UTAH LOW-LEVEL RADIOACTIVE WASTE DISPOSAL LICENSE AMENDMENT REQUEST (UT2300249) FOR THE CLASS A WEST EMBANKMENT

RESPONSES TO ROUND 1 INTERROGATORIES

October 28, 2011

For
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TABLE OF CONTENTS

Interrogatory		Page
1.	CAW R313-25-6(3)-01/1: Description of Facility ……	1
2.	CAW R313-25-7(1)-02/1: Specific Technical Information – Groundwater Elevation Value(s) Used in Analyses …….	1
3.	CAW R313-25-7(2)-03/1: Specific Technical Information – Buffer Zone …….....	3
4.	CAW R313-25-7(3)-04/1: Specific Technical Information – Design Criterion for Distortion of Liner and Clay Cover Components ……	7
5.	CAW R313-25-7(7)-05/1: Specific Technical Information -- Closure Plan ……..	9
6.	CAW R313-25-7(9)-06/1: Specific Technical Information – Quantities of Radioactive Materials …….	12
7.	CAW R313-25-7(10)-07/1: Specific Technical Information – Construction Quality Assurance/Quality Control Manual ……	13
8.	CAW R313-25-8(1)-08/1: Technical Analyses; Releases of Radioactivity ……	15
9.	CAW R313-25-8(2)-09/1: Technical Analyses; Protection of Inadvertent Intruders …….	16
10.	CAW R313-25-8(4)-10/1: Technical Analysis – Design Safety Factors ……...	16
11.	CAW R313-25-8(4)-11/1: Technical Analysis - Rock Cover Design And Rock Cover Design Calculations/ Analyses ……	18
12.	CAW R313-25-8(4)-12/1: Technical Analysis - Filter Stability/ Filter Permeability Criteria.	22
13.	CAW R313-25-8(4)-13/1: Technical Analyses - Perimeter Drainage Ditch Calculations …	23
14.	CAW R313-25-8(4)-14/1: Technical Analyses – Infiltration and Transport Modeling: Climate Conditions, Engineered Barrier Conditions, and Vertical Transport Distance ……	26
15.	CAW R313-25-8(4)-15/1: Technical Analyses – Groundwater Depth in Geotechnical Stability Analysis …….	29
16.	CAW R313-25-8(4)-16/1: Seismic Hazard Evaluation / Seismic Stability Analysis Update .	30

TABLE OF CONTENTS (continued)

Interrogatory		Page
17.	CAW R313-25-24(1 through 3)-17/1: Disposal Site Design for Near-Surface Disposal - Liner Design and Construction ……...	32
18.	CAW R313-25-24(5)-18/1: Disposal Site Design for Near-Surface Disposal - Drainage Juncture and Drainage Outlet Design for Perimeter Drainage Ditch System …….	33
19.	CAW R313-25-25(6)-19/1: Radiation Dose Rate at the Surface of the Cover ……..	35
20.	CAW R313-25-26(1)-20/1: Environmental Monitoring ……	37
21.	CAW R313-25-26 (2 and 3)-21/1: Technical Analyses - Horizontal Transport and Well Spacing Analysis Input Parameters ……	39
22.	CAW R313-25-33(1)-22/1: Records ……...	43
23.	CAW R317-6-6.4-23/1: Issuance of Discharge Permit: Best Available Technologies – Monitoring Wells Requiring Abandonment and Decommissioning and Lysimeters Proposed for Abandonment …….	43
	REFERENCES ……..	45

LIST OF TABLES AND FIGURES

Table/Figure	Page
Summary of Maximum Tensile Strain Studies for Clay Barriers	8
Airborne Particulate Analysis	39

1. INTERROGATORY CAW R313-25-6(3)-01/1: DESCRIPTION OF FACILITY

Regulatory Reference: R313-25-6(3). A description of:

(a) the location of the proposed disposal site;
(b) the general character of the proposed activities;
(c) the types and quantities of waste to be received, possessed, and disposed of;
(d) plans for use of the land disposal facility for purposes other than disposal of wastes;
(e) the proposed facilities and equipment

Division's Interrogatory Statement: *Refer to Sections1.2.2.12 and 3.3.1.6 of the Class A West (CAW) Embankment License Amendment Request (LAR):*

1. *Provide the updated site layout, referred to as "Figure 1" and revise references to the Figure 1 actually provided "MicroShield® Case Title – Class A West Cover".*

Energy*Solutions*' Response: References in Sections 1.2.2.12 and 3.3.1.6 corrected.

Division's Interrogatory Statement:

2. *Describe the proposed use of concrete (CLSM) in the CAW and explain any differences from its previously approved use in the Class A and Class A North embankments.*

Energy*Solutions*' Response: While the Division's interrogatory statement points to Section 3.3.1.6 of the LAR, it should be noted that Section 3.3.1.6 discusses closure of individual disposal units.

Please refer to Section 3.3.1.4 for the discussion on the proposed use of concrete and CLSM in the Class A West Embankment design. The following text was added to this section: "There are no proposed differences between CLSM usage in the Class A West Embankment and CLSM usage in the Class A or Class A North embankments."

2. INTERROGATORY CAWR313-25-7(1)-02/1: SPECIFIC TECHNICAL INFORMATION – GROUNDWATER ELEVATION VALUE(S) USED IN ANALYSES

Regulatory Reference: R313-25-7. The application shall include certain technical information…. (1) A description of the natural and demographic disposal site characteristics shall be based on and determined by disposal site selection and characterization activities. The description shall include geologic, geochemical, geotechnical, hydrologic, ecologic, archaeologic, meteorologic, climatologic, and biotic features of the disposal site and vicinity.

Division's Interrogatory Statement: *Refer to Sections 2.4.2 and 3.1.1 of the Class A West (CAW) Embankment License Amendment request (LAR): Please provide a clear reference or documentation for the statement that the highest recorded elevation of the upper unconfined aquifer is 4255 feet above sea level.*

Energy*Solutions*' Response: As is referenced in the Groundwater Reports submitted by Energy*Solutions* to the Utah Division of Water Quality from 1993 to present, the elevation cited in Sections 2.4.2 and 3.1.1 is conservatively higher than the maximum value for wells surrounding Class A and Class A North areas (maximum is 4,251.3 ft amsl; average is 4,249.7 ft amsl - for the period of observation of August 1993 to the most recently available of May 2011). Section 3.1.1 of the Class A West License Amendment Request has been revised to provide the observed maximum groundwater elevation of 4,251.3 ft amsl.

Division's Interrogatory Statement: *Describe how the historical groundwater data set from which this value was derived (and other historical groundwater elevation information, as applicable) were considered when selecting groundwater elevation data used in analyses (geotechnical stability analysis, contaminant transport analysis) that were performed by Energy Solutions and included in the CAW LAR and its attachments (see also Interrogatories R313-25-8(4)-06/1: Technical Analyses – Infiltration and Transport Modeling: Climate Conditions, Engineered Barrier Conditions, and Vertical Transport Distance and R313-25-8(4)-07/1 Technical Analysis-Groundwater Depth in Geotechnical Stability Analysis below).*

Energy*Solutions*' Response: As is referenced in the Groundwater Reports submitted by Energy*Solutions* to the Utah Division of Water Quality from 1993 to present, the average groundwater elevation in the shallow water-bearing zone beneath the Class A West Embankment footprint is 4,249.7 ft amsl, based on the most recent 17 years of data. The infiltration and transport model of Attachment 3 used an average of 4,249.6 ft amsl. This value is sufficiently close to the long-term average.

The updated geotechnical stability analysis cites depth to water data (26 ft) from Cone Penetrometer Testing (CPT) locations along the north side of Class A North (Figure 3A of Attachment 5 to the Class A West License Amendment Request). The average ground surface elevation for the closest wells to the CPT locations (GW-108 to GW-116) is 4,275.4 ft amsl (Envirocare, 2004). Using the depth of 26 ft reported in Attachment 5 to the Class A West License Amendment Request and the average ground surface elevation, the "representative" groundwater elevation presented in the geotechnical analysis in Attachment 5 is approximately 4,249.4 ft amsl. Based on this information, the average and "representative" groundwater elevations used in Class A West modeling and geotechnical analysis, respectively, are consistent with each other and the 17-year observed average.

Division's Interrogatory Statement: *Explain and justify differences between assumed elevation values used in different analyses and the historically highest groundwater elevation value mentioned in Section 3.1.1 of the CAW LAR.*

Energy*Solutions*' Response: References to groundwater elevation quoted in Section 3.3.1 of the Class A West License Amendment Request have been revised to the observed 17 years maximum value of 4,251.3 ft amsl. References have also been expanded to note that:

1) The infiltration and transport modeling uses an average groundwater elevation of 4,249.6 ft amsl. However, when the height of the capillary zone calculated by UNSAT-H (2.04 ft) is included in the calculation of the thickness of the unsaturated zone, it conservatively reduces the thickness of the unsaturated zone used in modeling more than using the 17-year maximum observed groundwater elevation in modeling, which is 1.6 feet higher than the 17-year average elevation (4,251.3 - 4,249.7 ft amsl = 1.6 ft). Thus although the infiltration and transport modeling uses an average groundwater elevation, the calculation of the vertical pathway thickness is still conservative with respect to groundwater elevation.
2) The geotechnical stability uses a conservative groundwater elevation of approximately 4,253.4 ft amsl. This value is approximately 2 feet greater than the 17-year maximum observed groundwater elevation of 4,251.3 ft amsl for the Class A West Embankment footprint.

Both models are conservative with respect to groundwater elevation and thickness of the unsaturated zone.

3. INTERROGATORY CAW R313-25-7(2)-03/1: SPECIFIC TECHNICAL INFORMATION – BUFFER ZONE

Regulatory Reference: R313-25-25(8).A buffer zone of land shall be maintained between any buried waste and the disposal site boundary and beneath the disposed waste. The buffer zone shall be of adequate dimensions to carry out environmental monitoring activities specified in R313-25-26(4) and take mitigative measures if needed.

Division's Interrogatory Statement: *Refer to Sections1.2.2.2 and 4.3.6 of the Class A West (CAW) Embankment License Amendment Request (LAR):*

1. Please explain how EnergySolutions allowed the buffer zone east of the Class A embankment to be constructed so that less than 94 feet were provided. Identify the root causes of this discrepancy. Explain what actions will be or have been taken to ensure that similar discrepancies in other locations do not occur in the future.

Energy*Solutions*' Response: The discrepancy lays with the approved design drawings for the Class A Embankment. Those drawings establish a design toe of waste at the southeast corner that is 92.7' west of the property boundary and at the northeast corner that is 95.4' west of the property boundary, as indicated in Figure A of Attachment 9 to the revised Class A West License Amendment Request. The root cause of this design discrepancy is unknown. However, the Section 32 survey rotational error that was identified and corrected in 2009 (RML Amendment 5) is a likely source. The corrected

section and property survey information has been added to the engineering design data base and all known incorrect survey information has been purged. This action should prevent similar future discrepancies in other locations at the facility.

Division's Interrogatory Statement:

2. *Describe in detail how waste disposal has encroached upon the bounds of buffer zones defined by Tables 3 and 7 of the Groundwater Quality Discharge Permit. Provide detail demonstrating how the configuration of the constructed disposal unit departs from the proposed and approved configuration.*

Energy*Solutions*' Response: As stated in Response 1 above, the design waste limits do not allow for a 94 ft buffer zone along the east side of the Class A Embankment. However, due to LLRW Embankment construction specifications (LLRW and 11e.(2) CQA/QC Manual, Revision 23 and earlier) imposed at the time of construction, the actual toe of waste was held back a minimum of 5 ft from the design waste limits to accommodate 1 ft of temporary cover. Although the design drawings and specifications for temporary cover were revised in 2009 (LLRW and 11e.(2) CQA/QC Manual, Revision 24E) to allow waste to be placed to the design limits, Energy*Solutions* has not placed (and will not place) any waste within the 5 ft offset from the design limits—soil material within that offset is clean native material previously placed as temporary cover. Therefore, as shown on Figure A of Attachment 9 to the revised Class A West License Amendment Request, there is a minimum of 97.7 ft from the toe of actual waste to the property boundary, thus allowing for a minimum 94 ft buffer zone. The design drawings for the Class A West Embankment, refer to Attachment 2 of the revised Class A West License Amendment Request, have been revised to identify a waste restricted area to prevent future placement of waste within the buffer zone. With this additional construction restriction and establishing the buffer zone limits along the Vitro property boundary (as shown on Drawing U01), a minimum buffer zone of 97.7 ft is established along the east side of the Class A West Embankment.

Division's Interrogatory Statement:

3. *Justify the statement that "This discrepancy in the buffer zone for the eastern waste limit of the Class A embankment does not compromise the facility's ability to comply with the well network early warning requirement at Part I.F.1(f) of the GWQPD."*

Present evidence to demonstrate that the ability "to carry out environmental monitoring activities . . . and take mitigative measures if needed" is preserved, despite this discrepancy, as required by R313-25-25(8). That is, present evidence to demonstrate that adequate time exists, not only to detect a contaminant release, but also to take mitigative measures throughout the entire buffer zone east of the Class A embankment, if they were required.

In providing this evidence, identify and discuss what mitigative measures could be implemented timely to preclude release of contaminant through the buffer zones.

Energy*Solutions*' Response: Evidence that adequate time exists to detect a contaminant release in the smaller buffer zone at the southeast corner of the Class A West Embankment is provided by the well spacing analysis, included as Attachment 6 to the Class A West License Amendment Request. This analysis relies upon the actual installed locations of existing wells to the east of the Embankment, specifically, GW-88, GW-89, GW-90, GW-91, and GW-92. As provided in Table 1.2 in Section 1.2.2.2 of the Class A West License Amendment Request, the minimum distance between these wells and the Vitro property line is 6.0 feet. Given these actual well locations, the analysis demonstrates that the evaluated well network will provide leak detection with greater than 95% efficiency for the Class A West Embankment.

Table 1.2 has been updated to add wells GW-92 and GW-24, as the drawings and further evaluation called for under item 4 of this interrogatory has revealed an area of concern for the Vitro buffer at the northeast corner of waste placement for the 11e.(2) Embankment. A concern is also identified and discussed regarding the 300 foot Tooele County buffer to the outside property line, at the southwest corner of the 11e.(2) Embankment.

Section 1.2.2.2 has also been revised accordingly.

Division's Interrogatory Statement:

4. *Provide a drawing(s) clearly showing the locations of ". . . the closest edge of any embankment (i.e., toe of waste) and the outside site boundary or property line." Ensure that other symbols do not obscure the symbol denoting the outside site boundary or property line. Indicate on the drawing(s) the minimum distances between the toe of waste for each embankment (whether existing or proposed) and the outside site boundary or property line. If any such minimum distance is less than 300 feet, identify what actions will be taken to remedy the discrepancy and to preclude occurrence of similar situations in the future. Provide evidence to demonstrate that adequate time exists, not only to detect a contaminant release, but also to take mitigative measures, if they are required.*

Energy*Solutions*' Response: Figures A, B and C provided in Attachment 9 to the Class A West License Amendment Request show the relationship between each Embankment (Class A West, Class A, Class A North, 11e.(2), LARW and Mixed Waste) and the property boundaries.

Figure A shows that the Class A West, Class A and Class A North embankments are all offset at least 300 ft from the external (north, west and south) property boundaries per the Tooele County CUP requirement. The discrepancy for the 94 ft buffer zone along the east perimeter of the Class A Embankment is discussed in Items 1 and 2 above.

Figure B shows two discrepancies for the 11e.(2) Embankment. One (along the south end of the west side), is for the 300 ft Tooele County CUP buffer zone requirement and the other (near the NE corner) is for the radioactive material license 94 ft buffer zone requirement. Both of these discrepancies are clearly detailed on Figure B. The discrepancy for the 300 ft buffer zone requirement will be resolved by revising the design waste limits in the SW corner; by relocating the SW corner to a point along the current south limits a distance of 300 ft from the property boundary. Waste has not yet been placed near this location; and will not be in the near future as the 2000 Pond would first need to be decommissioned. This will be done under a separate amendment request for the 11e.(2) license, RML #UT 2300478.

Section 1.2.2.2 has been updated accordingly.

Division's Interrogatory Statement: *Provide similar drawings to demonstrate that the width of no buffer zone between disposal embankments, other than those east of the Class A embankment, is less than 94 feet.*

Energy*Solutions*' Response: Figure C demonstrates that both the LARW and Mixed Waste embankments meet both the Tooele County CUP buffer zone requirement (300 ft) and the Ground Water Quality Discharge Permit buffer zone requirement (94 ft).

Division's Interrogatory Statement:

5. Correctly state the dimension of the buffer zones surrounding the CAW.

Energy*Solutions*' Response: Additional dimensions and information have been added to Drawing U01, Revision 1 to clearly show the dimensions of the buffer zone around the Class A West Embankment.

Division's Interrogatory Statement:

6. Please correctly label the exterior boundaries of the CAW waste limits and break-lines on drawing sheet C05, and redraw as needed.

Energy*Solutions*' Response: The requested changes are completed and included in Revision 1 of Drawing C05.

4. INTERROGATORY CAW R313-25-7(3)-04/1: SPECIFIC TECHNICAL INFORMATION – DESIGN CRITERION FOR DISTORTION OF LINER AND CLAY COVER COMPONENTS

Regulatory Reference: R313-25-7. The application shall include certain technical information…. (3) Descriptions of the principal design criteria and their relationship to the performance objectives.

Division's Interrogatory Statement: *Refer to Table 3-2 and Sections 1, 4, and 5 of Attachment 5 (Geotechnical Update Report, EnergySolutions Clive Facility Class A West Embankment, Clive, Toole County, Utah, February 15, 2011) to the Class A West (CAW) Embankment License Amendment request (LAR):Please provide additional documentary evidence (beyond that presented in a letter report from October 2000 [AMEC 2000] and referenced in analyses that were performed in 2005 ([AMEC 2005]), if such evidence is available and applicable, of the basis for choosing 0.02 as the design criterion for evaluating allowable distortion of the liner and clay components of the CAW Embankment cover.*

Energy*Solutions*' Response: While no basis for concern is provided over the cited reference, failure of landfill covers due to excessive differential settlement from linear elastic fracture mechanics has been long known to be problematic in landfill performance integrity. The deformation behavior of clay barriers at the onset of continuous differential settlements has been analyzed analytically, in full-scale field tests, and through reduced-scale laboratory testing (Viswanadham, 2009).

Several studies employing a variety of testing techniques have been conducted since AMEC's initial 2000 analysis. Viswanadham (2002) presented results conducted on less dense clays (with slightly higher liquid limits than those native to Energy*Solutions*' Clive site) in small-centrifuge laboratory tests, with maximum tensile strains ranging from 0.7% to 1.3%. Wang (2007) utilized an improved 3-point bending beam loading assembly to measure fracture resistance in clays used in earth-rock fill dams of Western China (maximum tensile strength of 0.5%). Wang's clays exhibited a lower plasticity index and liquid limit than those native to Energy*Solutions*' Clive site. Le (2009) used a Discrete Element Method to measure maximum tensile strengths for generic clays between 2.5% and 4.7%. Following his analysis in 2002, Viswanadham (2009) again used his centrifuge model to measure a maximum tensile strain of 0.7% for similar clays of those native to Energy*Solutions*' Clive site. Camp (2010) utilized a 4-point bending test protocol to measure maximum tensile strains of 0.2% to 0.6% for Aptien clays (similar to those native to Energy*Solutions*' Clive site). Subsequently, Gourc (2010) used fill-scale and centrifuge tests again on Aptien clays to observe maximum tensile strains of 0.3% to 0.9%. Finally, Rajesh (2010) utilized a hydraulic trap-door centrifuge system on clays used on Bombay, India landfills (which are also similar to those native to Energy*Solutions*' Clive site) to observe maximum tensile strains of 2.8% to 3.0%.

These references further substantiate LaGatta's (1997) demonstration of the relationship between differential settlement, tensile strain, and angular distortion, noting that at very small values of angular distortion, clay tensile strains are also very small. Table 1 summarizes the available data sets which were used to evaluate the validity of AMEC reference (2000) longevity. From these references, the selection of a maximum tensile strain of 0.2% is demonstrated to be a very conservative lower bound. At such a small tensile strain, LaGatta estimates an angular distortion of 0.06 (providing basis for the selected design criterion of 0.02 for allowable distortion of the liner and clay components of the Class A West Embankment cover).

Table 1 – Summary of Maximum Tensile Strain Studies for Clay Barriers

	Reference	Plasticity Index (%)	Liquid Limit (%)	Maximum Dry Density (pcf)	Maximum Tensile Strain (%)
Energy*Solutions*' Clay	AMEX, 2000	10 - 25 avg 16	36	97 - 106	0.8
Speswhite Kaolin Clay	Viswanadham, 2002	16.5	44.5	87.1 - 102.9	0.7 - 1.3
Nuozhadu Dam	Wang, 2007	8.9	29.1	99.9 - 109.9	0.5
Generic Clay	Le, 2009				2.5 - 4.7
Model Clay (80% Kaolin, 20% sand)	Viswanadham, 2009	16	38	101.3	0.7
Aube, France (Aptien Clays)	Camp, 2010	22	44	47.1 - 115.3	0.2 - 0.6
Aube, France (Aptien Clays)	Gourc, 2010	16-22	38 - 44	101.3 - 110.8	0.3 - 0.9
Landfill Barriers	Rajesh, 2010	16	38	101.3	2.8-3.0

Division's Interrogatory Statement: *Demonstrate whether, based upon a reasonable degree of research of more recent published literature and guidance pertaining to the matter of recommended allowable angular distortions for compacted clay engineered barriers, any revision is warranted to the maximum allowable angular distortion criterion value of 0.02 that was used in analyses done to support this CAW LAR.*

Energy*Solutions*' Response: As is demonstrated in the research summarized in Table 1, no revision is warranted to the maximum allowable angular distortion criterion value of 0.02 that was used in analysis done to support this Class A West License Amendment Request.

Division's Interrogatory Statement: *To the extent applicable, include consideration of how this criterion value relates to criteria typically used for other types of structures.*

Energy*Solutions*' Response: References cited in Table 1 address application of typical criteria for various types of structures, substantiating its use in the Class A West License Amendment Request.

Division's Interrogatory Statement: *Justify whether the choice of 0.02 continues to be appropriate for evaluating the compacted clay components in the CAW Embankment with respect to protecting the integrity of both the liner and the clay components of the embankment cover from potential future differential settlement-induced damage.*

Energy*Solutions*' Response: References cited in Table 1 demonstrate that a conservative value for maximum allowable distortion is much higher than the 0.02 value selected, which continues to be demonstrated as incorporating "considerable conservatism."

Division's Interrogatory Statement: *Verify that this criterion value remains consistent with current engineering practices for compacted clay layers or similar structures.*

Energy*Solutions*' Response: References cited in Table 1 demonstrate that consideration of this criterion in Energy*Solutions*' Class A West License Amendment Request remains consistent with current engineering practices for compact clay layers and similar structures.

Division's Interrogatory Statement: *Present information and revised analyses or findings, if applicable, based on considering any revised distortion criterion value that may be recommended.*

Energy*Solutions*' Response: While references cited in Table 1 support the use of higher allowable maximum distortion design criterion, Energy*Solutions*' use of a maximum allowable distortion of 0.02 remains conservative.

5. INTERROGATORY CAW R313-25-7(7)-05/1: SPECIFIC TECHNICAL INFORMATION -- CLOSURE PLAN

Regulatory Reference: R313-25-7. The application shall include certain technical information….(7) A description of the disposal site closure plan, including those design features which are intended to facilitate disposal site closures and to eliminate the need for active maintenance after closure.

Division's Interrogatory Statement: *Sections 1.3.1, 1.3.2, and 1.3.3, 3.1.6, 3.2.6, 3.3.1.6, 4.3.5, and 5.0 of the Class A West (CAW) Embankment License Amendment request (LAR), and Attachment 1 (Proposed Amendments ["RML Revisions and GWQDP Revisions"]), and Attachment 2 ("CAW License-Permit Drawings") of the CAW LAR:*

1. *Provide information on proposed staging of closure of the embankment in closure phases, as applicable. Provide a schedule for commencing and completing each identified phase of closure. Demonstrate that the timing of any such phase of final closure will be integrated with timing of settlement monitoring activities and with distortion analysis determinations based on acquired settlement monitoring data for any areas to be closed. Provide information that adequately demonstrates that the proposed plan for phased closure and for integrating the various closed phases will result in an effective, continuous closure cover and drainage system installation. Evaluate and address the need for further revisions, if any, to RML and/or GWQDP conditions, as appropriate.*

   Energy*Solutions*' Response: Sections 1.3.3, 3.2.6, and 3.3.1 have been revised to clarify embankment closure.

Division's Interrogatory Statement: *Refer to Section 2.5.4 of the Class A West (CAW) Embankment License Amendment Request (LAR):*

2. *Please provide fully checked and QA'd analyses of clay borrow and rock borrow (also referred to as "erosion materials" in Table 2.2) volumes, with references to engineering drawings as needed to establish the inputs for each calculation.*

   Energy*Solutions*' Response: Detailed, peer reviewed quantity calculations (included as Attachments 9 and 10 of the Class A West License Amendment Request) for clay liner, liner protective cover, temporary cover, radon barrier and the various cover erosion layers for the Class A West Embankment have been completed and are attached. In addition, Tables 2.1 and 2.2 have been updated to include the results of the more detailed calculations. Similar calculations were performed for the 11e.(2) and Mixed Waste embankments to determine the total borrow needs for all disposal embankments.

   Table 2.1: First, an error in Table 2.1 was identified and corrected—a thickness of 4.5 ft was used instead of the design 3.5 ft in the calculation of the "Erosion Materials (rock)" for the Side Slope of the Class A West design. In addition to this correction, the areas for the Class A West were updated to reflect the more accurate calculations referenced above, and the thickness for the "outer Ditch Slope Area" erosion materials was increased to 2.0 ft per the results of Interrogatory R313-25-8(4)-13/1. Last, clay borrow needs for liner and liner protective cover were added to the table. Table 2.2 has also been updated to reflect more detailed and accurate calculations for clay and rock borrow quantities for all embankments.

Division's Interrogatory Statement:

3. *Please provide affirmative evidence that adequate supplies of clay borrow and rock borrow materials will be available at a unit cost no greater than that assumed in closure cost estimates, to accomplish closure activities (insofar as these materials are involved) at a cost no greater than estimated is surety cost estimates. Identify each source beyond those already owned by or under contract to EnergySolutions.*

Energy*Solutions*' Response: Clay borrow (required for liner, liner protective cover, temporary cover and radon barrier) is available on Energy*Solutions* property. Rock, sand and gravel borrow material (needed for the filter, sacrificial soil and riprap cover layers) is available on BLM land in the Grayback Hills north of the facility.

Clay Borrow: Figure D of Attachment 9 to the Class A West License Amendment Request shows four potential borrow areas located within Section 29 of Energy*Solutions* property. Additionally, the calculations attached therein conservatively estimate 2.3 million cubic yards of suitable clay within these 4 areas, with a potential of nearly 3.2 million cubic yards. The clay resource in these areas is 1.2 to 1.7 times (respectively) more than the 1.9 million cubic yards (as summarized in Table 2.2) required for construction of clay liner, liner protective cover, temporary cover and radon barrier.

Rock Borrow: The total rock, sand and gravel borrow requirements for the Class A West, 11e.(2) and Mixed Waste embankments is calculated to be approximately 1.53 million cubic yards (refer to Table 2.2 for a summary of the calculations). Energy*Solutions* has previously demonstrated (through the annual surety review process) that there is a resource of at least 1.1 million cubic yards of suitable rock borrow within Energy*Solutions*' contract area of BLM Community Pit 24 (62744) located in the Grayback Hills north of the Clive facility. In review, provided as Attachment 9 to the Class A West License Amendment Request is an excerpt from a report prepared by PEPG Engineering, L.L.C. (2004) that summarizes exploratory digging and evaluation of Site C3, which is the Energy*Solutions* contract area of Pit 24. Per the report (refer to page 2) there is a proven and probable 1.1 million cubic yards of material within the pit with a possible additional 660,000 cubic yards.

The Figure entitled, "Central Grayback 24 CP 62744" of Attachment 9 to the Class A West License Amendment Request shows the community pit boundaries and the Energy*Solutions* contract area there within. No material has been removed from the contract area since the PEPG exploration was performed. Energy*Solutions* recently requested the BLM to provide an estimate of the resource available within the entire community pit. In response, the BLM has verbally confirmed that there is a resource of at least 1.6 million cubic yards within Community Pit 24 (Garahana, 2011, letter provided in Attachment 9 of the Class A West License Amendment Request). Last, in response to a request for information from the Division to demonstrate that the material within Community Pit 24 is suitable for cover materials, Energy*Solutions* has provided in

Attachment 9 a letter from John Garr, Montgomery Watson Harza. The attached letter confirms that the rock material within Pit 24 is the same type of material as that from previously approved borrow pits located on the south end of the Grayback Hills.

6. INTERROGATORY CAW R313-25-7(9)-06/1: SPECIFIC TECHNICAL INFORMATION – QUANTITIES OF RADIOACTIVE MATERIALS

Regulatory Reference: R313-25-7(9). The application shall include certain technical information. The following information is needed to determine whether or not the applicant can meet the performance objectives and the applicable technical requirements of R313-25: Descriptions of the kind, amount, classification and specifications of the radioactive material proposed to be received, possessed, and disposed of at the land disposal facility.

Division's Interrogatory Statement: *Refer to Sections 6.1.1 and 7.2 of the Class A West (CAW) Embankment License Amendment Request (LAR):*

(1) Correctly state in Section 6.1.1 the nature and extent of the change in quantities of waste expected to be disposed of in the proposed CAW.

(2) Correctly state in Section 7.2 the increase in quantity of LLRW to be disposed of in the proposed CAW and the effects such increases will have on the need for radiation protection.

Energy*Solutions*' Response: The referenced sections are not incorrect. Although total licensed capacity, and thus waste volume, will increase with the proposed Class A West Embankment, the types of waste to be received and annual receipts are not projected to change. The referenced sections of the 2005 License Renewal Application develop annual waste projections of up to 11 million cubic feet received per year. This rate continues to bound recent history and current projected waste volumes per year. In fact, waste received for disposal in the Class A and Class A North cells has averaged 4 million cubic feet per year for the last 4 years. Nonetheless, to clarify this point these sections have been revised.

Division's Interrogatory Statement: *Refer to Attachment 3 to the Class A West (CAW) Embankment License Amendment Request (LAR):*

(3) Please explain why many of the radionuclide concentrations in the modeling report (Whetstone 2011) are below the Class A upper limits.

Energy*Solutions*' Response: The correct concentrations were used in the modeling. The maximum concentrations listed in Table 22 in units of Ci/m^3 were converted incorrectly using a bulk density of 1.11 gm/cm^3 rather than 1.8 gm/cm^3. Table 22 has been corrected and will be submitted under separate cover, at a later date.

7. INTERROGATORY CAW R313-25-7(10)-07/1: SPECIFIC TECHNICAL INFORMATION – CONSTRUCTION QUALITY ASSURANCE/QUALITY CONTROL MANUAL

Regulatory Reference: Refer to R313-25-7. The application shall include certain technical information….(10)Descriptions of quality assurance programs, tailored to low-level waste disposal, including audit and managerial controls, for the determination of natural disposal site characteristics and for quality control during the design, construction, operation, and closure of the land disposal facility and the receipt, handling, and emplacement of waste.

Division's Interrogatory Statement: *Refer to Sections 1.3, 3.1.6, 3.2.6, 3.3.1.6 of the Class A West (CAW) Embankment License Amendment request (LAR), and Attachment 1 (Proposed Amendments ["RML Revisions and GWQDP Revisions"]) of the CAW LAR: Please provide revised and additional information in the CAW LAR and a revised version of Attachment 1 to the CAW LAR, as appropriate, to address specific procedures, methods, testing frequencies, and/or schedules for completing testing or other activities that apply to CQA/QC activities that would be performed at the proposed CAW Embankment.*

Provide a revised Construction Quality Assurance/Quality Control (CQA/QC) Manual that incorporates changes to all Work Elements of the currently approved CQA/QC Manual, as needed, to address these procedures, methods, schedules, etc…Include revised information pertaining to: (1) open-cell timeframe for the CAW Embankment; (2) proposed timetables for placing Temporary Cover and for completing related settlement monitoring and distortion analyses (e.g., by phase/area) at the CAW Embankment, if applicable; (3) schedules for conducting CQA/QC activities in conjunction with any proposed phasing/staging of partial closure activities that would be performed at the CAW Embankment; and (4) other items as needed.

Provide information demonstrating that any proposed staging for phased closure of the CAW Embankment will be integrated with timing of settlement monitoring activities and with distortion analysis determinations in any areas to be closed.

Energy*Solutions*' Response: Most of the speculated subjects within the Radioactive Material License, Ground Water Quality Discharge Permit, or CQA/QC Manual do not require further revision. Each is discussed below:

1. Open cell timeframe: Revision 25d of the CQA/QC Manual was approved on April 4, 2011. The reference provided in rev. 0 of the amendment request was outdated. Revision 25d updates the open cell timeframes for cover construction, within interim deadlines for temporary cover. No further changes are needed for the Class A West Embankment. See also the response to interrogatory 5 and the revisions to sections 1.3.3 and 3.3.1.6 of the amendment request.
2. Timetables for temporary cover, settlement monitoring, and distortion analysis: As with the open cell timeframe, these timetables were updated in revision 25d of the CQA/QC Manual approved on April 4, 2011. No further changes are needed

for the Class A West Embankment. See also the response to interrogatory 5 and the revisions to sections 1.3.3 and 3.3.1.6 of the amendment request.

3. Schedules affected by partial closure: Existing CQA/QC Manual controls adequately address construction of liner and cover over multiple staged projects. This approach has successfully been applied throughout the life of the facility and no revisions are needed. No further changes are needed for the Class A West Embankment. See also the response to interrogatory 5 and the revisions to sections 1.3.3 and 3.3.1.6 of the amendment request.
4. Other items as needed: Revision 26a of the CQA/QC Manual has been prepared to update applicable "Scope" specifications within each work element to replace references to the Class A and Class A North Embankment with reference to the Class A West Embankment. Similarly, Figures 2 and 6 of the CQA/QC Manual provide settlement monument locations for the Class A and Class A North embankments, respectively. These will be replaced with a revised Figure 2, and affected CQA/QC references to these figures updated accordingly. Forms provided in Appendix A of the CQA/QC Manual are also updated.

Reviewers will also note the following text has been deleted at work element – Interim Rad Cover Placement and Monitoring, specification "Interim Rad Cover Material": "This work element shall have an effective date one year following Division approval of its inclusion in the LLRW and 11e.(2) CQA/QC Manual." Work element – Interim Rad Cover Placement and Monitoring was first included in the CQA/QC manual at revision 23d, approved November 19, 2008. Accordingly, the effective date is now in force and the text is removed from the CQA/QC manual to prevent potential confusion. Revised pages resulting in 26a of the CQA/QC Manual have been provided as Attachment 8 to the amendment request.

The interrogatory basis goes on to state that "…Energy*Solutions* should clearly identify, evaluate, and discuss all particular features, attributes, etc… of the proposed Class A West Embankment that might impact one or more items or conditions in the currently approved Radioactive Materials [sic] License and/or Groundwater Quality Discharge Permit (GWQDP). For example, one such item is the open cell time limitation prescribed in Part I.E of the GWQDP." As discussed above, the open cell time limit and associated changes have already been set as separate licensing actions. No changes to the open cell time limit or other implementing controls are needed or requested associated with the Class A West Embankment.

In preparing rev. 0 of the amendment request, Energy*Solutions* already evaluated and discussed changes to the RML and GWQDP. No further changes, beyond the minor revision to the CQA/QC Manual (provided as Attachment 8 to the Class A West License Amendment Request), are needed.

8. INTERROGATORY CAW R313-25-8(1)-08/1: TECHNICAL ANALYSES; RELEASES OF RADIOACTIVITY

Regulatory Reference: R313-25-8(1). Analyses demonstrating that the general population will be protected from releases of radioactivity shall consider the pathways of air, soil, ground water, surface water, plant uptake, and exhumation by burrowing animals. The analyses shall clearly identify and differentiate between the roles performed by the natural disposal site characteristics and design features in isolating and segregating the wastes. The analyses shall clearly demonstrate a reasonable assurance that the exposures to humans from the release of radioactivity will not exceed the limits set forth in R313-25-19.

Division's Interrogatory Statement: *Refer to Sections 6.1.3 and 6.1.5 of the Class A West (CAW) Embankment License Amendment Request (LAR):*

1. *Summarize the results from Attachment 3 that justify the statement that the need to limit concentrations of several nuclides is eliminated. Ensure that the summary is nuclide-specific and addresses the radiological, physical, and chemical properties of the waste. Discuss the meaning of these summary results and show how the conclusion is reached.*
2. *Please state both the GW protection standard and the calculated maximum concentration for all radionuclides of concern in this table. Quantify the extent of change from values previously reported and those now reported. Explain why these changes occurred. What is the sensitivity of these results to assumed and estimated values?*

Refer to Section 6.1.5 of and Attachment 3 to the Class A West (CAW) Embankment License Amendment Request (LAR):

3. *Please explain the modeling results that indicate that the top slope infiltration rate (0.238 cm/yr) leads to earlier peak concentrations at the water table than the higher side slope infiltration rate (0.335 cm/yr). Also explain why the time to exceed the GWPLs at the water table is shorter for the lower infiltration top-slope case than for the side-slope case.*
4. *Please explain the modeling results for the compliance monitoring well that show the top slope infiltration rate (0.238 cm/yr) leads to earlier times to exceed the GWPLs than the higher side slope infiltration rate (0.335 cm/yr).*
5. *Please correct the vadose zone water velocities in Tables 30 and 31 of the Whetstone report (Whetstone 2011) to make them consistent with the vadose zone velocity equation given in Section 5.2.3 of the same report. Also, update the PATHRAE files and results that used the incorrect vadose zone velocities (Baird, 2011).*

Energy*Solutions*' Response: The Technical Analysis demonstrating that the general population will be protected from releases of radioactivity is under revision and will be submitted under separate cover, at a later date.

9. INTERROGATORY CAW R313-25-8(2)-09/1: TECHNICAL ANALYSES; PROTECTION OF INADVERTENT INTRUDERS

Regulatory Reference: R313-25-8(2). Analyses of the protection of inadvertent intruders shall demonstrate a reasonable assurance that the waste classification and segregation requirements will be met and that adequate barriers to inadvertent intrusion will be provided.

Division's Interrogatory Statement: *Refer to Section 6.2 of the Class A West (CAW) Embankment License Amendment Request (LAR): Please provide a dose analysis for an inadvertent intruder scenario.*

Energy*Solutions*' Response: The request for an inadvertent intruder dose assessment is contrary to the licensing basis for the facility. No new waste types or characteristics are requested specifically for the Class A West Embankment; therefore, there is no reason to overturn the existing license basis. Additional discussion justifying the lack of an inadvertent intruder dose assessment has been added to section 6.2 (with additional references incorporated to section 11).

10. INTERROGATORY CAW R313-25-8(4)-10/1: TECHNICAL ANALYSIS – DESIGN SAFETY FACTORS

Regulatory Reference: R313-25-8(4). Analyses of the long-term stability of the disposal site shall be based upon analyses of active natural processes including erosion, mass wasting, slope failure, settlement of wastes and backfill, infiltration through covers over disposal areas and adjacent soils, and surface drainage of the disposal site. The analyses shall provide reasonable assurance that there will not be a need for ongoing active maintenance of the disposal site following closure.

Division's Interrogatory Statement: *Refer to Sections 3.0, 3.1.7 and Tables 3-2 and 3-4 of the Class A West (CAW) Embankment License Amendment request (LAR), and Drawings 10014 C01 and 10014 C04 of the CAW LAR:*

1. *Please provide a clear, consistent, and appropriately referenced discussion of the approach used for selecting various minimum acceptable safety factors for evaluating the adequacy of design of different elements of the CAW Embankment.*

   Indicate how different minimum acceptable safety factors apply to different design features based on the precise characteristics of the materials that comprise them, the intended use of those materials and the features, and established and accepted Best Practices and published standards or guidelines, etc…

   Indicate, if applicable, that in no case was a minimum safety factor of less than 1.0 assumed for the design of any principal design feature or principal design aspect, or justify why a minimum safety factor of 1.0 would be adequate for design.

Rectify discrepancies that currently exist in Table 3-4 with respect to Safety factors listed as having been calculated for certain features (e.g., Static Safety Factor ≥ 2.1 vs. ≥ 2.3 for "Waste Placement and Backfill").

Clearly reference guidelines and standards that support the minimum safety factors that were used to which the computed factors of safety were compared when evaluating adequacy of the design feature and design criteria.

Explain the appropriateness of computed factors of safety and their physical significance in the context of the analysis methods used.

Explain the effects of assumptions inherent in the method of analysis used on the resulting margins of safety.

2. *Provide revised Tables 3-2 and 3-4 to include revised safety factor information and/or revised values under the "Design Criteria" column (Table 3-2) and "Design Criteria", "Projected Performance", and "Safety Factor" columns (Table 3-4) that: (1) are consistent throughout the tables; and (2) contain or clearly reference, in all cases, explanatory text describing what each calculated safety factor value (Table 3-4) represents, both in terms of the specific parameters included in the safety factor ratio and the physical meaning/significance associated with each resulting safety factor value presented; and (3) provide information that is currently missing (e.g., empty cells in Table 3-4 under "Safety Factor" column for the Required Function "Ensure Structural Stability" of the "Cover" Principal Design Feature. Provide additional explanation(s) in the CAW LAR text as necessary to describe the safety factor information provided in Tables 3-2 and 3-4.*

Energy*Solutions*' Response: The Division has accepted the approach and minimum factors of safety reported in Table 3-4 over Energy*Solutions*' multiple licensing actions (since the 2000 Class B& C License Application). The safety factor against frost penetration, under abnormal conditions, has been reported as 1.03 since that time. Thus, the allegation that "…a factor of safety of 1.0 is not considered to be conservative…" is contrary to the accepted licensing basis for the facility. Furthermore, in the case of the frost penetration analysis, the evaluation that leads to the factor of safety of 1.03 considers temperatures that are considerably lower than the published 500-year return minimum average temperatures (see 2005 License Application Renewal, section 3.3.3.1.4). Energy*Solutions* notes that a less-conservative way of calculating frost depth would inflate the factor of safety that could be reported in table 3.4; however, the issue does not impact the ability of the embankment to withstand frost penetration under reasonably-foreseeable worst case conditions throughout the period of performance.

Information has been updated in Table 3-4 for the Required Function "Ensure Structural Stability" of the "Cover" Principal Design Feature.

11. INTERROGATORY CAW R313-25-8(4)-11/1: TECHNICAL ANALYSIS - ROCK COVER DESIGN AND ROCK COVER DESIGN CALCULATIONS/ ANALYSES

Regulatory Reference: R313-25-8(4). Analyses of the long-term stability of the disposal site shall be based upon analyses of active natural processes including erosion, mass wasting, slope failure, settlement of wastes and backfill, infiltration through covers over disposal areas and adjacent soils, and surface drainage of the disposal site. The analyses shall provide reasonable assurance that there will not be a need for ongoing active maintenance of the disposal site following closure.

Division's Interrogatory Statement:

1. *Refer to Sections 3.0, 3.1.2, 3.2.2, and Tables 3-2 through 3-4 of the Class A West (CAW) Embankment License Amendment Request (LAR), and Drawings 10014 C01 and 10014 C04 of the CAW LAR: To account for the longer top-slope and side-slope lengths of the proposed CAW Embankment compared to those in the current Class A and Class A North Embankment, the LLRW Embankment, and the "Western LARW Cell", and to account for information contained in recently published studies on the performance of rounded riprap vs. angular riprap under overtopping conditions, please provide a revised set of Rock Cover Design Calculations that are specific to the currently proposed cover system for the Class A West Embankment that demonstrate conformance of the CAW Embankment cover system design with applicable design criteria contained in NUREG-1623 (NRC 2002) and NUREG/CR-4620 (Nelson et al. 1986) and in documents referenced therein and in other recently issued, relevant information (e.g., Abt et al. 2008; Tamagni 2010) that builds on the guidance provided in NUREG-1623 and NUREG/CR-4620*

Energy*Solutions*' Response: Rock Cover Design Calculations (included as Attachment 10 of the Class A West License Amendment Request) have been made using the method described in NUREG-1623. Additional analyses for rounded rock have been made using the equations in Abt (2008). These calculations are provided in "Class A West (CAW) Rock Cover Design Calculations" dated October 19, 2011, included as Attachment 10 to the Amendment Request.

Division's Interrogatory Statement: *Provide updated calculations that:*

- *Clearly describe the degree of roundness or angularity and the coefficient of uniformity of the rock materials (esp. for round-shaped riprap) to be used in constructing the riprap and granular filter layer material layers in the CAW Embankment cover as shown on Drawings 10014 C01 and 10014 C04 of the CAW LAR*

Energy*Solutions*' Response: The coefficient of uniformity is addressed in the Rock Cover Design Calculations. In accordance with Abt (2008), the degree of roundness is a qualitative parameter and is addressed using the coefficient of uniformity in the revised calculations for rounded rock

Division's Interrogatory Statement:

- *Explicitly and quantitatively account for the specific dimensions, slope inclinations, and granular size, angularity or roundness, as applicable, and coefficient of uniformity of any round-shaped materials to be used in these proposed cover system layers.*

Energy*Solutions*' Response: The Rock Cover Design Calculations explicitly incorporate the Class A West dimensions, slopes, material gradations and coefficients of uniformity.

Division's Interrogatory Statement: *Demonstrate that the most appropriate methodology (e.g., Leps 1973; Abt et al. 1991) is used for estimating interstitial velocities within the Type A Filter Zone layer for assessing the potential for internal erosion (e.g., erosion of the underlying sacrificial soil layer materials) that considers the final proposed gradation of the Type A Filter Zone layer material (e.g., that may categorize the material as a rock fill material rather than an earthen fill material (based on criteria presented in Leps 1973 as discussed in Nelson et al. 1986 and referenced in Section 2.1 of Appendix D of NUREG-1623 (NRC 2002))*

Energy*Solutions*' Response: Section 3.0 of the Rock Cover Design Calculations describes an analysis of interstitial velocities in the Type A Filter Zone using the Leps 1973 method - as described in NUREG/CR-4620. The conservative nature of this analysis belies the need to examine further methodologies. The Leps calculation provides a worst-case turbulent flow in the rock at the surface of the sacrificial soil; the fact that the rock may be more of an earthen fill material means that the interstitial velocity will be less than this worst-case turbulent flow condition.

Division's Interrogatory Statement:

- *Demonstrate that the most appropriate methodology (e.g., Equation D-1 in Appendix D of NRC 2002 rather than Equation 4.44 of Nelson et al. 1986) is used for estimating the time of concentration for use in estimating the rainfall intensity and rainfall depths for the proposed final rock riprap layer material, and*

Energy*Solutions*' Response: Equation D-1 in Appendix D of NUREG-1623 has been used in the Rock Cover Design Calculations.

Division's Interrogatory Statement:

- *Discuss and justify the need to oversize rock to be used for constructing the riprap layer based on its degree of roundness, taking into account recently published information.*

Energy*Solutions*' Response: The Rock Cover Design Calculations confirm that the rock meets the criterion of the guidance document, even considering rounding of the rock; therefore, no oversizing is necessary.

Division's Interrogatory Statement:

2. *Refer to 3.0, 3.1.2, 3.2.2, and Tables 3-2 through 3-4 of the Class A West (CAW) Embankment License Amendment Request (LAR), and Drawing 10014 C04 of the CAW LAR:*

- *Please provide additional information to justify the adequacy of the proposed thickness of 6 inches for the Type A Filter Zone Layer underlying the proposed 18-inch-thick riprap layer in the CAW Embankment cover. Discuss and justify the proposed 6 inch-thickness relative to the criteria provided in NUREG/CR-4620 (Nelson et al. 1986) that such a filter "should not be less than 6 to 9 inches thick…[with] filter thicknesses one-half the riprap layer thickness recommended".*

Energy*Solutions*' Response: As stated in the interrogatory, the guidance document states that the filter layer "should not be less than 6 to 9 inches thick." The design Type A Filter Layer, placed at a thickness of 6-inches, meets this criteria. The test of the applicability of the filter material is with the D_{15}/D_{85} ratios as described in Section 4.4 of NUREG/CR-4620. In general, the suggested criteria is that the D_{15}(riprap) to D_{85}(filter/base) be less than five. From the information provided in the Rock Cover Design Calculations, this ratio is 0.52 for the top slope and 0.19 for the side slope, yielding safety factors of 9.6 and 26.3 when compared with the ratio criteria of five. Furthermore, the Type A Filter Layer has a maximum size of 6-inches, exceeding the recommended maximum size of 3-inches; thereby providing a more stable base (however, the maximum 3-inch size is recommended in order to minimize segregation and bridging of large particles during placement of the rock – proper Quality Control testing of the placed rock found in the CQA/QC, Work Element – Filter Zone, Specification "Placement" obviates the need for that recommendation). Due to the high safety factor of the gradation ratios and the larger rock size, the 6-inch thick filter layer is adequate for stability of the rock cover and it is not necessary to meet the further recommendation that the filter layer thickness be half the riprap layer thickness.

Division's Interrogatory Statement:

- *Revise the design of the ditch outer slope (Detail 3 on Sheet C04) to be compatible with the specified gradation of the Type A riprap materials and to be consistent with guidance provided in NUREG-1623 (NRC 2002). Revise the design of the side-slope (detail 1), top slope (detail 2), and shoulder (detail 4) and the ditch outer slope (detail 3) to be consistent with guidance provided in NUREG-1623 (NRC 2002). Detail 3 shows a 12-inch thick layer of "Type A" riprap on the ditch outer slopes whereas the D100 of the Type A Riprap is*

specified to be 16 inches. Details 1, 2, 3, and 4 show a 6-inch-thick "Type A" filter zone layer on the cover side-slope, top slope, ditch outer slope, and shoulder, respectively, where the D100 of the "Type A filter zone" material is specified to be 6 inches. Revise the design of these layers as needed (or, alternatively, provide justification to support otherwise) to be consistent with NRC 2002 guidance (Section 3.2.4 of Appendix F) which recommends that: (1) no individual piece of riprap be greater in size than 90 percent of the riprap layer thickness; (2) filter zone material used as bedding material beneath a riprap layer typically have a D100 of approximately 3 inches; and (3) Riprap having a D100 of 16 inches (i.e., the proposed "Type A Riprap" for the CAW Embankment) be instead referred to as a "Type D" riprap rather than as a "Type A" riprap.

Energy*Solutions*' Response: Based on the discussions above as well as the results within the Rock Cover Design Calculations, no re-design is necessary for the top slope, side slope, or shoulder of the Class A West Embankment. The outer slope of the drainage ditch is being re-designed to a Type A riprap thickness of 18-inches. This is shown in drawing 10014-C04, revision 1.

The riprap maximum size guidance within Section 3.2.4 of NUREG-1623 conflicts with the guidance given in Section 2.1.2 of that document which allows a minimum layer thickness up to the maximum size of the stone (D_{100}). Energy*Solutions* uses this latter criterion in the design of the riprap.

NUREG-1623 suggests that the bedding material beneath the riprap layer have a D_{100} of 3-inches. The basis for this recommendation is so that segregation and bridging of large particles is minimized during placement of the material. Quality control requirements in Work Element – Filter Zone, Specification "Placement" of the CQA/QC provide for inspection of placed rock material that ensures the placed rock will be uniform, without segregation and bridging of large particles. Therefore, the basis for the recommendation is satisfied.

The designation of the Type A riprap material is local and consistent with other embankments and design information at Clive. It would be confusing and is not necessary to change this designation to match guidance document designations as long as it is clearly defined.

12. INTERROGATORY CAW R313-25-8(4)-12/1: TECHNICAL ANALYSIS - FILTER STABILITY/ FILTER PERMEABILITY CRITERIA

Regulatory Reference: R313-25-8(4). Analyses of the long-term stability of the disposal site shall be based upon analyses of active natural processes including erosion, mass wasting, slope failure, settlement of wastes and backfill, infiltration through covers over disposal areas and adjacent soils, and surface drainage of the disposal site. The analyses shall provide reasonable assurance that there will not be a need for ongoing active maintenance of the disposal site following closure.

Division's Interrogatory Statement: *Refer to Sections 3.0, 3.1.2, 3.2.2, and Tables 3-2 through 3-4 of the Class A West (CAW) Embankment License Amendment Request (LAR), Attachment 3 (Class A West Disposal Cell Infiltration and Transport Report, April 19, 2011), to the CAW LAR, and Drawing 10014 C04 of the CAW LAR:*

1. *To account for the longer top-slope and side-slope lengths of the proposed CAW Embankment compared to those in the current Class A and Class A North Embankment, the LLRW Embankment, and the "Western LARW Cell", and to account for changes in cover material characteristics, as applicable, resulting from additional analyses performed in response to other interrogatory items in these Round 1 Interrogatories (e.g., see also Interrogatory CAW R313-25-8(4)-11/1: Technical Analysis - Rock Cover Design and rock cover design Calculations/ Analyses), provide an appropriate calculation to demonstrate that any granular layers in the proposed final cover system that have a relatively high assumed steady-state saturated hydraulic conductivity (permeability) value or for which infiltration simulation results suggest that the layer is acting as a lateral drainage layer satisfy pertinent filter design criteria (e.g., Bertram 1940; NRCS 1994[e.g., Table 26-3]). Include in the calculation applicable filter design criteria related to permeability for ensuring that the layer(s) will retain sufficient permeability over the long term following facility closure and stabilization to prevent development of large seepage forces and hydrostatic pressures in the layer(s).*

Energy*Solutions*' Response: Section 4.0 within the Rock Cover Design Calculations (Attachment 10 of the Amendment Request) describes gradation criteria for the lateral drainage layer (Type B Filter Layer). Refer to that document for specific information. The Type B Filter and Sacrificial Soil Layer design specifications described on drawing 10014-C04 ensure that these gradation criteria will be met and that the lateral drainage layer will not be compromised throughout the life of the Class A West Embankment.

Division's Interrogatory Statement:

2. *Provide a set of calculations to demonstrate, for the proposed final layer materials and material properties for the cover system layers that final gradations proposed for the various adjacent layers meet all applicable published recommended filter stability requirements. Include consideration of filter criteria for preventing migration of granular materials into an adjacent coarser grained granular layer (e.g., Nelson et al. 1986, Equation 4.35); for preventing piping of finer grained cohesionless soil particles*

into an adjacent coarser-grained material layer (e.g., Cedegren 1989, Equation 5.3); and for preventing erosion of a finer-grained material layer from occurring over the long term as a result of flows in an adjacent coarser (filter zone) layer (e.g., Nelson et al. 1986, Equation 4.36). Include consideration of different specific filter stability criteria (e.g., NRCS 1994, Tables 26-1 and 26-2) for determining the maximum allowable D15 of a granular filter layer material for preventing erosion of any adjacent layer (e.g., sacrificial soil layer) consisting of fine-grained/finer-grained particles, as a function of soil type. Account for changes, if any, in any proposed material gradations that may result from analyses performed in response to other interrogatory items in these Round 1 Interrogatories, as appropriate.

Energy*Solutions*' Response: The Rock Cover Design Calculations included as Attachment 10 to the Class A West License Amendment Request demonstrate that final gradations proposed for the final cover system meet applicable published recommended filter stability requirements.

13. INTERROGATORY CAW R313-25-8(4)-13/1: TECHNICAL ANALYSES-PERIMETER DRAINAGE DITCH CALCULATIONS

Regulatory Reference: R313-25-8(4). Analyses of the long-term stability of the disposal site shall be based upon analyses of active natural processes including erosion, mass wasting, slope failure, settlement of wastes and backfill, infiltration through covers over disposal areas and adjacent soils, and surface drainage of the disposal site. The analyses shall provide reasonable assurance that there will not be a need for ongoing active maintenance of the disposal site following closure.

Division's Interrogatory Statement: *Refer To Sections 3.0, 3.1.5, 3.2.5, and Tables 3-2 through 3-4 of the Class A West (CAW) Embankment License Amendment Request (LAR), Attachment 4 (Clive Facility Total Ditch Flow Calculations) to the CAW LAR, and Drawing 10014 C03 of the CAW LAR:*

1. *Please provide a revised "Clive Facility Total Ditch Flow Calculations" package that calculates the 25-year and 100-year peak flow rates using the Rational Method or another standard engineering methodology. If the Rational Method is used please follow standard methodology:*
    a. *The rational formula is correctly referenced on Page 28 of 30 as Q=CiA*
    b. *Delineate watershed area (A); this seems to have been calculated correctly in Section 5 but for the Rational Method the area (A) should use acres for units instead of square feet.*
    c. *Calculate the time of concentration for each watershed using any of the standard time of concentration methods applicable.*
    d. *Using the time of concentration and the recurrence interval (i.e. 25-year or 100-year). Look up the intensity on a table, interpolate values as necessary. NOAA Atlas 14 intensity values can be found using the latitude and longitude for the site at this*

website http://hdsc.nws.noaa.gov/hdsc/pfds/pfds_map_cont.html?bkmrk=ut. The units for intensity for this method are inches/hour. Use NOAA Atlas 14 as the reference source since NOAA Atlas 14 supersedes and replaces NOAA Atlas 2.

e. The C value can be looked up in a table as was done on Page 8 of 30.

Energy*Solutions*' Response: Revised Drainage Ditch Calculations dated October 18, 2011 are provided in Attachment 4 of the Amendment Request. The revised calculations utilize the methodology presented in NUREG-1623 and NUREG/CR-4620. All items within this interrogatory statement are addressed in these revised calculations. Section 3.2.5 of the Amendment Request has been revised as a result of the calculations provided in Attachment 4.

Division's Interrogatory Statement:

2. Please provide a revised "Clive Facility Total Ditch Flow Calculations" package that calculates the capacity of the ditches to safely pass the 25-year and 100-year peak flow rates using the Manning's Equation or another standard methodology. Use the correct trapezoidal geometry of the ditch including the 15.3' minimum bottom width referenced on Drawing 10014-C03. Check the water surface elevations and freeboard in the ditches around the 90 degree bends, water may superelevate and increase water surface elevations. Please provide a determination of the required riprap sizes for the drainage ditches, completed in accordance with the methods recommended in NUREG-1623 (NRC 2002). Provide calculations that demonstrate that rock sizes in the rock riprap materials lining the perimeter drainage ditches will be adequate to withstand anticipated peak flood-flow-induced shear stresses. Provide information that demonstrates that the specific rock riprap materials proposed for use in the drainage ditches and in any other "critical areas" as defined in Section 7.2 of Appendix D of NUREG-1623 will satisfy minimum recommended rock quality criteria for such materials (refer also to Items 2 and 3 in Interrogatory CAW R313-25-7(7)-05/1: Specific Technical Information -- Closure Plan with regard to rock borrow sources)

Energy*Solutions*' Response: The noted 15.3 foot dimension is the minimum distance from the toe of waste to the centerline of the ditch, not necessarily the minimum bottom width of the ditch. Revision 1 of drawing 10014C03 details the ditch minimum bottom width dimensions as 14 feet. The revised Drainage Ditch Calculations dated October 18, 2011 in Attachment 4 uses the minimum 14 foot base trapezoidal geometry throughout. Super-elevation of the water around bends has been calculated in these revised calculations. The revised calculations also determine the appropriate size of riprap necessary to adequately armor the ditches. Shear stresses within the ditches have been calculated and are provided as well.

Regarding the rock quality criteria, Section 7.2.2 of Appendix D of NUREG-1623 defines "critical areas" as "frequently saturated areas, all channels, poorly-drained toes and aprons, control structures, and energy dissipation areas." The guidance also defines

non-critical areas as "occasionally-saturated areas, top slopes, side slopes, and well-drained toes and aprons." As the ditches surrounding the embankments rarely maintain water for extended periods of time, they fit into the "occasionally saturated areas" and/or "well-drained toes and aprons" definitions and may therefore be considered non-critical areas. The guidance document states that non-critical areas require a rock score of at least 50 to be acceptable. Within the CQA/QC Plan, Work Element - Rock Erosion Barrier, Specification "Quality of Rock", states that the rock must have a "Rock Quality" score of at least 50 to be acceptable. Therefore, the rock meets the criterion discussed in the guidance.

Additionally, the guidance of NUREG-1623 suggests that the rock be oversized by the percentage difference between the actual rock score and 80. This would mean that the rock would need to be able to be oversized by at least 30% (80-50) from the calculated required rock size. As calculated in the revised Drainage Ditch Calculations, the worst-case required rock size is a d_{50} of approximately 0.7 inches and the actual design rock has a d_{50} of 4.5 inches. Therefore, the necessary over sizing is already inherent in the design of the rock.

Division's Interrogatory Statement:

3. *Please provide information that supports the appropriateness of using the Abt et al. 1988 equation in Section 1 for computation of the Manning's n value for the various ditches (for comparing with the literature-based value of n chosen for use in this calculation package) and using Eq. 4.44 from NUREG/CR-4620 (Nelson et al. 1986) for calculating the time of concentration (tc) values in Section 7 (Peak Run-off Rate) for the different sections of the various embankment ditches. Alternatively, provide revised calculations using recommended alternative methods.*

Energy*Solutions*' Response: More appropriate equations have been used and referenced in the revised Drainage Ditch Calculations (provided as Attachment 4 to the Amendment Request).

Division's Interrogatory Statement:

4. *Please provide information demonstrating that rock riprap sizes at ditch corners will be adequate to withstand possibly higher peak flood flow-induced shear forces that may occur at those locations, as per the guidance provided in NUREG-1623.*

Energy*Solutions*' Response: An analysis of shear stresses around corners has been completed in the revised Drainage Ditch Calculations (provided as Attachment 4 to the Amendment Request). The required size of the riprap rock has been calculated based on these shear stresses.

Division's Interrogatory Statement:

5. *Please provide a revised Drawing 10014 C03, as required, showing the final riprap size requirements for the perimeter ditches.*

Energy*Solutions*' Response: As demonstrated in the Drainage Ditch Calculations, the currently designed riprap meets all criteria; therefore, redesign of this element is not necessary.

Division's Interrogatory Statement:

6. *In Section 3.2.5, please correct what appears to be a typographical error (reference to Attachment 45) or provide Attachment 45. Explain why the values reported for the Class A embankment are relevant to the request to construct and operate the CAW.*

Energy*Solutions*' Response: The Attachment 45 reference was a typographical error. The reader of the Class A West License Amendment Request should have been directed to Attachment 4. Section 3.2.5 has been changed accordingly.

With respect to answering the Division's interrogatory requiring Energy*Solutions* to explain, "why the values reported for the Class A Embankment are relevant to the request to construct and operate the CAW," it should be noted that referencing Section 3.1.4 of Energy*Solutions*' 2005 Radioactive Material License Renewal Application (LRA) does not compare drainage values of the Class A Embankment to values generated for the Class A West Embankment. Rather, this reference sets forth the following design criteria (not design values) for the drainage system:

1) Facilitate flow of precipitation away from the embankment;
2) Minimize infiltration under flood conditions; and,
3) Ensure ditch integrity.

The values generated in Attachment 4 of Class A West License Amendment Request seek to ensure that the design criteria above are met. These design criteria are pertinent to the Class A West design and have been evaluated specific to this design.

In order to eliminate the potential for confusion, reference to Section 3.1.4 of the 2005 LRA has been deleted from Section 3.2.5 of the Amendment Request.

14. INTERROGATORY CAW R313-25-8(4)-14/1: TECHNICAL ANALYSES – INFILTRATION AND TRANSPORT MODELING: CLIMATE CONDITIONS, ENGINEERED BARRIER CONDITIONS, AND VERTICAL TRANSPORT DISTANCE

Regulatory Reference: R313-25-8(5). Analyses of the long-term stability of the disposal site shall be based upon analyses of active natural processes including erosion, mass wasting, slope failure, settlement of wastes and backfill, infiltration through covers over disposal areas and adjacent soils, and surface drainage of the disposal site. The analyses shall provide reasonable assurance that there will not be a need for ongoing active maintenance of the disposal site following closure.

Division's Interrogatory Statement: *Reference Sections 3.1.1, 3.1.2, 3.2.1, and 3.2.2 and Tables 3.2 through 3.4 of the CAW LAR, and Section3.2 and Table 14 of the April 19, 2011 (Whetstone Associates 2011) CAW Cell Infiltration and Transport Modeling Report:*

1. *Provide additional information and rationale to support the selection of a range of climate conditions (e.g., precipitation conditions) to demonstrate that the climatic regime(s) used for modeling infiltration through the cover system bounds the range of uncertainties associated with potential climatic conditions that may occur over the CAW Embankment's performance period.*

   Provide a revised vertical fate and transport discussion and findings as needed based on the final selected range of climate conditions. Include sensitivity analyses, as appropriate, to demonstrate the sensitivity of infiltration results to changes in the input climate parameters.

2. *Provide a discussion, with supporting rationale, regarding potentially degraded conditions in the engineered barrier(s), including the radon barrier layer, in the CAW Embankment cover system that are important to the long-term performance of the CAW Embankment.*

   Provide results of infiltration performance analyses incorporating such degraded conditions into the modeling simulations. Alternatively, provide detailed justification why consideration of such degraded engineered barrier conditions in the infiltration simulations is not required.

Energy*Solutions*' Response: Please refer to sensitivity analyses performed as part of previous infiltration and transportation modeling (Adrian Brown Consultants, 1997).

The following sensitivity analyses have been performed for infiltration and transporting modeling of existing and proposed Clive facility embankments:

1) HELP infiltration model sensitivity analysis of wind speed, evaporative zone depth (EZD), increased precipitation, upper radon barrier thickness, freeze/thaw (sacrificial) layer thickness, waste layer thickness, and filter layer hydraulic conductivity. - Final Report on LARW Infiltration Modeling Input Parameters and Results (Adrian Brown Consultants, 1997).
2) Infiltration rate sensitivity analysis of the effect of varying the EZD and degrading the upper radon barrier - 11e.(2) Disposal Cell Infiltration Modeling Input Parameters and Results (Adrian Brown Consultants, August 20, 1997).
3) Infiltration rate sensitivity analysis of the impact of precipitation variation and a 100-fold increase in side-slope cover permeability - Revised Western LARW Cell Infiltration and Transport Modeling (Whetstone Associates, 2000a).
4) Sensitivity of infiltration rates to the variation in precipitation rates - Class A, B, & C Cell Infiltration and Transport Modeling (Whetstone Associates, 2000b) and

11e.(2) Disposal Cell Infiltration and Transport Modeling Report (Whetstone Associates, 2001).

5) Sensitivity of infiltration rates to variation in the thickness of the Type B filter layer in the cover - Class A Combined (CAC) Disposal Cell Infiltration and Transport Modeling Report (Whetstone Associates, May 2006) and Class A South Cell Infiltration and Transportation Modeling (Whetstone Associates, December 7, 2007).

Because these sensitivity analyses all inform the modeling approach employed and have been accepted by the Division, it is not necessary to repeat these sensitivity analyses in the Class A West modeling.

Division's Interrogatory Statement:

3. Provide an explanation, with supporting rationale, for selecting an appropriately conservative (i.e. shallow) average elevation of the groundwater surface beneath the CAW Embankment footprint for use in the infiltration and transport calculations/modeling.

Energy*Solutions*' Response: Please see the response to Interrogatory R313-25-7(1)-02/1

Division's Interrogatory Statement: *Demonstrate how historical fluctuations in the freshwater head levels in groundwater, in response to historical changes in weather conditions, were taken into consideration in the selection of the groundwater elevation used for calculating the vertical distance between the base of the clay liner and the groundwater surface (See also Interrogatory R313-25-7(1)-01/1: Specific Technical Information – Groundwater Elevation Value(s) used in Analyses, and Interrogatory R313-25-8(4)-07/1: Technical Analyses – Groundwater Depth in Geotechnical Stability Analysis). Provide information on the relationship of changes in climate conditions (e.g., precipitation levels) to groundwater recharge and resulting groundwater elevations over the same periods of time in the area of the CAW cell.*

Energy*Solutions*' Response: Measured pan evaporation rates for Clive, 16-year average of 52.52 inches per year greatly exceed the 16-year average precipitation rates of 8.56 inches per year (Meteorological Solutions Inc, 2011). Per Gates (1984), direct recharge by infiltration of precipitation in low-lying basin areas is probably minor because evapotranspiration consumes the precipitation. As stated in response to Interrogatory R313-25-7(1)-02/1, both the infiltration and transport modeling and geotechnical stability analysis are conservative with respect to groundwater elevation.

Division's Interrogatory Statement: *Demonstrate that the average groundwater elevation selected is representative of anticipated future conditions during the required performance period of the CAW Embankment and/or provide a range of average*

groundwater elevation values that bounds the range of uncertainties associated with potential groundwater fluctuations over the performance period.

Energy*Solutions*' Response: See response above. Also, see the response to Interrogatory R313-25-7(1)-02/1 - adding the capillary fringe (2.04 ft) to the average groundwater elevation conservatively decreases the vertical transport distance by 0.44 ft more than using the maximum observed groundwater elevation for wells associated with the Class A and Class A North embankments.

Division's Interrogatory Statement: *Provide a revised vertical fate and transport discussion and findings as needed based on the final selected average groundwater elevation. Include sensitivity analyses, as appropriate, to demonstrate the sensitivity of transport results (e.g., travel time) to changes in the average groundwater elevation.*

Energy*Solutions*' Response: Not necessary, vertical transport is conservative with respect to vertical transport distance and travel time.

15. INTERROGATORY CAW R313-25-8(4)-15/1: TECHNICAL ANALYSES – GROUNDWATER DEPTH IN GEOTECHNICAL STABILITY ANALYSIS

Regulatory Reference: R313-25-8(5). Analyses of the long-term stability of the disposal site shall be based upon analyses of active natural processes including erosion, mass wasting, slope failure, settlement of wastes and backfill, infiltration through covers over disposal areas and adjacent soils, and surface drainage of the disposal site. The analyses shall provide reasonable assurance that there will not be a need for ongoing active maintenance of the disposal site following closure.

Division's Interrogatory Statement: *Reference Sections 3.1.1 of the CAW LAR, and Section 2.2.3 of Attachment 5 (Geotechnical Update Report, EnergySolutions Clive Facility Class A West Embankment (AMEC 2011): Please provide the following:*

1. *Provide a revised stability analysis as needed to reflect the results of additional evaluations and analyses performed in response to other interrogatory items in these Round 1 Interrogatories (see Interrogatories R313-25-7(1)-01/1: Specific Technical Information – Groundwater Elevation Value(s) used in Analyses, and R313-25-8(4)-06/1: Technical Analyses – Infiltration and Transport Modeling: Climate Conditions, Engineered Barrier Conditions, and Vertical Transport Distance). Demonstrate that the average groundwater elevation selected for use in this analysis is representative of anticipated future conditions during the required performance period of the CAW Embankment and/or provide a range of average groundwater elevation values that bounds the range of uncertainties associated with potential groundwater fluctuations over the performance period. Provide a revised stability analysis as needed based on the final selected average groundwater elevation. Include sensitivity analyses, as*

appropriate, to demonstrate the sensitivity of the stability analysis results to changes in the average groundwater elevation.

Energy*Solutions*' Response: See responses to Interrogatories R313-25-7(1)-02/1 and R313-25-8(4)-14/1. A revised analysis is not needed.

16. INTERROGATORY CAW R313-25-8(4)-16/1: SEISMIC HAZARD EVALUATION / SEISMIC STABILITY ANALYSIS UPDATE

Regulatory Reference: R313-25-8(5). Analyses of the long-term stability of the disposal site shall be based upon analyses of active natural processes including erosion, mass wasting, slope failure, settlement of wastes and backfill, infiltration through covers over disposal areas and adjacent soils, and surface drainage of the disposal site. The analyses shall provide reasonable assurance that there will not be a need for ongoing active maintenance of the disposal site following closure.

Division's Interrogatory Statement:

1. *Refer to Sections 2.3.2, 3.1.3, 3.2.3, and 6.3.2 of the Class A West (CAW) Embankment License Amendment Request (LAR); Sections 2.1, 3.3, 4.5, and 5 of Attachment 5 (Geotechnical Update Report, EnergySolutions Clive Facility Class A West Embankment, Clive, Toole County, Utah, February 15, 2011) to the CAW LAR; and Appendix A (Update of Seismic Design Parameters for Envirocare of Utah Facility) to Attachment 5:*
   - *Please update the information, analyses, and results related to the selection of appropriate seismic design criteria, the seismic hazard evaluation, and seismic stability analysis results as presented in these CAW LAR sections and Attachment 5 and Appendix A to relevant information contained in several updated published articles and reports regarding seismic hazard evaluation methodologies, fault data, ground-motion prediction models (including Next Generation of Attenuation [NGA] relations), and other parameters that are relevant the analyses presented and described in Attachment 5 and Appendix A thereto. See "Basis for Interrogatory" below for a further discussion of selected relevant updated information that should be reviewed and applied as appropriate to the subject CAW LAR evaluations and analyses.*

Energy*Solutions*' Response: Information has been reviewed and an analysis performed. The results of said analysis are provided as an addendum to Attachment 5 of the Amendment Request. No technical changes were required as a result of the analysis performed.

Division's Interrogatory Statement:

- *Please provide a description of the location(s) and characteristics of any recently discovered faults in the region, such as the Carrington fault, that were not*

considered in the AMEC 2011 Geotechnical Update Report, and discuss the affect, if any, of such fault(s) on the updated seismic hazard evaluation results.

Energy*Solutions*' Response: Descriptions of locations and characteristics of faults in the region, such as the Carrington fault, have been provided in Appendix A of Attachment 5 to the Amendment Request.

Division's Interrogatory Statement:

2. *Refer to Sections 2.1, 2.2, and Appendix A of Attachment 5 (Geotechnical Update Report, EnergySolutions Clive Facility Class A West Embankment, Clive, Toole County, Utah, February 15, 2011) to the CAW LAR; and Appendix A (Update of Seismic Design Parameters for Envirocare of Utah Facility) to Attachment 5:*
   - *Please also revise Attachment 5 of the Geotechnical Update Report, EnergySolutions Clive Facility Class A West Embankment, Clive, Toole County, Utah, February 15, 2011 to reflect the following apparent errors and/or inconsistencies:*
     - ✓ *In reference to page 5, paragraph 2, last line states "recurrence interval". Please change to "return period".*

Energy*Solutions*' Response: Requested change has been made.

Division's Interrogatory Statement:

- ✓ *Page 7, paragraph 1, line 7, please revise "20,000 years" to "30,000 years"*

Energy*Solutions*' Response: Discussion of 20,000 years has been clarified.

Division's Interrogatory Statement:

- ✓ *Page 7, paragraph 1, line 9, states that the deposits of Unit 1 are "pre-Pleistocene". These deposits are not pre-Pleistocene and are likely associated with or are contemporaneous with the Little Valley Lake Cycle. Please correct as appropriate*

Energy*Solutions*' Response: Description of Unit 1 has been updated.

Division's Interrogatory Statement:

- ✓ *Notable references are missing from the reference list for this section. Please provide any missing references as necessary (e.g., Doelling et al., 1994, Panckow and Pechmann, 2004; and Swan et al., 2004)*

Energy*Solutions*' Response: Necessary references have been added to Appendix A.

Division's Interrogatory Statement:

- ✓ *In reference to Appendix A, page A-2, paragraph 1, the use of "line sources" should be referred to as "planes", since the USGS models faults as planes*

Energy*Solutions*' Response: Source geometry discussed in Appendix A has been clarified.

Division's Interrogatory Statement:

- ✓ *In Appendix A, revise Table A-2 or paragraph 3 on page A-7 or both to make them consistent. Several of the magnitude and ground motion values stated in the text do not match those listed in Table A-2 (e.g., M 7.1 for Skull Valley fault in text versus M 6.5 and M 6.8 in the table).*

Energy*Solutions*' Response: Table A-2 and Appendix A text has been revised.

17. INTERROGATORY CAW R313-25-24(1 THROUGH 3)-17/1: DISPOSAL SITE DESIGN FOR NEAR-SURFACE DISPOSAL - LINER DESIGN AND CONSTRUCTION

Regulatory Reference: R313-25-24(1) through (3):
(1) Site design features shall be directed toward long-term isolation and avoidance of the need for continuing active maintenance after site closure.
(2) The disposal site design and operation shall be compatible with the disposal site closure and stabilization plan and lead to disposal site closure that provides reasonable assurance that the performance objectives will be met.
(3) The disposal site shall be designed to complement and improve, where appropriate, the ability of the disposal site's natural characteristics to assure that the performance objectives will be met.

Division's Interrogatory Statement: *Refer to Section 1.3.1 of the CAW LAR and Drawings 10014 C01, 10014 C02 and 10014 C09 of the CAW LAR: Provide details defining how the liners under the Class A and Class A North Embankments will be joined , for both the clay subliner and the clay liner protective cover layers. Using engineering drawings, show limits and dimensions of existing liners and limits and dimensions of the proposed extended liner section between the existing embankments and north of the Class A North embankment. Define work processes that will be implemented in preparing the new liner location and in constructing the extended liner section and completing connections to the existing liners. Provide information on procedures and equipment to be used for removing overlying material as needed to uncover the existing liners, criteria that will be used to determine whether over excavation of any portion of the existing liners would be required prior to constructing the connecting liner extension and whether overlapping of compact clay layer material will be required at the liner junctures, information on proposed verification/testing methods to be used to demonstrate that the extended liner section has been bonded effectively and continuously to the existing liners to meet specified permeability*

requirements along the length and margins of the liner connections, and procedures and equipment to be used for covering and protection of the connected liner sections until covered by additional materials. Provide additional information regarding the staging of and timeframes for placing protective cover materials over joined liner sections in proximity to ongoing waste disposal operations. Revise the CQA/CQC Manual as needed to incorporate additional information developed regarding the joining of these liner and liner protection systems.

Energy*Solutions*' Response: Figure E has been developed and provided in Attachment 9 to the Class A West License Amendment Request to show the extents of completed Class A and Class A North liner, Class A West liner design limits, and areas where liner will need to be constructed. Reference to this Figure has been included in section 1.3.1 of the Class A West License Amendment Request. The construction of the remaining liner will be performed in multiple phases in the same manner as liner already completed in the Class A and Class A North embankments.

The logistics and method for constructing clay liner between the Class A and Class A North embankments and around the perimeter of the Class A North Embankment will be no different than that practiced over the last 10 years and as specified in the LLRW and 11e.(2) CQA/QC Manual. The clay liner constructed in the Class A and Class A North embankments has been completed through multiple phases of construction which have included and satisfied all of the elements identified in the interrogatory.

The current version (as well as the proposed revision; no changes are needed or proposed to CQA/QC specifications associated with this discussion) of the CQA/QC Manual contains specifications for preparing an area for liner construction (Work Element – Foundation Preparation) and clay liner construction (Work Element – Clay Liner Placement). The work element for clay liner placement includes specifications for connecting to existing liner (Specification "Keying-In"), protection of clay liner (Specification "Liner Drying Prevention"), and construction of liner protective cover (Specification "Liner Protective Cover").

18. INTERROGATORY CAW R313-25-24(5)-18/1: DISPOSAL SITE DESIGN FOR NEAR-SURFACE DISPOSAL - DRAINAGE JUNCTURE AND DRAINAGE OUTLET DESIGN FOR PERIMETER DRAINAGE DITCH SYSTEM

Regulatory Reference: R313-25-24(5). Surface features shall direct surface water drainage away from disposal units at velocities and gradients which will not result in erosion that will require ongoing active maintenance in the future.

Division's Interrogatory Statement: *Refer to Attachment 4 (Clive Facility Total Ditch Flow Calculations) to the CAW LAR, and Drawing 10014 C01 of the CAW LAR:*

1. *Please provide information and calculations that demonstrate that the surface water in the perimeter drainages surrounding the CAW Embankment will be conveyed and merge with the surface water flows in the 11e.(2) drainage ditch at the location shown on Drawing 10014 C01, and that surface water conveyed by the entire conceptual perimeter drainage ditch system shown in Figure 1 of the Clive Facility Total Perimeter Ditch Flow Capacity" calculation package will be discharged in such a way that during operations, and after closure, discharge velocities and gradients will not cause excessive erosion to the drainage system components, or otherwise result in erosion that would require ongoing active maintenance in the future.*

2. *Please provide detailed drawings (plan sections and details) showing the design of the drainage juncture at the southeast corner of CAW Embankment and the design of the ultimate drainage outlet (drainage culvert, discharge apron, etc...) at the point of discharge of the perimeter drainage ditch system.*

Energy*Solutions*' Response:
Since the southwest corner of the 11e.(2) requires adjustment and two differing designs for the discharge at the southwest corner have been identified during a document search performed to prepare a response., the final design of the 11e.(2) culvert and its associated outlet at the southwest corner of Section 32 will be completed as part of the 11e.(2) redesign which is forthcoming in response to Interrogatory CAW R313-25-7(2)-03/1, Item 4. The revised Drainage Ditch Calculations (Attachment 4 to the Amendment Request) demonstrates design feasibility by computing the required culvert size to accommodate peak runoff from the facility. As this component is not completely designed yet, rock layering of the outlet channel, and erosion calculations have not been performed at this time. The drawing and erosion calculations will be completed, and provided to the Division of Radiation Control for review and approval, prior to construction of the final outlet culvert.

Details of the drainage juncture (culvert) between the Class A West and 11e.(2) drainage systems are provided in Drawing 10014 C03, Revision 1 (See Attachment 2 to the Amendment Request). Flow calculations to ensure the design will accommodate the peak runoff from the Class A West drainage area are provided in the revised Drainage Ditch Calculations dated October 18, 2011 (Attachment 4 of the Class A West License Amendment Request).

Division's Interrogatory Statement: *Demonstrate that the ditch design ensures that any concentrated, severe peak storm-induced flows from runoff from the CAW Embankment will be accommodated by the receiving 11.e(2) ditch segment without damage to these ditch systems.*

Energy*Solutions*' Response: The Drainage Ditch Calculations in Attachment 4 to the Class A West License Amendment Request demonstrate that the ditch design ensures that

severe peak storm-induced flows will be accommodated by the receiving 11e.(2) ditch segment without damage.

Division's Interrogatory Statement: *Demonstrate that an appropriately sized culvert (if required) and appropriately designed rock discharge apron are included at the ultimate outlet of the entire drainage system to prevent damage to the native ground surface and the outlet structures through scour, long-term headward gullying, or other erosion processes.*

Energy*Solutions*' Response: As described above, the final 11e.(2) outlet culvert design has not been completed yet; but will be included in a future submittal. As the design has not been completed yet, culvert sizing and outlet erosion calculations could not be completed at this time. Complete calculations will be provided to the Division of Radiation Control, for review and approval, prior to construction of the final outlet culvert.

19. INTERROGATORY CAW R313-25-25(6)-19/1: RADIATION DOSE RATE AT THE SURFACE OF THE COVER

Regulatory Reference: R313-25-25(6). Waste shall be placed and covered in a manner that limits the radiation dose rate at the surface of the cover to levels that at a minimum will permit the licensee to comply with all provisions of R313-15-105 at the time the license is transferred pursuant to R313-25-16.

Division's Interrogatory Statement: *Refer to Section 3.1.9 and Figure 1 of the Class A West (CAW) Embankment License Amendment Request (LAR):*

1. *Confirm/revise and provide justification for the following parameter values used in MicroShield analyses:*
   - ✓ *Height and radius of 55-gallon drum*
   - ✓ *Dose points X, Y, and Z*
   - ✓ *Source dimension of 7.589 ft^3*
   - ✓ *Composition of Shield 3 (being clay and rock and not concrete as indicated)*
2. *Justify the choice of 11 Ci of Co-60 as the radioactive inventory of the 55-gallon drum modeled in the case reported.*
3. *Identify source conditions that would be required to produce MicroShield-projected dose rates at the cover surface that exceed stated regulatory limits.*
4. *Submit details of MicroShield analyses (revised, if necessary), including determinations of input parameter values.*

Energy*Solutions*' Response: UAC R313-15-301 requires that the dose rate at the surface of the completed embankment shall be less than 100 mrem total effective dose equivalent (TEDE) per year and ALARA. Abnormal conditions modeled in Section 3.1.9 consider effects of having a gamma source with a total activity of 11 curies (0.4 TBq) of

Co-60 at the top of the waste column. This activity was selected from DOT limits on package activity at 49CFR173.431 and the Table of A1 and A2 values for radionuclides at 49CFR173.435 (with the A2 value of 10.8 curie for Co-60 conservatively rounded upward). The A2 value represents an activity limit for DOT Type A packages; materials with higher activity would require special transportation equipment, such as shielded casks, etc.

Evaluation of an accident condition for reducing exposure to the general public is not addressed in Section 3.2 of NUREG-1199 (Nuclear Regulatory Commission, 1991). There is not a credible accident scenario that would cause exposure to the general public in excess of the evaluated abnormal condition. Normal conditions for this required function and design criteria were not assessed because the performance is bounded by the abnormal conditions analysis.

Potential external dose rates from gamma radiation were evaluated using the MicroShield® computer code. A generic 55-gallon drum (consistent with the numerous dimensions of 55-gallon drums currently in use for waste storage and disposal) containing a total activity of 11 curies was assumed to be placed on its side at top of waste, just below the Class A West cover. The cover consists of:

- Temporary cover – 1 foot depth
- 1E-6 radon barrier – 1 foot depth
- 5E-8 radon barrier – 1 foot depth
- Filter layer – 0.5 feet depth
- Sacrificial soil layer – 1 foot depth
- Filter layer – 0.5 feet depth
- Rip rap cover – 1.5 feet depth
- Total depth – 6.5 feet

An effective density of 1.6 g/cm^3 with a consistency and mineralogy of low density concrete was assumed. This density is conservative considering that each cover layer of cover will be compacted to greater than 95% standard Proctor density, as per the CQA/QC Manual. MicroShield® projected a contact dose rate on top of the completed cover of 3.75E-4 mR/hr. Multiplied over an entire year, this yields a dose rate of approximately 3 mrem.

20. INTERROGATORY CAW R313-25-26(1)-20/1: ENVIRONMENTAL MONITORING

Regulatory Reference: R313-25-26(1). During the land disposal facility site construction and operation, the licensee shall maintain an environmental monitoring program. Measurements and observations shall be made and recorded to provide data to evaluate the potential health and environmental impacts during both the construction and the operation of the facility and to enable the evaluation of long-term effects and need for mitigative measures. The monitoring system shall be capable of providing early warning of releases of waste from the disposal site before they leave the site boundary.

Division's Interrogatory Statement: *Refer to Sections4.4.3 and 7.3.4 of the Class A West (CAW) Embankment License Amendment Request (LAR):*

1. *Justify the assertion that no additional monitoring of airborne radioactive materials is required to ensure adequate protection against the increased volume of LLRW proposed to be disposed of.*
2. *Update the Environmental Monitoring Plan (or Program) to reflect changes that will result from granting the requested CAW amendment request.*

Energy*Solutions*' Response: The following assumptions are used to justify the assertion that the current number of air monitoring stations is adequate to perform environmental monitoring for the Class A West Embankment:

1. The current, approved Environmental Monitoring Plan (EMP) is rigorous enough to monitor airborne dispersion from the Class A (CA) and Class A North (CAN) footprints; and,
2. EnergySolutions is not requesting an increase to the operating open cell areas provided at License Condition 11.

Please refer to Figure 1 below throughout the rest of this discussion. Figure 1 superimposes wind speed and direction data obtained from Energy*Solutions'* Clive-site weather station over the last 18 years, over the location proposed for the Class A West Embankment.

Given the predominant wind direction, any amount of airborne, radioactive particulate matter is expected to travel to the north, northeast. Air monitoring stations A-30, A-35, A-36 and A-1 are positioned to intercept airborne contamination that could potentially result from operations in the Class A West Embankment.

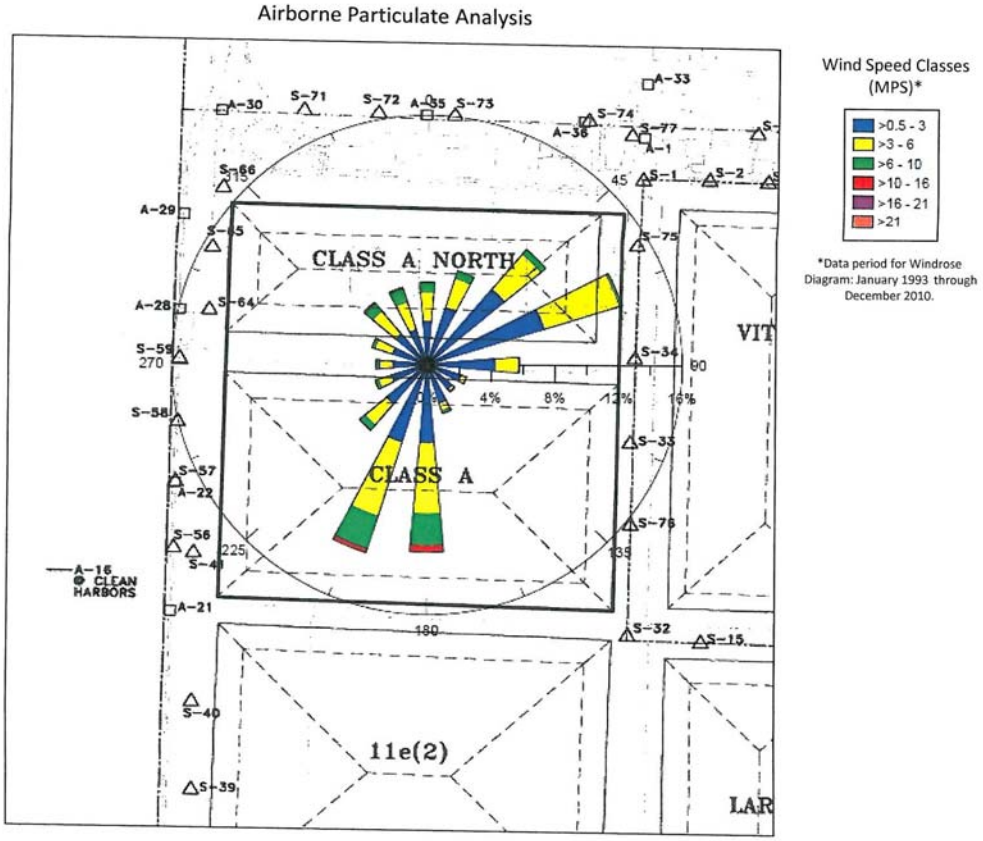

Figure 1. Airborne Particulate Analysis

Airborne contamination could reach the western fence line in any of the minor windrose directions despite the low wind velocities and infrequent occurrences; particularly if waste placement operations were occurring on the western edge of the Class A West Embankment. Under these circumstances, west-side placement of air stations A-29, A-28, and A-22 would intercept and alert environmental staff should airborne contamination be present. It should be noted that any contamination moving over the Class A Embankment or coming from the southern top slope of the proposed Class A West Embankment from the northeast, will be intercepted by A-22 and A-21.

The 35 mile-per-hour (mph), or 15.6 meters-per-second (mps), shut down requirement found in License Condition 53.D further supports the current EMP configuration for air monitoring. As detailed in License Condition 53.D, bulk waste handling ceases at the Clive facility when the 5-minute average wind speed reaches 35 mph.

There are no short or intermediate-term changes that need to be made to Energy*Solutions*' air monitoring network. As such, no revised EMP will be submitted at this time.

21. INTERROGATORY CAW R313-25-26 (2 AND 3)-21/1: TECHNICAL ANALYSES - HORIZONTAL TRANSPORT AND WELL SPACING ANALYSIS INPUT PARAMETERS

Regulatory Reference: R313-25-26(2). During the land disposal facility site construction and operation, the licensee shall maintain an environmental monitoring program. Measurements and observations shall be made and recorded to provide data to evaluate the potential health and environmental impacts during both the construction and the operation of the facility and to enable the evaluation of long-term effects and need for mitigative measures. The monitoring system shall be capable of providing early warning of releases of waste from the disposal site before they leave the site boundary.

R313-25-26(3). After the disposal site is closed, the licensee responsible for post-operational surveillance of the disposal site shall maintain a monitoring system based on the operating history and the closure and stabilization of the disposal site. The monitoring system shall be capable of providing early warning of releases of waste from the disposal site before they leave the site boundary.

Division's Interrogatory Statement: *Refer to Sections 2.2, 3.1.1, and 4.4.3of the Class A West (CAW) Embankment License Amendment Request (LAR); Sections 3.5 and 6.2 of the April 19, 2011 (Whetstone Associates 2011) CAW Cell Infiltration and Transport Modeling Report,and Sections 3.1, 3.2, and 3.3 and Figure 1 of Attachment 6 (Clive Facility Well Spacing Evaluation Class A West Embankment, April 28, 2011) to the CAW LAR:*

1. *Provide information to justify the use of a 90 % confidence level hydraulic conductivity value in the MEMO Model in the Well Spacing Evaluation Report that is based on slug test data from wells that are completed (only) in the Unit 2 clay, in contrast to using a 90% confidence level hydraulic conductivity value in the horizontal transport analysis section of the Whetstone Associates (2011) CAW Cell Infiltration and Transport Modeling Report that is based on slug test data from well completed in the Unit 3 Sand.*

Energy*Solutions*' Response: All wells associated with the Class A and Class A North embankments screened at the water table in the shallow water-bearing zone were used in the statistical calculation of the hydraulic conductivity values used in the Class A West well spacing evaluation. There was no attempt to bias the calculation to a particular hydrostratigraphic unit.

The hydrostratigraphic units dip to the west, whereas the groundwater table dips more gradually to the east. As a result, the water table on west side of the Class A West footprint is within Unit 3 and within Unit 2 on the east side (refer to Hydrogeologic Cross Sections A-A', B-B', and G-G' of the Revised Hydrogeologic Report [Envirocare, 2004] for illustration).

Section 6.2.1 of the infiltration and transportation modeling report will be revised to correctly state that hydraulic conductivity used in the modeling was calculated from data

for Hydrostratigraphic Units 2 and 3. Hydraulic conductivity data from all water-table wells at the facility are used in the statistical calculation of hydraulic conductivity for the Class A West modeling. Data were not biased to a particular hydrostratigraphic unit.

Division's Interrogatory Statement: *Also provide information to the explain and justify the difference between each of these derived 90 % hydraulic conductivity values and the 90% confidence level aggregate hydraulic conductivity value that was used in a prior analysis (Whetstone Associates 2009 Well Spacing Evaluation for the EnergySolutions Class North Embankment) that was based on slug test data from wells completed in both the Unit 3 Sand and the Unit 2 Clay.*

Energy*Solutions*' Response: As stated above, the Class A West well spacing evaluation used all water-table wells associated with the Class A and Class A North Embankments for the calculation of hydraulic conductivity statistics. The well spacing evaluation for Class A North (Whetstone, 2009a) used all water-table wells associated with the Class A North Embankment. The Class A West well spacing evaluation followed the convention of the approved Class A North and Mixed Waste well spacing evaluations by using hydraulic conductivity data from all water-table wells associated with the embankment or proposed embankment. Thus, minor differences in hydraulic conductivity values used in each analysis reflect the specific water-table wells associated with each embankment evaluated.

Division's Interrogatory Statement: *Indicate, if applicable, why different assumptions would be warranted in these three different analyses, or alternatively, revise the two current analyses to use a consistent methodology and consistent assumptions, and provide justification for the final selected approach and final adopted hydraulic conductivity input value (or different values, if justified)for use in the analyses.*

Energy*Solutions*' Response: As stated above, the infiltration and transport model used data from all water-table wells at the facility, while the well spacing evaluation used data from water-table wells associated with the Class A and Class A North Embankments.

The average linear groundwater velocity for horizontal transport in the Class A West infiltration and transport modeling is 2.6E-06 cm/s (0.82 m/yr). The average linear velocity for horizontal transport in the Class A West well spacing evaluation ranged from 2.1E-06 to 6.7E-06 cm/s (0.67 to 2.1 m/yr) (Table 5). The velocities used for horizontal transport in the infiltration and transport model and in the well spacing evaluation base case are conservative. For this reason, differences in the hydraulic conductivity values are inconsequential. Please note, the low end of the average linear velocity range used in the well spacing evaluation approximates more realistic conditions for sensitivity analysis.

Division's Interrogatory Statement: *Include a summary of monitoring well completion details, information on the distribution of hydrogeologic units in relation to the expected groundwater flow paths involved in the analyses, and other information as needed to support and justify the appropriateness of the final hydraulic conductivity model input data.*

Energy*Solutions*' Response: This is beyond the scope of the analysis and not necessary given the discussion above. All wells used are water-table wells screening in the shallow water-bearing zone.

Division's Interrogatory Statement:

2. *Provide a revised Well Spacing Evaluation Report and/or revised CAW Cell Infiltration and Transport Modeling Report, as appropriate, reflecting use of the final selected approach and final adopted hydraulic conductivity input value(s).*

Energy*Solutions*' Response: Not necessary, see responses above.

Division's Interrogatory Statement:

3. *Provide a revised approach for estimating longitudinal dispersivity that is more in keeping with supporting information and available published data and interpretations.*

Energy*Solutions*' Response: Longitudinal dispersivity has been defined as 0.1 times the average horizontal transport distance in the following well spacing evaluations approved by the Division: 1) LARW Embankment (Adrian Brown Consultants, 1998), 2) Mixed Waste Embankment (Whetstone Associates, 2009a), and 3) Class A North Embankment (Whetstone Associates, 2009b). The Class A West well spacing evaluation did not repeat the details of dispersivity selection, since it was provided in the earlier approved reports.

Technical discussion of the relationship between flow path length, longitudinal dispersivity, and transverse dispersivity are provided by Gelhar (1992), Gelhar (1986), and Fetter (1993).

Division's Interrogatory Statement: *Derive, defend, and incorporate a revised longitudinal dispersivity (and revised transverse dispersivity) value into the well spacing evaluation.*

Energy*Solutions*' Response: Conservatism is built into the well spacing evaluation. A sensitivity analysis was performed using more realistic groundwater velocities. Because dispersion is a function of groundwater velocity, dispersion is less in the sensitivity analysis runs compared to the base case. Also, setting the source width at 1.0 foot is a very conservative assumption because any release from the bottom of the liner will tend to disperse laterally as it migrates vertically through the vadose zone to the water table.

As a check on well spacing sensitivity to dispersivity, the technetium-99 base case well spacing evaluation for the full Class A West footprint was re-run using a longitudinal dispersivity of 27.2 feet and a transverse dispersivity of 2.72 feet. The longitudinal dispersivity was calculated from an equation provided by Xu, and Eckstein, (1995). Their method applies a weighting scheme, based on reliability, to the field data reviewed by Gelhar et al. (1992). The base case monitoring efficiency was 96.3% (see Table 9). When the dispersivities were changed to those listed above, the monitoring efficiency was 94.2%. This sensitivity run was then modified further by changing the source width from 1 foot to 3 feet, and the resulting monitoring efficiency was 95.0%.

Division's Interrogatory Statement: *Alternatively, provide sensitivity analyses that incorporate a range of possible αx and transverse dispersivity values, to bound the uncertainties associated with the methodology used for estimating the αx parameter for use in the well spacing evaluation, to assess the sensitivity of the modeling results to changes in these dispersivity values.*

Energy*Solutions*' Response: Please see the response immediately above.

Division's Interrogatory Statement:

4. *Provide rationale for assuming a single location below the center of the top slope of the CAW Embankment for determining the distance to the nearest compliance well as a basis for estimating an appropriate value of longitudinal dispersivity for the well spacing evaluation.*

Energy*Solutions*' Response: The center of the top slope is an approximate average path length from the embankment to the compliance wells. This approach follows that of previous approved well spacing evaluations. For potential release points that are located closer to the compliance wells, dispersion will be less than for longer flow paths regardless of what value of longitudinal dispersion is used in the modeling.

Division's Interrogatory Statement:

5. *Demonstrate that why such an assumption would be conservative, e.g., rather than assuming another potential origin points within the CAW Embankment footprint for a potential release that would be located closer to the compliance monitoring wells and consequently exhibit less dispersion at the locations of some or all compliance monitoring wells. Demonstrate that the well spacing analysis approach and assumptions result in a reasonably representative estimation of αx and transverse dispersivity values for assessing the adequacy of the well spacing intervals.*

Energy*Solutions*' Response: For potential release points that are located closer to the compliance wells, dispersion will be less than for longer flow paths regardless of what value of longitudinal dispersion is used in the modeling.

22. INTERROGATORY CAW R313-25-33(1)-22/1: RECORDS

Regulatory Reference: R313-25033(1). Licensees shall maintain records and make reports in connection with the licensed activities as may be required by the conditions of the license or by the rules and orders of the Executive Secretary.

Division's Interrogatory Statement: *Refer to Section 4.2 of the Class A West (CAW) Embankment License Amendment Request (LAR):Explain how the management of waste-related data for waste disposed of in the CAW will differ from that of waste disposed of in the Class A and Class A North embankments.*

Energy*Solutions*' Response: Section 4.2 has been revised to state that there will be no changes associated with records management for purposes of constructing the Class A West Embankment.

23. INTERROGATORY CAW R317-6-6.4-23/1: ISSUANCE OF DISCHARGE PERMIT: BEST AVAILABLE TECHNOLOGIES - MONITORING WELLS REQUIRING ABANDONMENT AND DECOMMISSIONING AND LYSIMETERS PROPOSED FOR ABANDONMENT

Regulatory Reference: R317-6-6.4(A). The Executive Secretary may issue a ground water discharge permit for a new facility if the Executive Secretary determines, after reviewing the information provided under R317-6-6.3, that: …2. the monitoring plan, sampling and reporting requirements are adequate to determine compliance with applicable requirements; 3. the applicant is using best available technology to minimize the discharge of any pollutant;…".

Division's Interrogatory Statement:

1. *Refer to Section 4.4.3 of the Class A West (CAW) Embankment License Amendment Request (LAR) and Drawing10014 U02 of the CAW LAR: Drawing 10014 U02 indicates that the locations of several existing monitoring wells (e.g., GW-81, -82, -83, -84, -85, -86, -109, -110, -111, -112, -137, -138, -140, and -141) would be covered by CAW Embankment (and also covered by waste). Please submit a well plugging and abandonment (well decommissioning) plan and well decommissioning schedule for sealing and decommissioning all existing monitoring wells prior to construction of the CAW over them.*

   Include information demonstrating that the plugging/sealing or other well abandonment technologies used to plug and decommission these wells represent BATs and will not compromise the long-term performance requirements for the CAW.

2. *Refer to Section 4.4.3 of the Class A West (CAW) Embankment License Amendment Request (LAR) and Drawing 10014 C01 of the CAW LAR: Drawing 10014 C01 indicates that four existing or currently planned lysimeters (CL-W2, CL-W3, CL-W4, and CL-N5) beneath the Class A and Class A North Embankments are proposed to be abandoned (as they would be covered by CAW Embankment, and also covered by waste). Please provide*

additional information and details regarding systems and measures that EnergySolutions proposes to implement to retain the ability to acquire data that would have been provided by these four lysimeters if they were not abandoned.

Demonstrate that the level and quality of vadose zone data will be equivalent to that obtainable from these four lysimeters once such systems and measures have been implemented.

Demonstrate that the systems and measures to be employed, if different than those current or planned, satisfy criteria for best available technologies for this type of monitoring.

Energy*Solutions*' Response:

1. Monitoring well abandonment: Monitoring well abandonment procedures are regulated at UAC R655-4-14. These regulations specify the materials and methods used to abandon wells. Prior Division notification and approval of well abandonment is required at Part IV.C.4 of the GWQDP. Obviously, well abandonment will need to be completed prior to clay liner construction. Thus, no more detailed schedule is required.
2. Collection lysimeter closure: On June 27, 2011, the Division approved a revision to Appendix C of the GWQDP, including the Collection Lysimeter Operation, Maintenance, and Closure Plan. Section 4 of this plan was updated to discuss notification requirements, abandonment procedures, and contamination control requirements applicable to this activity. Section 1.2.3 of the amendment request already addresses replacement of the lysimeters to be abandoned; including a demonstration of adequate lysimeter coverage with the replacement network. A reference to this discussion is added to section 4.4.3. The interrogatory is incorrect in asserting that "…no equivalent replacement monitoring devices… are proposed to take their place."

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