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**GUIDELINES FOR CLEANUP AND DISPOSAL  
OF SITES CONTAMINATED WITH TENORM**

The Michigan Department of Environment, Great Lakes, and Energy (EGLE), under the authority of Part 135, Radiation Control, of the Michigan Public Health Code, 1978 PA 368, as amended, and its *Ionizing Radiation Rules for Radioactive Material (IRR)*, has developed the following guidelines to address the remediation of sites contaminated with Technologically Enhanced Naturally Occurring Radioactive Material (TENORM), which includes radium-226, radium-228, lead-210, and their associated decay series.

**CLEANUP OF TENORM CONTAMINATED MATERIAL**

1. For release of facilities, equipment, or land for unrestricted use, the limits listed below will be used by EGLE to determine acceptable levels of residual contamination during remediation of sites contaminated with TENORM. Alternatively, EGLE will consider specific proposals based on the methodology contained in the *Multi-Agency Radiation Survey and Site Investigation Manual* (NUREG-1575 Rev. 1, EPA 402-R-97-016 Rev. 1, August 2000) and, in these cases, will approve a proposal for release for unrestricted use if the maximum individual total effective dose equivalent does not exceed 25 millirems per year under conditions of a reasonable worst-case scenario. Each specific site release proposal must include an "As Low as Reasonably Achievable" (ALARA) analysis.

**Unrestricted Use Cleanup Limits**

Surface Contamination Limits [disintegrations per minute (dpm) per 100 centimeters (cm)<sup>2</sup>] <sup>a, b</sup>

Measurement	Average <sup>c</sup>	Maximum <sup>d</sup>	Removable <sup>e</sup>
Alpha radiation	1,000	3,000	200
Beta-gamma radiation	1,000	3,000	200

Ambient Exposure Rate Limit <sup>f</sup>

10 microroentgens per hour (µR/hr) above the local background

Dust, Debris, or Recyclable Materials Limit <sup>g</sup>

5 picocuries per gram (pCi/g) of each of radium-226, radium-228, and lead-210 in any volumetrically defined material

Surficial Soils Limit <sup>h</sup>

5 pCi/g of each of radium-226, radium-228, and lead-210

<sup>a</sup> Surface contamination by both alpha and beta-gamma emitting nuclides is assumed. The limits established for alpha and beta-gamma emitting nuclides apply independently.

<sup>b</sup> As used in this table, dpm means the rate of emission by radioactive material as determined by correcting the counts per minute observed by an appropriate detector for background, efficiency, and geometric factors associated with the instrumentation.

<sup>c</sup> Measurements of the average contamination level should not be averaged over more than 1 square meter (m<sup>2</sup>). For objects of less than 1 m<sup>2</sup> surface area, the average should be derived for each object.

- <sup>d</sup> The maximum contamination level applies to an area of not more than 100 cm<sup>2</sup>.
  - <sup>e</sup> The amount of removable radioactive material per 100 cm<sup>2</sup> of surface area should be determined by wiping that area with dry filter or soft absorbent paper, applying moderate pressure, and assessing the amount of radioactive material on the wipe with an appropriate instrument of known efficiency. When removable contamination on objects of less than 100 cm<sup>2</sup> surface area is determined, the pertinent levels should be reduced proportionally, and the entire surface should be wiped.
  - <sup>f</sup> As measured with a properly calibrated exposure rate meter at a height of 1 meter (m) above any surface averaged over 100 m<sup>2</sup> in outside areas, and over 10 m<sup>2</sup> in structure interiors.
  - <sup>g</sup> Averaged over any individual item or containerized material.
  - <sup>h</sup> Averaged over any single 15 cm thick soil layer and averaged over any 100 m<sup>2</sup> of land surface.
2. For facilities, equipment, or land for which release under certain restrictions may be appropriate, EGLE will consider specific site proposals for other release limits based on the methodology contained in the *Multi-Agency Radiation Survey and Site Investigation Manual*. In no case will a restricted use release be approved if the maximum individual total effective dose equivalent can exceed 100 millirems per year under conditions of a reasonable worst-case scenario. Each specific site remediation proposal involving restricted use must include an ALARA analysis.

## **DISPOSAL OF TENORM CONTAMINATED MATERIAL**

1. TENORM contaminated materials in the form of bulk waste, such as soil or debris, containing a radium-226 concentration not exceeding 50 pCi/g, a radium-228 concentration not exceeding 50 pCi/g, or a lead-210 concentration not exceeding 260 pCi/g, averaged over any single shipment, may be disposed in a hazardous waste landfill or a Type II solid waste landfill, as defined in Part 111, Hazardous Waste Management, and Part 115, Solid Waste Management, respectively, of Michigan's Natural Resources and Environmental Protection Act, 1994 PA 451, as amended (Act 451). Prior to shipment, the generator must provide the following information to EGLE, MMD, Radiological Protection Section, and the owner of the landfill:
  - a. The concentrations of radium-226, radium-228, lead-210, and any other radionuclide identified using gamma spectroscopy, or an equivalent analytical method, in the TENORM based on techniques for representative sampling and waste characterization approved by EGLE.
  - b. An estimate of the total mass of the TENORM.
  - c. An estimate of the total radium-226 activity, the total radium-228 activity, and the total lead-210 activity of the TENORM.
  - d. The proposed date of delivery.

Proposed shipments are subject to independent confirmation testing by EGLE.

2. In addition, any naturally occurring radioactive material wastes that contain radium-226 at any concentration and are generated during mineral or oil and gas well plugging and abandonment operations may be disposed downhole, subject to any additional applicable requirements of EGLE, as specified or authorized under Part 615, Supervisor of Wells, and Part 625, Mineral Wells, of Act 451.

3. For disposal of TENORM contaminated waste that does not meet disposal options 1 or 2 above, the contaminated wastes should be transferred to a licensed radioactive waste disposal facility.

Applicable portions of the *IRR* containing related requirements and authorizing these guidelines are included in R 325.5123(3)(e); R 325.5237(1), (2), and (3); R 325.5253; and R 325.5272.

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