DOE/NV–325–Rev. 5
October 2003
Effective Date: December 1, 2003

Nevada Test Site
Waste Acceptance Criteria

Prepared by the

U. S. Department of Energy
National Nuclear Security Administration
Nevada Site Office
Waste Management Division

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Photograph on front cover: Desert National Wildlife Range landscape located southeast of Mercury.

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Approval Signatures

To the best of our knowledge, this document is correct and the process and criteria stated within meet the U.S. Department of Energy and appropriate federal regulation requirements.

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NTSWAC Revision History

Date	Pages Changed	Revision
09/1996	All	Rev. 0
08/1997	All	Rev. 1
05/1999	All	Rev. 2
02/2000	i, vi, 3-5, Ref-1	Rev. 2, DCN DOE/NV-325-03-01
11/2000	All	Rev. 3
01/2002	All	Rev. 4
10/2003	All	Rev. 5

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Acronyms

ACM	Asbestos-Containing material
ALARA	As Low as Reasonably Achievable
ALLW	Asbestiform Low-Level Waste
AMEM	Assistant Manager for Environmental Management
BN	Bechtel Nevada
Bq	Becquerels
CAR	Corrective Action Request
CFR	Code of Federal Regulations
Ci	Curie
CSE	Criticality Safety Evaluation
DOE	U.S. Department of Energy
DOT	U.S. Department of Transportation
DQO	Data Quality Objectives
EPA	U.S. Environmental Protection Agency
ETA	Estimated Time of Arrival
FGE	Fissile Gram Equivalence
HEPA	High-Efficiency Particulate Arresting
HRI	Human Readable Interpretation
LDR	Land Disposal Restrictions
LLD	Lower Limit of Detection
LLW	Low-Level Waste
MC&A	Materials Control and Accountability
M&TE	Measuring and Test Equipment
MW	Mixed Waste

Acronyms (continued)

NIC	NTSWAC Implementation Crosswalk
NNSA/NSO	National Nuclear Security Administration Nevada Site Office
NRC	Nuclear Regulatory Commission
NTS	Nevada Test Site
NTSWAC	Nevada Test Site Waste Acceptance Criteria
PCB	Polychlorinated Biphenyls
PCL	Package Certification Label
PE-g	Plutonium Equivalent Gram
PK	Process Knowledge
PSDR	Package Storage and Disposal Request
QA	Quality Assurance
QAP	Quality Assurance Plan
RCRA	Resource Conservation and Recovery Act
RWAP	Radioactive Waste Acceptance Program
RWMS	Radioactive Waste Management Site
SSC	Structures, Systems, and Components
SW-846	EPA Document SW-846, "Test Methods for Evaluation Solid Waste, Physical/Chemical Methods"
TCLP	Toxicity Characteristic Leaching Procedure
TRU	Transuranic
WAC	Waste Acceptance Criteria
WARP	Waste Acceptance Review Panel
WATS	Waste Generator Assistance and Technical Support
WCO	Waste Certification Official
WCPP	Waste Certification Program Plan
WMD	Waste Management Division
WP	Waste Profile

1.0

Radioactive Waste Management at the Nevada Test Site

Gate 100 - Mercury, Nevada

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1.0 Radioactive Waste Management at the Nevada Test Site

1.1 Purpose and Scope

This document establishes the U. S. Department of Energy, National Nuclear Security Administration Nevada Site Office (NNSA/NSO) waste acceptance criteria (WAC). The WAC provides the requirements, terms, and conditions under which the Nevada Test Site (NTS) will accept low-level radioactive (LLW) and mixed waste (MW) for disposal. MW generated within the State of Nevada by NNSA/NSO activities is accepted for disposal. It includes requirements for the generator waste certification program, characterization, traceability, waste form, packaging, and transfer. The criteria apply to radioactive waste received at the Nevada Test Site (NTS) Area 3 and Area 5 Radioactive Waste Management Site (RWMS) for storage or disposal. "Storage" in this document refers to the Area 5 RWMS classified units. The glossary defines the terms "storage" and "classified waste" as they are used in this document.

The NNSA/NSO and support contractors are available to assist you in understanding or interpreting this document. For assistance, please call NNSA/NSO Waste Management Division (WMD): phone (702) 295-3181, fax (702) 295-1153

1.2 Policy

1.2.1 NNSA/NSO Policies

- ensure safe and compliant storage and disposal of radioactive waste; be consistent with the current revision of all applicable federal, state, and local regulations;

- protect the environment, personnel, and public from chemical and radiological hazards in accordance with Title 40 Code of Federal Regulations (CFR), the Resource Conservation and Recovery Act (RCRA); Title 10 CFR 835, "Occupational Radiation Protection"; U.S. Department of Energy (DOE) Order 435.1, "Radioactive Waste Management"; and state of Nevada and applicable U. S. Department of Transportation (DOT) regulations;

- ensure that present and future radiation exposures are kept as low as reasonably achievable (ALARA) and do not exceed the radiation protection standards established in Title 10 CFR 835, "Occupational Radiation Protection"; and

- ensure that Quality Assurance (QA) programs are established and implemented to fulfill the requirements of DOE Order 435.1, "Radioactive Waste Management"; Title 10 CFR 830.122, "Quality Assurance" and DOE Order 414.1, "Quality Assurance."

1.2.2 Process

Waste will be accepted from generators approved by NNSA/NSO. The approval process is described in Section 2.0.

1.2.3 Waste Type

LLW and MW will be accepted for disposal at the NTS. However, to verify the current acceptance status of waste types, please contact NNSA/NSO WMD.

1.2.4 Regulators and Stakeholders

NNSA/NSO will facilitate appropriate oversight by state agencies and support the involvement of the stakeholders. Where appropriate, to the extent possible, and in accordance with applicable NNSA/NSO authority, NNSA/NSO will provide regulatory agencies and stakeholders access to information related to Nevada Test Site Waste Acceptance Criteria (NTSWAC) activities, including waste characterization data, from all generators. Upon request by such parties, arrangements may be made to observe NTSWAC-related facility evaluations and participate in other activities such as NTSWAC revisions.

1.3 Requirements

Requirements are identified by "***shall***" or "***must***." The source of the requirement is identified by a superscript number which corresponds to the reference list. Statements not identified in this manner are provided as guidance. Section 2.0 requirements do not have corresponding references because the approval process is NNSA/NSO policy. Section 5.0 requirements are written in accordance with DOE Order 414.1, "Quality Assurance"; Title 10 CFR 830.122, "Quality Assurance"; and NNSA/NSO Policy unless otherwise noted by superscript.

1.4 Responsibilities

The following offices and personnel have responsibilities for management and acceptance of radioactive waste at the NTS. The offices identified are within the NNSA/NSO, unless otherwise stated.

1.4.1 Manager

Responsibilities and authorities as assigned in DOE Order 435.1.

1.4.2 Assistant Manager for Environmental Management (AMEM)

Responsible for the NNSA/NSO Radioactive Waste Management Program (RWAP) according to DOE Manual NV M 435.1-1, "Radioactive Waste Management Manual". Provides approval to waste generators to dispose or store radioactive waste at the NTS and grants any deviations from the requirements of this document. Responsible for suspension of any generator. May delegate his/her responsibilities except for approval and suspension.

1.4.3 Director, Waste Management Division

Responsible for radioactive waste management operation of the Areas 3 and 5 RWMSs in compliance with applicable DOE Orders and federal and state regulations. Develop, implement, and maintain the NTSWAC.

1.4.4 Low-Level Operations Waste Team Lead

Responsible for management of radioactive waste disposal operations at NNSA/NSO, and implementation of the RWAP program to ensure compliance with with the NTSWAC, DOE Orders, and federal regulations.

1.4.5 Radioactive Waste Acceptance Program (RWAP) Task Manager

Responsible for interfacing with waste generators regarding RWAP program criteria and activities, scheduling facility evaluations of waste generator programs, initiate recommendations to the AMEM regarding the status of waste generator programs, and maintain RWAP quality records as defined by RWAP instructions.

1.4.6 RWAP Manager

Responsible for coordinating and managing daily activities of the RWAP program and RWAP personnel.

1.4.7 RWAP Personnel

Responsible for development, implementation, and maintenance of RWAP program documents (i.e., NTSWAC, instructions, checklists, etc.), and for providing guidance to generators shipping radioactive waste to the NTS.

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2.0

Approval Process

Bristlecone Pine, Rainier Mesa, and Stockade Wash, Nevada Test Site

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2.0 Approval Process

All waste/material offered for disposal/storage ***shall*** be evaluated pursuant to DOE Order 435.1. The following describes the approval process and generator document requirements used by NNSA/NSO to verify that waste generators have a program in place to ensure compliant waste is shipped to the NTS.

Official interactions between the generator and NNSA/NSO are initiated through the generator's DOE oversight office or designated points of contact.

Corrective Action Requests (CARs) are issued to generator sites when conditions adverse to quality are identified.

A flow diagram of the approval process is provided in Appendix A.

2.1 Generator Document Requirements

Generators should contact NNSA/NSO WMD and verify that the proposed waste type can be accepted at the NTS. The generator ***shall*** develop, implement, and maintain the documents listed below.

2.1.1 Waste Profiles

A Waste Profile (WP) ***shall*** be prepared and submitted to NNSA/NSO for each waste stream proposed for disposal. The WP summarizes the waste form and characterization data, and ***shall*** include a list of referenced procedures, citing the number and title. The WP instructions, numbering, and format that ***must*** be used are available from NNSA/NSO or on the NNSA/NSO website at http://www.nv.doe.gov/programs/RadioactiveWasteAcceptance.htm.

2.1.2 Waste Certification Plan

A Quality Assurance Plan (QAP) ***shall*** be documented in accordance with Section 5.0 and submitted to NNSA/NSO.

2.1.3 NTSWAC Implementation Crosswalk

An NTSWAC Implementation Crosswalk (NIC) ***shall*** be prepared and submitted to NNSA/NSO in accordance with Section 5.0. An electronic copy of the NIC is available from NNSA/NSO or on the NNSA/NSO website at http://www.nv.doe.gov/programs/RadioactiveWasteAcceptance.htm.

2.1.4 Certification Personnel List

A current list identifying the Waste Certification Official(s) (WCOs), alternate WCOs, and Package Certifier(s) ***shall*** be developed and submitted to NNSA/NSO. The list ***shall*** include the name and telephone number of each individual authorized to certify waste packages and shipments. This information is used by RWMS personnel to verify signatures on the Package Certification Labels (PCLs) and to assure that shipments are from authorized personnel. Any packages or shipments certified by unauthorized personnel ***shall not*** be accepted by the RWMS.

2.1.5 Document and Personnel Changes

Generators ***shall*** notify NNSA/NSO in writing of any changes to the above documents and/or key personnel.

2.2 RWAP Review

NNSA/NSO's approval process for a generator's waste certification program and waste streams includes document reviews and on-site evaluations to verify program implementation. During these evaluations, CARs may be issued when conditions adverse to quality are identified by NNSA/NSO. CARs require the generator to document a root cause, corrective action, and action to preclude recurrence. Failure to respond to CARs could lead to delays in approval or result in suspension in accordance with Section 2.4.

2.2.1 Facility Evaluations

Facility evaluations (audits, surveillances) are scheduled and conducted by RWAP.

2.2.1.1 Biennial Audit

New generators ***shall*** submit the documents described in Section 2.1 to NNSA/NSO prior to scheduling their initial audit. Audits of approved generators are scheduled and conducted on a biennial basis.

The purpose of the biennial audit is to examine and evaluate objective evidence to verify that the documents contain the necessary elements and are adequately implemented. The audit scope will include an on-site evaluation of the characterization, quality assurance, and waste traceability program elements. Audits are both performance- and program-based.

2.2.1.2 Surveillance

Scheduled or unscheduled surveillances may be performed to evaluate specific program elements, new waste streams, and verify implementation of corrective actions.

2.2.2 Waste Profiles

Waste profiles ***shall*** be submitted for review through the Waste Acceptance Review Panel (WARP) process. The WARP may require additional information from the generator, recommend a surveillance, or recommend NNSA/NSO approval or suspension of the waste stream.

New generators ***shall*** complete and submit at least one profile to NNSA/NSO for review prior to the initial audit.

Generators ***shall*** complete a WP's waste stream characterization activities prior to submitting the WP to NNSA/NSO for review by the WARP.

WPs for new waste streams or changes to approved waste streams may be submitted to NNSA/NSO for review by the WARP at any time.

The WCO ***shall*** perform a documented annual review of NTS approved WPs, based on the current revision date of each profile, to ensure the characterization data, waste stream information, and referenced procedures are current.

Changes to approved WPs ***shall*** be submitted to NNSA/NSO for review by the WARP. Depending on the significance of the change, the approval to ship may be temporarily suspended until the changes are reviewed and accepted.

Generators ***shall*** notify NNSA/NSO in writing when terminating an approved WP (project is complete, one-time-only waste stream has been shipped, etc.).

2.2.3 Split Sampling

The purpose of the split sampling program is to verify the results of waste analysis. NNSA/NSO may select a waste stream for split sampling based on its annual volume, the potential for finding hazardous components, or the scope and complexity of the sampling process to be performed. For mixed waste, NNSA/NSO may require split sampling prior to the waste stream being approved.

Samples will be collected by the generator's sampling team under the observation of an RWAP representative. NNSA/NSO may split a representative waste sample with the generator for independent analysis. Samples will be sent to the generator laboratory and to an independent laboratory chosen by NNSA/NSO. The samples will be analyzed by the same analytical methods. Results of the analyses from both

laboratories will be compared by RWAP after data validation. Differences between the two sets of data may require further investigation.

2.3 Approval

RWAP personnel recommend to NNSA/NSO AMEM that approval be granted after the generator has demonstrated satisfactory implementation of the NTSWAC. The NNSA/NSO AMEM will provide written notice of approval, identifying the last facility evaluation number, current Waste Certification Program Plan (WCPP) or QAP and revision, and approved waste stream(s). Conditions affecting waste stream approval will be identified.

Approved waste generators ***shall*** ensure the following documents are maintained current within the NNSA/NSO RWAP while their approval to ship waste is in effect:

- List of Authorized Certification Personnel
- Latest approved WP (Active WPs Only)
- Controlled copy of the QAP
- NIC

2.4 Suspending Approval

NNSA/NSO may suspend approval if generator's waste or documents do not meet the NTSWAC requirements. Individual waste streams or the generator's entire program may be suspended. Suspension may be issued verbally by NNSA/NSO representatives, followed by official written notification. Reasons for suspension may include but are not limited to:

- Improper manifesting (e.g., incorrect nuclide inventory or activity level reported),
- Repetitive programmatic deficiencies,
- Incorrect waste characterization,
- Waste container integrity deficiencies,
- Inadequate Nuclear criticality safety limits, and
- Facility evaluation results.

2.5 Assistance and Technical Support

The Waste Generator Assistance and Technical Support (WATS) program provides qualified technical assistance on NTSWAC issues at no cost to the generator. Generators wanting an independent review and one-on-one consulting on issues regarding their low-level waste management program are encouraged to contact WATS. WATS provides assistance to waste generators by providing:

- Gap-Analysis site visits.
- Review of profiles, certification documentation and corrective action plans.
- Policy and regulatory interpretations.
- Waste packaging and transportation issue assistance.

For additional information on requesting WATS support contact the NNSA/NSO WATS Task Manager at (702) 295-2969.

2.6 NNSA/NSO Policy

Because of changes in regulatory requirements, NTS policies, and changes instituted as a result of lessons learned, any aspect of the waste certification process may be subject to a full review to ensure its compliance with any changed requirements and effectiveness. This review may entail imposing additional requirements or reversing previous decisions. Unannounced facility evaluations may be performed at the discretion of NNSA/NSO.

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3.0

Waste Criteria

Area 5 Radioactive Waste Management Site, Nevada Test Site

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3.0 Waste Criteria

Waste accepted at the NTS ***must*** be radioactive and ***shall*** meet the waste form criteria outlined below.[6.6] Generators ***must*** ensure waste is handled, stored, and shipped in accordance with applicable DOE, DOT, U.S. Environmental Protection Agency (EPA), state, and local regulations and requirements. Waste streams deviating from these requirements will be evaluated in accordance with Section 3.4, WAC Deviations.[7.5/6.15]

3.1 General Waste Form Criteria

These waste form criteria are based on DOE radioactive waste management policies and practices.

3.1.1 Transuranics

The concentration of alpha-emitting transuranic nuclides with half-lives greater than 20 years ***must not*** exceed 100 nCi/g.[6.5] The net weight of the waste (excluding the weight of the container and shielding) ***must*** be used to calculate the specific activity of the waste in each container.[7.5] The following isotopes ***shall*** be considered when making the transuranic waste determination: ^{237}Np, ^{238}Pu, ^{239}Pu, ^{240}Pu, ^{242}Pu, ^{244}Pu, ^{241}Am, ^{242m}Am, ^{243}Am, ^{243}Cm, ^{245}Cm, ^{246}Cm, ^{247}Cm, ^{248}Cm, ^{250}Cm, ^{247}Bk, ^{249}Cf, ^{251}Cf. Also see Appendix E for radionuclide reporting requirements.[6.4]

3.1.2 Radionuclide Content or Concentration

Radionuclide concentration ***must*** be reported in accordance with Appendix E, "Radionuclide Characterization and Reporting Requirements."[6.7/6.16/6.18] Radionuclide limits for disposal are listed in Table E- 1, "Radionuclide Action Levels for Waste Characterization and Reporting." Waste having radionuclide concentrations above these limits may be acceptable for disposal upon review by NNSA/NSO provided the content does not exceed the package activity limits identified in Section 3.2.2.

3.1.3 Commercial Greater-Than-Class-C Waste

Greater-Than-Class-C waste, as defined by 10 CFR 61.55, generated by Nuclear Regulatory Commission (NRC) licensees ***shall not*** be accepted for disposal at the NTS. [7.12]

3.1.4 Hazardous Waste

Waste regulated under Title 40 CFR 261-268 and state of Nevada hazardous waste regulations ***shall not*** be accepted for disposal.[3.3/5.4] State of Nevada regulations require that waste regulated as hazardous in the state-of-generation ***must*** be regulated as hazardous when brought into the state of Nevada therefore, such waste ***shall not*** be accepted for disposal.[5.3] For mixed waste generated in Nevada by NNSA/NSO activities see Section 3.3.

Environmental media from cleanup activities may be acceptable for disposal if:

The State of origin makes a "Contained-In Determination" for LLW environmental media that was in contact with "listed" wastes. The generator ***must*** submit this determination to NNSA/NSO for evaluation, and provide and demonstrate:[7.5]

- Documentation that the waste is primarily environmental media (not debris). For the purpose of this determination, environmental media is defined as materials found in the natural environment such as soil, ground water, surface water, and sediments; or a mixture of such with liquids, sludges, or solids which is inseparable by simple mechanical removal processes;

- Documentation that the media was representatively sampled and evaluated for total contaminant concentrations (mg/kg) and TCLP concentrations (mg/L) where applicable;

- If the treatment standard is provided in "mg/kg" (totals), the "listed" constituents ***must*** be less than one tenth of the concentration of the RCRA Land Disposal Restriction (LDR) (40 CFR 268.40). If the treatment standard is provided in "mg/l TCLP," the Toxicity Characteristic Leaching Procedure (TCLP) concentration ***must*** be less than the Safe Drinking Water Act Standard (MCL);

- Laboratory data including QA/QC data;

NDEP will evaluate the state of origin "Contained-In Determination" on a case-by-case basis for concurrence and will issue written correspondence through the WARP process once the generator has provided and demonstrated the above-stated items.

Debris contaminated with "listed" constituents will be evaluated independent of the criteria established above for environmental media.

3.1.5 Free Liquids

Liquid waste and waste containing free liquids ***must*** be converted into a form that contains as little freestanding and noncorrosive liquid as is reasonably achievable.[6.11] Liquid waste and waste containing free liquids should be processed to a solid form or packaged in sufficient sorbent for twice the volume of the liquid. The free liquid ***must*** not exceed 1 percent of the volume of the waste when the waste is in a disposal container; or 0.5 percent of the volume of the waste processed to a solidified form.[6.11] Provisions for additional sorbent should be made when significant temperature and atmospheric differences exist between the generating site and the disposal site.

Waste ***must*** be evaluated to determine its potential to release liquid during handling, storage, and transportation.[7.6] High moisture content waste is defined as waste that has the potential to release moisture from its final waste form in excess of the NTSWAC requirement. Generators ***must*** document the decisions made when characterizing and determining sorbents for high moisture content waste (see the Nevada Test Site Generator Work Group "Position Paper for High Moisture Content Waste" Revision 0, dated 11/3/1998, for use as guidance).[7.5]

3.1.6 Particulates

Fine particulate wastes ***shall*** be immobilized so that the waste package contains no more than 1 weight percent of less-than-10-micrometer-diameter particles, or 15 weight percent of less-than-200-micrometer-diameter particles.[7.6] Waste that is known to be in a fine particulate form or in a form that could mechanically or chemically be transformed to a particulate during handling and interim storage ***must*** be immobilized.[7.6]

Secure packaging may be used in place of immobilization. The following are examples of acceptable packaging: overpacking (i.e., 55-gallon drum inside 85-gallon drum), steel boxes, drums with a sealed, 6 mil minimum (or equivalent) liner, and wooden boxes with a sealed, 6 mil minimum (or equivalent) liner. Disposal containers with contents individually wrapped and sealed in plastic are also acceptable.

3.1.7 Gases

LLW gases ***must*** be packaged at a pressure that does not exceed 1.5 atmospheres absolute at 20°C.[6.14/7.6] Compressed gases as defined by Title 49 CFR ***shall not*** be accepted.[7.6] Examples of compliance methods include puncturing aerosol cans and removing the valve mechanism from expended gas cylinders.

3.1.8 Stabilization

Where practical, waste ***must*** be treated to reduce volume and provide a more stable waste form.[6.23] Wastes ***must not*** react with other wastes or the packaging during storage, shipping, handling, and disposal.[6.8]

Structural stability can be accomplished by crushing, shredding, or placing a smaller piece inside an opening of a larger piece, such as nesting pipes

Chemical stability and compatibility ***must*** be demonstrated to ensure that no reactions occur and significant quantities of harmful gases, vapors, or liquids are not generated[6.13] (specifically when different waste forms are combined in a single waste container).

3.1.9 Etiologic Agents

LLW containing pathogens, infectious wastes, or other etiologic agents as defined in Title 49 CFR ***shall not*** be accepted.[7.6]

3.1.10 Chelating Agents

LLW packages containing chelating or complexing agents in amounts greater than 1 percent of the waste ***shall not*** be accepted unless stabilized or solidified.[6.9/7.6]

3.1.11 Polychlorinated Biphenyls (PCBs)

LLW containing PCB's that meet the standards under 40 CFR 761.50(b)(7) for disposal in DOE Order 435.1 landfills will be accepted. PCB-contaminated LLW ***must*** be packaged, marked, and labeled in accordance with the requirements of 40 and 49 CFR.[3.23/4.2] Packages containing PCB-contaminated LLW ***must*** meet the applicable shipping requirements for the radioactive content of the package.

Generators ***must*** provide written notice a minimum of 15 days in advance of the first shipment of each waste stream containing PCB bulk product waste.[3.22] The notice ***shall*** be faxed to Bechtel Nevada (BN) at (702)295-6852 and ***shall*** state the following: (1) This waste may include components containing PCB's at greater than or equal to 50 ppm (based on analysis or process knowledge), and (2) This waste is known or presumed to leach less than 10 micrograms of PCB's per liter of water.[3.22] [Note: Waste presumed to leach less than 10 micrograms of PCB per liter of water are those in which PCB's are tightly bound within a matrix. EPA lists the following as included in such waste: Plastics; preformed or molded rubber; applied dried paints; varnishes, waxes or other coating or sealants; caulking; non-liquid building demolition debris; and shredder fluff].

3.1.12 Explosives

Waste ***must not*** be readily capable of detonation or of explosive decomposition or reaction at normal pressures and temperatures, or of explosive reaction with water.[6.12]

3.1.13 Pyrophorics

Waste ***must not*** be pyrophoric.[6.12] Pyrophoric materials contained in the waste ***shall be*** treated, prepared, and packaged to be nonflammable.[6.12] Pyrophoric materials that are blended in a hardened concrete matrix are considered to be treated to be nonflammable.

3.1.14 Sealed Sources

Sources containing transuranic nuclides ***must*** be individually evaluated against the transuranic criteria (Section 3.1.1), considering only the mass of the source and any component integral to the source.[7.3]

Sealed sources that have an activity of less than 3.7 MBq (100μCi) can be a component of waste streams such as contaminated trash. The total volume of the waste can be used for waste classification and for determination of the radionuclide concentration. Characterization of non-transuranic sources (i.e., less than 3.7 MBq (100μCi)) on an individual source basis is not required, provided the characterization method used is adequate to ensure compliance with the radionuclide reporting criteria.

Sealed sources that have an activity of 3.7 MBq (100μCi) or greater ***shall*** be segregated from other waste and profiled as a separate waste stream.[7.3] These sealed sources ***shall*** be characterized on an individual basis using the volume or mass of the source to determine the radionuclide concentration.[7.3] Sealed sources may be co-packaged with other waste streams provided Section 3.0 Waste Acceptance Criteria are met. See Appendix E for more information on the encapsulation of sealed sources.

3.1.15 Low-Level Waste Containing Asbestos

Asbestiform Low-Level Waste (ALLW) is defined as any LLW containing friable asbestos material; Category I nonfriable asbestos-containing material (ACM) that has become friable; Category I nonfriable ACM that will be or has been subjected to sanding, grinding, cutting, or abrading; or Category II nonfriable ACM that has a high probability of becoming or has become crumbled, pulverized, or reduced to powder. ALLW ***must*** be packaged, marked, and labeled in accordance with the requirements of Title 40 CFR, State of Nevada Solid Waste Disposal Site Permit (SW1300001, current revision), state-of-generation, and the NTS Management Plan for the Disposal of Low-Level Waste with Regulated Asbestos Waste, current

revision.[7.2] Packages containing ALLW ***must*** meet the applicable shipping requirements for the radioactive contents of the package.[4.5] ALLW ***must*** be wetted with a water and surfactant mixture and packaged in a plastic bag which is not less than 6 mil in thickness, a combination of plastic bags which equal at least 6 mil in thickness, or a container which is lined with plastic.[5.1]

If free liquid is present, sorbent ***must*** be added to ensure compliance with the free-liquids criteria.[6.11] Sharp edges and corners in the package ***must*** be padded or protected to prevent damage to the plastic bag during handling, shipping, and disposal.[7.6]

Each container used to dispose ALLW ***must*** bear a label that contains one of the statements on the following page.[5.2]

(1) CAUTION CONTAINS ASBESTOS FIBERS AVOID OPENING OR BREAKING CONTAINER BREATHING ASBESTOS IS HAZARDOUS TO YOUR HEALTH	
(2) CAUTION CONTAINS ASBESTOS FIBERS AVOID CREATING DUST MAY CAUSE SERIOUS BODILY HARM	(3) DANGER CONTAINS ASBESTOS FIBERS AVOID CREATING DUST CANCER AND LUNG DISEASE HAZARD

ALLW ***must*** be segregated into a separate waste stream.[7.9] Because of state notification requirements and disposal cell capacity, ALLW ***must*** be packaged separately from other waste streams.[7.2] Call NNSA/NSO WMD at (702) 295-3181 for assistance and a copy of the current NTS Management Plan for the Disposal of Low-Level Waste with Regulated Asbestos Waste, which includes specific requirements for pre-shipment notifications. The pre-shipment notification ***must*** be faxed to NNSA/NSO at least seven (7) days prior to shipment arrival.[7.5] A signed copy of the notification will be returned to the generator indicating authorization of the shipment.

3.1.16 Radioactive Animal Carcasses

Animal carcasses containing, or contained in, radioactive materials ***shall*** be packaged with the biological material layered with lime and placed in a metal container meeting applicable requirements.[1.1/1.2/7.6] If the resultant waste matrix is capable of gas generation, the container ***shall*** be vented with a carbon composite High-Efficiency Particulate Arresting (HEPA) filtration device.[1.1/7.6] NNSA/NSO may require analysis of the waste decomposition gases. Animal carcasses preserved with formaldehyde ***shall not*** be accepted for disposal.[7.6]

3.1.17 Low-Level Beryllium Waste

For this section, beryllium is defined as elemental beryllium and any insoluble beryllium compound or alloy containing 0.1 percent beryllium or greater that may

be released as an airborne particulate. Beryllium-containing waste, and beryllium-contaminated equipment ***must*** be packaged in sealed, impermeable bags (minimum 6 mil), containers, or enclosures to prevent the release of beryllium dust during handling and transportation.[1.3/7.6] The bags, containers, and enclosures ***must*** be labeled with the following information[1.4]:

"DANGER, CONTAMINATED WITH BERYLLIUM
DO NOT REMOVE DUST BY BLOWING OR SHAKING
CANCER AND LUNG DISEASE HAZARD"

3.1.18 "Classified Waste"

"Classified Waste" ***must*** be segregated into a separate waste stream. For "Classified Waste" requiring protection from visual observation, the Advance Shipment Notification identified in Appendix C.4 ***must*** be faxed to BN at (702) 295-6852 at least seven (7) days prior to shipment arrival.

3.2 Waste Package Criteria

Waste packages ***must*** meet applicable DOE Orders, Title 10 CFR, Title 40 CFR, and Title 49 CFR requirements such as: design, nuclear safety, radiation levels, activity limits, nuclear heating, and multiple hazards. Waste packages ***must*** be capable of withstanding the stresses associated with the loading, handling, stacking, and shipping of the package.[4.4]

External contamination levels for waste packages and transport vehicles ***must*** meet the release limits specified in Title 10 CFR Part 835, Appendix D.[7.14]

NNSA/NSO has adopted the following waste package criteria to assure that the NTS RWMSs are operated safely and efficiently:

3.2.1 Nuclear Criticality Safety

The quantity of fissile (fissionable) material in a waste package ***shall*** be limited so that an infinite array of such packages will be subcritical under "as packaged" conditions and if the array were to be flooded with water to any credible degree.[6.2/7.15] Waste packages ***shall*** comply with the fissile material limits in Appendix E.8.[7.5] Compliance of a waste package with the fissile material limits is required to be documented in the WP.

3.2.2 Package Activity Limitations

Package Activity limits at the NTS are based on Plutonium-239 equivalent grams (PE-g). Packages offered for disposal ***must*** have PE-g limits in accordance with the table below.[7.6] These limits correspond to the type of package being disposed, not the shipping container (i.e. a plastic bag inside a re-usable container, once dumped

must meet the soft-sided package limits). PE-g calculations are confirmed by NTS personnel prior to shipment receipt based on the Package Storage and Disposal Request (PSDR). Any package in excess of these limits will result in the entire shipment being refused by NTS personnel. Conversion factors for PE-g from Becquerels can be found in Appendix B. For assistance in developing conversion factors for isotopes not listed in Appendix B, contact NNSA/NSO.

Table 3.1 Package Activity Limits

Package type	**PE-g limits**
LLW DOT Type-A Drum	190.5 PE-g/m^3 and 300 PE-g total
LLW Standard Waste Box	190.5 PE-g/m^3 and 300 PE-g total
Soft-Sided Packages (supersacks, etc)	6.0 PE-g total
Strong-Tight Container (Sealands, etc)	300 PE-g total
HSA Container (DOT Type A)	750 PE-g
DOT Type B containers (Supertigers)	No limit if type B container is disposed

PE-g limits for NTS shipments are limited to 750 PE-g per shipment. For example, two cargo containers with 300 PE-g each may be shipped together, but 10 drums of 80 PE-g each may not be shipped together because the total is greater than 750 PE-g. This does not apply to shipments made exclusively of DOT Type B containers where the Type B containers are for disposal.

NTSWAC deviations are available for all hard sided packages that may increase the PE-g limit per package and/or per shipment.

Packages projected to exceed the 1000 PE-g limit may be considered for disposal. Contact NNSA/NSO for guidance.

3.2.3 Closure

The package closure ***must*** be sturdy enough that it will not be breached under normal handling conditions.[4.5]

3.2.4 Lead Shielding

The use of lead for shielding in containers for the disposal of LLW is an acceptable practice provided that it has been documented that standard packaging without lead shielding would not reduce the exposure rate to less than 0.005 rem/hr at 30 centimeters and shielding is necessary for radiation protection. The lead being used for shielding ***must*** not be radioactively contaminated when introduced.[7.13]

3.2.5 Strength

The disposal package (packaging and contents) ***must*** be capable of supporting a uniformly distributed load (compressive strength) of 16,477 kg/m^2 (3,375 lbs/ft^2).[7.4]

This is required to support other waste packages and earth cover without crushing during stacking and covering operations. Actual physical testing or design engineering calculations may be used to demonstrate this requirement. This requirement does not apply to bulk waste, waste packaged in steel drums, or cargo containers.

Bulk waste containers, including cargo containers, ***must*** be sufficiently strong to not breach under normal offloading conditions.[7.6] Bulk waste containers with a reasonable probability of breaching during offloading (i.e., burrito wraps), regardless of the type of transport vehicle (i.e., intermodals), ***must*** meet the package activity limitations of section 3.2.2 for soft-sided packages.[7.6] All alternative packaging will be evaluated by NTS operations on a case by case basis and will be dependent on waste stream characteristics.

3.2.6 Handling

Handling procedures and ALARA documentation ***must*** be referenced on the WP for wastes requiring remote handling.[7.6] The disposal site may request this documentation. Packages exceeding 1 mSv/hr (100 mR/hr) dose rate at 30 cm ***shall*** be considered for remote handling.[7.6] Remote handling will incur additional cost for the generator and may delay the profile approval process. Waste streams with packages exceeding 100 mR/hr at 30 cm or alternative packages (i.e., supersacks, plastic wraps) require RadCon approval and may be evaluated against the Documented Safety Analysis using the Unreviewed Safety Question process.

Waste packages ***must*** be provided with cleats, offsets, rings, handles, permanently attached or removable skids, other auxiliary lifting devices to allow handling by means of forklifts, cranes, or similar handling equipment.[7.6] All waste streams with packages requiring cranes for offloading ***must*** have an approved lift plan generated by NTS Operations prior to shipment.[7.6] Additional costs incurred by this development and implementation will be the responsibility of the waste generator. Removable skids are preferred to assist in meeting NTS Performance Assessment objectives for reducing disposal cell subsidence. Lifting rings and other auxiliary lifting devices on the package are permissible, provided they are recessed, offset, or hinged in a manner that does not inhibit stacking the packages. Auxiliary lifting devices for any portion of the package extending from the top of the waste package ***must*** be no higher than 0.1 m (4 inches) in normal position.[7.6] The lifting devices ***must*** be designed with a 5:1 safety factor based on the ultimate strength of the material.[7.1] All rigging devices that are not permanently attached to the waste package ***must*** have a current load test based on 125 percent of the safe working load.[2.1/2.2] Permanently attached rigging devices ***shall*** have traceable certifications.[7.6] They ***must*** not show any signs of corrosion, kinking, birdcaging, or other deterioration.[7.6]

LLW packages that have abnormal centers of gravity ***must*** be clearly marked with the center of gravity.[7.6] Top-heavy loads are severely discouraged, and bulk waste

shipments with complex geometries ***shall*** be loaded in the most stable configuration.[7.6] Cargo containers are exempted from this requirement until the gross weight exceeds 30,000 lbs.

3.2.7 Size

Boxes measuring 1.2- x 1.2- x 2.1-m (4- x 4- x 7-ft) or 1.2- x 0.6- x 2.1-m (4- x 2- x 7-ft) (width x height x length, plus or minus ½ inch) or 208-liter (55-gallon) drums should be used. These sizes allow optimum stacking efficiency in disposal cells. Alternate packages (i.e., supersacks, burrito wraps) will be considered; however, RWMS operations personnel need to be consulted to ensure equipment compatibility. MW, "Classified Waste," ALLW, PCBs, or Low-Level Hydrocarbon Burdened waste in soft-sided packaging may incur additional handling costs.

Bulk waste generally exists in a form not suited to the conventional packaging requirements. Bulk LLW ***must*** meet the requirements of Title 49 CFR.[4.7] Large items of bulk waste, such as machinery, may be considered for disposal unpackaged. For the transfer of unpackaged bulk material having external contamination, the contamination ***must*** be fixed, covered, or contained sufficiently for safe transfer.[4.8]

Bulk containers may be returned to the generator if they can be closed completely and shipped as a DOT "Empty Package." PCBs, ALLW, Low-Level Beryllium Waste, and "Classified Waste," as defined in Section 3.1 "General Waste Form Criteria," shipped in bulk containers are not eligible to be returned to the generator. The return of bulk waste shipping containers may incur additional operational costs for the generator.

3.2.8 Weight

In addition to the weight limits for specific packaging designs, packages ***shall not*** exceed 4,082 kg (9,000 lbs) per box and 544 kg (1,200 lbs) per drum.[2.3] This weight limit does not apply to bulk waste.

3.2.9 Loading (Void Space)

Waste packages ***must*** be loaded to ensure that the interior volume is as efficiently and compactly loaded as practical to minimize void space.[6.10] More than one waste stream may be packaged in a disposal container (see Appendices C and D), except those waste streams that ***must*** be profiled separately (MW, "Classified Waste," ALLW, etc.)

3.2.10 Package Protection

Methods ***must*** be employed to ensure that the integrity of the in-process waste package is not compromised (i.e., prohibited items are not introduced into the waste package).[7.5]

Once the waste package certification activities have been completed and the packages have been sealed, the packages ***must*** be stored in a secure, protected area to prevent deterioration and unauthorized intrusion.[7.5] Storage should include protection from adverse weather, particularly rain and snow. Tamper indicating devices, clips, or banding can be used to indicate that the package has not been opened.

3.2.11 Marking and Labeling

Each waste package ***must*** be marked and labeled according to Appendix C.[7.6] Markings and labels ***must*** be intact and readable when the shipment arrives at the disposal site. [7.6]

3.2.12 Bar Coding

The shipment and package numbers ***must*** be bar coded according to the standards in Appendix C.[7.6]

3.3 Mixed Waste

MW offered for disposal ***must*** meet the applicable requirements of the NTSWAC, Title 40 CFR, state of Nevada, state-of-generation, package criteria and disposal site permit requirements for identification, treatment, and disposal.[3.2/3.10/5.4]

3.3.1 Mixed Waste Generated Within the State of Nevada by NNSA/NSO Activities Only

3.3.1.1 Free liquids

MW ***must*** contain no free liquids.[3.7] Any sorbents used in the waste ***must*** be non-biodegradable.[3.9]

3.3.1.2 Land Disposal Restrictions

MW accepted for disposal at the Mixed Waste Disposal Unit ***must*** meet applicable Title 40 CFR, "Land Disposal Restrictions."[3.10]

3.3.1.3 Incompatible Wastes

Incompatible MW ***must*** be packaged in accordance with Title 40 CFR, "Special Requirements for Incompatible Wastes."[3.8]

3.3.1.4 Marking and Labeling

MW packages of 416 liters (110 gallons) or less ***must*** be marked in accordance with Title 40 CFR.[3.5] Marking and labeling of the waste packages ***must*** be for the hazardous and radioactive waste.[4.3/7.6] Limited-quantity MW ***must*** *be* classified according to the requirements for hazardous components as defined by Title 49 CFR.[4.6]

3.3.1.5 Containers

The requirements of Title 40 CFR, "Use and Management of Containers," and "Special Requirements for Containers," ***must*** be met.[3.6/3.20/3.21]

3.3.2 Mixed Waste Generated Outside of the State of Nevada

(Reserved for future use) contact NNSA/NSO WMD for information.

3.4 WAC Deviations

Deviations from the NTSWAC that do not compromise the performance objectives for the disposal site, NTS Documented Safety Analysis requirements and limitations, or violate permit requirements may be accepted. The following information ***must*** be included with the WP: the NTSWAC requirement that cannot be met; the justification for not meeting the requirement; the duration of the deviation, if applicable; and the action plan to correct the deviation, if applicable[6.15/7.5]

Example:

Requirement: NTSWAC, Revision 5, Section 3.2.4 Strength, requires that the disposal package ***must*** be capable of supporting a uniformly distributed load of 16,477 kg/m^2 (3,375 lbs/ft^2).

Justification: Two 4- x 4- x 7-ft metal boxes (#33248 and # 33798) do not meet the NTSWAC strength requirement. The boxes contain contaminated soil from a remediation project. Because of ALARA concerns, the generator seeks to avoid unnecessary exposure to personnel during repackaging by allowing the waste to remain in the boxes. The boxes will be identified by marking "Box Does Not Meet Strength Requirement" on the tops of each container. Shipping and handling procedures provide details about these containers. The WCO certification checklist will ensure the markings are applied and documented.

Duration: The duration of the deviation is one time only (boxes 33248 and 33798).

Corrective Action: None required.

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4.0

Waste Characterization

Area 3 Radioactive Waste Management Site, Nevada Test Site

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4.0 Waste Characterization

Generators ***must*** characterize waste destined for disposal at NTS.[6.16] When similar requirements are listed in separate regulations, the most stringent ***shall*** be met.[7.5] Waste will not be accepted until the generator, through sampling and analysis, process knowledge (PK), or a combination of both demonstrates the waste to be LLW that meets the WAC requirements in Section 3.0. For waste characterized as MW, generators ***must*** demonstrate that the MW meets the applicable Title 40 CFR LDR and WAC.[3.10] Generators ***shall*** characterize waste with sufficient accuracy to permit proper segregation, treatment, storage, and disposal.[6.16] The characterization methods and procedures employed by the generator ***shall*** ensure that the physical, chemical, and radiological characteristics of the waste are recorded and known during all stages of the waste management process.[6.16] Methods selected by the generator for waste characterization ***shall*** undergo a documented peer review.[7.5] The Data Quality Objectives (DQOs) process, or a comparable process, ***shall*** be used for identifying characterization parameters and acceptable uncertainty in characterization data..[6.17]

Waste ***shall*** be characterized prior to profile submittal.[7.5] Generators ***must*** prepare and submit a WP for each waste stream which provides NNSA/NSO with a summary of waste characterization information.[6.7/6.22/7.5] Generators ***shall*** provide waste characterization documentation that supports the WP (see Appendix E for radiological requirements) to NNSA/NSO for review during facility evaluations or upon NNSA/NSO request.[6.16/7.5] Waste characterization documentation ***shall*** be traceable to the WP and disposal packages.[7.5] Isotopic distributions and corresponding activity concentrations ***shall*** be traceable to the package.[7.5] Traceability to a parcel level ***shall*** be required if characterization is being conducted at that level (e.g., individual sealed sources, bags, or components characterized on an individual basis, but packaged together).[7.5]

Waste characterization may be conducted using PK, sampling and analysis, or a combination of both. The following sections provide specific information and requirements for these characterizations methods:

4.1 Process Knowledge

PK is a characterization technique that relies on the generator's knowledge of the physical, chemical, and radiological properties of the materials associated with the waste generation processes. It includes knowledge of the fate of those materials during and subsequent to the process, and the associated administrative controls.

PK sources include but are not limited to the following programmatic and waste stream specific components:

- historic records, including historic analytical data
- facility maps delineating waste generation areas
- description of waste generating operations

- system descriptions
- plans and drawings
- areas and/or buildings where each waste stream is generated
- material inputs, including material safety data sheets
- manufacturing specifications
- mass balance documentation
- literature searches
- living memory(documented interviews)
- Laboratory notebooks and project reports
- process logs and batch records
- procedures

Historical data should be routinely verified through controlled analytical methods such as verification sampling and analysis; however, if the data can successfully undergo a full validation, this verification may not be necessary.

When PK relies on living memory, the individual's knowledge ***must*** be documented and signed by both the interviewer and the interviewee.[7.5] For telephone interviews, a statement outlining relevant information ***must*** be signed by the interviewer (and interviewee if possible).[7.5]

PK can be used for waste characterization in lieu of sampling and analysis if the generator's PK is of sufficient detail to qualify as acceptable. Acceptable PK is PK that is based on detailed information on the waste obtained from existing waste analysis data, studies on similar waste generating process(es), or detailed information relative to the properties of the waste that are known due to site-specific and/or process-specific factors.

Generators ***shall*** conduct a documented evaluation of compiled PK sources used for waste characterization.[7.10] The generator's evaluation ***shall*** identify uncertainties, inconsistencies, limitations, and usefulness.[7.10]

4.2 Sampling and Analysis

Generators ***shall*** ensure that all data be scientifically valid, defensible, and of known precision and accuracy to identify the physical, chemical , and radiological properties of the waste.[7.7] When waste streams are characterized by sampling and analysis, the process ***shall*** be controlled and documented.[6.24] Propagation of error throughout the sampling and analytical process ***shall*** be evaluated and considered when ascertaining usability of data for characterization of waste.[6.16] Generators should determine the appropriate analysis (total vs. TCLP) for RCRA hazardous and underlying hazardous constituent determinations. These results ***shall*** be reported in the waste profile.[7.5] See the profile instructions for further details on reporting sampling results.

Generators ***shall*** demonstrate that controls are in place to trace each sample number to a specific package number.[7.5] All sampling and analysis efforts, including verification and confirmatory sampling, should include screening analyses such as gamma spectroscopy, gross beta, and gross alpha.

NNSA/NSO may evaluate sampling and analysis documentation to ensure that: 1) samples will be representative of the waste inventory, 2) appropriate analytical procedures are used, and 3) sufficient quality controls have been established to allow measurement and documentation of data quality.

4.2.1 Data Validation

Data validation is a comprehensive analysis and review of analytical data conducted against a set of predetermined criteria and leading to the assignment of relative usability (i.e., completely usable, estimated value, unusable) for each analytical result. The validation criteria should be developed using the DQO process and depend upon the type(s) of data involved and the purpose for which the data are collected. Data ***shall*** be validated by technically qualified personnel who are independent of those performing the analyses.[7.5]

When sampling and analysis is used as a method of characterization, data validation ***shall*** be conducted on a portion of chemical and radiological data per NTS waste stream, prior to use of the data for characterization purposes.[7.5]

The WP instructions require completion of an analytical results summary (Table B-1) for inclusion in the WP. As required by the above paragraph, data validation will be performed on a portion of the data used to complete the table. If in subsequent sampling events, variations of analytical results remain less than 80% of the applicable regulatory threshold, revision of Table B-1 is not required. If the results ever exceed 80% of the regulatory threshold, it will be necessary to revise the table and submit appropriate validation summary reports (case narratives) for the values entered in the revised table.

Validation summary reports ***shall*** cite the guidelines or procedures used to validate the data.[7.5]

The completed validation report ***shall*** be submitted to NNSA/NSO as an attachment to the waste profile, and ***shall*** include, at a minimum:

- Method/Analysis-general discussion of the data set, including preparation/dilutions, initial and continuing calibration, holding times.
- Method blank Analysis

- LCS Analysis
- Surrogate Spike Recoveries
- Data Qualifier Codes
- Discussion/Statement of data quality

5.0

Quality Assurance Requirements for Waste Certification Program

Area 5 Radioactive Waste Management Site Workers Labeling Boxes, Nevada Test Site

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5.0 Quality Assurance Requirements for Waste Certification Program

RWAP quality requirements are written in accordance with DOE Order 414.1, "Quality Assurance"; Title 10 Code of Federal Regulations (CFR), 830.122, "Quality Assurance"; and NNSA/NSO Policy unless otherwise noted by superscript.

Generators ***shall*** develop, approve, and maintain a Quality Assurance Plan (QAP) demonstrating compliance to the NTSWAC: DOE Order 435.1, "Radioactive Waste Management"; DOE Order 414.1, "Quality Assurance"; and/or Title 10 CFR, 830.122, "Quality Assurance."

Generators ***shall*** submit a controlled copy of their approved QAP to the RWAP Manager. Generators maintaining a controlled Waste Certification Program Plan (WCPP) on file with RWAP are not required to submit their site QAP. Generators with an approved WCPP that choose to utilize their site QAP in lieu of maintaining a WCPP ***must*** notify the RWAP Manager and formally submit their site QAP for review and approval.

Generators ***must*** complete an NTSWAC Implementation Crosswalk (NIC) and submit it to the RWAP Manager. The NIC ***must*** describe and/or reference each site's quality affecting procedures, processes, or methods that demonstrate compliance and/or implement the specified NTSWAC criteria. Examples of procedures, processes, or methods may include:

- Plans and procedures from supporting organizations that satisfy the quality criteria in Section 5.0 of the NTSWAC.
- Waste characterization data.
- Documents demonstrating compliance to the waste criteria and packaging criteria in Section 3.0 of the NTSWAC.
- Documents assuring conformance to marking, labeling, electronic reporting, and forms requirements.

An electronic copy of the NIC and instructions are available from NNSA/NSO.

5.1 Program

Generators ***must*** develop an organizational chart specific to the waste management and support organizations. The organizational chart ***must*** depict the organizational structure, functional responsibilities, levels of authority, and interfaces necessary to manage the waste certification program. The chart ***must*** identify the organizations that generate, characterize, package, inspect, assess, ship, and perform support functions (i.e., procurement, document control, RCRA oversight, and training).

Each generator ***shall*** designate a WCO and alternate(s), if applicable, who are responsible for verifying implementation of the WCPP or QAP. The WCO ***must*** ensure that the waste certification processes, including waste, waste packages, supporting data, and waste shipments, comply with the requirements of the NTSWAC. The alternate WCO ***must*** report to the primary WCO for certification activities. The organizational structure ***must*** ensure the independence of the WCO, alternates(s), and package certifiers from the waste generator and allow for direct access to a management level having sufficient authority and organizational freedom, if necessary, to ensure compliance with the LLW program.

Generators may delegate the responsibility for signing the Package Certification Label (PCL) to Package Certifiers; however, the Package Certifiers ***must*** report directly to the WCO for certification activities.

5.2 Personnel Training and Qualification

Personnel ***shall*** be trained and qualified to perform their assigned functions and tasks. The level and type of training ***shall*** be evaluated and documented. Training ***shall*** be commensurate with the importance of the task and the activities affecting compliance with the NTSWAC waste certification activities. Personnel ***must*** be provided training to ensure that job proficiency with established requirements is maintained. Methods and records ***shall*** be specified to ensure training of personnel is current and maintained.

5.3 Quality Improvement

Process controls to detect and prevent quality problems and verify conformance to specified requirements ***must*** be established and implemented. Performance of quality improvement processes ***must*** be documented.

Control of nonconforming components and processes ***must*** provide for the identification, documentation, evaluation, segregation (when practical), disposition, and notification to the affected organizations, including the WCO. Nonconforming components ***must*** be conspicuously labeled, tagged, or otherwise marked to ensure removal from the waste certification process and prevent inadvertent use.

The disposition of nonconforming components, services, and processes ***must*** be reviewed for technical justification and disposition by authorized personnel. When nonconforming conditions are identified that affect the quality of previously shipped waste, NNSA/NSO ***must*** be notified.

A process ***shall*** be established for the identification and timely correction of quality problems. The root cause, corrective action, action to prevent recurrence, and estimated completion date ***must*** be documented. The WCO and appropriate levels of management ***must*** be involved in the corrective action process and the corrective actions tracked until successful resolution can be demonstrated.

5.4 Documents and Records

Activities affecting the quality of the waste certification program ***must*** be prescribed and performed in accordance with written instructions, procedures, or drawings and available to those performing the work. A document control system ***shall*** be established to assure that these documents are prepared, reviewed, approved, controlled, and revised.

The records system ***shall*** be defined and implemented in accordance with written instructions, procedures, or other documentation.

Records documenting compliance with waste certification criteria ***shall*** be specified, prepared, reviewed, and signed by authorized personnel.

Records ***shall*** be compiled into a records management system that includes provisions for transmittal, distribution, retention, handling, correction, disposition, and retrievability. Completed records ***must*** be protected from damage, loss, and deterioration.

The generator ***shall*** maintain records for time periods equivalent to on-site records retention requirements, but not less than three years (or for time periods designated by other regulatory authorities).

5.5 Work Processes

Work ***must*** be planned and performed to established technical standards and administrative controls using approved instructions, procedures, or other appropriate means.

Processes important to waste certification activities ***must*** have controls or verification steps identified as part of the operating procedures.

Controls ***shall*** be established to ensure that the traceability of waste from the point of generation through shipment is maintained. Waste characterization documentation ***must*** be traceable to the exact package in which waste was placed. Waste containers ***must*** be controlled through the life cycle of the component (e.g., receipt, handling, storage, packaging, and shipping) to prevent damage, loss, or deterioration.

Components used in the certification process such as waste containers, liners, sorbents, and solidifiers ***shall*** be controlled to ensure that only correct and acceptable items are used. Identification ***must*** be maintained on items or documents traceable to the items.

Measuring and Test Equipment (M&TE) used for process monitoring or data collection ***must*** be uniquely identified, controlled, and calibrated. Records of calibration ***shall*** be maintained, traceable to the equipment, and the equipment suitably marked to indicate calibration status. The M&TE marking ***must*** include a unique identification, date of calibration, calibration due date, and any limitations. Calibration equipment for M&TE ***shall*** be traceable to a nationally recognized standard or equivalent means to assure accuracy.

Testing and validation of computer programs and verification of data results from those programs (i.e., PSDR data, radioactivity calculations) ***shall*** be conducted and documented.

5.6 Design

Structures, Systems, and Components (SSCs) designed and/or constructed to ensure that waste will satisfy certification requirements ***must*** be designed using sound engineering/scientific principles and standards and performed in accordance with established design processes.

Design adequacy of SSCs ***shall*** be verified or validated by qualified personnel other than those who initiated the design. Verification and validation of SSC designs ***must*** be completed and approved prior to implementation of the design or design changes.

Design interfaces ***shall*** be identified and controlled. Waste generators ***shall*** document their review of product or process designs (e.g., waste containers, sorbents, waste treatment operations) when performed by others (e.g., suppliers or other generators) to ensure that they conform to established requirements and end-use application.

Design changes ***shall*** be approved commensurate with the same control measures that were applied to the original design.

5.7 Procurement

Components and services critical to the waste certification program ***must*** be procured under a controlled and documented system. Procurement documents ***shall*** identify applicable technical requirements such as drawings, specifications, codes, standards, regulations, tests, inspection and acceptance criteria, and certification records.

Procurement documents ***shall*** be reviewed and approved by authorized personnel to ensure that they contain appropriate references and technical requirements. Changes to procurement documents ***must*** receive the same degree of review and approval as the original documents.

Selection of suppliers providing components and services critical to the waste certification program ***must*** be evaluated and selected on the basis of specified criteria (e.g., waste packaging). The methods of evaluation (i.e., audits, surveillance, source inspection, receipt inspection) ***shall*** be established and provide adequate confidence that the selected supplier can meet the established requirements.

Suppliers of components (e.g., off-the-shelf sorbents) that are tested or verified by the purchasing organization for conformance to technical requirements may not need to be evaluated (audited), provided the testing demonstrates the procured component conforms to design requirements. Conformance testing ***must*** be documented.

A process to ensure approved suppliers continue to provide acceptable components and/or services ***must*** be established and implemented. Methods of evaluation ***shall*** be specified and documented.

5.8 Inspection and Acceptance Testing

Inspection and testing of components, services, and processes critical to the waste certification program ***must*** be conducted using established acceptance and performance criteria. Inspections ***must*** be performed by qualified personnel having no responsibility for the work activity being inspected.

Receipt inspections ***must*** be performed to verify conformance of components received to the procurement documents and design criteria.

In-process inspections, including waste container pre-use inspections and waste packaging activities, ***shall*** be conducted throughout the waste certification process.

Final inspections ***shall*** be conducted to verify conformance of the waste, containers, and waste certification process to the NTSWAC prior to shipment of the waste.

Records of inspection ***shall*** identify the type of inspection, component(s), services, or process inspected, date of inspection, inspector, inspection results, and action taken if nonconforming conditions are identified.

5.9 Management Assessment

Management of Waste Certification Programs ***shall*** periodically assess their management processes to ensure conditions which could preclude the organization from achieving its objectives are identified and corrected. Management assessments ***shall*** be documented in a final report and issued to appropriate organizations, including the WCO for review.

5.10 Independent Assessment

The WCO ***shall*** perform an annual review of the NIC to ensure procedures, processes, and methods referenced in the NIC are current. Upon Completion of the review the WCO ***shall*** sign and submit a current NIC to the RWAP Manager.

Waste certification programs ***must*** be independently assessed (audit and surveillances) annually to verify compliance with applicable quality program requirements and to promote process improvement.

Surveillances may be accumulated and used in lieu of the annual audit provided they have been conducted within 12 months of the last annual audit or surveillance roll-up, and encompass the entire waste certification program and supporting elements. When surveillances are used as the annual assessment, a final report ***shall*** be prepared and approved by a qualified Lead Auditor identifying the activities, conclusions, findings, and corrective actions initiated during each surveillance.

Audits and surveillances ***shall*** be planned, scheduled, and conducted in accordance with a documented and approved process. The WCO and/or supporting oversight organizations ***shall*** schedule and conduct periodic surveillances of activities critical to the waste certification program.

Personnel performing assessments ***must*** be qualified and knowledgeable in the areas being assessed. Assessment personnel ***must*** be independent of the assessed areas and have sufficient authority and freedom to effectively carry out the assessment activities.

Results of assessment activities (audits and surveillances) ***must*** be documented, approved, and reported to responsible management, including the WCO. Deficiencies identified during an assessment activity ***shall*** be tracked until acceptable resolution is achieved and verified.

6.0

Waste Transportation and Receipt Information

Waste placement in the Area 5 Radioactive Waste Management Site, Nevada Test Site

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6.0 Waste Transportation and Receipt Information

This section provides general guidelines that generators follow to expedite waste transportation and receipt.

6.1 Shipment Scheduling and Limitations

NTS Operations may impose schedule limitations on waste profiles that have specific handling and/or processing requirements. "Classified Waste," ALLW, and MW shipments may have a shipment frequency limitation to accommodate additional processing needs. (For example, classified shipments may be limited to 4 shipments per day per generator with a generator limited to Tuesday and Thursday arrivals.) All scheduling limitations ***must*** be made through NTS Operations.[7.6] Containers that are to be returned to the generator (e.g. inter-modal containers, shipping casks, etc) may have shipment scheduling limitations and (i.e. due to weather conditions) this schedule may be modified and/or suspended as warranted.

Generators ***shall*** provide NTS Operations with a monthly shipment schedule by the third Friday of each calendar month, estimating shipments for the following month. This schedule is to include:

- estimated number of shipments
- estimated arrival dates
- profile numbers
- type and quantity of packages
- special handling concerns

NTS Operations ***shall*** be notified of deviations from the schedule. Requests for rescheduled or additional shipments are subject to concurrence by NTS Operations.

NTS Operations may occasionally extend operating hours (i.e. Fridays). During these extra periods, NTS operations will designate which types of shipments they will receive on the given date (i.e. on the third Friday in September, the NTS will accept cargo containers of standard LLW and DOT non-regulated bulk).

6.2 Shipping Arrangements

After a generator secures written approval from the NNSA/NSO AMEM to send waste to an NTS RWMS, the generator ***shall*** contact BN to arrange for transfer of the waste and accompanying records.[7.5] BN coordinates waste shipment transfers at NTS.

6.2.1 Waste Receipt and Handling at NTS

To expedite waste receipt and handling at NTS, waste generators ***shall,*** at a minimum, comply with the following:[7.6]

- Prior to departure of a waste shipment to the NTS, the generator ***shall*** attach security seals to the shipping trailer's door latches or to each package if not enclosed in a trailer.[7.6]

- When the shipment leaves the generator site, the generator ***shall*** enter the following pre-notification information on the BN HAZTRAK database.[7.6] If the generator is unable to enter information on the BN HAZTRAK, fax the NTS Advance Shipment Notification (see Appendix C.4) to BN at (702) 295-6852. Shipments to the NTS ***must*** be entered in the BN HAZTRAK database prior to 1500 NTS local, at least one working day prior to shipment arrival (e.g. shipments scheduled to arrive Monday ***must*** be entered in HAZTRAK by 1500 NTS local on the previous Thursday).[7.6] If the shipper is faxing the NTS advance shipment notification to BN, the fax ***must*** be received prior to the cut-off time and date.[7.6] For "classified waste," having classified shipping documents, generators ***shall*** contact Wackenhut Services at (702) 295-7028.[7.6] For all shipments, the following information ***must*** be provided:[7.6]

  - Date and time shipment departed generator site
  - Estimated date and time of arrival (ETA) at NTS
  - Shipment number, shipper's name, shipper's contact number
  - Carrier, driver's name (***must*** be legible), driver's license number and state
  - Trailer number, seal number(s), DOT "Proper Shipping Name(s)"
  - Number of packages, package type (boxes, drums, cargo containers, burrito wraps, etc.), and gross weight
  - Waste stream number and description of waste

If the shipment's ETA should change, the generator ***must*** notify BN and ***shall*** enter the changes on the BN HAZTRAK database at the earliest opportunity and provide the new ETA.[7.6] Generators unable to update information on the BN HAZTRAK ***shall*** notify BN by phone at (702) 295-6811.[7.6]

The majority of the above information can be found on the "Bill of Lading."

- For waste shipments containing regulated asbestos, the 7-day advance notification form ***must*** be faxed to NNSA/NSO, see Section 3.1.15.

6.2.2 Consignment of Shipments

Consign waste shipments to:

Bechtel Nevada
For U.S. Department of Energy
Waste Management
Nevada Test Site - Zone 2
Mercury, NV 89023

Because unclassified and classified shipments are processed differently, they ***must*** be shipped separately (i.e., on different trailers and have different shipment numbers and separate shipping papers).[7.6] This also applies to ALLW, and MW (i.e., shipped separately from standard LLW). Under small-volume conditions, combined shipments can be arranged by contacting BN.

6.2.3 Receiving Hours

The hours for receiving waste at the RWMS are from 0700 to 1500 hours, Monday through Thursday, except holidays. Tractor-trailers arriving between 0400 and 1400 hours (Monday through Thursday) will be allowed to remain at the Area 3 or 5 RWMS until their delivery is complete. If a shipment arrives between 1400 and 0400 hours, tractor-trailers will only be allowed to the Area 3 or 5 RWMS to drop their trailer, and exit the NTS to return after 0400 hours to reconnect for off-loading. Drivers are discouraged from entering the NTS at Gate 100 between 0600 and 0700 hours. Shipments may be subject to off-loading delays at any time due to NTS operational schedules.

All shipments to Area 3 or Area 5 RWMS will be verified against a shipment tracking list by a Security Police Officer (SPO) at the NTS main gate. If the shipment tracking number is listed, the shipment will be authorized to enter the NTS. If the shipment is not listed, the SPO will attempt to contact an RWMS official to verify the shipment in order to authorize entry.

6.3 Shipping Documentation

The following records are required:

6.3.1 Accountable or Special Nuclear Material Shipments

For accountable or special nuclear material shipments, a "Nuclear Material Transaction Report" (DOE/NRC Form 741) ***shall*** *be* completed for transfers of nuclear material between facilities having differing Reporting Identification Symbols.[6.3] Transaction reports ***shall*** be sent to: Bechtel Nevada, P.O. Box 98521, Mail Stop NTS 403, Las Vegas, NV 89193-8521. Forms may be faxed to (702) 295-6852.[7.6] Reports should be received at the RWMS prior to the shipment arrival.[6.3] For additional information call the RWMS at (702) 295-6811. Contact Wackenhut Services at (702) 295-7028 if the shipping documentation contains classified information.

6.3.2 DOT Regulated Shipments

For materials regulated by DOT, complete shipping papers with shipper's certification, as required by Title 49 CFR, ***must*** accompany each shipment.[4.1]

A "Uniform Hazardous Waste Manifest" or equivalent state-of-generation manifest, accompanied by the appropriate documentation, ***shall*** be used when shipping MW.[3.4/3.11] For on-site shipments of MW, an on-site Waste Manifest may be used.

6.3.3 PSDR Submittal

The original completed and signed PSDR or the original of an equivalent, ***shall*** accompany each shipment.[6.20/7.6] An electronic version of the PSDR ***shall*** be transmitted to BN prior to shipment arrival (E-mail address: wmdata@nv.doe.gov).[7.6] Shipments ***shall not*** be accepted if an electronic PSDR is not on file.[7.6]

6.3.4 Additional Certification Statements

An appropriate LLW or LDR Certification Statement ***shall*** be signed by an authorized WCO or Alternate WCO for LLW and MW (see 40 CFR 286.7 and next page for examples).[3.11/6.21/7.5]

Low-Level Waste Certification
I certify that containers:

(Container I.D. number(s))

do not contain hazardous waste as defined in Title 40 CFR 261 or _____ (state-of-generation) hazardous waste regulations:

(1) according to the results of tests performed in accordance with the requirements as specified in Subpart C of Title 40 CFR 261: and/or

(2) according to the supporting documentation provided to me about the materials and processes that produced this waste.

To the best of my knowledge, I believe the information I have submitted is true, accurate, and complete.

Generator Waste Certification Official (print name/ sign) Date

EXAMPLE
Mixed Waste Certification for Land Disposal Restrictions:
I certify under penalty of law that I personally have examined and am familiar with the waste through analysis and testing or through knowledge of the waste to support this certification that the waste in containers:

(Container I.D. number(s))

complies with the treatment standards specified in Title 40 CFR 268, Subpart D, and _____ (state-of-generation) hazardous waste regulations.

I believe that the information I submitted is true, accurate, and complete. I am aware that there are significant penalties for submitting a false certification, including the possibility of a fine and imprisonment.

Generator Waste Certification Official (print name/sign) Date

6.4 Waste Transportation

Waste shipments consigned to BN ***shall*** be made in accordance with applicable DOE, DOT, EPA, state, and local hazardous waste regulations and requirements.[7.5]

Generators are responsible for the evaluation of the motor carriers used for transporting radioactive waste. Motor carrier documentation (e.g., past carrier performance, prior evaluations, accident history, vehicle maintenance, etc.) should be reviewed to ensure that the carrier is in compliance with Title 49 CFR, state, and local transportation requirements. If carrier performance has been determined to violate federal, state, or local transportation safety regulations, a demonstration of corrective action may be required. Failure to initiate corrective action may result in waste refusal at the NTS.

NNSA/NSO ***shall*** be notified when 1) the motor carrier(s) is being evaluated; 2) the motor carrier route selection is being reviewed; 3) a motor carrier discrepancy, noncompliance, or inadequate performance has been identified; or 4) there is a transportation incident or emergency situation.[7.6] This notification will keep NNSA/NSO personnel informed of generator transportation plans, activities, and issues. NNSA/NSO personnel will be able to use the information provided to inform stakeholders of transportation activities of radioactive LLW destined for the NTS. NNSA/NSO personnel may request to participate in the review of transportation-related information. NNSA/NSO may provide driver advisories to inform generators of local driving conditions (e.g., road construction, detours, safety issues). The generators will be responsible for providing carriers with driver advisories.

Generators ***shall*** ensure a National Environmental Policy Act (NEPA) analysis (10 CFR 1021) of the potential waste transportation impacts is completed prior to waste shipment. Transportation of the waste to the NTS should conform to a supporting finding or decision based on the impact analysis. NNSA/NSO encourages approved LLW generators and their carriers to review route selections. Transportation of LLW to the NTS ***must*** avoid Hoover Dam and Las Vegas.[7.5] Routes selected are required to minimize radiological risk. Information on accident rates, time in transit, population density, construction activities, and time of day ***must*** be considered when determining radiological risk.[4.9]

6.5 Waste Receipt and Records

BN will be responsible for inspecting radioactive waste shipments upon arrival and maintaining shipment records for NNSA/NSO. BN RWMS will take receipt of the waste after it has been unloaded, inspected, verified, and accepted by RWMS personnel.

6.6 Funding and Forecasting

For information regarding funding and forecasting requirements, contact NNSA/NSO WMD at (702) 295-0672.

6.7 Disposition of Noncompliant Conditions

NTS RWMS and RWAP personnel are responsible for identifying and documenting noncompliance issues (i.e., physical or documentation errors) discovered when conducting

LLW receipt and disposal activities. Radioactive waste shipments received at the NTS that are not in compliance with requirements may be returned to the generator facility or require resolution from the generator.

NNSA/NSO ***shall*** be notified of waste shipment noncompliance issues.[7.6] Appropriate action will be initiated based upon the type of the noncompliance and the established program requirements. Generators may be charged for costs incurred for noncompliant waste shipments.

6.8 Waste Refusal

BN personnel will be responsible for notifying the appropriate NNSA/NSO personnel regarding any refused radioactive waste shipments. Reasons for waste shipment refusal include, but are not limited, to failure to have:

- conforming package activity limits as specified in Section 3.2.2.
- sufficient funding transferred to BN to cover the cost of handling disposal, or storage.
- a DOE/NRC Form 741 on file at the NTS prior to the shipment's arrival.
- a signed certification statement accompanying the shipment.

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Appendix A

Waste Process Flow Diagrams

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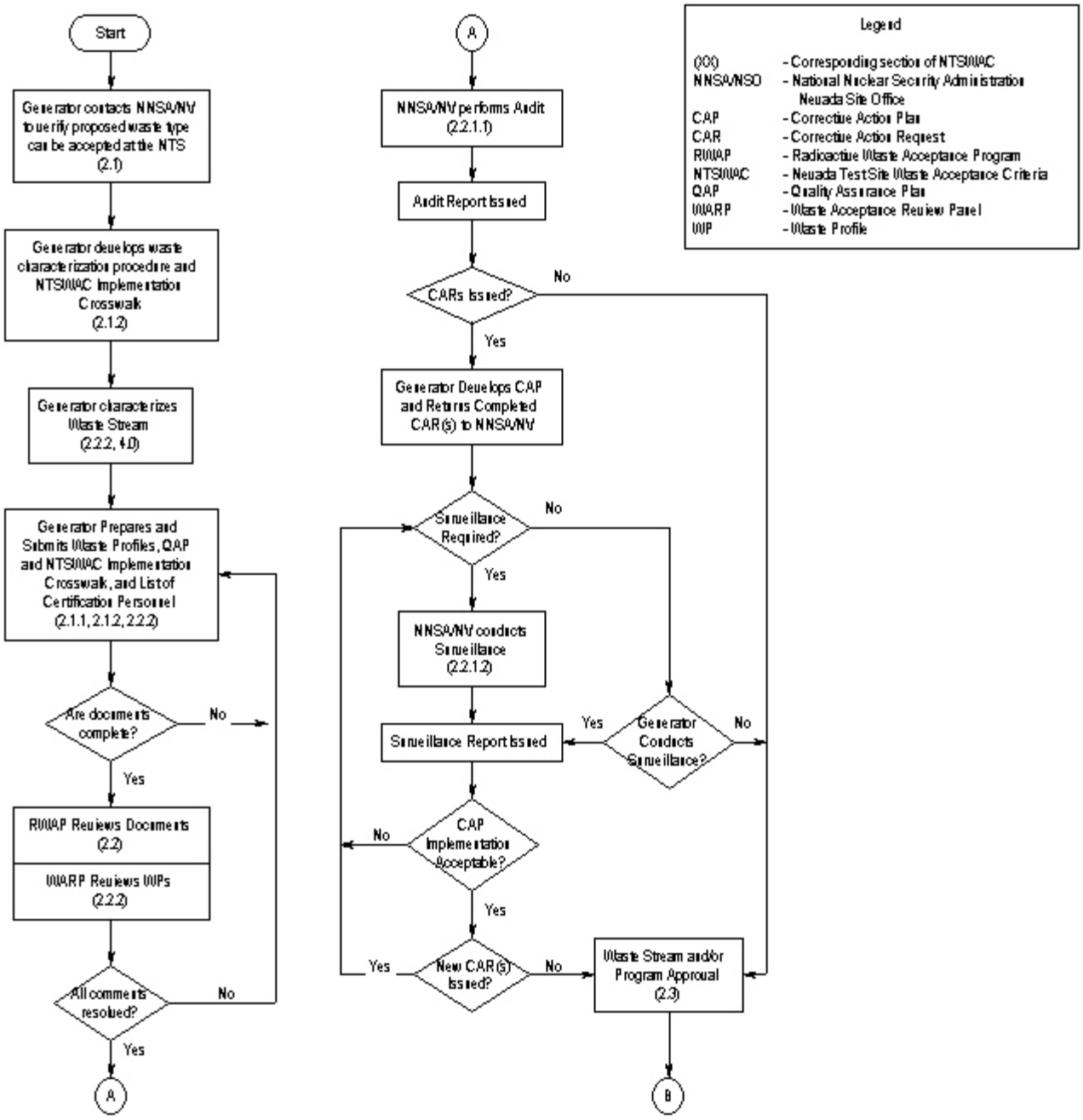
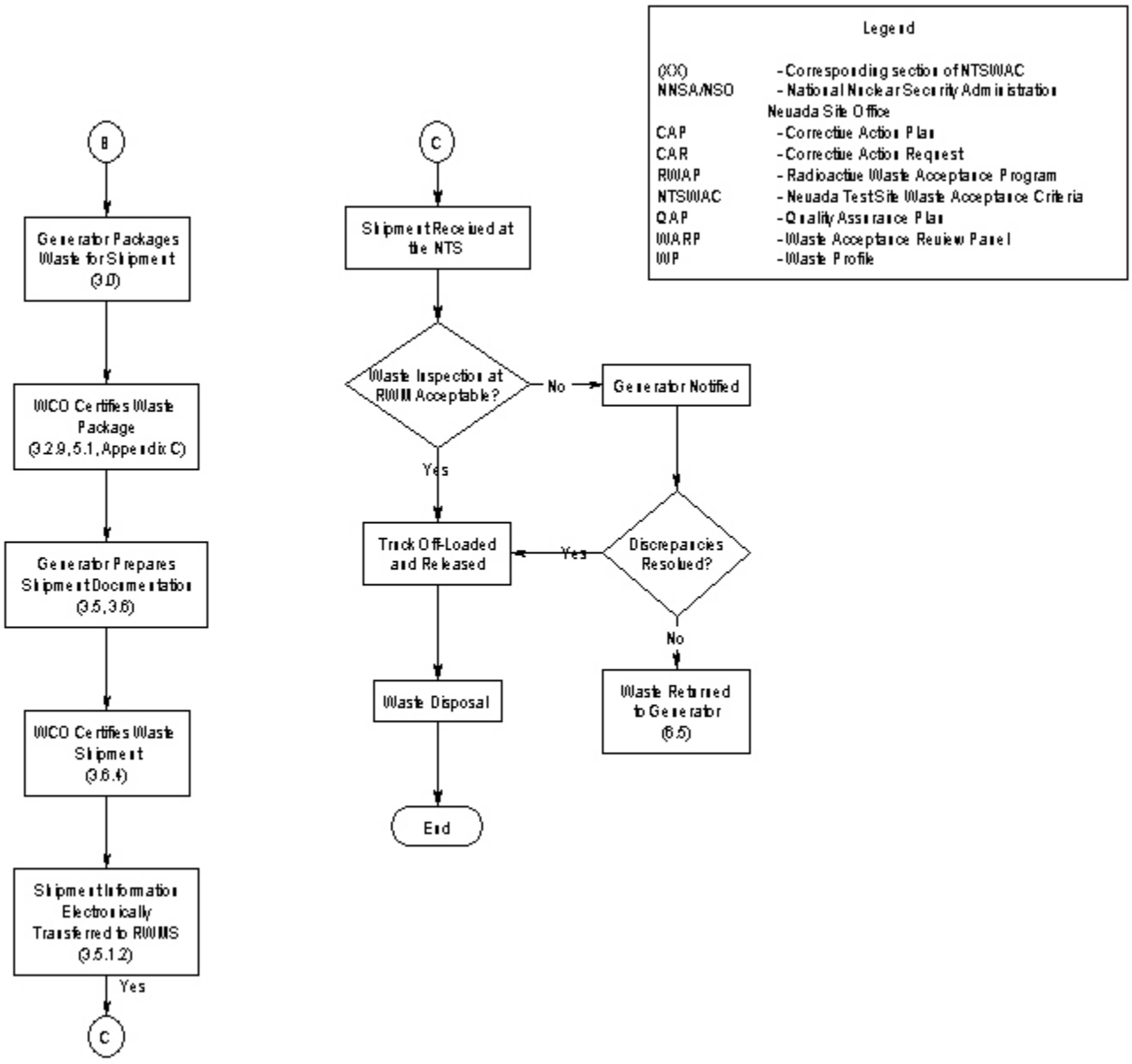
Appendix A - Waste Process Flow Diagram

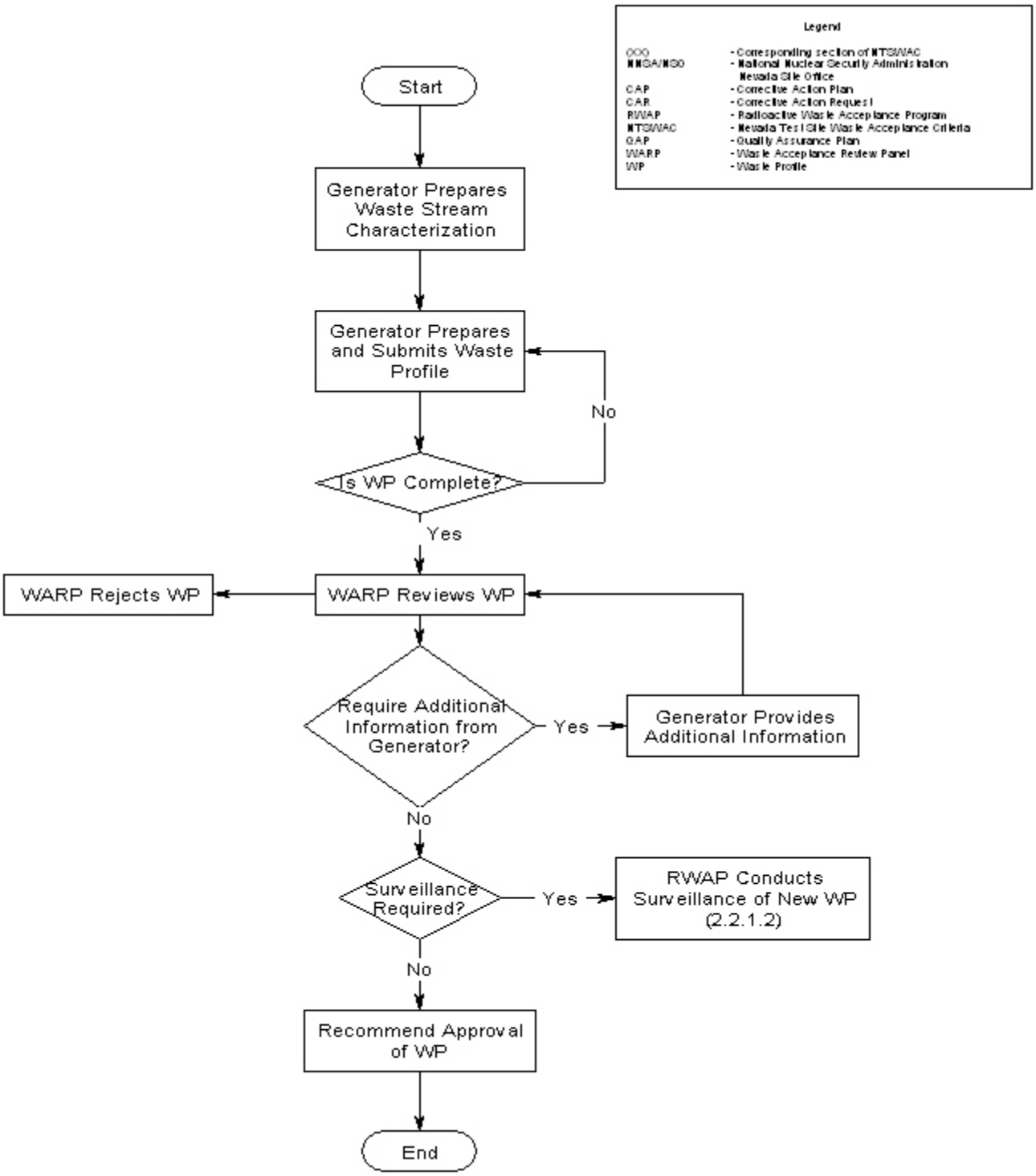
The following diagram identifies key process steps. Operations and logistics may influence the order in which these activities are conducted. Technical support may be requested at any time by the generator (Section 2.5).



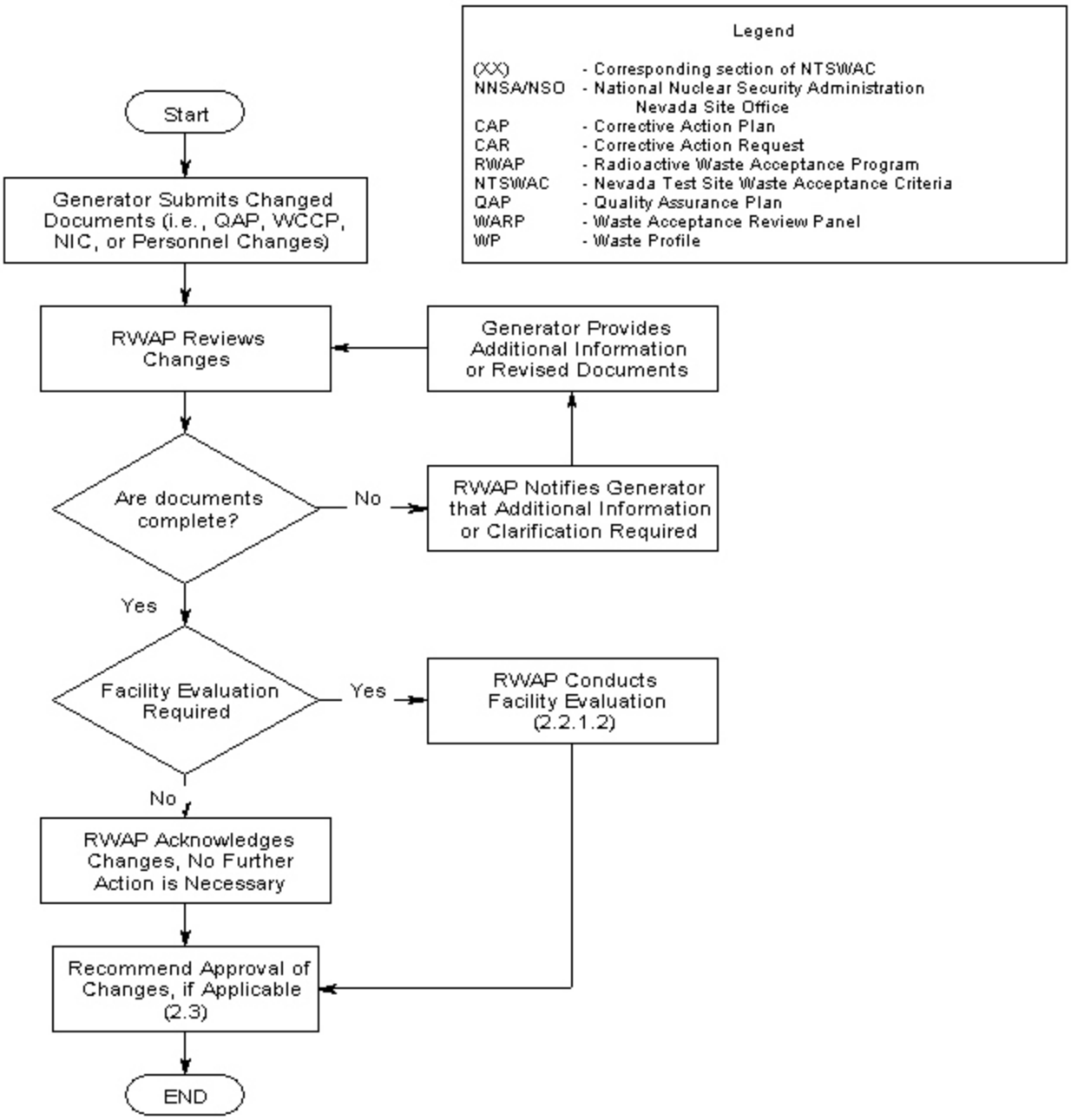
Appendix A - Waste Process Flow Diagram (continued)



Waste Profile Approval Process



Document and Personnel Changes



Appendix B

Plutonium Equivalent Gram (PE-g) Radionuclide Conversion Factors

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Plutonium Equivalent Gram (PE-g) Radionuclide Conversion Factors

Nuclide	CONVERSION FACTORS gPE / Bq
Ac-224	1.12E-13
Ac-225	9.19E-12
Ac-226	1.12E-12
Ac-227	5.70E-09
Ac-228	2.62E-13
Ag-102	2.87E-17
Ag-103	4.97E-17
Ag-104	6.05E-17
Ag-104m	5.32E-17
Ag-105	3.97E-15
Ag-106	2.81E-17
Ag-106m	6.08E-15
Ag-108m	2.56E-14
Ag-110m	6.83E-14
Ag-111	5.23E-15
Ag-112	5.64E-16
Ag-115	5.60E-17
Al-26	6.77E-14
Am-237	2.04E-17
Am-238	7.30E-16
Am-239	3.90E-16
Am-240	1.56E-15
Am-241	4.44E-10
Am-242	4.97E-14
Am-242m	4.35E-10
Am-243	4.44E-10
Am-244	1.41E-14
Am-244m	5.98E-16
Am-245	6.86E-17
Am-246	5.38E-17
Am-246m	2.84E-17
As-69	4.16E-17
As-70	1.08E-16
As-71	1.08E-15
As-72	3.46E-15
As-73	2.94E-15
As-74	6.77E-15
As-76	3.18E-15
As-77	8.97E-16
As-78	2.27E-16
At-207	2.06E-15
At-211	8.69E-14
Au-193	2.46E-16
Au-194	8.69E-16
Au-195	1.10E-14
Au-198	2.79E-15
Au-198m	4.12E-15
Au-199	1.28E-15
Au-200	7.56E-17
Au-200m	1.87E-15
Au-201	2.28E-17
Ba-126	3.12E-16
Ba-128	2.58E-15
Ba-131	5.70E-16
Ba-131m	3.94E-18
Ba-133	6.64E-15
Ba-133m	5.29E-16
Ba-135m	4.28E-16
Ba-139	1.46E-16
Ba-140	3.18E-15
Ba-141	6.86E-17
Ba-142	3.50E-17
Be-10	3.02E-13
Be-7	2.73E-16
Bi-200	5.60E-17
Bi-201	1.63E-16
Bi-202	1.08E-16
Bi-203	7.05E-16
Bi-205	3.68E-15
Bi-206	5.57E-15
Bi-207	1.70E-14
Bi-210	1.67E-13
Bi-210m	6.45E-12
Bi-212	1.84E-14
Bi-213	1.46E-14
Bi-214	5.60E-15
Bk-245	3.75E-15
Bk-246	1.46E-15
Bk-247	4.88E-10
Bk-249	1.18E-12
Bk-250	6.42E-15
Br-74	7.34E-17
Br-74m	1.39E-16
Br-75	1.11E-16
Br-76	1.36E-15
Br-77	2.35E-16
Br-80	2.40E-17
Br-80m	3.34E-16
Br-82	1.30E-15
Br-83	7.59E-17
Br-84	8.22E-17
C-11	1.04E-17
C-14	1.79E-15
Ca-41	1.15E-15
Ca-45	5.64E-15
Ca-47	5.57E-15
Cd-104	6.42E-17
Cd-107	9.26E-17
Cd-107	9.26E-17
Cd-109	9.73E-14
Cd-113	1.42E-12
Cd-113m	1.30E-12
Cd-115	3.59E-15
Cd-115m	6.14E-14
Cd-117	3.84E-16
Cd-117m	3.72E-16
Ce-134	6.96E-15
Ce-135	1.35E-15
Ce-137	3.56E-17
Ce-137m	1.20E-15
Ce-139	7.71E-15
Ce-141	7.62E-15
Ce-143	2.88E-15
Ce-144	3.18E-13
Cf-244	8.44E-15
Cf-246	5.10E-13
Cf-248	4.31E-11
Cf-249	4.91E-10
Cf-250	2.23E-10
Cf-251	5.01E-10
Cf-252	1.17E-10
Cf-253	2.65E-12
Cf-254	2.50E-10
Cl-36	1.87E-14
Cl-38	1.14E-16
Cl-39	9.63E-17
Cm-238	4.53E-15
Cm-240	6.83E-12
Cm-241	1.25E-13
Cm-242	1.47E-11
Cm-243	2.61E-10
Cm-244	2.11E-10
Cm-245	4.60E-10
Cm-246	3.84E-10
Cm-247	3.53E-10
Cm-248	1.41E-09
Cm-249	1.64E-16
Co-55	1.78E-15
Co-56	3.37E-14
Co-57	7.71E-15
Co-58	9.26E-15

Nuclide	CONVERSION FACTORS gPE / Bq
Co-58m	8.00E-17
Co-60	1.86E-13
Co-60m	1.81E-18
Co-61	9.01E-17
Co-62m	2.87E-17
Cr-48	7.46E-16
Cr-49	6.17E-17
Cr-51	2.84E-16
Cs-125	3.53E-17
Cs-127	5.01E-17
Cs-129	1.35E-16
Cs-130	2.54E-17
Cs-131	1.42E-16
Cs-132	1.05E-15
Cs-134	4.00E-14
Cs-134m	3.72E-17
Cs-135	3.87E-15
Cs-135m	2.10E-17
Cs-136	6.23E-15
Cs-137	2.72E-14
Cs-138	8.63E-17
Cu-60	5.89E-17
Cu-61	1.59E-16
Cu-64	2.36E-16
Cu-67	1.05E-15
Dy-155	1.89E-16
Dy-157	6.80E-17
Dy-159	2.07E-15
Dy-165	1.14E-16
Dy-166	6.36E-15
Er-161	7.71E-17
Er-165	2.54E-17
Er-169	1.78E-15
Er-171	4.79E-16
Er-172	3.50E-15
Es-250	4.09E-15
Es-251	4.03E-15
Es-253	3.37E-12
Es-254	3.50E-11
Es-254m	4.75E-13
Eu-145	2.33E-15
Eu-146	3.31E-15
Eu-147	3.01E-15
Eu-148	1.22E-14
Eu-149	1.61E-15
Eu-150 hr	5.73E-16
Eu-150 yr	2.28E-13
Eu-152	1.88E-13
Eu-152m	6.96E-16

Nuclide	CONVERSION FACTORS gPE / Bq
Eu-154	2.43E-13
Eu-155	3.53E-14
Eu-156	1.20E-14
Eu-157	9.48E-16
Eu-158	8.00E-17
F-18	7.12E-17
Fe-52	1.86E-15
Fe-55	2.29E-15
Fe-59	1.26E-14
Fe-60	6.36E-13
Fm-252	3.59E-13
Fm-253	4.91E-13
Fm-254	4.94E-14
Fm-255	2.27E-13
Fm-257	1.99E-11
Fr-222	1.05E-14
Fr-223	5.29E-15
Ga-65	2.86E-17
Ga-66	1.58E-15
Ga-67	4.75E-16
Ga-68	1.18E-16
Ga-70	2.68E-17
Ga-72	1.58E-15
Ga-73	3.24E-16
Gd-145	3.84E-17
Gd-146	3.24E-14
Gd-147	1.53E-15
Gd-148	2.81E-10
Gd-149	1.95E-15
Gd-151	7.56E-15
Gd-152	2.07E-10
Gd-153	2.02E-14
Gd-159	8.31E-16
Ge-66	2.70E-16
Ge-67	5.16E-17
Ge-68	4.41E-14
Ge-69	7.15E-16
Ge-71	1.04E-16
Ge-75	6.05E-17
Ge-77	8.97E-16
Ge-78	2.44E-16
H-3	5.45E-17
Hf-170	1.02E-15
Hf-172	2.71E-13
Hf-173	4.06E-16
Hf-175	4.75E-15
Hf-177m	8.41E-17
Hf-178m	2.09E-12
Hf-179m	8.60E-15

Nuclide	CONVERSION FACTORS gPE / Bq
Hf-180m	1.98E-16
Hf-181	1.31E-14
Hf-182	2.83E-12
Hf-182m	5.29E-17
Hf-183	9.95E-17
Hf-184	7.27E-16
Hg-193	1.58E-16
Hg-193m	6.55E-16
Hg-194	1.54E-13
Hg-195	1.76E-16
Hg-195m	1.30E-15
Hg-197	6.05E-16
Hg-197m	1.02E-15
Hg-199m	5.73E-17
Hg-203	6.23E-15
Ho-155	3.81E-17
Ho-157	4.44E-18
Ho-159	5.54E-18
Ho-161	1.32E-17
Ho-162	2.00E-18
Ho-162m	2.14E-17
Ho-164	7.40E-18
Ho-164m	1.62E-17
Ho-166	2.67E-15
Ho-166m	6.58E-13
Ho-167	9.26E-17
I-120	3.78E-16
I-120m	2.25E-16
I-121	1.01E-16
I-123	2.52E-16
I-124	1.65E-14
I-125	2.06E-14
I-126	3.78E-14
I-128	4.03E-17
I-129	1.48E-13
I-130	2.25E-15
I-131	2.80E-14
I-132	3.24E-16
I-132m	2.55E-16
I-133	4.97E-15
I-134	1.12E-16
I-135	1.05E-15
In-109	1.01E-16
In-110 hr	1.15E-16
In-110 min	2.62E-16
In-111	7.15E-16
In-112	7.68E-18
In-113m	3.50E-17
In-114m	7.56E-14

Nuclide	CONVERSION FACTORS gPE / Bq
In-115	3.18E-12
In-115m	1.13E-16
In-116m	6.49E-17
In-117	3.13E-17
In-117m	1.51E-16
In-119m	3.78E-17
Ir-182	4.12E-17
Ir-184	1.96E-16
Ir-185	4.66E-16
Ir-186	7.75E-16
Ir-187	1.79E-16
Ir-188	1.31E-15
Ir-189	1.40E-15
Ir-190	5.45E-15
Ir-190m	2.59E-17
Ir-192	2.40E-14
Ir-192m	3.27E-13
Ir-194	2.47E-15
Ir-194m	5.83E-14
Ir-195	1.18E-16
Ir-195m	2.12E-16
K-40	1.05E-14
K-42	1.16E-15
K-43	5.89E-16
K-44	7.05E-17
K-45	4.38E-17
La-131	4.41E-17
La-132	4.66E-16
La-135	5.04E-17
La-137	7.46E-10
La-138	1.17E-12
La-140	4.12E-15
La-141	4.94E-16
La-142	2.15E-16
La-143	5.10E-17
Lu-169	1.15E-15
Lu-170	2.19E-15
Lu-171	2.54E-15
Lu-172	4.25E-15
Lu-173	1.92E-14
Lu-174	3.37E-14
Lu-174m	2.16E-14
Lu-176	5.64E-13
Lu-176m	2.27E-16
Lu-177	2.09E-15
Lu-177m	6.11E-14
Lu-178	3.97E-17
Lu-178m	2.78E-17
Lu-179	2.87E-16

Nuclide	CONVERSION FACTORS gPE / Bq
Md-257	4.88E-14
Md-258	1.41E-11
Mg-28	4.19E-15
Mn-51	9.76E-17
Mn-52	4.85E-15
Mn-52m	5.76E-17
Mn-53	4.25E-16
Mn-54	5.70E-15
Mn-56	3.21E-16
Mo-101	3.53E-17
Mo-90	1.05E-15
Mo-93	2.42E-14
Mo-93m	3.27E-16
Mo-99	3.37E-15
Na-22	6.80E-15
Na-24	1.03E-15
Nb-88	2.29E-17
Nb-89(122)	3.50E-16
Nb-89(66)	1.52E-16
Nb-90	1.95E-15
Nb-93m	2.51E-14
Nb-94	3.53E-13
Nb-95	4.94E-15
Nb-95m	2.07E-15
Nb-96	1.95E-15
Nb-97	7.05E-17
Nb-98	1.04E-16
Nd-136	9.82E-17
Nd-138	8.75E-16
Nd-139	1.80E-17
Nd-139m	3.18E-16
Nd-141	8.75E-18
Nd-147	5.83E-15
Nd-149	1.90E-16
Nd-151	2.65E-17
Ni-56	3.53E-15
Ni-57	1.61E-15
Ni-59	2.30E-15
Ni-63	5.35E-15
Ni-65	2.93E-16
Ni-66	7.08E-15
Np-232	1.07E-15
Np-233	1.85E-18
Np-234	1.73E-15
Np-235	3.53E-15
Np-236 hr	7.02E-14
Np-236 yr	8.85E-11
Np-237	4.60E-10
Np-238	3.15E-14

Nuclide	CONVERSION FACTORS gPE / Bq
Np-239	2.13E-15
Np-240	6.93E-17
Os-180	1.48E-17
Os-181	1.14E-16
Os-182	1.17E-15
Os-185	8.82E-15
Os-189m	2.54E-17
Os-191	3.56E-15
Os-191m	2.58E-16
Os-193	1.70E-15
Os-194	5.70E-13
P-32	1.32E-14
P-33	1.97E-15
Pa-227	4.16E-14
Pa-228	3.75E-13
Pa-230	1.25E-12
Pa-231	1.09E-09
Pa-232	7.78E-14
Pa-233	8.12E-15
Pa-234	6.93E-16
Pb-195m	2.64E-17
Pb-198	6.55E-17
Pb-199	6.20E-17
Pb-200	6.74E-16
Pb-201	2.23E-16
Pb-202	8.34E-14
Pb-202m	1.52E-16
Pb-203	4.50E-16
Pb-205	3.34E-15
Pb-205	3.34E-15
Pb-209	8.06E-17
Pb-210	1.16E-11
Pb-211	7.40E-15
Pb-212	1.44E-13
Pb-214	6.64E-15
Pd-100	3.34E-15
Pd-101	1.58E-16
Pd-103	1.34E-15
Pd-107	1.09E-14
Pd-109	9.32E-16
Pm-141	2.70E-17
Pm-143	9.26E-15
Pm-144	4.57E-14
Pm-145	2.59E-14
Pm-146	1.25E-13
Pm-147	3.34E-14
Pm-148	9.29E-15
Pm-148m	1.92E-14
Pm-149	2.50E-15

Nuclide	CONVERSION FACTORS gPE / Bq
Pm-150	3.08E-16
Pm-151	1.49E-15
Po-203	6.74E-17
Po-205	1.15E-16
Po-207	1.72E-16
Po-210	8.00E-12
Pr-136	2.10E-17
Pr-137	4.06E-17
Pr-138m	1.15E-16
Pr-139	4.91E-17
Pr-142	2.45E-15
Pr-142m	3.14E-17
Pr-143	6.90E-15
Pr-144	3.68E-17
Pr-145	5.73E-16
Pr-147	2.59E-17
Pt-186	1.13E-16
Pt-188	2.67E-15
Pt-189	1.52E-16
Pt-191	5.23E-16
Pt-193	1.93E-16
Pt-193m	7.46E-16
Pt-195m	1.04E-15
Pt-197	4.82E-16
Pt-197m	1.04E-16
Pt-199	3.87E-17
Pt-200	1.42E-15
Pu-234	2.33E-14
Pu-235	1.94E-18
Pu-236	1.23E-10
Pu-237	1.68E-15
Pu-238	3.90E-10
Pu-239	4.35E-10
Pu-240	4.35E-10
Pu-241	8.50E-12
Pu-242	4.09E-10
Pu-243	1.40E-16
Pu-244	3.43E-10
Pu-245	1.12E-15
Ra-223	6.68E-12
Ra-224	2.69E-12
Ra-225	6.61E-12
Ra-226	7.30E-12
Ra-227	2.42E-16
Ra-228	4.06E-12
Rb-79	4.19E-17
Rb-81	1.11E-16
Rb-81m	1.71E-17
Rb-82m	2.47E-16

Nuclide	CONVERSION FACTORS gPE / Bq
Rb-83	4.19E-15
Rb-84	5.54E-15
Rb-86	5.64E-15
Rb-87	2.75E-15
Rb-88	7.12E-17
Rb-89	3.65E-17
Re-177	2.03E-17
Re-178	1.92E-17
Re-181	5.48E-16
Re-182(12.7)	3.43E-16
Re-182(64)	2.43E-15
Re-184	4.38E-15
Re-184m	1.25E-14
Re-186	2.72E-15
Re-186m	3.07E-14
Re-187	4.63E-17
Re-188	1.71E-15
Re-188m	3.50E-17
Re-189	1.06E-15
Rh-99	2.63E-15
Rh-99m	7.37E-17
Rh-100	1.18E-15
Rh-101	8.66E-15
Rh-101m	6.36E-16
Rh-102	1.02E-13
Rh-102m	4.06E-14
Rh-103m	4.35E-18
Rh-105	8.12E-16
Rh-106m	1.82E-16
Rh-107	2.06E-17
Rn-220	3.15E-14
Rn-222	8.82E-13
Ru-94	1.13E-16
Ru-97	3.84E-16
Ru-103	7.62E-15
Ru-105	3.87E-16
Ru-106	4.06E-13
S-35	1.11E-14
Sb-115	2.22E-17
Sb-116	1.97E-17
Sb-116m	6.52E-17
Sb-117	2.13E-17
Sb-118m	2.23E-16
Sb-119	1.79E-16
Sb-120 day	3.46E-15
Sb-120 min	1.11E-17
Sb-122	4.38E-15
Sb-124	2.14E-14
Sb-124m	8.82E-18

Nuclide	CONVERSION FACTORS gPE / Bq
Sb-125	1.04E-14
Sb-126	9.98E-15
Sb-126m	2.89E-17
Sb-127	5.13E-15
Sb-128 hr	1.44E-15
Sb-128 min	1.50E-17
Sb-129	5.48E-16
Sb-130	8.82E-17
Sb-131	1.22E-16
Sc-43	2.20E-16
Sc-44	4.19E-16
Sc-44m	6.45E-15
Sc-46	2.52E-14
Sc-47	1.57E-15
Sc-48	3.50E-15
Sc-49	8.66E-17
Se-70	1.50E-16
Se-73	3.90E-16
Se-73m	3.94E-17
Se-75	7.21E-15
Se-79	8.38E-15
Se-81	2.19E-17
Se-81m	7.53E-17
Se-83	4.66E-17
Si-31	1.90E-16
Si-32	8.63E-13
Sm-141	2.61E-17
Sm-141m	4.97E-17
Sm-142	1.83E-16
Sm-145	9.38E-15
Sm-146	7.02E-11
Sm-147	6.36E-11
Sm-151	2.55E-14
Sm-153	1.67E-15
Sm-155	2.14E-17
Sm-156	5.95E-16
Sn-110	4.28E-16
Sn-111	2.31E-17
Sn-113	9.07E-15
Sn-117m	3.68E-15
Sn-119m	5.32E-15
Sn-121	4.35E-16
Sn-121m	9.79E-15
Sn-123	2.77E-14
Sn-123m	3.94E-17
Sn-125	1.32E-14
Sn-126	8.47E-14
Sn-127	2.76E-16
Sn-128	1.84E-16

Nuclide	CONVERSION FACTORS gPE / Bq
Sr-80	4.28E-16
Sr-81	7.18E-17
Sr-83	1.29E-15
Sr-85	4.28E-15
Sr-85m	7.24E-18
Sr-87m	3.65E-17
Sr-89	3.53E-14
Sr-90	1.11E-12
Sr-91	1.41E-15
Sr-92	6.86E-16
Ta-172	4.82E-17
Ta-173	2.72E-16
Ta-174	5.73E-17
Ta-175	3.24E-16
Ta-176	3.97E-16
Ta-177	2.61E-16
Ta-178	7.05E-17
Ta-179	5.54E-15
Ta-180	2.08E-13
Ta-180m	7.93E-17
Ta-182	3.81E-14
Ta-182m	1.14E-17
Ta-183	4.44E-15
Ta-184	9.73E-16
Ta-185	7.15E-17
Ta-186	2.07E-17
Tb-147	1.77E-16
Tb-149	6.23E-15
Tb-150	2.65E-16
Tb-151	5.32E-16
Tb-153	9.26E-16
Tb-154	1.01E-15
Tb-155	6.61E-16
Tb-156	3.34E-15
Tb-156m (24.4)	6.49E-16
Tb-156m (5.0)	1.85E-16
Tb-157	7.84E-15
Tb-158	2.18E-13
Tb-160	2.13E-14
Tb-161	2.90E-15
Tc-101	1.52E-17
Tc-104	6.99E-17
Tc-93	6.05E-17
Tc-93m	2.85E-17
Tc-94	2.29E-16
Tc-94m	1.20E-16
Tc-96	2.02E-15
Tc-96m	1.97E-17
Tc-97	8.44E-16
Tc-97m	4.16E-15
Tc-98	1.95E-14
Tc-99	7.08E-15
Tc-99m	2.77E-17
Te-116	2.26E-16
Te-121	1.62E-15
Te-121m	1.36E-14
Te-123	8.97E-15
Te-123m	9.01E-15
Te-125m	6.20E-15
Te-127	2.71E-16
Te-127m	1.83E-14
Te-129	7.62E-17
Te-129m	2.04E-14
Te-131	4.06E-16
Te-131m	5.45E-15
Te-132	8.03E-15
Te-133	7.84E-17
Te-133m	3.68E-16
Te-134	1.08E-16
Th-226	2.98E-14
Th-227	1.38E-11
Th-228	2.13E-10
Th-229	1.83E-09
Th-230	2.77E-10
Th-231	7.46E-16
Th-232	1.39E-09
Th-234	2.98E-14
Ti-44	8.66E-13
Ti-45	1.83E-16
Tl-194	7.84E-18
Tl-194m	3.81E-17
Tl-195	3.94E-17
Tl-197	4.22E-17
Tl-198	1.40E-16
Tl-198m	9.10E-17
Tl-199	5.92E-17
Tl-200	4.00E-16
Tl-201	2.00E-16
Tl-202	8.38E-16
Tl-204	2.05E-15
Tm-162	1.87E-17
Tm-166	3.21E-16
Tm-167	2.51E-15
Tm-170	2.24E-14
Tm-171	7.78E-15
Tm-172	4.16E-15
Tm-173	4.09E-16
Tm-175	1.97E-17
U-230	1.66E-11
U-231	1.01E-15
U-232	5.60E-10
U-233	1.15E-10
U-234	1.13E-10
U-235	1.05E-10
U-236	1.07E-10
U-237	3.00E-15
U-238	1.02E-10
U-239	3.18E-17
U-240	1.93E-15
V-47	5.98E-17
V-48	8.69E-15
V-49	2.94E-16
W-176	9.07E-17
W-177	5.54E-17
W-178	2.30E-16
W-179	2.98E-18
W-181	1.29E-16
W-185	6.39E-16
W-187	5.26E-16
W-188	3.50E-15
Xe-120	2.21E-16
Xe-121	9.70E-16
Xe-122	2.96E-17
Xe-123	3.37E-16
Xe-125	1.45E-16
Xe-127	1.55E-16
Xe-129m	1.28E-17
Xe-131m	4.66E-18
Xe-133	1.91E-17
Xe-133m	1.69E-17
Xe-135	1.47E-16
Xe-135m	2.37E-16
Xe-138	6.05E-16
Y-86	1.46E-15
Y-86m	8.47E-17
Y-87	1.49E-15
Y-88	2.39E-14
Y-90	7.18E-16
Y-90m	4.00E-16
Y-91	4.16E-14
Y-91m	3.09E-17
Y-92	6.64E-16
Y-93	1.83E-15
Y-94	5.95E-17
Y-95	3.21E-17
Yb-162	1.90E-17
Yb-166	2.53E-15

Nuclide	CONVERSION FACTORS gPE / Bq
Yb-167	7.12E-18
Yb-169	6.86E-15
Yb-175	1.38E-15
Yb-177	1.24E-16
Yb-178	1.38E-16
Zn-62	1.75E-15
Zn-63	6.93E-17
Zn-65	1.73E-14
Zn-69	3.34E-17
Zn-69m	6.93E-16
Zn-71m	3.31E-16
Zn-72	4.25E-15
Zr-86	1.87E-15
Zr-88	2.07E-14
Zr-89	2.02E-15
Zr-93	2.73E-13
Zr-95	2.01E-14
Zr-97	3.68E-15

Nuclide	CONVERSION FACTORS gPE / Bq

Nuclide	CONVERSION FACTORS gPE / Bq

Appendix C

Marking and Labeling

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Appendix C - Marking and Labeling

C.1 Barcode

Barcodes (see Figure C-1) used on packages ***must*** meet the following standards:[7.6]

A. Code 39.

B. Low- to medium density; low-density preferred.

C. 1-inch high bar code not to exceed 6 inches wide.

D. Human readable interpretation (HRI) ½ inch high, printed below the bar code.

E. Spacing between bar code and HRI will be 1/10 of an inch.

F. Minimum left and right margin (quiet zones) will be at least 1/25 inch.

G. Bar codes and HRI will be stacked with a minimum separation of ½ inch and in the following order: shipment number, container number.

H. A total of two bar code labels ***must*** be placed on each package near the top and on opposite sides.[7.6] Drums ***must*** have a total of two bar code labels, one on top of the drum lid and one on the side near the top.[7.6]

I. Labels ***shall*** be securely attached and able to satisfy the following:
- Weatherproof (***must*** not deform when wet or fade in the sun)[7.6]
- Resistant to tearing, peeling, and cracking
- Print ***must*** be with permanent indelible ink and legible

A sample bar code ***must*** be submitted to BN prior to the first shipment to ensure that the RWMS equipment can be used to read the bar code.[7.6]

Figure C-1: Bar Code Label Example

MDL02001

000001

Note: Example not actual size.

C.2 Marking and Labeling

Packages ***must*** have the following markings and labels:[7.6]

A. Marking and labeling as required in Title 49 CFR; for additional Asbestos and Beryllium Labeling, see Sections 3.1.15 and 3.1.17.[4.2]

B. "Package Certification Label" (PCL) (see Figure C-2), signed by the Waste Certification Official or package certifier.[6.21/7.6] If the waste is unpackaged bulk, a signed PCL ***must*** accompany the shipment papers.[6.217.6]

C. Shipment number in the following sequence: Two alpha character generator-site-designator codes assigned by NNSA/NSO/WMD (see Section C-3); one alpha character for type of waste (L for LLW, M for MW); two numerical characters for current fiscal year; three numerical characters for shipment sequence. This number ***must*** be on the bar code.[7.6] Example: MDL99001 indicates a shipment from the Mound Facility of LLW in fiscal year 1999 and the first shipment.

D. Package number ***must*** be six characters (alpha, numeric, or combination) with no duplication within the shipment.[7.6] This number ***must*** be on the bar code.[7.6]

E. Package weight in units of kilograms and pounds ***must*** be included on the side of each waste package.[7.6] This requirement can be met through the use of a label, additions to bar code labels, or by writing the weight on the side of the waste package.

Figure C-2: Package Certification Label

NV-211 August 1997 **USDOE**

PACKAGE CERTIFICATION LABEL

This label certifies this container and its contents meet the requirements of DOT (49 CFR), EPA (40 CFR), and NTSWAC for transportation and disposal.

DATE: _____

CERTIFIED BY (print): _____

CERTIFIED BY (signature):_____

Waste Certification Official ☐

Alternate Waste Certification Official ☐

Package Certifier ☐

RWMS DESIGNATION (i.e., ONLO, ARIR): _____

C.3 Generator Waste Stream and Shipment Codes

GENERATOR	RWMS DESIGNATION	SITE DESIGNATOR
Aberdeen Proving Ground	USAA	AP
Argonne National Lab	ANLE	AE
Bechtel - NTS	LRY5	DP
Battelle Columbus	CEMP	BC
British Nuclear Fuel Limited	BNFL	ET
BWXT Y-12	BWXT	BW
RMI Environmental Services	ORMI	RM
Fernald	ONLO	WM
Foster Wheeler	FWOR	FW
GA Technologies	BGAT	BG
Grand Junction	JMTC	GJ
INEEL	INEL	IN
Shaw Environmental, Inc.	LITN	IT
Kansas City	ABXK	AS
LLNL	BCLA	LL
Lovelace Foundation	ALVI	LV
Mound	AMDM	MD
Nuclear Fuel Services	NFSI	NF
Oak Ridge National Lab	MMES	MM
Oak Ridge Reservation	ORTN	OR
Paducah	PGDP	PD
Pantex	AMHP	PX
Portsmouth	PORT	PM
Princeton Plasma Physics Lab	PPPL	PL
Boeing-Rocketdyne	BNRC	BN
Rocky Flats	ARIR	RF
Sandia - Albuquerque	ASLA	SA
Sandia - California	ASLL	SL
Savannah River	SVRS	SR
West Valley	WVDP	WV

Note: If generator site is not listed, develop designations and submit with first waste profiles. A database verification of uniqueness will be conducted by RWAP.

C.4 NTS Advance Shipment Notification

Nevada Test Site
Advance Shipment Notification

Shipper Name and Address: _____

_____

_____

Contact Name: _____ Phone/Pager:_____

Waste Stream
Number(s):_____

Shipment Number:_____

Shipment Departure Date: _____ Time: _____

Estimated Arrival Date:_____ Time: _____

Carrier: _____ Driver Name: _____

Driver's License No. _____ State: _____

Tractor License No. _____Trailer No. _____Seal No._____

Gross Wt. (Lbs) : _____ Type/Number of Packages: Box _____ Drum _____

Bulk _____ (cargo containers, equipment, burrito wraps, etc..) Other _____

DOT Proper Shipping Name(s) or Attached Bill of Lading:

_____

_____

_____

Special Handling Considerations:

[ ] Asbestos [ ] Classified [ ] Other: _____

Attachments:

[ ] PSDR [ ] Bill of Lading [ ] Other: _____

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Appendix D

Package Storage and Disposal Request

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Appendix D - Package Storage and Disposal Request

D. Package Storage and Disposal Request, Revision 1

The activity of each nuclide in a waste package as documented on the Package Storage and Disposal Request (PSDR) ***shall not*** exceed the corresponding maximum radionuclide concentration specified on the waste profile.[7.6] See Section 3.1.2 for reportable nuclides.

Shipment Number: _____ Prepared By: _____

Date: _____ Manifest No: _____

Package No.		Contact (mSv/h):		Completed Date:	
Container Code:		One Meter (mSv/h):		Operation Type:	
External Volume (m^3):		Gross Weight (kg):		Total Activity (bq):	
Waste Volume (m^3):		Net Weight (kg):		Activity Date:	
Comment:					

WasteStream Profile	Form Code	Form Description	Treatment Code	Treatment Description	Rev. No.	Rev. Date	Nuclide	Qty (Bq)

If you have any questions on completing this document, contact The BN Waste Management Department at (702) 295-6811. Data entered on the form ***must*** be legible. Hand-printing or typing of letters and numbers is preferred to handwriting. When using a decimal, it ***must*** be clearly defined. DO NOT USE COMMAS!

PSDR Instructions

SHIPMENT NUMBER: Consists of eight alphanumeric characters. Enter the shipment number in the following sequence: two-digit generator code assigned by WMD, L (low-level) or M (mixed), last two digits of the current fiscal year (Oct. 1 - Sept. 30), and the consecutive number of shipments from the generating facility. EXAMPLE: DPL90001 represents Decon Pad, low-level waste, fiscal year 1990, and the first shipment sent to WMD for fiscal year 1990. The shipment number ***must*** be eight characters in the above sequence.

MANIFEST NUMBER: Required only on mixed waste shipments; a five digit number.

PACKAGE NUMBER: Six unique characters for each container in the shipment.

CONTACT: Maximum radiation reading at the surface of the package in mSv/H: Written in scientific notation X.XXXE±00.

COMPLETION DATE: The date, in the formal DDMMMYYYY (e.g. 01Jan1992), that the last waste material was placed in the package.

CONTAINER CODE: Three digit number that identifies the type of container. If your container is not listed, contact the RWMS at (702) 295-6811.

					External Volume	
Code	**Description**	**Length**	**Width**	**Height**	**Cubic Feet**	**Cubic Meters**
100	Miscellaneous	N/A	N/A	N/A	N/A	N/A
101	30-gallon drum	N/A	N/A	N/A	4.99 - 6.99	0.141 - 0.1979
102	55-gallon drum	N/A	N/A	N/A	7.99 - 9.99	0.226 - 0.283
124	85-gallon drum	N/A	N/A	N/A	12.99 - 14.99	0.368 - 0.424
125	110-gallon drum	N/A	N/A	N/A	18.99 - 20.99	0.537 - 0.594
*200	Half box	78" - 90"	42" - 56"	18" - 30"	34.125 - 87.5	0.9663 - 2.4777
*201	Wooden half box	78" - 90"	42" - 56"	18" - 30"	34.125 - 87.5	0.9663 - 2.4777
*210	Full box	78" - 90"	42" - 56"	42" - 56"	79.625 - 163.33	2.2547 - 4.6250
*211	Wooden full box	78" - 90"	42" - 56"	42" - 56"	79.625 - 163.33	2.2547 - 4.6250
*220	Cargo Container	234" - 246"	90" - 102"	90" - 102"	1,096.875 - 1,481.125	31.060 - 41.940
*230	Supersack	N/A	N/A	N/A	N/A	N/A
240	Burrito Wrap	N/A	N/A	N/A	N/A	N/A
250	Concrete Monolith	N/A	N/A	N/A	149.734 - 199.987	4.24 - 5.663

*External volumes reported for containers using these codes ***must*** be based on the containers' external dimensions. Volume should be within range specified.

1 METER: Maximum radiation reading at 1 meter in mSv/h: Written in scientific notation X.XXXE±00.

OPERATION TYPE: B for burial, or R for retrievable storage.

EXTERNAL VOLUME: Total volume displaced by the container in cubic meters. Refer to CONTAINER CODE. Written in scientific notation X.XXXE±00.

GROSS WEIGHT: Total weight of container including waste and solidification or absorbent media in kilograms. Written in scientific notation X.XXXE±00.

TOTAL ACTIVITY: Total Becquerels; ***must*** equal the sum of becquerels for each nuclide reported. Written in scientific notation X.XXXE±00.

WASTE VOLUME: Actual volume of waste material in package in cubic meters. Written in scientific notation X.XXXE+00.

NET WEIGHT: Total weight of waste and solidification or absorbent media, excluding container, in kilograms. Written in scientific notation X.XXXE±00.

ACTIVITY DATE: The date, in the formal DDMMMYYYY (e.g., 01Jan1992), that the activity of the package was determined.

WASTE STREAM / PROFILE: Waste Stream Identification or profile number. Thirteen alphanumeric characters. First four characters will be the RWMS designation. Next nine alphanumeric characters will be assigned by the generator. EXAMPLE: LRY5000000001 represents waste from the NTS.

WASTE FORM CODES: Enter the appropriate three digit number that categorizes the waste in the package.

020 - Charcoal
021 - Incinerator Ash
022 - Soil
023 - Gas
024 - Oil
025 - Aqueous Liquid
026 - Filter Media
027 - Mechanical Filter
028 - EPA Hazardous
029 - Demolition Rubble
030 - Cation Exchange Media
031 - Anion Exchange Media
032 - Mixed Bed Ion Exchange Media
033 - Contaminated Equipment
034 - Organic Liquid (except oil)
035 - Glassware or Labware
036 - Sealed Source or Device
037 - Paint or Plating
038 - Evaporator Bottoms /Sludges /Concentrates
039 - Compactible Trash
040 - Noncompactible Trash
041 - Animal Carcasses
042 - Biological Material (except animal carcasses)
043 - Activated Material
044 - Other (Describe)

WASTE TREATMENT CODES: Enter the appropriate three digit number that categorizes which waste treatment was used on the waste in the package.

Sorption		Solidification
060 - SpeediDri	070 - Chemsil 50	090 - Cement
061 - Celetom	071 - Chemsil 3030	091 - Concrete Encapsulation
062 - Floor Dry/Superfine	072 - Dicaperl HP200	092 - Bitumen
063 - HiDri	073 - Dicaperl HP500	093 - Vinyl Toluene
064 - Safe T Sorb	074 - Zonolite Gd4	094 - Vinyl Ester Styrene
065 - Safe N Dry	075 - Petroset	095 - Other (Describe)
066 - Florco	076 - Petroset II	100 - No Sorption or Solidification
067 - Florco X	077 - Aquaset	
068 - Solid A Sorb	078 - Aquaset II	
069 - Chemsil 30	079 - Other (Describe)	

REVISION: WP Revision number found in Section B.1 of the approved profile: profile revision ***must*** be a two digit number.

REVISION DATE: WP Date found in Section B.1 of the approved profile: in the formal DDMMMYYYY (e.g., 01Jan1992).

NUCLIDE: Valid nuclide description. Attach additional sheet to report more nuclides than space allows. Dash (-) format is required for identifying radionuclides (e.g., Cs-137 and Pu-239).

QUANTITY: The quantity of the nuclide present in the container in Becquerels. The sum of each nuclide reported ***must not*** exceed the total activity reported for the total package. Written in scientific notation X.XXXE±00.

Appendix E

Radiological Waste Characterization and Reporting Requirements

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Appendix E - Radiological Waste Characterization and Reporting Requirements

E.1 Radionuclide Reporting

Reportable radionuclides ***shall*** be reported on the Waste Profile (WP) and Package Storage and Disposal Request (PSDR).[6.18/7.5] The WP is applied at a waste stream level. The PSDR is applied at a waste package level. Any radionuclides reported on the PSDR ***must*** also be identified on the WP.[7.5] (See Appendix D for example of the PSDR.)

A. Reportable Radionuclides

Radionuclides known or reasonably expected to be present in a waste stream ***shall*** be reported as follows:[6.7/6.16/6.18]

1. The activity concentration of the radionuclides in the final waste form exceeds 1 percent of the Action Level (Table E-1).[6.7/7.9] These radionuclides require rigorous waste characterization and ***shall*** be reported on the PSDR and the WP.[7.5]

2. Radionuclides that are alpha-emitting and transuranic with a half-life greater than five years, ^{241}Pu, or ^{242}Cm that exceed 10 pCi/g ***shall*** be reported on the WP.[7.5] The waste mass ***must*** be determined as described in Section E.5.[7.5] Transuranic waste radionuclides with concentrations that exceed 1 nCi/g require rigorous waste characterization methods and ***shall*** be reported on the PSDR and the WP.[7.5]

3. Activity concentrations in the final waste form that exceed 1 percent of the total activity concentration ***shall*** be reported on the PSDR and the WP.[7.5] The total activity concentration ***shall*** include the activity of all radionuclides except for those that are exempt from the reporting requirements as specified below.[6.7/7.9] For these radionuclides and for those present at a level less than the detection limit of industry-accepted characterization methods, Process Knowledge (PK) should be sufficient for characterization.

Table E-1: Radionuclide Action Levels for Waste Characterization and Reporting

Nuclide	Action Level ($Bq\ m^{-3}$)	Nuclide	Action Level ($Bq\ m^{-3}$)
Unlisted nuclide with a $t_{1/2} < 5$ yr	No Limit	^{227}Ac	1.0×10^{12}
^{3}H	5.6×10^{15}	^{229}Th	4.1×10^{9}
^{14}C	2.3×10^{8}	^{230}Th	9.6×10^{7}
^{36}Cl	1.1×10^{10}	^{232}Th	8.1×10^{8}
^{59}Ni	8.1×10^{12}	^{231}Pa	1.4×10^{9}
^{63}Ni (activated metal)	2.5×10^{14}	^{232}U	9.3×10^{9}
^{63}Ni	2.5×10^{13}	^{233}U	3.1×10^{10}
^{60}Co	No Limit	^{234}U	1.9×10^{10}
^{90}Sr	1.5×10^{12}	^{235}U	1.2×10^{10}
^{93}Zr	1.4×10^{13}	^{236}U	1.2×10^{11}
^{99}Tc	1.1×10^{11}	^{238}U	5.9×10^{10}
^{107}Pd	1.3×10^{14}	^{237}Np	7.0×10^{8}
^{126}Sn	5.9×10^{8}	^{236}Pu	2.3×10^{11}
^{129}I	2.9×10^{9}	^{238}Pu	1.2×10^{11}
^{133}Ba	No Limit	^{239}Pu	2.3×10^{10}
^{135}Cs	2.8×10^{12}	^{240}Pu	2.3×10^{10}
^{137}Cs	3.4×10^{11}	^{241}Pu	5.2×10^{11}
^{151}Sm	1.2×10^{15}	^{242}Pu	2.4×10^{10}
^{152}Eu	4.8×10^{13}	^{241}Am	1.8×10^{10}
^{154}Eu	1.2×10^{16}	^{243}Am	7.0×10^{9}
^{210}Pb	1.3×10^{13}	^{242}Cm	2.4×10^{13}
^{207}Bi	1.1×10^{11}	^{244}Cm	8.1×10^{12}
^{226}Ra	3.6×10^{7}	^{248}Cm	6.3×10^{9}
^{228}Ra	No Limit		

B. Exempt Radionuclides

Radionuclides meeting any of the following criteria are exempt from the reporting requirements:

1. Any radionuclide, as listed in Table E-2, that will reach a state of transient or secular equilibrium with a parent radionuclide within the operational period of the disposal site.

2. Any radionuclide occurring at activity concentrations not exceeding background ranges for the region in which it was generated and material of interest.

Table E-2: Exempt Radionuclides

The progeny radionuclides listed are exempt from reporting requirements, when a parent radio-nuclide is present.

^{90}Y, ^{93}Nb, ^{126m}Sb, ^{126}Sb, ^{137m}Ba
^{233}Pa, ^{225}Ra, ^{225}Ac, ^{221}Fr, ^{217}At, ^{213}Bi, ^{213}Po, ^{209}Tl, ^{209}Pb
^{239}Np, ^{231}Th, ^{227}Th, ^{223}Fr, ^{223}Ra, ^{219}Rn, ^{215}Po, ^{211}Pb, ^{211}Bi, ^{211}Po, ^{207}Tl
^{234}Th, ^{234m}Pa, ^{234}Pa, ^{222}Rn, ^{218}Po, ^{214}Pb, ^{214}Bi, ^{214}Po, ^{210}Bi, ^{210}Po
^{240}U, ^{240m}Np, ^{240}Np, ^{228}Ra, ^{228}Ac, ^{228}Th, ^{224}Ra, ^{220}Rn, ^{216}Po, ^{212}Pb, ^{212}Bi, ^{212}Po, ^{208}Tl

E.2 Waste Profile Instructions

The reported activity concentrations ***must*** be representative of the final waste form after treatment or stabilization.[7.5] Zero will not be accepted as the lower limit value. The lower limit ***must*** be set as the expected lower limit concentration or as the lower limit of detection (LLD) of the characterization method.[7.5] If the lower limit is set by the LLD, list the lower limit value in parenthesis. Waste packages exceeding the upper limit will not be accepted for disposal without prior approval of a revised waste profile. The waste concentration may be less than the lower limit without prior approval.

E.3 Radiological Characterization Methods

Waste characterization methods are described below and are not intended to be all-inclusive. These methods can be used individually or in combination. The NNSA/NSO will use a graded approach in its acceptance of waste characterization methods. Generators are encouraged to develop innovative waste characterization plans designed for the specific conditions at their facilities.

The acceptability of a generator's waste characterization plan will be based on a determination that the level of effort is appropriate, given the potential of the waste stream to exceed the waste concentration action levels (Table E-1) and the physical limitations of the waste stream. Physical limitations may include waste matrices that cannot be representatively sampled because of unreasonable radiation exposure. Generators are expected to identify, based on knowledge of their processes and facility, those radionuclides with a reasonable probability of exceeding 1 percent of the waste concentration action level. Waste streams or waste packages reasonably expected to exceed 1 percent of the waste concentration action levels (Table E-1) will require the greatest level of characterization and verification.

A. Materials Controls and Accountability (MC&A)

MC&A records are data developed from a mass balance of material entering and exiting a process. MC&A data can be used to estimate the activity concentration of waste streams. This method is expected to be most useful for generators possessing limited numbers of nuclides, such as special nuclear materials, in known activity concentrations.

B. Gross Radiation Measurements

Scaling factors can be developed that relate gross radiation measurements to the activity concentration of a waste stream. Generators using gross radiation measurements ***shall*** ensure that measurements correlate with activity concentration on a consistent basis. [7.8] Radionuclide distributions in the waste stream ***shall*** be initially determined and periodically verified through direct measurements or sampling and analysis.[7.8] Generators ***shall*** document all methods used to develop scaling factors which relate gross radiation measurements to the activity concentration.[7.8] When developing scaling factors, generators ***must*** consider the waste package and detector geometry, shielding and attenuation effects, self absorption, and the energy spectra and decay schemes of radionuclides in the waste.[7.8]

C. Direct Measurement of Specific Radionuclides

Direct measurement of radionuclides may include nondestructive analysis of waste packages. In using this method, individual radionuclides are measured.

D. Sampling and Analysis

Radiological characterization using sampling and analysis, including swipes taken for characterization, ***shall*** be controlled.[6.24]

E. Process Knowledge

Process knowledge will often be sufficient for characterization of radionuclides not having action levels or occurring at concentrations less than 1 percent of the action level. This method involves determining the radionuclide content of the waste through knowledge and control of the source of the waste.

E.4 Encapsulation of Sealed Sources and Other Waste

The encapsulation of sealed sources can mitigate dispersion of waste and limit the impacts from direct and potential exposure pathways. The bounding conditions for the encapsulation of sealed sources are as follows:

A. A minimum solidified volume or mass that precludes significant movement of the waste without the assistance of mechanical equipment.

B. A maximum solidified volume or mass for encapsulation of a single discrete source will be 0.2 m^3 or 500 kg (55-gallon drum).

C. A maximum amount of gamma-emitting radioactivity or radioactive material generally acceptable for encapsulation is that which, if credit is taken for a 500-year decay period, would result in a dose rate of less than 0.2 μSv/hr (0.02 mrem/hr) on the surface of the encapsulating media. The maximum Cs-137/Ba-137m encapsulation in a single disposal container is 1.1 TBq (30 Ci).

D. A maximum amount of any nontransuranic radionuclide that can be encapsulated in a single disposal container intended for shallow land disposal is that which, when averaged over the waste and the encapsulating media, does not exceed the maximum concentration limits for Class C waste, as defined in Tables 1 and 2 of Title 10 CFR 61.55.

E. Sealed sources containing transuranic (TRU) radionuclides ***shall*** be evaluated against the NTSWAC TRU waste criteria individually, considering only the mass of the source itself (no packaging, extrinsic shielding, or other waste-diluting materials).[7.3] Encapsulation and concentration averaging over the waste and encapsulating media cannot be used to meet the NTSWAC TRU criteria.

F. In all cases, when a discrete source of radioactive solid waste is encapsulated, written procedures should be established to ensure that the radiation source(s) is reasonably centered within the encapsulating medium.

Encapsulated waste ***must*** be recognizable after the institutional control period of the disposal site so that inadvertent intrusion would be unlikely.[7.3] This is accomplished by the waste maintaining its structural integrity under the expected disposal conditions. The NRC Technical Position on Waste Form provides guidance in using cementitious materials to solidify and stabilize LLW.

E.5 Determination of Waste Volume

Waste activity concentration ***shall*** be determined based on the volume of the final waste form as offered for disposal.[7.5] Measurement or analysis of samples may be performed prior to final processing if the measured activity concentration can be related to the final activity concentration. The volume of the waste can usually be taken as the internal volume of the container if the radionuclides are reasonably homogeneously distributed throughout the waste and the waste fills at least 90 percent of the waste container. When these conditions are not met, for example when the package contains significant void space or contains irregularly shaped equipment or components, the volume ***shall*** be taken as the volume occupied by the waste in the container.[6.19] The activity concentration of transuranic radionuclides in units of nCi/g ***shall*** be based on the mass of the contents of a single waste container, excluding the mass of the container and any shielding present.[7.6]

E.6 Examples of Waste Characterization Documentation

A. Process knowledge documentation:

Historical analytical data, literature searches, living memory, historic records, MC&A records, mass balance documentation, production specifications, certificates of traceability, plans and drawings, signed statements of living memory, system descriptions, work and operating procedures which generated waste, and Material Safety Data Sheets.

B. Evaluation of PK and historical data.

C. Independent review of program documents (may be in the form of a sign-off page within the approved document).

D. Reviewed and approved procedures:

Direct measurement and/or survey processes, surface area estimations (when surface area of waste material is utilized in radiological characterization calculations), and ratio/scaling factor information (approach to ratio/scaling factor development, application of ratios/scaling factors, justification for use of ratios/scaling factors, supporting calculations, operating procedures for assay equipment).

E. Evaluated Data, Validated Data, Sampling and Analysis Plan, Scope of Work, and Laboratory Acquisition Document.

E.7 Radiological Characterization Flow Diagram Overview

Figure E-1, the radiological characterization flow diagram, illustrates the approach that should be used to obtain adequate radiological characterization. The approach allows for the utilization of generally accepted radiological characterization methodologies and documentation. Radiological characterization documentation requirements are outlined by markers (□) on the radiological characterization flow diagram.

Figure E-1: Radiological Characterization Flow Diagram

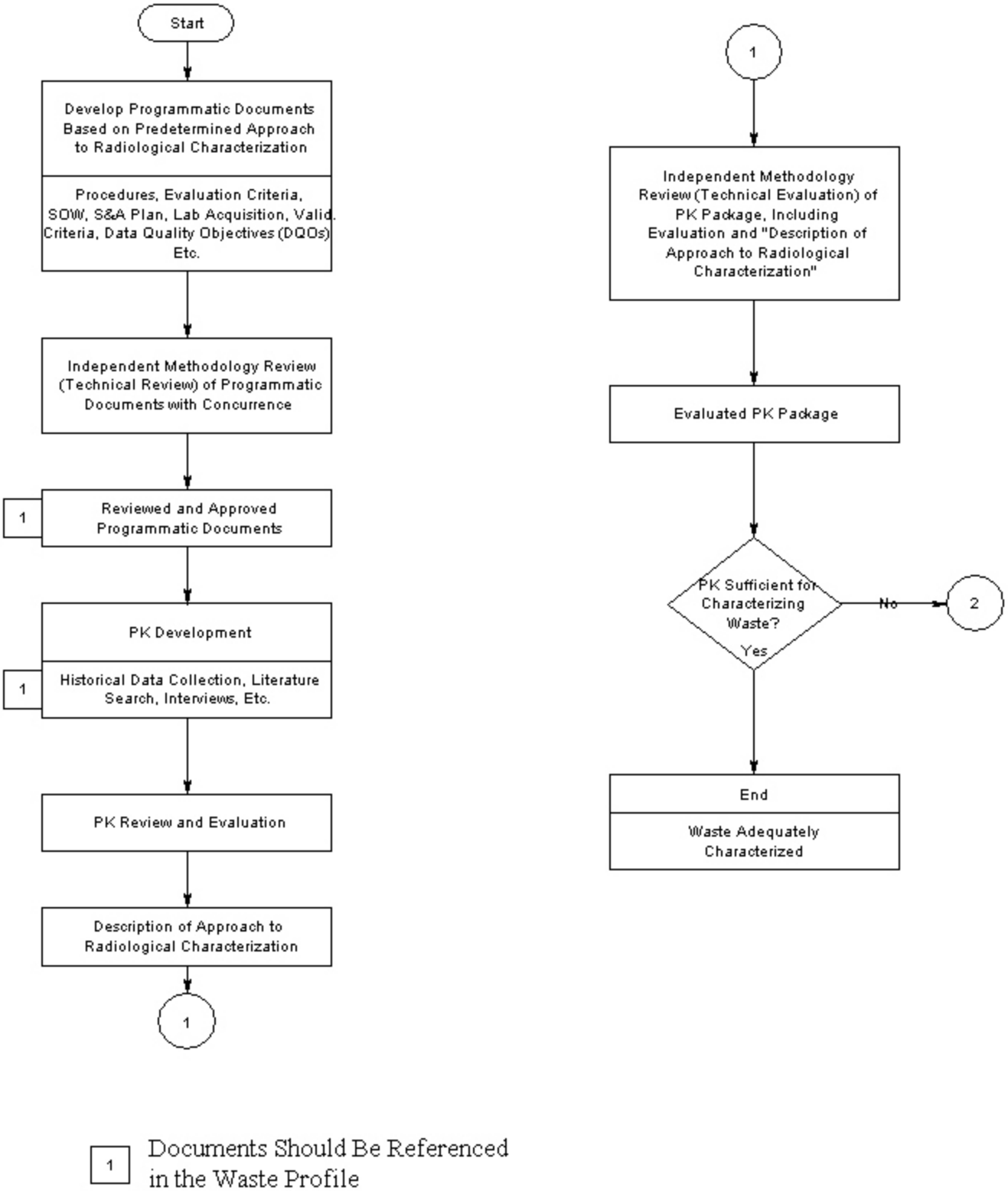
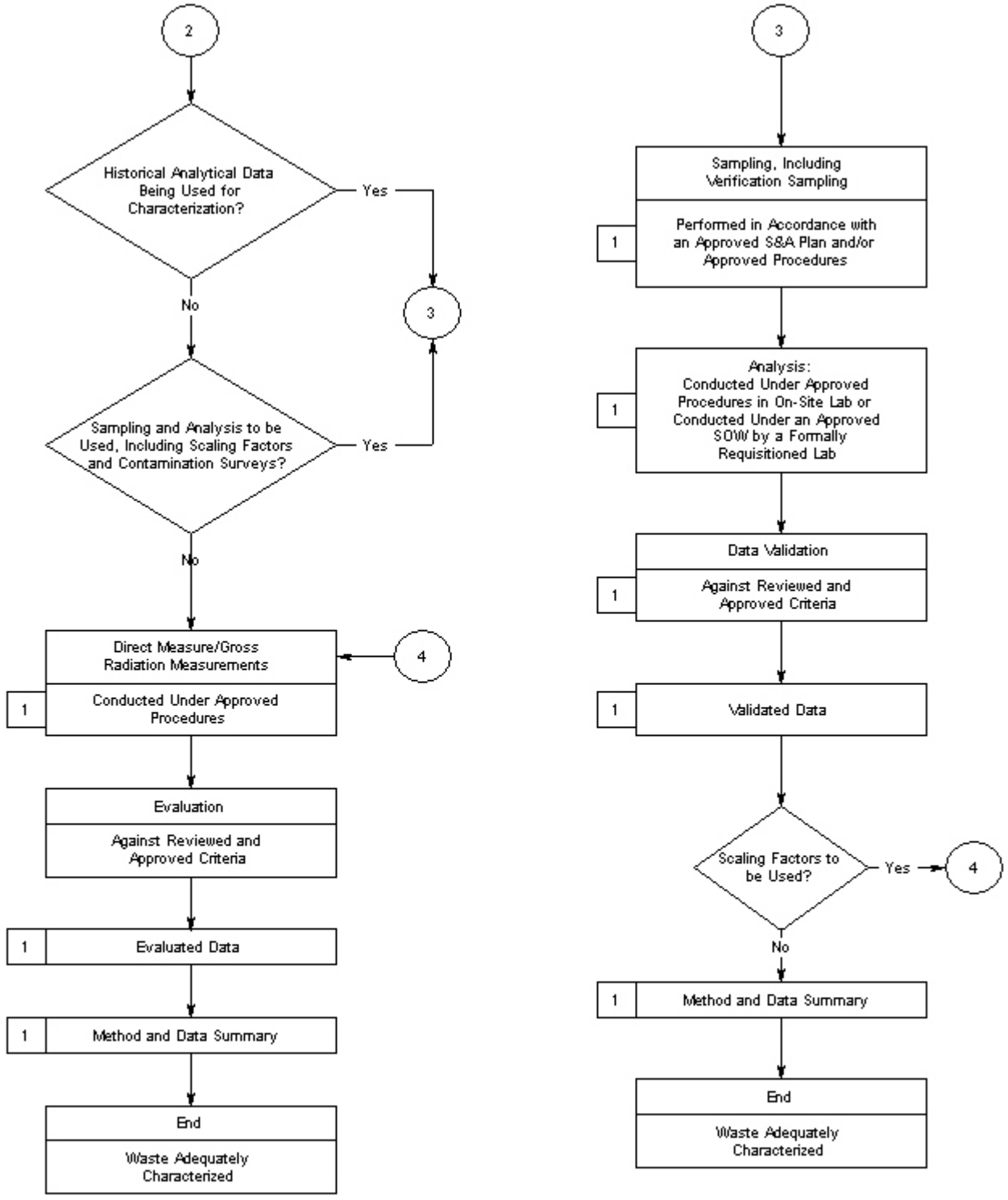


Figure E-1: Continued



NOTE: *Historical analytical data used for characterization should be verified through controlled analytical methods.*

1 Documents Should Be Referenced in the Waste Profile

E.8 Fissile Material Limits

The quantity of fissile material in a waste package acceptable for disposal ***shall*** be demonstrated to meet any of the following:

1. Does not exceed 15 g of ^{235}U Fissile Gram Equivalence (FGE) per package.[4.10] ^{235}U FGE is determined by completing Table E.3.

2. Does not exceed 350 grams of ^{235}U FGE per package nor does it exceed 2 g of ^{235}U FGE per kilogram of waste (mass of the package is not included in the mass of the waste) (graphite and beryllium ***must*** not exceed 1% by mass of the waste). **Both limits *must* not be exceeded.**[7.16]

3. Does not exceed the limits and the waste package meets the conditions as specified in Table E.4.[7.15/7.17]

4. Does not exceed the limits and the waste package meets the conditions as specified in Tables E.5 and E.6.[7.18]

Note: Waste containing uranium with an enrichment less than 0.90% ^{235}U by weight and those nuclides listed in Table E.3 such that their FGE is 1% or less of the grams of ^{235}U does not provide a fissile material concern.

If the waste does not comply with any of above, then a waste specific nuclear criticality safety evaluation (NCSE) may be necessary for acceptance of the waste. Please contact the RWAP Task Manager for further information on the criteria for performing a NCSE.

If the primary fissile nuclide in the waste is ^{235}U, the ^{235}U FGE and ^{235}U effective enrichment is required to be reported with the profile by completing Table E.3 for each enrichment range. The waste ***shall not*** exceed the total FGE as specified for the effective enrichment.

Table E.3: Calculation of ^{235}U Fissile Gram Equivalence and Effective ^{235}U Enrichment for LLW Packages

Nuclide (A)	High Activity Conc. (Bq/m^3) (B)	Volume of Package (m^3) (C)	Activity (Bq) (D)	Specific Activity (Bq/g) (E)	Mass of Nuclide (g) (D/E=F)	^{235}U FGE Factors (G)	^{235}U FGE (F*G=H)	If FGE is > 1% of ^{235}U Mass, then include (I)
^{233}U				3.6E+08		1.4E+00		
^{235}U				8.1E+04		1.0E+00		
^{239}Pu				2.3E+09		1.6E+00		
^{241}Pu				3.8E+12		3.5E+00		
^{242m}Am				3.6E+11		5.4E+01		
^{243}Cm				1.9E+12		7.8E+00		
^{245}Cm				6.4E+09		2.3E+01		
^{247}Cm				3.5E+06		7.8E-01		
^{249}Cf				1.5E+11		7.0E+01		
^{251}Cf				5.9E+10		1.4E+02		
Effective ^{235}U Enrichment = **Total ^{235}U FGE / Total U**							**TOTAL ^{235}U FGE**	
Effective ^{235}U Enrichment =								

Instructions for completing Table E.3 are as follows:

1. Multiply high activity range of the waste stream (Bq/m^3) by volume of waste to determine the maximum activity that could be present in a waste package for the nuclides listed above, resulting in Bq (Column D). For ^{235}U, the activity is only required to be included if the ^{235}U enrichment is equal to or greater than 0.90% by weight of total U.
2. Divide activity (Bq) (Column D) by the specific activity of the nuclide (Bq/g) (Column E) to determine the mass of the nuclide (Column F).
3. Multiply the mass (g) (Column F) of each nuclide by the ^{235}U FGE factor (Column G) to determine FGE (Column H).
4. If the FGE value is greater than 1% of the ^{235}U mass, then include in Column I to determine the total ^{235}U FGE for a waste package.
5. Effective ^{235}U enrichment (weight %) is calculated by dividing the total ^{235}U FGE by the total mass (g) of uranium and multiplying by 100.

Table E.4: Allowable Package Fissile Loadings for Various Package Steel Weights.

^{235}U Enrichment Weight %	Maximum Grams of ^{235}U per Package			
	35 Pounds (16 kg) Steel	50 Pounds (23 kg) Steel	70 Pounds (32 kg) Steel	105 Pounds (48 kg) Steel
80 - 100	54	66	82	103
60 - 80	55	67	83	105
40 - 60	56	68	85	107
20 - 40	60	73	90	110
15 - 20	65	78	95	120
10 - 15	70	83	100	130
8 - 10	75	90	110	140
7 - 8	80	97	120	150
6 - 7	85	104	130	160
5 - 6	90	109	135	170
4.5 - 5	100	121	150	190
4 - 4.5	105	129	160	200
3.5 - 4.0	110	136	170	210
3.0 - 3.5	120	146	180	230
2.5 - 3.0	140	170	210	270
2.0 - 2.5	170	209	260	330
1.9 - 2.0	220	271	340	440
1.8 - 1.9	240	296	370	480
1.7 - 1.8	260	324	410	530
1.6 - 1.7	290	363	460	590
1.5 - 1.6	330	411	520	670
1.4 - 1.5	380	479	610	790
1.3 - 1.4	460	580	740	960
1.25 - 1.3	580	739	950	1250
1.20 - 1.25	670	854	1100	1460
1.15 - 1.20	780	1003	1300	1700
1.10 - 1.15	950	1220	1580	2100
1.07 - 1.10	1150	1514	2000	2700
1.04 - 1.07	1400	1829	2400	3200
1.02 - 1.04	1700	2214	2900	4000
1.00 - 1.02	2000	2643	3500	4800
0.99 - 1.00	2350	3143	4200	5800
0.98 - 0.99	2600	3500	4700	6500
0.97 - 0.98	3000	4029	5400	7600
0.96 - 0.97	3400	4600	6200	8500
0.95 - 0.96	3800	5171	7000	10000
< 0.95	4400	5943	8000	unlimited

Instructions for using Table E.4 are as follows:

1. For LLW that has an enrichment exactly at the boundary between two enrichment ranges, the larger fissile mass loading may be used.
2. Linear interpolations between steel weights are allowed. For steel weights in excess of 105 lb (48 kg), use the fissile mass for 105 lb (48 kg); do not extrapolate to a larger fissile mass.
3. Table E.4 is not acceptable for LLW containing more than 1% beryllium and carbon graphite by package weight.
4. For waste with nuclides found in Table E.3 of the NTSWAC (other than ^{235}U) such that their fissile gram equivalence (FGE) exceeds 1% of the grams of ^{235}U present in the waste, then these nuclides ***must*** be accounted for. To account for these nuclides, an effective enrichment ***must*** be calculated as: (^{235}U grams + FGE) divided by Total U and multiplied by 100%. The effective enrichment and the sum of the total ^{235}U FGE are determined by completing Table E.3, and they are used to verify compliance with Table E.4.
5. The total weight of steel in a package may include that of all inner drums such as 10-, 15-, and 30-gallon drums inside of a 55-gallon drum, and the outer drum.
6. Mixing drums in an overpack, such as commingling 15-, 30-, and 55-gallon drums in a 4x4x7 box, is acceptable as long as the individual drums comply with Table E.4 limits.

Low-level waste (LLW) packages meeting the restrictions as specified in Table E.5 and the fissile limits in Table E.6 satisfy the criticality safety criteria specified in Section 3.2.1.

Table E.5: Criticality Safety Restrictions for the Use of the Fissile Limits in Table E.6.

Volume of overpack, if used	≥ nominal 55 gallons (outermost container)
Volume of waste container	55 gallon drum (may contain inner drums such as a 10-gallon container inside a 30-gallon drum, both within the 55-gallon outer drum)
Space between 55-gallon drum (waste container) and inner containers	If filled, the material ***must*** be loose, pourable material (e.g., vermiculite).
Boron location	Boron ***must*** be inside 55-gallon drum.
Boron physical properties (natural)	20 atom % ^{10}B, 80 atom % ^{11}B
Boron weight Note: For example, 12.9 kg of B_2O_3 is required to have 4 kg of boron	≥ nominal 9 pounds (4 kg) Note: the form is not controlled, e.g., Boraxo, B_4C, and Borosilicate glass are all acceptable, but it ***must*** be loose/pourable.
Beryllium and graphite by package weight	≤1% by weight
Maximum hydrogen content of waste as packed and as received at the NTS	Hydrogen to ^{235}U atom ratio (H/X) ***must*** be less than 50. For example, this limit is equivalent to a water-to-^{235}U mass ratio of 2. All hydrogenous materials, such as plastics and cellulose, may be assumed to be water to determine an equivalent water mass. That is, 1 g plastics = 1 g water.
Packaging (drum) material and mass	No restrictions.

^{235}U limits per package	The values presented in Table E.6.

Table E.6: Maximum Grams of ^{235}U as a Function of Enrichment (controls as specified in Table E.5)

^{235}U Enrichment (Weight %)	^{235}U (g)	^{235}U Enrichment (Weight %)	^{235}U (g)
0.95	9000	2.50	1810
0.96	8900	3.00	1650
0.97	8800	3.50	1554
0.98	8700	4.00	1485
0.99	8357	4.50	1436
1.00	7800	5.00	1400
1.02	7195	6.00	1225
1.04	6580	7.00	1179
1.07	5860	8.00	1125
1.10	5200	9.00	1072
1.15	4400	10.00	1028
1.20	3840	15.00	929
1.25	3500	20.00	873
1.30	3225	30.00	814
1.40	2895	40.00	776
1.50	2650	50.00	743
1.60	2460	60.00	720
1.70	2335	70.00	715
1.80	2215	80.00	700
1.90	2135	90.00	690
2.00	2060	100.00	680

Instructions for using Table E.6 are as follows:

1. For waste with nuclides found in Table E.3 of the NTSWAC (other than ^{235}U) such that their fissile gram equivalence (FGE) exceeds 1% of the grams of ^{235}U present in the waste, then these nuclides ***must*** be accounted for. To account for these nuclides, an effective enrichment ***must*** be calculated as: (^{235}U grams + FGE) divided by Total U and multiplied by 100%. The total ^{235}U FGE and effective ^{235}U enrichment are determined by completing Table E.3 and they are used to verify compliance with Table E.6.

Appendix F

Glossary

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Appendix F - Glossary

Certified Waste: Waste that has been confirmed to comply with disposal site Waste Acceptance Criteria (WAC) under an approved certification program.

Chelating Agents: Amine polycarboxylic acids (e.g., EDTA, DPTA), hydroxy-carboxylic acids, and polycarboxylic acids (e.g., citric acid, carbolic acid, and gluconic acid).

"Classified Waste": A term of art, defined for the purposes of the NTSWAC to mean: low-level radioactive material, including but not limited to, nuclear weapons components and assemblies designated by the United States Government, pursuant to Executive Order, Statue, or Regulation, that require protection against information or material disclosure for reasons of national security. Such materials include radioactive waste to which access has been limited for national security reasons and cannot be declassified, and that ***must*** be managed in accordance with the applicable DOE Orders and DOD Directives.

Controlled Copy: An approved, uniquely numbered document regulated through controlled distribution.

Corrective Action: Measures taken to rectify conditions adverse to quality and, where necessary, to preclude repetition.

Disposal: The emplacement of Low-Level Waste (LLW) or Mixed Waste (MW) in a manner which is considered permanent in that routine recovery is not provided for.

Facility Evaluation: A documented review to evaluate a generator's program to be in compliance with the WAC. Facility evaluations are conducted by Radioactive Waste Acceptance Program (RWAP) personnel in the form of an audit, surveillance, program reviews, or a combination of these.

Free Liquid: Liquids which readily separate from the solid portion of the waste including liquid that has been released during handling, storage, or transportation.

Generator: An individual, facility, corporation, government agency, or other institution that offers waste material for certification, treatment, storage, or disposal.

Hazardous Waste Component: Waste identified or listed in Title 40 Code of Federal Regulations (CFR) 261, or that otherwise meets the Resource Conservation and Recovery Act (RCRA) definition of hazardous, or waste identified by applicable state-of-generation hazardous waste regulations.

Incompatible Waste: Waste type that might react adversely with its containment materials or commingled waste as defined in Title 40 CFR 260.10.

Inspection: A planned and documented activity, performed by authorized personnel, to verify that an item, service, or process conforms to specified criteria.

Item: An all-inclusive term used in place of any of the following: assembly, component, equipment, material, part, structure, or system. The term "item" may also include technical data, documents, computer codes, or samples.

Land Disposal Restricted (LDR) Waste: Waste that is prohibited from land disposal in accordance with Title 40 CFR 268.

Low-Level Waste: Radioactive waste not classified as high-level waste, spent nuclear fuel, transuranic waste, uranium mill tailings, MW, or small quantities of 11e(2) by-product material as defined in U.S. Department of Energy (DOE) Order 435.1. Test specimens of fissionable material irradiated for research and development only, and not for the production of power or plutonium, may be classified as LLW, provided the concentration of TRU does not exceed 100 nCi/g.

Mixed Waste: Waste containing both radioactive and hazardous components as defined by the Atomic Energy Act of 1954 (as amended) and the RCRA. MW ***must*** meet the LDRs as listed in Title 40 CFR 268.

Nonconformance: A deficiency in characteristic, documentation, or procedure that renders the quality of an item or activity unacceptable or indeterminate.

Package: The packaging, together with its contents; a container (usually a drum or box) of waste in final form for disposal, one or more of which may constitute a shipment.

Packaging: The assembly of components necessary to ensure compliance with U.S. Department of Transportation (DOT), U.S. Environmental Protection Agency (EPA), and NNSA/NSO requirements. It may consist of one or more receptacles, absorbent materials, radiation shielding, spacing structures, thermal insulation, and devices for cooling or absorbing mechanical shocks. The conveyance, tie-down system, and auxiliary equipment may sometimes be designated as part of the packaging.

Parcel: An individual component, item, or bag of waste, two or more of which may make up a package.

Pyrophoric Material: A material which, under normal conditions, is liable to cause fires through friction, retain heat from processing, or which can be ignited readily and, when ignited, burns so vigorously and persistently as to create serious transportation, handling, or disposal hazards.

Qualification: The characteristics or abilities gained through education, training, or experience, as measured against established requirements, such as standards or tests, that qualify an individual to perform a required function.

Qualified: Having complied with the specific requirements or precedent conditions.

Quality Assurance: All those planned and systematic actions necessary to provide adequate confidence that a structure, system, or component will perform satisfactorily in service.

Radioactive Waste: Solid, liquid, or gaseous material that contains radioactive nuclides regulated under the Atomic Energy Act of 1954 (as amended).

Radioactive Waste Management Site: Designated locations where radioactive waste handling, storage, or disposal operations are conducted.

Real-Time Radiography: X-ray unit used to examine waste packages.

Removable Contamination: Removable radioactive material on the package surface or shipping vehicle.

Stabilization: A technique that limits the solubility and mobility of waste constituents by bonding or chemical reaction with the stabilizing material.

Storage: For the purposes of the NTSWAC, storage refers to the long-term management of "classified waste".

Solidification: A technique that limits the solubility and mobility of waste constituents by immobilization through physical means.

Supplier: Any individual or organization who furnishes items or services in accordance with a procurement document. An all-inclusive term used in place of any of the following: vendor, seller, contractor, subcontractor, fabricator, consultant, and their subtier levels.

Tamper-Indicating Devices: Devices that may be used on containers and that, because of their uniqueness in design or structure, reveal violations of containment integrity.

Treatment: Any method, technique, or process designed to change the physical or chemical character of waste to render it less hazardous; safer to transport, store, or dispose; or reduced in volume. Five basic treatments are (a) volume reduction, (b) immobilization of radioactive/hazardous components, (c) change of composition, (d) removal of radioactive or hazardous components from the waste, and (e) solidification of liquids.

Uniform Hazardous Waste Manifest: The shipping document EPA Form 8700-22 originated and signed by the generator in accordance with the instructions included in the Appendix to Title 40 CFR 262.

Verification Sampling: A NNSA/NSO program that confirms the accuracy and precision of a generator's analytical data by obtaining split samples of the waste from the generator, and having them analyzed.

Waste Characterization: Determination of the physical, chemical, or radiological properties of waste.

Waste Stream: A waste or group of wastes from a process or a facility with similar physical, chemical, and radiological properties.

References

Title 10 - Energy

1.1 10 CFR 61.56(a)(5)

1.2 10 CFR 61.56(a)(8)

1.3 10 CFR 850.32(b)

1.4 10 CFR 850.38

Title 29 - Labor

2.1 29 CFR 1910.66(f)(4)(v)

2.2 29 CFR 1910.66(f)(4)(ix)

2.3 29 CFR 1910.178(0)(2)

Title 40 - Protection of Environment

3.1 40 CFR 260.11(a)

3.2 40 CFR 261

3.3 40 CFR 261.1(a)

3.4 40 CFR 262.20(a)

3.5 40 CFR 262.32(b)

3.6 40 CFR 264.170 - .179

3.7 40 CFR 264.314(d)

3.8 40 CFR 265.177

3.9 40 CFR 265.314(f)

3.10 40 CFR 268

3.11 40 CFR 268.7

3.12 40 CFR 761.50(b)(7)(ii)

3.13 40 CFR 761.60(b)(4)

3.14 40 CFR 761.60(b)(6)(ii)(A)

3.15 40 CFR 761.61(a)(5)(i)(B)(2)(ii)

3.16 40 CFR 761.61(a)(5)(v)(A)

3.17 40 CFR 761.62(b)(1)(i and ii)

3.18 40 CFR 761.64(b)(2)

3.19 40 CFR 761.79(g)(6)

3.20 40 CFR 264.315

3.21 40 CFR 265.315

3.22 40 CFR 761.62(b)(4)(I)

3.23 40 CFR 761.40

Title 49 - Transportation

4.1 49 CFR 172.200 - .205

4.2 49 CFR 172 Subparts D and E

4.3 49 CFR 172.310

4.4 49 CFR 173.410

4.5 49 CFR 173.24

4.6 49 CFR 173.423

4.7 49 CFR 173.427

4.8 49 CFR 173.427(a)(6)(ii)

4.9 49 CFR 397.101

4.10 49 CFR 73.453

Nevada Administrative Code (NAC)

5.1 NAC 444.971(1)

5.2 NAC 444.971(2)

5.3 NAC 444.8565(2)(b)

5.4 NAC 444.8632

DOE Orders

DOE Order 420.1, "Facility Safety"

6.1 420.1 4.3.2

6.2 420.1 4.3.3

DOE Order 474.1, "Control and Accountability of Nuclear Materials"

DOE Manual M 474.1-1 "Control and Accountability of Nuclear Materials"

6.3 474.1-1 A II. 5(a)(2)

DOE Order 435.1, "Radioactive Waste Management"

DOE Manual M 435.1-1 "Radioactive Waste Management"

6.4 435.1-1 Attachment 2, 49

6.5 435.1-1 III. A

6.6 435.1-1 IV. G(1)

6.7 435.1-1 IV. G(1)(a)
6.8 435.1-1 IV. G(1)(b)
6.9 435.1-1 IV. G(1)(c)
6.10 435.1-1 IV. G(1)(d)(1)
6.11 435.1-1 IV. G(1)(d)(2)
6.12 435.1-1 IV. G(1)(d)(3)
6.13 435.1-1 IV. G(1)(d)(4)
6.14 435.1-1 IV. G(1)(d)(5)
6.15 435.1-1 IV. G(2)
6.16 435.1-1 IV. I
6.17 435.1-1 IV. I(1)
6.18 435.1-1 IV. I(2)
6.19 435.1-1 IV. I(2)(b)
6.20 435.1-1 IV. I(2)(d)
6.21 435.1-1 IV. J(2)
6.22 435.1-1 IV. K
6.23 435.1-1 IV. O

DOE Order 414.1, "Quality Assurance"

6.24 414.1 4(b)(2)(a)

Federal Manuals, Policy, and Organizations

7.1 DOE Hoisting & Rigging Manual, 8.3.1.a

7.2 State of Nevada Solid Waste Disposal Site Permit (SW1300001, current revision)

7.3 "Position Paper on the Proper Characterization and Disposal of Sealed Radioactive Sources." Revision 2, October 1997

7.4 Memo 9109-35 to Carol A. Shelton from Steve Okosisi, 11-21-1995, "Request for Evaluation of NVO-325 Criteria to Ensure Safe and Compliant Radioactive Waste Disposal Operations."

7.5 NNSA/NSO RWAP

7.6 NNSA/NSO Operations

7.7 "Test Methods for Evaluating Solid Waste, Physical/Chemical Methods," EPA Publication SW-846, Chapter 1, Section 1.0, 12/1996

7.8 Low-Level Waste Licensing Branch, Technical Position on Radioactive Waste Classification, May 1983, Revision 0, Section C.1.c

7.9 NNSA/NSO Performance Assessment

7.10 USEPA "Waste Analysis at Facilities that Generate, Treat, Store, and Dispose of Hazardous Wastes" PB94-463603, OSWER 9938.4-03, April 1994, Section 1.5.2

7.11 "Criticality Safety Plan for Low-Level Waste Disposal at the Nevada Test Site, Bechtel Nevada, L-E10.317.LAA, current version.

7.12 Title 42 USC, Chapter 23, Section 2021.c(b)(2)

7.13 "Position on the Use of Lead Shielding for the Disposal of Low Level Radioactive Waste at the Nevada Test Site"current version.

7.14 DOE/NV letter from Carl P. Gertz, 8/19/1998, "Contamination Release Limits for Radioactive Waste Transport Vehicles."

7.15 T. P. McLaughlin, "Nuclear Criticality Safety Review of Low-Level Waste Disposal at the Nevada Test Site Radioactive Waste Management Sites," CSR-A490.100, August 2002.

7.16 Bechtel Jacobs Company, "Nuclear Criticality Safety for Emplacement of ORR Waste at the Nevada Test Site, NCSE-MS-NTS1492, Rev. 0, August 2001.

7.17 S. G. Vessard and T. P. McLaughlin, "Nuclear Criticality Safety Evaluation of Low Level Waste Disposal at the Nevada Test Site Radioactive Waste Management Sites," CSE-A490.101, August, 2002.

7.18 S. G. Vessard and T. P. McLaughlin, "Nuclear Criticality Safety Evaluation of Low Level Waste Disposal at the Nevada Test Site Radioactive Waste Management Sites," CSE-A490.103, June, 2003.