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Dockets Management System
US Department of Transportation, PL 401
400 Seventh Street, SW
Washington, D.C. 20590-0001

Date: 05 April 2000

Re: Docket Number RSPA-99-6283-7
HM-230

Gentlemen:

This letter is in response to DOT's proposed rulemaking to amend its Hazardous Materials Regulations pertaining to the transportation of radioactive materials to conform to the recommended provisions published in the International Atomic Energy Agency document referred to as "ST-1".

Frontier Technology Corporation very strongly opposes the proposal to reduce the A_1 quantity for californium-252 from its present value of 0.1 TBq (2.7 Ci, or 5040 micrograms) to one-half that quantity, i.e., to 0.05 TBq (1.35 Ci, or 2520 micrograms).

Frontier is the world's major commercial fabricator and distributor of sealed Cf-252 neutron sources. We have shipped or received more than eight hundred fifteen Type A shipments of special form Cf-252 material since 1985. Seventeen such shipments contained Cf-252 contents between the proposed new Type A limit of 0.05 TBq and the pre-HM-169 (pre-1995) limit of 0.74 TBq, and an additional four shipments since 1997 contained quantities just below the present 0.1 TBq limit. Approximately three hundred of the shipments, including three having contents above the proposed new, 0.05 TBq limit, were international air shipments. No significant transport incidents occurred during any of these shipments: i.e., zero radioactive materials releases, zero package surface or one-meter dose rates above normal limits. In addition, Frontier has shipped or received more than four hundred eighty-five empty Type A packages of the designs used for californium source shipments. While most of these were truck shipments, some international shipments were by air and by vessel. There were no transport incidents during these shipments, and none of the packages would have released radioactive material or emitted above-limit levels of radiation had they contained californium sources during the shipments. We strongly believe that our incident-free experience with more than one thousand five hundred shipments of Type A packages is clear evidence that properly designed, constructed and maintained Type A packages are quite capable of withstanding the normal conditions of transport without endangering any person or the environment.

Our transport experience demonstrates that the probability of significant damage to a Type A package containing Cf-252 special form sources during transport is very small; less than one chance in fifteen hundred, or 0.067 percent. Since no amount of experience can preclude

the possibility of an accident or other incident, let us consider the result of an occurrence which would breach the package, and release the sealed Special Form source or sources. For reference, Tables 1 and 2 (appended to this letter) summarize the proposed (ST-l), present (HM-161), and previous (pre-1995) Type A package limits and radiation field intensities in air at three meters corresponding to those limits, respectively, for Cf-252 and for several other radioactive materials used in sealed radiation sources. A major historical criteria for setting A_1 quantities was to set the A_1 1 imit at that quant ity of material which would produce a radiation level of one Rem per hour (10 mSv/hr) at a distance of three meters from the unshielded material in air. Referring to Table 2, it is seen that the pre-1995 Al limits closely matched this criteria, with the unshielded 3-meter radiation levels for Cf-252, Co-60, Cs-137 and Ir-192 being 0.98, 1.03, 1.19 and 1.13 Rem/hr, respectively. HM-161 increased the A_1 limits in 1995 such that the unshielded dose rates at three meters from A_1 quantities became 1.32, 1.58, 2.14 and 1.53 Rem/hr, respectively. The A_1 limits for these four materials proposed in ST-l would reduce the 3-meter unshielded dose rate from an Al quantity of Cf-252 to 0.66 Rem/hr, while retaining the HM-161 values of A_1 for the other three materials.

The proposed reduction in the A_1 limit for Cf-252 is clearly not justifiable based on potential radiation exposure rates.

Now we consider an even more severe incident which not only releases the sources from the package, but also breaches the Special Form encapsulation and releases the radioactive contents. Californium-252 is available in several chemical/physical forms, one of which is Cf-Pd cermet or alloy material as currently made by Oak Ridge National Laboratory. This material is a uniform dispersion of californium sesquioxide, Cf_2O_3, throughout a larger volume of a noble metal, palladium. It is made by processes documented in the literature (Refs. l-a, l-b, l-c), for the express purpose of providing a primary confinement for the radioactive material. Neither the Cf_2O_3 nor the palladium are soluble in water or burnable in air. The Cf-Pd materials are ductile, essentially inert solid wires or pellets. The love 1 of removable radioactive material on the surfaces is approximately one-millionth (10^{-6}) of the radioactive content (ref. 2). Should a capsule containing a quantity of Cf-Pd material equal to the present AI maximum of 0.1 TBq (2.7 Ci) be breached and release its contents, those contents would not dissolve in water, burn or otherwise disperse in air, and the mechanically removable quantity of Cf-252 would be only about 0.1 TBq x 10^{-6} o r 0.1 MBq (2.7 microCurie). This is to be compared with Cs-137, commonly used in the form of the salt, cesium chloride (CsCl). CsCl is a powder or granular material which is easily dispersible in dry form, and which is very soluble in water and most other common liquids. Should a capsule containing either the present or proposed A_1 quantity of Cs-137 as CsCl release its contents, the result would be 2 TBq (54 Ci) of dispersible, soluble radioactive material which would be very likely to result in significant contamination of people and the environment.

Although Frontier uses only the Cf-Pd forms in its sources, Cf-252 is available in several other forms usable for large sources (greater than a few hundred micrograms): californium sesquioxide and californium oxysulfate, $(CfO)_2SO_4$. The oxide is insoluble in water and non-burnable in air, but may be mechanically dispersible. This form is somewhat more likely to result in contamination than are the Cf-Pd forms, but much

less likely to do so than is CsCl. The oxysulfate form is made by blending oxysulfate particles into a larger volume of aluminum powder, then pressing the powder into a solid. The resulting pellet is essentially non-soluble in water, non-burnable in air, and non-dispersible. This form is used at Oak Ridge National Laboratory to make some californium sources for government and research uses. As with other californium forms, it has much less potential for personnel and/or environmental contamination than does ^{137}CsCl.

Reduction of the A_1 limit for Cf-252 is not required or justified from the viewpoint of potential contamination, particularly for Cf-252 in the Cf-Pd forms.

Please note that ST-l proposes to increase the A_2 limit for Cf-252 to 3 x 10^{-3} TBq (81.1 milliCuries) which is three times greater than the present A_1 limit of 1 x 10^{-3} TBq, or 9.1 times greater than the pre-HM-169 A_1 limit of 3.3 x 10^{-4} TBq (9 milliCuries). Specifically, ST-l proposes to permit Type A shipments of 3 x 10^{-3} TBq of Cf-252 in normal form, an unspecified, and thereby conceivably despersible and/or soluble, form. Thus, the potential of a r&ease of 3 x 10^{-3} TBq of Cf-252 in a dispersble/soluble form is considered an acceptable risk. This quantity is approximately (3 x 10^{-3} TBq) / (0.1 x 10^{-6} TBq) or 30,000 times the quantity of removable (i.e., dispersable or soluble) Cf-252 from ^{252}Cf-Pd pellets or wire segments containing the present Type A limit quantity of 0.1 TBq.

Reducing the A_1 limit for Cf-252 **will** have adverse effects.

Frontier uses only Type A packages for Cf-252 shipments because the costs of designing, qualifying and using Type B packages are high and not necessary. We purchase bulk Cf-252 from Oak Ridge in Type A limit quantities as a means of minimizing certain quantity-insensitive service charges and shipping costs. Halving the Type A limit will double the number of shipments, thereby increasing the risk of transport damage and increasing the potential exposure of transport workers to radiation.

Service and transportation fees on a recent shipment of 4623 micrograms of Cf-252 totaled $29965, and the cost of the californium material itself was $277,380. Total unit cost was $66.48 per microgram. Reducing the Type A limit to the proposed 0.05 TBq, or 2520 micrograms, would effectively increase our costs to about ($277,380/2) t $29965 = $168,655 for a near-limit quantity of 2312 micrograms, or $72 95 per microgram, an increase of 9.7%. This will result in price increases for the neutron sources we fabricate. The half-life of Cf-252 is only 2.7 years, so industrial equipment requires on the order of ten source replacements over a life of twenty years. Increases in source prices could result in decisions to discontinue use of existing equipment or to forego the purchase of new equipment. As much of the equipment in which californium sources are used relates to environmental improvement or personnel safety (coal analysis, cement production control hazardous waste analysis, explosive detection, toxic materials analysis or detection, contraband detection, etc.) decreasing the Type A Limit for Cf-252 could ultimately result in significant adverse environmental or health effects.

Frontier has a substantial investment in Type A packages for Cf-252 shipment quantities above the proposed 0.05 TBq limit. Some are designed for specific customers to match source array requirements. A general-purpose unit for five milligrams of Cf-252 (0.1 TBq) is approximately fifty inches diameter by 64 inches long and weighs 7400 pounds. A specialty container for californium sources in rod arrays is

approximately 49 inches diameter by 192 inches long and weighs about 6900 pounds. Reduction of the Type A limit to 0.05 TBq will render such packages unusable. Not only will we lose our design, analysis, and fabrication costs, but we will need to decommission and dispose of the units. Since Cf-252 sources are neutron emitters, parts of the packages may contain activation products. This implies surveys, controlled dismantlement, and/or disposal of activated components as radioactive waste. Frontier's total costs resulting from the loss of these packages due to DOT decreasing the Type A limit are not known, but would be expected to be on the order of $500,000, excluding the costs of designing and constructing new specialty containers.

Frontier expects loss of future source sales should the Type A limit be decreased to 0.05 TBq for Cf-252. Applications exist which require Cf-252 sources or source sets in the 0.05 to 0.1 TBq range; Frontier has delivered sources for such requirements in Type A packages. Californium for those applications which do not require a single point source of neutrons may be divided into two or more sources and shipped in several packages, but only at increased expense, exposure and risk to workers, the public and the environment. Sources for applications requiring greater than 0.05 TBq in a single source could be shipped only in a Type B or C package, which is impractical due to the very high costs associated with certification, construction, licensing fees and use of such packages. Frontier will be effectively forced out of the large Cf-252 source market, and users of such sources may be unable to find a replacement supplier. Frontier has already been unable to complete a bid on a 3700 micrograms (0.074 TBq) contract for delivery overseas due to uncertainty in our ability to ship the product.

We request that the present A_1 value of 0.1 TBq for Cf-252 be retained. If that request is rejected, we request that the present A_1 value be retained for specified chemical and physical forms of material containing Cf-252, including the Cf-Pd cermet and alloy forms

Respectfully,

Edward F. Janzow

Edward F. Janzow, Ph. D.
President

Table 1

A_1 & A_2 Limits

per:	Proposed ST-1 [HM-230]		Present Aug 30, 1995 [HM-169]		Previous [10-1-94 edition of 49CFR]		
	Proposed (ST-1) A_1	Proposed (ST-1) A_2	Present A_1	Present A_2	Previous A_1	Previous A_2	T 1/2 Years
Cf-252	$5x10^{-2}$ TBq 1.35 Ci 2520 ug	$3x10^{-3}$ TBq 0.0811 Ci 151.2 ug	0.1 TBq 2.70 Ci 5040 ug	$1x10^{-3}$ TBq 0.027 Ci 50.4 ug	.074 TBq 2.0 Ci 3730 ug	$3.3x10^{-4}$ TBq 0.009 Ci 16.8 ug	2.65
Co-60	$4x10^{-1}$ TBq 10.81 Ci	$4x10^{-1}$ TBq 10.81 Ci	0.4 TBq 10.8 Ci	0.4 TBq 10.8 Ci	7.0 Ci	7.0 Ci	5.27
Cs-137 with daughter	$2x10^{0}$ TBq 54.05 Ci	$6x10^{-1}$ TBq 16.22 Ci	2.0 TBq 54.1 Ci	0.5 TBq 13.51 Ci	30.0 Ci	10.0 Ci	33
Ir-92	$1x10^{0}$ TBq 27.03 Ci	$6x10^{-1}$ TBq 16.22 Ci	1.0 TBq 27.0 Ci	0.5 TBq 13.5 Ci	0.74 TBq 20.0 Ci	$3.7x10^{-1}$ TBq 10 Ci	74.5 Days
Unknown Beta Gamma only	0.1 TBq 2.703 Ci	0.02 TBq 0.541 Ci	0.2 TBq 5.0 Ci	0.02 TBq 0.5 Ci	2.0 Ci	0.4 Ci	
Unknown Alpha Only	0. TBq 5.405 Ci	$9x10^{-5}$ TBq .0024 Ci	0.1 TBq 2.70 Ci	$2x10^{-5}$ TBq 5.4x10-4 Ci	2.0 Ci	0.002 Ci	

Table 2

Dose Rate @ three meters from A_1 and A_2 quantities (unsheilded)

	Proposed (ST-1)		Present (HM-169)		Previous (Pre 1995)	
	A1	A2	A1	A2	A1	A2
Cf-252	0.661 Rem/hr	.0396 Rem/hr	1.322 Rem/hr	.0071 Rem/hr	0.978 Rem/hr	.0044 Rem/hr
Co-60	1.586 R/hr	1.586 R/hr	1.584 R/hr	1.584 R/hr	1.027 R/hr	1.027 R/hr
Cs-137	2.140 R/hr	.637 R/hr	2.140 R/hr	.534 R/hr	1.187 R/hr	.396 R/hr
Ir-192	1.532 R/hr	.919 R/hr	1.532 R/hr	.765 R/hr	1.133 R/hr	.567 R/hr

Dose rates from Cf-252 based on data in Ref. 3, other dose rates based on data from Ref. 4.

References:

1. "Californium-252 Progress", US Atomic Energy Commission, Savannah River Operations Office, Aiken, SC,
   A. Number 8, July 1971, page 7
   B. Number 9, October 1971, page 4
   C. Number 11, April 1972, page 6

2. "specification for $Pd\text{-}Cf_2O_3$ Pellets and Wire", contained in "^{252}Cf Source and Shipping Capsule Assembly Design and Test Information", US Atomic Energy Commission, Savannah River Operations Office, Post Office Box A, Aiken, SC 29801, May 15, 1972, pages 2-4

3. "Guide for Fabricating and Handling ^{252}Cf Sources", US Atomic Energy Commission, Savannah River Operations Office, Aiken, SC, January 1971. SRO-153, pages 8 and 9.

4. *'Radiological Handbook", US Army Chemical Corps School, Pamphlet 25, May 1958, page 139.