DRC-2011-001849

ENERGY*SOLUTIONS*

February 14, 2011 CD11-0034

Mr. Rusty Lundberg
Executive Secretary
Utah Radiation Control Board
195 North 1950 West
Salt Lake City, UT 84114-5850

Re: Radioactive Material License #UT2300249: Justification for the Disposal of Blended Low Level Radioactive Waste at the Clive Containerized Waste Facility

Dear Mr. Lundberg:

Energy*Solutions* submits the attached analysis, "Justification for the Disposal of Blended Low Level Radioactive Waste at the Clive Containerized Waste Facility," for DRC review and approval. This analysis has been prepared to demonstrate that the disposal of blended waste on a large-scale can be done at Clive without exceeding the performance objectives in 10 CFR 61 Subpart C.

Specific waste types were not contemplated during the development of Energy*Solutions* Clive license; instead, analyses were performed that demonstrate disposal of Class A Low-Level Waste (LLW) at Clive meets all relevant Federal and State regulatory requirements. Previous performance assessments approved by DRC encompass the concentration and types of radio-isotopes types found in blended waste streams. In addition, the DRC approved Containerized Waste Facility (CWF) provides additional levels of protection not required for the disposal of Class A LLW.

Please contact me at 801-649-2109 with any questions conceming this issue.

Sincerely,

Daniel B. Shrum
Senior Vice President, Regulatory Affairs

cc: John Hultquist, DRC

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Justification for the Disposal of Blended Low Level Radioactive Waste at the Clive Containerized Waste Facility

Prepared: Mark R. Ledoux, CHP **Date:** 2-9-11

Reviewed: Sean McCandless **Date:** 2/9/11

Reviewed: Thomas E. Magette, PE **Date:** 2.10.11

Approved: Daniel B. Shrum, PG **Date:** 2-10-11

Introduction

The U.S. Nuclear Regulatory Commission (NRC) recently issued direction[1] regarding the blending of low-level radioactive waste (LLW). The direction, in the form of a Staff Requirements Memorandum (SRM), accepted the staff recommendation to revise the Commission's current position on blending to be risk-informed and performance-based through a combination of mlemaking and guidance.

In its analysis of the disposal of blended waste,[2] NRC staff expressed the concem that the disposal of large quantities of waste at or near the Class A limit had not been evaluated in the development of the regulations for the disposal of LLW in 10 CFR 61. However, the staff acknowledged that actual disposal practices for such wastes were far more robust than the disposal techniques analyzed. In particular, staff recognized that disposal in the Clive Containerized Waste Facility (CWF) includes an engineered barrier and increased depth that provide significant protection for the inadvertent intmder. Specifically, staff stated in their recommendation:

> The staff s preliminary independent analysis indicates that current practice at ... disposal facilities may safely accommodate an increase in the amount of disposed waste at or just below the Class A limits. Site-specific intmder analyses could be used to confirm protection of individuals from inadvertent intmsion at these sites.[3]

NRC has also recently stated its new position[4] that "large-scale LLRW blending may be conducted when it can be demonstrated to be safe." Energy*Solutions* has prepared this document to demonstrate that blended LLW[5] can be safely disposed at Clive. This document describes the existing analyses, summarizes current disposal practices in the CWF and the inherent protection provided to an inadvertent intmder, and provides justification that there is no feasible intmder scenario. Energy*Solutions* has prepared this analysis for review and approval by the Utah Division of Radiation Control (DRC). Specifically, we request DRC concurrence that the Clive CWF has, by this analysis, been demonstrated to be safe for the disposal of blended LLW.

Background

In the United States, LLW is disposed at licensed disposal facilities in accordance with 10 CFR 61, Licensing Requirements for Land Disposal of Radioactive Waste, or in Utah its Agreement State-equivalent, UAC R313-25, License Requirements for Land Disposal of Radioactive Waste - General Provisions. This regulation contains technical

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[1] Memorandum to R.W Borchardt, Staff Requirements – SECY-10-0043 – Blending of Low-Level Radioactive Waste, U.S. NRC, October 13, 2010

[2] SECY-10-0043, Blending of Low-Level Radioactive Waste, U.S. NRC, April 7, 2010

[3] SECY-10-0043, Blending of Low-Level Radioactive Waste, U.S. NRC, April 7, 2010

[4] Questions and Answers, January 2011

[5] Defined as homogenous radioactive waste, such as ion exchange resin or similar waste types that are at or near the Class A limit.

requirements for near-surface disposal (within approximately 30 meters of surface) of radioactive waste.

Each disposal site licensed under 10 CFR 61 must meet a minimum set of technical requirements in order to ensure that the site is acceptable for use as a near-surface disposal site of LLW. The primary emphasis for suitability is isolation of waste from the public and the environment. Disposal site features must ensure long-term performance objectives are met to avoid the need for continued active maintenance after site closure.

The performance objectives in 10 CFR 61, Subpart C establish the overall objectives that are required to be achieved in the disposal of LLW. The performance objectives establish performance standards for the design and operation of a LLW disposal facility and include radiation protection limits. (This is fundamentally different than prescriptive regulations that outline specific requirements for design and operation.) These criteria are:

- Protection of general population from releases of radioactivity
- Protection of individuals from inadvertent intrusion
- Protection of individuals during operations
- Stability of the disposal site after closure

These performance objectives set the fundamental safety requirements for a LLW disposal site. Utah has adopted these objectives in its Administrative Code.

Class A waste is the least radioactive class of LLW and therefore it has minimal requirements for waste characteristics and physical form. Class **B** waste is more hazardous than Class A and must meet more rigorous waste form requirements to ensure stability after disposal. The most hazardous class is Class C. Among the more rigorous requirements for this waste form is the requirement to protect a potential inadvertent intruder. This requirement can be met by a disposal depth at least 5 meters below grade.

Regulatory Basis for the Inadvertent Intruder

The inadvertent intruder is defined in Utah Administrative Code R313-25-2 as:

> A person who may enter the disposal site after closure and engage in activities unrelated to post closure management, such as agriculture, dwelling construction, or other pursuits which could, by disturbing the site, expose individuals to radiation.

Another important term to define is intruder barrier:

> A sufficient depth of cover over the waste that inhibits contact with waste and helps to ensure that radiation exposure to an inadvertent intruder will meet the performance objectives set forth in this part, or engineered structures that provide equivalent protection to the inadvertent intruder. (Utah Administrative Code R313-25-2, Definitions)

The radioactive limits for Class A waste disposal were calculated based upon an assumed limit of institutional control of 100 years. The 100-year institutional control limit: (1) recognizes that it is possible that at some time in the future a disposal site may be released for inappropriate use, and (2) is intended to help provide a boundary on long-term costs and social commitment.

Given the combination of 100 years of institutional control, an acceptable site, and disposal of waste without any regard to its waste form, NRC staff calculated what the upper concentration of certain isotopes would be, such that, if at the end of the 100-year institutional period, an intruder came onto the site and engaged in typical near-surface activities (lives on site), they would not receive more than a 500 mrem (5 mSv) total effective dose equivalent (TEDE).

Intruder Protection Inherent in Clive CWF Disposal Unit Design

Energy*Solutions* initiated licensing of the CWF to manage radioactive waste shipments with activity concentrations at the upper end of the Class A range (relatively low volumes) in contrast to their core business, which consisted of waste shipments of low activity at higher volumes. The CWF design has been replicated three times and has disposed of nuclear power plant wastes, including Class A resin since 2001. Resin wastes are disposed of in either a plastic or metal liner (container) and placed in the center of the disposal embankment. This disposal methodology exceeds the requirements of 10 CFR 61 and the Utah Administrative Code for disposal of Class A waste in several ways.

- **Engineered Facility** – Resin liners are placed in either the first or second layer of the CWF (see Attachment 1 – Clive CWF Disposal Unit Design). The containers are placed in a honeycomb pattern of concrete silos and backfilled with sand. At some interior locations in the CWF, the containers may instead be placed in a temporary steel silo. The silo is used to ensure the honeycomb spacing pattern, including minimum distances between adjacent containers, is achieved. After the steel silo is removed, voids around the containers are filled with the sand backfill. Once a specific area of containerized disposal (referred to as a "lift") is filled, additional compacted layers of sand and clay are placed above the container to complete and close the lift.

  An engineered facility is an important component in intruder protection. Reliance on engineered features is based on the assumption that an intruder encountering the barrier would recognize it as something out of the ordinary and cease attempts at construction or agriculture. This would cause the intruder to recognize that something is wrong, step back from the construction area and initiate an investigation of land records; thus reducing their exposure to radiation. The combination of the liner and CWF structure protects an intruder from penetrating the site and contacting the waste. This goes beyond Class A requirements.

- **Stability** – The design and operation of the CWF provides more stable disposal than is required by 10 CFR 61 for Class A waste. The placement of containerized

waste (liners), the sand backfill, the compacted sand, and clay above the container; the placement and compacfion of bulk waste above the layers of containerized waste, and the cover combine to form a stable disposal configuration. The CWF design provides stability to ensure the long-tern viability of the disposal unit cover. The use of containers, sand backfill, and compacfion combine to resist slumping and differential settlement, which limits infiltration and reduces the potential for dispersion of the waste over time. In addition to improving the performance of the disposal site, this provides inherent protection for the inadvertent intruder, since it provides a "recognizable and nondispersible waste" as contemplated in 10 CFR 61.56. (Utah Administrative Code R313-15-1009, Classificafion and Characteristics of Low Level Radioactive Waste)

- **D**epth – As described above, the Clive license requires that the liners are placed in either the first or second layer of the CWF and covered with mulfiple layers of compacted bulk waste. The result is that even the top layer of resin waste is a minimum of 5 meters below the cover, which would be sufficient to satisfy disposal requirements for Class C waste. The 5 meter thick barrier prevents access by an inadvertent intruder. This barrier may be composed of earth, lower activity waste or other similar material.

These aspects of the disposal regimen combine to provide a level of intruder protection that clearly exceeds the minimum required for Class A LLW. It is important to note, however, that the performance assessment prepared by Energy*Solutions*[6] does *not* take credit for these advantages but still shows full compliance with the performance objecfives of 10 CFR 61, Subpart C.

Absence of Credible Intruder Scenario

Prior licensing acfions for the Clive facility have evaluated intruder scenarios and concluded that the construction intruder, agriculture intruder, and off-site receptor scenarios are not reasonable.[7,8] The Bingham Environmental report developed the basis (described below) for this conclusion and was approved with the 1998 renewal of the Clive Radioacfive Material License UT 2300249 (RML). The Streamline Consulting report then incorporated the Bingham Environmental evaluation by reference, and was approved with the 2008 renewal of the RML.

Construction Intruder: The construction intruder is assumed to construct a house and live on the disposal site, with a basement beneath the house excavated into waste materials. However, the Clive facility is located in an arid region with saline soil conditions and no

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[6] Clive Radioactive Material License UT 2300249, Amendment 22 incorporating Class A North Disposal Cell

[7] Streamline Consulting, Potential Public Health Impacts From Open Disposal Cells at Envirocare of Utah's Waste Disposal Facility, Clive, Utah, April 6, 2005

[8] Bingham Environmental, Inc., Potential Public Health Impacts Associated with Radioactive Waste Disposal, December 17, 1996

local potable groundwater[9]. The facility and surrounding areas have never had permanent residents.

An archeological survey was performed in 1981 in order to qualify the site for the Vitro disposal cell.[10] This survey found no cultural resource sites and one isolated artifact, which consisted of four pieces of broken purple glass from an unknown object. No further resource sites have been uncovered as a result of operations at the facility.

A second cultural and archaeological resources survey was conducted in 2001 on the north half of section 5, directly south of the Clive disposal facility.[11] No paleontological, prehistoric, or historic resources were found in the survey area. This report also summarizes six prior cultural resource inventories performed within a mile of the subject area, including Archeological-Environmental Research Corporation, 1981.

This review identified one further isolated artifact consisting of an evaporated milk can and flattened tobacco tin. The report concludes that there is little probability that paleontological resources will be found in the area. Therefore, one may conclude that the Clive vicinity has not been inhabited by permanent residents in the past due to unfavorable conditions for human habitation; and is not likely to have permanent residences established in the future.

Bingham Environmental, 1996, assessed the situation as follows: "The arid conditions of the site; the lack of a source of potable water at the site; and the absence of any conditions that would promote the site as a desirable place to live; minimize the possibility of a residence being constructed at the site. Also the exisfing fencing, monuments, and signs, would waru of the site's former use. The thick layer of riprap on the cell itself would discourage the development of a residence on the completed cell..."

Agriculture Intruder: The agriculture intruder is similarly not a reasonable scenario. Given the salinity and low yield of both the upper unconfined and the deeper confined aquifer, local groundwater is not suitable for irrigafion. The arid climate precludes agricultural approaches that rely only on ambient precipitation; and the saline soils are not conducive to crops. Furthermore, the thick layer of riprap on the cell itself would not perunit crop growth directly on the disposal unit.

Livestock grazing is seasonally permitted and practiced on lands adjacent to the Clive facility. This potential pathway was evaluated by the NRC.[12] This evaluafion concludes, "The issue of potential food chain pathway for human exposure from sheep grazing in the

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[9] In fact, the groundwater is 2 times saltier than ocean water.

[10] Archeological-Environmental Research Corporation, Cultural Resource Inventory of One Square Mile in the Clive Locality of Tooele County, Utah, August 31, 1981

[11] Sagebrush Consultants, LLC, Class III Cultural and Archaeological Resources Survey for Alternative 1 – 320 Acres, the N ½ of Section 5, T. 2S., R. 11W., May 22, 2001

[12] Final Environmental Impact Statement to Construct and Operate a Facility to Receive, Store, and Dispose of 11e.(2) Byproduct Material Near Clive, Utah, NUREG-1476, August 1993

area is not considered significant because of the low level of potential contamination and the scarcity of vegetation."

Off-site Receptor: The offsite receptor was initially assumed to build near the edge of the site and use local groundwater for a potable water source.[13] As discussed in the construction intruder evaluafion above, these are not reasonable assumptions for the immediate vicinity around the disposal cells.

Pathway Analysis for Current Class A Disposal Embankments

Even though an intruder scenario is highly unlikely at the Clive facility, a ground water receptor pathway was sfill evaluated. For this analysis, the following assumptions were included:

- All waste was disposed at the Class A limits for all isotopes
- Although waste types were not specifically considered, a generalized waste form at the Class A limits was evaluated
- Ground water was potable and the receptor stayed at the facility for 30 years
- The ground water protection standard was 4 mrem/yr (0.04 mSv/yr), as opposed to the NRC prescribed 25 mrem/yr (0.25 mSv/yr)
- The lowest literature values for sorption coefficients (K_d) were used
- The disposal embankment was assumed to start at or near saturation

The results of the groundwater were used to calculate a dose to the receptor located near the site boundary. This analysis demonstrated that the 4 mrem/yr (0.04 mSv/yr) groundwater standard was not exceeded even after 500 years.

Conclusion

The Energy*Solutions* Clive disposal facility is sited, designed, and operated for the disposal of Class A LLW. The proposed disposal of blended LLW at the Clive facility falls well within the parameters of wastes evaluated as part of the original and subsequent licensing actions. Nonetheless, we have prepared this summary analysis to demonstrate that disposing of significant quantities of LLW at or near the Class A limit, may be safely done at the CWF. As such it clearly has been demonstrated that:

- the site is suitably sited and licensed for the disposal of Class A waste, including large quantities of waste at or near the Class A limits; and
- disposal of waste in the CWF provides inherent additional intruder protection; and
- protection of an intruder is provided even though there are no credible intrusion scenarios; and
- consumption of the groundwater will not result in a dose that exceeds the standard even though the groundwater is not potable.

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[13] Rogers and Associates Engineering Corporation, Evaluation of the Potential Public Health Impacts Associated with Radioactive Waste Disposal at a Site Near Clive, Utah, 1990

Even though not required for Class A waste, the design of the Clive CWF exceeds regulatory requirements for disposal of Class A waste. Specifically, the CWF provides an intruder barrier (engineered facility, disposal unit stability, and at least 5 meters depth to waste) that meets requirements for radioactive waste in excess of Class A concentrations. Therefore, the Clive CWF design, operation and licensing demonstrate that it is safe for the disposal of blended LLW.

Attachment 1 - Clive CWF Disposal Unit Design