February 23, 2012

CD12-0049

Mr. Rusty Lundberg
Executive Secretary
Utah Division of Radiation Control
Utah Division of Water Quality
195 North 1950 West
P.O. Box 144850
Salt Lake City, UT 84114-4850

Re: Radioactive Material License #UT 2300249 and Ground Water Quality Discharge Permit No. UGW450005. Amendment and Modification Request – Class A West Embankment: Response to Division Request and Round 3 Interrogatory

Dear Mr. Lundberg:

In a letter dated January 26, 2012, the Division requested that Energy*Solutions* provide edits to the Round 2, Class A West interrogatory submittal for clarity and completeness. This letter represents Energy*Solutions* response to the Division's request as well as a response to the Division's Round 3 interrogatory received February 6, 2012 via email. Energy*Solutions* will provide a response to interrogatory 16/3 under separate cover upon completion of its analysis.

Energy*Solutions*' responses to the Division's request for clarity and completeness are as follows:

1. RETARDATION FACTOR

The definition of and units presented for the nuclide-specific Retardation Factors in Whetstone's Fate and Transport Report and the Class A West License Application text have been revised to be consistent with those described in the PATHRAE-EPA Report (see revised pages in Attachment A).

2. PICOCURIES OR CURIES

The units presented for the calculated concentrations in Whetstone's Fate and Transport Report and the Class A West License Application text have been revised to be consistent with those described in the PATHRAE-EPA Report (see revised pages in Attachment A).

3. DISPERSIVITY IN PATHRAE MODELING

Further detail regarding dispersivity is provided in Response 4.

4. DISPERSIVITY IN MEMO MODELING

This response considers the high-reliability tracer tests cited in Gelhar et al. (1992) and precedence established by the DRC approval of well-spacing evaluations for the Clive facility.

Gelhar et al. (1992) High-Reliability Dispersivity Data and Comparison to CAW Well Spacing Model

The January 26, 2012 DRC review states that "Two of the model runs involve longitudinal dispersivity values under 10 feet, a source width of 1 foot, and a transverse to longitudinal dispersivity ratio of 0.1. The latter is considered typical by Gelhar et al. (2002). The longitudinal dispersivity value of 10 feet is slightly greater than the very highest end point in the range of high-reliability values referenced by Gelhar et al. (2002).....The other [Class A West] model runs use longitudinal dispersivity values outside the range of high-reliability values referenced by Gelhar et al. (2002).....Please amend the text of the ES Response to Round 2 Interrogatories to explain and justify why the DRC should be willing to accept the monitoring network with such a high number of non-detections indicated by ES modeling for data representing a reasonable source width and longitudinal dispersivity." Please note the correct reference is Gelhar et al. (1992).

Energy*Solutions* does not agree that only high-reliability dispersivity values cited in Gelhar et al. (1992) are acceptable for the Class A West (CAW) well-spacing evaluation. Only a limited amount of data are available from high-reliability studies, and the studies are dissimilar in scale and hydrogeology to the CAW evaluation and the Clive facility in general. Energy*Solutions* has provided references: 1) to demonstrate the scale-dependency of dispersion at the scale of the CAW embankment, and 2) to document industry- and regulator-accepted methods for the calculation and use of dispersivity values in groundwater modeling.

Energy*Solutions* reviewed the data for the high-reliability tracer tests cited in Gelhar et al. (1992). Out of 106 tracer tests included in their study, only 14 were considered by Gelhar et al. (1992) to be in the high-reliability category. Table 1 presents the Gelhar et al. (1992) high-reliability test data and provides comparison to Clive facility data. The Gelhar et al. (1992) high-reliability tests were conducted in media more permeable than the shallow aquifer at the Clive facility. The aquifer material was generally sand but was brecciated basalt in one study and sandstone in another. The average hydraulic conductivity of these tests was at least an order of magnitude greater than the average hydraulic conductivity of the Clive facility shallow aquifer. The scale, i.e., flow path length, of most high-reliability tests was significantly less than the average CAW model flow path length of 1,291 feet (Table 1).

The DRC states that *"Non-detection of 15 to 26 percent of plumes at the ES Clive Facility seems to be excessive..."* The results are from a sensitivity analysis provided in the CAW Round 2 Interrogatory Response. Energy*Solutions* does not consider all of the dispersivity values used in the sensitivity modeling to be representative of the system being modeled. The sensitivity analysis indicated longitudinal dispersivity values of $\leq$ 10 feet, combined with transverse dispersivity values of $\leq$ 1 foot will produce detection efficiencies less than 85 percent. However, these are extremely low dispersivity values for a flow path length of 1,291 feet. They are less than 0.8 percent of the flow path length, significantly below the longitudinal dispersivity values predicted/estimated by references provided in previous interrogatory responses on this subject.

Base-case detection efficiencies for the CAW well-spacing evaluation were 96.3 and 96.2 percent for the full embankment for I-129 and Tc-99, respectively. As part of its response to Round 1 Interrogatory CAW R313-25-26 (2 AND 3)-21/1, Energy*Solutions* calculated longitudinal dispersivity by an equation from Xu and Eckstein (1995). Using this dispersivity in the base-case Tc-99 model run for the full embankment footprint, detection efficiencies of 94.2 and 95.0 percent were determined for source widths of 1 foot and 3 feet, respectively.

The longitudinal dispersivity calculated for the CAW embankment using Xu and Eckstein (1995) was 27.2 feet, which is 2.1 percent of the average flow path length of 1,291 feet (Table 1). Table 1 indicates that the average ratio of longitudinal dispersivity to flow path length for the Gelhar et al. (1992) high-reliability data is 5.5 percent. When an equivalent ratio is applied to the average CAW embankment flow path length, the resulting longitudinal dispersivity value is 71.6 feet.

Table 1 – Comparison of Gelhar et al. (1992) High-Reliability Test Data To Clive Facility Hydrogeology

Location	Aquifer Material	Hydraulic Conductivity (cm/s)	Test Scale (feet)	Longitudinal Dispersivity (feet)	Long. Disp. /Scale
Borden Research Site Ontario, Canada	glaciofluvial sand	7.20E-03	295	1.4	0.5%
Cape Cod, Massachusetts	medium to course sand with some gravel	1.30E-01	820	3.1	0.4%
Hanford, Washington	brecciated basalt interflow zone	NR	56	2.0	3.5%
Mobile, Alabama	layered medium sand	NR	126	13.1	10.4%
Berkeley, California	sand and gravel w/clay lenses	9.00E-02	62	6.6 – 9.8	10.5 – 15.8%
Yavne region, Israel	sand and sandstone with some silt and clay	2.63E-08 to 3.00E-08	377	1.6 – 4.9	0.4 – 1.3%
Bonnaud, France	Sand	2.77E-02 to 3.67E-02	43	2.6	6.1%
			43	4.2	9.8%
			43	2.4	5.5%
			85	7.3	8.6%
			109	6.4	5.8%
			107	9.0	8.4%
Borden Research Site Ontario, Canada	glaciofluvial sand	7.20E-03	295	1.6	0.6%
Palo Alto, California	sand, gravel, and silt	2.50E-02	52	3.3	6.3%
Gelhar et al. (1992) High-Reliability Average Values:		3.93E-02	180	4.6	5.5%
Clive Facility[a]	Unit 2 - silty clay, with silty sand interbeds Unit 3 - silty sand with interbedded silt and clay layers	1.57E-03	1,291	Base Case: 129.1 Interrogatory 1: 27.2	Base Case: 10.0% Interrogatory 1: 2.1%

[a] Data from the CAW well-spacing evaluation (April 28, 2011).
NR – Not reported

Regulatory Precedence for Well-Spacing Evaluations at the Clive Facility

The following are well-spacing evaluations performed by Energy*Solutions* and its predecessor, Envirocare of Utah, Inc. Each used the scale-dependent relationship that longitudinal dispersivity equals 1/10 of the flow path length, and transverse dispersivity equals 1/10 of longitudinal dispersivity. DRC approved each without questioning the dispersivity-based assumptions.

- LARW embankment, Envirocare of Utah, Inc., April 10, 2000 (CD00-0229). Approved by DRC on April 13, 2000.
- Class A embankment, Envirocare of Utah, Inc., August 22, 2000 (CD00-0572). Approved by DRC on August 28, 2000.
- 11e.(2) embankment, Envirocare of Utah, Inc., September 4, 2002 (CD02-0349). Approved by DRC on September 6, 2002.
- Mixed Waste embankment, Whetstone Associates, Inc., March 9, 2009. Submitted by Energy*Solutions* on March 13, 2009 (CD09-0067). Approved by DRC on June 4, 2009. Revised by Energy*Solutions* and submitted on July 27, 2009 (CD09-0186), and subsequently approved by DRC on July 29, 2009.
- Class A North embankment, Whetstone Associates, Inc., March 12, 2009. Submitted by Energy*Solutions* on March 13, 2009 (CD09-0067). Approved by DRC on June 4, 2009.

Summary

Energy*Solutions* has performed a well-spacing evaluation for the CAW embankment, consistent with the evaluations performed and approved for the five existing embankments at the Clive facility. The detection efficiency for the proposed CAW monitoring network is greater than 90 percent, the DRC-established benchmark presented in writing by DRC in an August 8, 2002 letter to Envirocare of Utah, Inc.

In response to Round 1 and Round 2 Interrogatories, Energy*Solutions* has provided documentation regarding the technical basis for the scale-dependency and calculation of dispersivity values used in the CAW modeling. Energy*Solutions* has also provided a sensitivity analysis for source width and dispersivity. In this response, Energy*Solutions* has shown that the limited number of high-reliability tests evaluated in Gelhar et al. (1992) do not include a hydrogeologic setting analogous to the Clive facility. While the sensitivity analysis requested by DRC shows that at extremely low dispersivities detection efficiency could drop below the 90 percent criterion, examination of the high-reliability tests included in Gelhar et al. (1992) indicates that the scale and hydrogeology of the tests are dissimilar to those of the Clive facility and the CAW embankment. As such, no further changes have been made to the application or its supporting appendices.

ENERGYSOLUTIONS

5. TABLE 24 ACCEPTED. WHERE IS DATA FROM HORIZONTAL TRANSPORT

The results of Whetstone's horizontal fate and transport analysis have been appended to Whetstone's Fate and Transport Report (see revised pages in Attachment A).

6. JUSTIFY 1.9 MILLION CUBIC YARDS VERSUS 1.6 IDENTIFIED IN REFERENCE LETTER

The cause for this misunderstanding is the result of a typographical error in the interrogatory response. The correct value is 1.6 million cubic yards, as stated in the application text and the letter provided in Attachment 9; not 1.9 million as provided in the interrogatory response. As such, no changes have been made to the application or its supporting appendices.

The electronic file provided with this submittal contains Energy*Solutions*' response to the Division's Round 3 interrogatory, as well as a complete, updated application. It should be noted that although pagination changed for the Fate and Transport Modeling provided in Attachment 3 of the electronic file, only substantial, technically based changes were printed and provided in Attachment A to this letter. If you have any questions regarding this issue, please contact me at 801-649-2000.

Sincerely,

Sean McCandless
Director, Compliance and Permitting

enclosures

cc: John Hultquist, DRC (w/ encl.)
Robert Baird, URS (w/ encl.)

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.