UTAH DIVISION OF RADIATION CONTROL: ENERGY*SOLUTIONS'* CLIVE LLRW DISPOSAL FACILITY;

LICENSE AMENDMENT REQUEST; CLASS A WEST EMBANKMENT

ROUND 2B INTERROGATORIES

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(Highlighted items either addressed in these Round 2B interrogatories or deferred to Round 2C as indicated)

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ABBREVIATIONS AND ACRONYMS

CAW LAR	Class A West Embankment License Amendment Request
cm	centimeter
ft	foot
HELP	Hydrologic Evaluation of Landfill Performance Model
kg	kilogram
L	liter
LLW	low-level waste
UAC	Utah Code Annotated
US	United States

INTERROGATORY CAW R313-25-6(3)-01/2A: DESCRIPTION OF FACILITY

Refer to Interrogatory Round 2A

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

Round 1 Interrogatory Response is satisfactory.

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

Refer to Interrogatory Round 2A

INTERROGATORY CAW R313-25-7(3)-04/2A: SPECIFIC TECHNICAL INFORMATION – DESIGN CRITERION FOR DISTORTION OF LINER AND CLAY COVER COMPONENTS

Refer to Interrogatory Round 2A

INTERROGATORY CAW R313-25-7(7)-05/2B: SPECIFIC TECHNICAL INFORMATION -- CLOSURE PLAN

PRELIMINARY FINDING:

Refer to 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.

INTERROGATORY STATEMENT:

1. *Please revise Attachment 9 to the CAW LAR to address and justify the increased demand for clay and rock, as stated in Attachment 5 to ES letter CD11-0327.*

2. *Please demonstrate quantitatively that the amount of rock available for constructing the revised CAW cover system is adequate to meet the need for rock stated in the Round 1 Response to this interrogatory in Section 2.5.4 of CAW LAR, rev. 2.*
3. *Provide evidence that EnergySolutions has valid claims to rock in any of the "adjoining pit areas [that] contain several hundred thousand additional cubic yards of material." State and justify the total amount of rock to which EnergySolutions has valid claims.*
4. *Demonstrate that rock from these adjoining pits to which EnergySolutions has valid claims and has included in the total amount stated in Item 3 above is of adequate quality under NUREG-1623 for use in constructing the CAW cover system.*

BASIS FOR INTERROGATORY:

1. *The amounts of clay and rock needed to construct the revised CAW cover system are not justified by revisions to the Attachment 9, provided to quantify the need for clay and rock before the CAW cover design change was proposed.*
2. *The revised CAW LAR pages provided in Attachment 5 to ES letter CD11-0327 states the demand for rock material to total more than 1.7 million cubic yards of rock. The associated justification that adequate supplies of rock are actually available is provided in the statements that "This is one of several pits in the region; and EnergySolutions contract area alone provides approximately 1.1 million cubic yards of proven rock material. The adjoining pit areas contain several hundred thousand additional cubic yards of material." This qualitative assessment is inadequate and must be supplemented by quantitative estimates based on verifiable information about each adjoining pit.*
3. *The Division requires assurance that EnergySolutions will indeed be able to extract the rock from its various natural locations. Without such assurance, confidence that the proposed facility can be appropriately closed cannot exist.*
4. *The Division requires assurance that rock available from adjoining pits is of adequate quality to be acceptable under NUREG-1623 for use in constructing the proposed revised CAW cover system. Without such assurance, confidence that the proposed facility can be appropriately closed cannot exist.*

REFERENCES:

EnergySolutions, LLC. 2011a. License Amendment Request: Class A West Embankment, with Attachments 1 Through 7 and cover letter to Mr. Rusty Lundberg of Utah Division of Radiation Control dated May 2, 2011.

EnergySolutions, LLC. 2011b. License Amendment Request: Class A West Embankment, with Attachments 1 Through 7 and cover letter to Mr. Rusty Lundberg at Utah Division of Radiation Control dated May 2, 2011, including Attachment 1 – "RML Revisions".

EnergySolutions, LLC. 2011c. Radioactive Materials License #UT2300249 and Groundwater Quality Discharge Permit No UGW450005. Amendment and Modification Request – Class A West Embankment: Response to Interrogatory CAW R313-25-8(1)-08/1; Letter from Sean McCandless of EnergySolutions to Mr. Rusty Lundberg of Utah Division of Radiation Control dated November 29, 2011, including Attachment 5 – "CAW LAR redline/strikeout pages from the text based on the attached Groundwater Modeling".

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

Round 1 Interrogatory revised response (based on revised CAW cover design) is satisfactory.

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

Round 1 Interrogatory Response is satisfactory.

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

Round 1 Interrogatory revised response (based on revised CAW cover design) is satisfactory.

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

XXX A performance assessment to be completed in 2012 will address dose limits for disposal.

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

Round 1 Interrogatory Response is satisfactory.

INTERROGATORY CAW R313-25-8(4)-11/2B: TECHNICAL ANALYSIS - ROCK COVER DESIGN AND ROCK COVER DESIGN CALCULATIONS/ ANALYSES

PRELIMINARY FINDING:

Refer to 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.

INTERROGATORY STATEMENT:

1. **Refer to Drawing 10014 C04 of Energy*Solutions* 2011a; and 2011b and Drawing 10014 C04, Rev. 2 of Energy*Solutions* 2011c:** *To further justify and corroborate the expected hydraulic performance of the Type A Filter Zone/bedding layer and further evaluate its ability to accommodate the proposed change in riprap layer design (EnergySolutions 2011c), please provide the following:*

   1. *Calculations/estimates of expected interstitial flow velocities within the Type A Filter Zone Layer on the topslope and sideslope areas, derived using alternative analysis methods, including, but not necessarily limited to: (a) Abt et al. 1991/Abt et al. 1988, Section 5.3; and (b) Codell et al. 1990;*

   2. *Evaluation of the potential impact of results of additional infiltration analyses conducted in response to Interrogatory CAW R313-25-8(4)-14/2B: "Technical Analysis - Infiltration and Transport Modeling: Climate Conditions, Engineered Barrier Conditions, and Vertical Transport Distance" below on the projected performance of, and technical adequacy of, the various cover layers in proposed CAW Embankment cover, including but not limited to, the riprap layer, Type A Filter Zone layer, and the underlying Sacrificial Soil layer.*

   3. *Other additional information to fully justify the selection of a thickness of 6 inches for the Type A Filter Zone layer, which appears to be contrary to the following published guidance:*

      - *Nelson et al. 1986, Section 4.4, which indicates that a filter/bedding layer thickness of one-half the riprap layer thickness, but not less than 6 to 9 inches, depending on the riprap thickness and riprap design procedure, is recommended; and*

- *Abt et el. 1988, Section 7.1, which highly recommends the use of a filter/bedding layer greater than 6 inches thick (to ensure stability of the riprap, prevent migration of particles beneath the filter/bedding layer, and reduce any pressure gradient that may exist from seepage).*

BASIS FOR INTERROGATORY:

Applicable published guidance documents, cited in the interrogatory above, recommend that granular filter/bedding layers installed beneath rock riprap layers either have a thickness at least one-half of the riprap layer thickness (Nelson et al. 1986) or have a minimum thickness greater than 6 inches (Abt et al. 1988). The referenced documents discuss certain performance characteristics/performance issues that NRC considered when developing these minimum thickness recommendations. The Type A Filter Zone layer in the proposed CAW Embankment cover has a thickness of 6 inches, while the proposed thickness of the overlying riprap layer has been increased from 18 inches (EnergySolutions 2011a; 2011b) to 24 inches (Energy Solutions 2011c).

EnergySolutions has not provided information to justify the proposed thickness of 6 inches for the Type A Filter Zone layer, which is a departure from the above-described published recommendations, especially given the recent proposed increase in the riprap layer thiockness, and has not discussed, considered, and evaluated how use of a 6-inch thick filter/bedding layer in the CAW Embankment would impact cover performance with respect to the potential long-term performance issues described by the NRC in the cited references. Additional information and analysis results need to be provided to justify the proposed Type A Filter Zone layer design, or alternatively, a thicker and /or otherwise modified (as needed, based on analyses done in response to other interrogatories) Type A Filter Zone layer design should be proposed and justified.

REFERENCES:

Abt, S.R, Whittler, R.J., Ruff, J.F., LaGrone, D.l., Khattak, M.S., Nelson, J.D. 1988. Development of Riprap Design Criteria by Riprap Testing in Flumes: Phase II, Followup Investigations. NUREG/CR-4651, ORNL/TM-10100/V2, Vol. 2. 1988.

Abt, S.R, Ruff, J.F., and Whittler, R.J. 1991."Estimating Flow through Riprap", Journal of Hydraulic Engineering, Vol. 117, No. 5.

Codell, R.B., Abt, S.R., Johnson, T., and Ruff, J. 1990. "Estimation of Flow Through and Over Armored Slopes", in Journal of Hydraulic Engineering, Vol. 116, No. 10, October 1990. Pp. 1252-1269.

EnergySolutions, LLC. 2011a. License Amendment Request: Class A West Embankment, with Attachments 1 Through 7 and cover letter to Mr. Rusty Lundberg at Utah Division of Radiation Control dated May 2, 2011.

EnergySolutions, LLC. 2011b. Responses to Round 1 Interrogatories: License Amendment Request (UT2300249) for the Class A West Embankment and cover letter to Mr. Rusty Lundberg at Utah Division of Radiation Control, October 28, 2011.

EnergySolutions, LLC. 2011c. Drawing 10014 C04, Rev. 2. Class A West Embankment Sections and Details, 2 of 2, November 3, 2011.

Nelson, J.D., Abt, S.R., Volpe, R.L., van Zyl, D., Hinkle, N.E., and Staub, W.P. 1986. Methodologies for Evaluating Long-Term Stabilization Designs of Uranium Mill Tailings Impoundments. NUREG/CR-4620. June 1986.

INTERROGATORY CAW R313-25-8(4)-12/2B: TECHNICAL ANALYSIS - FILTER STABILITY/ FILTER PERMEABILITY CRITERIA

Round 1 Interrogatory response is satisfactory.

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

Round 1 Interrogatory revised response (based on revised CAW cover design) is satisfactory.

INTERROGATORY CAW R313-25-8(4)-14/2B: TECHNICAL ANALYSES – INFILTRATION AND TRANSPORT MODELING: CLIMATE CONDITIONS, ENGINEERED BARRIER CONDITIONS, AND VERTICAL TRANSPORT DISTANCE

PRELIMINARY FINDING:

Refer to 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.

INTERROGATORY STATEMENT:

Reference the November 28, 2011 (Whetstone Associates 2011c) CAW Cell Infiltration and Transport Modeling Report, Drawing 10014 C04 of Energy*Solutions* 2011a; and 2011b, and Drawing 10014 C04, Rev. 2 of Energy*Solutions* 2011c: *Please provide the following:*

1. *Provide an analysis, using an appropriate 2-D or 3-D modeling simulation tool other than the HELP Model (e.g., HYDRUS 2D or other appropriate modeling tool), to assess predicted peak moisture conditions and peak flow behavior within various layers of the cover system over different time spans (hours to several years) during the CAW Embankment's required performance period. Provide sensitivity analyses that consider peak precipitation conditions, including extreme, short-duration (e.g., on the order of hours) precipitation events, minimum and/or maximum evapotranspiration conditions, and degraded conditions within the various cover layers. Provide analysis results demonstrating that excessive seepage pressure gradients will not occur within the specific layers of the cover system (e.g., within the Type A Filter Zone layer) during the CAW Embankment's performance period, considering both as-built and degraded conditions. Demonstrate that all cover layers in both the topslope and sideslope areas have sufficient capacity to safely convey lateral flows that may occur within such layers under peak flow conditions, if they occur, and that cover system stability would not be compromised under such conditions. Demonstrate that the expected range of residence times for water accumulating within the riprap and Type A Filter Zone layers on the topslope would not be sufficiently long to allow freezing conditions (e.g., ice bridging) to occur during times of freezing temperatures, possibly resulting in blocking of flow at certain times (e.g., during meltwater flow episodes) within the riprap or Type A Filter Zone layer.*

2. *Provide information supporting the range of climate conditions, including peak precipitation events and durations, and/or periods of assumed higher average precipitation rates, and minimum and/or maximum evapotranspiration rates used in the simulations, and 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 results of infiltration performance analyses incorporating such peak/higher precipitation and/or minimum evapotranspiration conditions into the modeling simulations. Alternatively, provide detailed justification why consideration of such climatic conditions in the infiltration simulations is not required.*

3. *Provide rationale to support the selection of degraded conditions in the cover system layers that may affect the long-term performance of the CAW Embankment cover, including conditions developed as a result of environmental influences such as bioturbation, burrowing animals, and plant root development. Provide results of infiltration performance analyses incorporating such degraded conditions into the modeling simulations, or, alternatively, provide detailed justification why consideration of*

such degraded engineered barrier conditions in the infiltration simulations is not required.

4. *For the top slope PATHRAE analysis, please correct discrepancies between the fractional release rates in Table 24 of the November Infiltration and Transport Modeling Report (Whetstone 2011) and the values used in the PATHRAE modeling for the Class A West top slope analysis. State the values of all the input parameters used in the release rate equation in Section 5.1.5 of the report.*

5. *For the side slope PATHRAE analysis, please correct discrepancies between the fractional release rates in Table 25 of the November Infiltration and Transport Modeling Report (Whetstone 2011) and the values used in the PATHRAE modeling for the Class A West side slope analysis. State the values of all input parameters used in the release rate equation in Section 5.1.5 of the report.*

6. *Please correct the values for "Soil Retardation Factors" shown in Table 24 and ensure that the correct values are used in the PATHRAE top slope analysis.*

7. *Please provide information on transverse and longitudinal dispersivity values used in the horizontal transport component of the modeling done by Whetstone. Provide information justifying the selection of the parameter values used in modeling, including information demonstrating that the range of potential dispersivity values considered reasonably bounds the range of values that could be appropriate for the site conditions and scale of the investigation. Provide sensitivity values as appropriate for different assumed dispersivity values demonstrating the sensitivity of model results to changes in dispersivity values. Provide rationale to support use of dispersivity values in the horizontal transport simulations that are different from those used in MEMO Model simulations, or, alternatively, use the same assumed values for both simulations.*

BASIS FOR INTERROGATORY:

The information provided by EnergySolutions regarding the expected infiltration and runoff performance characteristics of the proposed CAW Embankment cover system does not adequately investigate the dynamics (pressure head distributions, flashy flow behavior/velocity surging, down dip loading, etc…) of percolating water flow within individual layers of the proposed cover system, including the dynamics of flow within the cover layers following extreme precipitation events. EnergySolutions' Response to the Round 1 interrogatory on this topic (EnergySolutions 2001a) indicating that additional infiltration sensitivity analyses are not needed for the CAW Embankment because previous infiltration sensitivity analyses completed for other disposal embankments at the Clive Facility are adequate does not address the potential differences in 2-D/3-D flow behavior within the CAW Embankment cover system compared to the other embankment covers owing to the larger size and longer slope lengths of the CAW Embankment compared to existing disposal embankments at the Clive Facility. Previous infiltration model sensitivity analyses also do not address the potential effects of the recently *proposed increase in thickness of the riprap layer for the CAW Embankment. Additionally, with one exception -- a report by The Mines Group, Inc. (2000) which included use of alternative infiltration models for the Mixed Waste Cell cover) -- all previous sensitivity analyses performed for disposal embankment covers at the Clive Facility were performed using the HELP® Model, which is a quasi-2-D model.*

Given the proposed longer topslope and longer sideslope lengths of the CAW Embankment, and also given the proposed recent increase in the riprap layer thickness in the cover (EnergySolutions2011c), while retaining the proposed Type A Filter Zone layer thickness at 6 inches, additional analysis/modeling should be completed, using an alternative 2-D or 3-D modeling tool, to provide additional information to gain further insight into the specific hydraulic performance of the individual cover layers, including both lateral subsurface and vertical fluxes, and pressure head distributions and lateral flow velocities and velocity profiles within the different cover layers. Additional assessment of the potential consequences of such layer-specific, transient flow conditions, including potential head buildup in one or more layers in the cover system and down dip loading effects in individual layers including the Type A Filter Zone layer and the Sacrificial Soil layer, on cover system stability is needed.

The Whetstone Associates (2011a and 2011b) Infiltration and Transport Modeling Reports use the HELP® Model (Version 3.06) to simulate infiltration behavior and predict infiltration rates through the proposed CAW Embankment cover system. This modeling approach does not investigate the characteristics of dynamic, transient (e.g., "flashy") flow behavior, including potential for velocity "surges" at certain locations, that may occur within the CAW Embankment cover system layers in response to shorter-term, high-intensity precipitation events. Likewise, the current modeling approach does not provide means of assessing, in a 2-D or 3-D manner, mechanisms that could lead to the build up of heads in individual layers. Minimizing buildup of head in the upper layers of the cover system will improve long-term stability of the upper part of the cover system.

The HELP® Model "spreads out" daily rainfall uniformly over 24 hour-periods, which decreases precipitation intensity compared to actual intensities that occur during certain shorter periods of time, thereby increasing infiltration and decreasing runoff during these events. This may result in underestimation of the maximum heads that may develop with different layers at certain times. In addition, the HELP® Model treats the Type A Filter Zone layer as a vertical percolation layer instead of a lateral drainage layer. While this approach may be conservative from the standpoint of estimating the maximum total water flux rates out of the base of the cover system, it does not provide insights or understanding of the internal flow dynamics within the upper parts of the cover system (e.g., riprap layer, Type A Filter Zone layer, and Sacrificial Soil layer, etc…) on the topslope and sideslope areas at times of interest that need to be considered in the performance assessment. In contrast to the HELP® Model, other, 2-D or 3-D simulation models, such as HYDRUS 2D®, allow a 2-D analysis of water flow behavior within the individual cover system layers. Alternative models such as HYDRUS 2D® also allow the user to use smaller time intervals to discretize precipitation, which better reflects the actual precipitation intensities, because the duration of most storms is significantly less than 24 hours.

Additionally, comparison study of four different modeling tools – two of which included HELP® and HYDRUS 2D® - by Albright et al. (2002) indicated the following observations with respect to sensitivity analyses that were completed for certain parameters and variables relative to the performance of multilayer cover systems designed for arid site conditions:

Cover Parameter or Variable	***HELP® Model Sensitivity Analysis Result***	***HYDRUS 2D® Model Sensitivity Analysis Result***
Available water content (AWC) = field capacity minus wilting point	*Sensitive to AWC but unrealistic response pattern observed*	*Sensitive to AWC and realistic response pattern observed*
Cover thickness response	*Low sensitivity and unrealistic response pattern observed*	*Highest sensitivity and realistic response*
Saturated hydraulic conductivity (K_s) of drainage layer and barrier layers	*Sensitive to K_s with realistic response patterns observed*	*Sensitive to K_s with realistic response patterns observed*

Although the cover systems evaluated by Albright et al. (2002) (a barrier layer and drainage layer overlain by a vegetative soil layer) differ from the proposed CAW Embankment cover system, the results of the above study are informative and may be relevant to simulation approaches that should be considered and used for assessing the performance of the CAW Embankment cover, e.g., the noted superior performance of the HYDRUS 2D compared to HELP with regard to model reliability in assessing impacts of changes in cover thickness).

Figure 3 and Table 4 of the November 2011 Whetstone Associates Infiltration and Transport Modeling Report (2011b) indicate that significantly higher precipitation levels have occurred during some years relative to others (e.g., 1997 and 1998 [136 % and 160 % , respectively, of the 17-year annual average precipitation for the 1992-2009 period]) and significant fluctuations in monthly precipitation have also occurred during several months during a 17-year-long period (1992 through 2009) at Clive. Figure 4 indicates that, for the 17-year period between 1992 and 2009, the average monthly precipitation level at Clive exceeded, in some cases (January, February, March, April, June) and was lower, in some cases, than at Dugway, Utah, where a considerably longer (60-year) climate record exists.

Sections 1.2 and 3.2.1 of NUREG-1573 (NRC 2000) specifies that weather conditions should be taken into consideration in performance assessments for low level radioactive waste disposal facilities. In particular, Section 3.2.1indicates that "a key aspect of an LLW performance assessment is determining how variations in precipitation result in varying rates of percolation into disposal units and of recharge to the water table. The NRC's Performance Assessment Working Group recommends using historical and current weather data, and other site information (e.g., field tests) to establish a broad range of infiltration rates that may be used to simulate both wetter and drier conditions than the current average. Sensitivity analyses performed as *part of the LLW performance assessment will provide some insight into the effects that such variations could have on the dose calculations…"*

Sections 3.2.2 and 3.3.4 of NUREG-1573 (NRC 2000) indicate that potentially degraded conditions in engineered barrier components of the closure cover system should be declared and taken into account when estimating the long-term performance of a reclaimed facility such as the closed CAW Embankment. Section 3.2.2 of NUREG-1573 indicates that " given natural forces likely to cause unavoidable and unpredictable deterioration of physical barriers, no compelling evidence was found [by NRC's Performance Assessment Working Group] to suggest that physical barriers, such as natural covers and reinforced concrete vaults, will perform at anticipated design levels, indefinitely." That section further recommends that an applicant assign and justify the credit given to engineered barrier performance, and indicates that "in the degraded condition, at the end of its intended service life, an engineered barrier (e.g., reinforced concrete vault, engineered subsurface drainage system, etc.) can still perform a function, but the (diminished) function would be established by the applicant based on the assumed properties of its constituent materials…In general, the parameter values for hydraulic conductivity and other physicochemical properties of [each] engineered barrier used in the performance assessment should represent its changed/degraded condition."

For the top slope transport analysis there are differences between the fractional release rates stated in Table 24 of the Infiltration and Transport report (Whetstone 2011) and the values used in the top slope PATHRAE files. For example, Table 24 states a Cl-36 fractional release rate of 3.85E-02 yr^{-1}, but the value used in the PATHRAE file "09Wa OUT.docx" (Attachment 3 of the Whetstone report) is 1.65E-02 yr^{-1}. This means that the top slope PATHRAE simulation used a Cl-36 release rate that was only about half of the release rate stated in Table 24. Other radionuclides (e.g., H-3, C-14) in Table 24 showed the same disagreement when compared to the PATHRAE computer file. Please correct the discrepancy and justify the correct values for the fractional release rates.

For the side slope transport analyses there are differences between the fractional release rate values stated in Table 25 of the Infiltration and Transport report and the values used in the side slope PATHRAE files. For example, Table 25 states a Cl-36 fractional release rate of 5.50E-02 yr^{-1}, but the value used in the side slope PATHRAE file "168Wa OUT.docx" (Attachment 3 of the Whetstone report) is 2.86E-02 yr^{-1}. The side slope PATHRAE analysis therefore used a Cl-36 release rate that was about half of the release rate stated in Table 25. Other radionuclides (e.g., H-3, C-14) in Table 25 showed the same disagreement when compared to the PATHRAE computer file. Please correct the discrepancy and justify the correct values for the fractional release rates.

Table 24 shows "Soil Retardation Factors" that appear different than the values calculated using the data at the top of Table 24. For example, the Cl-36 retardation factor in Table 24 is 1.039. Using the data at the top of Table 24, a different value is calculated:

$$R = 1 + (\text{soil density} * Kd/\text{soil moisture}) = 1.042$$

where,

Soil density = 1.8 g/cm3
Kd = 0.0025 ml/g
Soil moisture = 0.093

The error appears to be caused by using moisture contents from the side slope to calculate retardation factors for the top slope. The incorrect values were also used in the top slope PATHRAE analysis. Please correct the error in Table 24 and in the PATHRAE files.

The Infiltration and Transport Model Reports (Whetstone Associates 2011a and 2011b) used a (vertical) dispersivity value of 0.1 m (0.3ft) for the vertical transport portion of the model, but did not cite dispersivity values used for the horizontal transport portion of the model. This information should be provided for clarity and for completeness and to allow these input values to be reviewed for appropriateness.

REFERENCES:

Albright, W.H., Gee, G.W., Wilson, G.V., and Fayer, M.J. 2002. Alternative Cover Assessment Report Project, Phase 1 Report. Desert Research Institute. Publication No. 41183, October 2002.

EnergySolutions, LLC. 2011a. License Amendment Request: Class A West Embankment, with Attachments 1 Through 7 and cover letter to Mr. Rusty Lundberg at Utah Division of Radiation Control dated May 2, 2011.

EnergySolutions, LLC. 2011b. Responses to Round 1 Interrogatories: License Amendment Request (UT2300249) for the Class A West Embankment and cover letter to Mr. Rusty Lundberg at Utah Division of Radiation Control, October 28, 2011.

EnergySolutions, LLC. 2011c. Drawing 10014 C04, Rev. 2. Class A West Embankment Sections and Details, 2 of 2, November 3, 2011.

NRC (US NUCLEAR REGUALTORY COMMISSION) 2000. NUREG-1573. A Performance Assessment Methodology for Low-Level Radioactive Waste Disposal Facilities - Recommendations of NRC's Performance Assessment Working Group. Division of Waste Management Office of Nuclear Material Safety and Safeguards. U.S. Nuclear Regulatory Commission, Washington, DC. October 2000.

The Mines Group, Inc. 2000. Technical Report for the Mixed Waste Facility Cover Design, Clive, Utah. November 14, 2000.

Whetstone Associates 2011a. EnergySolutions Class A West Disposal Cell Infiltration and Transport Modeling Report, April 19, 2011.

Whetstone Associates 2011b. EnergySolutions Class A West Disposal Cell Infiltration and Transport Modeling Report, November 28, 2011.

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

Round 1 Interrogatory Response is satisfactory.

INTERROGATORY CAW R313-25-8(4)-16/2B/2C: SEISMIC HAZARD EVALUATION / SEISMIC STABILITY ANALYSIS UPDATE

PRELIMINARY FINDING:

Follow-up issues, if any, will be included in Round 2C Interrogatories.

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

Round 1 Interrogatory Response is satisfactory.

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

Round 1 Interrogatory revised response (based on revised CAW cover design) is satisfactory.

INTERROGATORY CAW R313-25-25(6)-19/2A: RADIATION DOSE RATE AT THE SURFACE OF THE COVER

Refer to Interrogatory Round 2A

INTERROGATORY CAW R313-25-26(1)-20/2A: ENVIRONMENTAL MONITORING

Refer to Interrogatory Round 2A

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

PRELIMINARY FINDING:

Refer to 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.

Refer to 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.

INTERROGATORY STATEMENT:

Refer to Attachment 6 (Clive Facility Well Spacing Evaluation Class A West Embankment, April 28, 2011) to the CAW LAR (Energy*Solutions* 2011a) and EnergySolutions' Response to this Round 1 Interrogatory (Energy*Solutions* 2011b):

1. *Please provide additional information to further support selection of appropriate dispersivity values, particularly longitudinal dispersivity (α_x) values, for use in the well spacing evaluation for the CAW Embankment (and for transport modeling). Evaluate, compare, and use, as appropriate, one or more other alternative methodologies, for estimating dispersivity values that may be appropriate for this well spacing evaluation, considering the scale of the distances involved in the well spacing evaluation and site-specific subsurface conditions. Estimate or otherwise justify that the full range of dispersivity values that may be appropriate for this evaluation have been considered. Demonstrate that the identified range of dispersivity values used bounds the uncertainties associated with available methodologies for estimating dispersivity parameters. Provide MEMO Model sensitivity analyses that incorporate the full range of inferred possible α_x and transverse dispersivity values to demonstrate that the effects of possible changes in dispersivity values on the well spacing evaluation conclusions have been characterized. Provide and compare model-predicted results including and comparing breakthrough curves for various representative radionuclides based on modeled longitudinal*

dispersivity values, as appropriate, to demonstrate sensitivity of model results to changes in the input dispersivity values.

2. *Please provide additional rationale for why the Xu and Eckstein (1995) method is defensible for use as a "check" of calculated dispersivity values, despite its use of low and moderate reliability data in development of the methodology.*

3. *Provide revised Transport Model results, as required, that either (i) reflect the use of dispersivity values that are consistent with those used in the final well spacing evaluation or (ii) further justify use of different dispersivity values in these different models.*

4. *Provide information demonstrating that the retardation factor (R) values calculated for all constituents and used in MEMO Model simulations were calculated correctly. In Section of 3.2.4 the Clive Facility Well Spacing Evaluation (Attachment 6 to EnergySolutions 2011a [April 28, 2011 MEMO Model Evaluation Report]), provide a corrected version of the retardation equation that specifies the correct set of units for all variables included in the equation.*

5. *Please provide a summary of all input parameters and copies of output from any MEMO Model simulations performed.*

BASIS FOR INTERROGATORY:

EnergySolutions, in their response to the Round 1 Interrogatory item regarding dispersivity (EnergySolutions 2011b), used an alternative method for estimating dispersivity values for use in the well spacing evaluation. Specifically, they used a method developed by Xu and Eckstein (1995) to independently calculate dispersivity values. Xu and Eckstein's approach involved using all calculated dispersivity values available, including those considered to have lower reliability, to create a statistical correlation model for model dispersity values based on scale length. They proposed some weighting schemes, but the weights chosen for reliability (e.g., 3, 2 and 1) appear to be somewhat arbitrary, with limited scientifically based justification provided for their selection. Work done by Gelhar et al. (1992) and summarized by Fitts (2002) indicates that certain published longitudinal dispersivity "data" that are considered to be less reliable are reported to have come from sources of information where there were apparent problems associated with a particular investigation or analysis. Such problems might be, for example, mismatches between the dimensionality of a model (e.g., a 1-D model) and field conditions (e.g., radial flow in 2-D), which tends to artificially inflate reported dispersivity values. Gelhar et al. 1992 indicate that for nearly all cases where the reported data on longitudinal dispersivity data were considered to be highly reliable, regardless of the model scale length examined, use of a value for longitudinal dispersivity on the order of one meter was considered to be most reliable.

Depending on the analysis, EnergySolutions has chosen or used values of longtitudinal dispersivity for horizontal flow and transport of radionuclides from the proposed CAW

Embankment in different models that are up to two to three orders of magnitude greater than one meter. Moreover, the values used are inconsistent for the same disposal cells, depending on the type of model used. For example, in Attachment 6 of the initially submitted CAW License Amendment Request (EnergySolutions 2011a), the longitudinal dispersivity (αx) was set at 129.1 ft in the MEMO Model simulation, which is equal to one tenth the average distance from the center of the top slope to the line of compliance wells. In the Response to the Round 1 version of this Interrogatory, an α_x value of 27.1 ft was derived and used in a second MEMO Model simulation. Results from that second simulation indicated that, in order to retain at least a 95 % level of confidence that the well spacing interval would ensure reliable detection of potential releases from the CAW Embankment, the geometry of the source term at the Embankment needed to be modified somewhat compared to the initial assumed source term geometry.

The Infiltration and Transport Model Reports (Whetstone Associates 2011a and 2011b) used a (vertical) dispersivity value of 0.1 m (0.3ft) for the vertical transport portion of the model, but did not cite dispersivity values used for the horizontal transport portion of the model. This information should be provided to allow these input values to be compared to the values used in the MEMO Model simulations.

In Section 3.2.4 of the "Clive Facility Well Spacing Evaluation, dated April 28, 2011, an equation for calculating the Retardation Factor(R) is presented where the set of units specified for certain variables are inconsistent/ incompatible with each other, as follows:

$$R = 1 + (\rho * K_d/\text{soil moisture})$$

where,

ρ = *Soil density (in kilograms per cubic meter)*
K_d = *Soil-water distribution coefficient (in L per kg); and*
Soil moisture is effective porosity (dimensionless units)

The correct set of units would be either:

ρ = *Soil density (in grams per cubic centimeter)*
K_d = *Soil-water distribution coefficient (in L per kg); and*
Soil moisture is effective porosity (dimensionless units)

or:

ρ = *Soil density (in kilograms per cubic meter)*
K_d = *Soil-water distribution coefficient (in L per kg) x (1 m^3/1000 L); and*
Soil moisture is effective porosity (dimensionless units)

It needs to be demonstrated/verified that the calculated R values that were used in the MEMO Model simulations are correct in all cases, given this error in descriptions of units for variables in the formula as presented. The description of units in the Retardation equation should also be corrected for accurateness.

REFERENCES:

Energy*Solutions, LLC. 2011a. Clive Facility, Well Spacing Evaluation, Class A West Embankment, dated April 28, 2011: Attachment 6 to the License Amendment Request: Class A West Embankment, with Attachments 1 Through 7 and cover letter to Mr. Rusty Lundberg at Utah Division of Radiation Control dated May 2, 2011.*

Fitts, C. 2002. Groundwater Science. Academic Press.

Gelhar, L. W., C. Welty, and K. R. Rehfeldt. 1992. A critical review of data on field-scale dispersion in aquifers. Water Resources Research, 28:1955-1974.

Whetstone Associates 2011a. EnergySolutions Class A West Disposal Cell Infiltration and Transport Modeling Report, April 19, 2011.

Whetstone Associates 2011b. EnergySolutions Class A West Disposal Cell Infiltration and Transport Modeling Report, November 28, 2011.

Zu, M. and Eckstein, Y. 1995. "Use of Weighted Least-Squares Method in Evaluation of the Relationship Between Dispersivity and Field Scale". Ground Water, Vol. 33, No. 6, pp. 905-908.

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

Round 1 Interrogatory Response is satisfactory.

INTERROGATORY CAW R317-6-6.4-23/2A: ISSUANCE OF DISCHARGE PERMIT: BEST AVAILABLE TECHNOLOGIES - MONITORING WELLS REQUIRING ABANDONMENT AND DECOMMISSIONING AND LYSIMETERS PROPOSED FOR ABANDONMENT

Refer to Interrogatory Round 2A