



U.S. Department
of Transportation
**Research and
Special Programs
Administration**

400 Seventh St., S.W.
Washington, D.C. 20590

MAY 10 2002

Mr. Stanley H. Hodges
RWE Solutions
3800 Fernandina Road
Suite 200
Columbia, SC 29210-3854

Ref. No.: 02-0047

Dear Mr. Hodges:

This is in response to your letter dated January 25, 2002, requesting clarification of the provisions in § 173.435 regarding the proper methodology and A_2 values that should be utilized for transport calculations for uranium radioisotopes under the Hazardous Materials Regulations (HMR; 49 CFR Parts 171-180).

Q1: When calculating transport parameters for waste materials that contain uranium isotopes, when should we utilize the individual radionuclide A_2 values vs. the A_2 values delineated for the uranium on an enrichment basis [e.g. natural uranium, enriched uranium $\leq 5\%$) or depleted uranium]?

A1: In § 173.403, Natural uranium (U(nat)) is defined as "uranium with the naturally occurring distribution of uranium isotopes." Depleted uranium (U(depleted)) is "uranium containing less uranium-235 (U-235) than the naturally occurring distribution of uranium isotopes." Similarly, enriched uranium (U(enriched)) contains more U-235 than the naturally occurring distribution of uranium isotopes. Not said, but implied, is that U(depleted) or U(enriched) are uranium with the natural occurring distribution of uranium isotopes that has then been processed to reduce or increase the amount of U-235. This process will also gradually change the fractions of other uranium isotopes present, as higher enrichments are reached.

Because of the above definitions, whenever radioisotopes of other elements are present in the material to be transported, the A_2 value to be used to determine the appropriate packaging requirements is the effective A_2 value for the mixture, using the formula in § 173.433(d)(2) and using as input for that formula the fractional activities and the A_2 values of the individual nuclides present.

In general, that includes the A_2 values of the various uranium isotopes which may be present. An exception may be made if it is clear from process knowledge that none of the uranium in the waste material came from uranium enriched to greater than 5% by mass of U-235, and that none of the uranium present had previously been irradiated (reprocessed). In that case, when applying the mixture formula, an unlimited A_2 value may be assumed for all isotopes of uranium present.



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- Q2: Since my waste does not contain U-230, U-232 and U-233, would these isotopes also be treated in a similar manner, if they were present?
- A2: No. Since these isotopes are not normally present in measurable quantities in natural uranium or uranium enriched to less than 5% by mass of U-235, if they are detected, the fractional activity of each, divided by each respective A_2 value, should be used in the mixture formula.
- Q3: If analytical data are not available for the individual uranium radionuclides, can we use the values based on enrichment or do we need to obtain additional analytical data to determine the uranium isotopic distribution in the package waste?
- A3: If it is known that all uranium in the waste had the same enrichment, standard activity ratios for each of the uranium isotopes present for that enrichment may be assumed. If uranium of more than one level of enrichment is present in the waste, it is preferable to determine these ratios experimentally.

I hope this information is helpful.

Sincerely,



Hattie L. Mitchell, Chief
Regulatory Review and Reinvention
Office of Hazardous Materials Standards

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§ 173.435
RAM
02-0047



January 25, 2002

Mr. Edward T. Mazzullo
Director, Office of Hazardous Materials Standards
U.S. DOT/RSPA (DHM-10)
400 7th Street S.W.
Washington, D.C. 20590-0001

Subject: 49 CFR 173.435 Clarification Request – Proper Selection of Uranium Isotope A₂ Values for Transport Calculations

Dear Mr. Mazzullo:

This letter is being written to you to request written clarification on the proper methodology and A₂ values that should be utilized for DOT transport calculations for Uranium radioisotopes.

The table following the text of this letter is an excerpt from the Code of Federal Regulations Title 49 Section 173.435 entitled "Table of A₁ and A₂ Values for Radionuclides". The element Uranium has individual A₁ and A₂ limits delineated for the individual uranium radionuclides in addition to limits based on its enrichment.

When calculating transport parameters for waste materials that contain uranium isotopes, when should we utilize the individual radionuclide A₂ values vs. the A₂ values delineated for the uranium on an enrichment basis [e.g. U (natural), U (enriched ≤ 5%), U (enriched > 5%) or U (depleted)]?

For example, recent calculations using the individual radionuclide A₂ values vs. the values for uranium on an enrichment basis produced different results when determining whether or not a package would exceed the limited quantity package limit as delineated in 49 CFR 173.425.

I had assumed that you would utilize the individual isotopic values up to a uranium enrichment of 5%. For uranium enrichment percentages greater than 5%, I had utilized the individual uranium values for U-234 and U-236 and an A₂ value of 2.70E-02 Ci for U-235 and U-238. When it was first discovered that the calculations would produce different results, I talked to Mr. Rick Boyle with the Department and he told me my methodology was correct. Since my waste did not contain U-230, U-232 and U-233, would these isotopes also be treated in a similar manner? You may want to consider revising 49CFR173.433 to clarify when you should utilize the individual isotopic limits vs. the enrichment basis limits for the A₂ values in 49CFR173.435.

If analytical data is not available for the individual uranium radionuclides, can the values based on enrichment be used or do we need to obtain additional analytical data to determine the uranium isotopic distribution in the package waste?

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Mission Statement:

RWE NUKEM provides safe, compliant and cost-effective solutions to industrial waste management problems through the innovative application of proven technologies.

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 Letter to Mr. Edward T. Mazzullo
 Subject: 49 CFR 173.435 Clarification Request



I would like to thank you in advance for your attention to this clarification request. Should you have any questions, please do not hesitate to contact me at 803-214-5848.

Sincerely,

Stanley M. Hodges, Jr.
 Sr. Project Manager

49 CFR 173.435 - "Table of A₁ and A₂ Values for Radionuclides" (Values for Uranium Radionuclides)

Symbol of Radionuclide	Element and atomic number	A ₁ (TBq)	A ₁ (Ci)	A ₂ (TBq)	A ₂ (Ci)	Specific Activity	
						(TBq/g)	(Ci/g)
U-230	Uranium(92)	40	1080	1x10 ⁻⁴	0.270	1.0x10 ³	2.7x10 ⁴
U-232		3	81.1	3x10 ⁻⁴	8.11x10 ⁻³	8.3x10 ³	2.2x10 ⁴
U-233		10	270	1x10 ⁻³	2.70x10 ⁻²	3.6x10 ³	9.7x10 ³
U-234		10	270	1x10 ⁻³	2.70x10 ⁻²	2.3x10 ³	6.2x10 ³
U-235		Unlimited	Unlimited	Unlimited	Unlimited	8.0x10 ³	2.2x10 ⁴
U-236		10	270	1x10 ⁻³	2.70x10 ⁻²	2.4x10 ³	6.5x10 ³
U-238		Unlimited	Unlimited	Unlimited	Unlimited	1.2x10 ³	3.4x10 ³
U (natural)		Unlimited	Unlimited	Unlimited	Unlimited	2.6x10 ³	7.1x10 ³
U (enriched - 5% or less)		Unlimited	Unlimited	Unlimited	Unlimited	(see §173.434)	
U (enriched - more than 5%)		10	270	1x10 ⁻³	2.70x10 ⁻²	(see §173.434)	
U (depleted)		Unlimited	Unlimited	Unlimited	Unlimited	(see §173.434)	