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ROCKWELL HANFORD OPERATIONS

MASTER

RADIOACTIVE WASTE PACKAGE ACCEPTANCE CRITERIA

These criteria were prepared in support of the National Waste Terminal Storage Program, Office of Nuclear Waste Isolation

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DISCLAIMER

ABSTRACT

Preliminary acceptance criteria have been developed for packages containing nuclear waste which must be stored or disposed of by the U. S. Department of Energy. Acceptance criteria are necessary to ensure that the waste packages are compatible with all elements of the Waste Management System. The acceptance criteria are subject to revision since many of the constraints that will be imposed on the waste packages by the Waste Management System have either not been defined or are being revised. Delineation of the acceptance criteria will provide bases for handling, transporting and disposing of the commercial waste.

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1.0 INTRODUCTION

The Code of Federal Regulations (CFR), Title 10, Part 50 (10CFR50) has established the requirement that high-level waste from nuclear fuel reprocessing plants must be solidified and placed in a sealed container (canister) within 5 years after reprocessing and transferred to a federal repository within 10 years after reprocessing.

On September 12, 1974, the U. S. Department of Energy (DOE) issued new proposed standards for transuranic (TRU) waste disposal (39FR32922). The new standards require that all TRU waste, generated by the commercial nuclear industry, be transferred to the DOE for storage as soon as practical, but within 5 years after generation. The proposed regulation defines TRU waste to include all materials contaminated to 10 nanocuries per gram as a lower limit and all wastes except those defined as high-level waste as an upper limit. Fuel cladding hulls are specifically included as TRU waste.

In view of this, in February 1976, the DOE announced an expanded program for the management of commercial radioactive waste. To implement that effort, the National Waste Terminal Storage (NWTS) Program was established. Its mission was "to provide facilities in various deep geologic formations at multiple locations in the United States which will safely dispose of commercial radioactive waste which must be delivered to a federal repository for terminal storage." The Oak Ridge Operations Office of DOE was assigned responsibility of overall coordination, and an Office of Waste Isolation (OWI) was established within the Union Carbide Corporation - Nuclear Division, to provide program management.*

**Effective July 1, 1978, the program management was transferred to the Office of Nuclear Waste Isolation (ONWI) within the Project Management Division of the Battelle Columbus Laboratories.*

Prior work for both defense and commercial waste had generated data on salt repositories, waste solidification, near-surface storage facilities, and waste packaging; however, adequate coordination and final criteria were lacking. Within the NWTS, the need for a program dealing with commercial waste packaging was clear and the OWI selected Rockwell Hanford Operations (Rockwell), formerly Atlantic Richfield Hanford Company, to have management responsibility for development of salt repository acceptance criteria for high-level waste packages, TRU waste packages, packages for fuel hulls, and the demonstration of criteria applicability via the development of fully tested and licensable containers for the various waste forms that will be received by DOE for storage and disposal. The Rockwell program is entitled the Commercial Waste Packaging (CWP) Program.(1)

Early in 1977, a "no reprocessing" policy was established by the White House and, as a result, the DOE established a program to study near-surface storage alternatives for storing spent unreprocessed fuel elements. Rockwell was assigned responsibility by DOE for management of the program. Its mission was to establish the required technology and, ultimately, a Spent Unreprocessed Fuel (SURF) Facility.* The scope of the program was expanded to include a SURF package suitable for geologic disposal which would be compatible with the waste management system which includes reprocessing.

The cumulative effect is a requirement that spent fuel and all TRU waste generated from nuclear fuel activities be transferred to a DOE repository for custody and storage. In view of this, spent unreprocessed fuel packages were added to the scope of the CWP Program. The purpose of this document is to present preliminary radioactive waste package acceptance criteria for waste packages that will be received by federal repositories for storage and disposal. Issuance of these acceptance criteria meets the initial objective of the CWP Program. The criteria will be updated as the NWTS program progresses.

**The mission has been changed to emphasize packaging of spent fuel for storage or disposal. The name has been changed to "Spent Fuel Handling and Packaging Program."*

2.0 COMMERCIAL WASTE PACKAGING PROGRAM

2.1 OBJECTIVES

The long-range objective of the CWP Program is to develop fully tested and licensable containers for the array of commercial wastes which must be received by the DOE. The initial objective of the program is to develop commercial waste package acceptance criteria which will assure that the packages are compatible with all federal repositories, their handling equipment all other parts of the waste management system such as transportation, regulations, reprocessing, and licensing. These various packages must retain their integrity and compatibility with all parts of the waste management system throughout a defined period of retrievability at the federal repositories and subsequent relocation to alternative storage and disposal if required.

2.2 PROGRAM SCOPE

The program is divided into five activities conducted essentially serially:

1. Package Acceptance Criteria - sets forth selected criteria which a package must meet in order to be transported, received, handled, stored, and disposed of within the waste management system. These criteria are based on controlling system constraints such as physical dimensions, shape, weight, thermal power, radiation level, surface contamination, etc.
2. Container Design Criteria - establishes container design control for the various packages. Again, the design criteria are based on controlling constraints which each part of the system imposes on the container. The level of control is greatly increased and provides constraints on features such as metallurgy, methods of fabrication, and structural design.

3. Container Prototype Designs - designs for all containers required for commercial wastes will be prepared for critical review and preliminary acceptance by participating agencies and concerns prior to fabrication and testing of prototypes.

4. Design Confirmation Testing - prototype containers will be fabricated and tested as required by the waste management system to provide design verification and demonstrate the applicability and acceptability of containers under specified accident scenarios.

5. Final Reporting and Licensing Support - this phase is scheduled and designed to provide the required technical reports and documentation necessary to support the licensing effort for the first salt repository scheduled to be established in 1985.

2.3 PROGRAM BASES

Several bases were established for the CWP Program. Some appear to be in the process of being modified; however, new guidance which would justify significant modification of these bases has not been provided.

1. To provide for several fuel cycle alternatives, containers for all waste forms should be prepared. (Thus, high-level waste, TRU waste, and spent fuel are considered in the study.)

2. A federal repository in salt will be established first, in calendar year 1985. (This basis influences program timing and scheduling and is currently under review by the DOE and the ONWI.)

3. To establish a system of related storage and disposal facility options, "waste packages" are needed for all waste forms. To keep all storage and disposal options open, the containers must be compatible with all elements of the system.

4. The "waste package" is the common denominator within the system. (One facility design may be independent from others so long as they can accept the "package".)

5. Waste form research and development is ahead of facility development, and suitable waste forms are likely to exist within present or threshold technology.

6. There is time to achieve compatibility with respect to the "waste package" and "system" by the iterative process of cycling waste package acceptance criteria, container design criteria, design and testing information through the various facility development programs for comment and refinement.

7. The waste management system is defined as:
   a. Waste immobilization and/or packaging
   b. Transportation
   c. Storage at:
      - Surface facilities
      - Geologic repositories
   d. Retrieval from storage
   e. Reprocessing (in the case of spent fuel)
   f. Disposal at federal repositories:
      - Salt
      - Basalt
      - Shale or granite
   g. Federal and state regulations.

8. Some waste forms will not logically be exposed to selected elements of the waste management system. Where this can be determined, the program will provide bases for eliminating a need for compatibility of a particular waste form package with the specific element of the waste system.

9. Assumptions must be in compliance with the CFR, Title 10, Part 50, Appendix F. "All waste packages must be stored in a retrievable mode for a period of five years in geologic repositories except for spent fuel elements. The retrievable period for spent fuel elements shall be 25 years in geologic storage."

10. All existing regulations, codes, and standards which constitute constraints on waste form, waste container, or shipment and storage of packaged waste shall be used as bases. In addition, trends in licensing and new regulations shall be anticipated where feasible and used as bases where applicable.

11. Criteria developed shall be based on the best data and information available. Where technology is not available, screening technical studies will be performed where feasible and warranted. Judgemental decisions will be made based on the best available opinions from cognizant sources.

12. Criteria will be improved or perfected by the iterative process of review, comment and incorporation of new data prior to translating acceptance criteria into design criteria, design criteria to design, and design to prototype containers for testing.

The relation of waste packaging to the waste management system is depicted in Figure 2-1.

3.0 RADIOACTIVE WASTE PACKAGE ACCEPTANCE CRITERIA

3.1 PURPOSE

The proposed criteria delineated herein are necessary for establishing guidelines for the acceptance of radioactive waste packages, including packaged spent fuel, by a federal repository for storage and ultimate disposal. Such criteria are a supplement to existing regulations pertaining to handling, storing, and shipping radioactive waste defined in the CFR, Title 10 and Title 49, and a proposed ammendment (39FR32922) to Title 10, Part 20, of the CFR. The criteria are preliminary since much of the waste management system process and design information, as well as federal and state regulations, are either undergoing change or are yet to be developed. As new information becomes available, the criteria will be updated.

Since the first federal repository to become operational will be located in a deep salt formation, the criteria are more specific for this type of geologic storage media. As studies and conceptual designs mature for repositories located in other storage media such as basalt, granite, and shale, the criteria will change to reflect identified constraints.

The proposed acceptance criteria cover packaged wastes resulting from the nuclear fuel cycle. The licensing of a repository and the waste management system will require that specific waste forms be used in all packages. These criteria assume that typical waste forms developed by prior work will be suitable for storage and disposal and are referred to as generic classification. The waste forms compatible with these criteria are shown in Table 3-1.

The proposed acceptance criteria are tabulated in Table 3-2 at the end of this section.

TABLE 3-1

Waste Type	Waste Form
Spent Fuel (SF)	Unmodified fuel assembly
High-Level Waste (HLW)	Glass produced by in-can melting or calcine produced by fluid bed
Cladding Waste (CW)	Compacted or uncompacted
Intermediate-Level TRU Waste (ILTW)	Contained in solid matrix
Low-Level TRU Waste (LLTW)	Contained in solid matrix

3.2 LICENSING REQUIREMENTS

The design of the radioactive waste packages will be reviewed by the Nuclear Regulatory Commission (NRC) as part of the licensing requirements of transportation, fuels reprocessing plants, interim storage facilities, and the federal repositories. It is assumed that licensing and DOE management of the waste management system will stipulate that:

1. Only DOE-approved waste forms can be routinely sent to repositories.
2. Only DOE-approved containers may be used to package wastes and each waste form requires a specific container.
3. Only DOE-approved manufacturers can fabricate a container.
4. QA and QC procedures will be applied at the point of packaging to ensure that acceptable waste forms, containers, and procedures are used.

3.3 ACCEPTANCE CRITERIA

3.3.1 SPENT FUEL (SF) PACKAGE

CRITERION 1, PHYSICAL DIMENSIONS AND WEIGHT

All SF assemblies must be packaged in standard DOE-approved canisters. The federal repository will accept packages with or without overpacks with the following dimensional limits:

Number and Type SF Assemblies Per Package	OD, in.	Length, ft
3 BWR w/o overpack	16	15.5
3 BWR w overpack	18	16.5
1 PWR w/o overpack	14	17.5
1 PWR w overpack	16	18.5

The maximum acceptable gross weight shall be 10,000 pounds.

CRITERION 2, THERMAL POWER

The thermal power limit of SF packages at the time of receipt at the repository shall not exceed 1.0 kW per package.

CRITERION 3, RADIATION LIMIT

The radiation level of the unshielded SF package shall not exceed 3×10^4 rem/hr total dose rate measured at the surface of the package at the midplane of the longitudinal axis.

CRITERION 4, INTERNAL PRESSURE LIMIT

The SF package internal pressure shall not exceed an operating pressure of 100 psia from time of closure through the end of the retrievability period in the federal repository under normal operating conditions. Records shall be made available by the packaging facility to show that analyses have been completed to assure that this operating pressure will not be exceeded.

CRITERION 5, SURFACE CONTAMINATION

There must be no significant removable radioactive surface contamination on the exterior of the SF package. Removable (non-fixed) radioactive contamination is considered significant if the level of contamination, when averaged over any area of 300 cm^2 of any part of the package surface, exceeds any of the following:

Contaminant	Maximum permissible level	
	$\mu Ci/cm^2$	dis/min
Natural or depleted uranium and natural thorium:		
Beta-gamma	10^{-3}	2,200
Alpha	10^{-4}	220
All other beta-gamma emitting radionuclides	10^{-4}	220
All other alpha emitting radionuclides	10^{-5}	22

CRITERION 6, DESIGN AND FABRICATION

Standard DOE-approved canisters for use in the packaging of SF which provide containment for SF from time of packaging through the retrievability period in the federal repository shall meet the requirements of Section III, Division 1, Class 3 of the American Society for Mechanical Engineers' (ASME) Boiler and Pressure Vessel Codes. If the waste container is overpacked, then standard DOE-approved overpacks shall be used and the overpacks shall meet the same requirements. Manufacturer of the container shall obtain a Certificate of Authorization to use an "N" type code stamp and shall affix the "N" stamp to the container prior to release to the waste packager or DOE.

CRITERION 7, MATERIALS OF CONSTRUCTION

Canisters intended for containment of SF shall be constructed of low carbon steel, type ASTM A-53, ASTM A-36, or approved equal. Material certification records shall satisfy requirements of Section III, Division 1, Class 3 of the ASME Code.

CRITERION 8, HANDLING

The SF package handling device shall be attached at the end centerline of the package and overpack, if used, by welding and shall remain operable after a tipping or dropping accident. It shall be compatible with the Oak Ridge handling mechanism.

CRITERION 9, PACKAGE IDENTIFICATION

A metal label bearing an identification number and fuel type (i.e., PWR, BWR) shall be permanently attached to the outside surface of the SF package and overpack, if used, in such a manner that the label and inscription thereon will remain legible at least through the retrievability period at the federal repository. The label shall not impair the integrity of the package or overpack. The label shall be legible to the repository operator using remote viewing devices during the handling process prior to emplacement in a federal repository. The label shall be fabricated, located, and attached to the canister and overpack, if used, in accordance with prescribed procedures furnished with DOE canisters.

CRITERION 10, PACKAGE CONTENT AND DOCUMENTATION

A set of permanent records bearing the identification number of the associated SF packages to be shipped shall be made available to the federal repository operator in advance of shipment. A second set of permanent records bearing the same identification number shall be maintained by the SF packaging facility. The permanent records shall include the following:

Package Content:

- Waste package identification number
- Type and number of fuel assemblies
- Condition of fuel assemblies (disassemblies, failed pins, method of stabilization, etc.)
- Date removed from reactor and name of reactor
- Radiation measurement of package at time of shipment to federal repository

- Thermal power measurement of package at time of shipment to federal repository
- Gross weight measurement of package
- Date of measurements
- Accountability data.

Package Documentation:

- Fabrication history and supplier of the SF canister and overpack, if used, materials of construction, and the QA procedures used to assure compliance with the design, procurement, and fabrication specification
- Operating history including loading, closure, post loading treatment, handling, and storage conditions
- Surface contamination readings prior to shipment
- Calculated maximum pressurization during storage under normal and abnormal operating conditions; and prescribed accident conditions.

3.3.2 HIGH-LEVEL WASTE (HLW) PACKAGE

CRITERION 1, PHYSICAL DIMENSION AND WEIGHT

All HLW shall be packaged in standard DOE-approved canisters. The federal repository will accept HLW packages with the following dimensional limits:

Waste Form	Without Overpack	With Overpack
Glass:		
OD, in.	11.5	13.5
Length, ft.	14.0	15.0
Calcine:		
OD, in.	8.5	10.5
Length, ft.	14.0	15.0

The gross weight of an HLW package and overpack shall not exceed 5,000 pounds.

CRITERION 2, THERMAL POWER

The waste heat content of the HLW package at the time of receipt at the federal repository shall not exceed 3.1 kW (glass waste form) or 2.8 kW (calcine waste form).

CRITERION 3, RADIATION LIMIT

The radiation level of the unshielded HLW package shall not exceed 1×10^5 rem/hr total dose rate measured 1 foot from the surface of the waste canister at the midplane of the longitudinal axis.

CRITERION 4, INTERNAL PRESSURE LIMIT

The HLW package internal pressure shall not exceed an operating pressure of 80 psia from time of closure through the end of the retrievability period in the federal repository. Records shall be made available by the waste producer/packager to show that analyses have been completed to assure that this operating pressure will not be exceeded.

CRITERION 5, SURFACE CONTAMINATION LIMIT

There must be no significant removable radioactive surface contamination on the exterior of the HLW package. Removable (non-fixed) radioactive contamination is considered significant if the level of contamination, when averaged over any area of 300 cm^2 of any part of the package surface, exceeds any of the following:

Contaminant	Maximum permissible level	
	$\mu Ci/cm^2$	dis/min
Natural or depleted uranium and natural thorium:		
Beta-gamma	10^{-3}	2,200
Alpha	10^{-4}	220
All other beta-gamma emitting radionuclides	10^{-4}	220
All other alpha emitting radionuclides	10^{-5}	22

CRITERION 6, DESIGN AND FABRICATION

Standard DOE-approved canisters for use in the packaging of HLW and intended for use as a means of providing containment of that waste from time of packaging through the retrievability period in the federal repository shall meet the requirements of Section III, Division 1, Class 3 of the ASME Boiler and Pressure Vessel Codes. If the waste container is overpacked, then a standard DOE-approved overpack shall be used and shall meet the same requirements. Manufacturers of the container shall obtain a Certificate of Authorization to use an "N" type code stamp and shall affix the "N" stamp to the container prior to release to the waste packager or DOE.

CRITERION 7, MATERIALS OF CONSTRUCTION

Canisters for use to package HLW shall be constructed of stainless steel, type 304L (ASTM A-312) or approved equal or better. Material certification records shall satisfy requirements of Section III, Division 1, Class 3 of the ASME Codes.

CRITERION 8, HANDLING

The HLW package handling device shall be attached at the end centerline of the package and overpack, if used, by welding and shall remain operable after a tipping or dropping accident. It shall be compatible with the Oak Ridge handling mechanism.

CRITERION 9, PACKAGE IDENTIFICATION

A metal label bearing an identification number and waste type (i.e., HLW) shall be permanently attached to the outside surface of the package and overpack, if used, in such a manner that the label and inscription thereon will remain legible at least through the retrievability period in the federal repository. The label shall not impair the integrity of the package or overpack. The label shall be legible to the repository operator using remote viewing devices during handling prior to emplacement in the federal repository. The label shall be fabricated, located, and attached to the container or overpack in accordance with prescribed procedures furnished with DOE containers.

CRITERION 10, PACKAGE CONTENT AND DOCUMENTATION

A set of permanent records bearing the identification number of the associated HLW packages to be shipped shall be made available to the federal repository operator in advance of shipment. A second set of permanent records bearing the same identification numbers shall be maintained by the shipper. The permanent records shall include the following:

Package Content:

- Waste package identification number
- Waste type
- Waste form (i.e., glass, calcine, ceramic, etc.)
- Maximum waste processing temperature
- Thermal power measurement at time of shipment to federal repository

- Name of reprocessor/packager
- Radiation measurement at time of shipment to federal repository
- Gross weight of package
- Date of measurements.

Package Documentation:

- Fabrication history and supplier of the canister and overpack, if used, materials of construction, and the QA procedures used to assure compliance with the design, procurement, and fabrication specifications
- Operating history including filling, closure, post filling treatment, handling, and storage conditions
- Surface contamination readings
- Calculated maximum pressurization during storage at the federal repository under normal and abnormal operating conditions.

3.3.3 CLADDING WASTE (CW) PACKAGE

CRITERION 1, PHYSICAL DIMENSIONS AND WEIGHT

All CW shall be packaged in standard DOE-approved containers. The federal repository will accept CW packages with the following dimension and weight limits:

- The maximum OD of the container shall not exceed the ASTM standard for a nominal 24-inch steel pipe.
- The maximum overall length of the container, including lifting fixtures, shall not exceed 8 feet 6 inches.
- The maximum gross weight of the waste package shall not exceed 10,000 pounds.

CRITERION 2, THERMAL POWER

The thermal power of a CW package shall not exceed 2.0 kW upon receipt at the federal repository.

CRITERION 3, RADIATION LIMIT

The radiation level of a CW package shall not exceed 4×10^3 rem/hr measured at the surface upon receipt at a federal repository.

CRITERION 4, INTERNAL PRESSURE LIMIT

The CW package internal pressure shall not exceed an operating pressure of 70 psia from time of closure through the end of the retrievability period in the federal repository. Records shall be made available by the waste producer/packager to show that analyses have been completed to assure that this operating pressure will not be exceeded.

CRITERION 5, SURFACE CONTAMINATION LIMIT

There must be no significant removable radioactive surface contamination on the exterior of the package. Removable (non-fixed) radioactive contamination is considered significant if the level of contamination,

when averaged over any area of 300 cm^2 of any part of the package surface, exceeds any of the following:

Contaminant	Maximum permissible level	
	$\mu Ci/cm^2$	dis/min
Natural or depleted uranium and natural thorium:		
Beta-gamma	10^{-3}	2,200
Alpha	10^{-4}	220
All other beta-gamma emitting radionuclides	10^{-4}	220
All other alpha emitting radionuclides	10^{-5}	22

CRITERION 6, DESIGN AND FABRICATION

Standard and DOE-approved containers for use in the packaging of CW and intended for use as a means of providing containment for that waste from time of packaging through the retrievability period in the federal repository shall meet the requirements of Section III, Division 1, Class 3 of ASME Boiler and Pressure Vessel Codes. If the waste container is overpacked, then a standard DOE-approved overpack shall be used and shall meet the same requirements. Manufacturers of the container shall obtain a Certificate of Authorization to use an "N" type code stamp and shall affix the "N" stamp to the container prior to release to the waste packager or DOE.

CRITERION 7, MATERIALS OF CONSTRUCTION

Containers for use as packages for CW shall be constructed of low carbon steel, type ASTM A-53, ASTM A-36 or approved equal. Material certification records shall satisfy requirements of Section III, Division 1, Class 3 of the ASME Codes.

CRITERION 8, HANDLING

The CW package handling device shall be permanently attached at the end centerline of the package by welding and shall remain operable after a

tipping or dropping accident. It shall be compatible with the Oak Ridge handling mechanism.

CRITERION 9, CRITICALITY

The quantity of fissile material in individual packages of CW shall meet the requirements of 49CFR173, 10CFR71, and shall meet the requirements of criticality safety based on container critical mass volume, and anticipated storage arrangements. Calculations made by the packager to assure criticality safety shall be available to the federal repository operator upon request.

CRITERION 10, PACKAGE IDENTIFICATION

A metal label bearing an identification number and waste type (i.e., CW) shall be permanently attached to the outside surface of the CW package in such a manner that the label and inscription thereon will remain legible at least through the retrievability period at the federal repository. The label shall not impair the integrity of the package or overpack. The label shall be legible to the repository operator using remote viewing devices during the handling process prior to emplacement in a federal repository. The label shall be fabricated, located, and attached to the package in accordance with prescribed procedures furnished with DOE-approved containers.

CRITERION 11, PACKAGE CONTENT AND DOCUMENTATION

A set of permanent records bearing the identification number of the associated CW packages to be shipped shall be made available to the federal repository operator in advance of shipment. A second set of permanent records bearing the same identification number shall be maintained by the CW packaging facility. The permanent records shall include the following:

Package Content:

- Waste package identification number
- Waste type
- Radiation measurement of package at time of shipment to federal repository

- Thermal power measurement of package at time of shipment to federal repository
- Gross weight measurement of package
- Date of measurements
- Fissile material content
- Source of waste
- Date of waste generation
- Date of packaging.

Package Documentation:

- Fabrication history and supplier of the CW canister and overpack, if used, materials of construction, and the QA procedures used to assure compliance with the design, procurement, and fabrication specifications
- Operating history including loading, closure, post loading treatment, handling, and storage conditions
- Surface contamination readings prior to shipment
- Maximum pressurization and calculated maximum pressurization during storage under normal and abnormal operating conditions, and prescribed accident conditions.

3.3.4 INTERMEDIATE-LEVEL TRU WASTE (ILTW) PACKAGE

CRITERION 1, PHYSICAL DIMENSIONS AND WEIGHT

All ILTW shall be packaged in standard DOE-approved containers. The federal repository will accept ILTW packages with the following dimension and weight limits:

- The maximum OD of the container shall not exceed the ASTM standards for a nominal 24-inch steel pipe.
- The maximum overall length of the container, including lifting fixtures, shall not exceed 8 feet 6 inches.
- The maximum gross weight of the waste package shall not exceed 10,000 pounds.

CRITERION 2, THERMAL POWER

The thermal power limit of an ILTW package shall not exceed 25 watts upon receipt at a federal repository.

CRITERION 3, RADIATION LIMIT

The maximum surface radiation level of an ILTW package shall not exceed 15 rem/hr upon receipt at a federal repository.

CRITERION 4, INTERNAL PRESSURE LIMIT

The ILTW package internal pressure shall not exceed an operating pressure of 50 psia from time of closure through the end of the retrievability period in the federal repository. Records shall be made available by the waste producer/packager to show that analyses have been completed to assure that this operating pressure will not be exceeded.

CRITERION 5, SURFACE CONTAMINATION LIMIT

There must be no significant removable radioactive surface contamination on the exterior of the package. Removable (non-fixed) radioactive contamination is considered significant if the level of contamination, when averaged over any area of 300 cm^2 of any part of the package surface, exceeds any of the following:

Contaminant	Maximum permissible level	
	$\mu Ci/cm^2$	dis/min
Natural or depleted uranium and natural thorium:		
Beta-gamma	10^{-3}	2,200
Alpha	10^{-4}	220
All other beta-gamma emitting radionuclides	10^{-4}	220
All other alpha emitting radionuclides	10^{-5}	22

CRITERION 6, DESIGN AND FABRICATION

Standard DOE-approved canisters for use in the packaging of ILTW which provide containment for ILTW from time of packaging through the retrievability period in the federal repository shall meet the requirements of Section III, Division 1, Class 3 of the ASME Boiler and Pressure Vessel Codes. If the waste container is overpacked, then standard DOE-approved overpacks shall be used and the overpacks shall meet the same requirements. Manufacturers of the container shall obtain a Certificate of Authorization to use an "N" type code stamp and shall affix the "N" stamp to the container prior to release to the waste packager or DOE.

CRITERION 7, MATERIALS OF CONSTRUCTION

Containers for use as packages to contain ILTW shall be constructed of low carbon steel, type ASTM A-53, ASTM A-36 or approved equal. Material certification records shall satisfy requirements of Section III, Division 1, Class 3 of the ASME Codes.

CRITERION 8, HANDLING

The ILTW package handling device shall be permanently attached at the end centerline of the package by welding and shall remain operable after a tipping or dropping accident. It shall be compatible with the Oak Ridge handling mechanism.

CRITERION 9, CRITICALITY

The quantity of fissile material in individual packages of ILTW shall meet the requirements of 49CFR173, 10CFR71, and shall meet the requirements of criticality safety based on container critical mass volume and anticipated storage arrangements. Calculations made by the shipper to assure criticality safety shall be available to the repository operator upon request.

CRITERION 10, PACKAGE IDENTIFICATION

A metal label bearing an identification number and waste type (i.e., ILTW) shall be permanently attached to the outside surface of the ILTW package and overpack, if used, in such a manner that the label and inscription thereon will remain legible at least through the retrievability period at the federal repository. The label shall not impair the integrity of the package or overpack. The label shall be legible to the repository operator using remote viewing devices during the handling process prior to emplacement in a federal repository. The label shall be fabricated, located, and attached to the package and overpack, if used, in accordance with prescribed procedures furnished with the DOE container.

CRITERION 11, PACKAGE CONTENT AND DOCUMENTATION

A set of permanent records bearing the identification number of the associated ILTW packages to be shipped shall be made available to the federal repository operator in advance of shipment. A second set of permanent records bearing the same identification number shall be maintained by the ILTW packaging facility. The permanent records shall include the following:

Package Content:

- Waste package identification number
- Waste type

- Radiation measurement of package at time of shipment to federal repository
- Thermal power measurement of package at time of shipment to federal repository
- Gross weight measurement of package
- Date of measurements
- Fissile material content
- Name of packager
- Source of waste
- Date of waste generation
- Date of packaging.

Package Documentation:

- Fabrication history and supplier of the ILTW canister and overpack, if used, materials of construction, and the QA procedures used to assure compliance with the design, procurement, and fabrication specifications
- Operating history including loading, closure, post loading treatment, handling, and storage conditions
- Surface contamination readings prior to shipment
- Calculated maximum pressurization during storage under normal and abnormal operating conditions; and prescribed accident conditions.

3.3.5 LOW-LEVEL TRU WASTE (LLTW) PACKAGE

CRITERION 1, PHYSICAL DIMENSIONS AND WEIGHT

All LLTW shall be packaged in standard DOE-approved containers. Containers for use in the packaging of LLTW shall meet the requirements of a 7A package and shall conform to Department of Transportation (DOT) specification numbers 17C and 17H, and shall not exceed a volume of 55 gallons, and a gross weight of 800 pounds.

CRITERION 2, THERMAL POWER

The thermal power limit of an LLTW package shall not exceed 10 watts per package at the time of receipt at the federal repository.

CRITERION 3, RADIATION LIMIT

The maximum surface radiation level of an LLTW package shall not exceed 10 mrem/hr upon receipt at a federal repository.

CRITERION 4, INTERNAL PRESSURE LIMIT

The LLTW package internal pressure shall not exceed an operating pressure of 10 psig from time of closure through the end of the retrievability period in the federal repository under normal operating conditions. Records shall be made available by the packaging facility to show that analyses have been completed to assure that this operating pressure will not be exceeded.

CRITERION 5, SURFACE CONTAMINATION

There must be no significant removable radioactive surface contamination on the exterior of the package. Removable (non-fixed) radioactive contamination is considered significant if the level of contamination, when averaged over any area of 300 cm^2 of any part of the package surface, exceeds any of the following:

Contaminant	Maximum permissible level	
	$\mu Ci/cm^2$	dis/min
Natural or depleted uranium and natural thorium:		
Beta-gamma	10^{-3}	2,200
Alpha	10^{-4}	220
All other beta-gamma emitting radionuclides	10^{-4}	220
All other alpha emitting radionuclides	10^{-5}	22

CRITERION 6, DESIGN AND FABRICATION

Drums for use as standard DOE-approved containers for LLTW shall be designed and fabricated in compliance with 49CFR178 specifications for DOT-approved 17C and 17H containers.

CRITERION 7, MATERIALS OF CONSTRUCTION

Drums for use as containers of LLTW shall be constructed of galvanized low carbon steel. Material certification and specifications shall meet the minimum requirements of ASTM materials for A-569 low carbon steel or approved equal.

CRITERION 8, CRITICALITY

The quantity of fissile material in individual packages of LLTW contained in DOT-approved 17C and 17H drums shall meet the requirements of 49CFR73, 10CFR71, and shall comply with DOT special permit No. 5948 for shipment of packages in approved "closed transport vehicles".

CRITERION 9, PACKAGE IDENTIFICATION

A metal label bearing an identification number and waste type (i.e., LLTW) shall be permanently attached to the outside surface of the LLTW package in such a manner that the label and inscription thereon will remain legible at least through the retrievability period at the federal repository. The label shall not impair the integrity of the package or overpack. The label shall be fabricated, located, and attached to the package in accordance with prescribed procedures furnished with the DOE container.

CRITERION 10, PACKAGE CONTENT AND DOCUMENTATION

A set of permanent records bearing the identification number of the associated LLTW packages to be shipped shall be made available to the federal repository operator in advance of shipment. A second set of permanent records bearing the same identification number shall be maintained by the LLTW packaging facility. The permanent records shall include the following:

Package Content:

- Waste classification (i.e., LLTW)
- Radiation measurement of package at time of shipment to federal repository
- Thermal power measurement of package at time of shipment to federal repository
- Gross weight measurement of package
- Date of measurements
- Fissile material
- Source of waste
- Date of waste generation
- Date of packaging.

Package Documentation:

- Fabrication history and supplier of the LLTW canister and overpack, if used, materials of construction, and the QA procedures used to assure compliance with the design, procurement, and fabrication specifications
- Operating history including loading, closure, post loading treatment, handling, and storage conditions
- Surface contamination readings prior to shipment
- Calculated maximum pressurization during storage under normal and abnormal operating conditions; and prescribed accident conditions.

TABLE 3-2

RADIOACTIVE WASTE PACKAGE ACCEPTANCE CRITERIA

	PHYSICAL DIMENSION AND WEIGHT (1)	THERMAL POWER	RADIATION LIMITS SURFACE	INTERNAL PRESSURE LIMIT	SURFACE CONTAMINATION	DESIGN & FABRICATION	MATERIALS OF CONSTRUCTION (2)	HANDLING (3)	PACKAGE IDENTIFICATION (4)	PACKAGE CONTENT AND DOCUMENTATION	CRITICALITY
SPENT FUEL 3 BWR 1 PWR	16" OD X 15.5' (18" OD X 16.5') 14" OD X 17.5' (16" OD X 18.5) 10,000 LBS	1.0 k W 1.0 k W	$3X10^4$ REM/H	100 PSIA	49 CFR 173.397	ASME CODE SECTION III DIVISION 1 CLASS 3 "N" STAMP	ASTM A-53 ASTM A-36 LOW CARBON STEEL	OAK RIDGE CONNECTOR	METAL LABEL	2 SETS OF RECORDS 1 PRODUCER 1 REPOSITORY	LIMITED NUMBER PER PACKAGE PRECLUDE CRITICALITY
HIGH LEVEL WASTE GLASS CALCINE	11.5" OD X 14' (13.5" OD X 15') 8.5" OD X 14' (10.5" OD X 15') 5,000 LBS.	3.1 k W 2.8 k W	$1X10^5$ REM/H	80 PSIA	49 CFR 173.397	ASME CODE SECTION III DIVISION 1 CLASS 3 "N" STAMP	ASTM A-312 TYPE 304L STAINLESS STEEL	OAK RIDGE CONNECTOR	METAL LABEL	2 SETS OF RECORDS 1 PRODUCER 1 REPOSITORY	BY DEFINITION CONTAINS NO FISSILE MATERIAL
CLADDING WASTE	2'OD X 8'-6" 10,000 LBS.	2.0 k W	$4X10^3$ REM/H	70 PSIA	49 CFR 173.397	ASME CODE SECTION III, DIVISION 1 CLASS 3, "N" STAMP	ASTM A-53 ASTM A-36 LOW CARBON STEEL	OAK RIDGE CONNECTOR	METAL LABEL	2 SETS OF RECORDS 1 PRODUCER 1 REPOSITORY	10 CFR 71 49 CFR 173
INTERMEDIATE LEVEL TRU WASTE	2'OD X 8'-6" 10,000 LBS	25 W	15 REM/H	50 PSIA	49 CFR 173.397	ASME CODE SECTION III, DIVISION 1 CLASS 3, "N" STAMP	ASTM A-53 ASTM A-36 LOW CARBON STEEL	OAK RIDGE CONNECTOR	METAL LABEL	2 SETS OF RECORDS 1 PRODUCER 1 REPOSITORY	10 CFR 71 49 CFR 173
LOW LEVEL TRU WASTE	55 GALLON DRUM DOT 17C AND 17H 800 LBS.	10 W	10 MR/H	10 PSIG	49 CFR 173.397	49 CFR 178 DOT 17C AND 17H DRUMS	ASTM A-569 GALVANIZED LOW CARBON STEEL	PALLETIZED	METAL LABEL	2 SETS OF RECORDS 1 PRODUCER 1 REPOSITORY	10 CFR 71 49 CFR 173 DOT SPECIAL PERMIT #5948

(1) OVERPACK DIMENSIONS ( ) IN PARENTHESIS.

(2) MATERIALS CERTIFICATION REQUIRED PER ASME CODE SECTION III, DIVISION 1, CLASS 3

(3) OPERABLE AFTER TIPPING OR DROPPING.

(4) REMOTE VIEWING LEGIBILITY.

4.0 RADIOACTIVE WASTE PACKAGE ACCEPTANCE CRITERIA BASES

4.1 GENERAL

The proposed acceptance criteria defined in Section 3.0 are based on the results of technical studies supporting the CWP Program and on information available from the NWTS Program.[2-12] Other studies conducted in support of the overall national waste management program effort are cited in the criteria bases as required.

The basis for each acceptance criterion is briefly stated for ease of reading. Where warranted for added clarification, further discussions on the criterion bases are found in Section 5.0

4.2 ACCEPTANCE CRITERIA BASES

4.2.1 SPENT FUEL (SF) PACKAGE

The SF package acceptance criteria are based on the following assumptions concerning the package contents:

- A package will contain either one PWR assembly or three BWR assemblies.
- The assemblies have been 5 years out of reactor when packaged.
- The assemblies are unmodified (i.e., not disassembled or sheared).
- The assemblies may contain surface water when packaged.
- The package will contain an inert cover gas.

CRITERION 1 BASES, PHYSICAL DIMENSIONS AND WEIGHT

The basis for maximum length is the length of the longest fuel element expected to be discharged by 1990, plus 2 feet allowance for canister bail and overpack, if required. The maximum diameter is based on the containment of three BWR fuel assemblies. The maximum weight is based upon twice the weight of the heaviest fuel element expected to be discharged by 1990 plus twice the calculated weight of a canister and overpack.

CRITERION 2 BASES, THERMAL POWER

The 1.0-kW limit is the thermal power of the reference SF package being used by the Spent Fuel Handling and Packaging (SFHP) Facility conceptual design effort.[13] This limit will permit the storage of either one PWR fuel assembly or three BWR fuel assemblies per package which have been aged 5 years.

CRITERION 3 BASES, RADIATION LIMIT

The radiation limit is based on the calculated dose rate expected to result from a single 5-year old packaged PWR fuel assembly that has been exposed to a burnup of 33,000 MWD/MTU. The radiation limit is intended to ensure the safety of personnel in facilities wherein the SF package may reside.

CRITERION 4 BASES, INTERNAL PRESSURE LIMIT

The following data have been estimated and used to calculate maximum internal pressure:

V =	Void space in canister	500,000 cm^3
T =	Maximum temperature (cladding temperature)	715°F/652°K
N_{sf} =	Maximum number of moles of gas that can escape from an assembly	29.6 moles/assembly
N_G =	Maximum number of moles of an inert gas medium at two atmospheres of pressure	7.4 moles/assembly
N_w =	Moles of water adhering to a fuel assembly which has not been adequately dried	26.3 moles/assembly

Therefore, using the ideal gas law, an approximation of the maximum internal operating pressure is equal to 100 psia per package.

CRITERION 5 BASES, SURFACE CONTAMINATION

The limits set forth for the SF package are based on those for shipping casks. These limits are the maximum permissible levels as set forth in the CFR, Title 49, paragraph 173.397.

The objective of the criterion is to minimize, to a practical level, the transfer of radioactive contaminants to the federal repository receiving area. The purpose is to provide for contact maintenance operation at the federal repository.

CRITERION 6 BASES, DESIGN AND FABRICATION

Section III, Division 1, Class 3 of the ASME Code is specified for Criterion 1 on the basis of an in-depth review of existing codes and standards to determine their applicability to design and fabrication of nuclear waste containers.[6] Additional supportive discussion is included in Section 5.0 of this document. Section III is specifically tailored for nuclear application. It provides for QA and QC procedures that are more stringent than Section VIII of the ASME Code. The use of an "N" stamp will provide verification that Section III requirements have been met.

It should be noted, however, that the scope of Section III and requirements for "N" stamping may have to be modified to permit delivery of containers to the packager prior to sealing and testing to Section III rules.

CRITERION 7 BASES, MATERIALS OF CONSTRUCTION

Low carbon steel has been chosen as the reference material for the SF canister. The choice of this material is supported by two recent material evaluations.[3,7] These conclude that in the absence of water in the federal repository, corrosion would be low. If, however, there is water present, corrosion could be moderate to severe; moderate in basalt and shale, and severe in salt. Isolation of the SF package in sleeved implacement holes in a salt repository to prevent contact with the salt media would be required to prevent loss of package integrity by accelerated corrosion during the retrievability period in the federal repository.

CRITERION 8 BASES, HANDLING

The Oak Ridge connector has been tentatively selected as the reference lifting mechanism based on its extensive use in remote handling operations. Final selection of the lifting mechanism for handling SF packages will be made during the waste package design phase of the CWP Program (see Section 2.0 of this document).

CRITERION 9 BASES, PACKAGE IDENTIFICATION

The metal label affixed to each SF package is necessary for identification of the package for nuclear material control from packaging through the end of the retrievability period in the federal repository.

CRITERION 10 BASES, PACKAGE CONTENT AND DOCUMENTATION

SF package content and documentation will be necessary for nuclear materials control and accountability, and provide for easy tracibility. QA and QC records relating to design, fabrication, and testing of the SF container will be required to verify adherance to Section III, Division 1, Class 3 of the ASME Code.

4.2.2 HIGH-LEVEL WASTE (HLW)

The HLW package acceptance criteria are based on the following assumptions concerning the package and its contents:

- The waste forms are borosilicate glass produced by the in-can melting process and calcine produced by the fluidized bed process.[14-16]
- The package is overpacked prior to emplacement in the repository.
- The package diameters and associated thermal power are constrained by either temperature limits on the waste, repository geologic media, or canister and are as follows:

Borosilicate glass	800°C
Calcine	700°C
Salt*	1%/250°C 25%/200°C
Basalt**	--
Shale**	--
Canister	350°C

CRITERION 1 BASES, PHYSICAL DIMENSIONS AND WEIGHT

The maximum allowable canister dimensions specified in Criterion 1 are based on the results of two-dimensional thermal modeling of an HLW package with an overpack containing either borosilicate glass or calcine waste form emplaced in either salt, basalt, or shale.[15] The OD specified in Criterion 1 will allow emplacement of glass-filled or calcine-filled packages in a salt repository on 30-foot centers. Emplacement of the same packages in basalt or shale will require greater spacing (pitch) as shown in Table 4-1. The package length limit specified in Criterion 1 is based

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** 250°C limit on 1% and 200°C limit on 25% of the salt in a unit cell (a unit cell is the volume of salt whose area is defined by the adiabatic boundary concentric with the HLW package and whose thickness is equal to the height of the package.*[17]

***Temperature limits on basalt and shale have not been established; hence, none were assumed.*

on the length allowed for SF packages and limited by length restrictions imposed by the in-can melting process. The gross weight limit is twice the calculated weight of a glass-filled canister with an overpack.

CRITERION 2 BASES, THERMAL POWER

The thermal power limits specified in Criterion 2 were obtained by using those values shown in Table 4-1 for a 10-foot canister and increasing them by a factor of 1.5 to equal that which would be contained in a 14-foot package with a waste length of 12 feet.

CRITERION 3 BASES, RADIATION LIMITS

The radiation limit is based on the calculated dose expected to result from the reprocessing of light water reactor fuel assumed to be solidified to the equivalent of 2.5 ft^3 per 1 metric ton of heavy metals charged to the reactor. These radiation limits are not expected to be restrictive for presently forecasted HLW compositions.

CRITERION 4 BASES, INTERNAL PRESSURE LIMIT

The internal operating pressure limit specified in Criterion 4 was developed using the ideal gas law assuming that contributions to pressurization from the borosilicate glass and calcine waste forms would be negligible under normal operating conditions. Higher pressure would result for calcine-filled canisters under abnormal operating conditions.[18] The limit of 80 psia includes a safety factor of 3.0.

CRITERION 5 BASES, SURFACE CONTAMINATION

The limits set forth for the HLW package are based on those for shipping casks. These limits are the maximum permissible levels as set forth in 49CFR173.397.

CRITERION 6 BASES, DESIGN AND FABRICATION

Section III, Division 1, Calss 3 of the ASME Code is specified for Criterion 6 on the basis of a review of existing codes and standards for their applicability to design and fabrication of nuclear waste containers.[6]

Additional discussion is included in Section 5.0 of this document. Section III is specifically tailored for nuclear application. It provides for QA and QC procedures that are more stringent than Section VIII of the ASME Code. The use of an "N" code stamp will provide verification that the Section III requirements have been met. However, it should be noted that the scope of Section III and requirements for "N" stamping may have to be modified to permit delivery of the containers to the packager prior to sealing and testing.

CRITERION 7 BASES, MATERIAL OR CONSTRUCTION

Type 304L stainless steel has been the reference HLW canister material in past studies supporting the NWTS Program.[17,19] An evaluation of type 304L stainless steel as an HLW canister material has been made. It is specified in Criterion 7 to provide adequate corrosion resistance, oxidation resistance, and required strength at operating temperatures during the in-can melting process to produce borosilicate glass waste form. As waste form development proceeds, the use of alternate canister materials with improved elevated temperature properties and greater resistance to environmental degradation may be specified as a replacement for type 304L stainless steel. Regardless of type selected, overpacking with carbon steel would be required before emplacement in direct contact with salt to survive the retrievability period.

CRITERION 8 BASES, HANDLING

The Oak Ridge connector has been tentatively selected as the reference lifting mechanism based on its extensive use in remote handling operations. Final selection of the lifting mechanism for handling HLW packages will be made during the waste package design phase of the CWP Program (see Section 2.0).

CRITERION 9 BASES, PACKAGE IDENTIFICATION

The metal label affixed to each HLW package is necessary for identification of the package for nuclear materials control from packaging through the end of the retrievability period in the federal repository.

CRITERION 10 BASES, PACKAGE CONTENT AND DOCUMENTATION

HLW package content and documentation will be necessary for nuclear materials control and provide for easy tracibility. QA and QC records relating to design, fabrication, and testing of the HLW container will be required to verify adherence to Section III, Division 1, Class 3 of the ASME Code.

4.2.3 CLADDING WASTE (CW) PACKAGE

To develop CW package acceptance criteria, certain assumptions were made concerning the waste form that would be permitted in the package. On-going studies may require modification of these assumptions, but for the present they are as follows:

- Concentration of nuclides present in a waste package shall conform to regulations set forth in 49CFR173 and 10CFR71, and special regulations as developed for the specific container size and shape.
- CW contents shall not exceed 0.5% of the actinides and 0.5% of the nonvolatile fission products originally contained in the unreprocessed spent fuel.
- Residue from the acid leaching of SF cores shall be rinsed and thoroughly dried to prescribed acceptable limits prior to placement in a radioactive waste container. The residue may or may not be compacted and shall be so indicated on the permanent records for each package.
- Fines shall be excluded to prevent explosive or phyrophoric conditions from existing in the waste.
- Waste package contents shall not exceed 80% of the active volume of the waste container.

CRITERION 1 BASES, PHYSICAL DIMENSION AND WEIGHT

Information and data have been collected from participants in the national waste management program.[11] Collation of this information and data provides the bases for the maximum package dimensions and weight cited in Criterion 1. The dimensions of 24-inch OD by 8 feet 6 inches long (includes handling fixtures) and gross weight of 10,000 pounds are selected to be compatible with waste management facilities.

CRITERION 2 BASES, THERMAL POWER

CW is sufficiently well defined so as to permit the establishment of a thermal power criteria. Untreated and uncompacted CW at age 1 year was assumed to have a heat density of 21 W/ft^3.[11] Under these conditions, a 24-inch OD by 8-foot 6-inch long package of CW would have a thermal power of approximately 450 watts. Compacted waste would result in heat loads in excess of 1600 watts for the same size container. Considering the maximum expected thermal power and allowing for unusual waste composition, a limit of 2×10^3 watts per container is specified for acceptance of a CW package at a federal repository.

CRITERION 3 BASES, RADIATION LIMITS

Anticipated radiation levels of 1-year old CW were analyzed based on mixing end bells and/or grid spacers with the residue from acid leaching of the SF cores.[8] Grid spacers and end bells were assumed to be located at the outer periphery of the package and would see 10% and 100% of the flux, respectively.

Based on the above analysis, it was determined that the maximum anticipated radiation levels would be 3400 rem/hr. A maximum surface radiation limit of 4×10^3 rem/hr as specified in the criterion should provide the proper guidelines for acceptance of CW packages at a federal repository.

CRITERION 4 BASES, INTERNAL PRESSURE

Prior to development of operating pressure limits for CW packages, certain assumptions must first be made:

- The solid waste form will fill 80% of container active volume.
- The remaining 20% of active container volume will consist of dry 60°F ambient air entrapped in the container during remote sealing.

- The CW form will remain reasonably stable up to 334°F and will only contribute small amounts of off gas and moisture to the air space.[8]

Assuming a factor of safety of 3.0, a maximum operating pressure of 70 psia is specified.

CRITERION 5 BASES, SURFACE CONTAMINATION LIMIT

The limits set forth for the CW package are based on those for shipping casks. These limits are the maximum permissible levels as set forth in 49CFR173.397.

CRITERION 6 BASES, DESIGN AND FABRICATION

Section III, Division 1, Class 3 of the ASME Code is specified for Criterion 1 on the basis of a review of existing codes and standards for their applicability to design and fabrication of nuclear waste containers.[6] Additional discussion is included in Section 5.0 of this document. Section III is specifically tailored for nuclear application. It provides for QA and QC procedures that are more stringent than Section VIII of the ASME Code. The use of an "N" code stamp will provide verification that the Section III requirements have been met. However, it should be noted that the scope of Section III and requirements for "N" stamping may have to be modified to permit delivery of the containers to the packager prior to sealing and testing.

CRITERION 7 BASES, MATERIALS OF CONSTRUCTION

Low carbon steel was specified for CW containers on the basis of recent evaluations.[3,7] In the case of CW, recommendations were to store the waste package in a controlled 50% relative humidity environment at the reprocessing and surface storage facilities. Storage of low carbon steel CW containers in a salt, shale, or basalt environment was also reviewed. Conclusions indicated that the expected low moisture atmosphere of a federal repository combined with isolation of the packages from direct contact with the geologic media should permit safe storage of CW during the 5-year retrievable period.

CRITERION 8 BASES, HANDLING

The Oak Ridge connector has been tentatively selected as the reference lifting mechanism based on its extensive use in remote handling operations. Final selection of the lifting mechanism for handling CW packages will be made during the waste package design phase of the CWP Program (see Section 2.0).

CRITERION 9 BASES, CRITICALITY

The requirements of Criterion 9 are needed to assure that packages shipped to the federal repository are critically safe in any storage array. The burden of proof is on the waste packager.

CRITERION 10 BASES, PACKAGE IDENTIFICATION

The metal label affixed to each CW package is necessary for identification of the package for nuclear materials control from packaging through the end of the retrievability period in the federal repository.

CRITERION 11 BASES, PACKAGE CONTENT AND DOCUMENTATION

CW package content and documentation will be necessary for nuclear materials control and accountability and provide for easy tracibility. QA and QC records relating to design, fabrication, and testing of the CW container will be required to verify adherence to Section III, Division 1, Class 3 of the ASME Code.

4.2.4 INTERMEDIATE-LEVEL TRU WASTE (ILTW) PACKAGE

The ILTW package acceptance criteria are based on the following assumptions concerning the package content:

- Free liquids shall be excluded from all waste packages.
- Concentration of nuclides present in a waste package shall conform to regulations set forth in 49CFR173 and 10CFR71.
- Waste classified as "combustible NHLTW" shall be incinerated and/or reduced to a solid state that will meet the combustion specifications of the federal repository designated to receive the waste.
- There shall be no known explosive, or phryphoric materials, or conditions existing in the waste.
- Waste package contents shall not exceed 80% of the active volume of the waste container.

CRITERION 1 BASES, PHYSICAL DIMENSION AND WEIGHT

Information and data have been collected from participants in the national waste management program.[11] Collation of this information and data provides the bases for the maximum package dimensions and weight cited in Criterion 1. The dimensions of 24-inch OD by 8 feet 6 inches long (includes handling fixtures), and gross weight of 10,000 pounds are selected to be compatible with waste management facilities.

CRITERION 2 BASES, THERMAL POWER

Heat densities of ILTW are low and have been estimated in the 0.1 to 0.2 W/ft^3 range.[20] At the higher range, the 24-inch OD by 8-foot 6 inch package would dissipate approximately 5 watts. Considering a safety factor of 5.0 and allowing for unusual waste composition, a maximum value of 25 watts is specified.

CRITERION 3 BASES, RADIATION LIMIT

By definition, the lower radiation limit for packaged ILTW is 10 mrem/hr.[21] The upper limit of 15 rem/hr specified in Criterion 3 is based on the collation of information and data gathered from participants in the national waste management program.[11] This limit will allow the design of adequate shielding for remote handling of ILTW packages.

CRITERION 4 BASES, INTERNAL PRESSURE

The internal pressure limit cited in Criterion 4 was developed using the ideal gas law. The following assumptions were made for the calculation:

- The solid waste form will fill 80% of container active volume.
- The remaining 20% of active container volume will consist of 60°F ambient air entrapped in the container during remote sealing.
- The cement or glass waste form will remain reasonably stable up to 120°F (the predicted maximum operating temperature)[8] and will only contribute small amounts of off gas and moisture to the air space.

Considering a safety factor of 3.0, a maximum operating pressure of 50 psia is specified.

CRITERION 5 BASES, SURFACE CONTAMINATION

The limits set forth for the ILTW package are based on those for shipping casks. These limits are the maximum permissible levels as set forth in 49CFR173.397.

CRITERION 6 BASES, DESIGN AND FABRICATION

Section III, Division 1, Class 3 of the ASME Code is specified for Criterion 1 on the basis of a review of existing codes and standards for their applicability to design and fabrication of nuclear waste containers.[6] Additional discussion is included in Section 5.0 of this document. Section III is specifically tailored for nuclear application. It provides for QA and QC procedures that are more stringent than Section VIII of the ASME Code. The use of an "N" code stamp will provide verification that the

Section III requirements have been met. However, it should be noted that the scope of Section III and requirements for "N" stamping may have to be modified to permit delivery of the containers to the packager prior to sealing and testing.

CRITERION 7 BASES, MATERIALS OF CONSTRUCTION

Low carbon steel was specified for an ILTW container on the basis of recent evaluations.[3,7] In the case of ILTW, recommendations were to store the waste package in a controlled 50% relative humidity environment at the reprocessing and surface storage facilities. Storage of low carbon steel containers in a salt, shale, or basalt environment was also reviewed. Conclusions indicated that the expected low moisture atmosphere of a geologic mine combined with isolation of the packages from direct contact with the geologic media should permit safe storage of ILTW during the 5-year retrievable period.

CRITERION 8 BASES, HANDLING

The Oak Ridge connector has been tentatively selected as the reference lifting mechanism based on its extensive use in remote handling operations. Final selection of the lifting mechanism for handling ILTW packages will be made during the waste package design phase of the CWP Program (see Section 2.0).

CRITERION 9 BASES, CRITICALITY

The requirements of Criterion 9 are needed to assure that packages shipped to the federal repository are critically safe in any storage array. The burden of proof is on the waste packager.

CRITERION 10 BASES, PACKAGE IDENTIFICATION

The metal label affixed to each ILTW package is necessary for identification of the package for nuclear materials control from packaging through the end of the retrievability period in the federal repository.

CRITERION 11 BASES, PACKAGE CONTENT AND DOCUMENTATION

ILTW package content and documentation will be necessary for nuclear materials control and accountability and provide for easy tracibility. QA and QC records relating to design, fabrication, and testing of the ILTW container will be required to verify adherence to Section III, Division 1, Class 3 of the ASME Code.

4.2.5 LOW-LEVEL TRU WASTE (LLTW) PACKAGE

The LLTW package acceptance criteria are based on the following assumptions concerning the package content:

- Free liquids shall be excluded from all waste packages.
- Concentration of nuclides present in a waste package shall conform to regulations set forth in 49CFR173, 10CFR71, and special DOT permit No. 5948.
- Waste classified as "combustible NHLTW" shall be incinerated and/or reduced to a solid state that will meet the combustion specifications of the federal repository designated to receive the waste.
- All solid or solidified waste classified as noncombustible NHLTW shall either be packaged in the original solid forms or shall be shredded and compacted in a solid matrix.
- There shall be no known explosive, or pyrophoric materials, or conditions existing in the waste.

CRITERION 1 BASES, PHYSICAL DIMENSIONS AND WEIGHT

The DOT-approved 17C and 17H drums are currently being used for storage of LLTW. The dimensions are fixed. The basis for the 800-pound gross weight limit is the DOT specifications 17C and 17H.

CRITERION 2 BASES, THERMAL POWER

The thermal density of LLTW has been estimated to fall in the range of 0.02 to 0.1 W/ft^3.[20] At the higher range, a 17C or 17H drum would contain approximately 0.7 watt. In addition, the maximum thermal power limit of LLTW packages shipped in a closed transport vehicle per DOT permit No. 5948 is 10 watts per 55-gallon drum.

Considering the expected low thermal power of LLTW and allowing for unusual waste composition, a limit of 10 watts for DOT-approved 17C or 17H drums is specified for storage and disposal of LLTW in a federal repository.

CRITERION 3 BASES, RADIATION LIMIT

The bases for the radiation limit of 10 mrem/hr is the definition of LLTW.[22] This radiation limit will allow the direct handling of LLTW packages without supplementary shielding.

CRITERION 4 BASES, INTERNAL PRESSURE LIMIT

Procurement specification for DOT 17C and 17H drums requires 15-psi hydrostatic test. A 10-psig maximum operating pressure is specified.

CRITERION 5 BASES, SURFACE CONTAMINATION

The limits set forth for the LLTW container are based on those for shipping casks. These limits are the maximum permissible levels as set forth in 49CFR173.397. The objective of the criteria is to minimize, to a practical level, the transfer of radioactive contaminants to the federal repository receiving area. The purpose is to provide for unlimited access and eliminate undue radiation exposure.

CRITERION 6 BASES, DESIGN AND FABRICATION

Basic design specification for DOT-approved 17C or 17H drums are described in 49CFR178. A set of procurement specifications are also available which describe necessary specifications for drum capacities, material thicknesses, hoop details, closures, etc.

CRITERION 7 BASES, MATERIALS OF CONSTRUCTION

Low carbon steel was specified for LLTW container on the basis of recent evaluations.[3,7] Protection against accelerated corrosion in environments with a relative humidity greater than 50% can be achieved by galvanizing the exterior surface of the container.

CRITERION 8 BASES, CRITICALITY

The DOT Permit No. 5948 limits the TRU (fissile) content to 200 g and graphite to 90 kg for each 17C or 17H drum which provides critically safe transport in a "closed transport vehicle". Further studies will be needed to determine critically safe storage arrays in a federal repository.

CRITERION 9 BASES, PACKAGE IDENTIFICATION

The metal label affixed to each LLTW package is necessary for identification of the package for nuclear materials control from packaging through the end of the retrievability period in the federal repository.

CRITERION 10 BASES, PACKAGE CONTENT AND DOCUMENTATION

LLTW package identification and documentation will be necessary for nuclear materials control and accountability and provide for easy tracibility. QA and QC records relating to design, fabrication, and testing of the LLTW container will be required to verify adherence to 49CFR178.

TABLE 4-1

HEAT TRANSFER STUDIES

HLW PACKAGES EMPLACED
IN A FEDERAL REPOSITORY

	CANISTER OD, INCHES[A]			THERMAL POWER, kW[A]		
MINE PITCH, FEET	30	40	50	30	40	50
SALT GLASS	11.5	15.0	18.0	2.1	3.6	5.6
CALCINE	8.5	11.5	12.0	1.9	3.6	4.1
BASALT GLASS	10.5	11.5	11.5	1.6	2.1	2.1
CALCINE	8.0	8.5	8.5	1.7	1.9	1.9
SHALE GLASS	10.0	11.0	11.5	1.5	1.8	2.1
CALCINE	7.5	8.0	8.5	1.4	1.6	1.9

(A) DATA WERE DEVELOPED ASSUMING THE PACKAGE WAS IN AN OVERPACK. ADD 2 INCHES TO OBTAIN OD OF OVERPACK.

5.0 DISCUSSION

5.1 WASTE PACKAGE ACCEPTANCE CRITERIA

A discussion of criterion involves many common factors which are more common to the criterion than waste form. In view of this, the discussion section has been organized by criterion rather than waste form. Factors associated with the various waste forms are discussed for each criterion. Where the information presented in the bases section (Section 4.0) is considered complete and self explanatory no additional discussion is presented under this section.

5.1.1 PHYSICAL DIMENSIONS AND WEIGHT

Spent Fuel Package - The package length criterion must accommodate the longest unmodified fuel assembly that is expected to be stored through 1990. This will be a pressurized water reactor (PWR) fuel assembly, 16 feet 6 inches in length, produced by Combustion Engineering. The package length criterion allows for an overpack and attached lifting mechanisms. The maximum diameters were established by the conceptual design study for the Spent Fuel Handling and Packaging Study.[13] The weight limit criterion will ensure that handling equipment in facilities comprising the waste management system will be designed with sufficient capacity.

High-Level Waste Package - A two-dimensional thermal model was used for transient thermal analysis of overpacked HLW packages in geologic storage at repositories located in salt, shale, and basalt formations.[5] These studies determined the maximum allowable diameter and thermal power for packages which would be consistent with the temperature limits for the waste form, canister, and geologic media. These limits are defined in the preface to Section 4.2.2. (The temperature limits for basalt and shale have not been defined, consequently, none were assumed for the thermal analysis.) The dominant temperature constraints for the package diameters shown in the Table 4-1 were found to be 350°C canister temperature limit for packages in basalt and shale. For packages emplaced in salt, the salt temperature limit is the dominant constraint except for calcine-filled

packages at a pitch of 50 feet and greater where the waste temperature limit becomes dominant.

The selected diameters and associated thermal loadings are for a 30-foot pitch in a salt repository. As repository designs are developed, it will facilitate cost-effective analysis of the diameter versus pitch for the various geologic formations. At that time, comprehensive systems analysis, encompassing the complete HLW package life cycle, should be conducted to determine the cost-effective sizes and the sensitivity of cost to variables such as package size, thermal power, repository design and operation, and transportation. It is conceivable however, that because of the system complexity, very little cost sensitivity may exist.

Low-Level TRU Waste Package - The size and weight are consistent with a DOT-approved 55-gallon drum containing waste which has been immobilized within a solid matrix having a density similar to concrete. It is appropriate to point out that repository designs have not been sufficiently developed at this time to ensure that a 55-gallon drum should be the only size or shape container used for LLTW. Operating procedures, handling equipment and waste stacking and storage configurations should be more extensively analyzed when feasible. However, the DOT-approved 55-gallon drum has been extensively and safely used in the past. The immobilization of LLTW in a solid matrix should improve the acceptability of the 55-gallon drum as a container for routine storage or disposal of LLTW. There will be a variety of wastes such as failed equipment and decontamination and decommissioning (D&D) wastes which may not be amenable to containerization in 55-gallon drums. Such packages may be dealt with on an individual basis or if warranted another size LLTW package may be designated for routine acceptance. Future studies are required as repository designs are developed and LLTW forms are fully cataloged.

Intermediate-Level TRU and Cladding Waste Packages - A standard size container was selected for both waste classifications.[11] It was an objective that a standard size container should result in a minimum change to existing reprocessing facilities and at the same time satisfy the requirements of planned federal repositories. The external diameter of the container and

length do not exceed values that will allow proper handling through repository elevators and corridors. If containers are placed in vertical holes in the floor of the repository geologic disposal area, the OD of the container should conform to practical and economical drilling capabilities.

5.1.2 THERMAL POWER

High-Level Waste Package - The thermal power limits shown in Table 4-1 were developed for canisters 80% filled (a waste length of 8 feet). It is assumed that increasing the length of the canister resulting in greater thermal power per canister will have minimal effect on the spacing (pitch) in the repository, (this will be verified in future heat transfer studies). Consequently, thermal power limit values of 3.1 kW for glass waste and 2.8 kW for calcine reflecting the increased waste volume were specified for 14-foot long packages with a waste length of 12 feet. In addition to confirming the effect of increased waste length, future thermal studies will be three dimensional rather than two dimensional.

The two-dimensional thermal model used in prior analysis did not allow for heat conduction through the repository room walls and pillars; hence, the data in Table 4-1 may be conservative. The two-dimensional thermal model was used for an initial heat transfer analysis in that it allowed an evaluation of a greater number of parameters in a short period of time. Repository designs were also not sufficiently developed for representative modeling. Since the temperature limits for the waste form, canister and repository media are being revised and repository layouts are being more fully developed, additional transfer studies are planned for both HLW and SF packages. Three-dimensional thermal modeling will be used. Evaluating the effect of heat conduction through the repository walls and pillars to the surface will more closely approximate repository thermal conditions.

Cladding Waste Package - The maximum thermal power of 2×10^3 watts per package is based on a waste composition of 0.5% actinides and 0.5% nonvolatile fission products. Recommended limits on fission products for CW range from 0.05 to 0.5%.[23] Additional studies of expected CW characteristics are needed. Until these are conducted, the 0.5% fission product limit will

be considered as the basis for determining the estimated thermal power for CW.

5.1.3 RADIATION LIMIT

Intermediate-Level TRU Waste Packages - The only apparent restriction on the maximum radiation level of an ILTW package is the ability of the reprocessing plant and federal repository to remotely handle and dispose of the packages. If ILTW packages are emplaced in a federal repository in a manner similar to the emplacement of HLW packages, the radiation levels expected should not present shielding problems. It is also anticipated that ILTW packages can be adequately shielded to meet all transportation standards.

Low-Level TRU Waste Packages - Maximum radiation limits for packages of LLTW will depend on maximum allowable radiation limits at any stage of the packaging life cycle. The main factors that must be considered prior to establishing radiation limits are whether "burn up" of personnel will be allowed, and the maximum allowable limits for shipment under present or proposed DOT and NRC standards.

A 40-hour work week is normally used as a basis for determining the maximum allowable radiation levels for contact handling in a waste management facility. Under these conditions, a 10-mrem/hr limit for container surface radiation should provide sufficient protection to transport the LLTW package from the packager to emplacement in the federal repository. Time and motion studies based on planned operations will ultimately be required to confirm this.

Standards for transportation of nuclear waste containers in "non-exclusive vehicles" limit the maximum radiation to 200 mrem/hr at the surface of the package. The use of "exclusive use vehicles" permits maximum limits of 1,000 mrem/hr at 3 feet from the package surface if enclosed in an approved "closed transport vehicle". Comparisons of these transportation radiation limits with those for personnel protection indicate that the controlling factor will be the "burn up" times for personnel handling LLTW packages.

The recommended 10-mrem/hr surface limit for contact handling does not indicate that the container must be unshielded. Shielding of a container

to reduce levels to permit contact handling must be based on additional transport costs versus the option to package and store the waste as ILTW. The additional container weight due to shielding the LLTW package would also have to be evaluated to prevent the DOT-approved drum from exceeding safety standards required by 49CFR178.

5.1.4 INTERNAL PRESSURE LIMITS

All Waste Packages - The specified internal pressure limits are based on simplistic assumptions, one of which is the ideal gas law. Properties of assumed waste forms are not sufficiently well characterized to permit a rigorous determination of expected pressurization during normal operating conditions throughout the package life cycle. Further studies are planned.

The prime objective and result of this criterion must be the assurance that HLW and SF canisters plus other containers shall not rupture catistrophically. The high-integrity canisters are capable of constraining high pressures and would therefore cause wide-spread damage and spread of radioactivity if ruptured. Safe operation must be assured and survival of its container must be assured under credible design basis accidents. Whether this is feasible with all waste forms has not been determined. Studies relating to design criteria will aid in selecting alternative approaches to the basic question of internal pressure within radioactive waste packages.

5.1.5 SURFACE CONTAMINATION LIMIT

All Waste Packages - This limit is a conservative and accepted limit for shipping packages. It has been specified as an acceptance criterion for waste packages pending the completion of studies to determine both reasonable limits for decontamination and the need for lowering the criterion limits to maintain "clean" handling facilities within the waste management system.

5.1.6 DESIGN AND FABRICATION

All Waste Packages Excluding LLTW - The anticipated internal pressures of the waste packages would indicate that ASME Codes should be considered for

the design and fabrication of the waste containers. How the ASME Codes would be applied to containers of nuclear waste is not precise at present. For example, it is difficult to determine if a portable pressure container of nuclear waste, with or without a pressure relief device, and exposed to the private sector of industry must be designed to ASME Codes. The container will reside in or be protected at all times by specially designed nuclear facilities and by shipping casks during transport. Final decisions for designing nuclear waste containers to ASME Codes or other standards will lie with the NRC during licensing of facilities in the waste management system.

Until these decisions are made, it will be assumed that a nuclear waste container should meet all requirements of Section III of the ASME Code. A discussion of the bases for determining the most applicable section and divisions of the ASME Codes follow.

ASME SECTION VIII, DIVISION 1

Section VIII, Division 1, of the ASME Codes is normally specified for standard industrial pressure vessels and is considered to be applicable for nearly all non-nuclear pressure vessels. Vessel design under Section 1 is based on applying the theory of maximum stress to 5/8 yield and 1/4 ultimate stress limits. This results in a safety factor of 4.0. QA and QC specifications are considered as minimal to meet the Certificate of Authorization for affixing a "U" stamp to the pressure vessel.

ASME SECTION VIII, DIVISION 2

Section VIII, Division 2 of the ASME Codes is normally specified for vessels where an extremely stringent stress analysis is required. Vessels designed under this section are based on a principle stress theory to 1/2 yield and 1/3 ultimate stress limits. This results in a safety factor of 3.0. QA and QC, although more rigid to meet the additional stress analysis, are basically the same as Section VIII, Division 1.

ASME SECTION III, DIVISION 1, CLASS 3

Class 3 under Division 1 of Section III of the ASME Codes is the only class considered by the CWP Program to be applicable to design and fabrication of nuclear waste containers. Class 1, 2, MC, etc., under this section were considered to be more applicable to design of nuclear reactors and associated critical components.

Vessels designed under this section are based on a 5/8 yield and 1/4 ultimate stress limit similar to Section VIII, Division 1. QA and QC requirements, however, are more stringent than Section VIII, Division 1 or 2 to meet the "N" stamp requirements of the nuclear industry.

In general, all mentioned sections of the ASME Code require a pressure relief device. Section VIII, Division 1 or 2, only apply to vessels 6 inches or larger in diameter and internal pressures in excess of 15 psig. Section III, Class 3, has no apparent minimum diameter or pressure limits.

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7.0 APPENDICES

Appendix A - Glossary

1. A canister is a special use container (i.e., spent fuel canister, HLW canister).

2. A container is a metallic or non-metallic barrier in contact with, and enclosing the radioactive waste.

3. Cladding waste includes solid fragments of zircaloy, stainless steel cladding, and structural elements that remain after dissolution of the spent fuel cores. This waste is highly radioactive due to neutron activation of the cladding and residual fission product contamination, and will normally generate a significant amount of heat.

4. Closed transport vehicle is a large cargo carrier used to ship Department of Transportation (DOT) approved packages of waste. The vehicle must be equipped with a securely attached exterior enclosure which restricts access by unauthorized persons during transport.

5. Disposal is the emplacement of radioactive waste packages in a facility designed to permanently isolate radionuclides from the biosphere with no expectation of retrieval after emplacement.

6. A federal repository means a facility for storage or disposal of packages constructed in an extensive underground rock formation having inherent properties that provide effective isolation of the radionuclides from the biosphere.

7. High-level waste means the solidified waste shipped to a federal repository for storage or disposal which meets the requirements of the Code of Federal Regulations Title 10 Part 50, Appendix F.

8. Intermediate-level TRU waste is defined as those materials (other than high-level or cladding wastes) that contain long-lived alpha emitters in known or suspected concentrations greater than 10 nanocuries per gram and also have sufficiently high radiation levels after packaging to require shielding before handling is allowable.

9. The life cycle comprises the various processing and storage environments the radioactive waste is exposed to from time of filling at the producer's facility until the end of the retrievability period in a federal repository.

10. Low-level TRU waste is defined as those materials which contain plutonium or other long-lived alpha emitters in known or suspected concentrations greater than 10 nanocuries per gram, and yet have sufficiently low radiation levels after packaging to permit contact handling.

11. An overpack is a permanently attached secondary or tertiary barrier enclosing a radioactive waste package.

12. Package means the canister and radioactive waste form contents. (May be used with a prefix, e.g., spent fuel package.)

13. Package acceptance criteria means a list of limiting constraints defining the chemical and physical properties, heat content, radiation, surface contamination levels, exterior dimensions, shape, and weight of packages with or without an overpack which an organization, agency, or federal repository operator will accept.

14. Packager means the agency, company, or organization packaging the waste.

15. Packaging is the operation of placing radioactive waste in a container.

16. A shipping cask is a massive enclosure in which the radioactive waste package is placed to provide protection and reduce surface dose rates to permissible levels during transportation.

17. Solidification is the process of converting the HLW solution to a solid form.

18. Spent fuel is irradiated fuel discharged from a light water reactor and cooled sufficiently to allow transport.

19. Storage is the retrievable emplacement of radioactive waste packages in either a surface or geologic repository.

20. Retrievability is the term used to describe the ability to recover the radioactive waste package from surface or geologic storage without loss of radioactive material or loss of container integrity.

21. Thermal power means the instantaneous amount of radioactive decay heat per container that is emitted from the waste. The units are in watts or kilowatts per container.

22. The waste management system is an integrated handling and storage system comprising all facilities and transport systems wherein the radioactive waste package resides during its life cycle.

23. A waste package consists of a waste container and the radioactive waste form contents. (As applied to transportation, "Shipping Package" includes any shielded enclosure containing one or more radioactive waste packages.)

Appendix B - Abbreviations

ASME	American Society for Mechanical Engineers
ASME Code	American Society for Mechanical Engineers Boiler and Pressure Vessel Code
ASTM	American Society for Testing and Materials
CFR	Code of Federal Regulations
CW	Cladding Waste
CWP	Commercial Waste Packaging
D&D	Decontamination and Decommissioning
DOE	Department of Energy
DOT	Department of Transportation
HLW	High-Level Waste
ILTW	Intermediate-Level Transuranic Waste
LLTW	Low-Level Transuranic Waste
LWR	Light Water Reactor
NHLTW	Non-High-Level Transuranic Waste
NRC	Nuclear Regulatory Commission
NWTS	National Waste Terminal Storage
OD	Outside Diameter
ONWI	Office of Nuclear Waste Isolation
OWI	Office of Waste Isolation
QA/QC	Quality Assurance/Quality Control
SF	Spent Fuel
SFHP	Spent Fuel Handling and Packaging
SURF	Spent Unreprocessed Fuel
TRU	Transuranic

8.0 REVISIONS

Waste Package Acceptance Criteria provide a design basis reference for the waste management system, including transportation. At the same time, these criteria must be responsive to and reflect facility designs where the inherent properties of the facilities create constraints which are unavoidable or too costly to mitigate.

Because of this, these criteria have been organized with the objective of being a living document subject to revision or update as the designs and regulations applicable to the waste management system mature. At appropriate times, revisions to the criteria document will be issued. Revision sheets listing the date, nature of the revision, and pages substituted for each revision will be furnished with each revision as a record within this section.