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ENVIRONMENTAL ASSESSMENT

Receipt and Storage at Oak Ridge National Laboratory, Oak Ridge, Tennessee of Transuranic Waste, Mixed Transuranic Waste, and Mixed Oxide Waste from Nuclear Fuel Services, Inc.

October 30, 1992

U.S. Department of Energy
Washington, D.C.

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October 30, 1992

U.S. DEPARTMENT OF ENERGY
WASHINGTON, D.C.

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LIST OF ACRONYMS, ABBREVIATIONS, AND SYMBOLS

ALARA	As Low As Reasonably Achievable
Am	americium
CFR	Code of Federal Regulations
CH TRU	contact-handled transuranic (waste)
Ci	curie
D&D	decontamination and decommissioning
DOE	U.S. Department of Energy
DOT	U.S. Department of Transportation
EA	environmental assessment
EIS	environmental impact statement
Energy Systems	Martin Marietta Energy Systems, Inc.
FONSI	Finding of No Significant Impact
ft	foot (feet)
g	gram
gal	gallon
HEPA	high-efficiency particulate air
ICRP	International Commission on Radiological Protection
in.	inches
INEL	Idaho National Engineering Laboratory
kg	kilogram
lb/h	pounds per hour
LCF	latent cancer fatality
m	meter
MOX	mixed oxide (PuO_2-UO_2)
mrem	millirem
nCi	nanocuries
NEPA	National Environmental Policy Act of 1969
NFS	Nuclear Fuel Services, Inc.
NRC	Nuclear Regulatory Commission
ORNL	Oak Ridge National Laboratory
ORR	Oak Ridge Reservation
Pu	plutonium
PuO_2	plutonium dioxide
RCRA	Resource Conservation and Recovery Act of 1976
SAR	safety analysis report
SEG	Scientific Ecology Group, Inc.
SRS	Savannah River Site
SWSA	solid waste storage area
TRU	transuranic
TSCA	Toxic Substances Control Act
U	uranium
UO_2	uranium dioxide
WEAF	Waste Examination and Assay Facility

SUMMARY

The U.S. Department of Energy (DOE) proposes to accept, for receipt and storage, a maximum of 5500 ft^3 (about 750 55-gal drums) of precharacterized contact-handled transuranic (CH TRU) wastes and up to 150 canisters of mixed oxide (MOX or PuO_2—UO_2) wastes from Nuclear Fuel Services, Incorporated (NFS) of Erwin, Tennessee. Among the CH TRU wastes, but segregated, could be "mixed" CH TRU waste, which would contain Resource Conservation and Recovery Act (RCRA)-regulated materials. All of these wastes would be generated by decontamination and decommissioning (D&D) of former fuel fabrication facilities at NFS. Based on preliminary surveys at NFS and review of material accountability records, the amount of plutonium in the wastes proposed to be accepted would be, at a maximum, approximately 30 kg. This proposed action (acceptance of the wastes) is necessary to meet a DOE contractual obligation with NFS.

DOE's preferred alternative is to take possession of the NFS wastes following shipment by NFS-contracted carrier to the Oak Ridge National Laboratory (ORNL) in Oak Ridge, Tennessee. Shipments would occur over a period of approximately 12 months. The wastes would be stored in appropriately secured and permitted facilities at ORNL until an appropriate disposal facility becomes available. The alternatives of no action (i.e., not to take possession of the wastes) and storage at other DOE installations were considered.

This environmental assessment (EA) analyzes the potential environmental impacts of the preferred alternative: transportation to and storage of NFS CH TRU, mixed CH TRU, and MOX wastes at ORNL. Although NFS, not DOE, would be responsible for the shipment of wastes to the Oak Ridge facilities, this EA also considers the potential environmental impacts of off-site (non-ORNL) transportation. This EA does not address the impacts of the D&D activities at NFS that generate the waste nor the ultimate disposal of the wastes. Disposal of the wastes would be the subject of NEPA documentation.

Handling, transportation, and storage activities would be conducted in accordance with regulations of the Nuclear Regulatory Commission (NRC), the Department of Transportation (DOT), the Occupational Safety and Health Administration, DOE orders, ORNL and other directives. Wastes that have been assayed at NFS would be packaged in NRC- and DOT-approved containers and loaded onto trucks. Transport of wastes would either be (1) directly to ORNL or (2) via the Scientific Ecology Group, Inc. (SEG) facility in Oak Ridge, Tennessee, where wastes would first be reduced in volume, then transported to ORNL. At ORNL, wastes would be examined at the Waste Examination and Assay Facility (WEAF) for compliance with ORNL waste acceptance criteria. Nonconforming wastes would be returned to NFS or SEG. CH TRU wastes would be stored temporarily in Bldg. 7879, the CH TRU/Solid Low-Level Waste Staging Facility, and mixed oxide wastes would be stored temporarily in a vault in Bldg. 3100. A new building is proposed to be built as part of the proposed action for extended storage of the NFS CH TRU wastes. Mixed oxide wastes would be stored in Bldg. 3019, the Radiochemical Development Facility.

This EA describes the existing environment of ORNL that could be impacted by the proposed action. A complete description of the ORNL environment is provided in an assessment of the impacts of ORNL operations [Boyle et al., *Environmental Analysis of the*

Operation of the Oak Ridge National Laboratory (X-10 Site) ORNL-5870, Oak Ridge, Tennessee, November 1982].

The potential for environmental impacts from the proposed transportation of NFS wastes to ORNL; the proposed construction of a storage building for NFS CH TRU wastes; and the handling, transport, and storage of CH TRU, mixed CH TRU, and MOX wastes at ORNL are analyzed in this EA. Because complete chemical and physical characterization and quantification of NFS waste streams will not be available until the completion of D&D, a conservative, bounding approach was used to predict maximum potential impacts. Radiation exposures from transportation for routine and accident scenarios were estimated using the RADTRAN 4 model. The findings of this EA are as follows:

- New construction of a 50 ft × 80 ft × 12 ft storage building for NFS CH TRU waste would disturb a maximum of 3 acres of an undisturbed, partly wooded site at ORNL. This represents about 0.03% of the total acreage of the ORNL site. Except for a single plant species, found near the proposed site, vegetation and wildlife on the construction site are not unique in the ORNL environment. Land use for waste storage would be consistent with ORNL resource management plans.
- No threatened or endangered plant or animal species or critical habitat would be impacted by construction activities or facility operations.
- The proposed site for the new TRU waste storage facility is not located in the floodplain, and wetlands are not present.
- Proposed construction would not affect any sites on or eligible for the National Register of Historic places or any archaeological resources.
- The proposed construction would not alter surface drainage patterns, and neither surface water nor groundwater resources would be adversely affected by sediment in site runoff.
- Small quantities of nitrogen oxides, hydrocarbons, particulates, carbon monoxide, and volatile organic compounds would be generated by construction vehicles and equipment. Temporary, localized increases in ambient concentrations of these pollutants would occur at the construction site; however, no measurable effects on ambient air quality would be expected at other ORNL locations or off-site.
- Operation of construction vehicles and equipment would increase ambient sound levels at the construction site. Noise emissions would be sporadic and localized, and changes in ambient sound levels at other ORNL locations or off-site would not result.
- Solid and liquid wastes from construction would not be unique, and they would be managed in accordance with federal, state, and local regulations and in compliance with permits for existing ORNL storage and disposal facilities.
- Incident-free transport of NFS wastes to ORNL would expose the public to minimal radiological releases. The maximally exposed individual, who in this case would be hypothetically located 30 m from each shipment as it passes by, would receive about 0.003 mrem, (less than 0.002% of the 300-millirem average annual background dose received from natural sources). Occupational exposure during transport would be limited in accordance with DOT regulations.
- No fatalities from acute radiation exposure would result from the most serious NFS-to-ORNL transportation accident involving release of radioactive materials. The results of the RADTRAN 4 analysis indicate that the maximum latent cancer fatalities for the

affected population as a result of a transportation accident are 4.93×10^{-6}. This value is 0.002% of the national average lifetime risk of latent cancer fatalities from all causes (0.25).

- Incident-free operation of the storage facilities for waste would generate minimal atmospheric emissions, and would not generate effluents to surface water or groundwater, noise, or solid or liquid wastes. Therefore, air quality, land use, or ecological resources would be minimally affected by storage operations. Water resources would not be affected.
- Off-site populations would not be at increased risk for exposure to radiological hazards during incident-free on-site handling, transport, or storage. Annual worker exposure to radiation (on-site) is expected to be well below occupational dose limits established in DOE Order 5480.11.
- Maximum on-site worker exposure from the extreme risk accident involving handling and storage of NFS CH TRU waste would result in a committed effective dose equivalent of 11.7 rem. This dose would result in no immediate physical effects and the number of deaths expected would be less than one. This is less than 2% of the national average lifetime risk of latent cancer fatalities from all causes (0.25).
- The construction and operations workforce for the proposed action would consist of about 35 employees. Labor requirements would be met locally, and adverse impacts to the local economy would not result.
- Only minor cumulative impacts would result from a small incremental increase in exposure of workers during initial handling at ORNL and to the public as a result of radioactive shipments to and from ORNL. The proposed action would contribute a portion of the annual radiological dose received by waste management personnel. Exposure would be limited by ORNL and DOE practices in accordance with DOE Order 5480.11

1. INTRODUCTION

1.1 PROPOSED ACTION

The U.S. Department of Energy (DOE) proposes to receive and store a maximum of 5500 ft^3 (about 750 55-gal drums) of precharacterized CH TRU wastes and up to 150 canisters (about 2.5 inches in diameter by 6 inches in length) of MOX or PUO_2-UO_2 wastes from NFS of Erwin, Tennessee. Among the 5500 ft^3 of CH TRU waste could be "mixed" CH TRU wastes, which would be those containing one or more hazardous constituents regulated under the RCRA. The wastes would be transported by NFS to the ORNL in Oak Ridge, Tennessee (Fig. 1), and stored at ORNL until an appropriate disposal facility becomes available. Extended storage for the CH TRU wastes would be in a newly constructed, RCRA-permitted 80 ft × 50 ft × 12 ft building in Solid Waste Storage Area (SWSA) 7. The MOX canisters would be temporarily stored in Building 3100 and placed in extended storage in Building 3019. (For bounding estimates of the quantity of MOX wastes, see page 6-6.)

1.2 PURPOSE AND NEED

NFS, which produces nuclear reactor fuel for the U.S. government, has been in operation since 1958. The NFS operation is licensed (License No. SNM-124) by the Nuclear Regulatory Commission (NRC) to handle special nuclear materials and to conduct various activities related to nuclear fuel research, development, and production. An environmental impact appraisal related to plant operations was issued by the NRC in January 1978 (NRC 1978) and an environmental assessment (EA) for NRC license renewal was prepared in October 1986 (Docket No. 70-143; NRC 1986). The NFS TRU wastes and MOX wastes are the result of past and current decontamination and decommissioning (D&D) of former NFS MOX fuel fabrication facilities in Erwin, Tennessee. From 1965 until 1972, when they were placed on standby, these facilities operated under contract to the Atomic Energy Commission (DOE's predecessor agency).

In 1986, DOE contracted with NFS to inspect, process, store, and dispose of NFS TRU wastes that could not be disposed of at a commercially operated disposal site. The action addressed in this EA is proposed to satisfy this commitment.

1.3 SCOPE OF THIS ENVIRONMENTAL ASSESSMENT

This EA has been prepared in accordance with the National Environmental Policy Act of 1969 (NEPA), as amended, the Council on Environmental Quality regulations for implementing NEPA (40 CFR 1500-1508), and DOE regulations establishing DOE's NEPA implementing procedures (57 FR 15122, April 24, 1992 to be codified as 10 CFR 1021).

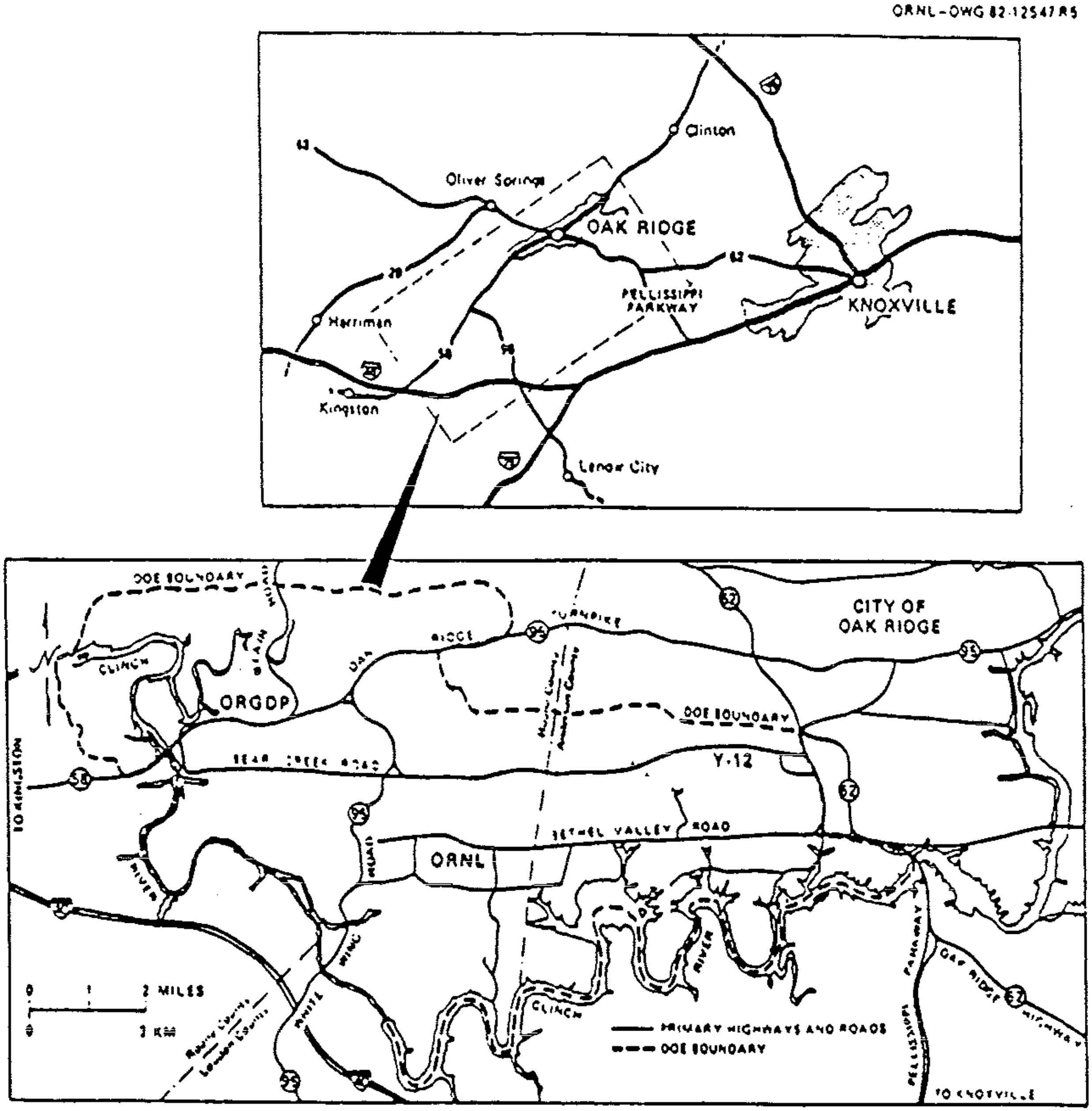

Fig. 1. General location of the Oak Ridge National Laboratory in Oak Ridge, Tennessee.

This EA analyzes the potential environmental impacts at ORNL of on-site (ORNL) transport, handling, and storage. In addition this EA analyzes NFS-contracted shipments to ORNL. NFS would have sole responsibility for shipping wastes directly to ORNL or to ORNL via the Scientific Ecology Group, Inc. (SEG) facility in Oak Ridge. Because detailed information regarding waste characteristics and quantities will not be available until D&D is completed, the analysis assumes conservative upper limits on chemical and radiological constituents and quantities to bound potential impacts. For example, the distribution of the maximum expected quantity (30 kg) of Pu to be received from NFS between CH TRU wastes or MOX waste is unknown. Therefore, for the risk analysis of the transportation of CH TRU wastes and mixed oxide wastes to ORNL, the 30 kg of Pu was assumed to be present in both the CH TRU waste shipments and the MOX shipments. This assumed maximum quantity of Pu used in the analyses of waste shipments would exceed any actual quantity of Pu in the proposed shipments.

During the preparation of this EA, DOE consulted the Tennessee Wildlife Resources Agency, the State Historic Preservation Officer, and the U.S. Department of Interior, Fish and Wildlife Service. Correspondence is provided in Appendix A.

2. ALTERNATIVES

2.1 PREFERRED ALTERNATIVE

DOE's preferred alternative comprises the same actions as those described in Section 1.1 Proposed Action. DOE would receive, take possession of and store a maximum of 5500 ft^3 (about 750 55-gallon drums) of precharacterized CH TRU wastes and up to 150 canisters (about 2.5 inches in diameter and 6 inches in length) of MOX wastes from NFS of Erwin, Tennessee. Among the precharacterized CH TRU wastes could be mixed CH TRU wastes (i.e., TRU wastes containing one or more hazardous constituents regulated under RCRA). The mixed CH TRU waste would be stored apart in the proposed facility from those CH TRU wastes not containing hazardous constituents. The wastes would be transported by NFS to ORNL in Oak Ridge, Tennessee. At NFS's discretion, shipments would either be directly to ORNL or via SEG where additional compaction of wastes would take place (see Sect. 6). Extended storage for all but the MOX wastes would be in the proposed new, RCRA-permitted, pre-engineered 80 ft x 50 ft x 12 ft building in SWSA 7, the construction and operations of which would be part of this alternative. MOX wastes would be temporarily stored in Building 3100 and placed in extended storage in Building 3019, the Radiochemical Development Facility, ORNL.

2.2 NO ACTION

Under the no action alternative, DOE would not accept NFS wastes for extended storage. NFS currently possesses a NRC license and State of Tennessee permits which require shipment of all D&D wastes off-site to approved facilities. Because there are no non-DOE facilities approved for extended storage of TRU and MOX wastes, the no action alternative would require modification of NFS's NRC license and State permits to allow for storage of the wastes on-site.

Assuming such modifications were possible, the environmental impacts associated with extended storage at NFS would be similar to impacts associated with extended storage at ORNL. An approved storage facility at NFS would be required to meet the same or similar regulatory requirements for CH TRU, mixed CH TRU, and MOX waste storage as would the ORNL storage facilities under the preferred alternative. These requirements are designed to reduce or eliminate potential environmental effects associated with normal storage and accidents. The requirements include: characterization of waste in each waste container; waste acceptance criteria that control criticality and hazardous constituent content; prevention of gaseous build-up in containers; prevention of radioactive and hazardous emissions to the atmosphere or other media; RCRA facility requirements; and, because of the waste's fissile content, additional security requirements for the storage of MOX wastes.

Under this no action alternative, there would be no potential impacts associated with shipment of the wastes to ORNL. (For analysis of the impacts associated with shipment to

ORNL, please see Sect. 6.) The potential impacts of storage of the wastes at ORNL, including the impacts from construction and operation of the new RCRA-permitted storage building, would not occur. Extended storage of the wastes at NFS is not consistent with DOE's contractual commitment to NFS.

2.3 STORAGE AT OTHER DOE FACILITIES

There are no approved non-DOE facilities for the extended storage of TRU waste. DOE considered the alternative of transporting NFS wastes to DOE facilities at Hanford, Washington, Idaho National Engineering Laboratory (INEL) near Idaho Falls, Idaho and the Savannah River Site (SRS) near Aiken, South Carolina.

The HIGHWAY model (Joy 1990) was used to define the potential routes for transportation of NFS wastes to DOE facilities at Hanford, INEL, and SRS. The model incorporates several types of constraints established by federal, state, and local requirements, including constraints on truck use, preferred routes for radioactive waste transport, avoidance of ferry crossings, and nonintersecting interstate access.

The Erwin-to-Hanford route would be 2,613 miles long, or 17 times longer than the Erwin-to-Oak Ridge route, and would take an approximate road time of 53 hours, 14 minutes. Most of the route would consist of limited access, multilane highway (2602 miles). Major population centers along the way would be: Knoxville and Nashville, Tennessee; St. Louis, Independence, and Kansas City, Missouri; Kansas City and Topeka, Kansas; Denver, Colorado; Cheyenne and Laramie, Wyoming; Ogden, Utah; and Boise, Idaho. The Erwin-to-INEL route would be 2200 miles long or 15 times longer than the Erwin-to-Oak Ridge route, and would take an approximate road time of 45 hours and 22 minutes. This route, too, would be mostly limited access, multilane highway. It would follow the same route as the Erwin-to-Hanford route, passing through the same major population centers to Ogden, Utah from where it would go to Pocatello and Idaho Falls, Idaho. The Erwin-to-SRS route would be 405 miles long, or about 3 times longer than the Erwin-to Oak Ridge route, and would take approximately 8.5 hours to travel. Three hundred seventy-two miles of this route would be limited access, multilane highway with two major population centers before arriving at Aiken: Asheville, North Carolina and Columbia, South Carolina.

The road distance between Erwin and Oak Ridge is approximately 150 miles. The proposed route passes through only one metropolitan area, Knoxville, Tennessee. Based on the above distance and population center information and keeping all other assumptions regarding waste handling, packaging, and transport means identical to the Erwin-to-Oak Ridge scenario, it can be reasonably inferred that the total public radiological exposure from incident-free transportation of NFS wastes to either of the three alternate locations would be greater than for transport to ORNL. In addition, increased distance would increase the probability of accidents along the routes to the alternate locations. This, in turn, would incrementally increase the corresponding risks associated with transport accidents.

Impacts associated with handling and storage of NFS wastes at the alternate locations would be similar to those expected at ORNL because of the similarities of waste management activities and facilities at the four DOE sites.

Because of the potential increased impacts from the extended shipping routes, and no other clear advantages of the alternative DOE sites, they are not preferred.

3. DESCRIPTION OF THE PREFERRED ALTERNATIVE

3.1 HANDLING AND STORAGE OF CH TRU WASTES

Transuranic radioactive waste is defined in DOE Order 5820.2A as, "Without regard to source or form, waste that is contaminated with alpha-emitting transuranium radionuclides with half-lives greater than 20 years and concentrations greater than 100 nanocuries (Nci) per gram (g) at the time of assay." Contact-handled transuranic (CH TRU) waste is defined as TRU waste whose external dose rate does not exceed 200 mrem per hour (Ibid.). Further, CH TRU waste is designated as "mixed" if it contains chemical elements or compounds designated by the EPA as hazardous (40 CFR Part 261, Subparts C and D). Metallic mercury is known to be present in the NFS CH TRU wastes in concentrations less than the RCRA regulatory threshold. Based on official inspections conducted by the Tennessee Department of Health and Environment (now the Tennessee Department of Conservation), no hazardous solvents are known to be present in the wastes (Hale 1991a and b). Preliminary laboratory analyses of NFS wastes indicated the presence of cadmium and barium; polychlorinated biphenyls (PCBs) are present at concentrations near regulatory threshold values. If final characterization indicates that some NFS CH TRU wastes contain a listed hazardous waste or exhibit a hazardous characteristic, those wastes would be managed as mixed wastes.

Gloveboxes and equipment comprise most of the NFS CH TRU wastes. Because of the age of the NFS wastes, radioactive decay of plutonium has occurred, and the CH TRU wastes contain americium, a daughter product of plutonium decay. Americium represents less than 1% of the wastes' plutonium inventory; its packaging will be appropriate for contact handling.

The residual radioactive content of CH TRU, mixed CH TRU and MOX wastes would be reduced through remote decontamination techniques at NFS. CH TRU wastes, in some instances, would be reduced in volume by a high capacity shear/baler; compacted into 16 × 16 in. square "pucks" of varying thicknesses (about 4 or 5 in.); assayed; and packaged in stainless steel drums having a 90 mil polyethylene liner. Respirable fines in the CH TRU wastes would be stabilized by mixing them with a grout material (e.g., cement). Wastes containing hazardous constituents would be segregated and handled and packaged separately. Handling and packaging of mixed wastes would not differ from similar activities for non-mixed wastes, with the exception of differences in labeling, which would indicate the presence of mixed wastes. Fissile content of the waste packages would be limited to a critically safe amount for all configurations. The potential for an explosion due to gaseous buildup from radiolysis of moisture and other waste constituents would be essentially eliminated by the use of high-efficiency particulate air (HEPA) vent filters in the drum heads. The drums would be placed in NRC-approved containers and loaded onto trucks for transport. A DOE representative would be present at NFS to assure that these procedures are performed as described.

The shipment scenarios for NFS CH TRU wastes are shown in Fig. 2. Mixed waste would travel directly to ORNL; non-mixed waste would travel either directly to ORNL or to SEG for further compaction. The SEG, a subsidiary of Westinghouse, is licensed by NRC

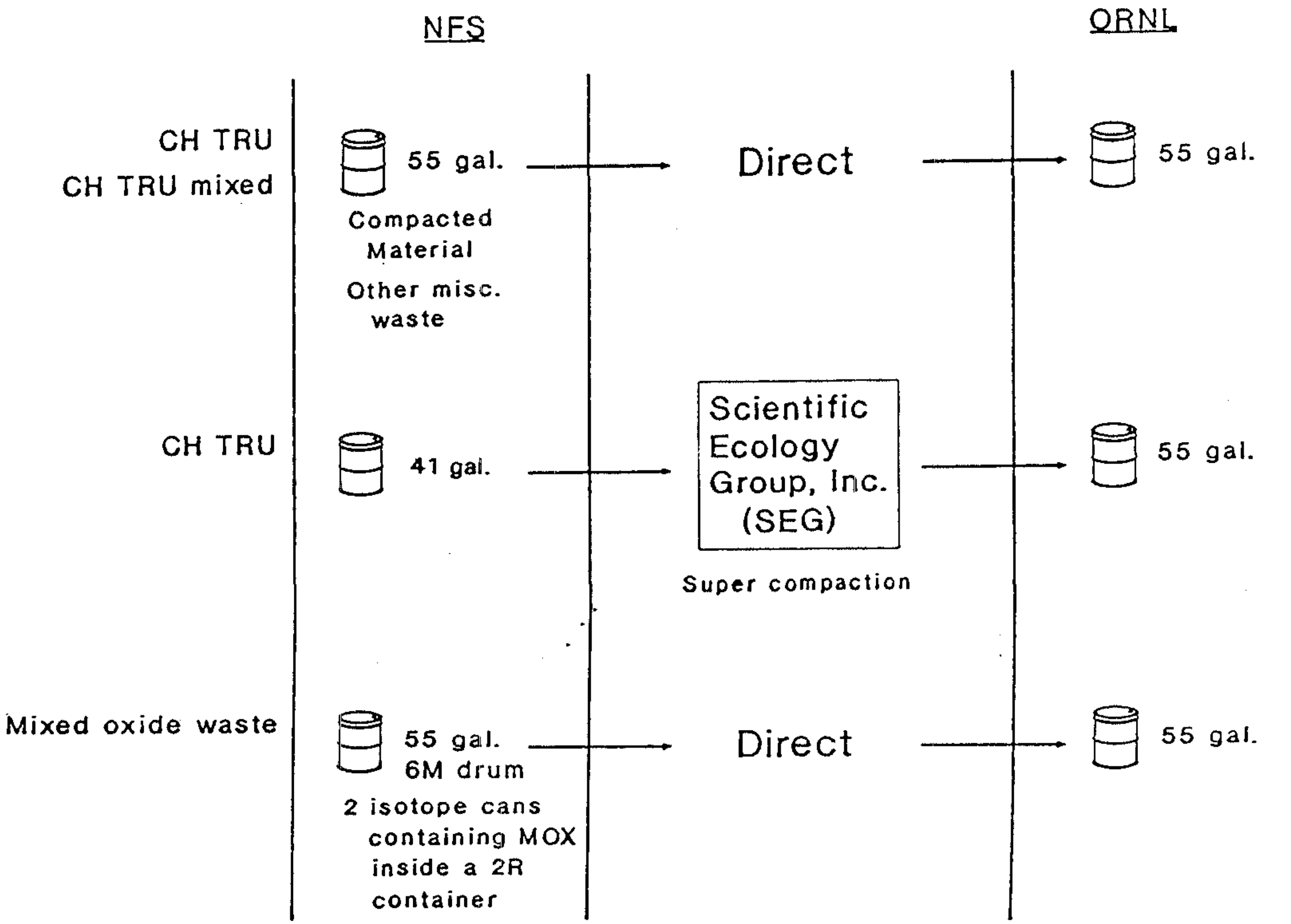

Fig. 2. Transuranic waste shipment scenarios from Nuclear Fuel Services to Oak Ridge National Laboratory and Scientific Ecology Group, Inc.

(No. R-73008-E94), and is a major processor of commercial low-level radioactive waste in the United States. Waste treatment operations are conducted under a controlled environment at SEG including the use of HEPA filters. At SEG, a 520-ton drum compactor would be used to further reduce the volume of waste. After drum compaction, SEG would overpack the compressed drums into 55-gal stainless steel drums for shipment in a NRC-licensed package to ORNL. A DOE representative would also oversee procedures at SEG related to NFS waste handling and transport.

NFS CH TRU wastes received at ORNL would be temporarily stored in the Bldg. 7879 Staging Facility (Fig. 3), which already provides short-term storage for ORNL CH TRU and low-level wastes. Single pallets, each containing 4 drums of NFS CH TRU wastes, would be transported by forklift to the WEAF, Bldg. 7824 (Fig. 3), for nondestructive assay and examination to verify compliance with ORNL CH TRU waste acceptance criteria [Martin Marietta Energy Systems, Inc. (Energy Systems) 1991a]. ORNL waste acceptance criteria are similar to those for the DOE Waste Isolation Pilot Plant (WIPP) near Carlsbad, New Mexico (DOE 1989). Restrictions are placed on the type of container; the degree of immobilization of the waste; and require the absence of liquids, pyrophorics, explosives, or compressed gases; specific radioactivity levels; criticality potential; and hazardous constituents. Constituents of the waste that are designated as hazardous under 40 CFR Part 261, Subparts C and D are permitted, while those listed under the Toxic Substances Control Act (TSCA) are not permitted to be stored in ORNL TRU waste facilities. Nonconforming wastes would be returned to NFS or SEG to correct the nonconformity. Drums that meet waste acceptance criteria would be returned to Bldg. 7879 for temporary storage until a new NFS CH TRU waste storage facility is constructed (see Sect. 3.3). CH TRU wastes would be transferred to the proposed new facility for extended storage after the facility is operational.

All waste handling and storage operations associated with the proposed action would be carried out in accordance with all applicable requirements. These requirements include DOE Order 5480.4, *Environmental Protection, Safety, and Health Protection Standards*; DOE Order 5480.10, *Contractor Industrial Hygiene Program*; DOE Order 5483.1A, *Occupational Safety and Health Program for DOE Contractor Employees at Government-Owned Contractor-Operated Facilities*; DOE Order 5480.11, *Radiation Protection for Occupational Workers*; and DOE Order 5480.1B, *Environment, Safety, and Health Program for DOE Operations*.

3.2 HANDLING AND STORAGE OF MIXED OXIDE (MOX) WASTES

At NFS, MOX wastes would be assayed, packaged in DOT-approved containers (see Sect. 6.1), loaded into closed trucks, and transported directly to ORNL. Containers would be unloaded and temporarily stored in a security vault located in Bldg. 3100. Containers would be transported by truck to WEAF for examination to verify compliance with ORNL waste acceptance criteria (Energy Systems 1991a). Constituents that are designated as hazardous under 40 CFR Part 261, Subparts C and D (RCRA wastes) and those listed under TSCA are both prohibited in the NFS MOX wastes because Building 3100 and Building 3019 are not

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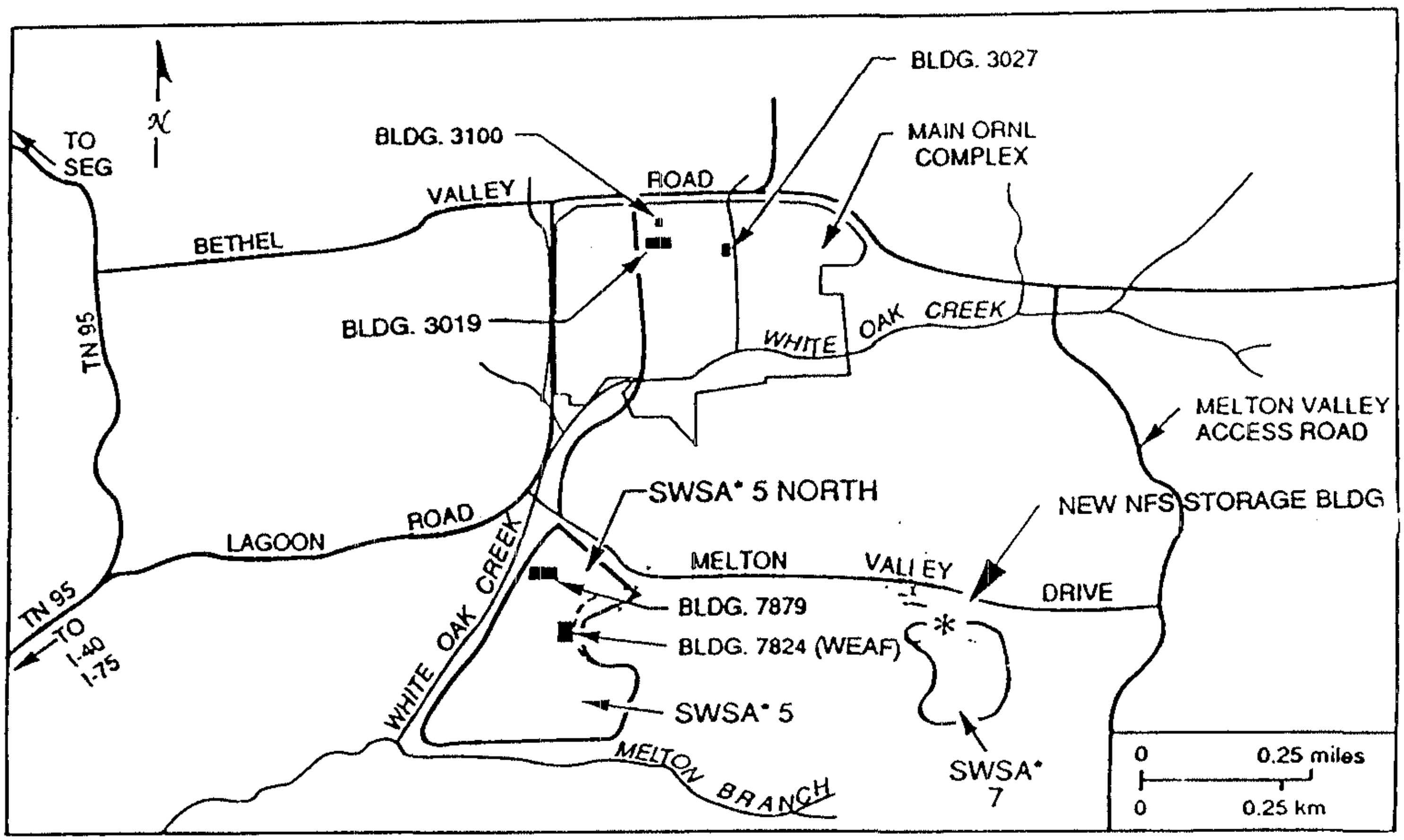

Fig. 3. Location of transuranic waste storage buildings and solid waste storage areas at Oak Ridge National Laboratory.

RCRA- or TSCA-permitted storage facilities. Waste acceptance criteria for criticality limit fissile content and geometry so that the contents of the packages would be safe in any configuration. Conforming MOX wastes would be returned to temporary storage in the vault in Building 3100. Nonconforming waste would be returned to NFS to correct the nonconformity.

NFS MOX waste subsequently would be transferred from the storage vault to the Radiochemical Development Facility, Bldg. 3019 (Fig. 3), which is currently used to store U-233. Storage of MOX waste containers would be in existing monolithic concrete structures ("wells") having openings of about 4 in. (10.2 cm) in diameter and approximately 15 ft deep. The occupied wells currently in use are physically separate from the empty wells where the MOX waste will be stored and no interaction does or would occur between the presently occupied and proposed to be occupied wells.

3.3 CONSTRUCTION OF NFS CH TRU WASTE STORAGE BUILDING

A 3-acre site in the SWSA-7 area (see Fig. 3) which meets RCRA sitting standards under 40 CFR 264.18 and DOE Order 5820.2A would be developed for the storage of CH TRU waste. The facility would include a 250-ft asphalt-paved access road and a single-story, prefabricated metal building (about 50 ft × 80 ft × 12 ft) built to RCRA specifications and constructed on the site to accommodate mixed TRU waste. The building, which would be vented through HEPA filters, would be unoccupied except during maintenance and/or inspection. Construction would involve site clearing and grading, pouring of concrete footings and a slab, and erection of the building. The entire perimeter of the concrete pad would have 3-inch to 6-inch curbing for spill control and a minimum of two pumpable floor sumps (with covers) to serve as a liquid collection system in the event floor washing is needed and to contain leaks, spills, and a 10-minute discharge from the building's fire protection system. To ensure the integrity of the floor sumps, they will be leak tested prior to operation of the proposed facility, according to all applicable RCRA requirements given in 40 CFR 264.191, and annually thereafter.

It is anticipated that construction would be completed in 6 to 8 months and would require a maximum of 15 workers. Labor would be provided by an ORNL construction subcontractor.

In order to provide a safe environment for the workers during this phase of the proposed action, construction activities will be carried out in accordance with DOE Order 5480.9, *Construction Safety and Health Program*, and ORNL guidance in the *ORNL Environmental Protection Manual*.

4. AFFECTED ENVIRONMENT AT OAK RIDGE NATIONAL LABORATORY

4.1 DESCRIPTION OF OAK RIDGE NATIONAL LABORATORY

ORNL, one of three industrial complexes located on the DOE Oak Ridge Reservation (ORR), is located in a rural area of hills and valleys approximately 13 km (8 miles) southwest of residential areas of Oak Ridge in eastern Tennessee (Fig. 1). A detailed description of the ORNL environment and functions is given in Boyle et al. (1982). ORR covers 14,245 ha (35,200 acres) and is bounded by the Clinch River on its eastern, southern, and western borders. Residential areas of Oak Ridge are adjacent to the northern border of the ORR. ORNL is centrally located on the southern border of the ORR. Its principal research and development facilities consist of nuclear research reactors; particle accelerators; hot cells; engineering process development facilities; and research facilities in physics, chemistry, and the environmental sciences. There are currently about 5500 workers at ORNL and 2300 guest assignments. The 1990 estimated population within 8 km (5 miles) of ORNL is about 5000 and the total population within 80 km (50 miles) of the site is 950,000.

ORNL and its accompanying buffer zone, encompassing 3550 ha (8771 acres), lie almost entirely within the 17-km^2 (6.5-mile^2) White Oak Creek drainage basin. The main ORNL complex area is located in Bethel Valley (Fig. 1), which runs approximately in a northeast-southwest direction. Although the valley floor is highly developed within the central site area, the surrounding terrain is wooded. White Oak Creek passes to the south of the developed area and leaves the valley through a gap in Haw Ridge into Melton Valley.

The average annual effective dose equivalent to an individual in the United States is approximately 360 mrem. Of this total, exposures to radon and its progeny account for about 200 mrem, exposures to other natural sources (cosmic and terrestrial radiation) account for about 100 mrem, medical exposures (x-rays and nuclear medicine) account for about 50 mrem, and all other sources (consumer products, occupational, nuclear fuel cycle) account for between 5 and 10 mrem (NCRP 1987).

According to the 1990 Oak Ridge Reservation Environmental Report (ORRER 1991), the average annual effective dose equivalent from all sources of radiation to an individual residing in Tennessee is approximately 316 mrem which is 44 mrem less than the national average. A typical, annual, 50-year committed, effective dose equivalent[1] to the maximally exposed individual due to gaseous and liquid effluents from ORNL is about 0.5 mrem. A typical annual collective effective dose equivalent to the population living within 50 miles of ORNL due to gaseous and liquid effluents from ORNL is about 4 person-rem.

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[1]The committed effective dose equivalent is the sum of doses of radiation to tissue and organs as a result of radionuclide deposition in those tissues.

4.2 EXISTING TRU WASTE MANAGEMENT FACILITIES

Existing ORNL CH TRU waste management facilities include WEAF and Bldg. 7879, which are located in SWSA-5 in Melton Valley on the south side of Haw Ridge (see Fig. 3). Primary access to these areas is via Lagoon Road and Melton Valley Drive.

Bldgs. 3100 and 3019, where MOX waste would be placed for temporary or extended storage, are security vaults and concrete-shielded structures, respectively, and are located at the intersection of Third Street and Hillside Avenue within the main fenced ORNL complex (Fig. 3). Bldg. 3019, which is currently the national repository for U-233, is rated as a Category I (as defined in DOE Order 5633.3) facility for security and safeguard requirements of nuclear materials.

Average radiation exposures to workers currently are about 100 mrem/year at WEAF and Bldg. 7879, and up to 400 mrem/year at Bldg. 3019. These exposures are less than 10% of the annual occupational dose limit (5 rem) established by DOE Order 5480.11.

4.3 PROPOSED SITE FOR NFS CH TRU WASTE STORAGE

The new NFS CH TRU Waste Storage Facility is proposed to be built in the SWSA-7 area (Fig. 3). The proposed NFS facility site is partly wooded and is located near other disturbed areas, some of which are already used for waste storage. The facility and access driveway would occupy about 3 acres in an area which is tree-covered, unused and providing a buffer sufficient to allow for further development in the vicinity. The terrain is generally flat and would require minimal alteration for facility construction. An inventory of ORNL waste management areas indicates no active or inactive waste disposal areas at the proposed site (Chance 1986). Results of a 1991 soil survey at the proposed site indicated that radioactive contamination was not present (Jeffers 1991). There are no prominent surface water features or wetlands at the proposed site, and it is not within the 500-year floodplain (Fitzpatrick, 1982). Analysis of water retained in two augured holes on site indicated no radioactive constituents (Lee 1991). Existing air quality at ORNL is generally good and is in attainment with National Ambient Air Quality Standards for all criteria pollutants. Federal- or state-listed threatened and endangered animal species and critical habitats are not present in the immediate area of the proposed site (see Appendix A). A state-listed threatened lily species (either *Lilium Canadense* or *Lilium Michiganense*) is located about 40 ft west of the 3-acre site in a low marshy area (oral communication). There are no listed historical or archaeological resources in the SWSA-7 area (see Appendix A).

5. ENVIRONMENTAL CONSEQUENCES OF THE PROPOSED ACTION ON-SITE

5.1 CONSTRUCTION AND OPERATION OF NEW NFS WASTE CH TRU STORAGE FACILITY

The new NFS CH TRU waste storage building would conform to the existing land use in the SWSA-7 area. A maximum of 3 acres of natural vegetation could be disturbed for the building site and the access road. This represents about 0.03% of the total acreage of the ORNL site. With the exception of the state-listed threatened lily (Section 4.3), the vegetation and wildlife near SWSA-7 are commonly found on ORNL property and ORR. During grading operations and construction, precautions would be taken to protect the lily and its habitat which are located about 40 ft. west of the 3-acre site. This area would be enclosed and flagged to prevent equipment and workers from encroaching on it. Displaced wildlife would be easily assimilated by similar habitat nearby. According to the U.S. Fish and Wildlife Service and the Tennessee Wildlife Resources Agency, neither federal- or state-listed threatened and endangered animal species nor critical habitat would be affected by new construction (Appendix A).

Emissions of nitrogen oxides, hydrocarbons, carbon monoxide, particulates, and volatile organic compounds would result from construction vehicle operation. Quantities emitted would be small, temporary, and localized. Therefore, measurable effects on ambient air quality would not be expected.

Construction vehicles and equipment would generate sporadic noise, which would increase ambient sound levels for short periods of time. Construction worker safety would be assured by compliance with all DOE requirements for construction safety. Because of the distance of SWSA-7 from off-site receptors, changes in ambient off-site noise would not result. Wildlife could occasionally be startled by noise, but no effects on populations would be expected.

The new facility is proposed to be sited in a partly wooded area away from surface water resources. Because a minimum of grading would be necessary, surface drainage patterns would not be altered. With alterations of terrain being performed above the water table, groundwater would not be affected. No consumptive use of either surface water or groundwater would be required during construction.

No soil is expected to be removed from the 3-acre site as a result of grading (O. A. Rogers, ORNL, personal communication to A. W. Campbell, ORNL, Sept. 30, 1991). Best management practices which conform to applicable federal, state or local erosion protection standards, such as the use of erosion fences and rip-rap, would be implemented to minimize erosion and sediment-laden runoff. Accidental spills of construction liquids may cause minor contamination of localized areas of soil. Rapid spill emergency response would minimize impacts to groundwater. Any soil contaminated by a spill would be collected and disposed of at appropriate ORNL waste disposal facilities in accordance with the ORNL Spill Prevention, Control, Countermeasures and Contingency Plan (September 1985).

Construction labor drawn would be from the local labor pool; therefore, adverse socioeconomic impacts would not result.

Facility operation would involve unloading and emplacement of waste drums on pallets up to three drums high using a fork truck. Wastewater effluents, or solid/liquid wastes would not be generated during routine operation of the storage facility. The building would be vented with HEPA filters to remove 99.9999% of airborne radionuclide-containing particulates. A monitor would operate continuously to detect the presence of alpha, beta, and gamma radioactivity. An alarm would sound to alert workers to airborne contamination. Monitoring for environmental compliance and security would include regular visual inspections of drums and facility walk-throughs.

Floor sumps and curbing would serve as a liquid collection system for any leaks or spills. Thus, off-site contamination of groundwater or surface water would not be expected and flora and fauna would not be adversely affected.

5.2 HANDLING AND STORAGE OF NFS CH TRU WASTES

5.2.1 Routine Operations

The primary environmental concern during handling and storage of NFS CH TRU waste is occupational health and safety. Preliminary characterization of NFS CH TRU wastes indicates that fewer than 5 drums may contain mixed CH TRU wastes. Preliminary results indicate the presence of small quantities of cadmium, mercury and other regulated metals. Because of the projected small quantities and the form of the hazardous constituents, risks to workers from handling and storage of mixed CH TRU wastes are expected to be similar to risks associated with handling and storage of CH TRU wastes. Workers would be exposed to radiation when handling drums and when present in storage areas and buildings. Each of the 16 to 20 ORNL workers who would be involved in handling NFS CH TRU wastes typically would receive about 100 mrem/year in conducting his/her normal duties. ORNL policy limits exposure to no more than 2 rem/year for each employee. Exposures are also limited by application of the as low as reasonably achievable (ALARA) process (see Sect. 5.4). ORNL work crews are assigned to the waste operations group on a rotating basis and work with CH and RH TRU wastes and LLW. When personnel are not assigned to the waste operations group, they work within other areas of ORNL and are subject to radiation exposure at those areas; therefore, the average annual occupational dose a worker receives is not due solely to TRU waste operations. At ORNL in 1990, the average occupational dose to waste operation workers was 22 mrem; the maximum occupational dose received by an individual worker was 149 mrem and the minimum was 0 mrem (Setaro 1991). This is well below DOE's occupational radiation dose limit of 5 rem per year established in DOE Order 5480.11. Occupational exposure from handling NFS CH TRU waste is expected to be similar to that from existing operations. No off-site person would be close enough to the ORNL TRU waste storage facilities to receive any measurable radiation dose from normal operations or accidents involving the storage of NFS wastes (Energy Systems 1991b).

5.2.2 Accidents

Accidents, such as the puncture of a CH TRU waste package with a fork lift, could result in a breach of the waste package and release of radioactivity resulting in accidental exposure of workers. Accidental releases have been evaluated in safety analyses prepared for the WEAF and Bldg. 7879. Since the proposed storage facility would be a replication of Building 7879, the safety analysis for Building 7879 was used to examine the potential consequences of an accident at the proposed facility. The safety assessment has been reviewed to ensure that it adequately addresses the types of materials and procedures that would be encountered in handling and storing the NFS waste. CH TRU wastes from NFS would be similar to ORNL CH TRU wastes and would not be expected to pose any unique hazards for the facilities. No changes in emergency response plans would be expected.

The primary hazard identified in the safety study for Bldg. 7879 (Energy Systems 1991b) is the release of radioactive particulates. A release scenario would be an operator error or forklift malfunction which results in drums of CH TRU wastes being dropped. For this scenario, it was conservatively assumed that four 55-gal drums, each containing the maximum activity of the dose equivalent of 1000 Ci of Pu-239, fall and rupture. (This activity far exceeds the expected activity for NFS CH TRU waste.)

The radiological assessment of this release scenario in the safety study concludes that a maximum 50-year committed effective dose equivalent of 15.6 rem would be received by the forklift operator and a maximum of 11.7 rem would be received by an individual at 300 ft from the accident, the distance from Bldg. 7879 to the nearest inhabited building. The model used to determine the operator dose assumes that the operator is aware that an accident has occurred and immediately leaves the area, resulting in a relatively short exposure time. On the other hand, the model used to estimate the nearby and off-site dose conservatively assumes that the exposed person is unaware of the accident and does not evacuate the area. Although this person is further from the source, his exposure time is longer (the time that it takes the cloud to pass by) than that of the operator, but the overall concentration of radioactivity that he is exposed to is less than that of the operator. The latent cancer fatalities (LCFs) expected from a given occupational dose can be calculated by multiplying the dose by 4×10^{-4} deaths per person-rem [ICRP publication 60 (1991) based on BEIR V report (NAS 1990)]. Therefore, the chance of incurring an LCF for each individual worker who is 300 ft from the facility following an accident, would be 0.0047 or about 5 per 1000 and for the operator, 0.006. The collective risk from a 0.19 person-rem dose at ORNL would be 0.4. Based on an estimated 0.005 person-rem accident dose to a population of 30,000 in the Y-12 Plant/Oak Ridge area, the collective risk would be 0.06. The overall number of deaths expected from this bounding (and very conservative) scenario would be less than one.

5.3 HANDLING AND STORAGE OF NFS MOX WASTE

5.3.1 Routine Operations

As with the CH TRU waste, the primary environmental concern during the handling and storage of NFS MOX waste is occupational health and safety. Occupational exposure has been evaluated in the Safety Analysis Report (SAR) for Building 3019. Findings of the SAR were used to estimate worker exposure from the handling and storage of NFS MOX waste. Workers would be exposed to radiation when handling the MOX waste containers and when present in the waste storage areas of the buildings. Each of the ORNL workers who would be involved in handling NFS MOX wastes typically would receive up to about 400 mrem/year in conducting his/her normal duties. ORNL policy limits exposure to no more than 2 rem/year for each employee, which is well below DOE's occupational radiation dose limit of 5 rem/year established in DOE Order 5480.11. Exposures are further limited by application of the ALARA process. No off-site person would be close enough to the MOX waste to receive a radiation dose from normal operations. A safeguards and security assessment of the handling and storage of NFS MOX waste was completed in November 1990.

5.3.2 Accidents

Accidents during handling could result in a breach of the MOX waste containers and exposure of workers. Based on the accident scenarios analyzed in the Building 3019 SAR, the maximally exposed individual worker would receive a dose of 1.5 rem as a result of an accident handling MOX waste from NFS. The scenario of breaching of four MOX waste containers simultaneously due to an earthquake was determined to be the reasonably foreseeable maximum accident for handling the MOX waste containers. In order to constrain the potential dose from four MOX containers to the value in the SAR of 1.5 rem to operating personnel, a waste acceptance criteria limit of 215 grams ^{239}Pu, or the inhalation dose equivalent, was imposed on each container of MOX waste from NFS. Since Building 3019 is operated with a primary and secondary containment system, the off-site consequences of any accident are minimized. The Building 3019 SAR results for exposure at the site boundary due to the postulated accident is 0.33 Rem.

6. ENVIRONMENTAL CONSEQUENCES OF OFF-SITE TRANSPORTATION OF NFS WASTES

6.1 TRANSPORTATION MODES

The shipment scenarios used in this analysis are summarized in Table 1. CH TRU wastes and MOX waste would be packaged in accordance with the requirements of 49 CFR 173 and 10 CFR 71. CH TRU waste packages would be NRC-approved containers that have current NRC Certificates of Compliance; examples of these include the "B-2" (NRC No. 6144), the "Supertiger" (NRC No. 6400), and the TRUPACT II (NRC No. 9218). Each B-2 package is about 4.5 × 7.5 × 12 ft in size; fifteen 55-gal drums would be loaded into the B-2. One B-2 can be loaded onto a truck for shipment. The Supertiger is about 8 × 8 × 20 ft; up to twenty-one 55-gal drums are loaded into the Supertiger for transport, and 1 Supertiger is loaded per truck. The TRUPACT II is a right circular cylinder with outside dimensions of about 94 in. diameter and 122 in. in height. Each TRUPACT II can be loaded with 14 drums, and 3 TRUPACT IIs can be loaded per truck. Mixed oxide waste would be contained in DOT 6M packages (average 5 packages per shipment, 2 canisters per package) a maximum of 2 kg Pu per shipment and shipped in enclosed trucks having appropriate safeguards for the material.

6.2 TRANSPORTATION ROUTES

Shipments of wastes would follow the transportation routes shown in Fig. 4. Shipments would originate in Erwin and proceed (1) directly to ORNL for storage or (2) from Erwin to SEG for compaction, then from SEG to ORNL for storage. Selection of routes was based on the maximum reasonable utilization of the interstate highway system, as prescribed by DOT and DOE regulations governing the transport of hazardous materials, and the use of bypasses around major cities (e.g., the Interstate 640 bypass around Knoxville), unless an alternate route is dictated by state or local regulations. The selection criteria are consistent with those used for "highway route controlled quantities" of radioactive materials, as defined in 49 CFR 77.825.

Direct transport of CH TRU mixed and MOX wastes to ORNL would begin at the NFS facility in Erwin and would use a local road to access U.S. Route 19W/23 to Interstate 181 at Johnson City, Tennessee. Interstate 181 would be followed for 15 miles to Gray, Tennessee, at Interstate 81. Interstate 81 would be followed to Interstate 40 near the Dandridge exit. Interstate 40 would be travelled to the Interstate 640, which bypasses downtown Knoxville and rejoins Interstate 40 west of Knoxville. Continuing westward, trucks would exit Interstate 40 at State Route 95 near Lenoir City. State Route 95 would then be followed north for 3 miles to Lagoon Road, which turns into Melton Valley Drive for the final mile to Solid Waste

Table 1. Scenarios for shipment of Nuclear Fuel Services wastes from Erwin, Tennessee, to Oak Ridge National Laboratory

	Case	Package	Drums/Shipment	No. Truck Shipments[a]
Scenario 1	A	B-2 Cask or TRUPACT II[b,d]	15	50
Waste shipped directly to ORNL	B	Supertiger[b]	21	1[c]
Scenario 2	A	B-2 Cask or TRUPACT II[b,d]	15	100
Waste shipped to ORNL via SEG	B	B-2 Cask or TRUPACT II[b,d]	7.5	100
Scenario 3	—	DOT-6M	5	15

[a]Total inventory was assumed to be divided evenly among shipments. The average inventory is approximately 40 g Pu/drum for Scenarios 1A and 2B; 20 g Pu/drum for Scenario 2A; and 2000 g Pu/shipment for Scenario 3.

[b]NRC Certificate of Compliance numbers are: Supertiger=6400; B-2 Cask=6144, and TRUPACT II = 9218. These types of containers will transport all CH TRU wastes, both mixed and nonhazardous.

[c]Extreme risk scenario using 21 drums (one Supertiger) per single truck with 128 g Pu/drum (2688 g Pu total), which is the maximum waste acceptance limit at ORNL.

[d]If TRUPACT II is used there will be more drums per shipment and fewer shipments.

Storage Area-5 (SWSA-5) at ORNL. This route would be 151 miles long and would have an approximate travel time of at least 3 hours.

Indirect shipments of CH TRU waste to ORNL via SEG would follow the same routes for direct shipments except that trucks would continue past the State Route 95 exit to about 5 miles east of Kingston, where they would exit onto State Route 58 and proceed to the SEG facility. SEG is located on Bear Creek Road near the Clinch River, about 1 mile southwest of the Oak Ridge K-25 Site (see Fig. 4). This first segment of the NFS-SEG-ORNL route would be 159 miles long and would have an approximate travel time of at least 3 hours.

For the second segment of the NFS-SEG-ORNL route, trucks would proceed east on Bear Creek Road for 3 miles to State Route 95, then south for 3 miles to Lagoon Road and Melton Valley Drive, for the final mile to SWSA-5. This route would be 7 miles long and would require at least 15 minutes to travel.

The terrain along all routes is moderately hilly. The interstate routes pass through the outskirts of one major city, Knoxville, Tennessee, and cross three rivers: the Holston, Clinch,

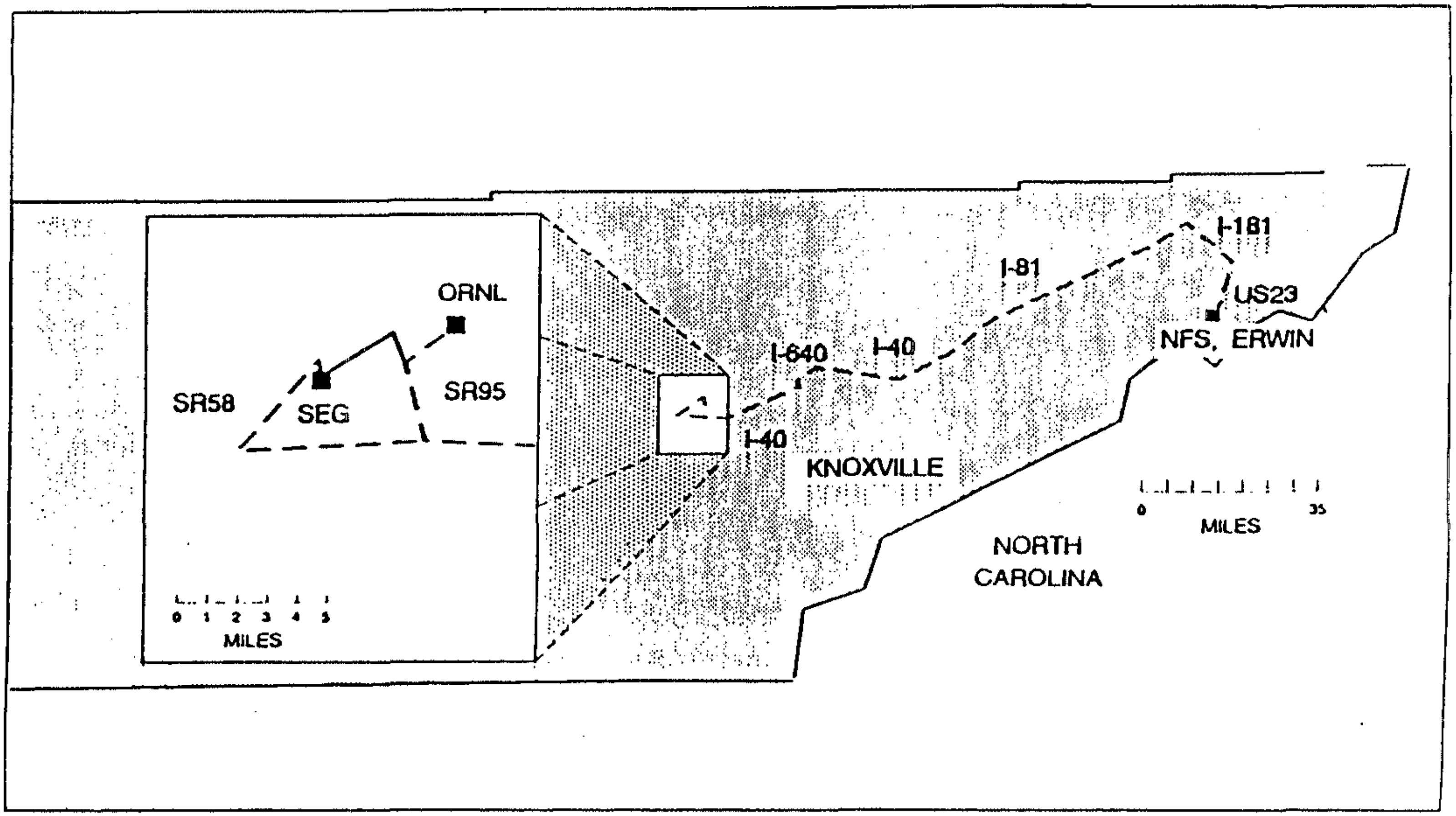

Fig. 4. Proposed truck routes for transport of Nuclear Fuel Services, Inc., waste and MOX waste to Oak Ridge National Laboratory.

and Nolichucky. A 7.2-mile segment of the Nolichucky River, from the railway bridge at Poplar, North Carolina, to the confluence with Mine Branch near Unaka Springs, Tennessee, has been recommended by the U.S. Forest Service for inclusion in the National Wild and Scenic Rivers System (see Appendix A). This segment is upstream from the NFS facility at Erwin; thus, it would not be at risk during NFS-to-ORNL transportation of wastes.

The HIGHWAY model (Joy and Johnson 1983) was used to select and analyze the distances along each route and to calculate the fraction of travel in 12 population density zones.

Routing distances and fractions of travel are input variables to RADTRAN 4. Table 2 summarizes the analysis of the selected transportation routes. In RADTRAN 4, three population density zones are used: rural, suburban, and urban, and probabilities and consequences of various types of accidents are assigned. The data from the HIGHWAY model (12 zones) is merged into 3 zones for use in RADTRAN 4. The LINKS option in RADTRAN 4 is used to distinguish between different characteristics along each route. The rural zone was subdivided into freeway (interstate) and non-freeway (U.S., state and local roads) categories. Suburban and urban zones were divided to assume that 95% of the route distance would be in "non-rush-hour" conditions, with the remaining 5% of the distance considered to be "rush-hour." The bases of this assumption were: (1) trucks would have to depart and arrive at ORNL during workday or "non-rush" hours, and (2) the only city along the route having "rush hour" traffic would be Knoxville, and this would be only a small fraction of the total route in terms of both road time and distance. Route specific accident rates for the NFS to ORNL route were not available; therefore, national average accident rates were used for the RADTRAN 4 calculations.

6.3 ASSUMPTIONS FOR RADTRAN ANALYSIS

The CH TRU wastes and MOX waste were assumed to have the same isotopic composition. The only important difference in assumptions made about the two types of waste was that the CH TRU wastes were assumed to have generally distributed contamination (especially on HEPA filters) while MOX waste would result from the collection and treatment of concentrated amounts of mixed oxides. The isotopic inventory used in this analysis (Table 3) is based on NFS data (personal communication, R. L. Booth, NFS, to W. N. Lingle, DOE-Oak Ridge Operations, June 11, 1991). Masses were converted to activity units using conversion factors contained in ORIGEN2 (Croff 1980).

The RADTRAN 4 model predicts both the incident-free radiological exposure and the consequence of radiological releases due to severe accidents. The incident-free risks are dependent on the assumed package dose rate, number of shipments, package dimensions, distance and velocity of travel through each population zone. The accident risks are dependent on the package inventory, the probability of an accident of sufficient severity to release radioactive materials, the fraction of material released, the fraction of material aerosolized, the aerosolized fraction that is respirable, and the dispersion of the material. Some of the important input parameters to RADTRAN 4 are summarized in Table 4.

Table 2. Transportation route mileage analysis for Nuclear Fuel Services shipment of wastes to Oak Ridge National Laboratory (ORNL)

	Erwin to ORNL (direct)	Erwin to ORNL (via SEG)	
Route segment	Total miles	Miles to SEG	Miles to ORNL
Distances per highway sign			
Interstate	132	139	
U.S. highway	14	14	
State highway	3	5	2
Local road	2	1	5
Total	151	159	7
Distances per lane type			
Limited access multilane	146	153	0
Other	5	6	7
Total	151	159	7
Distances in population zone			
0 - 139 persons/mile^2	88	96	7
139 - 3,326 persons/mile^2	61	61	0
3,326 - 10,000+ persons/mile^2	2	2	0
Total	151	159	7
RADTRAN "LINKS" distances			
Rural freeway	69	76	7
Rural nonfreeway	19	20	0
Suburban freeway—nonrush	58	58	0
Suburban freeway—rush	3	3	0
Urban freeway—nonrush	2	2	0
Urban freeway—rush	<1	<1	0
Total	151	159	7

Note: SEG = Scientific Ecology Group, Inc.

Table 3. Radioactive material inventory assumed for waste shipments from Nuclear Fuel Services to Oak Ridge National Laboratory

Isotope	Mass (g)[a]	Activity (Ci)
Am-241	140.80	4.834×10^{2}
Pu-238	10.85	1.858×10^{2}
Pu-239	27,317.44	1.698×10^{3}
Pu-240	2,512.20	5.727×10^{2}
Pu-241	143.81	1.482×10^{4}
Pu-242	15.70	6.000×10^{2}
Total	30,000.00	1.728×10^{4}
U-233	600.0	5.688×10^{0}
U-234	6.0	3.72×10^{-2}
U-235	4,200.0	9.0×10^{-3}
U-238	115,194.0	3.84×10^{-2}
Total	120,000.0	5.773×10^{0}
Total Inventory	150,140.8	1.777×10^{4}

[a] For a conservative analysis, the inventory provided by NFS was adjusted to increase the plutonium content from 24 kg to 30 kg and the uranium content accordingly.

The package dose rate [i.e., the dose rate (mrem/hr) at 1 m from the surface of the package] for the CH TRU waste shipments was assumed to be 2.0 mrem/hr for Case 1A and 10.0 mrem/hr for Case 1B to simulate shipment of a single "extreme risk" package that is loaded to the waste acceptance criteria limit of 128 g Pu/drum. The dose rate for Scenario 2 was assumed to be 1.0 mrem/hr, because the same inventory would be shipped using double the number of shipments. The dose rate for Scenario 3 was assumed to be 0.1 mrem/hr to simulate the additional shielding provided by the shipping package. A dose rate of 10.0 mrem/hr is commonly used in RADTRAN 4 for analysis of 160-day-old spent fuel shipments. Dose estimates from spent fuel shipments exceed those expected from CH TRU and MOX shipments and are viewed as conservative estimates for this analysis.

Each shipment was modeled as a single "effective" package, and a homogeneous distribution of the waste inventory was assumed throughout the package. The radionuclide inventory listed in Table 3 (in grams) was converted to curies (Ci) using conversion factors provided by ORIGEN2 (Croff 1980).

Table 4. Assumptions in the RADTRAN 4 analysis for shipment of Nuclear Fuel Services wastes to Oak Ridge National Laboratory

Scenario/ Case	Package	Dose Rate (mrem/hr)	Dispersion Category[a]	PKGSIZ[b]
1A	B-2 Cask[c] or TRUPACT II	2.0	3	3.61 m
1B	Supertiger[c]	10.0	3	5.21 m
2A	B-2 Cask or TRUPACT II	1.0	3	3.61 m
2B	B-2 Cask or TRUPACT II	1.0	3	3.61 m
3	DOT-6M[d]	0.1	4	1.52 m

[a]Dispersion category 3 is described in RADTRAN 4 as "sintered, loose chunks (e.g., fuel pellets)." Dispersion category 4 is described in RADTRAN 4 as "loose powder, large." For all cases, the release fractions were assumed to be 0.0 for accidents in severity categories 1-6, and 1.0 (100%) for categories 7 and 8. Dispersion values for aerosolized fraction of released material (1.0×10^{-2} for category 3 and 5×10^{-2} for category 4 for all 8 accident severity categories) and respirable fraction of aerosolized material (5.0×10^{-2} for all 8 accident severity categories for both dispersion categories 3 and 4.) were assumed.

[b]The PKGSIZ, or characteristic dimension is the largest linear dimension of the configuration. This value is used in determining the incident-free risk from exposure to radiation emitted from the package.

[c]Will transport non-mixed and mixed CH TRU wastes.

[d]Will transport MOX wastes.

Because CH TRU wastes would be compacted into 16 x 16 inch pucks at NFS before being loaded into drums, and then packed into NRC-approved packages, dispersion category 3 (sintered chunks, such as fuel pellets) was used and assumed to be conservative. The waste acceptance criteria (Energy Systems, 1991a) requires that any respirable fines be immobilized (e.g. solidified in grout). The MOX waste was assumed to be present as a loose powder (dispersion category 4), to be conservative.

To conservatively bound the scenario, the shipments were designated in RADTRAN 4 as "exclusive-use" shipments, although automatic "regulatory-checks" performed by RADTRAN indicated that "exclusive-use" status was not required. The assumed "effective" package characteristic dimensions (PKGSIZ) are listed in Table 4. The source term was assumed to be composed of 100% gamma-rays, a very conservative assumption. Furthermore, the numbers of shipments assumed for each of the scenarios and cases shown in Table 1 was very conservative to ensure that the bounding analysis included the possibility of return shipments in the event that some of the wastes do not meet ORNL's acceptance criteria.

Again, route specific accident rates for the NFS to ORNL route were not available; therefore, national average accident rates were used for the RADTRAN 4 calculations.

6.4 TRANSPORTATION IMPACTS

6.4.1 Radiological

Incident-free transportation of NFS wastes to ORNL would expose truck crews and persons along the transportation route to low levels of radiation ($\leq$ 2 mrem/hr). Hazardous constituents of mixed waste would not affect the environment or public under incident-free conditions. An additional risk of radiation exposure would be associated with transportation accidents that breach containment of the packages and release radioactive wastes. To assess impacts, radiation exposures were examined using the model, RADTRAN 4 (Neuhauser and Reardon 1989).

The results of the RADTRAN 4 analysis indicated that there would be no fatalities from acute radiation exposure as a result of the release of radioactive material from the consequence of a reasonably foreseeable maximum accident.

Table 5 lists the risk of latent cancer fatalities expected to result from radiation exposure during incident-free transportation and accidents. This assessment indicates that the radiological risks of the shipment of NFS wastes to ORNL are extremely low. During incident-free transportation for any of the cases considered, the number of LCFs statistically expected to occur from the calculated exposures would not exceed 1.88×10^{-5} LCFs for the truck driver (2 crew members), or 1.67×10^{-5} LCFs for the population at risk. The largest accident risk for CH TRU waste shipments would be 9.85×10^{-7} LCFs; the accident risk for the MOX waste shipments is 4.93×10^{-6} LCFs. The release fractions were assumed identical for all cases, thus yielding identical accident results for all cases that assumed identical initial inventories. Risk associated with incident-free transport would be slightly greater than for an accident because of the assumption of continuous exposure to the crew and population along the entire transport route while an accident would occur at a single point and would involve only the immediate population.

The maximum individual cumulative dose to a member of the public along the route assumed to be adjacent to the roadway 30 m from each shipment was also determined for each scenario (see Table 5). For scenario 1A, this hypothetical individual, who is modeled as being located adjacent to the roadway 30 m from each shipment as it passes by, would receive about 0.003 mrem cumulative dose from all shipments, less than 0.001% of the 300-mrem average annual effective dose received from natural background radiation sources.

Table 5. Latent cancer fatalities (LCFs) associated with the transportation of Nuclear Fuel Services (NFS) wastes to Oak Ridge National Laboratory (ORNL)[a]

Scenario/Case	CH TRU Wastes 1A NFS → ORNL B-2 Cask	CH TRU Wastes 1B NFS → ORNL Supertiger	CH TRU Wastes 2A NFS → ORNL B-2 Cask	CH TRU Wastes 2B NFS → ORNL B-2 Cask	Mixed Oxide Waste 3 NFS → ORNL DOT-6M
Incident-free transport (LCFs)					
Total[c]	1.63×10^{-5}	2.33×10^{-6}	1.67×10^{-5}	7.05×10^{-7}	9.65×10^{-8}
Crew[d]	1.79×10^{-5}	2.54×10^{-6}	1.88×10^{-5}	8.00×10^{-7}	1.06×10^{-7}
Accidents (LCFs)[e]					
Total	9.85×10^{-7}	8.85×10^{-8}	9.85×10^{-7}	6.10×10^{-10}	4.93×10^{-6}
Maximum individual cumulative dose[f] (rem)	3.01×10^{-6}	4.27×10^{-7}	3.01×10^{-6}	3.01×10^{-6}	1.78×10^{-8}

[a]Transportation risks were calculated using RADTRAN 4.0.10 (August 15, 1990). Access to RADTRAN 4 was furnished on the TRANSNET MicroVAX computer by the Transportation Technology Center at Sandia National Laboratories.

[b]The number of LCFs statistically expected to occur from the calculated exposures was estimated with a conversion factor of 5×10^{-4} LCFs per person-rem for the public (Listed as Total) and 4×10^{-4} LCFs per person-rem for the crew [ICRP publication 60 (1991)based on BEIR V report (NAS 1990)].

[c]The incident-free transport total population risk does not include the risk to the crew.

[d]The crew size was assumed to be 2 persons.

[e]The total accident risk is the summation of the impacts (person-rem) per accident severity category times the probability of an accident of each severity.

[f]The maximum individual cumulative dose is that received by a hypothetical member of the public located 30 m adjacent to the roadway during all shipments.

6.4.2 Nonradiological

The potentially hazardous constituents in the NFS CH TRU waste would be solids that would be completely contained within the NRC- and DOT-approved shipping packages and isolated from the environment during transportation. Therefore, no risk from the waste is posed to human health under normal transportation conditions.

Minor nonradiological impacts from incident-free transport of NFS wastes would result from the generation of nonradiological air pollutants (such as truck exhaust combustion products) in urban areas. The impacts are the same as those resulting from transporting nonnuclear materials and are not characteristic of the container that is shipped or its contents. Nonradiological unit risk factors have been developed for tractor-trailer transportation (Rao et al. 1982) that describe the number of human health effects (mortality) per unit distance traveled. For tractor-trailer shipments, the unit risk factor is 9.9×10^{-8} deaths/km (1.6×10^{-7} deaths/mile), applicable only in urban areas. The pollutants examined in Rao et al. (1982) included sulfur oxides, particulates, nitrogen oxides, carbon monoxide, hydrocarbons, and photochemical oxidants. However, the unit risk factor only considers sulfur oxides and particulates. The results of the RADTRAN 4 analysis of transportation routes (see Table 1) indicate that the NFS wastes would travel through just 2 miles of urban areas. Therefore, a very low risk of air pollution-related deaths (3.2×10^{-7}) would be expected from vehicle exhaust emissions during transportation of NFS wastes.

No adverse human health effects are expected to result from exposure to any hazardous constituent that may be present in CH TRU mixed wastes and that could be released during a transportation accident in which all packages in a shipment are breached because of (1) the very low concentrations of hazardous constituents expected within the waste containers and (2) the solid form of the hazardous constituents, which limits their availability for release to environmental pathways.

As discussed in Sect. 3.1, wastes that do not meet ORNL's acceptance criteria would be returned to NFS or SEG to correct the nonconformity. These are considered to be highly unlikely events but should they occur, the impacts of the return trips are included in the bounding analysis conducted for this EA.

7. CUMULATIVE IMPACTS

Cumulative impacts would include those direct and indirect impacts that result from acceptance and storage of NFS wastes in combination with other planned or current ORNL actions. Small-scale projects planned at SWSA-7 include a 56 ft × 136 ft × 15 ft CH TRU Waste Storage Facility for ORNL wastes and a proposed facility for the storage of contaminated soil and debris. Both of these proposed facilities would be located in the same proximate area as the NFS facility. Cumulatively, the NFS project and other proposed projects would use 0.03% of the total land area at ORNL. Such land use is consistent with long-range waste management and resource management plans for SWSA-7 and ORR. In addition, no endangered species, critical habitat, or protected historic/archaeological resources have been identified on this site. Construction of the NFS facility would result in no measurable impacts to air quality and surface water and groundwater quantity or quality. Therefore, cumulative impacts of the construction project would be minimal.

At this time no other transuranic waste shipments are planned for the routes from NFS to SEG and ORNL. NFS periodically ships low-level waste either directly to Barnwell, South Carolina for disposal or to SEG for treatment, then to Barnwell for disposal. Specific data on the quantities and timing of low-level waste shipments along these routes are not available for analysis in this assessment. However, all other radioactive shipments would be regulated by the same NRC and DOT requirements as the proposed waste shipments. The NFS shipments of TRU Waste to ORNL would result in minimal incremental radioactive doses to the public and workers, and therefore, would contribute minimally to the cumulative impact of all radioactive shipments along these routes.

Minimal incremental radiological impacts to the public would result from the waste compaction operations at SEG (see Section 3.1). The proposed action would contribute a portion of the annual radiological dose received by waste management personnel. (see Sect. 3.2) However, daily, weekly, and annual worker exposure will be limited by ORNL and DOE practices in accordance with DOE Order 5480.11.

Handling and storage of NFS wastes would increase the ORNL inventory of these types of radioactive materials by between 2 and 10%.

8. REGULATORY COMPLIANCE AND AGENCY CONSULTATION

Actions undertaken as part of the proposed acceptance of NFS wastes and MOX waste for storage at ORNL would comply with all applicable requirements: the Clean Air Act and its amendments; the Resource Conservation and Recovery Act (RCRA), as amended by the Hazardous and Solid Waste Amendments of 1984; the Toxic Substances Control Act; the Endangered Species Act of 1973; and Section 106 of the National Historic Preservation Act; In addition, the following DOE orders would be adhered to: DOE Order 5820.2A, *Radioactive Waste Management*; DOE Order 5480.5, *Safety of Nuclear Facilities*; DOE Order 5480.3, *Safety Requirements for the Packaging and Transportation of Hazardous Materials, Hazardous Substances, and Hazardous Wastes*; DOE Order 5480.9, *Construction Safety and Health Program*; DOE Order 5480.11, *Radiation Protection for Occupational Workers*; DOE Order 5400.5, *Radiation Protection of the Public and the Environment*; DOE Order 5483.1A, *Occupational Safety and Health Program for DOE Contractor Employees at Government-Owned Contractor-Operated Facilities*; and DOE Order 5480.10, *Contractor Industrial Hygiene Program*. Construction of the new facility, handling, and storage of NFS waste and MOX waste would also adhere to the policies and procedures established in the ORNL *Standard Practices and Procedures Manual*.

The current RCRA permit under interim status for Bldg. 7879 would be amended and the new NFS Waste Storage Facility would be RCRA-permitted.

During the preparation of this EA, DOE contacted the Tennessee Wildlife Resources Agency, the State Historic Preservation Officer, and the U.S. Department of Interior, Fish and Wildlife Service, for information and input on potential impacts of the proposed action. Correspondence is provided in Appendix A.

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10. PREPARERS

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S. B. Ludwig, M.S., Nuclear Engineering; B.S., Mechanical Engineering; 8 years' experience in nuclear waste management and risk assessment, specializing in determination of source terms, transportation routing, and risks.

D. W. Turner, M.S., Engineering Administration, University of Tennessee; M.S., Nuclear Engineering, Virginia Polytechnical Institute; B.S., Engineering Science, Tennessee Technological University; 18 years' experience in waste management and enrichment.

APPENDIX A

AGENCY CORRESPONDENCE

TENNESSEE WILDLIFE RESOURCES AGENCY

ELLINGTON AGRICULTURAL CENTER
P. O. BOX 40747
NASHVILLE, TENNESSEE 37204

May 31, 1991

Ms. Andrea W. Campbell
Oak Ridge National Laboratory
P.O. Box 2008
Oak Ridge, TN 37831

Dear Ms. Campbell:

Reference is made to your letter of May 21 concerning the proposal for construction of a 4000 square foot non-hazardous waste storage building south of Melton Valley Drive on ORNL lands. There are no known threatened or endangered wildlife in that immediate area, except that the endangered ospreys(state listed) and bald eagles (state and federally listed) are expanding on Watts Bar and Melton Hill Lakes. These species wi not be affected unless hazardous material escapes to these wate systems.

Sincerely,

TENNESSEE WILDLIFE RESOURCES AGEN

Robert M. Hatcher

Robert M. Hatcher, Coordinator
Nongame/Endangered Species

United States Department of the Interior
FISH AND WILDLIFE SERVICE
Post Office Box 845
Cookeville, TN 38503

June 24, 1991

Ms. Andrea W. Campbell
NEPA Project Leader
Oak Ridge National Laboratory
P. O. Box 2008
Oak Ridge, TN 37831

Dear Ms. Campbell

We have reviewed the information contained in your letter of May 21, 1991, concerning the Environmental Assessment being prepared for the proposed acceptance and storage of radioactive wastes and scrap from Nuclear Fuel Service, Erwin, TN.

According to our records, there are no federally listed or proposed endangered or threatened species in the project impact area. Therefore, requirements of Section 7 of the Endangered Species Act are fulfilled. Consultation should be reinitiated if (1) new information reveals impacts not previously considered to listed species, (2) the project is subsequently modified, or (3) new species are listed or critical habitat designated that may be impacted.

We appreciate the opportunity to review and comment at this early stage of project planning.

Sincerely,

Lee A. Barclay

Lee A. Barclay, Ph.D.
Field Supervisor

TENNESSEE HISTORICAL COMMISSION
701 BROADWAY
DEPARTMENT OF CONSERVATION
NASHVILLE, TENNESSEE 37243-0442
615/742-6716

June 21, 1991

Andrea W. Campbell
Oak Ridge National Lab
P. O. Box 2008
Oak Ridge, Tennessee 37830

Re: DOE, STORAGE/NUCLEAR FUEL SERVICES, , ROANE COUNTY, X

Dear Ms. Campbell:

The above-referenced undertaking has been reviewed pursuant to Executive Order No. 12372 and Section 106 of the National Historic Preservation Act for compliance by the participating federal agency or applicant for federal assistance. Procedures for implementing Section 106 of the Act are codified at 36 CFR 800 (51 FR 31115, September 2, 1986)

Based on the documentation submitted, it is our opinion that due to the location, scope and/or nature of the undertaking, and/or the size of the area of project impact, the undertaking will have no effect on National Register of Historic Places listed or eligible properties either because none exist in the area of project impact or because the undertaking will not alter any characteristics of an identified eligible or listed property which qualify the property for listing in the National Register, or alter such property's location, setting or use. Therefore, this office has no objections to proceeding with the project.

If you are applying for federal funds, license or permit, you should submit this letter as evidence of compliance with Section 106 to the appropriate federal agency, which, in turn, should contact this office as required by 36 CFR 800. If you represent a federal agency, you should submit a formal determination to this office for comment. Questions or comments should be directed to Joe Garrison (615)742-6720. Your cooperation is appreciated.

Sincerely,
Herbert L. Harper

Herbert L. Harper
Executive Director and
Deputy State Historic
Preservation Officer

HLH/jyg

United States Department of Agriculture
Forest Service
National Forests in North Carolina
United States Federal Court House Building
100 Otis Street
P.O. Box 2750
Asheville, NC 28802

Reply to: 2350

Date: October 2, 1991

Freida Glenn
Oak Ridge National Laboratory
PO Box 2008
Oak Ridge, TN 37831-6200

Dear Ms. Glenn:

This is in response to your inquiry about the status of the wild and scenic river study for the Nolichucky River.

The wild and scenic river study report and final environmental impact statement (FEIS) for the Nolichucky River Gorge addresses the eligibility and suitability of the river segment between Poplar, North Carolina, and Unaka Springs, Tennessee, for inclusion in the National Wild and Scenic Rivers System. The gorge is located within the Pisgah National Forest in Mitchell and Yancey Counties, North Carolina, and within the Cherokee National Forest in Unicoi County, Tennessee.

The FEIS recommends wild and scenic river designation for the 7.2 mile segment of river from the railway bridge at Poplar, North Carolina, (river mile 106.5) downstream to the confluence with Mine Branch (river mile 99.3) near Unaka Springs, Tennessee. The river would be classified scenic.

The report/FEIS will be available to the public pending distribution to Congress by the Secretary of Agriculture.

for Geo H Cook

BJORN DAHL
Forest Supervisor