

Considerations of the Occurrence of Source and 11.e (2) Byproduct Materials that Should Be Below Regulatory Concern

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Outline

- Key Issues and Concerns
- Recent History and Events
- Source Material, 10 CFR 40 – exemptions and unimportant quantities
- 11.e (2) Byproduct material - 10 CFR 40 Appendix A, Criteria 6(6)
- Criteria for material clearance, unrestricted use and release
- General Considerations – environmental samples, human excreta, US DOT
- Conclusions



Premise / Claim

Unlike source material, NRC regulations do not provide general license for possession of small quantities of 11.e (2) byproduct material, thus possession of any quantity requires specific license per 10 CFR 40.3



Key Issues and Concerns

- Environmental samples (soil, water, air filters) may be licensed material
- Human excreta (urine samples) may be licensed material
- DOT regulations may apply to transportation of these samples



Recent History and Events

- NMA U Workshop, 4 June 2019 Denver – NRC staff presentation - *Status of NRC Inspection Program and Some Lessons Learned*
- *Follow up discussion with NRC U Recovery and Region IV staff, 14 June 2020 (# ML19198A009)*
- Industry Letter to NRC of 13 September 2019 (# ML19288A212) - *Issues Regarding Classification of Environmental Samples as 11e.(2) Byproduct Material and Request for Consideration for Inclusion of Additional Regulatory Language in Potential Upcoming Rulemaking*
- NRC hosted Conference call – April 23 2020 - *Industry perspectives on classification of environmental samples as 11e.(2) byproduct material (# ML20126G504)*



Source Material, 10 CFR 40 – Exemptions and Unimportant Quantities

- 10 CFR 40.13 - Unimportant Quantities : < 0.05 % (500 ppm) by weight in any chemical or physical form ; unrefined /unprocessed ore, many products containing “source material”
- 10 CFR 40.14 – Specific Exemptions: Commission may, upon application of any interested person or upon its own initiative, grant such exemptions from the requirements of the regulation in this part.....
- 10 CFR 40.22 - Small Quantities: General license granted for possession and use if < 7 kg (15.3 lbs.) ; < 1.5 kg (3.3 lbs.) dispersible



11.e(2) Byproduct Material – Example Circumstances That Are Considered Below Regulatory Concern

- Termination of Licenses for and Unrestricted Release of U recovery facilities - 10 CFR 40, Appendix A, Crit. 6(6)
- Clearance and unrestricted use and release of equipment and materials from licensed facilities, e.g. RG 8.30¹ and FC 83-23²

¹Regulatory Guide 8.30. Health Physics Surveys at Uranium Recovery Facilities 2002

²Guidelines for Decontamination of Facilities and Equipment Prior to Release for Unrestricted Use or Termination of Licenses for Byproduct, Source, or Special Nuclear Material. FC 83-23.1993.



License Termination and Unrestricted Release of U Recovery Facilities: 10 CFR 40 App. A, Crit. 6 (6) – Concentrations in Soil That Are “Below Regulatory Concern”

- Ra 226: ≤ 5 picocuries per gram (pCi/g) averaged over the first 15 centimeters (cm) below the surface, and 15 pCi/g averaged over 15-cm thick layers more than 15 cm below the surface
- Byproduct material containing concentrations of radionuclides other than radium in soil, and surface activity on remaining structures: \leq total effective dose equivalent (TEDE) from cleanup of radium contaminated soil to the above standard (“Radium Benchmark Dose”)*

* NUREG 1520 (SRP U Mill Tailings Reclamation Plan), Appendix H and NUREG 1569 (SRP ISR License App.), Appendix E - *Guidance to the U.S. Nuclear Regulatory Commission Staff On The Radium Benchmark Dose Approach*



Radium Benchmark Dose

- Calculate dose to public from the 5 /15 pCi / gram of soil Ra 226 criteria (“max exposed individual(s)” – usually a future farmer / rancher, typically using ANL RESRAD family codes
- This is the Radium Benchmark Dose (RBD)
- Determine concentrations (pCi/g) in soil at the 15 and > 15 cm horizons for Uranium (and other nuclides of importance at site if necessary, often = Thorium) that would also result in the RBD
- So theoretically, in addition to the Ra 5/15 criteria, a “below regulatory concern” concentration could be determined for any nuclide in the U decay chain, i.e., for other 11.e (2) byproduct materials



Radium Benchmark Dose – Examples (Surface Soil)

- Mt Lucas ISR, TX (license terminated, site released for unrestricted use)
RBD = 32.1 mrem / yr. U = 498 pCi/g
- Ross ISR, WY: RBD = 33.4 mrem / yr. U = 497 pCi / gram
- Sweetwater Conventional Mill, WY: RBD = 42.5 mrem / yr. U = 324 pCi / gram. Th 230 = 14 pCi / gram

Therefore, the 5/15 pCi / gram Ra 226 and these site specific criteria represent levels “Below Regulatory Concern”



Clearance and Unrestricted Use and Release of Equipment and Materials From Licensed Facilities

- Relates to surficial (surface) and/or volumetric concentrations of licensed material in / on equipment, tools, clothing, recyclables, etc. below which can be released to the public domain without further controls
- Typically expressed as disintegrations per minute (dpm) per cm^2 (surface contamination) or per cm^3 or gram for volumetric (1 pCi – about 2 dpm)
- Surficial criteria have existed virtually unchanged since the early 1970s
- These concentrations are “Below Regulatory Concern” since no controls necessary



Historical Surface Contamination Criteria for Unrestricted Use and Release from Licensing Controls *

Table 1. Acceptable Contamination Criteria and Associated Dose Bases in NMSS Policy and Guidance Directive FC 83-23

Contamination	Criterion	Stated Dose Basis+	Estimated Dose Basis (EDE)+
Average, fixed U-nat, ²³⁵ U, ²³⁸ U, and decay products	5000 dpm/100 cm ²	None	~13mrem/yr
Average, fixed ²²⁶ Ra, ²²⁸ Ra, transuranics, etc.	100 dpm/100 cm ²	None	~0.2mrem/yr#
Average, fixed Th-nat, ²³² Th, ⁹⁰ Sr, etc.	1000 dpm/100 cm ²	None	~28 mrem/yr#
Avg. and max. external beta-gamma dose	0.2-1 mrad/hr at 1 cm	None	~20 mrem/yr

- Dose equivalents developed by NRC staff as reported in NMSS Handbook for Decommissioning Fuel Cycle and Materials Licenses, NUREG/BR-0241, App C. 1997.
- Note that for all nuclide categories doses associated with respective criteria are < annual public exposure limit for licensed facilities of 100 mrem per 10 CFR 20.1301 and approximately equivalent to or less than the 25 mrem annual public exposure criteria per Subpart E (License Termination), 10 CFR 20.1402, *Radiological Criteria for Unrestricted Use*



Historical Perspective on these Criteria

Have appeared in similar tables (with essentially identical nuclide categories and limits) for almost 50 years, e.g.:

- US NRC Regulatory Guide 1.86, *Termination of Operating Licenses for Nuclear Reactors*, 1974
- *Annex A: Guidelines for Decontamination of Facilities and Equipment Prior to Release for Unrestricted Use or Termination of Licenses for Byproduct, Source, or Special Nuclear Material*, 1976
- Subsequent versions of this document ("The Guidelines") under the identifier FC 83-23 (1983, 1989, 1993)
- US NRC Regulatory Guide 8.30, *Health Physics Surveys at Uranium Recovery Facilities* (1983 and 2002)



Specific for Uranium Recovery Facilities: RG 8.30

- Numerical criteria limits presented in its Table 2 (next slide) are intended as unrestricted release and use criteria since these criteria are applicable to “equipment to be released for unrestricted use” and/or “surveys of equipment and packages leaving the UR facility.”
- Minutes of 2009 US NRC/National Mining Association Uranium Recovery Workshop (November 17-18, 2009)* **“The staff has determined that Regulatory Guide 8.30 will be the standard until it is revised.”** [Emphasis in original.].
- Represents and defines, as stated therein “...health physics surveys that are acceptable to the NRC staff for protecting workers at uranium recovery (UR) facilities... and for surveys of equipment and packages leaving the UR facility.”

* Stephen Cohen, Uranium Recovery Branch Team Leader, to Bill Von Till, Chief Uranium Recovery Licensing Branch, December 22, 2009.



RG 8.30 - continued

TABLE 2

Surface Contamination Levels for Uranium and Daughters on Equipment To Be Released for Unrestricted Use, on Clothing, and on Nonoperating Areas of UR Facilities*

Average**	5,000 dpm alpha per 100 cm ²	Average over no more than 1m ²
Maximum**	15,000 dpm alpha per 100 cm ²	Applies to an area of not more than 100 cm ²
Removable	1,000 dpm alpha per 100 cm ²	Determined by smearing with dry filter or soft absorbent paper, applying moderate pressure, and assessing the amount of radioactive material on the smear

* These values are taken from Regulatory Guide 1.86, "Termination of Operating Licenses for Nuclear Reactors" (Ref. 23), and from "Guidelines for Decontamination of Facilities and Equipment Prior to Release for Unrestricted Use or Termination of Licenses for Byproduct Source or Special Nuclear Material," Division of Fuel Cycle and Material Safety, USNRC, Washington, DC 20555, August 1987 (Ref. 24). Available in NRC Public Document Room for inspection and copying for a fee.

** The value includes both fixed and removable contamination.



RG 8.30 - continued

- Note that its Table 2 values identical to Row 1 of FC 83-23
- Dose equivalency per NUREG-0241 = 13 mrem / yr., therefore should be “Below Regulatory Concern”
- Title of Table 2 of RG 8.30 is clear on the intended application of the criteria listed: “Surface Contamination Levels for Uranium and Daughters on Equipment to Be Released for Unrestricted Use, on Clothing, and on Nonoperating Areas of UR Facilities.”
- Understood that in recent U recovery licensing actions, NRC staff have invoked both FC 83-23 for “release for unrestricted use” as well as RG 8.30 for “removal to unrestricted areas.”
- How can it be one but not the other ?
- **This is a subject for another day**



General Considerations # 1 : Environmental Samples (soil, water, air filters)

- Example has been used of NRC's 5 Oct 1993 letter on U mill tailings as the initiator of these concerns.
- Tailings that could be dispersed to unrestricted areas may pose a public safety risk if not controlled. Makes perfect sense.
- However, U tailings as discrete licensed entity "relocated" (windblown?) to unrestricted areas should be easily distinguishable radiologically from the otherwise naturally occurring "primordial" radionuclides * that were there before humans were.

* Existed since formation of earth –U / Th series and K40



General Considerations # 1 : Environmental Samples - Continued

- Uranium series nuclides are not “color coded” – cant easily distinguish these few “11 e (2) byproduct material atoms” from their naturally occurring equivalents
- Ubiquitous occurrence of U series nuclides collectively can be 10 + pCi / gram almost anywhere in temperate zones and higher in mineralized areas.
- EPA under 40 CFR 261.4(d) promulgated a specific exclusion for samples: “ ...a sample of solid waste or a sample of water, soil, or air, which is collected for the sole purpose of testing to determine its characteristics or composition, is not subject to any requirements of this part..” (Part 261 = ID and Listing of Haz. Waste)



General Considerations # 2: Human Excreta (Urine Samples)

- At the RG 8.22 (Bioassay at Uranium Mills, 2014) action level of 35 ug / liter = 0.035 ppm ! (vs. 500 ppm for licensed source material)
- In over 50 years of experience as a licensee under 10 CFR Parts 20, 40, 30-35, 50 and 70 unaware of any worker bioassay samples controlled / handled as “licensed material”
- Colleagues who are RSOs at large university hospital campuses confirmed that no restrictions are placed on the excreta from patients who have been administered licensed “byproduct material” for diagnosis or treatment
- If the excreta from the human is licensed material, doesn't that make the human from whom it came a licensed material? What are the implications of this?



General Considerations # 3 – Applicability of US DOT Regulations for Shipment of Samples

Difficult to imagine these types of samples would ever contain radioactivity above the DOT exemption limits:

- In general, exempt as Class VII RAM if $< 0.002 \text{ uCi / gram}$ (49 CFR 173.403) = 2000 pCi / gram
- Specifically, (49 CFR 173.436) exempt if:
 - For Ra-226 $< 270 \text{ pCi / gram}$ or Total of $2.7 \text{ E}5 \text{ pCi}$
 - For Unat $< 27 \text{ pCi / gram}$ or Total of $2.7 \text{ E}4 \text{ pCi}$



Conclusions

- There are circumstances within existing NRC regulations under which specific concentrations or quantities of 11 e (2) byproduct material can be “exempt” from licensing controls and are therefore “Below Regulatory Concern”
- These include numerical criteria for license termination and unrestricted use and release
- These “benchmarks” can be useful to assess whether license controls are necessary for the very low levels of uranium series radionuclides that may be present in environmental samples



Conclusions - continued

- Must recognize that the U series nuclides are not “color coded” – cant easily distinguish these few 11 e (2) byproduct material atoms from their naturally occurring equivalents, which may exist at much higher concentrations in the environment
- EPA under 40 CFR 261.4(d) promulgated a specific exclusion for samples
- Consideration of human excreta samples as licensed material is contrary to nuclear medicine, fuel cycle and related material facility protocols implemented under the US AEA for over 50 years.
- It is highly unlikely that “environmental samples” would contain concentrations or quantities of radioactivity that would exceed DOT exempt levels for Class VII RAM.



Thank You For Your Attention Questions ?

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