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LOW-LEVEL WASTE DISPOSAL FACILITY SAFETY ANALYSIS EXPERIENCE: ESTABLISHING RADIONUCLIDE INVENTORIES

by

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DISCLAIMER

Low-Level Waste Disposal Facility Safety Analysis Experience: Establishing Radionuclide Inventories

C. C. Fields, Westinghouse Savannah River Company

INTRODUCTION

This paper describes work performed to estimate radionuclide inventories (Material at Risk) for use in developing upgraded safety documentation for the Solid Waste Management Facility (SWMF) at the Department of Energy's Savannah River Site (SRS).

The SWMF includes disposal and storage facilities for low-level radioactive waste generated at SRS and other government-owned locations. The SWMF is primarily composed of "burial grounds," where waste has been disposed of in trenches since 1953, concrete vaults, scheduled to be used for disposal starting in 1994, and above-ground paved "pads," where transuranic (TRU) waste is stored in containers awaiting future disposal at the Waste Isolation Pilot Plant (WIPP) in New Mexico. The SWMF also includes areas for above-ground storage of contaminated used equipment, a waste compactor, tanks for storage of slightly contaminated reprocessing solvents, a facility to certify waste prior to shipment to WIPP, and buildings for storage of containerized mixed and hazardous waste.

The SRS is an approximately circular region approximately 30 km (18 miles) in diameter and approximately 800 square kilometers (300 square miles) in area. Most of the areas (or "subfacilities") making up the SWMF are located near the center of the site.

DESCRIPTION

The objective of the work was to produce radionuclide inventories (including projections for future material) that are conservatively bounding for safety assessments (but not grossly overconservative so as to artificially cause predicted accident consequences to exceed acceptance limits) without excessive effort or cost. Projecting future inventories was crucial because the inventories of waste storage/disposal facilities tend to increase; several of the areas making up the SWMF either currently have the physical capacity to operate for several more years or can be expanded.

Inventories were needed for several different types of safety assessments. Some types of assessments need total subfacility (or subfacility-segment) inventories. Others need the inventory in the containers that can be affected by a single postulated credible event. Several different types of inventories were developed for each subfacility to meet these needs. For example, the TRU inventories included evaluation-basis inventories for single containers inventories of several different types.

The general approach was to: (1) identify the best available information for the current inventory of each subfacility (or the maximum credible inventory for process-type subfacilities, such as the compactor); (2) adjust the current inventory for uncertainty allowances, biases, and projections of future additions; and (3) convert the information to a form readily usable for safety assessments. For most of the subfacilities, this readily-usable form consisted of lists of the radioactivity (in curie units) for 27 key radionuclides, plus two pseudonuclides, "other beta-gamma emitters" and "other alpha emitters," to cover less important nuclides not on the standard list.

Difficulties encountered included dealing with: (1) the "expandable" nature of a waste storage/disposal facility; (2) the many different areas within the SWMF and the different types of waste in each area; (3) the number of waste streams coming to the facility (which may change as the SRS mission shifts to decontamination and decommissioning); (4) lack of detail in data in the existing computer-based inventory tracking system; and (5) the need to estimate inventories for material already in the facility that was assayed, packaged, and emplaced under procedures and standards that have evolved over a 40-year period (some older procedures allowed higher single-container inventories than are allowed today).

Since waste disposal began over 40 years ago and the last extended period of high-power reactor operation was in 1988, radioactive decay is significant for several important nuclides (e.g., tritium, most fission products, and most neutron activation products). The estimates of radionuclide inventories took credit for decay where data was readily available and the decay was expected to result in significant inventory reductions.

Available data for some material does not specify its precise isotopic makeup (some enriched uranium at SRS has relatively large amounts of U-234 and U-236) and, for short-half-life material, the isotopic mix changes while the waste is stored. The estimation techniques were conservatively based on assumed isotopic mixes that maximized the calculated radiation doses from postulated releases of the material. In some instances, the assumed isotopic fractions summed to more than 100%. For example, the (14.1-year half-life) Pu-241 content of plutonium was counted as both parent (beta-emitting) Pu-241 and as daughter (alpha-emitting) Am-241 to ensure calculated doses will be bounded for material of any age.

RESULTS

The results of this work, which consist of several multi-column (and in some cases, multi-page) tables of nuclide activity values, were documented in an Engineering Calculation prepared in accordance with SRS procedures.

Much of the available data on material deposited in the SWMF pre-dates development of current nuclear industry quality assurance requirements. Since the inventory estimates were partly based on this early data, the final inventory values were qualified for use in safety assessments by an interdisciplinary team review process, conducted in accordance with SRS procedures (in addition to the normal detailed technical peer review).

Projected future inventories are very sensitive to initial assumptions, such as the scheduled operational status of certain subfacilities, continued use of current waste packaging procedures, and continuation of restrictions on bringing specific types of waste into certain areas. These assumptions were documented in detail in the Engineering Calculation so that, in the future, they can be linked to administrative controls to protect the safety basis.

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