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Radioactive Waste Classification Regulatory Framework

KHNP Training Program

Module 3: Waste Classification and Characterization

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Outline

I. Background

II. DOE Order 435.1 (LLW, TRU, HLW)

III. Resource Conservation and Recovery Act (RCRA; MLLW)

IV. Code of Federal Regulations (CFR) Title 10, Part 61 (Class A, B, C, GTCC)

V. Disposal Waste Acceptance Criteria (Nevada Test Site, Energy Solutions, WIPP)

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Regulatory Framework Background

1946	The McMahon Atomic Energy Act creates the Atomic Energy Commission (AEC).
1954	Atomic Energy Amendments Act (AEA) defines and restricts access to nuclear materials, makes possible a civilian nuclear power program, and is the law by which Congress endows agencies with the authority to manage and regulate nuclear materials.
1971	AEC restricts disposal of TRU waste.

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Regulatory Framework Background, continued

1978 Uranium Mill Tailings Radiation Control Act provides for disposal, long-term stabilization, and control of mill tailings and remedial action at abandoned mill tailings sites.

The Atlas Site in Moab, Utah

Tailings Cover, Gas Hills, Wyoming

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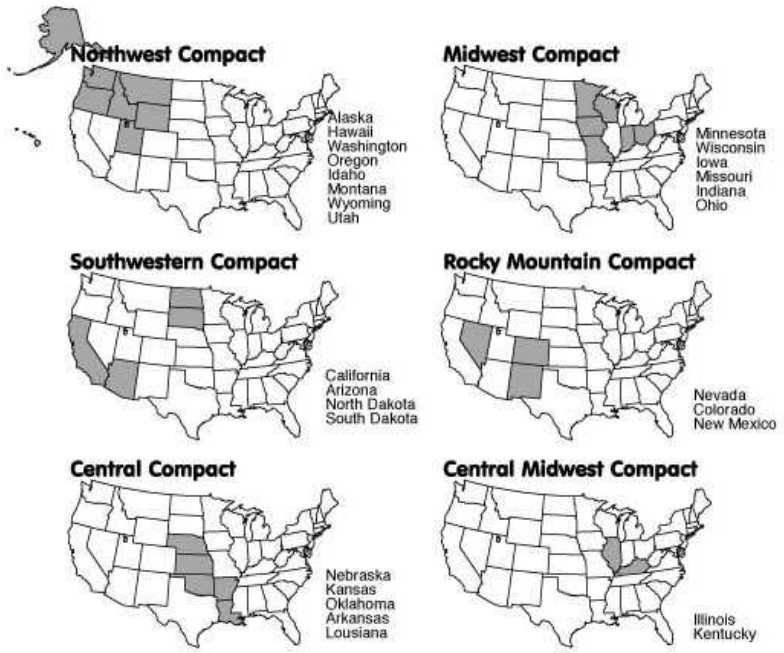
Regulatory Framework Background, continued

1980 Low-level Radioactive Waste Policy Act defines LLW and encourages states to form compacts, or regional associations, for LLW disposal.



1985 Act amended to extend the deadline for compact formation, and makes DOE responsible for disposal of GTCC waste.

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Regulatory Framework Background, continued

1982 The Nuclear Waste Policy Act :

- Establishes a framework for siting, characterizing, constructing and operating two geologic repositories for HLW disposal.
- Provides for siting and constructing a monitored retrievable storage facility for HLW.
- Establishes the Office of Civilian Radioactive Waste Management in DOE.

1987 Amendment to the Act directs DOE to characterize only the Yucca Mountain site, and defers a decision regarding a second repository until 2007.

Yucca Mountain

Tour group entering North Portal of Yucca Mountain

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Regulatory Framework Background, continued

1992 **Federal Facility Compliance Act amends the Resource Conservation and Recovery Act to establish that Federal facilities are subject to state environmental laws. As a result, all Federal agencies managing a solid waste facility or hazardous waste disposal site are subject to all applicable Federal, state, and local laws, regulations, and ordinances addressing solid and hazardous waste.**

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Regulatory Framework Background, continued

- Congress makes laws that define the responsibilities of Federal agencies regarding radioactive waste management. The responsible agencies (DOE, NRC, EPA) then develop their own rules and regulations to carry out these responsibilities:

  DOE – DOE Order 435.1 and its associated Manual.
  NRC – Code of Federal Regulations (CFR) Title 10, Part 61
  EPA – Resource Conservation and Recovery Act

DOE Order 435.1

- DOE Order 435.1 and its associated manual provide detailed "how to" instructions for HLW, TRU and LLW management. Topics covered include:
  - Definitions
  - Regulatory Requirements
  - Responsibilities
  - Quality Assurance
  - Waste: Characterization, Certification, Treatment, Transfer, Storage, Packaging, Transportation, Monitoring and Disposal

Resource Conservation and Recovery Act (RCRA)

- As a result of RCRA and the Federal Facility Compliance Act of 1992, a new waste category, mixed waste, was defined as waste that is both radioactive and hazardous according to RCRA.

- Wastes that are mixed can be either characteristic or listed mixed wastes, or both.

Characteristic Mixed Waste

- **A characteristic mixed waste has one or more of the following characteristics:**

  - Ignitability (Flash point <60 deg C, ignites at standard temperature and pressure, oxidizer)

  - Corrosivity (Acid or base)

  - Reactivity (Potentially explosive, water-reactive, cyanides, sulfides)

  - Toxicity (Based on the Toxicity Characteristic Leaching Procedure)

TABLE 1—MAXIMUM CONCENTRATION OF CONTAMINANTS FOR THE TOXICITY CHARACTERISTIC

EPA HW No.[1]	Contaminant	CAS No.[2]	Regulatory Level (mg/L)
D004	Arsenic	7440–38–2	5.0
D005	Barium	7440–39–3	100.0
D018	Benzene	71–43–2	0.5
D006	Cadmium	7440–43–9	1.0
D019	Carbon tetrachloride	56–23–5	0.5
D020	Chlordane	57–74–9	0.03
D021	Chlorobenzene	108–90–7	100.0
D022	Chloroform	67–66–3	6.0
D007	Chromium	7440–47–3	5.0
D023	o-Cresol	95–48–7	[4]200.0
D024	m-Cresol	108–39–4	[4]200.0
D025	p-Cresol	106–44–5	[4]200.0
D026	Cresol		[4]200.0
D016	2,4-D	94–75–7	10.0
D027	1,4-Dichlorobenzene	106–46–7	7.5
D028	1,2-Dichloroethane	107–06–2	0.5
D029	1,1-Dichloroethylene	75–35–4	0.7
D030	2,4-Dinitrotoluene	121–14–2	[3]0.13
D012	Endrin	72–20–8	0.02
D031	Heptachlor (and its epoxide).	76–44–8	0.008
D032	Hexachlorobenzene	118–74–1	[3]0.13
D033	Hexachlorobutadiene	87–68–3	0.5
D034	Hexachloroethane	67–72–1	3.0
D008	Lead	7439–92–1	5.0
D013	Lindane	58–89–9	0.4
D009	Mercury	7439–97–6	0.2
D014	Methoxychlor	72–43–5	10.0
D035	Methyl ethyl ketone	78–93–3	200.0
D036	Nitrobenzene	98–95–3	2.0
D037	Pentrachlorophenol	87–86–5	100.0
D038	Pyridine	110–86–1	[3]5.0
D010	Selenium	7782–49–2	1.0
D011	Silver	7440–22–4	5.0
D039	Tetrachloroethylene	127–18–4	0.7
D015	Toxaphene	8001–35–2	0.5
D040	Trichloroethylene	79–01–6	0.5
D041	2,4,5-Trichlorophenol	95–95–4	400.0
D042	2,4,6-Trichlorophenol	88–06–2	2.0
D017	2,4,5-TP (Silvex)	93–72–1	1.0
D043	Vinyl chloride	75–01–4	0.2

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Listed Mixed Waste

- **Wastes that contain listed RCRA chemicals, primarily organics, must be treated to Universal Treatment Standards prior to disposal.**

UNIVERSAL TREATMENT STANDARDS

[Note: NA means not applicable]

Regulated constituent common name	CAS[1] number	Wastewater standard	Nonwastewater standard
		Concentration in mg/l[2]	Concentration in mg/kg[3] unless noted as "mg/l TCLP"[4]
Organic Constituents			
Acenaphthylene	208-96-8	0.059	3.4
Acenaphthene	83-32-9	0.059	3.4
Acetone	67-64-1	0.28	160
Acetonitrile	75-05-8	5.6	38
Acetophenone	96-86-2	0.010	9.7
2-Acetylaminofluorene	53-96-3	0.059	140
Acrolein	107-02-8	0.29	NA
Acrylamide	79-06-1	19	23
Acrylonitrile	107-13-1	0.24	84
Aldicarb sulfone[5]	1646-88-4	0.056	0.28
Aldrin	309-00-2	0.021	0.066
4-Aminobiphenyl	92-67-1	0.13	NA
Aniline	62-53-3	0.81	14
Anthracene	120-12-7	0.059	3.4
Aramite	140-57-8	0.36	NA
alpha-BHC	319-84-6	0.00014	0.066
beta-BHC	319-85-7	0.00014	0.066
delta-BHC	319-86-8	0.023	0.066

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10 CFR Part 61

- The NRC is responsible for the licensing and regulation of radioactive waste disposal facilities that accept commercial radioactive waste. 10 CFR Part 61, Licensing Requirements for Land Disposal of Radioactive Waste, covers the following topics:

  - License Application Requirements
  - Disposal Site Performance Objectives
  - Technical Requirements, including:

    - Facility Design and Monitoring
    - Waste Classification
    - Waste Characteristics (Acceptance Criteria)
    - Labeling

10 CFR 61.55, Waste Classification

- **To determine if a waste is Class A, B, or C, long-lived radionuclides:**

Table 1

Radionuclide	Concentration curies per cubic meter
C-14	8
C-14 in activated metal	80
Ni-59 in activated metal	220
Nb-94 in activated metal	0.2
Tc-99	3
I-129	0.08
Alpha emitting transuranic nuclides with half-life greater than 5 years	[1]100
Pu-241	[1]3,500
Cm-242	[1]20,000

[1]Units are nanocuries per gram.

- **If concentration is <0.1 times the value in Table 1, waste is Class A.**
- **If 0.1(Table 1 value)<concentration≤Table 1 value, waste is Class C.**

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10 CFR 61.55, Waste Classification, continued

- **If waste contains none of the radionuclides listed in Table 1, waste class is determined using Table 2:**

Table 2

Radionuclide	Concentration, curies per cubic meter		
	Col. 1	Col. 2	Col. 3
Total of all nuclides with less than 5 year half-life	700	(1)	(1)
H-3	40	(1)	(1)
Co-60	700	(1)	(1)
Ni-63	3.5	70	700
Ni-63 in activated metal	35	700	7000
Sr-90	0.04	150	7000
Cs-137	1	44	4600

1 There are no limits established for these radionuclides in Class B or C wastes. Practical considerations such as the effects of external radiation and internal heat generation on transportation, handling, and disposal will limit the concentrations for these wastes. These wastes shall be Class B unless the concentrations of other nuclides in Table 2 determine the waste is Class C independent of these nuclides.

- **If concentration is <value in Column 1, waste is Class A.**
- **If Column 1 value<concentration<value in Column 2, waste is Class B.**
- **If Column 2 value<concentration<value in Column 3, waste is Class C.**

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10 CFR 61.55, Waste Classification, continued

- If the waste contains none of the radionuclides in Tables 1 and 2, waste is Class A.
- If the waste contains a mix of radionuclides from both Tables 1 and 2, classification is determined as follows:

  - If the concentration of a Table 1 radionuclide <0.1 times the value listed in Table 1, class is determined by the concentration of Table 2 radionuclides.
  - If 0.1(Table 1 value)<concentration≤Table 1 value, waste is Class C if concentration of Table 2 radionuclides <Column 3 values.

10 CFR 61.55, Sum of Fractions Rule

- If a waste contains a mixture of Table 1 or Table 2 radionuclides, the sum of fractions rule is used. To determine the sum of fractions, divide each nuclide's concentration by the appropriate limit and add the resulting values. The appropriate limits must all be taken from the same column of the same table. The sum of fractions for the column must be <1.0 if the waste class is to be determined by that column.

Example: Waste contains 50 Ci/cubic meter Sr-90 and 22 Ci/cubic meter Cs-137. Since both concentrations >Column 1 values in Table 2, they must be compared to Column 2 values. For Sr-90, 50/150 = 0.33; for Cs-137, 22/44 = 0.5; 0.33 + 0.5 = 0.83. Since this is <1.0, waste is Class B.

Disposal Site Waste Acceptance Criteria

- Disposal site waste acceptance criteria are based on the requirements of 10 CFR 61.56. The following slides summarize the waste acceptance criteria for the DOE Nevada Test Site, Energy Solutions in Clive, Utah, WIPP and Yucca Mountain.

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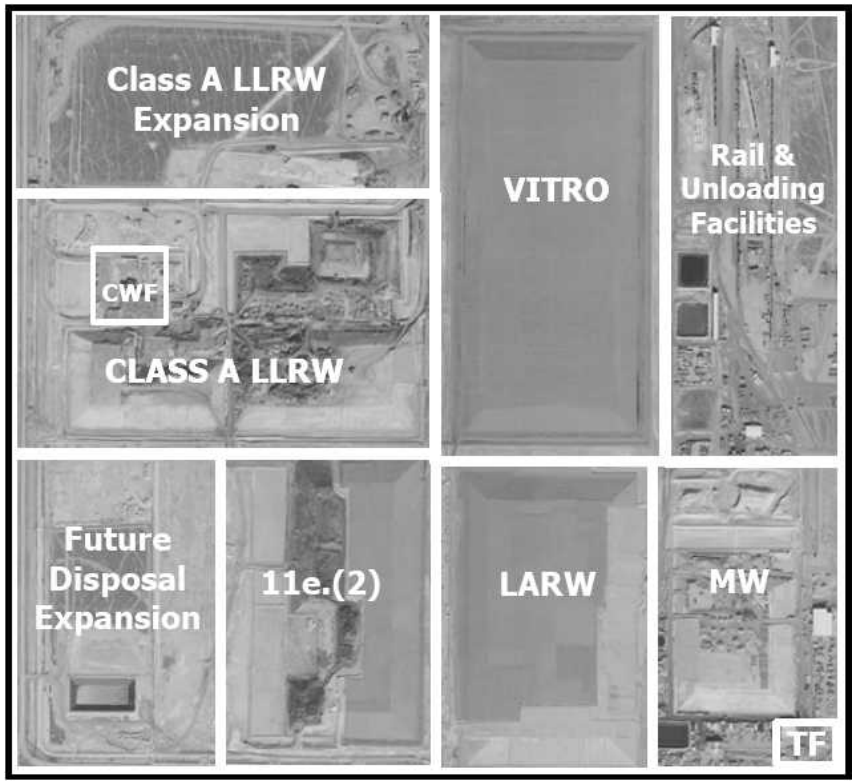
Energy Solutions Waste Acceptance Criteria

Energy Solutions accepts Class A radioactive and mixed wastes, SNM, NORM/NARM and byproduct material.



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Nevada Test Site Waste Acceptance Criteria

- **The Nevada Test Site accepts DOE-titled LLW and MLLW for disposal.**

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

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Nevada Test Site Waste Disposal

Gate 1 – Mercury, Nevada

Area 3 Radioactive Waste Management Complex, Nevada Test Site

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Nevada Test Site Waste Disposal, continued

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

Area 5 Radioactive Waste Management Complex, Nevada Test Site

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Waste Profiles

You will receive Waste Profile forms for the Nevada Test Site and Energy Solutions as examples of the requirements that drive waste characterization in the United States.

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WIPP Waste Acceptance Criteria

WIPP accepts defense-related transuranic waste.

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Yucca Mountain Waste Acceptance Criteria

- **Formal waste acceptance criteria for the Yucca Mountain geologic repository are under development.**

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