Utah Department of Environmental Quality
Division of Radiation Control
Room 212, Airport East Business Building (Bldg #2)
168 North 1950 West.
Salt Lake City, Utah 84114-4850

December 21, 2009

Dear Sirs:

I wish to comment on the the proposed license amendment to the Energy Solutions license. This proposed amendment addresses a perceived problem with the ingrowth of radioactivity in the DU waste. I have analyzed the characteristics of the depleted uranium very carefully and can see no problem which should cause any regulatory concern.

- The radiations coming from the DU waste are either non-penetrating or of very low intensity and cannot represent a problem when compared to other wastes which have been successfully disposed of in the past.
- The amount of buildup in radioactivity, even over thousands of years, is trivial when compared with the radioactivity of uranium mill tailings.
- There is no significant amount of radon in the waste and cannot be for thousands of years because of the extremely long half lives concerned.

The following is my analysis of the perceived problem.

Depleted uranium, DU, is different from natural uranium in the amount of the lighter isotopes which are present. Most of the U-234 and U-235 have been removed making DU less radioactive than natural uranium. The U-234 is a decay product of U-238 and is approximately in equilibrium with the U-238 in natural uranium. However, DU has only about 20% of the original U-234 left.

Table I
Isotopic Abundance of Natural and Depleted Uranium

Isotope	Natural Uranium abundance by weight	Depleted Uranium abundance by weight
U-238	99.2760%	99.8%
U-235	0.7196%	0.20%
U-234	0.0055%	0.0011%

The U-238 decay chain continues after U-234 for about a dozen radioactive isotopes,but all those after U-234 have been removed by chemical separation prior to the enrichment process. Thus these isotopes must grow in from the decay of the U-234.

The U-234 (half life 247,000 years) decays into Th-230 (half life 80,000 years) which is the parent of Ra-226 (half life1,600 years) which decays into Rn-222 (half life 3.8 days).

The decay products of Th-230 produce the radiations which are of interest. Since the Th-230 has the longest half life, the later decay products will grow in equilibrium with the Th-230. The activities of Ra-226, Rn-222, etc. will be in equilibrium with Th-230 and thus have equal activities.

Table II
Ingrowth of Radioactivity in DU Waste with Time

Elapsed years since separation	U-234 activity as % of U-238	Th-230 activity as % of U-234	Th-230 activity as % of U-238
0	20.00%	0.00%	0.00%
1,000	20.28%	0.86%	0.17%
2,000	20.56%	1.72%	0.35%
3,000	20.84%	2.57%	0.54%
4,000	21.10%	3.41%	0.72%
5,000	21.40%	4.24%	0.91%
10,000	22.80%	8.30%	1.89%

It is important to understand that these decay products of Th-230 which emit the ionizing radiations of concern to health are identical to the radioisotopes in uranium mill tailings. The Vitro uranium mill tailings which were handled very successfully by the Bureau of Radiation Control had an average Ra-226 activity of about 500 pCi/gram with a maximum of about 1,000 pCi/gram. **A sample of DU waste containing 5% DU after 1,000 years would contain only 28.3 pCi/gram Ra-226.**
There are two separate matters to consider. One is the radiations coming directly from the depleted uranium and the other is the radiations coming from radium and its decay products.
First, the radiations coming from the DU and its short lived decay products are 1. alpha which cannot penetrate a sheet of paper, 2. beta which is easily stopped by ½ inch of water or plastic, and 3. gamma which is of very low intensity. Even the 1 Mev gamma occurs in only a 0.6% of the decays.
Second, the Th-230 decay products (Ra-226, Rn-222, etc.) are not even present in the fresh DU and are only 0.17% of the activity of the U-238 after 1,000 years of ingrowth. **A sample of DU waste containing 5% DU after 1,000 years would contain only about 5% of the average Ra-226 in the Vitro tailings.**

Thus, there should be no problems with radiation coming from the DU waste for thousands of years. The concern with the increase in radioactivity with time is not founded on good science and should not be considered as a big problem. In fact, I see no problem.

If the standards which were applied to the uranium mill tailings were to be used for the disposal of this waste, I would consider this more than adequate.

Please consider very carefully the facts I have presented in this analysis and don't require radon detectors where there is no radon and don't make a problem when none exists. If you are concerned about appeasing HEAL Utah and other radical anti-nuclear activists, please understand that true science and the advice of experts who understand these problems should outweigh any comments by emotional non-scientific groups.

Sincerely yours,

Blaine N. Howard, Health Physicist (retired)
323 Legacy Lane
Grantsville, Utah 84029