at the 12-ft. depth. Analytical results of the verification samples will be used to conduct a preliminary risk assessment. Based upon the results of the risk assessment a decision will be made as to conducting additional excavation from 12-ft. to 20-ft. bgs. Off-site laboratory verification sampling and backfilling activities for all four designated areas will begin once the entire excavation is completed. Upon completion of the verification sampling and backfilling, the areas will be crowned or graded to prevent water from ponding within the original landfill boundary.

The successful execution of this landfill excavation project has relied on the cooperation of multiple departments, work groups, and agencies within and external to SNL/NM. These have included such organizations as the New Mexico Environment Department, the United States Environmental Protection Agency, the Citizen's Advisory Board, SNL/NM Hazardous Waste Management Facility, SNL/NM Radioactive and Mixed Waste Management Facility, SNL/NM Radiation Protection Group, as well as many others.

One of the most significant challenges at the CWL has been to define and iterate a thorough Environmental Safety & Health (ES&H) process with concerned personnel at the neighboring facilities that closely surround the landfill. This process has included the development of extensive air release modeling and emergency scenarios, coupled with response actions to mitigate subsequent concerns.

Issues related to regulatory interpretation and permitting have also been substantial and the DOE and regulatory agencies have been extremely helpful and supportive of the excavation project and subsequent treatment and management of the excavated materials at the CAMU.

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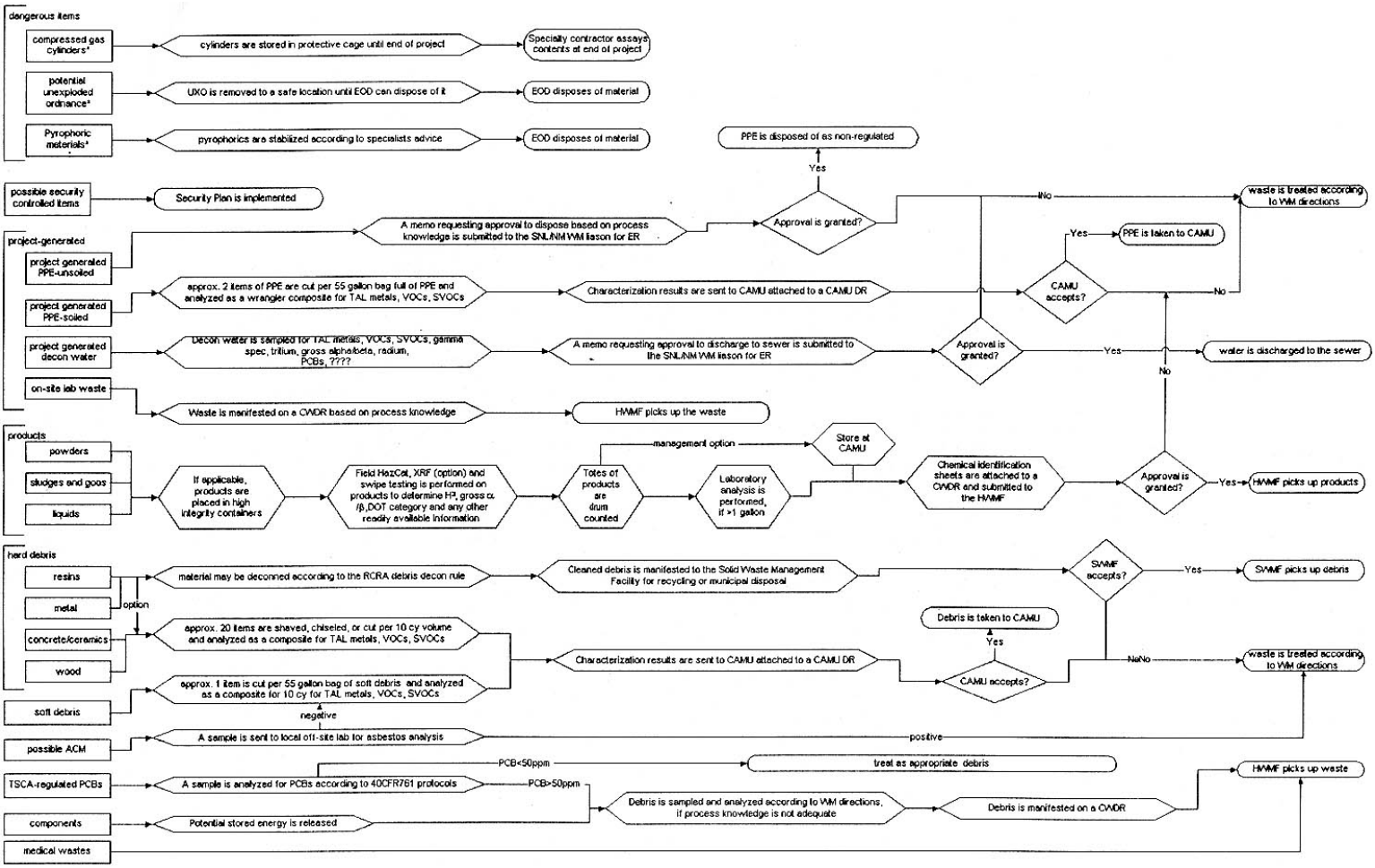

Figure 4. Debris Characterization Process