

PROPOSED TECHNICAL CRITERIA FOR STABILIZATION OF WASTES AND
DECOMMISSIONING AND DECONTAMINATION AT FACILITIES USED TO RECOVER
HAFNIUM, ZIRCONIUM, AND RARE EARTHS FROM SOURCE MATERIAL

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INTRODUCTION

On January 7, 1983, the United States Congress enacted Public Law 95-425, the Nuclear Waste Policy Act of 1982, to protect public health and the environment from the effects of radioactive waste. In Section 151(c), Subtitle D, of the Act, Congress stated its finding concerning the disposition of the special sites and wastes associated with licensed activities to recover zirconium, hafnium, and rare earths: "... the Secretary (of Energy), upon request of the owner of the site involved, shall assume title and custody of such waste and the land on which it is disposed when such site has been decontaminated and stabilized in accordance with the requirements established by the Nuclear Regulatory Commission (NRC)"

The Nuclear Regulatory Commission (NRC) has developed technical criteria for stabilization of wastes and decontamination and decommissioning of these facilities. The radiological characteristics of the typical wastes and the technical criteria are discussed in the following sections.

RADIOLOGICAL CHARACTERISTICS OF WASTES AND POTENTIAL HEALTH HAZARDS

The ores of zirconium, hafnium and rare earths generally also contain source materials such as thorium and uranium. Because of its source material contents, such operations are licensed by the Nuclear Regulatory Commission (NRC) or its Agreement States. Wastes materials generated during the processing of such ores can therefore contain natural uranium and thorium and their respective daughter products. These are the same naturally-occurring radionuclides contained in uranium and thorium mill tailings, although the relative concentrations of certain nuclides in special site wastes may differ substantially from those found in the mill tailings. In general, the thorium plus uranium concentration in the ores range from 0.05 percent to 10 percent depending on the origin of the ores.

At some of these sites, the ores and processing wastes, including most or all of the radionuclides present in the ore, have contaminated the soil and facilities; and small quantities may have been discharged directly onsite to land. The radiation produced by the radioactive component of the contamination is expected to be the primary source of potential hazard associated with these sites.

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Radionuclides in the uranium and thorium decay chains emit alpha, beta, and gamma radiation. The general pathways for radiation dose to person are from direct radiation, inhalation, and ingestion. The most significant pathways are from direct gamma radiation and from the inhalation of radon and its daughter products. The following technical criteria for decontamination and decommissioning (D&D) of sites and stabilization of source materials onsite are mostly emphasizing the reduction of radon emission and direct gamma radiation to acceptable levels. It is also assumed that the daughter products of the uranium and thorium series are generally in secular equilibrium. Any deviation from this assumption will be treated on a case-by-case basis.

PROPOSED CRITERIA FOR DECONTAMINATION AND DECOMMISSIONING (D&D)

Some of the land, structures, and equipment at these sites can be released for unrestricted use after clean-up by the licensee to the following criteria.

1. Structures, equipment to be released for unrestricted use shall be decommissioned and decontaminated so that:
 - a. Direct gamma radiation exposure rates shall not exceed the background level by more than 20 μ R per hour in any occupied or habitable building. Radon emanation to the interior of buildings shall be controlled in a manner that will ensure the annual average radon and its daughter product concentration within the structure is less than 0.03 working level (WL) and where reasonably achievable, below 0.02 WL. These criteria are taken from the U. S. Environmental Protection Agency's (EPA) standards established in 40 CFR 192 for protection against uranium and thorium mill tailings.¹
 - b. Surface residual radioactive contamination levels are as low as reasonably achievable (ALARA). Facilities and equipment below the levels established in NRC's "Guidelines for Decontamination of Facilities and Equipment Prior to Release for Unrestricted Use or Termination of Licenses for Byproduct, Source, or Special Nuclear Materials"² are considered in compliance with this criterion.
2. The concentration of radium-226 and radium-228 in land averaged over areas of 100 square meters, shall not exceed natural background levels by more than:
 - a. 5 pCi/g, average over the first 15-cm surface thickness, or;
 - b. 15 pCi/g, average over any 15-cm thickness that is more than 15 cm below the surface.

These limits are from the EPA's clean-up standards specified in 40 CFR 192. These limits are applicable only if the daughter radionuclides in the soil are in secular equilibrium with the parent nuclides.

PROPOSED CRITERIA FOR ONSITE STABILIZATION OF WASTES

Wastes generated at these sites are allowed to be disposed of onsite by stabilization meeting the following criteria:

1. Controls used to meet the stabilization criteria will be designed to be effective for up to one thousand years, to the extent reasonably achievable and in any case, for at least two hundred years.
2. Controls shall be designed to provide reasonable assurance that releases of radon-222 and radon-220 to the atmosphere from residual radioactive material will not:
 - a. Exceed an average release rate of $20 \text{ pCi/m}^2\text{-sec}$ or;
 - b. Increase the annual average concentration of radon-222 and radon-220 in air at or above any location outside the disposal site by more than 0.5 pCi/liter .

The above stabilization criteria are from the EPA's standards as specified in 40 CFR 192.

3. The site must be graded and drained to divert all surface water away from the waste area and located so that the integrity of the waste confinement is not jeopardized by the 100-year flood.
4. Waste shall be stabilized in a manner that provides maximum assurance that slumping or differential subsidence does not jeopardize containment integrity.
5. A multiple-layer cover shall be constructed over all disposed waste.
6. A soil stabilization program shall be implemented to minimize erosion of the cover or other engineered barriers formed of earthen materials and constructed on the surface.
7. An integrated drainage system shall be installed to remove surface runoff and infiltrated drainage water from the waste cover.
8. The cover shall be designed and installed to retard water from percolating into the waste.
9. The waste cover shall include a barrier that is designed to deter living organisms from breaching its integrity.
10. The disposal site should be located so that wastes are not subject to intrusion by ground water.
11. The disposal site should be located so that the integrity of the waste confinement is not jeopardized by geologic hazards.

CONCLUSION

The NRC staff believes that if these special sites are cleaned up and stabilized to the above technical criteria, they can be transferred to and under the custody of the Department of Energy for long-term control and maintenance and should not create an adverse impact to the environment.

REFERENCES:

1. U. S. Environmental Protection Agency. "Final Environmental Impact Statement for Standards for the Control of Byproduct Materials from Uranium Ore Processing." 40 CFR 192, EPA 520/1-83-008-1, September 1983.
2. U. S. Nuclear Regulatory Commission. Guidelines for Decontamination of Facilities and Equipment Prior to Release for Unrestricted Use or Termination of Licenses for Byproduct, Source, or Special Nuclear Material, August 1987.