Appendix B

Comments from HEAL Utah, Christopher Thomas, Policy Director

September 21, 2007

Dane Finerfrock
Utah Division of Radiation Control
P.O. Box 144850
Salt Lake City, UT 84114-4850

Dear Mr. Finerfrock,

We are pleased to submit these comments for your consideration in the renewal of EnergySolutions' Radioactive Material License 2300249 (0). We do not believe the license should be renewed as currently drafted, but should be modified as follows:

1) Disposal of Depleted Uranium (DU) or Low-Enriched Uranium (LEU) in large amounts, as from enrichment facilities and as recovered from high-level waste reprocessing, should be specifically excluded from the scope of EnergySolutions' license. Please see the Technical Report prepared by the Institute for Energy and Environmental Research that follows for a technical and legal discussion of DU and other matters related to EnergySolutions' licenses.
2) The license as well as the "Incident Reporting, Investigation, and Tracking" procedure document should be revised to indicate that incidents involving higher than expected radiation exposures should require re-assay of the radioactive material involved prior to disposal.
3) We are concerned that EnergySolutions is able (as under the Waste Generator Access program, as well as other scenarios) to delegate radioactive waste sampling to other entities. This framework creates a situation where mischaracterization of waste can be attributed to external generators or contracted labs while EnergySolutions disposes of waste that is specifically prohibited by its license.[1] We suggest that the license as well as any other procedural documents and paperwork, as required, be revised to require EnergySolutions to assay radioactive waste shipments under State of Utah supervision, with results received prior to disposal. As long as EnergySolutions is not responsible for accurately characterizing the waste coming through its gates, waste ineligible for disposal can and will be disposed here with minimal consequences for EnergySolutions. We find this situation unacceptable.
4) As Barnwell prepares to close its doors to most of the country's B and C low-level wastes, we are concerned that EnergySolutions as well as waste generators will look for ways to combine hotter Class B, C or Greater-Than-C wastes with other materials or waste to achieve an overall dilution consistent with the regulatory definition of Class A waste. We believe such a scheme would contradict the spirit and possibly the letter of current laws, rules, and guidance governing radioactive waste disposal, and should be specifically prohibited in EnergySolutions' license.

[1] See Brent Israelsen, "Envirocare Cited for 'Hot' N-Waste Cargo," *Salt Lake Tribune*, September 26, 2000. 1,350 cubic feet of Class C waste was reportedly disposed at EnergySolutions' Clive site with no monetary penalty to the company, since, as the author put it, "the errant waste was the fault of the shipper."

5) We note with interest the addition of License Condition 28. The requirement for such a substantive corrective action plan for the Cover Test Cell seems to suggest that data collected thus far may indicate that proposed or approved cover designs have failed to meet performance objectives. We thank the Executive Secretary for imposing this corrective action plan as a license condition if such is the case. However, we believe that renewing the license at this time in the absence of a proven cover design may be inappropriate.

Thank you for your consideration of these comments.

Sincerely,

Christopher Thomas
Policy Director
HEAL Utah

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Regulatory and Health Protection Considerations in the Re-licensing of the EnergySolutions Low-Level Waste Disposal Facility near Clive, Utah

by

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Prepared by

The Institute for Energy and Environmental Research

for

HEAL Utah

21 September 2007

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Regulatory and Health Protection Considerations in the Re-licensing of the EnergySolutions Low-Level Waste Disposal Facility near Clive, Utah[1]

Arjun Makhijani, Ph.D.
21 September 2007

A. Main Findings and Recommendations

Findings

1. Depleted uranium (DU) in large amounts, such as that from enrichment plants, was excluded from the framework of the Federal low-level waste regulation when it was promulgated in 1982.
2. The classification of depleted uranium from enrichment plants is an "open question" at the federal level within the framework of low-level waste regulations. It has not been classified as Class A low-level waste.
3. DU in its radiochemical and radiological properties is most like Greater-than-Class-C (GTCC) waste with long-lived, alpha-emitting transuranic radionuclides. The difference is not substantive, but nomenclatural. DU should be classified as GTCC waste based on its characteristics, longevity, and hazard.
4. Uranium recovered from reprocessing plants of any kind is more radioactive than DU. It was also excluded from the framework of the low-level waste regulation when it was promulgated in 1982. It should also be classified as GTCC waste.
5. There is an internal inconsistency in the Utah Division of Radiation Control (DRC) waste acceptance criteria for radium-226 and thorioum-230. The latter has a limit of 60 nanocuries per gram for byproduct material. The former has a limit of 4 nanocuries per gram for the same. However, thorium-230 decays into radium-226, with a half-life of over 75,000 years. As a result, radium-226 will continue to build up due to the decay of thorium-230. The total radium-226 concentration from the decay of Fernald Silo 3 waste accepted at EnergySolutions' Clive, Utah site will contain more than the allowable amount of radium-226 in about 50 years, due to this process.
6. The Baird et al. 1990 report, which formed the technical basis of the initial license to Envirocare, is flawed. Its scenarios only extend to 1,000 years, whereas peak doses would be expected after that. Low-level waste radiation limits (at 10 CFR 61 Subpart C) contain no time limit. The report also contains scientifically absurd and physically impossible results, indicating a lack of quality control. More recent reports do nothing to remedy these problems.

[1] Portions of this report have been drawn from Makhijani and Smith 2005, Makhijani and Smith 2005a, Makhijani 2006, and Makhijani and Makhijani 2006.

Recommendations

1. *EnergySolutions' license should prohibit disposal of depleted uranium in large amounts, such as that from enrichment plants. It should also prohibit disposal of uranium recovered from reprocessing plants, whatever the process used to separate radionuclides in spent fuel. Further, EnergySolutions should be prohibited from representing to third parties that it is authorized to accept either of these types of waste.*
2. *EnergySolutions' licenses should include restrictions that the combination of radium-226 and thorium-230 should not exceed 4 nanocuries per gram in byproduct material or 10 nanocuries per gram in other Class A waste.*
3. *The Baird et al. 1990 report should not be used, explicitly or implicitly, as part of the license renewal. The Utah DRC should require that a new environmental analysis that extends to the time of peak dose be done. It should be carefully reviewed before EnergySolutions' license is renewed.*

B. Introduction

The Utah Division of Radiation Control is considering the re-licensing of the EnergySolutions low-level waste disposal site near Clive, Utah. The site has been licensed to receive Class A low-level waste. It is not licensed to receive Class B, Class C, or any other low-level waste.

This report is focused on whether depleted uranium in large amounts, such as those generated by commercial uranium enrichment plants, can be disposed of as Class A waste. It further considers whether the federal low-level waste regulation standards, which must be met by all licensees, can be met were large amounts of DU to be disposed of at the site. The federal regulations for radiation dose are specified at 10 CFR 61 Part C and the criteria for waste classification are specified at 10 CFR 61.55.

In addition, we will consider a lacuna in the current Utah regulation that limits the radium-226 concentration of waste that is disposed of, but does not limit the accumulation of that radionuclide as a decay product of thorium-230, even if the buildup eventually exceeds the limit of 4 nanocuries per gram for radium-226.

Finally, we will also consider the question of whether the technical work that was the basis for initially granting a license to the site to dispose of the waste, which was published in 1990, provides an adequate and reasonable scientific underpinning for the license.

C. DU Classification

1. The Classification of Depleted Uranium from Enrichment Plants

The classification of large amounts of depleted uranium, for instance, from uranium enrichment plants, has become an issue in the last dozen years or so in the context of the licensing of new uranium enrichment plants. This is because at the time the low-level waste regulations were promulgated, depleted uranium was still considered a "source material," in the same category as natural uranium. At that time, only the Department of Energy was in possession of a large quantity of depleted uranium hexafluoride tails in the United States.

In considering the low-level waste rule, the U.S. Nuclear Regulatory Commission (NRC) at first proposed including enriched, natural, and depleted uranium within the framework of low-level waste disposal. It proposed a limit of 0.05 microcuries per cubic centimeter (0.05 μCi/cc) for Class A, B, or C waste for DU or natural uranium.[2] This would not have allowed pure depleted uranium in any chemical form to be disposed of as Class A (or B or C) waste. For instance, pure DU_3O_8, the oxide form that would be produced by deconversion of the DU from the National Enrichment Facility now being built in New Mexico, has a specific activity of about 340 nanocuries per gram. Natural uranium has about double this specific activity. At relatively low density of 1.5 grams per cc (about the density of soil), waste containing DU_3O_8 to a level of 0.05 μCi/cc is equivalent to about 33 nanocuries per gram.[3] In other words, pure DU_3O_8 is about 10 times more radioactive than the maximum that would have been allowed under the draft rule proposed in 1981, for Class A (or B or C) waste, if the draft proposal of the NRC had been adopted in 1981. It is clear, therefore, that even at the draft EIS stage, there was no intention of classifying pure DU in any chemical form as either Class A, B, or C waste. Had the draft rule been finalized without modification, pure DU in any chemical form would have been GTCC waste. Similarly, there was no intent to classify pure enriched uranium in any chemical form as a Class A, B, or C waste. The proposed concentration limit for enriched uranium in the draft EIS was 0.04 μCi/cc, which is about 27 nanocuries per gram if mixed mainly with soil.[4]

As it turns out, uranium (depleted, natural, and enriched) was deleted from the low-level waste table in the final rule.

When the NRC issued its final rule and supporting Environmental Impact Statement (EIS) in 1982, the removal of uranium from the list of radionuclides was explained as follows:

> Uranium has been removed as a radionuclide that must be considered for waste classification. The Commission's analysis shows that *the types of uranium-bearing wastes disposed of* do not present a sufficient hazard to warrant limitation on the concentration of this naturally occurring material.[5]

It is clear that the disposal of uranium, other than the small amounts typically disposed of by NRC licensees in 1982, was removed from the purview of the low-level waste rule.

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[2] NUREG-0782 1981 Vol. 2, Table 7.2 (page 7-18)
[3] Higher density assumptions would result in a lower maximum allowable concentration per unit weight.
[4] NUREG-0782 1981 Vol. 2, Table 7.2 (page 7-18). Assuming a density of 1.5 grams per cc for waste containing natural or enriched uranium (in the form of U_3O_8). Higher density assumptions would result in a lower maximum allowable concentration per unit weight.
[5] NUREG-0945 1982 Vol. 3, Appendix F, p. 42, emphasis added.

Specifically, disposal of large amounts of uranium, including depleted uranium, was removed from the rulemaking. Based on this decision, the results of applying the 10 CFR 61 performance assessment methodology to uranium were not presented by the NRC in the Final EIS covering the low-level waste regulation. Hence, an official assessment evaluating the radiological consequences of disposing of large amounts of DU remained to be done. Since disposing of large amounts of DU would be a major federal action, and since it was not covered by the 1982 EIS, it cannot be disposed of as low-level waste until a classification process within the low-level waste scheme and an accompanying environmental impact process has been completed.

Uranium recovered in the course of reprocessing has an even higher specific activity than depleted uranium (typically more than double that of DU). It is also not covered by the low-level waste rule. This is because natural and enriched uranium were also removed from the scope of the low-level waste rule in the process of its finalization in 1982 and because reprocessed uranium was not generated as a waste by any NRC licensee at the time the low-level waste rule was promulgated. All of the comments that follow regarding large amounts of DU apply *a fortiori* to uranium recovered from reprocessing plants.

Even though the Department of Energy has not officially reclassified DU as a waste, it has been recognized as a practical matter for some time (over a decade) that most of the DU in the DOE inventory, which was generated as part of uranium enrichment for commercial and military uses, will likely have to be disposed of as a waste. Hence, it follows that additional large amounts of DU created by new enrichment plants would also have to be disposed of as waste. The Nuclear Regulatory Commission recognized this reality during consideration of a license application for a new enrichment plant, called the National Enrichment Facility, filed by Louisiana Energy Services (LES). LES was granted a license to build the plant in June 2006. Rulings by the NRC in that case are germane to the question of whether DU can be disposed of as Class A low-level waste in general, and at the EnergySolutions site in particular.

It is important to understand the general concept of "low-level" waste prior to addressing its classification as Class A, B, C, or Greater-than-Class-C. Low-level waste is simply a catch-all category for radioactive waste that does not fit into any other legal definition. The specified categories are:

- Spent fuel
- High-level waste, which is defined as first-cycle reprocessing waste and consists mainly of fission products
- Mill tailings, also called 11e.(2) byproduct material
- Transuranic waste, which is waste with more than 100 nanocuries per gram of long-lived, alpha-emitting transuranic radionuclides

"Low-level" waste is a rather misleading term that has been applied to the catch-all category. It can consist of debris or booties and gloves that are slightly contaminated and/or consist mainly of short-lived radionuclides. However, it should be noted that class A waste

can have fairly high levels of external radiation. It can also contain significant amounts of radionuclides such as cesium-137, cobalt-60, and other radionuclides. The concentration limits on the radionuclides in Class A waste are specified in two tables in 10 CFR 61.55. Class B or Class C low-level waste can contain larger concentrations of radioactivity than Class A waste. For some radionuclides, such as tritium or cobalt-60, there are no numerical concentration limits for Class B and C waste. The limits are determined on an ad hoc basis, depending on factors such as heat generation and external radiation rates. Greater-than-Class-C (GTCC) waste is also part of this catch-all low-level waste category, but it is the most radioactive. GTCC can contain any concentrations of radioactivity above the maximum limits specified for Class C waste. Some GTCC waste is more radioactive (per unit volume) than some high-level waste.[6]

In sum, pursuant to this classification system, any material that does not fall into the existing named categories in the bulleted list above is "low-level" waste, *independent of its hazard and longevity*. Hence this also applies to DU. But this does not mean that DU poses low risks or that it can be assumed to be Class A waste. It cannot. The NRC has recognized both these realities.

In the LES case, the NRC has issued rulings and filed opinions that are germane to the issue of whether DU is Class A waste (and hence whether EnergySolutions can accept it for disposal under the conditions of its license). First the NRC determined that DU is "low-level" waste as part of the catch-all scheme of classifying everything as low-level waste that does not have another legal classification. The NRC also affirmed that DU contained in waste that was *within the framework of the original rule* could be considered Class A waste, under 10 CFR 61.55(a)(6). That is, small amounts of DU that were typical of those generated by NRC licensees in 1982 could be considered Class A waste. The NRC also specifically excluded DU from enrichment plants from the scope of its order.[7] This is because the environmental impacts of disposal of the large amounts of DU generated by enrichment plants were not examined in the Final EIS for low-level waste. Hence, the Commission ordered the NRC staff to conduct *a separate proceeding, apart from the LES license proceeding*, to determine the class to which large amounts of DU from enrichment plants belong:

> The Commission is aware that in creating the section 61.55 waste classification tables, the NRC considered depleted uranium, but apparently examined only specific kinds of depleted uranium waste streams – "the types of uranium-bearing waste being typically disposed of by NRC licensees" at the time. The NRC concluded that those waste streams posed an insufficient hazard to warrant establishing a concentration limit for depleted uranium in the waste classification tables. Perhaps the same conclusion would have been drawn had the Part 61 rulemaking explicitly

[6] Makhijani and Saleska 1992 Table 4 (page 26). It should be noted here that dilution of wastes with non-radioactive materials or one class with another would render the federal waste classification meaningless. Were it permitted any higher (more hazardous) waste category (Class B, C, or GTCC) could be downgraded to a lower waste classification by such mixing.

[7] There was no uranium enrichment plant licensed by the NRC at the time. The 2006 license granted to LES was the first such license granted by the NRC.

> analyzed the uranium enrichment waste stream. But as Part 61's FEIS indicates, no such analysis was done. Therefore, the Commission directs the NRC staff, outside of this adjudication, to consider whether the quantities of depleted uranium at issue in the waste stream from uranium enrichment facilities warrant amending section 61.55(a)(6) or the section 61.55(a) waste classification tables.[8]

It is plain that an *a priori* assumption that DU from enrichment plants is Class A low-level waste under 10 CFR 61.55(a)(6) is contrary to the Commission's order until the NRC staff considers the issue separately from the LES license.

In its brief to the Court of Appeals in the LES case (the intervenors have appealed the granting of the license), the NRC explicitly acknowledged that the classification status of DU from enrichment plants under the low-level waste rule is not settled:

> [T]he Commission expressly acknowledged [in the course of the LES license proceedings] that properly classifying large quantities of DU is an *open question, requiring further study by NRC staff, a study the Commission directed its staff to undertake*.[9]

The fact that this is an open question was extensively discussed during the hearing before the federal Court of Appeals in Washington, D.C. on September 7, 2007. The possibility that it could be something other than Class A, including a class that would require deep disposal was discussed. The NRC's counsel acknowledged before the court that both of these contingencies could occur.[10] Hence, notwithstanding the opinion of the NRC staff, or any "literal reading" of 10 CFR 61.55, according to which Class A is a default category for unclassified low-level waste, the classification of DU from enrichment plants has been explicitly stated by the NRC to be an "open question."

The NRC staff has yet to begin the study that the Commission ordered it to undertake.

It is to be noted that Utah is an Agreement state with the NRC. As such it sets and enforces its own regulations. But Utah must do so within the framework of NRC regulations. The Division of Radiation Control can enact regulations that are more stringent than the NRC rules and it has done so in the past. For example, the DRC has limits on radium-226 in Class A waste that are not specified in Tables 1 or 2 of the federal rule at 10 CFR 61.55. However, the Utah DRC cannot go beyond NRC rules and make decisions about classification of radioactive waste that are in contravention of federal regulations. In the particular instance of DU from enrichment plants as well as natural or enriched uranium such as that resulting from separation in reprocessing plants, the NRC excluded these materials from the framework of the 1982 low-level waste Final EIS. In regard to DU, the NRC has affirmed that its classification status within the low-level waste framework is an "open question" that remains to be decided at the federal level. In light of these facts, the DRC cannot legally assert that DU is Class A low-level waste. Any action it takes in this

[8] NRC CLI-05-20 pages 523, 535-536 (footnotes omitted)
[9] NRC 2007 page 40, emphasis added. Pages 40 and 41 are reproduced in Attachment 2.
[10] Court of Appeals 2007

regard must await a federal decision. In the interim, the DRC cannot license or in any other way authorize EnergySolutions to accept DU from enrichment plants as Class A waste. Neither can it authorize EnergySolutions to represent that it could accept such waste (see Attachment 1).

D. Technical Analysis of DU Classification

DU from enrichment plants should be classified as Greater-than-Class C (GTCC) waste. Radiological analyses show that disposal at shallow land disposal sites would result in doses far above the maximum allowable limits under 10 CFR 61 Subpart C. The radiochemical and radiological properties of DU are similar to those for GTCC waste except for nomenclature. Under 10 CFR 61.55, waste containing more than 100 nanocuries per gram of long-lived, alpha-emitting transuranic radionuclides are considered GTCC waste. DU fits this description, except for the fact that its atomic number is 92, and hence cannot be called "transuranic" because the latter radionuclides have atomic numbers greater than 92, by definition of the term "transuranic." In other respects DU fits the GTCC category. It consists entirely of long-lived, alpha-emitting radionuclides, as can be seen from Table 1.

Table 1: Radiological properties of U-234, U-238 and selected transuranic radionuclides

Isotope	Main decay mode	Alpha particle energy, MeV	Half-life, years	Comments
Uranium-238	Alpha	4.1	4.46 billion	
Uranium-235	Alpha	4.4	700 million	weak gamma emitter
Uranium-234	Alpha	4.8	245,000	
Neptunium-237	Alpha	4.8	2.14 million	
Plutonium-238	Alpha	5.5	87.7	
Plutonium-239	Alpha	5.1	24,110	
Plutonium-240	Alpha	5.1	6,537	
Americium-241	Alpha	5.5	432	strong gamma emitter

Note: All energies rounded to two significant figures. The alpha-emitting radionuclides emit alpha particles with more than one characteristic energy, with each energy level being produced with a known probability. The alpha particle energy shown is an approximate average of these particles energies, weighted by the emission probability.

The specific activities of various chemical forms of depleted uranium are shown in Table 2. Potential chemical forms for disposal are DUO_2 and DU_3O_8. The NRC staff has proposed the latter.

Table 2: Specific activities of various chemical forms of depleted uranium, TRU waste, and typical uranium ore with 0.2% natural U by weight

Chemical form	**Specific activity, nCi/gm**
uranium metal (DU)	400
uranium dioxide (DUO_2)	350
uranium oxide (DU_3O_8)	340
transuranic activity in TRU or GTCC waste	>100
0.2% uranium ore	4 (See Note 1)

Notes: 1. The specific activity shown for 0.2% uranium ore includes all decay products of uranium-238 up to and including radium-226, assuming they are in secular equilibrium with uranium-238. Radon-222, and its decay products are not included in this number.
2. All values in the table are rounded to one or two significant figures as indicated.

The risk of internal exposure to DU is greater than that of internal exposure to GTCC waste containing plutonium at the threshold value of 100 nanocuries per gram, as can be seen from Table 3. This is true even without taking any in-growth of the daughter products of uranium-238 into account. The problem increases with time, as the daughter products of U-238 build up in DU. If the build up of uranium-234, thorium-230, and radium-226 is considered, the ratio of the eventual radiotoxicity of DU and its decay products would be over ten times that of GTCC waste containing 100 nanocuries per gram of plutonium-239. It should be noted that Federal low-level waste regulations contain no time limit for maximum permissible dose limits (10 CFR 61 Subpart C).

Hence, in all respects, DU is comparable to GTCC waste containing transuranic radionuclides. The EPA and the Department of Energy have a waste category "transuranic waste" (TRU waste, for short) that is essentially similar to the NRC definition of GTCC, when the latter consists of long-lived, transuranic alpha-emitting radionuclides.

It is important to note in this context that the Department of Energy is considering using the NRC's low-level waste classification system for GTCC waste to classify some of its own as "GTCC-like" for the purpose of considering its disposal.[11] The DOE considers this "GTCC-like" waste similar in hazard to GTCC or TRU waste. The intent is not to create a new waste category, but to treat the waste in a manner parallel to GTCC waste for the purpose of disposal. One reason for the DOE's use of the term "GTCC-like" is that some of this DOE waste is similar in characteristics to TRU waste. As noted, the latter is essentially the same

[11] DOE 2007 and DOE 2007a

by definition as NRC-defined GTCC waste consisting of long-lived, transuranic, alpha-emitting radionuclides.

Table 3: Comparison of mortality risk per Bq and mortality per gm of depleted uranium oxide at secular equilibrium to that of plutonium-239 contained in TRU waste at 100 nCi per gram[12]

	Mortality per Bq Tap Water	Mortality per Bq, Food	Ratio, DU_3O_8 to GTCC at 100 nCi/g, Tap Water (See Note)	Ratio of DU_3O_8 to GTCC at 100 nCi/g, Food (See Note)
Uranium-238	1.13E-09	1.51E-09	1.14	1.20
Uranium-234	1.24E-09	1.66E-09	0.23	0.24
total mortality ratio DU_3O_8 to GTCC at 100 nCi/gram			**1.37**	**1.44**
Plutonium-239	2.85E-09	3.63E-09	1	1

Note: The source for the drinking water and dietary mortality factors is EPA Federal Guidance Report 13.[13] The two right most columns show the ratio of the mortality coefficients for uranium-238 and uranium-234 in the proportion in which they are present in DU_3O_8 initially. This table does not include any in-growth of thorium-230 and radium-226. The specific activity of DU is taken as 340 nanocuries per gram, which is the specific activity of DU_3O_8. Of this about 287 nanocuries per gram is attributable to U-238 and the rest to U-234. U-235, which makes a relatively small contribution to the total dose, is ignored for simplicity. The DU_3O_8 is compared to GTCC waste containing Pu-239 at the threshold value of 100 nanocuries per gram.

It should also be noted that quantitative evaluations conducted by the NRC, Sandia National Laboratory, and IEER of shallow land disposal of DU from enrichment plants – that is, for large amounts of DU, carried to the time of peak dose or at least well beyond 1,000 years, have all concluded that such disposal would cause the dose limits of the low-level waste regulation, 10 CFR 61 Subpart C, to be greatly exceeded.[14]

Recommendation: EnergySolutions' license should prohibit disposal of depleted uranium in large amounts, such as that from enrichment plants. It should also prohibit disposal of uranium recovered from reprocessing plants, whatever process they may use to separate radionuclides in spent fuel. Further, EnergySolutions should be prohibited from representing to third parties that it is authorized to accept either of these types of waste.

[12] Source for Table 3: Makhijani and Smith 2005 Table 4.
[13] FGR 13 1997 pages 102-103
[14] Makhijani and Smith 2005 and 2005a, and Kozak et al. 1992 pages 19-20. In the first LES case, the NRC's EIS concluded that "Because for near-surface disposal of U_3O_8, projected doses exceed 10 CFR Part 61 limits, a deep disposal site is most likely to be selected for ultimate disposition of depleted uranium. NRC CEC EIS Final 1994, p. A-9. Kozak and the NRC considered wet sites; Makhijani and Smith considered dry sites. The 10 CFR 61 standard was exceeded at all shallow land burial sites, regardless of climate.

E. Inconsistency in EnergySolutions Waste Acceptance Criteria

There is a significant inconsistency in the waste acceptance criteria for the EnergySolutions Site near Clive, Utah, in regard to radium-226 and thorium-230. There are two limits for radium-226:[15]

- 4 nanocuries per gram in 11e.(2) byproduct material
- 10 nanocuries per gram in other Class A radioactive waste

The limit for thorium-230 in 11e.(2) byproduct material is 60,000 nanocuries per gram. There is no limit for thorium-230 in Class A waste other than byproduct 11e.(2) material.

Thorium-230 is the parent radionuclide of radium-226 – that is when thorium-230 decays, it emits an alpha particle and the remaining nucleus is radium-226. Hence, any waste that contains thorium-230 in relatively large concentrations will build up similarly large concentrations of radium-226 in time, even if the latter is not present initially or present at a level less than 4 nanocuries per gram. This is the case with the Fernald Silo 3 that has been accepted at the site.

The EnergySolutions site has accepted waste from Silo 3 of the now-decommissioned Feed Materials Production Center (also called the Fernald Environmental Management Project) in Ohio. This is byproduct material, which arose as waste from processing of ores and ore concentrates. This waste contains 2.97 nanocuries per gram of radium-226, which is just under the waste acceptance criterion of 4 nanocuries per gram. But it also contains thorium-230 at 51.2 nanocuries per gram.[16] In about 50 years, the original radium-226 plus its build-up from the decay of thorium-230 will cause the activity of radium-226 to exceed the waste acceptance criterion of 4 nanocuries per gram. If the waste were simply stored for 50 years and then sent to EnergySolutions, it would be unacceptable for disposal.

It is to be noted that the actual hazard of the waste lies at a future time when the waste cover has substantially eroded. Since radium-226 is a gamma-emitter, it would constitute the primary radiation hazard to a short-term intruder onto the site.

A run of the Argonne National Laboratory model, ResRad, using parameters that would simulate the EnergySolutions disposal of Silo 3 waste, shows that peak doses, which would occur thousands of years hence, would be huge – in the hundreds of rem.[17] These doses would be almost entirely due to the build-up of radium-226 from thorium-230, since the original radium-226 would have largely decayed away by that time. In other words, the hazard is defined, in the license, by radium-226. But the waste becomes more dangerous as the decades pass due to the presence and decay of thorium-230 into radium-226.

[15] EnergySolutions 2006 page 18
[16] Makhijani and Makhijani 2006 Table 3 (page 21)
[17] Makhijani and Makhijani 2006 Section 4.7.2

Recommendation: EnergySolutions' licenses should include restrictions that the combination of radium-226 and thorium-230 should not exceed 4 nanocuries per gram in byproduct material or 10 nanocuries per gram in other Class A waste.

F. The Baird Report

The 1990 Baird et al. report[18] provides the environmental analysis that is the technical foundation of the license that was granted to Envirocare, now EnergySolutions. This report contains the various scenarios, such as future construction on the site, an "intruder explorer" scenario, etc. In some scenarios, the waste cover stays intact as it is not penetrated by intrusion or construction.[19]

There are two central problems with this document. First, the scenarios only extend to 1,000 years. This is too short a time for erosive processes to uncover the waste. Hence, in the case of the intruder explorer scenario, the estimated doses are extremely low – essentially zero. In effect the Baird report's implicit claim is that a future intruder will experience no more than an infinitesimal dose were he/she to unknowingly wander onto or near the site. [20]

It should be noted that neither the federal regulation (10 CFR 61) nor Utah law (UAC-313-25) has a time limit on doses. Further, both rules require that institutional control should not be relied upon for more than 100 years. According to Utah Administrative Code R313-25-28(2):

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[18] Baird et al. 1990

[19] More recent reports continue to refer to the Baird et al. report as a basic relevant document. None has remedied the problems in Baird et al. discussed here. For instance, Whetstone Associates 2000 only goes out 500 years and relates only to requirements for a groundwater discharge permit. Its scope does not include scenarios in which an intruder would be exposed to external radiation. In an even more recent report, Streamline Consulting 2005 does not cover long-term doses at all, because it concluded that "[t]he predominant potential pathway for exposure to contamination is atmospheric transport of particulates that are resuspended from exposed waste piles, and during off loading and placement operations." (Streamline Consulting 2005 page 2) It accepts another study's conclusion that "an intruder explorer would not receive significant doses." (Cited at Streamline Consulting 2005 page 1.) Makhijani and Smith 2005 and Makhijani and Smith 2005a show that this conclusion is incorrect if calculations are carried out to the time of peak dose, as required by 10 CFR 61.

[20] It is perhaps instructive to note here that there has been an intruder on to the EnergySolutions site even during the period of waste disposal and supposedly firm institutional control. According to a news report (Ashe 2007, emphasis added):

> At about 3 a.m. on Saturday morning, Trooper Andy Prescott spotted a gold 2000 Mercedes traveling west on I-80 at speeds in excess of 120 mph. Prescott pursued the vehicle until it turned off at the Clive exit. The vehicle sped toward the EnergySolutions facility where it tore through several chain-link fences and entered a low-level radioactive waste disposal cell, Rapich said.
>
> **During the chase on EnergySolutions property**, the driver tried to ram a highway patrol car. And at one point, troopers lost sight of the Mercedes. **When they found the car, it was in a ravine in a contained area of the facility.**
>
> The driver had fled on foot.

> Institutional Control. The land owner or custodial agency shall conduct an institutional control program to physically control access to the disposal site following transfer of control of the disposal site from the disposal site operator. The institutional control program shall also include, but not be limited to, conducting an environmental monitoring program at the disposal site, periodic surveillance, minor custodial care, and other equivalents as determined by the Executive Secretary, and administration of funds to cover the costs for these activities. The period of institutional controls will be determined by the Executive Secretary, but institutional controls may not be relied upon for more than 100 years following transfer of control of the disposal site to the owner.

This language is identical to that in the federal regulation at 10 CFR 61.59(b). Hence, under Utah law and federal regulations, an intruder must be protected beyond the term of institutional control of 100 years. Scenarios that extend out only 1,000 years are not sufficient to show compliance with 10 CFR 61 Subpart C, which governs the EnergySolutions disposal site. As noted above, there is no time limit for dose under this regulation. Utah law (UAC-313-25) also imposes no time limit. Radiation doses must therefore be calculated to peak times. Peak doses from disposal are estimated to run into hundreds of rem from current disposal practices, as has been noted above in the case of Fernald Silo 3 waste, which has been accepted for disposal at the site. It would appear, therefore, that there is a fundamental flaw in the entire regulatory analysis underlying the license, since its scenarios are limited to 1,000 years.

Further, the Baird et al. report has not been checked properly. This is evident from the fact that it contains many scientifically absurd results in its estimates of the allowable concentrations of some radionuclides in Utah soil. Table 4 shows some of the problematic results of the Baird et al. scenario calculations. For instance, the report estimated that the allowable concentration per gram of soil of uranium-238 and of thorium-232 would be tens of thousands of times greater than the weight of the Earth. Similar problem results were obtained for plutonium-239 and plutonium-242.

Table 4: Some of the Scientifically Absurd Results in the Baird et al. report

	"Allowable" conc.: pCi/gm (Intruder/explorer scenario)	"Allowable" conc.: gm radionuclide/gm soil	Comment
Uranium-238	5.2E+37	1.5E+32	Allowable concentration is about 25,000 times the weight of the Earth
Thorium-232	5.1E+37	4.6E+32	Allowable concentration is about 75,000 times the weight of the Earth
Plutonium-239	9.5E+37	1.5E+27	Much more than 100,000 trillion times the Pu-239 ever made
Plutonium-242	7.1E+37	1.8E+28	Many million-trillion times the Pu-242 ever made

Source: Columns 1 and 2 are from Baird et al. 1990 page 5-13. Column 3 is calculated from column 2 using the specific activities of the radionuclides in question (about 0.34 microcuries per gram for U-238, 0.11 microcuries per gram for Th-232, 0.063 Ci/gram for Pu-239, and 4 millicuries per gram for Pu-242).

Obviously, soil concentration per gram of any substance cannot exceed more than one gram of that substance. That is physically impossible. In the above examples (which are not the only ones of this kind in the report), the "allowable" soil concentration exceeds one gram by large margins.

It appears that the enormous values for allowable waste concentrations arise from the minuscule dose estimates per unit of radioactivity disposed of for the scenario in question. But there is an evident failure of quality control in permitting physically impossible numbers to be published. The question arises, if the computer model that was used to determine these values did not contain a check against absurd numbers, what other problems might lurk in the data and analysis that are not immediately evident because they are not completely impossible?

We do not claim that all the calculations or results in the report are wrong. Some may not be. But it is evident that many of them absurd and physically impossible, and, hence, wrong. This report did not provide a suitable basis for granting the license renewal to EnergySolutions.

Recommendation: The Baird et al. 1990 report should not be used, explicitly or implicitly, as part of the license renewal. The Utah DRC should require that a new environmental analysis that extends to the time of peak dose and that is carefully done and checked be completed and reviewed before EnergySolution's license is renewed.

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Attachment 1

Memorandum

To: Arjun Makhijani, IEER
From: Diane Curran of Harmon, Curran, Spielberg & Eisenberg, LLP
Cc: Vanessa Pierce, HEAL Utah
Re: Comments on EnergySolutions License Renewal Application
Date: September 20, 2007

Utah is an Agreement State pursuant to Section 274 of the Atomic Energy Act, 42 U.S.C. § 2201. Therefore, the State's authority to regulate the disposal of low-level radioactive waste ("LLRW") is limited to activities approved by the NRC as "compatible" with its own regulatory program and "adequate to protect the public health and safety" with respect to the materials regulated by the State. 42 U.S.C. § 2201(d)(2). The renewed license for the EnergySolutions facility should contain language prohibiting disposal of large quantities of depleted uranium ("DU") there, because the question of whether classification of DU as Class A LLRW is compatible with the NRC's regulatory scheme or adequate to protect public health and safety has not been determined and is open to serious question. Before making any decision to allow disposal of large quantities of DU at the EnergySolutions facility, the State must await the NRC's determination of the appropriate classification of DU.

Utah's NRC-approved regulations for near-surface disposal of LLRW limit the State's radioactive waste disposal authority to LLRW classified as Class A, B, or C. Utah Administrative Code ("UAC"), § R313-25-25(3). Thus, Utah has no legal authority to regulate near-surface disposal of Greater Than Class C ("GTCC") LLRW. It is possible that when the NRC finally rules on the classification of large amounts of DU, such as those from uranium enrichment plants, it may find DU to be GTCC waste.

Utah has its own regulatory scheme for classification of LLRW [UAC § R313-15-1008], which is virtually identical to the NRC's standards in 10 C.F.R. § 61.55(a). Under the Atomic Energy Act, Utah's waste classification standards must be interpreted and applied in a manner that is "compatible" with NRC standards and that protects public health and safety. 42 U.S.C. § 2201(d)(2). While DU would fall into Class A under a literal interpretation of both sets of regulations, the NRC has acknowledged that such a "literal reading" is inappropriate for large quantities of DU and that the correct classification is an "open question." See Brief for the Federal Respondents, *Nuclear Information and Resource Service v. NRC,* No. 06-1301 at page 40 (May 16, 2007), citing *Louisiana Energy Services, Inc.* (National Enrichment Facility), CLI-06-15, 63 NRC 687, 699 (2006). Thus, in order to be compatible with the NRC's interpretation of its own regulations and adequately protective of public health, UAC § R313-15-1008 may not be interpreted to classify large quantities of DU as Class A LLRW.

Under the circumstances, EnergySolutions should be prohibited from accepting large quantities of DU or representing to third parties that it is authorized to do so unless and until the NRC

makes a determination regarding the appropriate classification of DU. Moreover, as discussed in Section D of these comments, we believe that large quantities of DU should be classified as GTCC waste, and that to classify it as Class A waste would pose a serious threat to public health and safety.

Attachment 2

Brief for the Federal Respondents

Selected pages only: title, [1], 40-41

ORAL ARGUMENT NOT YET SCHEDULED

IN THE UNITED STATES COURT OF APPEALS
FOR THE DISTRICT OF COLUMBIA CIRCUIT

Nos. 06-1301 and 06-1310 consolidated

NUCLEAR INFORMATION AND RESOURCE SERVICE, and
PUBLIC CITIZEN,
Petitioners,
v.

U.S. NUCLEAR REGULATORY COMMISSION
and the UNITED STATES OF AMERICA,
Respondents.

ON PETITION FOR REVIEW OF ORDERS AND LICENSE ISSUED
BY THE U.S. NUCLEAR REGULATORY COMMISSION

BRIEF FOR THE FEDERAL RESPONDENTS

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May 16, 2007

JURISDICTIONAL STATEMENT

These petitions for review challenge Nuclear Regulatory Commission (NRC) adjudicatory decisions culminating in an NRC license for a uranium enrichment facility. Petitioners properly invoke this Court's subject matter jurisdiction under the Hobbs Act, 28 U.S.C. § 2341 *et seq.* *See* Pet. Br. 1. But, as we show in Argument I (below), petitioners lack standing to pursue most of the claims they make in this Court.

STATEMENT OF THE ISSUES

1. Whether petitioners – who represent New Mexico residents opposing a local uranium enrichment facility – have standing to challenge NRC findings about the potential costs and environmental impacts of the facility's disposal of depleted uranium (DU) out-of-state.

2. Whether NRC reasonably described the potential environmental impacts of DU disposal in compliance with the National Environmental Policy Act (NEPA), 42 U.S.C. § 4321 *et seq.*

3. Whether NRC denied petitioners their statutory hearing right by supplementing the environmental impact analysis based on the adjudicatory record without reopening the hearing.

4. Whether NRC reasonably found that the license applicant provided a "plausible strategy" and an acceptable cost estimate for DU disposal.

Envirocare or other specific sites are licensable – defeats the lion's share of NIRS/PC's NEPA-based "DU" claims.

C. *NRC's Assessment of the Environmental Impacts of Depleted Uranium Disposal Was Reasonable*

If an adequate NEPA review had been done, NIRS/PC argue, NRC would have found that LES's DU doesn't qualify as "Class A" low-level waste, doesn't meet Part 61's performance objectives, and isn't suitable for near-surface disposal. *See, e.g.,* Pet. Br. 28-36, 43-46. NIRS/PC argue relentlessly that Envirocare never should have been selected as NRC's "reference" site for considering the impacts of near-surface disposal of LES's DU because Envirocare is licensed to take Class A waste only and the amount of DU the NEF will generate exceeds Class A limits. *See id.* at 43-46.

But the Commission expressly acknowledged that properly classifying large quantities of DU is an open question, requiring further study by NRC staff, a study the Commission directed its staff to undertake. *See* CLI-06-15, 63 NRC at 699. (JA__). Thus, contrary to NIRS/PC's repeated assertion, it's not true that the Commission declared DU to be Class A waste without question, not subject to rethinking, although it's also true, outside the context

of the staff study, that "a literal reading of 10 C.F.R. § 61.55(a)(6)," as it currently stands, "would render DU 'Class A' waste." *Id.*

In any event, for the reasons given below, NRC reasonably used Envirocare as a "reference" site to illustrate likely environmental impacts of near-surface disposal. The Commission upheld Board fact findings that the impacts at such a site would likely be "small," but nothing in the Commission's decision commits DU disposal to a near-surface facility. *Id.* at 700. (JA__). And as a backstop, in case "no near-surface disposal [site] is ultimately selected and approved," *id.*, NRC also considered the impacts of NIRS/PC's own preferred option, deep disposal, whose impacts NIRS/PC's expert agrees are acceptable. *See id.* at 706 & n.89. (JA__). Given the record, NRC's findings were reasonable, certainly not "arbitrary and capricious."

1. Near-Surface Disposal

It was reasonable for NRC staff (in its FEIS) and the Board to focus on Envirocare as a "reference" site for analyzing the impacts of near-surface disposal. Significantly, Envirocare is already licensed by Utah to accept unlimited quantities of DU. CLI-06-15, 63 NRC at 693. JA(__). As the Commission pointed out, NRC staff conducted a conference call with Utah