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**ASSESSMENT OF IMPACTS OF ADDITIONAL
ARAR, 40CFR191 AUGUST 14, 1990**

8-14-90

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REPORT**

ASSESSMENT OF IMPACTS OF ADDITIONAL ARAR, 40CFR191

FEED MATERIALS PRODUCTION CENTER
FERNALD, OHIO



August 14, 1990

U.S. DEPARTMENT OF ENERGY
OAK RIDGE OPERATIONS OFFICE

INTRODUCTION

- Regulatory Implications
- Technical Impacts & Issues
- Schedule Impacts & Issues
- Recovery Plan

IMPACT OF ADDITIONAL ARARs

- August 7, 1990, EPA notified DOE
- 40CFR191 is ARAR for K-65 Material
- K-65 Does Not Meet Applicability
- EPA maintains part 191 is "relevant and appropriate"

IMPACT OF ADDITIONAL ARARs
(Continued)

- DOE and Contractor Maintain that Part 191 Is Not Well-Suited to K-65 Material

- To-Date RI/FS Activities Reflect this Stance

- Unilateral decisions by EPA Require Reconsideration of RI/FS Studies

IMPACT OF ADDITIONAL ARARs
(Continued)

- Cannot Anticipate All Regulations EPA May Require
- FFA in April 1, 1990, Gives EPA Final ARAR Determination Without Dispute
- But EPA Must Determine "Relevant and Appropriate" Correctly

40CFR191 RELEVANCY

- Radionuclide Concentration > 100 nCi/g
- Alpha-emitters with ≥ 20 yr. half-life

RADIONUCLIDE CONCENTRATION IN THE SILOS

SILO 1

Nuclide (pCi/g)	S1NE1A	S1NE1B	S1NE1C	S1SE1	S1SE2	S1SW1	S1NW1
Th-228	ND	ND	ND	ND	ND	ND	ND
* Th-230	21,412	39,693	30,751	10,569	20,848	40,818	43,771
* Th-232	ND	ND	ND	ND	ND	ND	766
* Ra-226	108,100	192,600	166,400	116,800	89,280	181,200	163,300
Ra-228	ND	ND	ND	ND	ND	ND	ND
Pb-210	181,100	83,110	77,460	71,920	48,980	69,480	54,350
* U-234	815	326	622	663	814	594	897
* U-235/236	ND	ND	ND	ND	56	ND	50
* U-238	920	398	610	545	758	532	687
U-Total (ppm)	2753	1189	1831	1633	2280	1602	2066
Total (nCi/g)	131	233	198	129	112	223	209
							746

SILO 2

Nuclide (pCi/g)	S2SW1	S2NW1	-S2NE2	S2SW2	S2NE1	S2NW2
Th-228	ND	ND	ND	411	ND	638
* Th-230	31,825	32,784	8365	29,716	40,124	25,391
* Th-232	ND	ND	ND	851	ND	ND
* Ra-226	145,300	61,780	657	104,900	65,520	68,310
Ra-228	ND	ND	ND	ND	ND	ND
Pb-210	141,900	145,200	87,930	77,940	150,700	39,200
* U-234	859	1107	974	121	848	1404
* U-235/236	ND	74	47	ND	36	70
* U-238	661	1069	874	46	814	1240
U-Total (ppm)	1972	3210	2620	137	2437	3717
Total (nCi/g)	179	96.8	10.9	136	107	96.4

40CFR191 APPLICABILITY

- Spent Nuclear Fuel
- High Level Wastes
- Transuranic Wastes



K-65 material is none of the above

**SIGNIFICANT ADDITIONAL TECHNICAL
CONSIDERATIONS DUE TO 40CFR191**

- Locate Permanent Disposal Facility
- Design On-Site Interim Storage Facility
- Develop New Packaging and Shipping Requirements

TECHNICAL ISSUES

- Separation of SOUs
Sub-Operable Units (SOUs)
- New Technologies
- Availability of Disposal Sites
- New Alternatives
- Redesign & New Design of Process Options

SEPARATION OF OU-4 INTO SOUs

- Metal Oxide Silo, Structure and Subsoils Remain as One Sub-Operable Unit (SOU-A)
- 40CFR191 ARAR Only Pertains to K-65 Material (SOU-B)
- K-65 Structures, Berms and Subsoils Still Being Treated as Low-Level Waste (SOU-C)
- *Unused Silo 4 (SOU-D)*

NEW PROCESS OPTIONS / TECHNOLOGIES

- Lack of Disposal Facility Requires Evaluation of Interim On-Site Storage Facilities
- Waste Separation, Volume Reduction, & Concentration Technologies Become More Economically Feasible
- Packaging, Shipping, & Disposal Requirements Change

DISPOSAL SITES

- Commercial Low-Level Waste Disposal Sites Excluded
- Nevada Test Site Will Not Accept High-Level Waste
- WIPP Site Designated to Accept Defense-Related Transuranic Wastes Only (10 Selected Generator Facilities; FMPC Not One of Them)
- No Sites Available for High-Level Waste Disposal or High-Level Mixed Waste

WIPP FACILITY

- Limited Test for 5 Years
- "Defense - Related TRU"
- Greater than 100 nCi/g and 20 Year Half-Life
- FMPC Is Not on the Intended List
- Bare Cost of the Facility Will Be \$12,000/yd³

NEW / REVISED ALTERNATIVES

- Redefine Existing Alternatives for Respective SOUs
- Define New Alternatives for Respective SOUs Based on New Technologies / Process Options

POSSIBLE SUB-OPERABLE UNIT (SOU) AND CORRESPONDING ALTERNATIVES

SOU A - Metal Oxide Material, Structure, and Subsoil

Alternative # (Old #)	Description	Status
A-0 (0)	No action	No revision required
A-1 (1b)	Slurry wall and cap	No revision required
A-2 (2b)	Shallow soil mix & cap	No revision required
A-3 (3 modified)	Remove, <u>treat</u> , on-site disposal	Modified to include treatment
A-4 (4 modified)	Remove, <u>treat</u> , off-site disposal	Modified to include treatment
A-5 (5 modified)	Rehabilitate silo	No revision required

POSSIBLE SUB-OPERABLE UNIT (SOU) AND CORRESPONDING ALTERNATIVES

SOU B - K-65 Material

Alternative # (Old #)	Description	Status
B-0 (0)	No action	Revision required
B-1 (1a)	Slurry wall and cap	Not applicable
B-2 (2a)	Shallow soil mix & cap	Not applicable
B-3 (6)	Remove, treat (stabilization) on-site disposal	Not applicable
B-4 (7)	Remove, treat (stabilization), interim storage, off-site disposal	Revision required
B-5 (8)	Remove, volume red./ contaminant separation stabilization, on-site disposal	Not applicable
B-6 (9)	Remove, volume red./ contaminant separation stabilization, interim storage off-site disposal	Revision required

POSSIBLE SUB-OPERABLE UNIT (SOU) AND CORRESPONDING ALTERNATIVES

SOU C - K-65 Structures, Berms, and Subsoils

<i>Alternative # (Old #)</i>	<i>Description</i>	<i>Status</i>
C-0 (0)	No action	Revision required
C-1	Remove, stabilize, on-site disposal	Revision required
C-2	Remove, stabilize, off-site disposal	Revision required
C-3	Remove, package, on-site disposal	Revision required
C-4	Remove, package, off-site disposal	Revision required
C-5	Cap	Revision required

REDESIGN / DESIGN

- Refine / Redesign Contaminant Separation Process
- Resize Equipment Based on New or Revised Processes
- Design Interim Storage Facility
- Interactive With Cost and Schedule Evaluation (which impacts determination of exposure hours and total schedule duration)

SCHEDULE ISSUES & IMPACTS

- Treatment Technologies and Process Options Reconsidered (cannot be eliminated)
- Analysis Repeated (less time required)
- 2 Extra Weeks for First DOE Comment Resolution

MINOR CHANGES

- Text Changes for Metal Oxide Alternatives
- Text changes to Eliminate On-Site Disposal Alternatives for K-65 Material

MAJOR MODIFICATIONS

- Reanalyze K-65 Material Off-Site Disposal Alternatives
- Analyze On-Site Interim Storage
- Estimate Costs
- Perform Risk Assessment
- Analyze K-65 Silos and Berms Separately from K-65 Material

NEW WORK

- New Process Options / Technologies
- Packaging and Shipping Requirements
- Interim Storage
- Permanent Disposal

RECOVERY PLAN

Schedule Recap

WEEKS
Compressed Crash
Schedule Schedule

• Screening of Technologies and Process Options	4	4
• Detailed Analysis	17	12
• Selection of Preferred Alternatives	1	1
• Draft FS	8	4
• DOE Review and Responses	18	15
TOTAL	48	36
Delta Time	30	21
FFA Adder :		

SCREENING OF TECHNOLOGIES & PROCESS OPTIONS

	WEEKS	
	<i>Compressed Schedule</i>	<i>Crash Schedule</i>
• Examine Universe of Technologies		
• Write up New Applicable Technologies	1	1
• Establish Screening Factors for New Technologies		
• Assemble Process Options	1	1
• Assemble New or Modified Alternatives		
• Screen for Implementability, Overall Protection of Health & Environment, and Cost	2	2
TOTAL	4	4

DETAILED ANALYSIS

	WEEKS	
	<i>Compressed Schedule</i>	<i>Crash Schedule</i>
<ul style="list-style-type: none"> • Develop Detailed Conceptual Designs • Develop Cost Estimates • Evaluate Against 2 Threshold Factors & 5 Balancing Factors 	17	12
TOTAL	17	12

SELECTION OF PREFERRED ALTERNATIVES

WEEKS

Compressed Schedule Crash Schedule

Compare Alternatives Using EXPERT CHOICE

- 2 EXPERT CHOICE Models will be run per SOU - 1 run including cost, 1 run excluding cost

	1	1
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TOTAL 1 1

DRAFT FS**WEEKS*****Compressed Crash
Schedule Schedule***

- Prepare Draft for Internal Review
- Internal Review
- Comment Resolution & Incorporation
- Deliver Draft FS

4 2

2 1

2 1

TOTAL 8 4

DOE REVIEW AND RESPONSES**WEEKS****Compressed Schedule Crash Schedule**

• DOE Review	4	4
• Resolve & Incorporate Comments	6	4
• DOE Review (II)	4	4
• Resolve & Incorporate Comments	4	3
TOTAL	18	15

KEY ASSUMPTIONS

- No Resubmittal of Initial Screening Report
- No Oral Briefing of Detailed Analysis and Selection of Preferred Alternatives

SUMMARY

Additional 40CFR191 ARAR Triggers:

- Major technical issues, uncertainties, and impacts
- New and revised engineering evaluations of process options / technologies
- Re-evaluation of cost and schedule estimates
- Major section rewrites and new text additions
- Recovery Plan impacts schedule from 36 to 48 weeks

ered a member of the public during any period in which he is engaged in carrying out any operation which is part of a nuclear fuel cycle.

(1) "Regulatory agency" means the government agency responsible for issuing regulations governing the use of sources of radiation or radioactive materials or emissions therefrom and carrying out inspection and enforcement activities to assure compliance with such regulations.

Subpart B—Environmental Standards for the Uranium Fuel Cycle

§ 190.10 Standards for normal operations.

Operations covered by this subpart shall be conducted in such a manner as to provide reasonable assurance that:

(a) The annual dose equivalent does not exceed 25 millirems to the whole body, 75 millirems to the thyroid, and 25 millirems to any other organ of any member of the public as the result of exposures to planned discharges of radioactive materials, radon and its daughters excepted, to the general environment from uranium fuel cycle operations and to radiation from these operations.

(b) The total quantity of radioactive materials entering the general environment from the entire uranium fuel cycle, per gigawatt-year of electrical energy produced by the fuel cycle, contains less than 50,000 curies of krypton-85, 5 millicuries of iodine-129, and 0.5 millicuries combined of plutonium-239 and other alpha-emitting transuranic radionuclides with half-lives greater than one year.

§ 190.11 Variances for unusual operations.

The standards specified in § 190.10 may be exceeded if:

(a) The regulatory agency has granted a variance based upon its determination that a temporary and unusual operating condition exists and continued operation is in the public interest, and

(b) Information is promptly made a matter of public record delineating the nature of unusual operating conditions, the degree to which this operation is expected to result in levels in excess of the standards, the basis of

the variance, and the schedule for achieving conformance with the standards.

§ 190.12 Effective date.

(a) The standards in § 190.10(a) shall be effective December 1, 1979, except that for doses arising from operations associated with the milling of uranium ore the effective date shall be December 1, 1980.

(b) The standards in § 190.10(b) shall be effective December 1, 1979, except that the standards for krypton-85 and iodine-129 shall be effective January 1, 1983, for any such radioactive materials generated by the fission process after these dates.

PART 191—ENVIRONMENTAL RADIATION PROTECTION STANDARDS FOR MANAGEMENT AND DISPOSAL OF SPENT NUCLEAR FUEL, HIGH-LEVEL AND TRANSURANIC RADIOACTIVE WASTES

Subpart A—Environmental Standards for Management and Storage

Sec.

- 191.01 Applicability.
- 191.02 Definitions.
- 191.03 Standards.
- 191.04 Alternative standards.
- 191.05 Effective date.

Subpart B—Environmental Standards for Disposal

- 191.11 Applicability.
- 191.12 Definitions.
- 191.13 Containment requirements.
- 191.14 Assurance requirements.
- 191.15 Individual protection requirements.
- 191.16 Ground water protection requirements.
- 191.17 Alternative provisions for disposal.
- 191.18 Effective date.

APPENDIX A—TABLE FOR SUBPART B

APPENDIX B—GUIDANCE FOR IMPLEMENTATION OF SUBPART B

AUTHORITY: The Atomic Energy Act of 1954, as amended; Reorganization Plan No. 3 of 1970; and the Nuclear Waste Policy Act of 1982.

SOURCE: 50 FR 38084, Sept. 19, 1985, unless otherwise noted.

**Subpart A—Environmental Standards
for Management and Storage**

§ 191.01 Applicability.

This subpart applies to:

(a) Radiation doses received by members of the public as a result of the management (except for transportation) and storage of spent nuclear fuel or high-level or transuranic radioactive wastes at any facility regulated by the Nuclear Regulatory Commission or by Agreement States, to the extent that such management and storage operations are not subject to the provisions of Part 190 of Title 40; and

(b) Radiation doses received by members of the public as a result of the management and storage of spent nuclear fuel or high-level or transuranic wastes at any disposal facility that is operated by the Department of Energy and that is not regulated by the Commission or by Agreement States.

§ 191.02 Definitions.

Unless otherwise indicated in this subpart, all terms shall have the same meaning as in Subpart A of Part 190.

(a) "Agency" means the Environmental Protection Agency.

(b) "Administrator" means the Administrator of the Environmental Protection Agency.

(c) "Commission" means the Nuclear Regulatory Commission.

(d) "Department" means the Department of Energy.

(e) "NWPA" means the Nuclear Waste Policy Act of 1982 (Pub. L. 97-425).

(f) "Agreement State" means any State with which the Commission or the Atomic Energy Commission has entered into an effective agreement under subsection 274b of the Atomic Energy Act of 1954, as amended (68 Stat. 919).

(g) "Spent nuclear fuel" means fuel that has been withdrawn from a nuclear reactor following irradiation, the constituent elements of which have not been separated by reprocessing.

(h) "High-level radioactive waste," as used in this part, means high-level radioactive waste as defined in the Nu-

clear Waste Policy Act of 1982 (Pub. L. 97-425).

(i) "Transuranic radioactive waste," as used in this part, means waste containing more than 100 nanocuries of alpha-emitting transuranic isotopes, with half-lives greater than twenty years, per gram of waste, except for: (1) High-level radioactive wastes; (2) wastes that the Department has determined, with the concurrence of the Administrator, do not need the degree of isolation required by this part; or (3) wastes that the Commission has approved for disposal on a case-by-case basis in accordance with 10 CFR Part 61.

(j) "Radioactive waste," as used in this part, means the high-level and transuranic radioactive waste covered by this part.

(k) "Storage" means retention of spent nuclear fuel or radioactive wastes with the intent and capability to readily retrieve such fuel or waste for subsequent use, processing, or disposal.

(l) "Disposal" means permanent isolation of spent nuclear fuel or radioactive waste from the accessible environment with no intent of recovery, whether or not such isolation permits the recovery of such fuel or waste. For example, disposal of waste in a mined geologic repository occurs when all of the shafts to the repository are back-filled and sealed.

(m) "Management" means any activity, operation, or process (except for transportation) conducted to prepare spent nuclear fuel or radioactive waste for storage or disposal, or the activities associated with placing such fuel or waste in a disposal system.

(n) "Site" means an area contained within the boundary of a location under the effective control of persons possessing or using spent nuclear fuel or radioactive waste that are involved in any activity, operation, or process covered by this subpart.

(o) "General environment" means the total terrestrial, atmospheric, and aquatic environments outside sites within which any activity, operation, or process associated with the management and storage of spent nuclear fuel or radioactive waste is conducted.

(p) "Member of the public" means any individual except during the time when that individual is a worker engaged in any activity, operation, or process that is covered by the Atomic Energy Act of 1954, as amended.

(q) "Critical organ" means the most exposed human organ or tissue exclusive of the integumentary system (skin) and the cornea.

§ 191.03 Standards.

(a) Management and storage of spent nuclear fuel or high-level or transuranic radioactive wastes at all facilities regulated by the Commission or by Agreement States shall be conducted in such a manner as to provide reasonable assurance that the combined annual dose equivalent to any member of the public in the general environment resulting from: (1) Discharges of radioactive material and direct radiation from such management and storage and (2) all operations covered by Part 190; shall not exceed 25 millirems to the whole body, 75 millirems to the thyroid, and 25 millirems to any other critical organ.

(b) Management and storage of spent nuclear fuel or high-level or transuranic radioactive wastes at all facilities for the disposal of such fuel or waste that are operated by the Department and that are not regulated by the Commission or Agreement States shall be conducted in such a manner as to provide reasonable assurance that the combined annual dose equivalent to any member of the public in the general environment resulting from discharges of radioactive material and direct radiation from such management and storage shall not exceed 25 millirems to the whole body and 75 millirems to any critical organ.

§ 191.04 Alternative standards.

(a) The Administrator may issue alternative standards from those standards established in § 191.03(b) for waste management and storage activities at facilities that are not regulated by the Commission or Agreement States if, upon review of an application for such alternative standards:

(1) The Administrator determines that such alternative standards will

prevent any member of the public from receiving a continuous exposure of more than 100 millirems per year dose equivalent and an infrequent exposure of more than 500 millirems dose equivalent in a year from all sources, excluding natural background and medical procedures; and

(2) The Administrator promptly makes a matter of public record the degree to which continued operation of the facility is expected to result in levels in excess of the standards specified in § 191.03(b).

(b) An application for alternative standards shall be submitted as soon as possible after the Department determines that continued operation of a facility will exceed the levels specified in § 191.03(b) and shall include all information necessary for the Administrator to make the determinations called for in § 191.04(a).

(c) Requests for alternative standards shall be submitted to the Administrator, U.S. Environmental Protection Agency, 401 M Street, SW., Washington, DC 20460.

§ 191.05 Effective date.

The standards in this subpart shall be effective on November 18, 1985.

Subpart B—Environmental Standards for Disposal

§ 191.11 Applicability.

(a) This subpart applies to:

(1) Radioactive materials released into the accessible environment as a result of the disposal of spent nuclear fuel or high-level or transuranic radioactive wastes;

(2) Radiation doses received by members of the public as a result of such disposal; and

(3) Radioactive contamination of certain sources of ground water in the vicinity of disposal systems for such fuel or wastes.

(b) However, this subpart does not apply to disposal directly into the oceans or ocean sediments. This subpart also does not apply to wastes disposed of before the effective date of this rule.

§ 191.12 Definitions.

Unless otherwise indicated in this subpart, all terms shall have the same meaning as in Subpart A of this part.

(a) "Disposal system" means any combination of engineered and natural barriers that isolate spent nuclear fuel or radioactive waste after disposal.

(b) "Waste," as used in this subpart, means any spent nuclear fuel or radioactive waste isolated in a disposal system.

(c) "Waste form" means the materials comprising the radioactive components of waste and any encapsulating or stabilizing matrix.

(d) "Barrier" means any material or structure that prevents or substantially delays movement of water or radionuclides toward the accessible environment. For example, a barrier may be a geologic structure, a canister, a waste form with physical and chemical characteristics that significantly decrease the mobility of radionuclides, or a material placed over and around waste, provided that the material or structure substantially delays movement of water or radionuclides.

(e) "Passive institutional control" means: (1) Permanent markers placed at a disposal site, (2) public records and archives, (3) government ownership and regulations regarding land or resource use, and (4) other methods of preserving knowledge about the location, design, and contents of a disposal system.

(f) "Active institutional control" means: (1) Controlling access to a disposal site by any means other than passive institutional controls; (2) performing maintenance operations or remedial actions at a site, (3) controlling or cleaning up releases from a site, or (4) monitoring parameters related to disposal system performance.

(g) "Controlled area" means: (1) A surface location, to be identified by passive institutional controls, that encompasses no more than 100 square kilometers and extends horizontally no more than five kilometers in any direction from the outer boundary of the original location of the radioactive wastes in a disposal system; and (2) the subsurface underlying such a surface location.

(h) "Ground water" means water below the land surface in a zone of saturation.

(i) "Aquifer" means an underground geological formation, group of formations, or part of a formation that is capable of yielding a significant amount of water to a well or spring.

(j) "Lithosphere" means the solid part of the Earth below the surface, including any ground water contained within it.

(k) "Accessible environment" means: (1) The atmosphere; (2) land surfaces; (3) surface waters; (4) oceans; and (5) all of the lithosphere that is beyond the controlled area.

(l) "Transmissivity" means the hydraulic conductivity integrated over the saturated thickness of an underground formation. The transmissivity of a series of formations is the sum of the individual transmissivities of each formation comprising the series.

(m) "Community water system" means a system for the provision to the public of piped water for human consumption, if such system has at least 15 service connections used by year-round residents or regularly serves at least 25 year-round residents.

(n) "Significant source of ground water," as used in this part, means: (1) An aquifer that: (i) Is saturated with water having less than 10,000 milligrams per liter of total dissolved solids; (ii) is within 2,500 feet of the land surface; (iii) has a transmissivity greater than 200 gallons per day per foot, *Provided*, That any formation or part of a formation included within the source of ground water has a hydraulic conductivity greater than 2 gallons per day per square foot; and (iv) is capable of continuously yielding at least 10,000 gallons per day to a pumped or flowing well for a period of at least a year; or (2) an aquifer that provides the primary source of water for a community water system as of the effective date of this subpart.

(o) "Special source of ground water," as used in this part, means those Class I ground waters identified in accordance with the Agency's Ground-Water Protection Strategy published in August 1984 that: (1) Are within the controlled area encompassing a disposal system or are less than five kilome-

ters beyond the controlled area; (2) are supplying drinking water for thousands of persons as of the date that the Department chooses a location within that area for detailed characterization as a potential site for a disposal system (e.g., in accordance with section 112(b)(1)(B) of the NWPA); and (3) are irreplaceable in that no reasonable alternative source of drinking water is available to that population.

(p) "Undisturbed performance" means the predicted behavior of a disposal system, including consideration of the uncertainties in predicted behavior, if the disposal system is not disrupted by human intrusion or the occurrence of unlikely natural events.

(q) "Performance assessment" means an analysis that: (1) Identifies the processes and events that might affect the disposal system; (2) examines the effects of these processes and events on the performance of the disposal system; and (3) estimates the cumulative releases of radionuclides, considering the associated uncertainties, caused by all significant processes and events. These estimates shall be incorporated into an overall probability distribution of cumulative release to the extent practicable.

(r) "Heavy metal" means all uranium, plutonium, or thorium placed into a nuclear reactor.

(s) "Implementing agency," as used in this subpart, means the Commission for spent nuclear fuel or high-level or transuranic wastes to be disposed of in facilities licensed by the Commission in accordance with the Energy Reorganization Act of 1974 and the Nuclear Waste Policy Act of 1982, and it means the Department for all other radioactive wastes covered by this part.

§ 191.13 Containment requirements.

(a) Disposal systems for spent nuclear fuel or high-level or transuranic radioactive wastes shall be designed to provide a reasonable expectation, based upon performance assessments, that the cumulative releases of radionuclides to the accessible environment for 10,000 years after disposal from all significant processes and events that may affect the disposal system shall:

(1) Have a likelihood of less than one chance in 10 of exceeding the quantities calculated according to Table 1 (Appendix A); and

(2) Have a likelihood of less than one chance in 1,000 of exceeding ten times the quantities calculated according to Table 1 (Appendix A).

(b) Performance assessments need not provide complete assurance that the requirements of § 191.13(a) will be met. Because of the long time period involved and the nature of the events and processes of interest, there will inevitably be substantial uncertainties in projecting disposal system performance. Proof of the future performance of a disposal system is not to be had in the ordinary sense of the word in situations that deal with much shorter time frames. Instead, what is required is a reasonable expectation, on the basis of the record before the implementing agency, that compliance with § 191.13 (a) will be achieved.

§ 191.14 Assurance requirements.

To provide the confidence needed for long-term compliance with the requirements of § 191.13, disposal of spent nuclear fuel or high-level or transuranic wastes shall be conducted in accordance with the following provisions, except that these provisions do not apply to facilities regulated by the Commission (see 10 CFR Part 60 for comparable provisions applicable to facilities regulated by the Commission):

(a) Active institutional controls over disposal sites should be maintained for as long a period of time as is practicable after disposal; however, performance assessments that assess isolation of the wastes from the accessible environment shall not consider any contributions from active institutional controls for more than 100 years after disposal.

(b) Disposal systems shall be monitored after disposal to detect substantial and detrimental deviations from expected performance. This monitoring shall be done with techniques that do not jeopardize the isolation of the wastes and shall be conducted until there are no significant concerns to be addressed by further monitoring.

(c) Disposal sites shall be designated by the most permanent markers, records, and other passive institutional controls practicable to indicate the dangers of the wastes and their location.

(d) Disposal systems shall use different types of barriers to isolate the wastes from the accessible environment. Both engineered and natural barriers shall be included.

(e) Places where there has been mining for resources, or where there is a reasonable expectation of exploration for scarce or easily accessible resources, or where there is a significant concentration of any material that is not widely available from other sources, should be avoided in selecting disposal sites. Resources to be considered shall include minerals, petroleum or natural gas, valuable geologic formations, and ground waters that are either irreplaceable because there is no reasonable alternative source of drinking water available for substantial populations or that are vital to the preservation of unique and sensitive ecosystems. Such places shall not be used for disposal of the wastes covered by this part unless the favorable characteristics of such places compensate for their greater likelihood of being disturbed in the future.

(f) Disposal systems shall be selected so that removal of most of the wastes is not precluded for a reasonable period of time after disposal.

§ 191.15 Individual protection requirements.

Disposal systems for spent nuclear fuel or high-level or transuranic radioactive wastes shall be designed to provide a reasonable expectation that, for 1,000 years after disposal, undisturbed performance of the disposal system shall not cause the annual dose equivalent from the disposal system to any member of the public in the accessible environment to exceed 25 millirems to the whole body or 75 millirems to any critical organ. All potential pathways (associated with undisturbed performance) from the disposal system to people shall be considered, including the assumption that individuals consume 2 liters per day of drinking water

from any significant source of ground water outside of the controlled area.

§ 191.16 Ground water protection requirements.

(a) Disposal systems for spent nuclear fuel or high-level or transuranic radioactive wastes shall be designed to provide a reasonable expectation that, for 1,000 years after disposal, undisturbed performance of the disposal system shall not cause the radionuclide concentrations averaged over any year in water withdrawn from any portion of a special source of ground water to exceed:

(1) 5 picocuries per liter of radium-226 and radium-228;

(2) 15 picocuries per liter of alpha-emitting radionuclides (including radium-226 and radium-228 but excluding radon); or

(3) The combined concentrations of radionuclides that emit either beta or gamma radiation that would produce an annual dose equivalent to the total body or any internal organ greater than 4 millirems per year if an individual consumed 2 liters per day of drinking water from such a source of ground water.

(b) If any of the average annual radionuclide concentrations existing in a special source of ground water before construction of the disposal system already exceed the limits in § 191.16(a), the disposal system shall be designed to provide a reasonable expectation that, for 1,000 years after disposal, undisturbed performance of the disposal system shall not increase the existing average annual radionuclide concentrations in water withdrawn from that special source of ground water by more than the limits established in § 191.16(a).

§ 191.17 Alternative provisions for disposal.

The Administrator may, by rule, substitute for any of the provisions of Subpart B alternative provisions chosen after:

(a) The alternative provisions have been proposed for public comment in the FEDERAL REGISTER together with information describing the costs, risks, and benefits of disposal in accordance

with the alternative provisions and the reasons why compliance with the existing provisions of Subpart B appears inappropriate;

(b) A public comment period of at least 90 days has been completed, during which an opportunity for public hearings in affected areas of the country has been provided; and

(c) The public comments received have been fully considered in developing the final version of such alternative provisions.

§ 191.18 Effective date.

The standards in this subpart shall be effective on November 18, 1985.

[50 FR 38084, Sept. 19, 1985; 50 FR 40003, Oct. 1, 1985]

APPENDIX A—TABLE FOR SUBPART B

TABLE 1—RELEASE LIMITS FOR CONTAINMENT REQUIREMENTS

(Cumulative releases to the accessible environment for 10,000 years after disposal)

Radionuclide	Release limit per 1,000 MTHM or other unit of waste (see notes) (cures)
Americium-241 or -243.....	100
Carbon-14.....	100
Cesium-135 or -137.....	1,000
Iodine-129.....	100
Neptunium-237.....	100
Plutonium-238, -239, -240, or -242.....	100
Radium-226.....	100
Strontium-90.....	1,000
Technetium-99.....	10,000
Thorium-230 or -232.....	10
Tin-126.....	1,000
Uranium-233, -234, -235, -236, or -238.....	100
Any other alpha-emitting radionuclide with a half-life greater than 20 years.....	100
Any other radionuclide with a half-life greater than 20 years that does not emit alpha particles.....	1,000

APPLICATION OF TABLE 1

NOTE 1: *Units of Waste.* The Release Limits in Table 1 apply to the amount of wastes in any one of the following:

(a) An amount of spent nuclear fuel containing 1,000 metric tons of heavy metal (MTHM) exposed to a burnup between 25,000 megawatt-days per metric ton of

heavy metal (MWd/MTHM) and 40,000 MWd/MTHM;

(b) The high-level radioactive wastes generated from reprocessing each 1,000 MTHM exposed to a burnup between 25,000 MWd/MTHM and 40,000 MWd/MTHM;

(c) Each 100,000,000 curies of gamma or beta-emitting radionuclides with half-lives greater than 20 years but less than 100 years (for use as discussed in Note 5 or with materials that are identified by the Commission as high-level radioactive waste in accordance with part B of the definition of high-level waste in the NWPA);

(d) Each 1,000,000 curies of other radionuclides (i.e., gamma or beta-emitters with half-lives greater than 100 years or any alpha-emitters with half-lives greater than 20 years) (for use as discussed in Note 5 or with materials that are identified by the Commission as high-level radioactive waste in accordance with part B of the definition of high-level waste in the NWPA); or

(e) An amount of transuranic (TRU) wastes containing one million curies of alpha-emitting transuranic radionuclides with half-lives greater than 20 years.

NOTE 2: *Release Limits for Specific Disposal Systems.* To develop Release Limits for a particular disposal system, the quantities in Table 1 shall be adjusted for the amount of waste included in the disposal system compared to the various units of waste defined in Note 1. For example:

(a) If a particular disposal system contained the high-level wastes from 50,000 MTHM, the Release Limits for that system would be the quantities in Table 1 multiplied by 50 (50,000 MTHM divided by 1,000 MTHM).

(b) If a particular disposal system contained three million curies of alpha-emitting transuranic wastes, the Release Limits for that system would be the quantities in Table 1 multiplied by three (three million curies divided by one million curies).

(c) If a particular disposal system contained both the high-level wastes from 50,000 MTHM and 5 million curies of alpha-emitting transuranic wastes, the Release Limits for that system would be the quantities in Table 1 multiplied by 55:

$$\frac{50,000 \text{ MTHM}}{1,000 \text{ MTHM}} + \frac{5,000,000 \text{ curies TRU}}{1,000,000 \text{ curies TRU}} = 55$$

NOTE 3: *Adjustments for Reactor Fuels with Different Burnup.* For disposal systems containing reactor fuels (or the high-level wastes from reactor fuels) exposed to an average burnup of less than 25,000 MWd/MTHM or greater than 40,000 MWd/MTHM, the units of waste defined in (a)

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and (b) of Note 1 shall be adjusted. The unit shall be multiplied by the ratio of 30,000 MWd/MTHM divided by the fuel's actual average burnup, except that a value of 5,000 MWd/MTHM may be used when the average fuel burnup is below 5,000 MWd/MTHM and a value of 100,000 MWd/MTHM shall be used when the average fuel burnup is above 100,000 MWd/MTHM. This adjusted unit of waste shall then be used in determining the Release Limits for the disposal system.

For example, if a particular disposal system contained only high-level wastes with an average burnup of 3,000 MWd/MTHM, the unit of waste for that disposal system would be:

$$\frac{60,000 \text{ MTHM}}{1,000 \text{ MTHM}} \times$$

$$1,000 \text{ MTHM} \times \frac{(30,000)}{(5,000)} = 6,000 \text{ MTHM}$$

If that disposal system contained the high-level wastes from 60,000 MTHM (with an average burnup of 3,000 MWd/MTHM), then the Release Limits for that system would be the quantities in Table 1 multiplied by ten:

$$\frac{60,000 \text{ MTHM}}{6,000 \text{ MTHM}} = 10$$

which is the same as:

$$\frac{(5,000 \text{ MWd/MTHM})}{(30,000 \text{ MWd/MTHM})} = 10$$

NOTE 4: Treatment of Fractionated High-Level Wastes. In some cases, a high-level waste stream from reprocessing spent nuclear fuel may have been (or will be) separated into two or more high-level waste components destined for different disposal systems. In such cases, the implementing agency may allocate the Release Limit multiplier (based upon the original MTHM and the average fuel burnup of the high-level waste stream) among the various disposal systems as it chooses, provided that the total Release Limit multiplier used for that waste stream at all of its disposal systems may not exceed the Release Limit multiplier that would be used if the entire waste stream were disposed of in one disposal system.

NOTE 5: Treatment of Wastes with Poorly Known Burnups or Original MTHM. In some cases, the records associated with particular high-level waste streams may not be adequate to accurately determine the original metric tons of heavy metal in the reactor fuel that created the waste, or to determine the average burnup that the fuel was exposed to. If the uncertainties are such that the original amount of heavy metal or the average fuel burnup for particular high-level waste streams cannot be quantified, the units of waste derived from (a) and (b) of Note 1 shall no longer be used. Instead, the units of waste defined in (c) and (d) of Note 1 shall be used for such high-level waste streams. If the uncertainties in such information allow a range of values to be associated with the original amount of heavy metal or the average fuel burnup, then the calculations described in previous Notes will be conducted using the values that result in the smallest Release Limits, except that the

Release Limits need not be smaller than those that would be calculated using the units of waste defined in (c) and (d) of Note 1.

NOTE 6: Uses of Release Limits to Determine Compliance with § 191.13 Once release limits for a particular disposal system have been determined in accordance with Notes 1 through 5, these release limits shall be used to determine compliance with the requirements of § 191.13 as follows. In cases where a mixture of radionuclides is projected to be released to the accessible environment, the limiting values shall be determined as follows: For each radionuclide in the mixture, determine the ratio between the cumulative release quantity projected over 10,000 years and the limit for that radionuclide as determined from Table 1 and Notes 1 through 5. The sum of such ratios for all the radionuclides in the mixture may not exceed one with regard to § 191.13(a)(1) and may not exceed ten with regard to § 191.13(a)(2).

For example, if radionuclides A, B, and C are projected to be released in amounts Q_A , Q_B , and Q_C , and if the applicable Release Limits are RL_A , RL_B , and RL_C , then the cumulative releases over 10,000 years shall be limited so that the following relationship exists:

$$\frac{Q_A}{RL_A} + \frac{Q_B}{RL_B} + \frac{Q_C}{RL_C} < 1$$

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APPENDIX B—GUIDANCE FOR IMPLEMENTATION OF SUBPART B

(NOTE: The supplemental information in this appendix is not an integral part of 40 CFR Part 191. Therefore, the implementing agencies are not bound to follow this guidance. However, it is included because it describes the Agency's assumptions regarding the implementation of Subpart B. This appendix will appear in the Code of Federal Regulations.)

The Agency believes that the implementing agencies must determine compliance with §§ 191.13, 191.15, and 191.16 of Subpart B by evaluating long-term predictions of disposal system performance. Determining compliance with § 191.13 will also involve predicting the likelihood of events and processes that may disturb the disposal system. In making these various predictions, it will be appropriate for the implementing agencies to make use of rather complex computational models, analytical theories, and prevalent expert judgment relevant to the numerical predictions. Substantial uncertainties are likely to be encountered in making these predictions. In fact, sole reliance on these numerical predictions to determine compliance may not be appropriate; the implementing agencies may choose to supplement such predictions with qualitative judgments as well. Because the procedures for determining compliance with Subpart B have not been formulated and tested yet, this appendix to the rule indicates the Agency's assumptions regarding certain issues that may arise when implementing §§ 191.13, 191.15, and 191.16. Most of this guidance applies to any type of disposal system for the wastes covered by this rule. However, several sections apply only to disposal in mined geologic repositories and would be inappropriate for other types of disposal systems.

Consideration of Total Disposal System. When predicting disposal system performance, the Agency assumes that reasonable projections of the protection expected from all of the engineered and natural barriers of a disposal system will be considered. Portions of the disposal system should not be disregarded, even if projected performance is uncertain, except for portions of the system that make negligible contributions to the overall isolation provided by the disposal system.

Scope of Performance Assessments. Section 191.13 requires the implementing agencies to evaluate compliance through performance assessments as defined in § 191.12(q). The Agency assumes that such performance assessments need not consider categories of events or processes that are estimated to have less than one chance in

10,000 of occurring over 10,000 years. Furthermore, the performance assessments need not evaluate in detail the releases from all events and processes estimated to have a greater likelihood of occurrence. Some of these events and processes may be omitted from the performance assessments if there is a reasonable expectation that the remaining probability distribution of cumulative releases would not be significantly changed by such omissions.

Compliance with § 191.13. The Agency assumes that, whenever practicable, the implementing agency will assemble all of the results of the performance assessments to determine compliance with § 191.13 into a "complementary cumulative distribution function" that indicates the probability of exceeding various levels of cumulative release. When the uncertainties in parameters are considered in a performance assessment, the effects of the uncertainties considered can be incorporated into a single such distribution function for each disposal system considered. The Agency assumes that a disposal system can be considered to be in compliance with § 191.13 if this single distribution function meets the requirements of § 191.13(a).

Compliance with §§ 191.15 and 191.16. When the uncertainties in undisturbed performance of a disposal system are considered, the implementing agencies need not require that a very large percentage of the range of estimated radiation exposures or radionuclide concentrations fall below limits established in §§ 191.15 and 191.16, respectively. The Agency assumes that compliance can be determined based upon "best estimate" predictions (e.g., the mean or the median of the appropriate distribution, whichever is higher).

Institutional Controls. To comply with § 191.14(a), the implementing agency will assume that none of the active institutional controls prevent or reduce radionuclide releases for more than 100 years after disposal. However, the Federal Government is committed to retaining ownership of all disposal sites for spent nuclear fuel and high-level and transuranic radioactive wastes and will establish appropriate markers and records, consistent with § 191.14(c). The Agency assumes that, as long as such passive institutional controls endure and are understood, they: (1) Can be effective in deterring systematic or persistent exploitation of these disposal sites; and (2) can reduce the likelihood of inadvertent, intermittent human intrusion to a degree to be determined by the implementing agency. However, the Agency believes that passive institutional controls can never be assumed to eliminate the chance of inadvertent and intermittent human intrusion into these disposal sites.

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Consideration of Inadvertent Human Intrusion into Geologic Repositories. The most speculative potential disruptions of a mined geologic repository are those associated with inadvertent human intrusion. Some types of intrusion would have virtually no effect on a repository's containment of waste. On the other hand, it is possible to conceive of intrusions (involving widespread societal loss of knowledge regarding radioactive wastes) that could result in major disruptions that no reasonable repository selection or design precautions could alleviate. The Agency believes that the most productive consideration of inadvertent intrusion concerns those realistic possibilities that may be usefully mitigated by repository design, site selection, or use of passive controls (although passive institutional controls should not be assumed to completely rule out the possibility of intrusion). Therefore, inadvertent and intermittent intrusion by exploratory drilling for resources (other than any provided by the disposal system itself) can be the most severe intrusion scenario assumed by the implementing agencies. Furthermore, the implementing agencies can assume that passive institutional controls or the intruders' own exploratory procedures are adequate for the intruders to soon detect, or be warned of, the incompatibility of the area with their activities.

Frequency and Severity of Inadvertent Human Intrusion into Geologic Repositories. The implementing agencies should consider the effects of each particular disposal system's site, design, and passive institutional controls in judging the likelihood and consequences of such inadvertent exploratory drilling. However, the Agency assumes that the likelihood of such inadvertent and intermittent drilling need not be taken to be greater than 30 boreholes per square kilometer of repository area per 10,000 years for geologic repositories in proximity to sedimentary rock formations, or more than 3 boreholes per square kilometer per 10,000 years for repositories in other geologic formations. Furthermore, the Agency assumes that the consequences of such inadvertent drilling need not be assumed to be more severe than: (1) Direct release to the land surface of all the ground water in the repository horizon that would promptly flow through the newly created borehole to the surface due to natural lithostatic pressure—or (if pumping would be required to raise water to the surface) release of 200 cubic meters of ground water pumped to the surface if that much water is readily available to be pumped; and (2) creation of a ground water flow path with a permeability typical of a borehole filled by the soil or gravel that would normally settle into an open hole over time—not the permeability of a carefully sealed borehole.

PART 192—HEALTH AND ENVIRONMENTAL PROTECTION STANDARDS FOR URANIUM AND THORIUM MILL TAILINGS

Subpart A—Standards for the Control of Residual Radioactive Materials from Inactive Uranium Processing Sites

- Sec.
192.00 Applicability.
192.01 Definitions.
192.02 Standards.

Subpart B—Standards for Cleanup of Land and Buildings Contaminated with Residual Radioactive Materials from Inactive Uranium Processing Sites

- 192.10 Applicability.
192.11 Definitions.
192.12 Standards.

Subpart C—Implementation

- 192.20 Guidance for implementation.
192.21 Criteria for applying supplemental standards.
192.22 Supplemental standards.
192.23 Effective date.

Subpart D—Standards for Management of Uranium Byproduct Materials Pursuant to Section 84 of the Atomic Energy Act of 1954, as Amended

- 192.30 Applicability.
192.31 Definitions and cross-references.
192.32 Standards.
192.33 Corrective action programs.
192.34 Effective date.

TABLE A TO SUBPART D

Subpart E—Standards for Management of Thorium Byproduct Materials Pursuant to Section 84 of the Atomic Energy Act of 1954, as Amended

- 192.40 Applicability.
192.41 Provisions.
192.42 Substitute provisions.
192.43 Effective date.

AUTHORITY: Sec. 275 of the Atomic Energy Act of 1954, 42 U.S.C. 2022, as added by the Uranium Mill Tailings Radiation Control Act of 1978, Pub. L. 95-604, as amended.

SOURCE: 48 FR 602, Jan. 5, 1983, unless otherwise noted.