ORNL/TM-13129

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OAK RIDGE NATIONAL LABORATORY

LOCKHEED MARTIN

SPECIAL CASE WASTE LOCATED AT OAK RIDGE NATIONAL LABORATORY FACILITIES

SURVEY REPORT

J. R. Forgy, Jr.

November 1995

Waste Management and Remedial Action Division

LOCKHEED MARTIN ENERGY SYSTEMS, INC.
Oak Ridge, Tennessee

Prepared for the U. S. Department of Energy
under U. S. Government contract DE-AC05-840R21400

MANAGED BY
LOCKHEED MARTIN ENERGY SYSTEMS, INC.
FOR THE UNITED STATES
DEPARTMENT OF ENERGY

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Acronyms and Abbreviations

ALARA	as low as reasonably achievable
BSR	Bulk Shielding Reactor
CTD	Chemical Technology Division
DOE	US Department of Energy
DOE-HQ	Department of Energy Headquarters
EDL	economic discard limit
EPA	US Environmental Protection Agency
GCO	generator certification official
GTCC	greater than class C
HEPA	high efficiency particulate air (filter)
HFIR	High Flux Isotope Reactor
HRE	Homogeneous Reactor Experiment
M&C	Metals and Ceramics Division
MSRE	Molten Salt Reactor Experiment
NRC	US Nuclear Regulatory Commission
NTS	Nevada Test Site
ORNL	Oak Ridge National Laboratory
PA	performance assessment
PAL	performance assessment limited
RCRA	Resource Conservation and Recovery Act
RH	remotely handled
RRD	Research Reactors Division
SCW	special case waste
SWSA	solid waste storage area
TSF	Tower Shielding Facility
WIPP	Waste Isolation Pilot Plant
WMRAD	Waste Management and Remedial Action Division

EXECUTIVE SUMMARY

Between October 1994 and October 1995, a data base was established at the Oak Ridge National Laboratory (ORNL) to provide a current inventory of the radioactive waste materials, located at ORNL, for which the US Department of Energy (DOE) has no definite planned disposal alternatives. DOE refers to these waste materials as special case waste. To assist ORNL and DOE management in future planning, an inventory system was established and a baseline inventory prepared. This report provides the background of the ORNL special case waste survey project, as well as special case waste category definitions, both current and anticipated sources and locations of special case waste materials, and the survey and data management processes.

1. BACKGROUND

With the issue of DOE Order 5820.2A, "Radioactive Waste Management," in September 1988, DOE began to provide comprehensive guidance for managing its radioactive waste materials. The order addressed three major radioactive waste classifications: high-level, low-level, and transuranic radioactive waste. The basis for classifying radioactive waste materials in this manner was developed partially in response to regulatory requirements, but primarily in conjunction with projected permanent disposal alternatives. Since the DOE order was published, permanent disposal of radioactive waste materials at ORNL has been essentially limited to those materials which can be characterized as being within the DOE classification of low-level waste and within a set of overall radioisotope concentration parameters associated with ORNL disposal sites. Any waste materials not meeting these parameters must be stored on an interim basis and transported elsewhere for permanent disposal. Additionally, the permanent disposal at ORNL of low-level waste materials identified as mixed low-level radioactive waste materials is prohibited. These mixed waste materials, in addition to the radioactive constituent, contain a hazardous waste constituent regulated by the Environmental Protection Agency (EPA) under the Resource Conservation and Recovery Act (RCRA). Thus, only a very restricted subset of radioactive waste materials are allowed permanent on-site disposal at ORNL; all other radioactive waste materials must be transported to an off-site location for permanent disposal. At the present time, DOE long-range planning has only identified permanent off-site disposal locations for transuranic waste materials (from defense program sources) and some mixed low-level waste materials.

This lack of off-site disposal alternatives creates a significant on-site waste management problem. Because of the restrictive nature of the physical characteristics, transportation criteria, and acceptance criteria at an off-site disposal facility, waste management planning is normally conducted "in reverse," starting with the disposal site engineering. Logically, the planning and engineering for waste characterization, packaging, and transportation from an on-site location to an off-site disposal facility will be designed and scheduled around the off-site disposal facility characteristics. If such characteristics do not exist, however, on-site waste management activities must be postponed as long as possible to avoid excess cost and unnecessary radiation exposure of waste handling personnel. The ramifications of this delay are manifold. Many radioactive waste materials will require costly characterization, treatment, and packaging before planning and shipment for disposal can be made; these activities cannot be delayed indefinitely without incurring the additional expense associated with maintaining unnecessary nuclear facilities or interim storage. Further, these on-site activities, once implemented, can generate extensive cost impacts and requirements for coordination between waste generators, waste management organizations, and disposal facility operators. Procurement of special processing facilities may be necessary. Even if some waste materials can meet the currently planned off-site disposal facility criteria, there may be no on-site means at ORNL for packaging and shipping of a particular form of waste to the planned disposal site. Other waste materials may be prevented from being managed at the planned permanent disposal sites for regulatory reasons. With these potential problems in mind, DOE has termed radioactive waste materials, which cannot be managed under its current long-range planning as high-level, low-level, and transuranic waste, as special case waste (SCW) materials.

In practice, the distinction of a radioactive waste material as special case waste is a matter of the amount, half-life, and placement of the radioactivity with which the waste material is contaminated. **Special case waste will be that waste material which, no matter how much practical characterization, treatment, and packaging is made, will never meet the acceptance criteria for permanent disposal at ORNL, and does not meet the criteria at a currently planned off-site permanent disposal facility.** An example of such a radioactive waste material would be an encapsulated radiation source containing cobalt-60 in a concentration which greatly exceeds the allowed concentration for disposal as low-level waste at ORNL. Currently, there is no DOE definite planned disposal site for such material. Such a waste material will be included in this report. Conversely, those radioactive waste materials which could eventually be accepted for permanent disposal at ORNL or at an off-site disposal facility, if relatively short-term planning problems such as decontamination, characterization, volume reduction, or removal of RCRA materials could be solved at relatively low cost, will not be designated as special case waste. An example of such a radioactive waste material would be a 2-ton industrial furnace with minor radioactive contamination and residual contamination by hazardous waste in several components. Currently, ORNL has no funded capability to remove the hazardous material contamination, reduce the volume of the material to fit transport and packaging criteria, or remove the radioactive contamination. Should such funding be approved, however, practical means would be available to prepare the waste material for disposal at ORNL or an off-site location. Such a radioactive waste material would not be considered special case waste, but rather is given the DOE designation of "material-in-inventory" (DOE 1994). In essence, special case waste is a small subset of the "material-in-inventory."

In addition, the distinction of a radioactive waste material as special case waste is a matter of how much detailed information is known about a particular waste material. Since radioactive waste materials include a wide variety of chemical/physical forms and isotopic mixtures, and since characterization of these waste materials is typically incomplete, the distinction of a waste material as special case waste must be somewhat subjective, based only on what is known about the waste material. In the past, little waste characterization was performed because of limited requirements to do so. Further, usually because of the high specific activity, waste forms which might be denoted as special case waste are difficult to adequately sample and costly to analyze. Detailed examination of the waste is usually postponed until final packaging for disposal so that personnel exposure is reduced to a level as low as reasonably achievable (ALARA). For these reasons, the inventory of special case waste at ORNL will change with time as more waste characterization is conducted and more waste management activities occur.

The purpose of this report is to provide ORNL and Department of Energy personnel with information about the special case waste materials at ORNL in order to support various waste management decisions and planning. Section 2 provides the basic definitions which DOE uses to group special case waste into categories for planning purposes, and then indicates which of these categories is to be found at ORNL. Section 3 describes the current generators of special case waste materials at ORNL. Section 4 indicates the ORNL locations where an operating organization other than the Waste Management and Remedial Action Division (WMRAD) stores radioactive materials with the potential to become special case waste. Section 5 indicates where an operating organization other than the Waste Management and Remedial Action Division stores radioactive materials at a WMRAD site. Section 6 describes where the Waste Management and Remedial Action Division stores special case waste. Section 7 provides details of the special case waste data base planning and coordination. Summary reports that can be prepared from the data base are provided in an appendix.

2. DEFINITION OF SPECIAL CASE WASTE

Special case waste will be those radioactive waste materials which, no matter how much practical characterization, treatment, and packaging is made, will never meet the acceptance criteria for permanent disposal at ORNL, and do not meet the criteria at a currently planned off-site permanent disposal facility. It should be noted that there is no "official" definition of special case waste; instead DOE has "defined" nine categories of special case waste. In this section, these DOE categories for special case waste will first be identified (Section 2.1), and then the ramifications to these categories and their application to ORNL discussed (Section 2.2).

2.1 Categories of Special Case Waste

For planning purposes, DOE grouped special case waste in the following categories in 1990 (Idaho National Engineering Laboratory May 1990). In the future the planning categories can be expected to change.

- Non-certifiable defense transuranic waste
- Non-defense transuranic waste
- Greater than class C (GTCC) waste (originally: specific performance assessment required (SPAR) waste)
- Performance assessment limited (PAL) waste (originally: also SPAR waste)
- Fuel and fuel debris
- Uncharacterized waste
- Excess nuclear material
- Radiation sources
- DOE-titled waste or material held by Nuclear Regulatory Commission (NRC) licensees.

Each of the planning categories is described in the following subsections.

2.1.1 Non-certifiable defense transuranic waste

DOE transuranic waste materials are defined on the basis of their activity content. That is, "without regard to source or form, waste that is contaminated with transuranium radionuclides with half-lives greater than 20 years and concentrations greater than 100 nCi/g at the time of assay" is transuranic waste as defined in DOE Order 5820.2A. The order continues, "transuranic waste shall be certified, pursuant to the Waste Isolation Pilot Plant - Waste Acceptance Criteria, placed in interim storage, and sent to the Waste Isolation Pilot Plant when it becomes operational."

Non-certifiable defense transuranic waste is defined as transuranic waste materials generated from DOE defense programs that are not certifiable for disposal at the plant for one or more of the following reasons:

- the waste does not meet the Waste Isolation Pilot Plant acceptance criteria;
- the waste cannot be shipped in the designated shipping container for transport; or
- the waste contains shapes or materials that cannot be sent to the Waste Isolation Pilot Plant because of security classification.

That is, these waste materials are transuranic (by activity), defense program (by source) waste, but noncertifiable (by form). Such waste materials are defined as special case waste (as a result of their form) because, without transportation to or acceptance at the Waste Isolation Pilot Plant, no long-range disposal alternatives are presently available for them. Figure 1 indicates how this category fits into the current overall DOE planning for transuranic waste.

2.1.2 Non-defense transuranic waste

DOE non-defense transuranic waste is defined as transuranic waste that has been generated by DOE non-defense programs. Currently, the Waste Isolation Pilot Plant will dispose only of waste materials from DOE defense programs.

Waste materials in this category are denoted as special case waste because, although they may be transuranic, no long-range disposal alternative currently exists for transuranic waste materials from non-defense programs (as a result of their source). Figure 1 indicates how this category fits into the current overall DOE planning for transuranic waste.

2.1.3 Greater than class C low-level waste

When the planning categories for special case waste were originally configured, a category described as *specific performance assessment required waste* was used to denote any low-level radioactive waste from any source which might be unsuitable for near-surface permanent disposal. Problems with this definition arise, however, because the low-level waste at a DOE site which has no definite disposal alternative can come from either DOE programs or be accepted by DOE from NRC licensees under the Low-Level Waste Policy Amendments Act of 1985. Practical waste management experience in compliance with DOE Order 5820.2A indicates that the SPAR description is too simplistic because the criteria used to define this waste are different for DOE and NRC. The planning category of *greater than class C* low-level waste is now used for waste accepted by DOE from NRC licensees under the Low-Level Waste Policy Amendments Act of 1985, and the planning category of *performance assessment limited* low-level waste is now used for waste generated by DOE programs.

For licensees of the NRC, low-level waste is defined by 10 CFR Part 61.2 as "radioactive waste not classified as high-level waste, transuranic waste, spent nuclear fuel, or byproduct material as defined in section 11e.(2) of the Atomic Energy Act (uranium or thorium tailings and waste)." High specific activity low-level radioactive waste materials having activity concentrations that exceed the class C waste limits as defined in 10 CFR Part 61, "The NRC Regulations for Near-Surface Disposal of Low-Level Radioactive Waste," are considered unsuitable for near-surface permanent disposal. Waste materials meeting this low-level waste definition could be accepted by the DOE from an NRC licensee.

The upper limits for class C waste are summarized in Table 1. If a DOE site is holding low-level waste materials from an NRC licensee containing activity concentrations greater than these class C limits, and the waste materials are not considered high-level waste, the waste materials are denoted as greater than class C low-level waste. These waste materials are denoted as special case

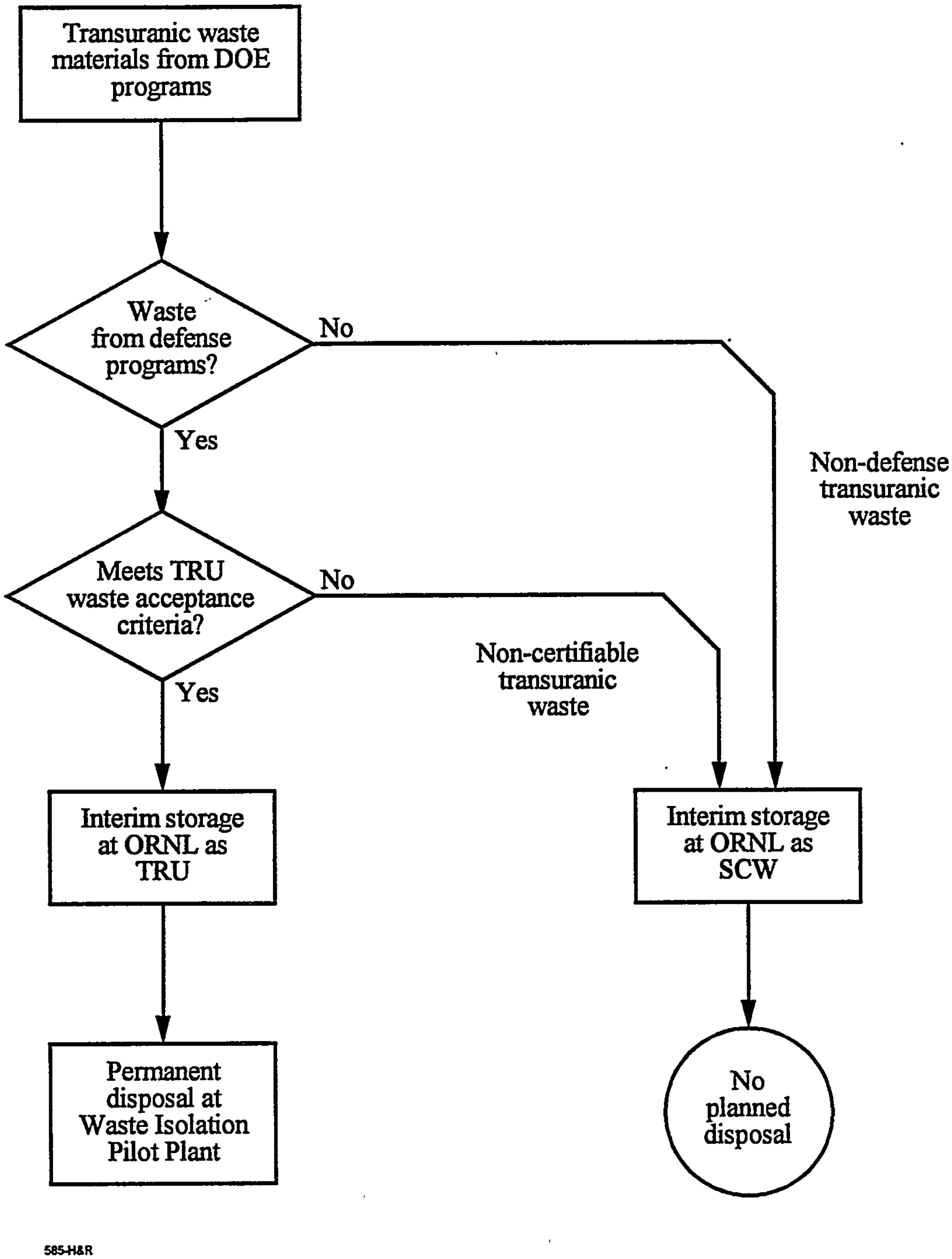

Figure 1. Transuranic Waste Disposal Planning

waste because, although the waste materials may be low-level waste, no disposal alternative currently exists for greater than class C low-level waste from an NRC licensee. Figure 2 indicates how this category fits into the current overall DOE planning for low-level waste.

It should be noted that the source of the waste materials (an NRC licensee) is the critical factor for this category definition. The NRC does not have a defined transuranic waste classification and DOE does not have a defined GTCC waste classification. Waste materials which DOE considers transuranic (Section 2.1.1) would generally be considered GTCC low-level waste by the NRC.

For example, a waste package containing 500 nanocuries per gram of Pu-238 (exceeding the class C limits of Table 1) would be considered transuranic waste if it came from a DOE source and GTCC low-level waste if it came from an NRC source. It has not been determined if DOE would change the planning category of such a waste package from *GTCC low-level waste* to *non-defense transuranic waste* if the DOE accepted the waste package from an NRC licensee. In either planning category, there is no planned disposal alternative for such a package.

2.1.4 Performance assessment limited waste

Like the GTCC low-level waste planning category, this planning category was originally denoted as *specific performance assessment required waste*. This planning category, however, describes waste materials generated by DOE programs. In general, the specific activity criteria for this planning category are lower than the specific activity criteria for the planning category of GTCC low-level waste.

For DOE programs, low-level waste is defined by DOE Order 5820.2A as "waste that contains radioactivity and is not classified as high-level waste, transuranic waste, spent nuclear fuel, or 11e.(2) byproduct material." DOE low-level waste materials may contain concentrations of radionuclides that exceed ORNL site-specific performance assessment limits for disposal. That is, the radionuclide concentrations of the waste materials may exceed the environmental protection performance limits established for the near surface permanent disposal areas at ORNL.

Table 1 NRC limits for class C low-level radioactive waste

Long-Lived Radionuclides [a]

Nuclide (half-life) [b]	Concentration (Ci/m^3 or $\mu Ci/cc$)
^{14}Carbon (5,730 years)	8
^{14}Carbon in activated metal (5,730 years)	80
^{59}Nickel in activated metal (75,000 years)	220
^{94}Niobium in activated metal (20,000 years)	0.2
^{99}Technetium (214,000 years)	3
^{129}Iodine (16,000,000 years)	0.08
	(nCi/g)
Alpha-emitting transuranics (half-life greater than 5 years)	100
^{241}Plutonium (14 years) [c]	3,500
^{242}Curium (162.8 days) [d]	20,000

Short-Lived Radionuclides [a]

Nuclide (half-life) [b]	Concentration (Ci/m^3 or $\mu Ci/cc$)
^{63}Nickel (100 years)	700
^{63}Nickel in activated metal (100 years)	7,000
^{90}Strontium (29 years)	7,000
^{137}Cesium (30 years)	4,600

a. Limits are for single radionuclides; for mixtures of radionuclides, limits are obtained by a sum-of-fractions rule separately for long-lived and for short-lived radionuclides. The sum of fractions for either short- or long-lived radionuclides is determined by dividing each nuclide's concentrations by its class C limit and adding the resulting values. If the sum exceeds 1 for either short- or long-lived radionuclides, the waste is greater-than-class-C.

b. Half-lives are from Lederer (1978).

c. Decays to a long-lived daughter product, neptunium-237 (2,200,000 yrs).

d. Decays to long-lived daughter products, plutonium-238 (90 yrs) and uranium-234 (250,000 yrs).

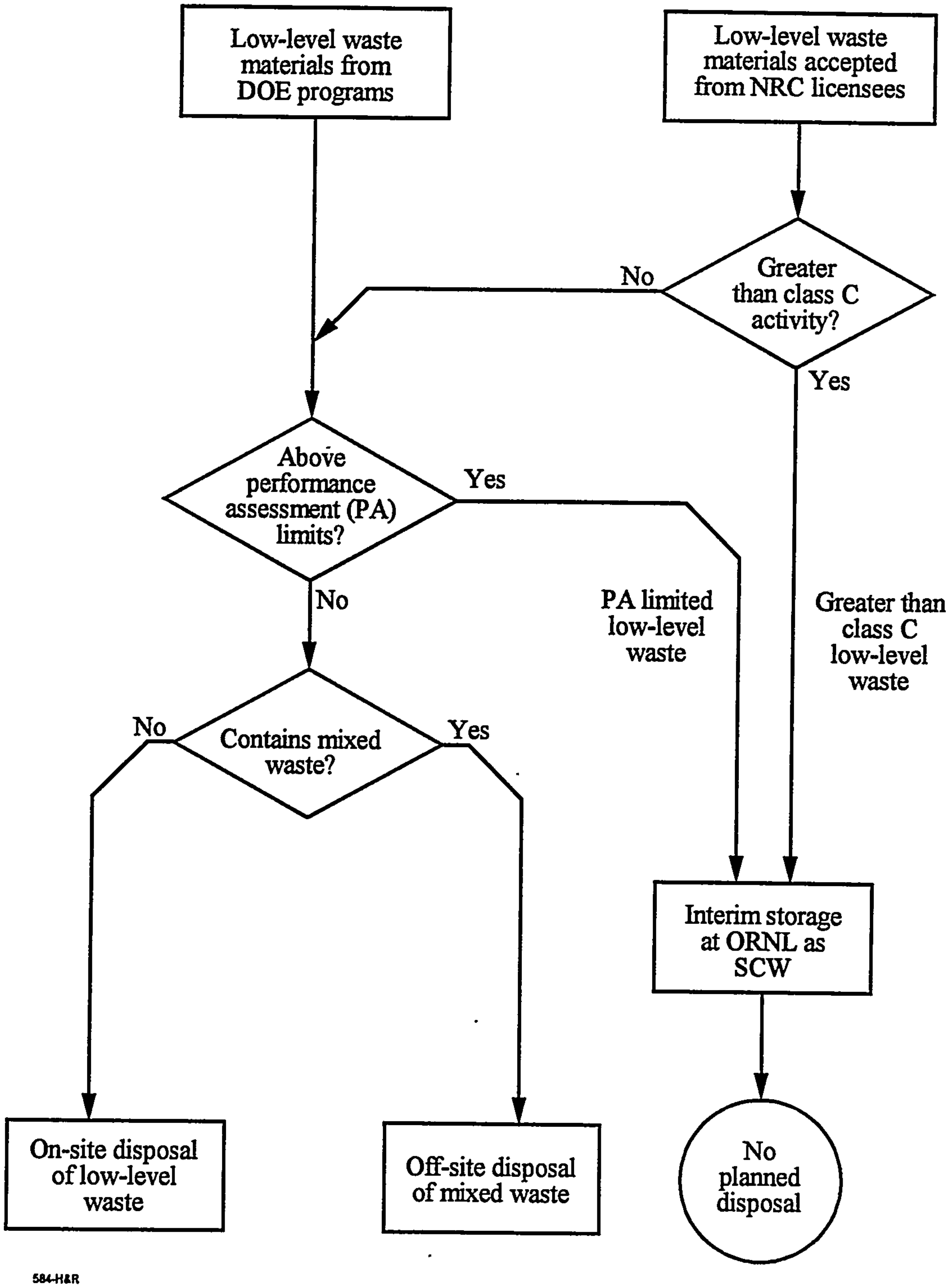

Figure 2. Low-level Waste Disposal Planning

These performance assessment limits are shown in Table 2. The DOE low-level waste materials from an ORNL facility are screened against the performance assessment limits as part of the ORNL waste acceptance procedure. If the activity concentrations in the waste are significantly greater than these performance assessment limits, the waste materials are denoted as performance assessment limited low-level waste (by activity). These waste materials are denoted as special case waste (as a result of their activity) because no on-site disposal alternative currently exists for performance assessment limited low-level waste. Figure 2 indicates how this category fits into the current overall DOE planning for low-level waste.

2.1.5 Spent fuel and fuel debris

This planning category includes DOE spent nuclear fuel and fuel debris generated by research and development programs. Spent fuel and fuel debris materials are defined as fuel (or parts of fuel) that have been withdrawn from a nuclear reactor following irradiation, but that have not been reprocessed to remove its constituent elements. It should be noted that test specimens (targets) of fissionable material irradiated for research and development purposes only and not for the production of power or plutonium may be classified as transuranic or low-level waste rather than as spent fuel.

These materials were originally denoted as special case waste (as a result of their source) because the disposal and facility acceptance criteria for such waste materials had not yet been defined. Recently, DOE has established a national program for management of these materials. The program involves interim storage and ultimate disposition. A programmatic environmental impact statement has been prepared; interim regional storage for these materials at Savannah River Site and Idaho National Engineering Laboratory was selected. As a result of this program, ORNL is cataloguing these materials and working towards shipment of these materials to either of the two sites. From an ORNL viewpoint, therefore, a definite planned alternative for the off-site management of these materials exists, and ORNL can be considered as no longer having waste materials in this special case waste planning category.

Table 2 Performance assessment limits for ORNL Interim Waste Management Facility

Isotope	Half-life (years)	Concentration Limit (Ci/ft³) [a]	Isotope	Half-life (years)	Concentration Limit (Ci/ft³)[a]
H-3	1.22 E+01	5.319 E+00	Pa-231	3.25 E+04	1.212 E-07
C-14	5.73 E+03	4.894 E-04	Th-232	1.41 E+10	1.646 E-06
Al-26	7.20 E+05	1.445 E-06	U-232	7.20 E+01	4.706 E-05
Cl-36	3.01 E+05	5.903 E-06	U-233	1.60 E+04	6.520 E-04
K-40	1.28 E+09	2.082 E-05	U-234	2.45 E+05	6.441 E-04
Co-60	5.27 E+00	1.251 E+01	U-235	7.04 E+08	3.726 E-05
Ni-63	1.00 E+02	3.138 E-01	U-236	2.42 E+07	7.079 E-04
Kr-85	1.07 E+01	2.185 E+01	Np-237	2.10 E+06	1.221 E-05
Sr-90	2.86 E+01	4.436 E-03	Pu-238	8.78 E+01	2.226 E-03
Tc-99	2.13 E+05	6.442 E-04	U-238	4.47 E+09	1.770 E-04
I-129	1.57 E+07	1.204 E-07	Pu-239	2.41 E+04	1.785 E-04
Cs-137	3.02 E+01	2.200 E-03	Pu-240	6.57 E+03	1.827 E-04
Sm-151	9.00 E+01	4.755 E-01	Am-241	4.32 E+02	2.045 E-04
Eu-152	1.36 E+01	1.180 E-02	Pu-242	3.76 E+05	1.864 E-04
Eu-154	8.80 E+00	1.693 E-01	Am-243	7.38 E+03	2.697 E-05
Eu-156	4.96 E+00	3.183 E+05	Cm-243	2.85 E+01	5.034 E-02
Bi-207	3.22 E+01	3.197 E-02	Cm-244	7.81 E+01	2.500 E-01
Po-209	1.03 E+02	9.077 E-07	Pu-244	8.20 E+07	1.204 E-07
Pb-210	2.23 E+01	5.308 E-03	Cm-248	3.40 E+05	1.205 E-07
Ra-226	1.60 E+03	2.371 E-06			
Ra-228	5.75 E+00	3.468 E+01	Cf-249	3.51 E+02	2.247 E-05
Th-229	7.34 E+03	1.400 E-05	Cf-250	1.31 E+01	1.089 E+00
Th-230	8.00 E+04	6.452 E-04			

[a] The concentration limits are from WM-SWO-502. Concentration limits are derived by dividing the performance assessment limits, in curies, by the volume of storage space available in the on-site disposal facility, in cubic feet. In actual practice, the concentration limits are specified in Ci per storage vault (96.4 cubic ft volume).

2.1.6 Uncharacterized waste

Uncharacterized waste materials are radioactive materials which have been identified as waste, but about which little can be currently known for certain. Based on process knowledge or other factors (such as uncertainty of future packaging), it is believed that the waste will meet the definition of one of the other categories of special case waste (e.g., it will probably contain radioactive waste isotopes above the performance acceptance limits for low-level waste). Further characterization and/or packaging of such waste to determine its material forms, approximate mass, and activity is necessary but may not be currently feasible.

These waste materials are denoted as special case waste (as a result of their expected high specific activity) because it is likely that they will meet the definition of one of the first five categories of special case waste (Sec. 2.1.1- 2.1.5) at some time in the future. Quantitative criteria for this category do not exist. The primary focus of this category is to identify waste and potential waste, the exact composition of which is unknown, but which is known or suspected to be prohibited from near surface disposal as low-level waste at ORNL. Waste materials which have not been characterized may be denoted as special case waste for any of the following reasons:

- the waste has external dose rates too high to allow characterization;
- the waste consists of material such as a vessel, a sampling system, or another item of plant equipment that cannot be opened for sampling, but is suspected to contain a residual quantity of radionuclides that would be performance assessment limited special case waste; or
- the waste consists of material that contains a radionuclide not listed in the table for performance assessment limited special case waste but that may be considered special case waste, because of unusual radioactive or environmental performance characteristics.

Figure 3 indicates how this category fits into the current overall DOE planning for radioactive waste.

2.1.7 Excess nuclear materials

DOE maintains special accountability for certain radioactive and stable isotopes that have strategic policy value. These materials currently include depleted uranium, enriched uranium, uranium-233, normal uranium, plutonium, americium-241, americium-243, curium, berkelium, californium-252, lithium-6, neptunium-237, deuterium, tritium, and thorium. DOE routinely evaluates these "nuclear materials" against an economic discard limit (EDL). (The term "nuclear material" as used in this subsection is a programmatic rather than technical definition.) The economic discard limit is the concentration of nuclear material in residues below which the nuclear material is uneconomical to recover. The economic assessment primarily considers the cost of producing new materials, but includes some waste management costs. DOE identifies materials above the economic discard limit as scrap nuclear material and usually processes these to recover the usable nuclear material.

Excess nuclear materials are scrap nuclear materials, in quantities above the economic discard limit, that are no longer useful to the present custodians, but require processing that is not available to recover the useable nuclear materials. For example, some of the materials may contain hazardous constituents (regulated by the EPA), which preclude processing because recovery facilities do not have EPA permits. Strictly speaking, these materials would not be considered waste, although they may be stored, handled, and managed as such. Since these materials cannot be discarded at ORNL and have no long-range planned disposal program, they have been denoted as special case waste. Excess nuclear materials may include both unirradiated materials and irradiated materials. Figure 3 indicates how this category fits into the current overall DOE planning for radioactive waste.

2.1.8 Sealed radiation sources

Radiation sources are encapsulated (sealed) radioactive materials used to generate calibrated amounts of radiation. Eventually these sources become waste and the concentrations of their radioactive materials may exceed the performance assessment limits for low-level waste at the time of disposal. Figure 3 indicates how this category fits into the current overall DOE planning for radioactive waste.

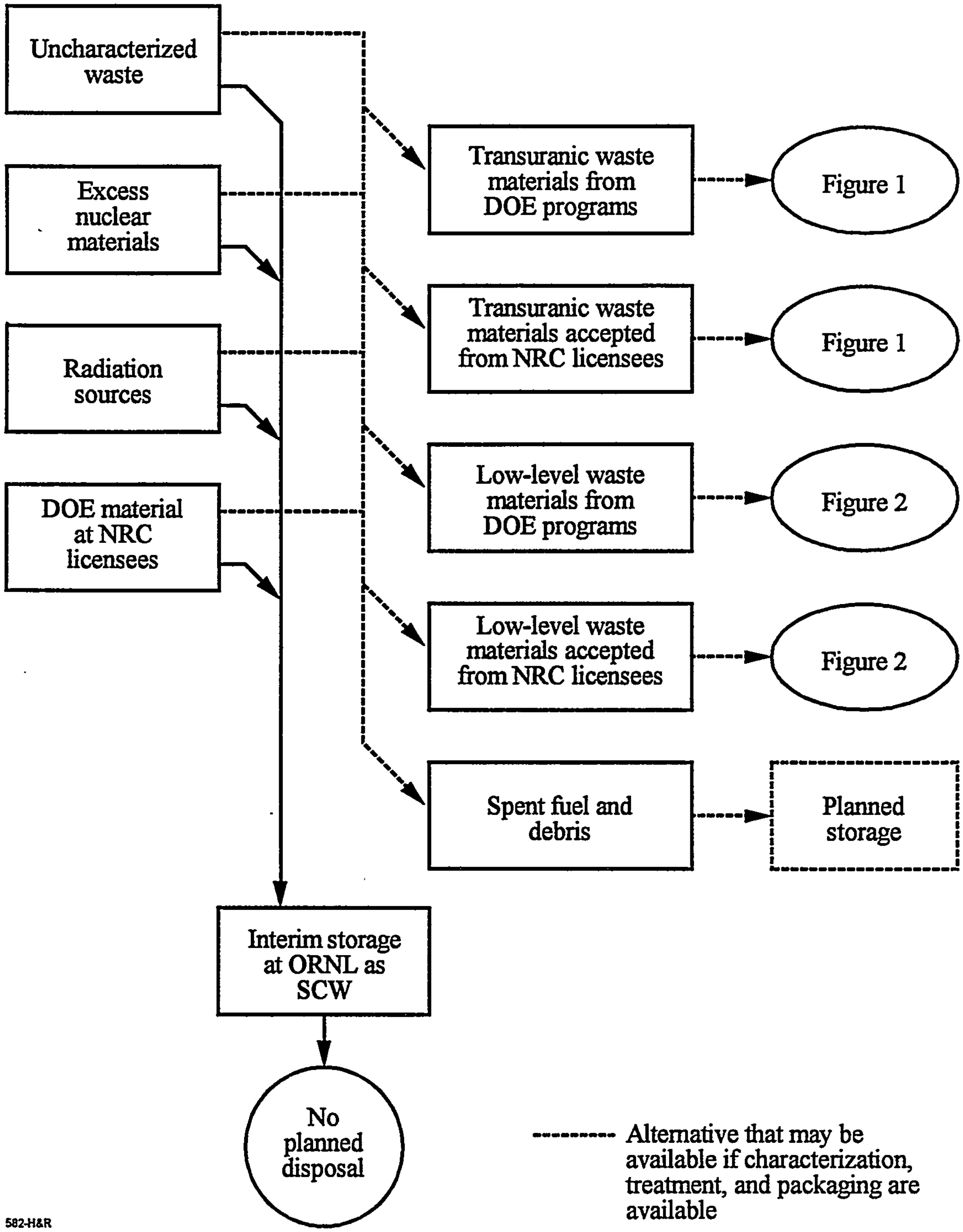

Figure 3. Uncharacterized Waste and Non-waste Disposal Planning

2.1.9 DOE-titled waste or material held by licensees

This category includes radioactive waste or material for which a DOE organization holds responsibility, but is held by licensees of the NRC (or agreement states). DOE has provided nuclear material to licensees through various mechanisms, including contracts, loans, leases, and grants for use in nuclear-related research fields. Both material and waste are usually returned to DOE. This category would apply to waste materials (currently held at some location other than ORNL) which DOE intends to bring to ORNL, but which do not meet the criteria for permanent disposal at ORNL. Figure 3 indicates how this category fits into the current overall DOE planning for radioactive waste.

2.2 Identification of Special Case Waste at ORNL

A preliminary inventory of special case waste made in 1990 indicated that ORNL held about 1100 Ci of non-certifiable defense program transuranic waste, 1.1 megacuries of specific performance assessment required waste, 15 Ci of spent fuel, and 7800 Ci of excess nuclear materials (DOE 1990). Table A-1 in the appendix provides more detail. The currently ongoing special case waste inventory program has updated and revised that preliminary inventory. Similarly, in the future, the amount of special case waste at ORNL can be expected to vary from that listed in this report. By establishing planning categories for special case waste, DOE is acknowledging that the packaging, transport, and disposal of high specific activity radioactive waste materials are expected to be conducted over a time frame measured at least in decades, primarily because of the programmatic complexity required to achieve disposal. As a consequence, for two important reasons, the identification of radioactive waste materials at ORNL that meet the category definitions of special case waste will be an ongoing process.

First, few of the high specific activity radioactive waste materials at ORNL which might be considered as special case waste are neatly packaged and ready for transport. Most of the waste materials are located where they were left when the research programs which produced them were eliminated. This means that assumptions about how this material will be sectioned and packaged must be made in order to determine which planning category best describes the waste materials. These assumptions include the expected means by which the materials will be removed from their current locations, their expected means of volume reduction, and the expected configuration of their final packaging. Because the category criteria for the first four planning categories are dependent either directly or indirectly on package volume (note the measurement units in Tables 1 and 2), these assumptions will often make the difference between compliance with disposal criteria at ORNL and other alternatives. As future waste removal programs at ORNL are funded and defined, the assumptions made during this survey may change.

The second important reason that the identification of special case waste will be an ongoing process is that DOE waste management planning can be expected to change. A credible scenario would be one in which DOE accepts radioactive waste from NRC licensees or other sources for interim storage at ORNL until long-range disposal alternatives for this waste are available. In the following subsections, radioactive waste materials which are either present or anticipated at ORNL are generally compared to the nine planning category definitions of Section 2.1.

2.2.1 Non-certifiable defense transuranic waste at ORNL

It is likely that ORNL will have waste materials which might be in this planning category of special case waste. At this time, however, it is not useful to include such potential materials in this inventory, for two reasons. First, these materials (in their current forms) are well catalogued at both the ORNL and DOE-HQ level as part of the planning for the Waste Isolation Pilot Plant (Oak Ridge National Laboratory 1994, Chapter 3). Second, various ORNL-based treatment and packaging alternatives are under review by DOE, with the objective of transferring as much defense transuranic waste to the Waste Isolation Pilot Plant as possible. If at the end of the review, no treatment and packaging alternative is selected, most of the remotely handled (RH) transuranic waste at ORNL will meet the definition of non-certifiable transuranic waste, by default. If treatment and packaging alternatives at ORNL are selected, then the amount of non-certifiable transuranic waste at ORNL will be dependent on the selected alternatives, since whatever waste materials cannot be treated and packaged for shipment to the Waste Isolation Pilot Plant will meet that planning category definition.

Examples of currently non-certifiable defense transuranic waste materials at ORNL include unsolidified sludges and large concrete structures containing or contaminated with transuranic elements. These remotely handled transuranic waste materials have forms which could require a major procurement line item project to provide a facility at ORNL or an off-site location for their characterization and conversion to a form which meets both the Waste Isolation Pilot Plant acceptance criteria and shipping container restrictions.

2.2.2 Non-defense transuranic waste

Because of its historic role in Manhattan Project and cold war programs, and because transuranic waste materials have not been segregated by programmatic source, ORNL transuranic waste is usually considered defense program transuranic waste. At this time, for example, the transuranic waste materials received from the Nuclear Fuel Services Inc. naval fuel fabrication plant by DOE are being considered for designation as defense program transuranic waste by DOE. In the future, however, it may be necessary to draw a distinction between defense program and non-defense program transuranic waste, particularly if waste is sent to ORNL from other DOE sites. Examples of such waste might then include high efficiency particulate air (HEPA) filters from hot cells, dewatered ion exchange resin, wastes containing americium, and wastes generated from the decontamination and decommissioning of fuel fabrication facilities.

2.2.3 Greater than class C low-level waste

While, historically, ORNL has accepted significant quantities of radioactive waste materials from off-site facilities at DOE direction, nearly all the low-level waste from such sources has been buried at the various ORNL disposal areas; little, if any, is in retrievable storage. In addition to waste from DOE programs, contaminated waste materials from non-DOE sources such as Department of Defense contractors and commercial isotope suppliers were accepted sporadically until about 1984. In the future, however, DOE may accept GTCC low-level waste for retrievable storage at ORNL from Nuclear Regulatory Commission licensees. Examples of GTCC low-level waste at ORNL might then include items such as strontium-90 powered radioisotope thermoelectric generators from non-DOE sources, some hot cell wastes, equipment contaminated with mixed fission products that also contain neutron activation products, sealed sources from commercial operations, or ion exchange resins, sludges, and filter media that contain uranium and technetium-99.

2.2.4 Performance assessment limited waste

Examples of performance assessment limited waste at ORNL include absorbed tritiated liquid, hot cell waste from destructive examination of fuels, reactor internals, sludge and solidified supernatant containing mixed fission products, gauges and dials containing radium-226, and some uranium solids with associated decay products.

2.2.5 Spent fuel and fuel debris

ORNL has conducted extensive research programs for fission reactor fuel design. These have generated a significant amount of spent fuel and fuel debris. Examples of such materials include molten salt reactor fuel, debris from both government and commercial fuel examination studies, and spent fuel from ORNL research reactors. Planning activities are underway for the aluminum clad reactor fuel to be transferred to Savannah River Site for interim storage and all other fuel and fuel debris to transferred to Idaho National Engineering Laboratory for interim storage. An inventory of these materials is being prepared as part of the DOE spent nuclear fuel program (Oak Ridge National Laboratory 1994, Chapter 2). For this reason, this report will not include such materials in this special case waste inventory.

2.2.6 Uncharacterized waste

An example of this category of waste at ORNL would be the containment vessels in which molten salt reactor fuel is currently located. After the fuel is removed, these vessels will require disposal. At this time, the disposal methodology cannot be determined for the vessels, but permanent disposal at ORNL is unlikely, given the expected residual activity of the materials.

2.2.7 Excess nuclear materials

Because of the nature of the research programs conducted at ORNL, waste materials containing any of the "scrap nuclear materials" listed in Section 2.1.7 will most likely be in the form of spent fuel or fuel debris. Some waste materials are present at ORNL, however, which will meet the definition of this planning category. Examples of excess nuclear materials would include plutonium isotopes, encapsulated neptunium, and uranium hexafluoride gas cylinders from isotope separation research.

2.2.8 Sealed radiation sources

ORNL organizations have over a thousand sealed radiation sources which have specific activities high enough to require that they be accountable under the DOE radiation protection regulations. Eventually these sources will become waste and, depending upon how they are packaged, the concentrations of their radioactive materials will probably exceed the criteria set for performance assessment limited low-level waste at the time of disposal.

2.2.9 DOE-titled waste or material held by licensees

At this time, no ORNL organization is accountable for materials in this planning category. In the future, however, it may be possible that DOE-titled waste materials from a Nuclear Regulatory Commission licensee are accepted by DOE at ORNL. Such materials could include sealed radiation sources, uranium fuel elements, uranium slugs, thorium, heavy water, and fission chambers.

2.3 Summary

For planning purposes, DOE has defined nine categories of special case waste. Of these categories, ORNL currently has waste materials which meet the definitions of six: non-certifiable defense transuranic waste, performance assessment limited low-level waste, spent fuel and fuel debris, uncharacterized waste, excess nuclear materials, and sealed sources. For the reasons cited at the beginning of this section, changes in this status can be expected. Because waste management of special case waste will be a long-term effort involving ORNL organizations with different sources of funding, it is more useful for waste management planning to view ORNL special case waste in the context of time and organizational responsibility, rather than by these defined planning categories. The following four chapters represent this viewpoint of special case waste at ORNL.

3. NEWLY GENERATED SPECIAL CASE WASTE AT ORNL

The Oak Ridge National Laboratory currently has a limited capability to generate special case waste. The primary on-site source capability is the High Flux Isotope Reactor. The reactor can generate special case waste from basic reactor operations (i.e., as spent fuel or as scrap reactor internals), or from the generation of irradiated target materials for various DOE programs. The irradiated target materials are usually transferred to other ORNL divisions; that is, the responsibility for the ultimate disposal of these materials actually transfers from Research Reactors Division (RRD) to another ORNL division. The ORNL divisions which receive the irradiated materials then become responsible for the storage and disposal of any secondary special case waste derived from the target materials.

There are two exceptions to this. The first exception would be an item of irradiated material from reactor operations requiring examination or modification by another ORNL division; the waste derived from these activities may or may not become the responsibility of Research Reactors Division. The second exception would be an item of irradiated material shipped from ORNL to an off-site program; the waste derived from the program may or may not become the final responsibility of an ORNL division.

3.1 Research Reactors Division

Presently, ORNL Research Reactors Division operates one nuclear reactor. The High Flux Isotope Reactor, Building 7900, generates special case waste from basic reactor operations as spent fuel, as irradiated target materials or as scrap reactor internals. The responsibility for the ultimate disposal of the fuel and scrap reactor internals is that of Research Reactors Division. The reactor generates about one core (i.e., one inner and one outer fuel element) per month of spent fuel and fuel debris. The reactor generates an average of about 350,000 Ci of performance assessment limited low-level waste (scrap reactor internals) per ten year period (Section 5). Additionally, the reactor produces about four containers per year of low-level waste which must be stored as if it were special case waste because of the current way the waste is packaged (Section 6.2).

This special case waste is either stored at the reactor (RRD pool storage), stored away from the reactor at an ORNL Waste Management and Remedial Action Division area (as RRD cask storage), transferred to ORNL Waste Management and Remedial Action Division for interim storage pending final disposal (WMRAD retrievable storage), or transferred to another DOE site (for DOE processing and/or disposal).

3.2 Chemical Technology Division

The Chemical Technology Division operates a set of radioactive material research facilities with the capability to process and handle materials with a high specific activity. Generally the facility managers make every effort to avoid generating special case waste from basic research operations because of the cost penalty and waste management difficulties associated with such materials. For example, Building 7920 generates more than 95% of contact handled transuranic waste and all the remotely handled transuranic waste at ORNL. Great care is taken to insure that transuranic waste materials from this facility are characterized and packaged in a form that allows the waste to be certified for disposal at the Waste Isolation Pilot Plant. Similarly, radioactive waste materials from the division hot-cell research facilities are characterized and packaged in a form that allows the waste to be certified for disposal as transuranic or low-level waste. As research programs are curtailed, however, the facilities can be expected to remain useful to DOE for the processing and packaging of special case and other high specific activity waste materials. In this situation, the responsibility for the ultimate disposal of these materials after their processing and packaging will remain with the DOE program which receives the processed and packaged materials; that program can be expected to become responsible for the storage and disposal of any secondary special case waste derived from the materials as well.

As the Chemical Technology Division operates radioactive material research facilities in support of waste management or environmental restoration activities, some high specific activity waste will necessarily be generated. As an example, a prototype treatment process is being developed to reduce the volume of transuranic and fission product isotopes in the liquid waste streams going to the Melton Valley Storage Tanks. The process would be expected to generate a small volume of residual solid waste materials (resin) with the potential to be non-certifiable defense transuranic special case waste. Similarly, experiments and studies related to the treatment of waste from the tanks would be expected to generate a small volume of residual solid waste materials with the potential to be performance assessment limited low-level special case waste. In any case, continued hot cell and glove box operations will require eventual hot cell upgrades or dismantling operations. These are expected to produce a small volume of performance assessment limited low-level special case waste. At present, the division is not generating special case waste.

3.3 Metals and Ceramics Division

The Metals and Ceramics Division also operates a set of radioactive material research facilities with the capability to process and handle materials with a high specific activity. For example, Building 3525 has hot cells equipped to dismantle and examine spent fuel element sections and reactor target materials. Again, the facility managers make every effort to avoid generating special case waste from basic research operations because of the cost penalty and waste management difficulties associated with such materials. For example, great care is taken to insure that low-level waste from these facilities is characterized and packaged in a form that allows the waste to be certified for disposal at ORNL. As research programs are curtailed, however, the facilities can be expected to remain useful to DOE for the processing and packaging of special case and other high specific activity waste materials. In this situation, the responsibility for the ultimate disposal of these materials after their processing and packaging will remain with the DOE program which receives the processed and packaged materials; that program can be expected to become responsible for the storage and disposal of any secondary special case waste derived from the materials as well.

As the Metals and Ceramics Division operates radioactive material research facilities in support of waste management or environmental restoration activities, some high specific activity waste will necessarily be generated. Treatment and packaging of spent fuel and fuel debris are expected to generate a small volume of residual solid waste materials with the potential to be performance assessment limited low-level special case waste. In any case, continued hot cell and glove box operations will require eventual hot cell upgrades or dismantling operations. These are expected to produce a small volume of performance assessment limited low-level special case waste. At present, the division is not generating special case waste.

3.4 Summary

At present, the Oak Ridge National Laboratory has a limited capability to generate special case waste, primarily at the High Flux Isotope Reactor. The reactor operations are expected to continue for at least five to ten years, so spent fuel and scrap reactor internals will be generated on a routine basis. The facilities operated by the Chemical Technology Division and the Metals and Ceramics Division represent resources which DOE can be expected to utilize in its future waste management activity. If utilized for this purpose, the routine waste treatment and packaging activities and the normal repair and maintenance of these facilities can be expected to result in a small volume of special case waste. Table A-2 summarizes the expected new generation of special case waste at ORNL.

4. GENERATOR SCW STORED AT GENERATOR FACILITIES AT ORNL

Several organizations have active and inactive facilities at ORNL which hold waste materials that may meet the special case waste planning category criteria.

4.1 Research Reactors Division

Waste materials from the High Flux Isotope Reactor are being stored in the reactor fuel storage pool until disposal is available. As the reactor is operated, spent fuel elements and scrap reactor internals will be removed for pool storage until the waste materials can be taken off-site for either disposal or reprocessing, or stored on-site at a WMRAD location. A fuel pool inventory is maintained by the division. A ten-year accumulation of scrap reactor internals was removed from the pool to away-from-reactor storage in early 1995 (Section 5); consequently, the special case waste in the pool is now primarily spent fuel.

4.2 Metals and Ceramics Division

This division has two facilities in which uncharacterized waste is present that might meet the criteria of a special case waste planning category if it were characterized and packaged.

4.2.1 Irradiated Materials Examination & Testing Facility, Building 3025E

Continued operation as well as repair and maintenance of this facility is expected to produce waste materials with a high specific activity. At the present time, a relatively small volume of uncharacterized waste is stored in the hot cell area. Approximately 20 cans (5.5-in. diameter, 10-in. long cylinders) of specimens from discontinued irradiation programs have been accumulated. If considered as waste, the material would be considered to be in the "uncharacterized waste" category of special case waste. An additional 20 to 30 more cans of waste, from more recent campaigns, are also awaiting disposal. Some of the waste is likely to meet the definition for performance assessment limited low-level waste, excess nuclear material, or possibly sealed radiation source waste, depending on its final characterization and packaging. No more storage space is available at this time and no funding is available for the disposal of this waste from discontinued programs. A detailed inventory of the specimens is available.

4.2.2 Irradiated Fuels Examination Laboratory, Building 3525

Continued operation as well as repair and maintenance of this facility is expected to produce waste materials with a high specific activity. At one time the majority of ORNL waste which could be considered as spent fuel debris came from research activities conducted in this facility. At the present time, the facility is in transition from research activities; renovation of the hot cell areas can be expected. While no specific items of special case waste have been identified in the hot cells, it is likely that a relatively small volume of uncharacterized waste remains in the hot cell area, having the potential to be classified as performance assessment limited low-level waste or possibly fuel debris waste, depending on its final characterization and packaging. No funding is available for the disposal of this waste from discontinued programs. No further data associated with the special case waste inventory can be determined until the facility has been repaired and cleaned.

4.3 ORNL Sealed Source Inventory

Sealed calibration or research radioactivity sources are on hand at many ORNL division facilities. As programs change, many of these sources will no longer have a planned use. If viewed as waste, most of these materials will generally meet low-level waste, mixed low-level waste, or transuranic waste acceptance criteria. About 1300 of these sources, however, exceed the exempt activity level listed in Appendix B of G-N 5400.9/M1, the DOE implementation guide for sealed radioactive source accountability and control. In general, if a sealed source is exempt from accountability under this guide, it will not exceed the ORNL performance assessment limits for near-surface disposal as low-level waste. If, however, a source is accountable under the implementation guide criteria, then it may be above the performance assessment limits, depending on the source packaging or the actual activity at the time of disposal. An ongoing project is being conducted by ORNL Office of Radiation Protection to provide an itemized listing and description of each accountable sealed source on hand at ORNL divisions in response to the implementation guide requirements. This list makes an excellent data base for identifying sources which might meet the criteria of the radioactive source planning category of special case waste. Using an assumed final waste package volume of one cubic foot or an assumed package mass of 1000 grams, a preliminary review of the list of ORNL accountable sources indicates that perhaps 200 of the 1300 listed items will meet the criteria of the radioactive source planning category of special case waste because, at the assumed package volume or mass, the materials will exceed the ORNL performance assessment limits. Using the assumed final package volume or mass, perhaps another 160 listed items would be considered transuranic materials; some of these may not be certifiable for disposal at the Waste Isolation Pilot Plant because of their current form. Using different assumptions for the final package mass may place some of these materials in the performance assessment limited planning category of special case waste.

4.4 Environmental Restoration Organization

This Lockheed Martin Energy Systems organization oversees the closure and remediation of ORNL nuclear or radiological facilities and areas which have no further planned use. The organization manages a wide array of formerly used and partially used nuclear and radiological facilities at ORNL. Some, such as the ORNL Graphite Reactor (Building 3001 and associated buildings) and the Oak Ridge Research Reactor (Building 3042 and associated buildings) have been defueled and are used for office areas; residual contamination remains in these facilities, but it will be unlikely that waste meeting the criteria of a special case waste planning category will be generated when the facilities are eventually decontaminated. The current forecast of waste expected from the remediation of the waste area grouping operable units (inactive ORNL disposal sites) does not indicate materials which might meet special case waste criteria (Oak Ridge National Laboratory 1994). Other facilities clearly contain uncharacterized radioactive waste materials which, no matter how much practical characterization, treatment, and packaging is made, will never meet the acceptance criteria for permanent disposal at ORNL, and are not likely to meet the criteria at an off-site permanent disposal facility. The facilities that may contain radioactive waste materials which might meet the criteria of a special case waste planning category if it were characterized and packaged are listed below. All of these facilities will require substantial programmatic funding before they can be released for unrestricted use; some are currently in shutdown programs in which surplus radioactive materials inventories are scheduled for removal and the facilities are placed in a safe condition; others are in decontamination and decommissioning programs, the last stage before release of a facility for unrestricted use. Table 3 lists the facilities reviewed for this report.

4.4.1 Molten Salt Reactor Experiment (MSRE), Building 7503

This liquid fuel reactor still contains its fuel inventory. Unlike a clad fuel system, most of the internal reactor components were contacted and activated by the fuel during reactor operations. A significant inventory of highly activated scrap metal components will remain after the fuel is eventually removed. A preliminary inventory has been prepared based on the current proposed plan for fuel removal. At this time, the areas that may contain radioactive waste materials which might meet the criteria of a special case waste planning category are located in Building 7503.

4.4.2 Homogeneous Reactor Experiment (HRE), Building 7500

This liquid fuel reactor has had its fuel inventory removed. Like the MSRE, most of the internal reactor components were contacted and activated by the fuel during reactor operations. A significant inventory of highly activated scrap metal components remain. A preliminary inventory has been prepared based on the known reactor characteristics; however, the site was later used for other activities including spent fuel meltdown studies, and little documentation about residual waste materials remains. At this time, the areas that may contain radioactive waste materials which might meet the criteria of a special case waste planning category are located in Building 7500.

4.4.3 Bulk Shielding Reactor (BSR), Building 3010

This pool reactor still contains its fuel inventory as well as fuel from the Oak Ridge Research Reactor. Due to the reactor system design, the inventory of potential special case waste will be limited to the spent fuel and a relatively small quantity of highly activated scrap metal components which will remain after the fuel is eventually removed. An inventory of the radioactive materials has been prepared by Research Reactors Division. At this time, the areas that may contain radioactive waste materials which might meet the criteria of a special case waste planning category are located in Building 3010.

Table 3 ORNL facilities undergoing remediation or closure

Remediation Program	Shutdown Program	Decontamination and Decommissioning
WAG 1 Main Area (10 operable units)	Bldg 3010 Bulk Shielding Reactor and associated buildings [a]	Bldg 2654 Sewage Digester
WAG 2 White Oak (2 operable units)	Bldg 3026C Krypton Enrichment	Bldg 3001 Graphite Reactor and 3 associated support buildings
WAG 3 Solid Waste Storage Area (SWSA) 3 (1 operable unit)	Bldg 3026D Segmenting Cell	Bldg 3005 Low Intensity Test Reactor and 2 associated support buildings
WAG 4 SWSA 4 (3 operable units)	Bldg 3028 Alpha Power	Bldg 3042 Oak Ridge Reactor and 15 associated support buildings
WAG 5 SWSA 5 (1 operable unit)	Bldg 3029 Source Development [b]	Bldg 3505 Metal Recovery
WAG 6 SWSA 6 (8 operable units)	Bldgs 3030, 3031, 3032, 3033, and 3118 Isotope Production	Bldg 3506 Waste Evaporator
WAG 7 Melton Valley (2 operable units)	Bldg 3033A Actinide Fabrication	Bldg 3515 Fission Product Pilot Plant
WAG 8 HFIR area (1 operable unit)	Bldg 3034 Area Services	Bldg 3517 Fission Product Development Laboratory (5 areas)[b]
WAG 9 Homogeneous Reactor area (1 operable unit)	Bldg 3038 (3 areas)[b]	Bldg 4507 High Level Chemical Development
WAG 10 New Hydrofracture area (3 operable units)	Bldg 3047 Isotope Technology	Bldg 7500 Homogeneous Reactor and 9 associated support buildings [b]
WAG 11 Scrap Yard (1 operable unit)	Bldgs 3093, 3099 Krypton Storage and Storage Pad	Bldg 7503 Molten Salt Reactor and 8 associated support buildings [a]
WAG 13 Test Plots (1 operable unit)	Bldg 3517 Fission Product Development (except 5 areas)[b]	Bldg 7852 Old Hydrofracture and 3 associated equipment areas
WAG 21 Groundwater	Bldg 7025 Tritium Target	Bldg 9201-3 (3 areas)
	Bldg 7600 Robotics and Process Systems and associated buildings	Bldg 9419-1 Decontamination
	Bldg 7700 Tower Shielding Facility and associated buildings [a]	5 Shielded Transfer Tanks

[a] Spent fuel present

[b] Likely to have waste meeting special case criteria

4.4.4 Tower Shielding Facility (TSF), Building 7700

This reactor still contains its fuel inventory. Due to the reactor system design, the inventory of potential special case waste will be limited to the spent fuel and a relatively small quantity of highly activated scrap metal components which will remain after the fuel is eventually removed. An inventory of the radioactive materials has been prepared by Research Reactors Division. At this time, the areas that may contain radioactive waste materials which might meet the criteria of a special case waste planning category are located in Building 7700.

4.4.5 Former isotope separation and production facilities

The remaining inventory of radioisotopes from these facilities is awaiting planned transfer to other sites and organizations. In addition to this radioisotope inventory, a significant amount of highly activated scrap metal components remains in the former Fission Product Development Laboratory, Building 3517. A very small amount of highly activated scrap metal components remains in Buildings 3029 and 3038. An inventory has been prepared by Chemical Technology Division.

4.5 Excess Nuclear Materials

ORNL organizations hold nuclear materials for current and future use. Should the materials become surplus, they are usually declared as scrap and transferred for further use as part of nuclear materials management programs. Surplus materials exceeding the economic discard limit which cannot be transferred for lack of a further use or for technical reasons are held either in their current facility or at the special nuclear materials vault in Building 3027. In the past, excess nuclear materials have been reported as special case waste. However, recent DOE programs to consolidate isotope stockpiles have been able to relocate most of the excess materials to other sites or organizations. (One such stockpile is the U-233 in Building 3019, managed directly by DOE and held in the Chemical Technology Division facility.) Unlike other sites, such as K-25, the nature of excess nuclear material at ORNL usually precludes its residence at ORNL for more than a year or so before it is transferred for reuse elsewhere; about ten scrap declarations are currently in progress. Current DOE nuclear materials management programs, therefore, have made the presence of excess nuclear material a relatively transient problem with little impact at present on DOE and ORNL long-term waste management planning. Since a day-to-day inventory of these materials is available from ORNL

Nuclear Materials Accountability Department if needed, an inclusion of an inventory of these relatively high turnover items is not useful for this report. It should be noted, however, that this situation could change, either as a result of program changes at other sites or if DOE begins accepting such materials from NRC licensees.

4.6 Summary

Several organizations other than ORNL Waste Management and Remedial Action Division have active and inactive facilities at ORNL which hold waste materials that may meet the special case waste planning category criteria. These materials are the responsibility of the organizations until the materials have been declared as waste, characterized, and packaged for disposal. Particular care must be taken in the assumptions used for packaging volumes when small volume, high activity wastes such as radiation sources are packaged (Section 4.3). Table A-3 summarizes the known special case waste at ORNL generator areas.

5. GENERATOR SCW STORED AT WASTE MANAGEMENT AREAS

There exists a need for organizations other than ORNL Waste Management and Remedial Action Division to place high specific activity materials in long-term interim storage away from the location where the materials are generated or used. This can be done at a waste management location which already has the necessary monitoring and surveillance functions available. These materials are the responsibility of the organizations until the materials have been declared as waste, characterized, and packaged for disposal. At this time, Research Reactors Division has a shielded storage cask containing High Flux Isotope Reactor internals located at a waste management site in SWSA 6. This storage enables the division to keep the reactor fuel storage pool relatively clear of reactor internals scrap metal. An inventory of the radioactive materials has been prepared by Research Reactors Division. As currently packaged, the scrap metal exceeds the ORNL performance assessment limits for H-3, Ni-63, Co-60, Eu-152, and Eu-154. The Environmental Restoration organization is planning to transfer surplus isotope inventory from former isotope separation and production facilities to a waste management site in SWSA 6 in order to provide continuity in shutdown projects and free valuable hot cell operations capability at ORNL. This practice can be expected to increase as other organizations at ORNL also store materials away from their operating locations. Table A-4 summarizes the known special case waste belonging to an ORNL generator, but stored at a waste management site.

6. WASTE MANAGEMENT SCW STORED AT WASTE MANAGEMENT AREAS

The ORNL Waste Management and Remedial Action Division holds the bulk of the ORNL waste materials that are considered to be special case waste. These materials are held in retrievable storage facilities at Solid Waste Storage Areas 5 and 6.

6.1 Facility 7822A

Facility 7822A is the designation given a group of retrievable storage wells located in SWSA-6. Two storage wells contain waste packages with contamination levels which exceed the ORNL performance acceptance limits.

6.2 Facility 7822J

Facility 7822J is the designation given a storage pad located in SWSA-6. The pad has been used since 1995. Waste packages containing special case waste can be expected at this location in the future. The pad is currently holding two containers of low-level waste materials which are stored as special case waste because of the current way the waste is packaged. As packaged, the waste cannot be physically placed in the ORNL low-level waste tumulus disposal without further analysis and/or special fixtures. Final disposal alternatives for these materials include repackaging in standard tumulus disposal packaging, alternative near-surface disposal on-site, and near-surface disposal off-site.

6.3 Facility 7823A

Facility 7823A is the designation given to the eight SWSA-5N retrievable storage wells located adjacent to Building 7823. The wells are stainless steel-lined auger holes covered with either a steel or concrete lid. The wells were used from 1972 to 1975. There are nine separate storage containers, either drums or welded tubes, buried in sand, within the wells. The waste materials in the storage containers are currently uncharacterized or poorly characterized. Dose equivalent rates produced by (or associated with) the waste are greater than 200 mrem/hr at container surfaces. Only one container of waste, as packaged, will fall below ORNL performance assessment limits for transuranic and fissile isotopes. The dose rate and the fact that the other eight containers of waste contain plutonium-239 in curie quantities make this remaining waste RH transuranic waste by definition. These eight containers of waste have not been certified for Waste Isolation Pilot Plant disposal, but may be certifiable after repackaging. The waste may or may not have resulted from defense program activities. The original storage records are not available. The waste was transferred to the wells from both the Chemical Technology and Metals and Ceramics Divisions. This means that depending on the final characterization of the waste, packaged waste from the 7823A storage facility may be certified as low-level waste or defense transuranic waste for the Waste Isolation Pilot Plant (i.e., not special case waste), or it may be classified as non-certifiable defense transuranic waste, spent fuel or fuel debris (most likely), performance assessment limited low-level waste, or excess nuclear materials.

6.4 Facility 7827

Facility 7827 is the designation given to the fifty-four retrievable storage wells located near the center of SWSA-5N. The wells are stainless steel-lined auger holes covered with a concrete lid. The wells have been used since 1976. There are usually multiple storage containers, either drums or welded tubes, within the wells. The waste materials in the storage containers are poorly characterized. Dose equivalent rates produced by (or associated with) the waste are much greater than 200 mrem/hr at container surfaces. Most of the waste is either spent fuel and fuel debris or waste, when packaged, which will exceed ORNL performance assessment limits. The waste was transferred to the wells from both the Chemical Technology and Metals and Ceramics Divisions.

6.5 Facility 7829

Facility 7829 is the designation given to the ten retrievable storage wells located near the center of SWSA-5N. The wells are stainless steel-lined auger holes covered with a concrete lid. The wells have been used since 1975. There are fourteen storage containers within the wells. The waste materials in the storage containers are poorly characterized. Dose equivalent rates produced by (or associated with) the waste are much greater than 200 mrem/hr at container surfaces. The waste is spent fuel and fuel debris from the Peach Bottom reactor. The waste was transferred to the wells from Metals and Ceramics Division.

6.6 Facility 7841

Facility 7841 is the designation given to the contaminated equipment storage yard. Items of contaminated equipment which cannot be easily decontaminated are stored in the yard. The equipment items are currently uncharacterized. It is expected that after the equipment is dismantled and decontaminated, some portions of the equipment may have activated components or fixed contamination levels which exceed the ORNL performance acceptance limits. Two packages at the yard have waste materials which exceed the limits.

6.7 Facility 7842A

Facility 7842A is the designation given to a special case waste storage pad located near the center of SWSA-6. The storage pad has been used since 1991. The waste materials in the storage containers are characterized. Currently Research Reactors Division has a cask placed on the pad for interim storage (Chapter 5). There are 215 casks of solidified liquid low-level waste from the Melton Valley Storage Tanks which exceed the ORNL performance assessment limit for Cs-137. Recently, an off-site storage alternative for these casks at Nevada Test Site (NTS) has been proposed. At this time, this report will catalogue these waste materials as special case waste, for two reasons. First, these materials (in their current forms) are well characterized and currently listed on the ORNL waste tracking system as special case waste. Second, the NTS storage alternative is best characterized as a short-term expedient, rather than as a planned long-term option; it may not materialize or may be curtailed suddenly. If in the future these casks are shipped to NTS, they can be removed from this catalogue.

6.8 Interim Waste Management Facility

Pad 4 of the Interim Waste Management Facility is holding four waste packages containing materials with contamination levels which exceed the ORNL performance acceptance limits.

6.9 Liquid Low-level Waste Facilities

ORNL has an active liquid low-level waste transfer system which will continue to undergo significant upgrading and modification. Shutdown and replacement operations involving older or no longer useful equipment will generate radioactive waste. At this time, no specific items of equipment have been identified as special case waste, but the potential to generate such waste exists.

6.10 Summary

The ORNL Waste Management and Remedial Action Division holds the bulk of the ORNL waste materials that would be considered without question as special case waste. These materials are held in retrievable storage facilities at the solid waste storage areas operated by the division. It should be noted again that this report does not catalogue ORNL waste materials which might be considered in the planning category of non-certifiable defense transuranic special case waste for the reasons given in Section 2.2.1. If no ORNL treatment and packaging alternative for defense transuranic waste is selected, most of the remotely handled transuranic waste at WMRAD sites will meet the definition of non-certifiable transuranic waste, by default. Such waste would include unsolidified sludges at the Melton Valley Storage Tanks and large concrete storage casks containing or contaminated with transuranic elements (SWSA-5N). Table A-5 summarizes the known special case waste held by WMRAD.

7. SPECIAL CASE WASTE DATA BASE

Between October 1994 and October 1995, a data base was established at ORNL to provide a current inventory of the radioactive waste materials, located at ORNL, for which DOE has no long-range planned disposal alternatives. To assist ORNL and DOE management in future planning, an inventory system was established and a baseline inventory prepared.

7.1 Data Collection

The waste generator certification officials (GCOs) for each ORNL division were contacted in writing and by telephone to identify any waste that could be considered special case waste. While the DOE SCW planning categories were used to convey specific definitions of special case waste to the GCOs, the area of interest was deliberately kept broad in order to avoid overlooking materials which might become of interest as the planning categories change in the future. From the initial results of the contacts, however, it became clear that the GCOs tended to focus on radioactive materials which have been explicitly denoted as "waste," as well as immediate waste management problems such as characterization requirements, lack of ORNL facilities to decontaminate or dismantle equipment items with high specific activity, etc. The information gathered from the GCOs was valuable for current waste management planning, but did not give a complete picture of the potential for special case waste generation at ORNL. A second contact cycle was initiated; this time the facility managers for each ORNL division were contacted to identify any waste that could be considered special case waste. As expected, the facility managers were able to focus on the long-term planning aspects of the survey as well as to identify materials which might not now be denoted as "waste," but which would almost certainly become special case waste in the future. The experience of the facility managers in waste management was very helpful in that much of the need to explain terminology and concepts was shortened. As the data base is updated in the future, both the facility managers and the GCOs should be contacted, preferably together, to give the best status of potential high specific activity waste at the ORNL divisions.

After identifying ORNL divisions with potential special case waste, a survey was conducted at the division to collect more detailed information. Initially a survey form was prepared, using the information items that had been originally requested by DOE in its 1991 request for information. The use of the survey form proved to be largely impractical for two important reasons. First, radioactive materials at ORNL which have the potential to be special case waste are usually not characterized and certainly are not characterized well enough for detailed waste management planning. Because the materials are highly radioactive and because facilities and funding for remotely handled sampling and analysis of such materials are in short supply, little or no detailed information is likely to be available in the short term. Second, few of these materials are packaged, in the sense that they can be readily shipped if a means of transportation and a disposal site are available. Usually some characteristic of the material is known that indicates the potential for generation of special case waste, but the volume, activity per unit mass, etc. must await any treatment, characterization, and packaging steps required for off-site disposal. For purposes of placing the materials in the appropriate DOE special case waste planning category, some assumptions about final packaging and mass were made which will be discussed further below.

Once radioactive materials had been identified with the potential to be special case waste, other ORNL information sources were reviewed to gain additional information and to avoid redundancy or waste classification errors. This was especially difficult for materials from programs which have been terminated for many years. Unlike DOE sites with single missions and continuous process facilities, as a true laboratory ORNL has used and reused both facilities and materials for many different research efforts. Often radioactive materials, equipment, and work areas have little available documentation because a research program was suddenly terminated, and funds for cleanup, characterization, and packaging of waste items were not available at the time of termination.

7.2 Data Elements

Most data management processes are constructed by the sorting of data stream elements into appropriate storage categories. This was not possible for this survey, since there is no stream of waste data available as explained above. Instead, a data storage array was first constructed that can be filled by the waste data which will eventually become available over time. The storage array and the data elements were selected on the basis of the experience of the ORNL Waste Management and Remedial Action Division in anticipating the type and level of detail necessary to transfer waste off-site for permanent disposal.

The storage array was organized into six data base tables: waste characteristics, waste radioactivity, waste transport requirements, waste packaging requirements, waste storage facility requirements, and waste safeguards and security requirements. For flexibility of report generation, a relational data base manager software program was chosen. Such a relational data base requires that a key data element be constructed to relate all data tables. This key element, a unique waste package identifier, had to be different from identification number systems used by the ORNL waste management organization because not all the potential ORNL special case waste is currently the responsibility of that organization, nor is the waste in discrete packages.

The use of this key data element, however, requires that assumptions be made about how a waste form will be sectioned for disposal purposes. For example, the spent fuel of the molten salt reactor experiment is currently contained in tanks in a hot cell. Discussions with decommissioning personnel indicate that the spent fuel will be removed from the tanks and that the tanks and other activated equipment will be removed separately later. Consequently, the spent fuel itself was identified as a separate "waste package"; the tanks and other equipment were identified individually as other waste packages. Eventually as decommissioning proceeds and the fuel is removed into actual shipping packages, the original waste package key data element used in the data base for the spent fuel can be easily subdivided into the appropriate sections as required.

For the situation in which ORNL waste management has already assigned a waste package identifier (such as an ATN-series or LLN-series number), a key data element identifier was assigned to the package on a one-to-one basis, since it is unlikely that the waste contents of the package will change, even after repackaging in the future. For the situation in which the waste exists already in discrete packages (such as sealed radiation sources), a key data element identifier was assigned to the package on a one-to-one basis to avoid confusion in waste tracking, even though it is likely that the waste package contents will change after future repackaging.

The waste characterization table contains the following data elements in addition to the key data element package identifier: generator identification, waste location, physical form of the waste, SCW planning category, ORNL SCW type, mass of waste without packaging, type of absorption/solidification media, volume per cent of solids, volume per cent of free liquid, volume per cent of solidified liquid, volume per cent of unpressurized gas, volume per cent of pressurized gas, weight per cent of particles having a mean diameter less than 10 microns, weight per cent of particles having a mean diameter less than 200 microns, chemical constituents of the waste, hazardous characteristics (corrosivity, reactivity, ignitability, toxicity) and hazardous constituents as defined by the EPA, hazard category and hazardous constituents as defined by the Occupational Safety and Health Administration, certification method, nuclear criticality safety requirements, source of the waste data, and special notes.

The waste radioactivity table contains the following data elements in addition to the key data element package identifier: UCN Form 2822 or 2109 waste classification, UCN Form 2822 or 2109 waste type, total waste activity, radioactive constituents of the waste and their activity components, beta-gamma radiation of the waste package, beta-gamma surface contamination of the package, alpha surface contamination of the package, neutron radiation of the package, last activity decay calculation date, and whether decay daughter radiation has been considered.

The waste transportation information table contains the following data elements in addition to the key data element package identifier: transport material handling requirements, transport confinement requirements, transport shielding requirements, transport cooling requirements, and transport restrictions.

The waste packaging information table contains the following data elements in addition to the key data element package identifier: package type, package shape, package length, package width, package height, package volume, package weight, package diameter, package shielding, package confinement, and package vent information.

The waste storage facility information table contains the following data elements in addition to the key data element package identifier: specific facility location, facility material handling requirements, facility confinement requirements, facility shielding requirements, facility cooling requirements, and facility restrictions.

The waste safeguards and security information table contains the following data elements in addition to the key data element package identifier: safeguards considerations, security considerations, special nuclear materials, other nuclear materials, and source materials.

7.3 Data Entry

A relational data base management program was selected so that a variety of reports concerning different aspects of the data could be prepared, using different sorting criteria. Microsoft ACCESS was chosen for simplicity, user-friendliness for personnel unfamiliar with data management software, compatibility with larger, more expansive data base management software, economics, and portability. In addition, the current version of ACCESS is particularly well-suited for data entry using restricted selection lists (menus) and pushbutton commands. This tends to insure uniformity throughout the data fields. Using the program, a set of electronic data entry forms was prepared that enable an unfamiliar user to add information to the data tables in a manner which insures that the data being added are compatible with data already in the table. This is a particularly important consideration when the time frame over which the data will be used is considered.

The first step in data entry is the determination of what constitutes the "waste package" and the selection of the key waste package identifier. For waste which has been previously characterized and packaged, this is a straightforward exercise. For waste which has not been characterized or packaged, judgement must be applied in predicting the most likely final form of the waste before off-site shipment. This requires some consideration of the form of the waste, the expected type, size, and volume of a discrete package of the waste, and the specific activity of the waste. The personnel making these judgements should have some experience in radioactive waste packaging. Of particular importance in this determination is the judgement as to how a small object such as a radiation source will be packaged for disposal. For example, if the disposal criteria for a 0.1 cubic foot source capsule allowed no overpacking of the capsule in a larger container such as a drum or metal waste box, the activity concentration of the package would be much higher than if the volume of a 96.4 cubic foot waste box is used as the package volume. This difference in activity concentration could affect whether or not the waste material is designated as special case waste. The NRC has recently established guidelines for acceptable practices in this decision-making (NRC 1995). While DOE has not issued such guidelines, it is likely that they will be applied at DOE sites. An understanding of the current and projected capabilities at ORNL for the characterization, treatment, and packaging of RH waste materials will be of great value, as will detailed discussions with divisional personnel who have actually been involved with the original generation of the waste materials.

Once a provisional special case waste package has been given a key waste package identifier, any package data that are available are added to the data tables by selecting the electronic data entry form to be used, inserting the key waste package identifier at the top of the form, and then selecting the appropriate menu item or inserting a quantitative number in an appropriate location on the electronic form. Alternatively, for repetitive data, data may be added to the data storage tables directly. As with any data acquisition process, a quality assurance activity must be conducted manually after data has been entered before this second step is complete. Each data element should be reviewed in the context of the data storage array to insure that the data elements in the array will be compatible. Of particular importance is the necessity to check the precise wording of any technical terms to avoid confusion. When extracting information from waste management forms completed prior to the mid-1980s; for example, confusion can occur if the GCO or radiation protection technician considered the on-site transport device ("carrier") for RH waste materials as part of the "waste package" when they filled out the waste management form. This can introduce errors of large magnitude in package weight and volume and significant underestimation of radiation fields. Similarly, the terms "fissile material" and "enriched uranium" were frequently misused on early waste management forms to describe U-235 isotope measurements in depleted uranium, normal uranium, or denatured uranium waste. Again, detailed discussions with divisional personnel who have actually been involved with the original generation of the waste materials will insure that the data entered in the data base accurately represent characteristics of the waste.

Data entry is expected to be a periodic process as the ORNL divisions are checked annually for changes in operations which might affect the ORNL special case waste inventory, or changes in the information available about a waste form or package.

7.4 Data Manipulation

A relational data base allows the manipulation of the data elements from multiple storage tables in response to a specific query. A query can be as simple as a printout of a complete data storage table, or as complex as a comparison of data elements from different tables to some discrimination value for a specific type of waste. This flexibility allows the data base to support different uses of the data and varied requests for information. Since the data base will be utilized over a long period of time, and since it can be expected that the sorting and storing of data elements will occur over a long period of time, query flexibility will be a important capability for the data base. Some examples of the kinds of reports available from the data base are shown in the appendix.

This flexibility is also important because the special case waste planning category definitions can be expected to change. The criteria for inclusion of a waste in a category may change or a category may be added or removed. Such changes should have minimum effect on the data base because data fields may be added or subtracted to any table and tables may be added or subtracted at any time. The data manipulation is only affected if the data element which relates all the data fields in all the tables (the key waste package identifier) is changed. The key waste package identifier was selected as the relational data element that will be least likely to change in the future.

7.5 Summary

Information items pertaining to waste materials at ORNL with the potential to be DOE special case waste have been stored in a relational data base for periodic update and interrogation by the WMRAD Radioactive Solid Waste Operations Group others involved in long range planning. Much of the information which will be needed for the final off-site disposal of these materials will remain unavailable until funds are provided for characterization, treatment, and packaging of these waste materials. The data base has been configured around the type of information which experience has shown to be necessary for final disposal and will be updated periodically as the information becomes available.

8. CONCLUSION

Between October 1994 and October 1995, a data base was established at the Oak Ridge National Laboratory to provide a current inventory of the radioactive waste materials, located at ORNL, which meet the Department of Energy definitions of special case waste. Special case waste is that waste material which, no matter how much practical characterization, treatment, and packaging is made, will never meet the acceptance criteria for permanent disposal at ORNL, and does not meet the criteria at a currently planned off-site permanent disposal facility. For planning purposes, DOE has defined nine categories of special case waste. Of these categories, ORNL currently has waste materials which meet the definitions of six: non-certifiable defense transuranic waste, performance assessment limited low-level waste, spent fuel and fuel debris, uncharacterized waste, excess nuclear materials, and sealed sources. Changes in this status can be expected, particularly if DOE accepts waste materials from NRC licensees for interim storage at ORNL.

At present, ORNL has a limited capability to generate special case waste, primarily at the High Flux Isotope Reactor. The reactor operations are expected to continue for at least five to ten years, so spent fuel and scrap reactor internals will be generated on a routine basis. The hot cell research facilities operated by the Chemical Technology Division and the Metals and Ceramics Division represent resources which DOE can be expected to utilize for routine waste treatment and packaging activities; the normal repair and maintenance of these facilities can be expected to result in a small volume of special case waste.

Several organizations other than ORNL Waste Management and Remedial Action Division have active and inactive facilities at ORNL which hold residual waste materials from previously curtailed operations. The bulk (by volume) of these materials will meet the planning category of spent fuel and fuel debris. A smaller amount of these waste materials will meet other special case waste planning category criteria. These other materials will be the responsibility of the organizations until the materials have been declared as waste, characterized, and packaged for disposal. At this time only a general identification and estimate of these materials can be made because funding for planning, characterization, and packaging of these waste materials is not currently available. It can be expected that organizations other than ORNL Waste Management and Remedial Action Division will have a limited need to place high specific activity materials in long-term interim storage away from the location where the materials are generated or used. At this time, Research Reactors Division has a shielded storage cask containing High Flux Isotope Reactor internals located at a waste management site in SWSA 6. This storage enables the division to keep the reactor fuel storage pool relatively clear of reactor internals scrap metal. Similar storage will be needed as facilities belonging to these other organizations are cleared of spent fuel or other high specific activity waste materials.

The ORNL Waste Management and Remedial Action Division holds the bulk of the ORNL waste materials that would be considered as special case waste. These materials are held in retrievable storage facilities at the solid waste storage areas operated by the division. It should be noted again that this report does not catalogue ORNL waste materials which might be considered in the planning category of non-certifiable defense transuranic special case waste. The amount and type of these materials will depend on the level of DOE funding of treatment and packaging capability at ORNL. If no ORNL treatment and packaging alternative for defense transuranic waste is funded by DOE planners, most of the remotely handled transuranic waste at WMRAD sites (approx. 205 m^3 of solid waste and 470 m^3 of liquid waste) will meet the definition of non-certifiable transuranic special case waste, by default. Similarly, the amounts of waste materials in the planning categories of non-defense transuranic waste and other planning categories of waste materials will depend on alternatives selected by DOE planners. Additionally, the initial placement of waste in a particular planning category can be expected to be revised as changes in DOE policy and funding affect the planned disposal alternatives. For example, the transuranic waste materials accepted from Nuclear Fuel Services by DOE for interim storage at ORNL are currently categorized as defense program transuranic materials certified for disposal at the Waste Isolation Pilot Plant (i.e., not special case waste). A programmatic change could clearly place these waste materials in a special case waste category. Similarly, the ORNL surplus isotope production inventory at Building 3517 is categorized as low-level and transuranic waste scheduled for recycle and/or disposal at both on-site and off-site facilities. A programmatic change could also place these materials in a special case waste category. Table A-6 summarizes these two well documented groups of waste and surplus materials which might become special case waste as a result of programmatic change.

Since DOE waste management planning is evolutionary, the information items pertaining to waste materials at ORNL with the potential to be DOE special case waste have been stored in a relational data base for periodic update and interrogation by the WMRAD Solid Waste Operations Department and others involved in long range planning. The data base has been configured around the type of information which experience has shown to be necessary for final disposal and will be updated periodically as the information becomes available from characterization, treatment, and packaging of these waste materials.

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APPENDIX

Table A-1 Previously reported SCW materials at ORNL (1990)

Location	SCW Category	No. of Containers	Total Weight (kg)	Total Activity (Ci)
Bldg 7827	SPAR	44		1.12 E+06
Bldg 7827	Spent fuel debris	15	524	1.30 E+01
Bldg 7829	Spent fuel	10		2.24
Bldg 3019 [a]	NC DP TRU	402	4020	1.06 E+03
Bldg 3019 [a]	ENM	653	3570	7.77 E+03
Bldg 3027 [b]	SPAR	1	10	1.11 E - 03
Bldg 3027 [b]	SPAR	1	110	1.07 E - 02
Bldg 3027 [b]	ENM	1	.026	1.63
Bldg 3027 [b]	ENM	1	.003	2.16 E - 03
Bldg 4515 [b]	SPAR	1	4.1	4.02 E - 04

[a] Now managed directly by DOE as a fissile material stockpile. No longer considered ORNL SCW.

[b] Transferred or sent to near surface disposal.

ENM - excess nuclear material

NC DP TRU - non-certifiable defense program transuranic waste

SCW - special case waste

SPAR - specific performance assessment required

Table A-2 Newly generated SCW materials at ORNL

Location	SCW Category	No. of Containers	Total Weight (kg)	Total Activity (Ci)
Bldg 7900	PAL [a]	not packaged		
Bldg 7900	Spent fuel [b]	not packaged		

[a] HFIR reactor scrap internals accumulate in the fuel pool.

[b] Planned transfer of HFIR fuel to Savannah River Site. One core (2 elements) per month to fuel pool.

PAL - performance assessment limited waste

HFIR - High Flux Isotope Reactor

Table A-3 ORNL waste generator SCW materials at generator locations

Location	SCW Category	No. of Containers	Total Weight (kg)	Total Activity (Ci)
Bldg 7900	PAL [a]	unpackaged	accumulating	unk
Bldg 7900	Spent fuel [b]	unpackaged	accumulating	unk
Bldg 3025E	Uncharacterized [c]	up to 50 cans	unk	unk
Bldg 3525	Uncharacterized [d]	up to 1 can	unk	unk
ORNL buildings	Radiation sources	About 360 items	unk	1.57 E+06
Bldg 7503	Uncharacterized [e]	unpackaged	unk	unk
Bldg 7503	Spent fuel [f]	unpackaged	(37HM)	unk
Bldg 7500	Uncharacterized [g]	unpackaged	unk	unk
Bldg 3010	Uncharacterized [h]	unpackaged	unk	unk
Bldg 3010	Spent fuel [I]	unpackaged	(59HM)	unk
Bldg 7700	Uncharacterized [j]	unpackaged	unk	unk
Bldg 7700	Spent fuel [k]	unpackaged	(9HM)	unk
Bldg 3038	Uncharacterized [l]	unpackaged	unk	unk
Bldg 3029	Uncharacterized [l]	unpackaged	unk	unk
Bldg 3517	Uncharacterized [l]	unpackaged	unk	unk
ORNL buildings	ENM	varies		

[a] HFIR scrap reactor internals accumulate in the fuel pool.

[b] HFIR spent fuel accumulates in the fuel pool. Planned for transfer off-site.

[c] Reactor research target residue.

[d] Spent fuel examination residue.

[e] MSRE scrap reactor internals. [f] MSRE spent fuel planned for transfer off-site.

[g] HRE scrap reactor internals.

[h] BSR scrap reactor internals. [I] BSR spent fuel planned for transfer off-site.

[j] TSF scrap reactor internals. [k] TSF spent fuel planned for transfer off-site.

[l] Isotope production residue after planned transfer of isotopes to other sites is complete.

MSRE - Molten Salt Reactor Experiment HRE - Homogeneous Reactor Experiment

BSR - Bulk Shielding Reactor TSF - Tower Shielding Facility HM - heavy metal

Table A-4 ORNL waste generator SCW materials at waste management locations

Location	SCW Category	No. of Containers	Total Weight (kg)	Total Activity (Ci)
Bldg 7842A	PAL	1	25318	3.88 E+05

[a] Research Reactors Division scrap reactor internals from HFIR.

Table A-5 ORNL waste management SCW materials at ORNL

Location	SCW Category	No. of Containers	Total Weight (kg)	Total Activity (Ci)
Bldg 7822A	PAL	2	4264	3.57 E+03
Bldg 7822J	none [a]			
Bldg 7823	Spent fuel debris	9	175 (1HM)	1.71 E+01
Bldg 7827	Spent fuel	72	2187 (85HM)	1.78 E+05
Bldg 7827	PAL	1	510	4.50 E+00
Bldg 7827	ENM	1	23	6.00 E - 05
Bldg 7827	Radiation sources	19	2598	1.88 E+05
Bldg 7829	Spent fuel	14	552 (10HM)	1.34 E+01
Bldg 7841	PAL	2	215	1.11 E+00
Bldg 7842A	PAL	207	1693636	6.78 E+03
IWMF Pad 4	PAL	4	4595	2.00 E+00
LLLW Facilities	none [b]			

[a] Special case waste storage pad. Other SCW expected.

[b] SCW can be generated from decontamination activities.

IWMF - Interim Waste Management Facility

SWSA - Solid Waste Storage Area

LLLW - liquid low-level waste

HM - heavy metal

Table A-6 Non-SCW nuclear materials of planning interest at ORNL

Location	SCW Category	No. of Containers	Total Weight (kg)	Total Activity (Ci)
Bldg 7879	n.a.	822	207067	6.34 E+03
Surplus Isotope Inventory	n.a.	not completely packaged	unk	~1.399 E+06

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