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To: Vanessa Pierce
From: Arjun Makhijani
Subject: Italian radioactive waste classification
Date: March 31, 2008

I have examined the data submitted to the Nuclear Regulatory Commission regarding the proposed importation by EnergySolutions of radioactive waste from Italy to the United States. The waste would be processed in Tennessee; subsequently some of it would be disposed of at the EnergySolutions low-level waste facility near Clive, Utah, which is licensed only for Class A low-level waste. The EnergySolutions license also has a number of other specific restrictions as to what can be in its possession as part of waste disposal operations. This memorandum sets forth a preliminary analysis of the proposed importation of radioactive waste from Italy.

Summary

The data provided in the Federal Register notice to import waste from Italy[1] are scant and do not allow for detailed determination of waste classification. Until detailed data on the various waste streams are provided, the classification of the waste under U.S. low level waste regulations cannot be determined with certainty. The data provided indicate average concentrations that could exceed Class A waste limits by significant margins. For instance, if the maximum allowed transuranic radionuclides were distributed throughout the entire waste content, it would likely constitute Class C waste. Processing by incineration would concentrate the radionuclides in the residual ash, further increasing concentrations. While the actual waste may contain far lower amounts of transuranic radionuclides, these amounts may also be distributed in far lower amounts of waste. The result may be higher or lower concentrations, depending upon actual waste characteristics. Very detailed data on each different component of the waste and the anticipated characteristics after processing are essential, especially since portions of the processed waste stream would be sent to the facility near Clive, Utah, for disposal. These data are also essential for estimating environmental and health impacts. The calculations below, based on the values provided by EnergySolutions in the February 11, 2008, Federal register notice, demonstrate these conclusions.

Recommendations:

1. EnergySolutions must be required to provide detailed data on the characteristics of each waste stream prior to and after processing--in terms of weight, volume, and radionuclide content.

[1] Federal Register 2008 U.S. Nuclear Regulatory Commission. "Request for a License to Import Radioactive Waste." Notice. *Federal Register*, v.73, no.28 (February 11, 2008) pages 7765–7766. On the Web at http://edocket.access.gpo.gov/2008/pdf/E8-2484.pdf

Assurances by EnergySolutions that the processed waste to be sent to Utah will meet the license conditions for its Clive, Utah, site are not and should not be a substitute for actual data provided prior to the granting of the license.

2. Waste data provided by EnergySolutions should be independently verified in Italy by U.S. regulators.
3. All data and verification methods should be made public.
4. Processing-related emissions and health and environmental impacts should be estimated in detail and the results should be made public. Overall, the import of the specified waste is a major federal action and should not be permitted without an Environmental Impact Statement. Such a statement would include options for management and disposal of the wastes in Italy and a no action alternative of non-import of the waste.

Analysis of the data

The maximum amount of various classes of radionuclides that may be contained in the waste are provided as well as the maximum volume and weight of the waste. The waste characteristics as described in the Federal Register are summarized in Table 1:

Table 1: Characteristics of Italian Radioactive Waste Proposed to Be Imported into the United States

	Amount	Comments (IEER comments are indicated)
Cumulative weight	"Up to approximately 20,000 tons"	All materials – "contaminated metals, graphite, dry activity material…, liquids…and ion exchange resins" Fed. Register
Cumulative volume	"estimated to be 1,000,000 cubic feet"	Materials as above
Special nuclear material (SNM)	Not to exceed 5 kilograms	NRC definition of special nuclear material: plutonium, uranium-233, or uranium enriched in uranium-233 or uranium-235.
Natural/Depleted Uranium	Not to exceed 1 million kilograms	IEER comment: Constitutes a large amount of depleted or natural uranium.
Transuranics except plutonium	Not to exceed 20 terabecquerels (about 540 curies)	IEER note: Common transuranic radionuclides other than plutonium include alpha neptunium-237, amercium-241, and curium-244. These are all alpha-emitters, all of which are included in the limit for Class A waste specified by the NRC in 10 CFR 61.55 of 10 nanocuries per gram. Beyond that it is Class C waste up to 100 nanocuries per gram and Greater than Class C waste above 100 nCi/g.
All other radionuclides	600 terabecquerels (about 16,000 curies)	IEER comment: Could include a variety of radionuclides including activation products, fission products, carbon-14, and tritium that are found in various low-level waste streams

Source: Federal Register 2008 U.S. Nuclear Regulatory Commission. "Request for a License to Import Radioactive Waste." Notice. *Federal Register*, v.73, no.28 (February 11, 2008) pages 7765–7766. On the Web at http://edocket.access.gpo.gov/2008/pdf/E8-2484.pdf

These figures do not allow a projection of how much waste will actually be imported or how much radioactivity of various types will be contained in it. They only provide maximum limits to the waste volume, weight, and radionuclide quantities. If we assume that the radionuclides will be present in the

largest permissible amount and also distributed throughout the largest amount indicated by the maximum weight and volume of the waste, we can estimate the average classification of the waste proposed to be imported, as a whole.

For instance, if the maximum allowable amount of transuranics of 20 terabecquerels (about 540 curies) were diluted in the entire weight of the waste of 20,000 tons (about 18,000 metric tons), the transuranic content would be almost 30 nanocuries per gram. Since plutonium is excluded from this waste amount (according to the Federal Register notice), its most common beta-emitting isotope, plutonium-241, would also be absent. On the assumption that the transuranic radionuclides in the wastes would be typical of those in U.S. waste streams (excluding plutonium), the content would be dominated by radionuclides such as neptunium-237, americium-241, and curium-244. This would put the waste in the Class C category even before incineration, which could only further increase radionuclide concentrations in the residues.

Further, if the five kilograms of special nuclear material that could be in the waste were all plutonium-239 and if it were diluted in the entire waste volume (whose weight would be about 18,100 metric tons)[2], the concentration of plutonium would be about 17 nanocuries per gram. However, a portion of it would likely be plutonium-241, which, as a beta-emitter, has a much more lax limit than the alpha-emitting plutonium isotopes. Hence it is unclear if plutonium-containing waste would be Class C all by itself under the assumption used in this calculation of uniform distribution in the waste. However, the combination of plutonium and the other transuranics, discussed above, would push the waste farther into the Class C category. With or without plutonium, the maximum amount of transuranics, distributed throughout the stated upper limit of waste quantity, would constitute Class C waste.

Since the waste is described as being quite heterogeneous (see Table 1 above), some portions of it would contain lower concentrations of transuranics and special nuclear material while others would contain higher concentrations, possibly much higher concentrations. Hence some portions of the waste may be Greater than Class C waste even prior to concentration by incineration.

Incineration of the waste would further concentrate the radionuclides in the ash, though some presumably would wind up in the filters. Any carbon-14 contained in the waste would be emitted as carbon-14 dioxide to the atmosphere. The composition of the 16,000 curies of other radionuclides is not provided. Therefore, the impact of potential air emissions during incineration cannot be estimated at the present time. A detailed radionuclide inventory, careful characterization of the physical and chemical properties of the waste, and a detailed description of the incineration and filtration arrangements are necessary to estimate the environmental impact. What can be said at present is that the concentration of non-volatile radionuclides in the waste, such as transuranics and plutonium, would likely increase after incineration. It is possible that some of the resulting waste stream may then be pushed into the Greater than Class C category.

EnergySolutions has stated that waste not suitable for disposal in the United States would be screened out at the source and not be brought to the United States or that it would be re-exported. The company has applied for a waste Export License.[3] Full waste characterization should occur now, prior to the granting of the license, not as the import is occurring. Moreover, importing and then re-exporting wastes creates needless risk. If the volumes of waste and the amounts of radionuclides specified in the Federal Register notice do not correspond to the anticipated waste characteristics, then a new notice with more accurate

[2] We assume that the weight of the waste provided in the application is in U.S. short tons, since metric tons are not specified. The concentration would be about 27 nanocuries per gram if it were in metric tons. This makes no difference to the analysis in or conclusions of this memorandum.

[3] Federal Register 2008a U.S. Nuclear Regulatory Commission. "Request for a License to Export Radioactive Waste." Notice. *Federal Register*, v.73, no.28 (February 11, 2008) pages 7764–7765. On the Web at http://edocket.access.gpo.gov/2008/pdf/E8-2483.pdf

information, based on measurements of the types of waste that would actually be imported is necessary. Such characterization should be based on measurements of waste streams from the generators who would supply the waste proposed to be imported. The characteristics should be independently verified by the NRC at the points of waste generation.

Given that EnergySolutions only has a license for disposing of Class A waste in its Clive, Utah, facility, a proposal to dispose of any part of the Italian waste in Utah is very troubling, to say the least. The data provided are scant. While some portion of the waste may be Class A, there is no way to determine that based on the information provided in the application for an Import License. The data indicate that some portion of the waste could be Class C, should the waste contain the radionuclides indicated in the notice distributed in the maximum amount estimated to be imported. Such waste could not be legally disposed of in Utah before or after incineration.

The import of significant amounts of radioactive waste, containing large amount of transuranics, depleted uranium, natural uranium, special nuclear materials, as well as other radionuclides is a major federal action. Full data, a thorough assessment of alternatives, including alternatives for management and disposal in Italy, and a careful assessment of the health and environmental impacts need to be done so the public can be fully aware of the consequences of granting an import license to EnergySolutions. Until then, the import of this waste should be prohibited, as should disposal of any part of it in Utah.