CONF-871075--9

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DE88 000948

WASTE EXAMINATION ASSAY FACILITY OPERATIONS

TRU WASTE CERTIFICATION*

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To be presented at
Oak Ridge Model Conference '87
Oak Ridge, Tennessee
October 13-16, 1987

*Research sponsored by the Defense Waste and Transportation Management Office, U.S. Department of Energy, under contract DE-AC05-84OR21400 with the Martin Marietta Energy Systems, Inc.

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WASTE EXAMINATION ASSAY FACILITY OPERATIONS, TRU WASTE CERTIFICATION -

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ABSTRACT

The ORNL Waste Examination Assay Facility (WEAF) was established as a cooperative program with the Los Alamos National Laboratory (LANL) in April, 1982 to nondestructively assay (NDA) transuranic (TRU) waste generated at ORNL. The present facility charter encompasses the NDA and nondestructive examination (NDE) of both TRU and low-level wastes (LLW).

Presently, the WEAF's NDA/NDE equipment includes a Neutron Assay System* (NAS), a Segmented Gamma Scanner (SGS), a drum-sized Real-Time Radiography (RTR) system, and a Neutron Slab Detector (NSD). The first three instruments are computer interfaced.

Approximately 2300 TRU waste drums have been assayed with the NAS and the SGS. Another 3000 TRU and LLW drums have been examined with the RTR unit. Computer data bases have been developed to collate the large amount of data generated during the assays and examinations.

Additional NDA and NDE instruments will be added to the WEAF in the near future: a crate-sized RTR unit and an external gamma and neutron dose rate scanner. The WEAF is being expanded by an additional 1600 sq. ft. to accommodate the new instruments, additional office space, and drum storage.

1. INTRODUCTION

The Oak Ridge National Laboratory (ORNL) Waste Examination Assay Facility (WEAF) was established as a cooperative program with the Los Alamos National Laboratory (LANL) in April, 1982 to nondestructively assay (NDA) contact-handled transuranic (CH-TRU)* waste generated at ORNL. The WEAF is a 50 ft. by 100 ft. converted general storage building located in Solid Waste Storage Area 5 (approximately one-half mile south of the main ORNL complex), adjacent to the CH-TRU waste retrievable storage bunkers and the remote-handled transuranic (RH-TRU) waste storage area. Present WEAF personnel include one supervisor and three technicians.

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*Transuranic waste as defined by DOE Order 5820.2 (ref. 1) is radioactive waste, without regard to source or form, that at the end of institutional control periods is contaminated with alpha-emitting transuranium radionuclides (any radionuclide having an atomic number greater than 92) with half-lives greater than 20 years and concentrations greater than 100 nCi/g. CH-TRU waste is defined as that waste whose measured container surface dose rate is less than 200 mrem/h.

ORNL was chosen by DOE as the site to field test a new NDA instrument developed by LANL (ref. 2). The unique waste characteristics and a willingness to test and demonstrate the instrument led to the selection of ORNL. The NAS, which was developed by LANL researchers John T. Caldwell and Walter E. Kunz (ref. 3, 4, 5), assays bulk solid waste to determine the TRU content. The lower limit of detection of the instrument allows the examiner to ascertain the fissile content (e.g., ^{239}Pu and ^{235}U) and the spontaneous fission component (e.g., ^{240}Pu and ^{252}Cf) of the waste at the 10 nCi/g level, which was the old definition of TRU waste. The NDA of these waste drums and, also, the NDE is required by the Waste Isolation Pilot Plant Waste Acceptance Criteria (WIPP-WAC) for those drums being shipped to the WIPP (ref. 6).

The original charter of the TRU Waste Drum Assay Facility (the name of WEAF from 1982 to 1985) called for the NDA of CH-TRU waste packaged in 55- and 30-gallon mild and stainless steel drums. The NDA instruments which were first available to accomplish this task included a SGS, a NSD, and the LANL-developed NAS. Descriptions of these systems, as well as proposed systems, are found in the Systems Descriptions section of this report.

2. SYSTEMS DESCRIPTIONS

Present Systems:

Neutron Assay System:

The NAS is a 4-π neutron detection system using shielded (cadmium-wrapped) and bare ^{3}He detectors embedded in the assay chamber walls. The system is capable of both active and passive scans. The active scan uses a deuterium-tritium pulsed neutron generator which emits 14-MeV neutrons and is pulsed 2000 times per assay. The neutrons are thermalized by the surrounding graphite chamber walls. These thermal neutrons are then captured by any fissile nuclides (e.g., ^{235}U and ^{239}Pu) contained in the waste drum. The resulting fission neutrons are detected by the cadmium-wrapped ^{3}He detectors. The passive scan detects any spontaneous fission and (alpha,n) neutrons. The combined assay yields the total TRU content of the waste drum.

Segmented Gamma Scanner:

The SGS is a passive gamma-ray detection system using a high-purity germanium detector. Gamma rays which are emitted during radionuclide decay and are contained in sufficient quantities in the waste drum are detected and the energies compared by the system software to a nuclide library. A printout listing the possible radionuclides emitting the detected gamma rays is produced. The system is being upgraded to perform quantitative measurements. The upgrade is expected to be completed in October 1987. The system has been in operation since April 1982.

Real-Time Radiography:

The RTR unit is used to detect nonconformance items (e.g., lead, liquids, etc.), as defined by ORNL and the Waste Isolation Pilot Plant Waste Acceptance Criteria Certification Committee (WIPP-WACCC), contained in LLW and CH-TRU waste drums. A 320 kV (max) constant potential X-ray tube head generates the X-rays used in the examinations. A rare-earth phosphor screen converts the X-ray energy to light energy, which, in turn, is viewed on a TV screen. The drum is rotated and scanned vertically, while the X-ray generator and image system remain stationary. The system has been in operation since November 1985.

Neutron Slab Detector (NSD):

The NSD is used as a screening station to segregate "hot" (> 1.0 E04 n/s) from "cold" (<1.0 E04 n/s) drums. The "hot" drums are sent through the WEAF systems first to reduce the background encountered during assay of the "cold" drums. The drums are also weighed at this station. This system has been operational since January 1983.

Proposed Systems:

Crate RTR Unit:

The crate RTR unit will nondestructively examine crate-size containers (up to 10 ft. long x 6 ft. wide x 7 ft. high) in the same manner as previously outlined in the drum RTR unit description. The system will use a 420 KV (max) constant potential X-ray tube head and will also be capable of examining drums. A vendor has been selected, and the system is scheduled to be delivered to ORNL by January 1988.

External Gamma and Neutron Dose Rate Scanner:

The gamma and neutron external dose rate scanner will automatically scan each waste package, including both drums and crates, for total external dose rate (neutron and gamma ray). Each hot spot detected by the NaI crystal detectors will be recorded by an IBM-AT computer and located relative to a starting position on the waste container surface. This measurement will negate the need for the WEAF technicians or Health Physicists to perform these measurements manually. The installation of this system will reduce the radiation dose received by the WEAF technicians and thus follow the ALARA principle. The waste package will also be weighed at this station (replacing the weigh station described above). Funding in the amount of $110K has been approved for this system. Specifications have been developed and are being reviewed prior to initiating the bidding cycle.

3. PAST CERTIFICATION ACTIVITIES

A DOE-HQ controlled milestone (OR85.10), which required the assay of all newly-generated (NG) and stored inventory CH-TRU waste drums, was accomplished on schedule (September 1985). The number of waste drums assayed by the NAS and SGS systems totaled 2151. Of this total, 1489 drums (69% of drum population) were categorized TRU, while 118 drums (6% of drum population) were categorized LLW. The remaining 544 drums (25% of drum population) were not categorized. The criteria used to establish each drum's category (i.e., TRU, LLW, or unknown) are presented in Table 1.

Table 1. CH-TRU Waste Drum Categorization Criteria

Waste Type	Criteria
LLW*	1. NAS assay scan
	a. active: less than 67 mg ^{239}Pu equivalent and,
	b. passive: less than 20 neutrons per second (n/s)
	2. SGS scan
	a. Did not detect presence of ^{241}Am or ^{237}Np daughters
TRU	1. NAS assay scan
	a. active: greater than 67 mg ^{239}Pu equivalent or,
	b. passive: greater than 1.0 E05 n/s
Unknown	1. NAS assay scan
	a. active: less than 67 mg ^{239}Pu equivalent and,
	b. passive: greater than 20 n/s and less than 1.0 E05 n/s
	2. SGS scan
	a. Detects presence of ^{241}Am or ^{237}Np daughters]

*For a drum to be categorized low-level waste (LLW) both criteria (1 and 2) must be satisfied.

4. PRESENT CERTIFICATION ACTIVITIES

The present charter of the WEAF calls for the continuation of the NDA of CH-TRU waste drums using the NAS and SGS systems. Additional certification activities now include the NDE of both CH-TRU and LLW drums using the RTR system (see Systems Descriptions section). The waste acceptance criteria used in the examination of LLW are very similar to those used in the examination of CH-TRU waste drums.

The waste acceptance criteria of interest which are noted by the WEAF examination technicians during RTR inspections of waste drums are (1) no free liquids, (2) no compressed gas cylinders, (3) note presence of lead, and (4) note presence of high-efficiency particulate air filters (HEPA filters). Waste drums (both CH-TRU and LLW) are rejected, a nonconformance report filed, and returned for repackaging if the presence of free liquids and/or unpunctured compressed gas cylinders are confirmed by RTR inspection. Drums are either returned to the waste generator or stored to await construction of a repackaging facility depending on the generation date of the drum. LLW drums are rejected if the presence of lead is confirmed by the RTR inspection. CH-TRU waste drums are tagged "HOLD" if the presence of HEPA filter(s) is detected by RTR inspection.

A DOE-HQ milestone, ORO87.01, which requires the completion of the NDE (using RTR unit) of the stored inventory of CH-TRU waste drums, is due to be completed by second quarter fiscal year 1988. To date (September 1987), 1826 CH-TRU waste drums have been examined at the WEAF using the RTR unit and 984 drums (54%) have passed the inspection, while 736 drums (40%) have been rejected. One hundred and six drums have been tagged "HOLD" due to the suspected presence of HEPA filter(s). The rejection rate of the NG CH-TRU waste drums has declined steadily since the inception of the program. The rejection rate since March 1987 through the present is 11%.

As of September 1987, 1198 LLW drums have been examined at the WEAF using the RTR unit. Of this number, 942 drums (79%) have passed the inspection, and 256 drums have failed (21%). The rejection rate time history for LLW drums parallels the rate for the CH-TRU waste drums.

A variety of computer data bases have been developed by WEAF personnel to collate and analyze the large volume of data acquired during the NDA and NDE waste drum certification activities. The data bases use commercially available software.

5. FUTURE CERTIFICATION ACTIVITIES

Future certification activities at the WEAF will include the NDE of CH-TRU and low-level wastes packaged in boxes using the crate-sized RTR unit. This activity is scheduled to begin in the second quarter of fiscal year 1988.

The waste acceptance criteria, which had been established for the waste drums, will be applied to the acceptance or rejection of waste boxes. The NDA and NDE of NG CH-TRU and low-level waste drums and boxes will continue.

The WEAF is scheduled to be expanded by an additional 1600 sq. ft. The expansion is required to accommodate the new instruments expected (see Proposed Systems in Systems Descriptions section) to be installed, additional office space, and waste drum and box storage areas.

CH-TRU waste drums are scheduled to be shipped from ORNL to WIPP beginning in the first quarter fiscal year 1989 (DOE-HQ controlled milestone, ORO87.02). To prepare for these shipments, WEAF future certification activities will focus on the preparation of the WIPP waste drum data packages and completion of the NDA and NDE of all CH-TRU waste drums and boxes. These data packages must accompany each shipment to the WIPP.

REFERENCES

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