ENERGY*SOLUTIONS*

March 27, 2009 CD09-0077

Attn: Charles Garlow, Attorney-Advisor
OECA, Air Enforcement Division
U.S. Environmental Protection Agency
1200 Pennsylvania Avenue, N.W. – MC 2242A
Washington, DC 20460

Re: Request to Provide Information Pursuant to the Clean Air Act

Dear Sir:

In a letter dated February 24, 2009, the Environmental Protection Agency (EPA) requested information regarding Energy*Solutions*' operations in the United States. This letter and attachments provide our response to this request. As directed, each numbered item below corresponds to questions itemized in the February 24, 2009 request.

1. Energy*Solutions* does not own or operate any uranium mills or uranium mill tailings impoundments in the United States. Energy*Solutions* has not in the past owned or operated any uranium mills or uranium mill tailings impoundments in the United States.

2. Energy*Solutions* does not own or operate any uranium in-situ leaching facilities in the United States. Energy*Solutions* has not in the past owned or operated any uranium in-situ leaching facilities in the United States.

3. No information is available, since Energy*Solutions* does not own or operate any facilities subject to this question.

4. No information is available, since Energy*Solutions* does not own or operate any facilities subject to this question.

5. No information is available, since Energy*Solutions* does not own or operate any facilities subject to this question.

6. No information is available, since Energy*Solutions* does not own or operate any facilities subject to this question.

As you may be aware, Energy*Solutions* owns and operates a licensed disposal facility for uranium and thorium byproduct material as defined under Section 11e.(2) of the Atomic

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Energy Act. This disposal facility is located at Clive, Utah and regulated by the Utah Division of Radiation Control under Radioactive Material License Number UT 2300478. As provided in 40 CFR 61.250, Subpart W: "This subpart does not apply to the disposal of tailings."

The facility was originally sited and licensed in 1993 by the Nuclear Regulatory Commission under License Number SMC 1559. At that time, the facility was owned and operated by Envirocare of Utah. In 2004, Utah became an Agreement State for 11e.(2) byproduct material, assuming primary regulatory authority over the facility. Envirocare of Utah was bought and re-named Energy*Solutions* in 2005.

The Energy*Solutions* Clive 11e.(2) disposal facility is not a uranium mill, uranium mill tailings impoundment, or uranium in-situ leaching facility. It is a disposal facility licensed in accordance with 10 CFR 40 to receive solid 11e.(2) byproduct material; i.e., tailings, from off-site sources, principally remediation sites. The remediation sites are not owned by Energy*Solutions*. This license controls radon emanation via engineering controls on waste and radon barrier placement as supported by a radon attenuation model. Attached please find the Technical Evaluation Report prepared by the U.S. Nuclear Regulatory Commission in support of the 11e.(2) cell radon barrier design. This report concludes that the approved design and operating controls will maintain radon flux from the disposal cell below 20 pCi/m^2-sec.

Energy*Solutions* would be happy to meet with you and your staff to further discuss any questions or concerns relating to our 11e.(2) tailings disposal facility, at a time and location that is mutually convenient.

Please contact me at 801-649-2000 with any questions regarding this issue.

Sincerely,

Sean McCandless
Director of Compliance and Permitting

cc: Andrew Gaydosh, US EPA, Region 8
Cindy Reynolds, US EPA, Region 8
Rusty Ruby, Utah Division of Air Quality
John Hultquist, Utah Division of Radiation Control

I certify under penalty of law that I have examined and am familiar with the information in the enclosed documents, including all attachments. Based on my inquiry of those individuals with primary responsibility for obtaining the information, I certify that the statements and information are, to the best of my knowledge and belief, true and complete. I am aware that there are significant penalties for knowingly submitting false statements and information, including the possibility of fines or imprisonment pursuant to section 113(c)(2) of the Act, and 18 U.S.C. §§ 1001 and 1341.

TECHNICAL EVALUATION REPORT OF THE ENVIROCARE OF UTAH, INC.
REQUEST FOR AMENDMENT OF LICENSE TO
REDUCE THE COVER RADON BARRIER THICKNESS

DATE:	**January 18, 2002**
DOCKET NO:	**40-8989**
LICENSE NO:	**SMC-1559**
LICENSEE:	**Envirocare of Utah, Inc.** **46 West Broadway, Suite 116** **Salt Lake City, UT 84101**
FACILITY:	**South Clive Site, Tooele County, Utah**
PROJECT MANAGER:	**Myron Fliegel**
TECHNICAL REVIEWERS:	**Elaine Brummett (health physics)** **John Lusher (health physics)** **Daniel Rom (geotechnical engineering)**

SUMMARY AND CONCLUSIONS:

By letter dated September 4, 2001, with additional information provided by letter dated September 13, 2001, Envirocare of Utah, Inc. (Envirocare) requested that the U.S. Nuclear Regulatory Commission (NRC), approve revision of the radon barrier design. The revised design would reduce the thickness of the radon barrier from 8.5 feet on sides and 9 feet on the top of the disposal cell to 3 feet and 3.5 feet the sides and top respectively, with the assumption that the average radium concentration of waste in the upper 10 feet of the cell is equal or less than 500 pCi/g radium (Ra-226). Envirocare also requested that two new conditions be added to its license to address several concerns of NRC staff. On November 28, 2001, after several telephone and e-mail discussions with NRC staff, Envirocare e-mailed a revised license condition and a revised radon flux model (input parameter values in the code calculations of flux) with a minimum 3.5-foot barrier thickness on the side and 4.0-foot on the top of the disposal cell. Further discussions resulted in Envirocare proposing to limit the concentration of radium in the upper 3 feet of waste to 300 pCi/g.

The NRC staff reviewed the basis for the proposed radon flux model input and determined that the values were reasonable, given certain stipulations (which have been incorporated into the staff's proposed license condition) and previous measurements of the barrier material. The staff concluded that with the restrictions identified in the proposed license condition, the long-term radon flux from the disposal cell will be less than the regulatory limit of 20 pCi/m^2/sec.

BACKGROUND:

Envirocare's existing radon barrier design, approved by the staff in 1993, requires 8 feet of undamaged, compacted clay to be placed (the actual thickness of clay required on the top of the disposal cell is 9 feet to account for long-term damage by frost). During the NRC staff review of the Envirocare license application (LA) radon attenuation design for the disposal cell cover, it could not be determined that the estimated values used in that radon attenuation (flux) model were representative. As Envirocare could not identify what major types of waste might be disposed over the design life of the cell, it could not provide adequate waste characterization data to justify the model parameter values. Also, the borrow material for the radon barrier had not been throughly characterized. The LA provided a radon flux model to justify that the cell cover would meet the long-term radon flux limit identified in 10 CFR Part 40, Appendix A, Criterion 6 (1). The staff approved the design, using conservative parameter values to model radon attenuation.

By letter dated August 30, 2000, Envirocare requested that the radon flux model be updated to reflect measured values for the radon barrier material and to amend LA Section 16.2.2 to indicate that the radon barrier design (with 9 feet of clay on the top of the disposal cell) would meet the long-term radon flux limit with waste in the top 10 feet of the disposal cell having concentrations of Ra-226 up to 4,000 pCi/g (or thorium up to 11,000 pCi/g). A new radon attenuation model (with most parameter values revised and using the RADON computer code) was provided to support the request. The radon barrier was modeled as 8-foot thick, conservatively disregarding the limited attenuation by frost-damaged clay. The NRC staff determined that the revised radon flux model was acceptable and supported the requested increase of Ra-226 or Th-230 concentration in the waste. This August 2000 model supercedes the model in the LA and is now referenced in LC10.2 c (Amendment 35, May 1, 2001).

In August 2001, Envirocare informed the NRC staff that its Safety and Environmental Review Panel (SERP), under the performance based license prevision in LC 9.4, had approved reduction of the radon barrier thickness to 3.5 feet on top and 3 ft on the side of the cell. In an August 29, 2001, meeting between Envirocare and NRC staff, the SERP package was provided and NRC staff indicated that it would need to review and approve any reduction in the barrier thickness. Several radon flux issues were discussed and Envirocare provided a response by letter dated September 13, 2001.

In its Technical Evaluation for Amendment 35 (May 1, 2001), the staff identified concerns with several of the parameter values used by Envirocare in its flux model. Specifically, the staff disputed the value used for long-term moisture content of the radon barrier and questioned the proposed diffusion coefficient value. However, because of the overall conservatism of the radon barrier design provided by the 8 feet of compacted clay (with 9 feet on the top of the disposal cell), the staff approved the requested amendment. However, as Envirocare is now proposing a major change in its radon barrier design, primarily a major reduction in barrier thickness, all the parameter values were re-examined and some issues were re-visited that were less relevant in previous staff reviews.

TECHNICAL EVALUATION:

The staff evaluated the long-term radon emanation rate (flux) from the proposed revised cover design using the RADON computer code. The code models radon release in layers of waste and cover, its diffusion upward, and calculates its release to the atmosphere, all of which are strongly influenced by the characteristics of the waste and radon barrier materials. Therefore, the staff's review addressed the adequacy of the parameter values used in the code. The parameters reviewed were the radium concentration in the material, the density and porosity (which are related), the emanation fraction, moisture content, and diffusion coefficient. The discussion that follows considers those parameters for the proposed radon barrier and for the top layers of waste.

Radon Barrier Parameters:

Barrier Thickness

The radon barrier proposed to be built by Envirocare, would be 3.5 and 4.0 feet thick on the sides and top, respectively. In evaluating the effectiveness of the radon barrier, consideration must be given to the potential for damage of the material by frost. In the 1991 Safety Evaluation Report, the NRC staff concluded that 36 inches is the appropriate depth to use for frost damage to the cover. Erosion protection components of the cover (rock riprap and bedding material), with a thickness of 2.5 feet on the sides of the disposal cell and 2 feet on the top, will be placed above the radon barrier. Therefore, it is concluded that the top 6 inches on the sides and 1 foot on the top of the disposal cell could be damaged by frost penetration, leaving 3 feet of undamaged radon barrier on both the sides and top. The uppermost, frost damaged part of the radon barrier (i.e., the upper 6 inches on the side and 1 foot the top) are modeled by assuming the density decreases by 10 percent, with a commensurate increase in the porosity, based on the Department of Energy (DOE) work in the Uranium Mill Tailings Remedial Action (UMTRA) Program.

Barrier Construction and Stability

As the proposed new cell configuration includes a thinner radon barrier than the previously-approved version, staff queried Envirocare on stability issues. In particular, Envirocare was requested to show that the proposed thinner radon barrier would not be subject to cracking which could promote radon emanation. In response to staff's inquiry, Envirocare submitted engineering documentation showing that the thinner radon barrier was sufficiently capable of withstanding forces which could lead to cracking. Specifically, Envirocare reconfirmed its commitment to compact radon barrier material to not less than 95 percent of maximum dry density as determined by Standard Proctor Method ASTM-698. Measurements will be taken at least once for every 200 yards of compacted material, with all lifts tested and at least one test conducted each day that radon barrier material is placed.

Staff reviewed the licensee submittals and commitments and found them appropriate. A license condition confirming material placement and compaction procedures should provide adequate assurance that cover cracking concerns are addressed.

Dry Density and Porosity

Envirocare has been testing the density of the material used in the construction of the radon barrier in the past. Test data for the past 2 years indicate that dry density of the clay used varied from 89.7 to 102.7 lb/ft^3 (1.44 to 1.65 g/cm^3) and averaged 1.54 g/cm^3 after placement. Envirocare stated that the characteristics of the material were fairly uniform. Envirocare proposed using a value of 1.5 g/cm^3 in the model, which is reasonable given the test data. Envirocare will be required to continue testing the density of the radon barrier clay and to maintain the average dry density of the placed material at 1.5 g/cm^3 or greater.

The porosity of the material can be calculated from the dry density and specific gravity values. Envirocare proposed using a value of 0.44 in the flux model. Staff concludes that 0.44 is a reasonable value for porosity, given the requirement that the density be maintained at 1.5 g/cm^3 or greater.

Long-Term Moisture

Envirocare took 20 samples at depth from the borrow area to be used for the radon barrier clay and measured their moisture content. The in situ values ranged from 25.6 to 41.4 percent by weight moisture. NRC Regulatory Guide 3.64 includes this procedure as one of several to estimate the long-term moisture content of the barrier soil. However, NUREG-1620, which supercedes Regulatory Guide 3.64, states that the borrow in-situ moisture can be compared to the proposed long-term moisture value, but does not identify it as an acceptable method for estimating the long-term moisture of the barrier. Based on DOE test results (a -15 bar capillary test to reflect moisture level for plant wilting) used in designing the adjacent Clive cell radon barrier, Envirocare proposed a value of 19 percent to be used in the model. The staff concludes that 19 percent is a reasonable value to use as the long-term moisture content of the clay barrier.

Diffusion Coefficient

The radon diffusion coefficient characterizes radon movement in the pore space, with a small coefficient indicating little movement of radon. Envirocare measured the diffusion coefficient of the barrier material at different moisture contents and at a density about the same as the placed barrier soil. The test is not precise and provides a wide distribution of results at typical moisture values. Figure 1 in the August 30, 2000, submittal shows the data points used by Envirocare to derive a value of 6 x 10^{-4} cm^2/s for the diffusion coefficient. The staff determined that only one of the data points is in the area of interest (16-20 percent moisture) and that the indicated linear relationship between moisture and diffusion coefficient is unlikely given the large amount of DOE data from the UMTRA program indicating a non-linear relationship. Considering the data developed by DOE for the neighboring Clive cell barrier soil and extrapolating from the Envirocare data (by drawing a curve similar to the DOE Clive data graph) the staff concluded that a value of 3 x10^{-3} cm^2/s at a density of 1.5 g/cm^3 is a reasonable value for the diffusion coefficient.

Waste (11e.(2) byproduct material):

Volume and Thickness

Envirocare stated in its letter of March 6, 2001, that considering the waste that has been placed in the cell during the last several years has an average Ra-226 level below 50 pCi/g, LA Section 6.4, limiting the concentration in the cell to an "average of 500 pCi/g Ra-226" does not need to be revised. Based on the information that 885,000 cubic yards (cy) of waste has been placed as of February 2001, and that the design volume is 5.5 million cy, the staff determined that 16 percent of the allowed waste volume has been placed with a thickness of about 1341 cm (44 feet). When calculating radon flux, 500 cm (16.4 feet) is considered to be an infinite thickness because under typical tailings placement situations, the contribution of deeper material to radon emanation at the surface is insignificant. Envirocare proposed modeling the upper 10 feet of waste as limited in radium concentration (see below), with waste below that assumed to be at the maximum allowed radium concentration of 4000 pCi/g. The staff concludes that modeling waste below 10 feet at the maximum allowed radium concentration is conservative.

Cell Construction

As the proposed new cell configuration differs from that which is currently-approved, staff required the licensee to reconfirm the stability of the planned embankment. In particular, the proposed new configuration will replace 5 feet of radon barrier material with waste material which will be placed at a lower degree of compaction. The proposed change brought forth questions of total and differential settlement within the cell, differential settlement at the interface of the old and new portions of the cell cover, and cover cracking.

In response to staff's inquiries, Envirocare submitted engineering documentation which verified that total and differential settlement, as well as the probable extent of cover cracking for the new configuration, would be within tolerable limits.

The compaction of each lift of waste material must be within 90 percent of the density at optimum moisture as specified in Envirocare's QA/QC Manual, Attachment IIA, page 24. These specifications are consistent with the assumptions made in the revised stability and cover cracking models submitted by Envirocare. The compaction specification also better assures that the porosity of the material placed will be minimized, which is consistent with the revised radon emanation model. Staff reviewed the licensee submittals and considered them adequate. A license condition confirming material placement and compaction procedures should provide adequate assurance that these concerns are addressed.

Moisture, Dry Density, and Porosity

Envirocare stated in its submittal of April 11, 2001, that there have been hundreds of measurements made on the placed waste but the data provided to NRC were limited to measurements made on 1 lift (approximately 9 inches thick) a quarter for the past 5 years. The average moisture content and dry density measured were 12.9 percent and 1.85 g/cm^3, respectively. Given that these values cannot be ensured for future waste placement,

Envirocare proposed values of 9 percent for the long term moisture content and 1.5 g/cm^3 for the density to be used in the model. Additionally, Envirocare proposed using a porosity 0.44. The staff finds these values acceptable. Envirocare will be required to continue testing the density of the placed waste and to maintain the average dry density at 1.5 g/cm^3 or greater.

Radium and Thorium Concentration

Envirocare is required by its license (condition 10.2.c) to limit the average concentration of radium (actually a combination of radium-226 and thorium-230, which decays to radium-226, such that the total concentration of radium-226 will be limited over the next 1000 years) in the upper 10 feet of the waste to the value used in the radon flux model. However, as the radium concentration in the upper few feet of the waste can be the most critical with respect to radon emanation, Envirocare proposed (telephone conversation of December 12, 2001, and e-mail of December 13, 2001) to maintain the average radium concentration in the upper 3 feet of waste, at or below 300 pCi/g and the next 7 feet of waste at or below 500 pCi/g under the thinner radon barrier. Envirocare will be required to analyze and provide data in annual reports and the completion report on the cumulative average concentration of radium (including that produced by decay of Th-230) in the upper 3 feet and also the next 7 feet of waste. The requirement to maintain the radium concentration in the upper 3 feet and next 7 feet of waste will apply only to waste placed after January 1, 2001. Waste placed prior to that date will be under the thicker radon barrier previously approved.

Radon Emanation and Diffusion

The radon emanation fraction is the fraction of radon produced that is released from the material to the pore space, rather than being trapped within a solid grain of the material. Envirocare stated (August 30, 2000) that the average measured emanation fraction coefficient of waste placed in the embankment for the past two years was 0.19. Since the characteristics of the majority of the waste to be placed in the cell are unknown (84 percent of the licensed capacity has not been used), a value of 0.30 was proposed by Envirocare. The default value in the RADON code is 0.35 and is considered to be conservative. The staff finds the proposed value of the radon emanation to be acceptable.

Envirocare allowed the RADON code to calculate the diffusion coefficient, which is acceptable.

RADON FLUX MODELS AND RESULTS:

The input parameters for the radon flux model proposed by Envirocare for use in the RADON code are summarized below:

AREA/ MATERIAL	THICK-NESS (cm.)	POROS-ITY	DRY DENSITY (g/cm^2)	Ra-226 (pCi/g)	EMAN. FRACT.	MOIST Percent (by wt.)	DIFF. COEF. (cm^2/s)
Deep Waste	300	.44	1.5	4000	.3	9	.0257
7 ft Waste	213	.44	1.5	500	.3	9	.0257
3 ft Waste	91	.44	1.5	300	.3	9	.0257
3 ft Barrier	91	.44	1.5	0	-	19	.003
Frost Damaged Barrier							
1 ft Top Barrier	30	.49	1.35	0	-	16	.018
0.5 ft Side Barrier	15	.49	1.35	0	-	16	.018

The NRC staff used the parameters identified above in the RADON code. The calculated radon emanation from the top of the cell (with a 4 foot radon barrier, 1 foot of which was assumed to be frost damaged) was 18.3 $pCi/m^2/s$ and from the side of the cell (with a 3.5 foot barrier with 6 inches of frost damage) was 19.9 $pCi/m^2/s$. Modeling the existing cell (with 8 feet of undamaged barrier and with the Ra-226 concentration of the waste assumed to be 100 pCi/g) resulted in a calculated radon flux of 0.05 $pCi/m^2/s$. Therefore, the staff concluded that there is reasonable assurance that the completed cell cover will meet the average long-term radon flux limit of 20 $pCi/m^2/s$.

CONCLUSIONS:

The staff determined that Envirocare has demonstrated by modeling and by accepting restrictions to be placed in a new license condition that there is adequate justification for the values used to determine that a radon barrier thickness of 4.0 feet on the top and 3.5 feet on the sides of the cell, for the cover placed after December 1, 2001, will meet the long-term radon flux limit.

RECOMMENDED NEW LICENSE CONDITION:

The staff recommends that Material License SMC-1559 be amended to revise the thickness of the radon barrier and to require confirmation of several parameters of the waste and the barrier by adding License Condition 10.9 to read as follows:

10.9 The minimum compacted radon barrier thickness placed after December 1, 2001, will be 4.0 ft. on the top and 3.5 ft. on the side of the disposal cell.

a) The placed radon barrier material will be compacted to not less than 95 percent of maximum dry density in accordance with Standard Proctor Method ASTM-698, field-tested for compliance at least every 200 cubic yards (compacted). All lifts shall be field-tested for density and moisture content, and at least one test shall be conducted each day that barrier material is placed.

b) The waste shall be placed and compacted to not less than 90 percent of the maximum dry density in accordance with Standard Proctor Method ASTM D-698,field-tested for compliance at least every 1000 cubic yards (compacted). All lifts shall be field-tested for density and moisture content, and at least one test shall be conducted each day that the waste material is placed.

c) At the end of every calender year starting with 2001, the licensee shall ensure that the cumulative average activity concentration of waste placed after Jan. 1, 2001, within the upper 3 feet of disposed waste does not exceed 300 pCi/g of Ra-226 or 900 pCi/g of Th-230, and within the next 7 feet does not exceed 500 pCi/g Ra-226 or 1500 pCi/g of Th-230. When both radionuclides are present, the unity rule defined below will apply to ensure that the Ra-226 limit is not exceeded within 1000 years.

   Activity of Th-230 (pCi/g)/X + Activity of Ra-226 (pCi)/Y < or = 1

   Where:
   X = 900 pCi/g in the upper 3 feet and 1500 pCi/g in the next 7 feet of waste
   and
   Y = 300 pCi/g in the upper 3 feet and 500 pCi/gm in the next 7 feet of waste

d) The cumulative average densities of the waste and of the compacted barrier placed since January 1, 2001, shall not be less than 1.5 g/cm^3 for either.

e) These cumulative average values will be provided in the annual report starting with the 2001 report, and in the construction completion report.

ENVIRONMENTAL IMPACT STATEMENT:

An environmental review was not performed as this licensing action is categorically excluded under 10 CFR 51.22(c)(11) because there will be no significant increase in the amounts of any effluents, radiation exposure, construction impacts, or consequences from radiological accident. An environmental report from the licensee is not required by 10 CFR 51.60(b)(2).