UTAH DIVISION OF RADIATION CONTROL
ENERGYSOLUTIONS
(FORMERLY ENVIROCARE OF UTAH)
LLRW DISPOSAL FACILITY
RADIOACTIVE MATERIAL LICENSE RENEWAL:

SAFETY EVALUATION REPORT

June 14, 2007

for
Utah Division of Radiation Control
168 North 1950 West
Salt Lake City, UT 84114-4850

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ACRONYMS AND ABBREVIATIONS

11e.(2)	Section 11e.(2) of the Atomic Energy Act of 1954, as amended
1998 LRA	License Renewal Application dated March 16, 1998
2003 LRA	License Renewal Application dated July 2, 2003
2005 revision of the LRA	License Renewal Application dated June 20, 2005
ABC ALA	Application for License Amendment (Classes A, B & C waste) dated December 13, 2000.
Act	Utah Radiation Control Act
ALARA	As Low As Reasonably Achievable
AMEC	AMEC Earth and Environmental, formerly AGRA Earth and Environmental
ASCE	American Society of Civil Engineers
ASTM	ASTM International, formerly American Society for Testing and Materials
BWF	Bulk Waste Facility
CCE	certified cost engineer
CEDE	committed effective dose equivalent
CFR	Code of Federal Regulations
cm/sec	centimeters per second
cm/yr	centimeters per year
CQA/QC	Construction Quality Assurance/Quality Control
CSLM	Controlled Low Strength Material
CTC	Cover Test Cell
CWF	Containerized Waste Facility
DDE	deep dose equivalent
DOE	US Department of Energy
DOT	US Department of Transportation
Division	Utah Division of Radiation Control
DRC	Utah Division of Radiation Control

EDIS	electronic document imaging system
EIS	environmental impact statement
EnergySolutions	Applicant; formerly Envirocare of Utah, LLC; and Envirocare of Utah, Inc.
Envirocare	Applicant; changed to EnergySolutions, LLC
EPA	US Environmental Protection Agency
EWIS	Electronic Waste Information System
Fernald	DOE Fernald Closure Project, Fernald OH
FR	Federal Register
ft	feet; foot
ft-lbf/ft^3	foot-pound force per cubic foot (unit of energy density)
ft/ft	feet per foot
g	gravity
GWQDP	groundwater quality discharge permit
H	horizontal
HEC-1	USACE Hydrologic Engineering Center, Flood Hydrograph Package Code
HEC-2	USACE Hydrologic Engineering Center, Water Surface Profiles Code
HIC	High Integrity Container
hr	hour; hours
in	inch; inches
in/yr	inches per year
kN-m/m^3	kilonewton-meters per cubic meter (unit of energy density)
LARW	Class A Low-Level Radioactive Waste
LLRW	Low-level Radioactive Waste
LRA	License Renewal Application
mm	millimeters

mR/hr	milliroentgen/hour
mrem	millirem
mrem/yr	millirem/yr
NGS	National Geodetic Survey
NORM	naturally occurring and accelerator produced material
NQA	Nuclear Quality Assurance
NRC	US Nuclear Regulatory Commission
PATHRAE	Low-Level Radioactive Waste Environmental Transport and Risk Assessment Code
pCi/g	picocuries per gram
pCi/m^2-s	picocuries per square meter-second
PE	professional engineer
PMF	Probable Maximum Flood
PMP	Probable Maximum Precipitation
QAM	Quality Assurance Manual
QAP	Quality Assurance Program
R	Roentgen
RCRA	Resource Conservation and Recovery Act
S&H	safety and health
SER	safety evaluation report
SLB&M	Salt Lake Baseline and Meridian
SNM	Special Nuclear Material
SSC	superconducting supercollider
SWCA	SWCA Environmental Consultants
TEDE	total effective dose equivalent
TSD	Treatment, Storage and Disposal
UDOGM	Utah Division of Oil, Gas and Mining
UDSHW	Utah Division of Solid and Hazardous Waste

UDWQ	Utah Division of Water Quality
UMTRA	Uranium Mill Tailing Remedial Action
UNSAT-H	Unsaturated Soil Water and Heat Flow
URCB	Utah Radiation Control Act
URCB	Utah Radiation Control Board
URCR	Utah Radiation Control Rules
URS	URS Corporation
USACE	US Army Corps of Engineers
USGS	United States Geologic Survey
V	vertical
yr	year

1.0 INTRODUCTION

The Utah Division of Radiation Control (Division) is responsible to regulate activities in the State of Utah that involve radioactive materials, some types of radioactive waste, and radiation. As part of this responsibility, the Division enforces requirements promulgated by the State of Utah. The regulations that deal with disposal of radioactive waste are contained in the Utah Radiation Control Rules (URCR), Sections R313-25, "License Requirements of Land Disposal of Radioactive Waste, General Provisions". More generally applicable regulations are contained in URCR Sections R313-15, "Standards for Protection Against Radiation" (that defines the requirements for protecting individuals from the effects of radiation) and R313-22, "Specific Licenses" (that identifies general licensing conditions, many of which are satisfied by or superseded by the provisions of URCR R313-25). Other sections of URCR are also indirectly applicable.

Pursuant to regulation implementation, the Division has issued licenses to various entities within the State of Utah to possess and manage radioactive materials and wastes. In order to assist the Division in ensuring that all applicable regulatory requirements are currently being satisfied and will likely continue to be satisfied, the Division statutes require licensees to have their radioactive materials licenses routinely reviewed and renewed. The purpose of this Safety Evaluation Report (SER) is to identify and summarize the information the Division evaluated in its review of a license renewal application and the grounds upon which the Division staff concludes whether regulatory requirements are satisfied.

The license under review for renewal is held by EnergySolutions, LLC. Previously this entity was Envirocare of Utah, Inc. (See Section 5.3.1 of this document for further discussion of the name change). EnergySolutions (Envirocare) is licensed to receive, store, and dispose by land burial several classifications of radioactive materials and waste:

- Naturally occurring and accelerator produced material (NORM)
- Class A Low-level radioactive waste (LARW)
- Special Nuclear Material (SNM)
- Radioactive waste that is also determined to be hazardous (mixed waste)

EnergySolutions (formerly Envirocare) holds the following licenses and permits:

- State of Utah Radioactive Material License UT 2300249, Amendment 22
- US Nuclear Regulatory Commission (NRC) 11e.(2) Byproduct Material License SMC-1559, Amendment 49 (Currently, State of Utah RML UT2300478)
- State-issued Part B RCRA Solid Waste Permit
- State of Utah Ground Water Quality Discharge Permit Number UGW450005.
- Air Quality Approval Order

As is required by these statutes, EnergySolutions (formerly Envirocare) (herein referred to as "Applicant") submitted to the Division an Application for Renewal of its radioactive materials licenses (LRA) on July 2, 2003 (2003 LRA), and was granted timely renewal. In preparation to review the Applicant's LRA, the Division employed the services of its contractor, URS Corporation (URS). Revision 2 of the LRA was submitted on June 20, 2005 (2005 revision of the LRA).

1.1 HISTORICAL NATURE OF SAFETY EVALUATIONS

Under provisions of Section 105 of the Utah Radiation Control Act (Act), no person may construct a new commercial radioactive waste treatment or disposal facility until, among other things, the requirements of Section 104 of the Act have been met. Under authority of Section 104 of the Act, the Radiation Control Board has established criteria for siting commercial low-level waste treatment or disposal facilities. These regulations are contained in the Section 3 of URCR R313-25 entitled "Siting Criteria and Pre-licensing Plan Approval for Commercial Radioactive Waste Disposal Facilities." The requirements of URCR R313-25-2 address such site-related topics as:

- Land Use Designations
- Geology
- Groundwater Hydrology
- Surface Water Hydrology
- Transportation System
- Emergency Response Plans
- Projected Risks of Facility Operation

Historically, the focus of the Division's reviews of new license applications has been on satisfaction of each applicable regulatory requirement and that particular licensing actions are justifiable under provisions of the regulations. These reviews generally followed these steps:

1. Prepare draft and final description of the program the Division will follow in responding to the license application.
2. Prepare draft and final regulatory findings and associated bases that must be addressed in the review of the license application.
3. Review the license application.
4. Prepare interrogatories as necessary.
5. Review interrogatory responses, assuming that all required information is contained in either the initial submittal or responses to the first round of interrogatories.
6. Prepare draft and final Safety Evaluation Report.

7. Conduct public hearings.

8. Review and prepare draft and final responses to technical comments received during public comment.

Since these evaluations addressed new facility licenses, a different approach was chosen to address the review of an existing license.

1.2 BASIS FOR UNIQUE LRA REVIEW APPROACH

The Division has used a unique approach in this review of the Applicant's latest LRA, including a program of observing committed, authorized, and expected operations and conditions. Justifications and reasons that the Division has pursued this approach to license renewal include the following:

- URCR R313-25-35(1) provides that the Licensee "shall afford to the Executive Secretary, at reasonable times, opportunity to inspect … the premises, equipment, operations, and facilities in which wastes are received, possessed, handled, treated, stored, or disposed of."
- URCR R313-25-35(2) provides that the Licensee "shall make available to the Executive Secretary for inspection, upon reasonable notice, records kept by it pursuant to these rules. Authorized representatives of the Executive Secretary may copy and take away copies of, for the Executive Secretary's use, any records required to be kept pursuant to URCR R313-25."
- URCR R313-25-13(4) provides that " … the Executive Secretary will apply the criteria set forth in URCR R313-25-11" in evaluating an application for license renewal,
- URCR R313-25-11 provides that the Executive Secretary will [re-]issue the license upon finding that:
    - The [re-]issuance of the license will not constitute an unreasonable risk to the health and safety of the public;
    - The Applicant is qualified by reason of training and experience to carry out the described disposal operations in a manner that protects health and minimizes danger to life or property;
    - The Applicant's disposal site, disposal design, land disposal facility operations, including equipment, facilities, and procedures, disposal site closure, and post-closure institutional control, are adequate to protect the public health and safety [protect general Public from releases] as specified in the performance objectives of URCR R313-25-19;
    - The Applicant's disposal site, disposal site design, land disposal facility operations, including equipment, facilities, and procedures, disposal site closure, and post-closure institutional control are adequate to protect public health and safety in accordance with the performance objectives of URCR R313-25-20;

- The Applicant's land disposal facility operations, including equipment, facilities, and procedures, are adequate to protect the public health and safety [standards for protection against radiation] in accordance with URCR R313-15;
- The Applicant's disposal site, disposal site design, land disposal facility operations, disposal site closure, and post-closure institutional control plans are adequate to protect the public health and safety in that they will provide reasonable assurance of the long-term stability of the disposed waste and the disposal site and will eliminate to the extent practicable the need for continued maintenance of the disposal site following closure;
- The Applicant's demonstration provides reasonable assurance that the requirements of URCR R313-25 will be met;
- The Applicant's proposal for institutional control provides reasonable assurance that control will be provided for the length of time found necessary to ensure the findings in URCR R313-25-11(3) through (6) and that the institutional control meets the requirements of URCR R313-25-28 [Land Ownership and Institutional Control (including environmental monitoring program, periodic surveillance, minor custodial care, and administration of funds)].
- The financial or surety arrangements meet the requirements of URCR R313-25.

- The Division's LRA review observations confirm that the assumptions and projections that formed the basis for previous regulatory decisions are being realized. Such confirmation is not an objective of the Division's inspection program, which instead focuses on demonstrating compliance with broader parameters, criteria, and requirements stated in License Conditions and the Construction Quality Assurance/Quality Control (CQA/QC) Manual.
- The scope of the Utah Division of Radiation Control's (DRC) LRA review observations are consistent with DRC's inspection program but will complement (without duplicating the scope of the Division's inspection program) by demonstrating whether the facility is being constructed and operated consistent with assumptions made in preparing and other bases present in calculations, evaluations, reports, and procedures that have been previously reviewed and approved. DRC's current inspection program does not address this aspect.
- The LRA seeks to demonstrate that the facility will operate safely in the future, without attempting to demonstrate that the bases for regulatory decisions are being realized and are still valid. The LRA relies upon previously developed and submitted reports and evaluations, with little attention to demonstrating that current conditions are acceptable and satisfy applicable regulations.

In addition to the standard approach of ensuring regulatory requirement compliance, the Division's unique approach includes a program of observing committed, authorized, and

expected operations and conditions. The activities include review of records, conduction of interviews, onsite measurements, and procedure observation and are concentrated in the following areas:

1. Site Characteristics (Hydrogeology, Meteorology, Demography/Land Use, Geotechnical, Geochemical, Biotic Features, Natural Resources, Waste Handling Operations, Waste Receipt, Waste Inspection, Waste Transfer, Waste Preparation, Waste Placement, and Waste Storage)
2. Site Closure Plan (Decontamination and Decommissioning Plan)
3. Performance Assessment (Groundwater Pathway, Atmospheric Pathway)
4. Health & Safety Plan
5. Quality Assurance Program
6. Facility Design/Construction/Operation (Liner Construction, Test Cell Plans and Reports, Container Preparation, Waste Placement, Void Management, Settlement/Differential Settlement, Backfill Activities & Characteristics, Cover Construction, Settlement Monitoring/Investigation, and Water Management)
7. Waste Characteristics (Voids Received/Disposed, Radionuclide Inventories, Waste Containing Mobile Nuclides, and Radionuclides Requiring Special Attention)
8. Environmental Monitoring (Groundwater, Air, Soil & Sediment, Vegetation, Radon, and Onsite Laboratory Performance)
9. Radiation Protection Program (Occupational Radiation Exposures, and Worker Certifications/Training)
10. LLRW Financial Assurances
11. Physical and Radiological Security Plans

2.0 HISTORICAL OVERVIEW

US Department of Energy (DOE) remedial activities began for the Salt Lake City Vitro mill site in February 1985 and activities were completed in June 1989. Contaminated materials that remained at the site were excavated and relocated by rail and truck to a newly acquired site by the State of Utah, located 85 miles west of Salt Lake City in South Clive. Concurrent to this operation, the Applicant began disposal operations at its Clive facility in 1988 under a State license to dispose of NORM. In 1990, the Applicant submitted a license application to modify its license to allow disposal of LARW. In 1991, the Division granted this amendment request by issuing a license for LARW disposal. From time to time, the LARW disposal license has been amended to address the Applicant's changing needs and those of the public interest. In 1998, the Division renewed the Applicant's license to dispose of LARW.

The Applicant's operations are also subject to the provisions of Ground Water Quality Discharge Permit Number UGW450005, issued by the Utah Division of Water Quality (UDWQ). On September 1, 2004, the Applicant submitted a renewal application for this permit, which is currently under review by DRC staff. This permit specifies that groundwater quality protection levels for radioactive constituents must be met for no fewer than 500 years following facility closure.

The Applicant conducts other treatment and disposal operations in areas adjacent to its LARW embankments. These activities involve mixed hazardous and low-level radioactive waste under a Treatment, Storage and Disposal (TSD) permit issued by the Utah Division of Solid and Hazardous Waste (UDSHW) and 11e.(2) waste under a license issued by the NRC. Said 11e.(2) license is now administered by the DRC, and is not a part of this proposed action.

2.1 CHRONOLOGY OF THE APPLICANT'S LICENSE ACTIVITIES

Currently, the Applicant is disposing of NORM, LARW, and mixed radioactive and hazardous waste at its Clive, Utah disposal facility under licenses issued by the Division. In receipt of these licenses and arrival at its currently operating condition, the Applicant followed the subsequent chronology:

- 1984-1988 – DOE disposal of Vitro Tailings: Remedial activities began at the Salt Lake City Vitro mill site in February 1985 and were completed in June 1989. Contaminated materials that remained at the site were excavated and relocated by rail and truck to a South Clive disposal cell; a new site acquired by the State of Utah and located 85 miles west of Salt Lake City.
- 1987 – Ownership exemption granted for proposed naturally occurring radioactive material waste disposal facility.
- 1988 – Envirocare begins disposing of NORM: On February 28, 1988, Envirocare received its first license from the Bureau of Radiation Control to dispose of naturally occurring radioactive material.
- 1991 – Ownership exemption granted for LARW disposal facility.

- 1991 – License amendment for LARW disposal: On March 21, 1991, Envirocare received a low-level radioactive license from the Bureau of Radiation Control that allowed them to accept 44 radionuclides with specified concentration limits less than the Class A LLRW limits.
- 1991 – Mixes Waste permit: On November 30, 1991, Envirocare received a Resource Conservation and Recovery Act (RCRA) hazardous waste permit from the Bureau of Solid and Hazardous Waste to accept mixed waste.
- 1992 – Resolution and Order agreement with Northwest Compact: On May 28, 1992, Envirocare entered into an arrangement, the "Resolution and Order" with the Northwest Interstate Compact that allowed them to accept certain types of low-level radioactive wastes from outside of the Compact. Low-level waste from Northwest Compact states was not granted access to Envirocare. Envirocare was also granted permission to accept mixed waste from all states. The Resolution and Order was the result of a discussion at a December 18, 1991 meeting of the Compact. The Resolution and Order has been subsequently modified and reviewed since the original. The Second Amended Resolution and Order of November 9, 1998 is currently in effect. It was most recently reviewed at the June 5, 2002 meeting of the Compact and no changes made.
- 1993 – Envirocare and Utah Department of Environmental Quality sign "Agreement Establishing Covenants and Restrictions" detailing deed restrictions and covenants acceptable to the US NRC and the State of Utah to create, in part, protections comparable to the regulatory requirement for public ownership of land on which an LLRW disposal is built
- 1993 – Uranium Mill Tailings disposal license by NRC: On November 30, 1993, Envirocare received a license from the NRC to accept uranium mill tailings.
- 1993 – LARW License Amended: On August 27, 1993, Envirocare's LLRW license was modified by the Division to accept 14 additional radionuclides with specified concentration limits less than the Class A limits.
- 1995 – LARW License Amended: On June 20, 1995, Envirocare's LLRW license was modified by the Division to accept 17 additional radionuclides with specified concentration limits less than the Class A LLRW limits. It was subsequently amended on November 13, 1995; to accept eight additional radionuclides with specified concentration limits less than the Class A LLRW limits.
- 1996 – LARW Renewal request submitted: In August 1996, Envirocare submitted a renewal request for the LLRW license to the Division.
- 1996 – Macro-encapsulation approval: On October 3, 1996, Envirocare received a Hazardous and Solid Waste Amendments permit from the US Environmental Protection Agency (EPA) Region 8.
- 1998 – Amended Resolution and Order agreement with Northwest Compact:
- 1998 – LARW Renewal request approved: On October 22, 1998, Envirocare was issued a 5-year permit renewal from the Division on the LLRW license, which includes concentration limits by radionuclides less than and up to the Class A LLRW limits.

- 1999 – Class B & C application submitted:
- 2000 – Full Class A waste disposal license approved: On October 5, 2000, Envirocare was issued a license from the Division for a new disposal cell that allowed them to take up to the Class A LLRW limits.
- 2001 – Land Ownership exemption granted: On January 19, 2001, the Utah Radiation Control Board (URCB) granted Envirocare an exemption to the state and federal land ownership rule based on several conditions being met.
- 2001 – Class B & C License granted pending approval: On July 9, 2001, Envirocare was issued a separate license to accept Class B and C LLRW to the Division pending legislature and gubernatorial approval. The license was subsequently appealed to the URCB.
- 2001 – Class A LLRW Cask Amendment Granted: On October 19, 2001, Envirocare was issued an approval for an amendment to receive and dispose of Class A LLRW in casks.
- 2002 Liquid waste approval: On September 10, 2002 Envirocare was issued approval for an amendment to receive and treat liquid radioactive waste at the Mixed waste facility. This approval did not extend to disposal of liquid wastes and all waste must have free liquid content less than 1 percent.
- 2003 – Final agency action of Class B & C: On February 10, 2003, Envirocare was granted final agency action by the URCB on the Class B and C LLRW license (pending legislative and gubernatorial approval).
- 2003 – Uranium Mill Tailings amendment request: On March 27, 2003, Envirocare submitted a request to the U.S. NRC to amend their current uranium mill tailings license to accept tailings with radium-226 concentrations up to 100,000 pCi/g. This was to allow them to accept the DOE Fernald Closure Project (Fernald) waste if it were classified as 11e.(2).
- 2003 – Uranium Mill Tailings disposal renewal request: On May 27, 2003, Envirocare submitted a renewal application to the NRC for the uranium mill tailings disposal cell. Envirocare was granted timely renewal (current license remaining in effect until a decision is reached on the renewal application).
- 2003 – Class A LLRW renewal request: On July 2, 2003, Envirocare submitted a renewal application to the Division for its current license. Envirocare was granted timely renewal.
- 2003 – Withdrawal of mill tailings amendment request: On November 19, 2003, Envirocare withdrew their request for a license amendment from the NRC to accept the Fernald waste.
- 2004 – Mixed Waste license public comment period: On May 4, 2004, a 30-day public comment period commenced on a license amendment for Envirocare to accept mixed waste up to Class A limits.
- 2004 – Company is purchased in December by Lindsay Goldberg & Bessemer. Original company name is retained.

- 2005 – Class A LLRW North Embankment amendment request: On January 17, 2005, Envirocare submitted a request for a license amendment to allow disposal of Class A materials in the northern area previously approved for Class A, B, and C waste disposal.
- 2005 – Withdrawal of Class B/C license request during February 2005 following sale of Envirocare of Utah, Inc.
- 2006 – Effective February 2006, the company changed its name to EnergySolutions LLC, and requests DRC change name under License accordingly.

2.2 REGULATORY CONCLUSION OF THE APPLICANT'S SAFETY AND REGULATORY COMPLIANCE

All activities at the Applicant's Clive site are conducted under programs designed to protect the health and safety of facility workers, the general public, and the environment. The Applicant's operations are conducted under the ongoing regulatory scrutiny of the Division inspectors who provide continuing assurance that the interests of radiological safety are properly addressed.

Additionally, the Applicant has demonstrated that it is financially capable to carry out all licensed activities. The Applicant has provided financial assurances sufficient to fund the safe closure of the facility, as well as the long-term monitoring and maintenance of the facility. It has also provided information about the required qualifications of those persons who will operate the facility and about its existing training program.

3.0 LICENSE RENEWAL APPLICATION

In reviewing the LRA for the development of this SER, the following major issues were identified and resolved:

- Characteristics and design of the embankments, including the clay liner, waste emplacement and backfill, buffer zone, and cover system.
- Radiological characteristics of waste to be received, handled, and emplaced.
- Waste handling concept, outline of detailed waste handling procedures, and potential occupational radiation exposures.
- Physical performance of the embankment, including effects of cover design on projected differential settlement and consolidation, annual infiltration rates, and effective transit times for water and contaminants migrating within and under the waste embankment.
- Radiological performance of the disposal system, including determining the extent to which the Utah groundwater protection standards are satisfied and estimating potential radiological impacts to members of the public that might be exposed to releases from the facility during operations.
- Operations

In reviewing the LRA and supporting information referenced, the Division and the Applicant have resolved all major issues required by the Division regulations for the development of the SER as discussed in detail in this SER. The Division has received or developed information that provides reasonable assurance that all applicable performance objectives and regulatory requirements involved in these major issues of this SER will be satisfied.

Since the license renewal process was commenced, several unrelated licensing actions have been requested and granted. These include:

- Class A North Disposal Embankment
- Shredder Facility
- Rotary Dump Facility
- Intermodal Container Wash Building
- Decontamination Access Control Building
- East Side Drainage Project

The Division is also currently considering a license amendment request to construct and operate the proposed Northwest Corner Pond as a means of controlling waste water generated at the facility.

None of the facilities listed above is considered to any appreciable extent in this document. Rather, their merits and the license conditions and other revisions that resulted to grant these amendment requests are available for review in files maintained at the Division. The justifications for granting these license amendment requests can be seen from those files.

4.0 SITE VISIT AND INTERVIEWS

In connection with the Utah Division of Radiation Control's review of the Applicant's license renewal application (LRA), its contractor, URS Corporation, conducted interviews with 25 responsible employees of the Applicant. The objectives of these interviews were:

1. To obtain information through general observations of operational function and application of procedures.

2. To assess the extent to which the Applicant's numerous programs and procedures have been implemented.

Interviews were conducted on April 5 through 7, April 25, and May 18, 2005 at both the Clive facility and company headquarters in Salt Lake City, depending upon the person being interviewed and his or her schedule. Interviews were conducted by URS personnel who are experienced in LLRW disposal regulatory requirements, the Applicant's plans and procedures, and facility operations.

The results of these interviews are presented in detail in the Appendix A to this SER and summarized below.

4.1 SUMMARY OF FINDINGS

Overall, personnel interviewed demonstrated a commendable knowledge and understanding of their job functions and responsibilities and appeared diligent in performing their work requirements. Each individual appeared knowledgeable with respect to their job function, department function, and their connection and interfaces with other departments.

When personnel were presented questions concerning operations or activities within their department, they demonstrated understanding of their responsibilities and discussed their roles clearly. Most questions regarding job duties, operations, and procedures were answered definitively and without hesitation, thus indicating appropriate knowledge and understanding. The interviewees behaved professionally and were forthcoming in providing requested information.

Specific observations associated with each interview are provided in Section 5.0 of this report. General observations or findings noted as a result of the interviews are listed below:

1. Management and supervisors are familiar with and have effectively implemented the Applicant's operating and quality assurance procedures.

2. No mechanisms are currently employed to ensure that changes to the Applicant's procedures and program descriptions included in submittals supporting licensing actions or revisions and updates to other documents are communicated timely to UDEQ and its contractors.

3. Radiation safety appears to be delegated appropriately and Health Physics personnel exercise authority to stop unsafe practices or deviations from procedures.

4. High employee turnover at the Bulk Waste Facility (BWF) causes work stoppages and potential worker exposures beyond what might be achieved if a more stable work force were present.

5. State inspection modules are very detailed regarding construction quality, but are limited in review and supervision of other required conditions.

6. Clive facility staff has the ability to propose changes to operating procedures, but review and formalization process is discouraging and overly complex.

7. Although BWF staff sign-in daily stating they have read and understand appropriate job-specific concerns, no effort is made to verify understanding until an individual deviates from the procedures during BWF operations. In contrast, CWF staff conducts briefings before each job to discuss all relevant aspects that may be of concern.

8. No revisions to model projections have been made in the current LRA to account for increased waste receipt rates or to assess whether the low projections of previous license applications appreciably affect earlier conclusions. Waste receipt rates may affect worker radiation exposures by necessitating longer working hours and longer times spent by workers in proximity to waste. Staffing should be sufficient to handle the increased volume of incoming waste in a timely manner.

9. Changes implemented by the Applicant's new ownership appear to be beneficial to several groups at the facility by providing greater and improved material resources. However, human resources in departments and divisions at the Clive facility should be reviewed to ensure that an adequate number of properly trained staff is maintained.

10. Due to time limitations and the high volumes being disposed, the Applicant's operations often emplace waste prior to completing and verifying laboratory analyses. Resulting problems with incoming waste have forced the excavation of emplaced waste to address one or another deficiency.

4.2 GENERAL RECOMMENDATIONS

The following recommendations were developed as a result of interviews conducted with personnel working for the Applicant between April 5 and May 18, 2005. Detailed summaries of each interview conducted, including any recommendations with respect to specific positions and personnel, are provided in Section 5.0 of Appendix A to this SER. The majority of the recommendations are related to quality assurance and quality control, engineering and design control, procedural development and implementation, and training. Many of the recommendations overlap into multiple areas. The recommendations are divided into two categories: areas of concern to the Division and areas not impacting licensure at this time.

4.2.1 Areas of Concern to the Division

1. The Applicant should require its design and technical support contractors to conduct their work under an adequate Nuclear QA (NQA) program. The Applicant should conduct audits of design and technical support contractors' implementations of their QA Programs.
2. The Applicant should review each design and analysis deliverable against criteria the Applicant has established a priori to determine whether the deliverable is acceptable. The Applicant should submit to the State of Utah only documents it has formally reviewed and accepted and that it has concluded are adequate and correct. The Applicant must not rely upon the Division to assess the adequacy of design deliverables it receives from design and technical support contractors.
3. The Applicant should develop consistent criteria for evaluating effectiveness of training for field functions per the requirements of qualification cards and designate responsible individual(s) to conduct and approve each field-training element.
4. The Applicant's Engineering Department should develop and implement procedures (1) to ensure that only information known to be current and correct is used in the design process and (2) to accurately control, verify, change, and incorporate design changes.
5. The Applicant's Engineering Department should develop and implement procedures to ensure that "…all permit and license requirements are identified prior to approval…" of design documents per QAP-3.0. These procedures should also ensure that such requirements are incorporated into the design process early enough that satisfying the requirements is a dominant, not incidental consideration of the design process.
6. All design documents, whether originated by the Applicant or by design or technical support contractors, should be approved (stamped and signed) by a Utah-certified Professional Engineer.
7. The Applicant should develop and implement an approach to its regulated activities that does not involve numerous revisions to its procedures, plans, and program descriptions. The Applicant should maintain revision control of all documents submitted to the Division and ensure that all revisions and updates to controlled documents are communicated timely to the Division.
8. The Applicant should develop and implement procedures that ensure superceded documents are not used in support of quality-affecting activities. The Applicant should also ensure that all personnel are appropriately trained and informed to ensure the use of only documents known to be current and correct in support of quality-affecting activities.
9. The Applicant should consider a separation between organizational functions and responsibilities that maintains proper balance between the commercial objective of receiving waste (generating revenue) and the regulatory objective of ensuring safe operations and protected environment media.

10. The Applicant should develop and implement polices and practices that do not penalize personnel of the Applicant or personnel of contractors hired by the Applicant for raising questions or reservations that might impede waste receipt, or regulated requirements.

11. The Applicant should update the training procedures to include appropriate reference to current job titles and training requirements. The Applicant should implement training as required. The Applicant should review qualification card requirements and update as appropriate based on current procedures.

12. The Applicant should ensure that all personnel have ready access to copies of procedures in addition to being trained and readily familiar with provisions of procedures that define and control their operations and quality assurance activities.

13. All members of the Applicant's Engineering Department should use Form EC-98001 to document and ensure acceptable resolution of comments arising from the design review process. Use of this form should not displace the existing practice of capitalizing upon the collective experience and critical thinking of all members of the Engineering Department. Rather, it should create or enhance documentation that the design process is correct and that the design is adequate.

14. The Applicant should institute appropriate changes within purchasing department that focuses adequate resources, as appropriate, on materials and services that require QA review.

15. The Applicant should review human resources in a number of departments and divisions at the Clive facility to ensure that adequate numbers of properly trained staff are maintained.

4.2.2 Areas Not Impacting Licensure at This Time

1. Within the constraints allowed under its administrative rules, the Division should continually consider the advantages and disadvantages of issuing Notices of Violation for actions or conditions that the Applicant has self-reported to the State.

2. The Applicant should develop formal process defined by procedure for conducting ALARA reviews of embankment and facility design changes.

3. The Applicant should more formally document the Environmental Engineer's review of design documents (under QAP 3.0) of changes that impact compliance with the Hazardous Waste Permit.

4. The Applicant should update procedures and program descriptions to reflect current organization, operations, and assignments of responsibility. The Applicant's procedures and program descriptions should be consistently and comprehensively revised to reflect the current organization and operations.

5. The Applicant should consider appending information regarding OSHA-regulated substances (29 CFR 1910.1001 – 1101) to the S&H Manual including any hazards they may present.

5.0 FACILITY SAFETY AND REGULATORY COMPLIANCE

Part R313-25 of the URCR contains regulatory requirements that apply to the amendment of a license to disposal of low-level radioactive waste. This chapter of the SER addresses the extent to which applicable requirements are met, as documented to the Division in the Applicant's license amendment application and other associated submittals.

Sections 1 through 5 of URCR R313-25 contain general information, present definitions of terms with special meanings, list requirements for siting new LLRW disposal facilities, enumerate the State's requirement that a license is required to dispose of radioactive waste, and identify in broad terms the content requirements of a license amendment application. Section 12 of URCR R313-25 addresses the concept of license conditions. Sections 14 through 17 of URCR R313-25 address licensing actions for which the Applicant is not now applying, and that, therefore, do not now apply. Section 27 of URCR R313-25 addresses alternative requirements for design and operation, which also do not apply to the Applicant's facility and operation. Finally, Sections 34 and 35 of URCR R313-25 deal with activities and authorities of the Executive Secretary and do not relate to the review of the Applicant's license amendment application. The sections in this paragraph were not considered in evaluating the extent to which the Applicant has satisfied applicable licensing requirements.

Several other regulatory provisions exist for which findings in support of this LRA are not required. Among other reasons, these requirements may apply only to the Division or may enumerate options available to the Division or the Applicant. Those requirements of URCR R313 Section 25 for which no finding is necessary are listed below:

Table 1 - Requirements of URCR R313 Section 25 for Which No Finding is Necessary

URCR R313 Section	Reason
25-3(1)	Requirements do not apply to the renewal of a license for an existing facility.
25-4(1)	A general requirement that a person must have a license to dispose of LLRW, for which the Applicant is already licensed in the current LLRW cell and is the subject of this Amendment Request review.
25-12	Conditions applicable to transferring, assigning, disposing of or transferring control of a license granted under URCR R313-25, none of which is a request of this amendment request.
25-14	Requirements of an Application for Site Closure and Stabilization that is not an issue in the review of this Amendment Request.
25-15	Requirements of the Licensee to conduct Post-Closure Observation and Maintenance that are not an issue in the review of this Amendment Request.
25-16	Requirements for the transfer of the License that is not an issue in the review of this Amendment Request.
25-17	Requirements for the termination of the License that is not an issue in the review of this Amendment Request.
25-25(12)	Requirements for applications to dispose of wastes that are not generally acceptable for near-surface disposal that is not an issue in the review of this Amendment Request.

URCR R313 Section	Reason
25-27	Empowers the Executive Secretary to authorize provisions other than those contained in URCR R313-25-24 and -25-26 for the segregating and disposing of waste and for designing and operating a land disposal facility, which, to date, he has not done.
25-31(2) through (8)	Identify acceptable financial assurance arrangements and defines options available to the Executive Secretary that require action on the part of neither the Applicant nor the Division.
25-33	Specifies record keeping and reporting requirements of a person licensed for LLRW disposal under URCR R313-25. As such, this is an issue for compliance monitoring rather than a criterion for granting a license amendment. However, the information and procedures provided in the Amendment Request and other submittals demonstrate that the the Applicant intends to maintain information and records that are required by this regulation and that will be necessary to develop the required reports.
25-34	Requires that the Licensee perform or allow the Executive Secretary to perform tests that the latter considers necessary. Tests may address any of (1) wastes, (2) facilities used for receipt, storage, treatment, handling or disposal of wastes, (3) radiation detection and monitoring instruments, and (4) other equipment and devices used in connection with the receipt, possession, handling, treatment, storage, or disposal of waste. As such, this is an issue for compliance monitoring rather than a criterion for initial licensing.
25-35	Requires that the Licensee allow the Executive Secretary access to the disposal facility for facility and records inspections. As such, this is an issue for compliance monitoring rather than a criterion for granting a license amendment.

Regulatory requirements that the Applicant must satisfy are contained in Sections 6 through 11, 13, 18 through 26, and 28 through 33 of URCR R313-25. The extent to which these requirements are satisfied as documented in the Applicant's license amendment application and other associated submittals are addressed in this Chapter.

5.1 R313-25-4; LICENSE REQUIRED BEFORE COMMENCING CONSTRUCTION

Requirement 2504-2: Persons shall file an application with the Executive Secretary pursuant to URCR R313-22-32 and obtain a license as provided in URCR R313-25 before commencement of construction of a land disposal facility. Failure to comply with this requirement may be grounds for denial of a license and other penalties established by law and rules. [URCR R313-25-4(2)]

Basis: The information contained in the 2005 revision of the LRA the Applicant has submitted indicates that the requirements of URCR R313-25-4(2) have been met. The condition that an appropriate license must be granted is the subject of this SER and the associated License Application review. Therefore, this requirement has been satisfied.

Reference Notes:

Envirocare of Utah, Inc., 2005c

5.2R313-25-5; REQUIREMENTS AND INFORMATION NEEDED FOR APPLICATION

Requirement 2505-1: In addition to the requirements set forth in URCR R313-22-33, an application to receive from others, possess, and dispose of wastes shall consist of general information, specific technical information, institutional information, and financial information as set forth in URCR R313-25-6 through R313-25-10. [URCR R313-25-5(1)]

Basis: The information contained in the 2005 revision of the LRA and other relevant documents the Applicant has submitted indicate that the requirements of URCR R313-25-5 have been met. The Applicant has satisfied the requirements of URCR R313-22-33 through their submission of the LRA and other referenced documents. The extent to which the Applicant has satisfied the requirements for the additional types of information listed are addressed in the following sections:

Table 2 - Information/SER Requirement Crosswalk

Type of Information	SER Requirement	SER SECTION
General Information	Requirements 2506-1 through 2506-4	5.3
Specific Technical Information	Requirements 2507-1 through 2507- 14	5.4
Technical Analyses	Requirements 2508-1 through 2508-4	5.5
Institutional Information	Requirements 2509-1 and 2509-2	5.6
Financial Information	Requirements 2510-1, 2511-9, and 2530-1	5.7

The bases for affirmative findings for these requirements are presented in the sections listed above.

Reference Notes:

(See Also: Sections of this document as listed in Table 2)

Envirocare of Utah, Inc., 2005c

5.3R313-25-6; GENERAL INFORMATION

5.3.1 Identity of Applicant

Requirement 2506-1: The general information shall include the identity of the applicant including:

(a) the full name, address, telephone number, and description of the business or occupation of the applicant;

(b) if the applicant is a partnership, the names and addresses of the partners and the principal location where the partnership does business;

(c) if the applicant is a corporation or an unincorporated association;

(i) the state where it is incorporated or organized and the principal location where it does business; and

(ii) the names and addresses of its directors and principal officers; and

(iii) if the applicant is acting as an agent or representative of another person in filing the application, the applicant shall provide, with respect to the other person, information required under R313-25-6(1) [URCR R313-25-6(1)]

Basis: At the time of the submittal, the information contained in Section 1.1 of the 2005 revision of the LRA and other relevant documents the Applicant has submitted indicate that the requirements of URCR R313-25-6(1) have been met. Also included in the referenced documentation are the names and addresses of the Applicant's directors and principal officers. The Applicant is not a partnership. Envirocare of Utah, LLC was a limited liability company organized under the laws of the State of Utah. During the time of the review process, the Applicant changed ownership. On February 3, 2006, the Applicant applied to the Division for an update of the facility ownership as EnergySolutions, LLC. The Applicant's new ownership is a large corporation with operations across the country. The corporation was formed from the joining of several radioactive waste and nuclear materials companies. As a corporation, the Applicant announced on March 29, 2007, plans to make a public offering of stock. The principal business in Utah and under this radioactive materials license is the operation of the radioactive waste disposal operations located at Clive, Utah. The Applicant is not acting as an agent or representative of another person in submitting the application.

Table 3 - Identification of Applicant

Identity of Applicant in 2003	Current Identity of Applicant
Envirocare of Utah LLC 605 North 5600 West Salt Lake City, Utah 84116	EnergySolutions, LLC 423 West 300 South, Suite 200 Salt Lake City, Utah 84101 (801) 532-1330

Reference Notes:

EnergySolutions (Rebeccah McCloud) to Utah Division of Radiation Control (Dane Finerfrock). 2006

EnergySolutions (Tye Rogers) to Utah Division of Radiation Control (Dane Finerfrock). 2006

Envirocare of Utah, Inc., 2005c

Utah Division of Radiation Control, 2006b

5.3.2 Qualifications of Applicant

Requirement 2506-2: The general information shall include the qualifications of the applicant including:

(a) the organizational structure of the applicant, both offsite and onsite, including a description of lines of authority and assignments of responsibilities, whether in the form of administrative directives, contract provisions, or otherwise;

(b) the technical qualifications, including training and experience of the applicant and members of the applicant's staff, to engage in the current activities. Minimum training and experience requirements for personnel filling key positions described in URCR R313-25-6(2)(a) shall be provided;

(c) a description of the applicant's personnel training program; and

(d) the plan to maintain an adequate complement of trained personnel to carry out waste receipt, handling, and disposal operations in a safe manner [URCR R313-25-6(2)]

Basis: The information contained in the LRA and other relevant documents the Applicant has submitted indicate that the requirements of URCR R313-25-6(2)] have been met. The general information of the application included the Applicant's qualifications including:

- The Applicant's organizational structure, both offsite and onsite, including a description of lines of authority and assignments of responsibilities, whether in the form of administrative directives, contract provisions, or otherwise;
- The Applicant's technical qualifications, including training, experience and members of the Applicant's staff, to engage in the current activities. Minimum training and experience requirements for personnel filling key positions described in R313-25-6(2)(a)] is provided in Appendix I of the 2005 revision of the LRA;
- Description of the Applicant's personnel training program; and the plan to maintain an adequate complement of trained personnel to carry out waste receipt, handling, and disposal operations in a safe manner.

However, issues relating to quality assurance of human resources processes were identified in Section 4 of this document. The Division has reviewed these issues and determined the underlying procedures are sufficient to meet the intent of the regulations. Additional discussion regarding these concerns and resulting actions are in Section 6 of this document.

Reference Notes:

(See Also: Sections 4 and 6 of this document)

Envirocare of Utah, Inc., 2005c

Envirocare of Utah, Inc., 2005d, Procedures Train-1 (Rev. 10) and Train-2 (Rev. 14)

Utah Division of Radiation Control, 2005

5.3.3 Disposal Site and Activities

Requirement 2506-3: The general information shall include a description of:

(a) the location of the disposal site;

(b) the general character of the current 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; and

(e) the existing facilities and equipment [URCR R313-25-6(3)]

Basis: The information contained in the 2005 revision of the LRA, and other relevant documents the Applicant has submitted indicate that the requirements of URCR R313-25-6(3) have been met. The 2005 revision of the LRA provides an adequate description of the operating Clive radioactive waste disposal facility. The 2005 revision of the LRA and other documents describe the legal location of the operating Clive radioactive waste disposal facility as Section 32, Township 1 South, Range 11 West, SLB&M, Tooele County, Utah. The Applicant also identifies other operations that are conducted by the Applicant and nearby facilities.

The 2005 revision of the LRA also presents an adequate description of the general character of waste disposal operations at the Clive facility. The Applicant and licensee disposes of naturally-occurring radioactive material, low-level radioactive waste, mixed (hazardous and) low-level radioactive waste, and 11e.(2) wastes. These operations are licensed and permitted by the State of Utah through the divisions of Radiation Control, Water Quality, and Solid and Hazardous Waste.

The 2005 revision of the LRA references several plans and program descriptions that control the activities that are carried on at the facility, including the Waste Characterization Plan, CQA/QC Manual, Radiation Safety Manual, ALARA Plan, Health and Safety Plan, Emergency and Contingency Plan, Site Security Plan, and Quality Assurance Manual.

By reference, the waste to be received, processed, and disposed of is described in Appendix J of the 2005 revision of the LRA. Appendix J contains a listing of waste streams expected for receipt and disposal in the future. Sixteen waste streams from different generators are described, including the general sources of the waste streams, a description of the waste streams, the anticipated volumes of each waste stream, and the average concentrations of principal radionuclides in each waste stream.

The 16 waste streams adequately represent the range of waste streams by including soil, debris, rubble, equipment, and containerized wastes. While variations between the actual wastes and the 16 waste streams described by the Applicant are possible (and likely) the 16 waste streams

encompass the expected range of waste forms. Radionuclide release characteristics of the waste streams may also vary, but the radionuclide release rates in the performance assessment are modeled in a conservative manner that does not take credit for improved waste forms. The 16 waste streams conservatively represent the radionuclide release characteristics of all waste streams accepted for disposal.

Beyond the presence and operation of the separately permitted mixed LLRW treatment facilities at its Clive location (Utah Hazardous Waste Permit UTD991301748), the Applicant has stated no plans for using the land disposal facility for purposes other than waste disposal. The design, operation, construction, and closure of the mixed LLRW treatment and disposal facilities are covered under Permit by the Utah Division of Solid and Hazardous Waste and satisfy all the Division's applicable requirements. All waste received at the Clive facility must contain radioactive constituents and is covered by Utah Radioactive Materials License UT #23000249. Section 3 of the 2005 revision of the LRA includes descriptions of the waste disposal embankment and equipment. The embankment is to be constructed from materials native to the site or available in close proximity to the site. Due to requirements regarding the long-term stability of the embankment, the principal design features of the embankment do not rely upon synthetic materials to provide stability and isolation of the wastes from the environment. The principal construction materials will be the naturally low-permeability clay taken from between the ground surface and the unconfined aquifer and the rock riprap and filter material taken from pits located within 10 miles of the facility.

However, the analyses reviewed have not sufficiently addressed the Division's concern regarding the potential affects of the Applicant's clay mining activities in areas adjacent to Section 32. The Division has formally expressed the concerns to the Applicant in Division letters and requests for information dated November 12, 2004, February 23, 2005, April 22, 2005, and February 16, 2007. Two possible outcomes of these clay and sand excavation activities are (1) changes to the groundwater hydrology system that would compromise the ability of the licensed facility to meet performance objectives and (2) headward erosion caused by runoff from the licensed or other upgradient areas entering into the adjacent mining excavations that could destabilize waste embankments in Section 32. These possible outcomes are a product of soil excavations both inside and outside Section 32. In an attempt to resolve Division concerns regarding borrow areas inside Section 32, the Licensee modified the annual surety proposal in a February 23, 2007 submittal to include backfilling these excavations at the time of site closure. As for those excavations outside of Section 32, the Division is not satisfied that the licensed facility is adequately protected from possible future effects.

The Division has determined that it will renew the license with conditions identifying submittals with specified content that are due to the Division on a stated schedule (see new License Condition 34). The purpose of these submittals is to include additional analyses regarding the potential affects of the Applicant's clay mining activities, and resolve the technical issues outlined in the February 16, 2007 Division Round 1 Interrogatory. Additional discussion regarding these concerns and license conditions is in Section 6 of this document.

The Applicant's disposal operations are supported by various facilities and infrastructure, including the following[1]:

- Administration buildings.
- Vehicle decontamination wash-down pads
- Rail sidings
- Rail rollover facility
- Truck unload areas
- LARW evaporation ponds
- Container storage
- Bulk waste transfer facility
- Outdoor wash pads
- Mixed waste storage building
- Mixed waste treatment buildings
- Evaporation tanks
- Mixed waste evaporation ponds
- Intermodal Container Wash Building
- Access Control Building
- Railcar Rotary Dump facility
- Waste Shredder facility

The Applicant's waste disposal facility includes a surface water drainage system to prevent run-on from the vicinity surrounding the facility, and to contain contaminated runoff from the waste disposal area.

Equipment and methods of construction will be provided by the contractor performing the work, and will be approved by the QA/QC personnel inspecting the work to ensure design and construction specifications are met per the CQA/QC Manual.

Reference Notes:

(See Also: Section 5.3.3 of this document)

Envirocare of Utah, Inc., 2004d

[1] The Division is currently reviewing the proposed design for and construction of the Northwest Corner Pond with the objective of determining whether to grant a license amendment request to construct and operate the same

Envirocare of Utah, Inc., 2004e

Envirocare of Utah, Inc., 2005c

Envirocare of Utah, Inc., 2005f

Utah Division of Radiation Control (Dane Finerfrock) to Envirocare of Utah, Inc. (Tye Rogers), 2004

Utah Division of Radiation Control (Dane Finerfrock) to Envirocare of Utah, Inc. (Tye Rogers), 2005a

Utah Division of Radiation Control (Dane Finerfrock) to Envirocare of Utah, Inc. (Tye Rogers), 2005b

Utah Division of Radiation Control (Dane Finerfrock) to Envirocare of Utah, Inc. (Tye Rogers), 2007

5.3.4 Expected Schedules

Requirement 2506-4: The general information shall include the Expected schedules for construction, receipt of waste, and first emplacement of waste at the existing land disposal facility [URCR R313-25-6(3)]

Basis: The information contained in the 2005 revision of the LRA and other relevant documents the Applicant has submitted indicate that the requirements of URCR R313-25-6(4) have been met. The information includes schedules for construction, receipt, and emplacement of waste.

Reference Notes:

Envirocare of Utah, Inc., 2004d

Envirocare of Utah, Inc., 2004e

Envirocare of Utah, Inc., 2005c

Envirocare of Utah, Inc., 2005d

Envirocare of Utah, Inc., 2005f

5.4R313-25-7; SPECIFIC TECHNICAL INFORMATION

5.4.1 Natural and Demographic Disposal Site Characteristics

Requirement 2507-1: 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 URCR R313-25: 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.

Basis: The information contained in the 2005 revision of the LRA and other relevant documents the Applicant has submitted indicate that the requirements of URCR R313-25-7(1) have been met. Section 2 of the 2005 revision of the LRA describes the characteristics of the Applicant's South Clive site. Section 2.1 of the 2005 revision of the LRA describes geographic and demographic characteristics. These include a description of the site location and nearby facilities. Section 2.1 also describes the current and projected future distribution of populations near the site. Section 2.3 of the 2005 revision of the LRA describes the meteorological and climatological characteristics of the site, including weather patterns, winds, temperature, precipitation, evaporation, and severe weather phenomena.

Section 2.4 of the 2005 revision of the LRA describes the geologic and seismologic characteristics of the site and surrounding region. The Revised Hydrogeologic Report dated August 2004 includes a regional geologic map (Figure 3), a text description of regional geology (Section 4), hydrogeologic cross-sections (Figures 6 through 13), and isopach maps of near-surface units (Figures 4 and 5).

Sections 2.5 and 2.6 of the 2005 revision of the LRA describe the surface-water and groundwater hydrology, respectively, of the site and surrounding region. The description of the groundwater hydrology includes a description of unsaturated zone and saturated zone characteristics. The description of the groundwater hydrology also includes a description of the groundwater flow regime, including a description of hydrologic testing; groundwater elevations, gradients and velocities; and groundwater modeling. Section 2.7 of the 2005 revision of the LRA describes groundwater quality, chemistry, and geochemistry and Section 2.8 describes geotechnical characteristics of the site. Finally, Section 2.9 of the 2005 revision of the LRA describes natural geologic and water resources at the site and Section 2.10 describes biotic features of the site, including vegetation, wildlife, and endangered and threatened species.

Reference Notes:

Bingham Environmental, 1996

Envirocare of Utah, Inc., 2004a

Envirocare of Utah, Inc., 2005c

Whetstone Associates, Inc., 2000a

5.4.2 Principal Design Features: Descriptions, Design Criteria, Justification, and Codes

Requirement 2507-2, Requirement 2507-3, Requirement 2507-4, and Requirement 2507-5: The regulatory requirements of URCR R313-25-7(2) , -7(3) , -7(4) , and -7(5) form a system of requirements that apply to numerous principal design features at the existing LLRW disposal facility and ensure that they will perform adequately to achieve the performance objectives stated in URCR R313-25-18 through -26. These requirements are stated below:

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 URCR R313-25.

Requirement 2507-2: Descriptions of the design features of the land disposal facility and of the disposal units for near-surface disposal shall include those design features related to infiltration of water; integrity of covers for disposal units; structural stability of backfill, wastes, and covers; contact of wastes with standing water; disposal site drainage; disposal site closure and stabilization; elimination to the extent practicable of long-term disposal site maintenance; inadvertent intrusion; occupational exposures; disposal site monitoring; and adequacy of the size of the buffer zone for monitoring and potential mitigative measures. [URCR R313-25-7(2)]

Requirement 2507-3: Descriptions of the principal design criteria and their relationship to the performance objectives. [URCR R313-25-7(3)]

Requirement 2507-4: Descriptions of the natural events or phenomena on which the design is based and their relationship to the principal design criteria. [URCR R313-25-7(4)]

Requirement 2507-5: Descriptions of codes and standards which the applicant has applied to the design, and will apply to construction of the land disposal facilities. [URCR R313-25-7(5)]

Basis: These requirements do not apply equally to all principal design features: One principal design feature might perform the required function of minimizing contact between water and disposed LLRW but would play no role in protecting against inadvertent intrusion. In contrast, another might perform the required function of protecting against inadvertent intrusion but have nothing to do with structural stability of the disposed LLRW. Thus, the applicability of the various regulatory requirements dealing with the design of principal design features depends upon each individual feature.

In this SER, all information required by the regulations for a single design feature is presented in one SER section. For example, the Clay Liner is addressed in Section 5.4.2.1 (a description of the Clay Liner design in Section 5.4.2.1.1, its design criteria in Section 5.4.2.1.2, its design basis and justification of the design criteria in Section 5.4.2.1.3, and applicable codes and standards considered in Section 5.4.2.1.4). All principal design features are discussed in this same format:

- Liner
- Waste Placement and Backfill
- Cover

- Drainage system
- Buffer Zone

In the following sections, each principal design feature is addressed. Each principal design feature is described, its design criteria identified, justification that it will perform as required is presented, and the codes and standards applicable to design and construction are summarized. To ensure that no applicable regulatory requirement is overlooked, each applicable regulatory requirement is repeated as each principal design feature is taken up in the SER.

The provisions of URCR R313-25-7(2) identify 11 required functions that the principal design features must perform. These are listed below:

- Minimize infiltration of water.
- Ensure integrity of covers for disposal units.
- Ensure structural stability of backfill, wastes, and covers.
- Minimize contact of wastes with standing water.
- Provide disposal site drainage.
- Ensure disposal site closure and stabilization.
- Eliminate to the extent practicable long-term disposal site maintenance.
- Protect against inadvertent intrusion
- Limit occupational exposures.
- Provide for disposal site monitoring.
- Provide a buffer zone for monitoring and potential mitigative measures.

The Applicant has identified the following five principal design features:

- Clay Liner
- Class A Waste Emplacement and Backfill
- Cover
- Drainage Systems
- Buffer Zone

The Applicant has determined that the principal design features identified perform the required functions, as indicated in table below. Table 4 summarizes the required functions met by specific design features. At least one required function is performed by each principal design feature. Details about the functions of each principal design feature are discussed in subsequent sections of this document, as detailed above.

Reference Notes:

Envirocare of Utah, Inc., 2005c

Table 4 - Summary of Principal Design Features and the Required Functions they Perform.

REQUIRED FUNCTION	COMPLEMENTARY FUNCTIONS PERFORMED BY PRINCIPAL DESIGN FEATURE				
	Clay Liner	**Class A Waste Emplacement and Backfill**	**Cover**	**Drainage Systems**	**Buffer Zone**
Minimize infiltration of water	Limit infiltration of water/leachate during operations		Minimize infiltration Encourage runoff Protect radon barrier from desiccation Protect radon barrier from frost damage Limit Biointrusion-related damage to radon barrier		
Ensure integrity of covers for disposal units			Withstand differential settlement without damage (e.g., cracking) Prevent internal erosion Ensure material stability Endure weathering Prevent external erosion		
Ensure structural stability of backfill and wastes and ensure integrity of cover	Mitigate differential Settlement	Mitigate differential settlement Maintain slope stability	Withstand differential settlement without damage (e.g., cracking) Maintain slope stability		
Minimize contact of wastes with standing water	Allow positive drainage away from waste during operations Allow cell drainage after closure		Minimize infiltration after final closure		
Provide disposal site drainage				Facilitate flow away from embankment Minimize infiltration under flood conditions	
Ensure ditch integrity				Prevent internal erosion	

REQUIRED FUNCTION	COMPLEMENTARY FUNCTIONS PERFORMED BY PRINCIPAL DESIGN FEATURE				
	Clay Liner	**Class A Waste Emplacement and Backfill**	**Cover**	**Drainage Systems**	**Buffer Zone**
Ensure disposal site closure and stabilization	Comment: Stability of Clay Liner contributes to closure and stabilization	Comment: Stability of Waste Embankment contributes to closure and stabilization	Comment: Construction of stable Cover contributes to closure and stabilization	Comment: Stability of Drainage Systems contributes to closure and stabilization	
Eliminate to the extent practicable long-term disposal site maintenance	Comment: Stability of Clay Liner contributes to eliminating long-term maintenance	Comment: Stability of Waste Embankment contributes to eliminating long-term maintenance	Comment: Construction of stable Cover contributes to eliminating long-term maintenance	Comment: Stability of Drainage Systems contributes to eliminating long-term maintenance	
Protect against inadvertent intrusion			Provide inadvertent intruder barrier		
Limit occupational exposures			Limit exposures at cover surface		
Provide for disposal site monitoring			Allow for settlement monitoring to be conducted		Allow site monitoring to be conducted
Provide a buffer zone for monitoring and potential mitigative measures					Comment: Providing a buffer performs the required function

5.4.2.1 Clay Liner

5.4.2.1.1 Description of Design Feature

Requirement 2507-2: Descriptions of the design features of the land disposal facility and of the disposal units for near-surface disposal shall include those design features related to infiltration of water; integrity of covers for disposal units; structural stability of backfill, wastes, and covers; contact of wastes with standing water; disposal site drainage; disposal site closure and stabilization; elimination to the extent practicable of long-term disposal site maintenance; inadvertent intrusion; occupational exposures; disposal site monitoring; and adequacy of the size of the buffer zone for monitoring and potential mitigative measures. [URCR R313-25-7(2)]

Basis: The Liner of the Class A Disposal Embankment is described in Section 3.0 of the 2005 revision of the LRA. The foundation of the Liner will consist of in-situ soils whose top six inches are either scarified and compacted to 95 percent of a Standard Proctor (ASTM D-698) or simply compacted to 95 percent of a Standard Proctor, depending on the conditions of the in-situ soils (refer to CQA/QC Manual Attachment II-A, "Work Element: Foundation Preparation").

As designed, the Liner will be constructed so the elevation of the top surface is at elevation of nominally 4265.0 ft and will have zero slope in both the east-west or north-south directions. With a natural ground surface at an elevation of as high as 4276.9 as shown in Drawing 9407-4, the top surface of the Liner will exist at a depth of nearly 12 ft. In the performance assessment, the distance from the bottom of the waste to the top of the water table is 4.3 meters. This includes the 2-foot clay liner plus the 12-foot thickness of Unit 3 Sand, less the capillary fringe of about 1 foot. If the top of the clay liner is at elevation 4265.0 ft, the modeling is consistent with the observed water table elevation of 4250 ft. The spatial characteristics of the Liner are depicted on Drawings 9821-02.

The Liner is constructed using procedures that the Division has confirmed are adequate and appropriate. The Applicant submitted test procedures and results of the Clay Liner Test Pad construction (refer to CQA/QC Manual Attachment II-A, "Work Element: Clay Liner Test Pad") to the Division for review. The Division approved results of the test pad construction and the associated procedures that will be used in constructing the Liner.

The Liner will be comprised of a 2-foot-thick layer of compacted clay. The thicknesses of clay lifts are limited by approved construction procedures to no more than 9 or 12 inches, depending on location in the Liner. Successive lifts are bonded to previous lifts through either of two procedures (refer to CQA/QC Manual Attachment II-A, "Work Element: Clay Liner Placement").

The Liner will have an as-built saturated hydraulic conductivity (permeability) equal to or less than 1×10^{-6} cm/sec, which is less than the design criterion stated in Table 3-2 of the 2005 Revision of the LRA (1×10^{-4} cm/sec). The permeability of the Liner will be greater than that of the Disposal Embankment Cover System to preclude the "bathtub" effect that could occur if water migration into the embankment were greater than water loss from it (refer to Sections 5.2.1 and 5.2.3 of this SER).

Liner material is compacted to 95 percent of a Standard Proctor with moisture content between optimum and 5 percent over optimum. The liner will be constructed of soil borrow materials having 85 percent fines (that pass a No. 200 sieve); plasticity index range 10 to 25; and liquid limits ranging between 30 and 50. The maximum dry clod size of clay will be 1 inch.

The Liner is protected by an overlying one-foot-thick Debris-Free Zone. This is specified in the CQA/QC Manual Attachment II-A, "Work Element – Waste Placement". The Applicant has imposed special restrictions on the construction of the Liner to ensure that the material will perform as required. These restrictions address unwanted liner drying (which might cause desiccation), snow removal, cold weather placement of clay material, contamination of clay materials, operation of heavy equipment on the constructed Liner, and quality assurance sampling of clay materials (CQA/QC Manual "Work Element: Radon Barrier Borrow Material").

Based on the foregoing summary of information contained in the 2005 revision of the LRA, and other relevant communications and documents, the Division concludes that the requirements of URCR R313-25-7(2) as they pertain to the description of the Liner are met.

Reference Notes:

ASTM International Committee D18.03 on Texture, Plasticity and Density Characteristics of Soils, 2000a

Envirocare of Utah, Inc., 2004d

Envirocare of Utah, Inc., 2005c, Section 3

5.4.2.1.2 Principal Design Criteria

Requirement 2507-3: Descriptions of the principal design criteria and their relationship to the performance objectives. [URCR R313-25-7(3)]

Basis: Table 5 of this SER summarizes the functions required of the Liner. Required and complementary functions of the Liner include:

- Minimize contact of wastes with standing water, both during operations and after closure.
- Ensure cover integrity by mitigating differential settlement (to which secondary settlement/consolidation of the materials underlying the waste placement and backfill contribute)

The Liner will be constructed to minimize the potential for secondary settlement that could jeopardize the integrity (and effective permeability) of the embankment Cover System. Thus, the Liner contributes to the stability of the Cover System, thereby contributing also to minimizing water infiltration. The Liner will also be constructed so that any water found at its top surface will not accumulate to the extent that it will come in contact with the emplaced waste, whether during operations or following closure. Moreover, construction of the Liner will

be managed and conducted to preserve the integrity of the Liner, to maintain its low permeability, and to minimize the potential for desiccation cracking.

During operations, conditions of the 25-year, 24-hour and the 100-year, 24-hour storm events were considered in designing the Liner.

Section 3.1.1 of the 2005 revision of the LRA provides information regarding the design criteria pertinent to the Liner for the Class A Disposal Embankment. Section 3.1.1 and Table 3-2 of the 2005 revision of the LRA summarize the principal design criteria for the Class A Liner. These design criteria are summarized in Table 5 with respect to each of its defined complementary design functions.

Table 5 - Summary of Clay Liner Design Criteria.

Required Function	Design Criteria
Minimize contact of wastes with standing water during operations.	The clay Liner will be constructed with a permeability no greater than 1.0×10^{-6} cm/sec, which is sufficient to encourage runoff rather than allowing infiltration. To supplement this operational requirement during operations, any water ponds or pools on top of the working surface will immediately be removed by active means such as vacuuming or pumping.
Minimize contact of wastes with standing water following closure. That is, the rate of water enters the disposal unit must be less than the rate at which water leaves.	The clay Liner will be constructed with a permeability that is greater than that of the Cover System to ensure that the rate of water entering the disposal unit is less than the rate at which it leaves via infiltration into underlying materials.
Ensure integrity of cover by mitigating differential settlement	Foundation and clay Liner settlement will be limited (through design and construction) in concert with settlement within waste placement and backfill such that distortion in the Cover System does not exceed 0.02 ft/ft.

Based on the foregoing summary of information contained in the 2005 revision of the LRA, and other relevant communications and documents, the Division concludes that the requirements of URCR R313-25-7(3) have been met as they pertain to providing descriptions of the design criteria for the Liner.

Reference Notes:

AMEC Earth & Environmental, Inc., 2000a

Envirocare of Utah, Inc., 2005c, Section 3

Miller *et al*, 1973, Figures 28 and 30

5.4.2.1.3 Design Basis Conditions and Design Criteria Justification

Requirement 2507-4: Descriptions of the natural events or phenomena on which the design is based and their relationship to the principal design criteria. [URCR R313-25-7(4)]

Basis: Section 3.3.1 of the 2005 revision of the LRA presents the projected performance of the Liner under normal, abnormal, and accident conditions. Table 3-2 of the 2005 revision of the LRA summarizes the conditions considered in the design of the Liner. Table 3-4 of the 2005 revision of the LRA summarizes the results of evaluations conducted to assess the projected performance of the Liner principal design feature.

The Applicant has designed and will construct the Liner to be less permeable (by a factor of 100) than the maximum permeability that has been observed to effectively limit infiltration of precipitation into the subgrade at the Applicant facility (Section 3.3.1.1 and Table 3-4 of the 2005 revision of the LRA). This condition satisfies the first Liner design criterion.

The Applicant has designed the Liner to be more permeable (by a factor of 20) than the final cover in order to minimize the possibility of water accumulating on the liner after closure. By so doing, the possibility of standing water coming into contact with waste following final closure of the disposal cell is limited as required (Section 3.3.1.2 and Table 3-4 of the 2005 revision of the LRA). The Applicant performed a series of infiltration evaluations, including sensitivity analyses to assess the significance of projected infiltration rates through the LLRW cover to abnormal meteorological events, as well as to possible changes in the properties of the cover units resulting from possible root penetration from a deep-rooted plant species present in the vicinity of the site, over the design life of the facility. The analyses indicate that the cover should continue to be able to limit infiltration rates through the cover to less than flux rates through the Liner after closure (state reviewed and approved methods and findings of these tests).

Supporting analyses described in Section 3.3.1 of the 2005 revision of the LRA include an evaluation of allowable distortion in the compacted clay radon barrier component of the cover system, and a quantitative estimation of anticipated maximum future differential settlement magnitudes within the embankment. Settlement calculations presented in "Evaluation of Settlement of Compressible Debris Lifts, LARW Embankments," (by AGRA, dated June 1, 2000) and discussed in Section 3.3.3.3 of the 2005 revision of the LRA indicate that liner (and foundation) settlement will not adversely affect the cover (*i.e.*, will not induce cover distortion in excess of the allowable distortion).

Based on the foregoing summary of information contained in the 2005 revision of the LRA and other relevant documents and communications the Applicant has submitted, the Division concludes that the requirements of URCR R313-25-7(4) have been met as they pertain to justifying adequate performance of the Liner.

Reference Notes:

AGRA Earth & Environmental, Inc., 2000a

AGRA Earth & Environmental, Inc., 2000b

AMEC Earth & Environmental, Inc., 2000b

Envirocare of Utah, Inc., 2005c, Section 3

5.4.2.1.4 Applicable Codes and Standards

Requirement 2507-5: Descriptions of codes and standards that the applicant has applied to the design, and will apply to construction of the land disposal facilities. [URCR R313-25-7(5)]

Basis: The primary standards considered by the Applicant in the design of the Liner are those codified in URCR R313-25-24. The 2005 revision of the LRA invokes provisions of the CQA/QC Manual for constructing the Liner and associated Liner test pad, and QC and QA procedures be used during its construction.

Based on the foregoing summary of information contained in the 2005 revision of the LRA and other relevant documents and communications the Applicant has submitted, the Division concludes that the requirements of URCR R313-25-7(5) have been met as they pertain to identifying codes and standards applicable to the design and construction of the Liner.

Reference Notes

AGRA Earth & Environmental, Inc., 2000a

Envirocare of Utah, Inc., 2004d

Envirocare of Utah, Inc., 2005a

Envirocare of Utah, Inc., 2005c

Envirocare of Utah to URS Corporation, 2005

Miller *et al*, 1973

5.4.2.2 Class A Waste Emplacement and Backfill

5.4.2.2.1 Description of Design Feature

Requirement 2507-2: Descriptions of the design features of the land disposal facility and of the disposal units for near-surface disposal shall include those design features related to infiltration of water; integrity of covers for disposal units; structural stability of backfill, wastes, and covers; contact of wastes with standing water; disposal site drainage; disposal site closure and stabilization; elimination to the extent practicable of long-term disposal site maintenance; inadvertent intrusion; occupational exposures; disposal site monitoring; and adequacy of the size of the buffer zone for monitoring and potential mitigative measures. [URCR R313-25-7(2)]

Basis:

Waste Placement

The Applicant has provided waste placement descriptions in Section 3.2.2.1, 3.2.2.2, and 3.2.2.3 of the 2005 revision of the LRA. Interfaces between bulk, CLSM, and CWF are discussed.

Section 3.1.2 describes waste placement and backfill in embankment design and Section 3.3.2 describes embankment performance with respect to waste placement and backfill.

Drawing 9407-4 shows waste placement area for the LARW to be 1,670 feet long by 1,115 feet wide with the Class A waste disposal site has dimensions 2,260 feet by 1,400 feet as shown in Drawing 9821-01. Side slopes of waste within the two placement areas are shown to be no greater than 5:1 in Drawings 9407-4B and 9821-02. Drawing 04080-C02 shows waste placement area for the Class A North disposal embankment to be 2,216 feet long by 878 feet wide, with side slopes no greater than 5:1

Section 3.2.2 of 2005 revision of the LRA addresses the pertinent characteristics of the principal design features for waste placement and backfill including the waste types to be disposed in the existing embankments. This waste may take a variety of physical forms, including soil or soil-like material, compressible debris, incompressible debris, oversized debris and containerized Class A LLRW. Liquid waste may not be disposed in the embankments. Waste placement is conducted in accordance with the CQA/QC Manual, Attachment II-A. Wastes are disposed at the Applicant's Disposal Embankments in accordance with the provisions of the Operating Procedures Manual (2005 revision of the LRA, Appendix C and the CQA/QC manual, Attachment II-A).

If voids are minimized during the placement of waste material, including spreading and placement of debris with fill materials or filling all voids surrounding debris and large components, the waste embankment integrity will be assured and is expected to last for 1000 years (10 CFR 40, Appendix A, Criterion 6). Section 3.2.2 of the 2005 revision of the LRA describes the characteristics of the Class A waste emplacement and backfill. These characteristics will be identical for all Disposal Embankments.

The procedures for placement of the embankment cover and the equipment used may be found in the CQA/QC Manual, Attachment II-A. The designed cover has been modeled and it has been found to be sufficiently impermeable to water (Whetstone, 2000), structurally sound, and erosion resistant. Workers will be protected during waste emplacement procedures in accordance with the policies the Applicant's Safety Plan (2005 revision of the LRA Appendix B, Section 15), and ALARA Plan (2005 revision of the LRA, Appendix H).

The design of the facility enables isolation of each embankment after it has been filled and covered. Thus, once the embankment is closed, it will not be disturbed by continuing operations at the site. The final embankment cover integrates long-term water and erosion control methods into the overall design (refer to Sections 3.1.1 and 3.1.2 of the 2005 revision of the LRA), thus eliminating the need for active maintenance of a closed embankment. Modeling has demonstrated that the waste disposal system will perform as designed, even if the waste cell remains open for as long as 12 years before the final cover system is placed over the waste.

Containerized Waste Placement

In accordance with License Condition 16.M, the Applicant operates the CWF within the Class A Disposal Embankment. Documentation in support of the CWF is referenced at License

Condition 84, items M, N, O and P. Following acceptance and unloading, waste packages are stacked in order to minimize the volume of void spaces created. Containerized Waste Facility operations are provided in the CQA/QC Manual, Attachment II-A, "Work Element – Containerized Waste Facility Waste Placement."

The area used for containerized waste disposal is constructed in the form of a truncated pyramid. The CWF will be managed as a facility separate from the Large Components Area.

Containerized Class A LLRW will be disposed of in DOT-approved "strong, tight" containers, like 55-gallon drums, B-12 or B-25 steel boxes, Division-approved High Integrity Containers (HIC), or oversized DOT-approved containers. The containers may hold a variety of different waste forms, including solidified wastes, spent ion exchange resins, spent filters, other compressible debris, incompressible debris, and soil. In accordance with License Condition 37.B, spent ion exchange resins will be solidified using a solidification agent approved by the Division; disposed of in HICs approved by the Division; or disposed of in carbon-steel liners, unapproved HICs, or poly HICs meeting the void space criteria of no more than 15 percent void per container.

In settlement modeling, void space in 55-gallon drums, B-12 boxes, B-25 boxes, and HICs may be up to 15 percent of the respective container volume without compromising the integrity of the cover system. Any container with internal void space greater than 15 percent will have the void space filled with CLSM prior to disposal (Utah Division of Radiation Control, 2005). Many HICs are designed to remain structurally stable for 300 years or more. All HICs will also conform to the Certified Containerized Waste Characterization requirements.

The Applicant proposes to dispose of the containerized waste packages using the same handling and operating procedures that the division has approved for use in the Class A Disposal Embankment. Voids between/around the containerized waste drums, boxes, HICs, or other containers and components will be backfilled with sand (or other backfill materials the Division approves) using procedures that have been shown in previous backfill test demonstrations to successfully fill the voids. A Containerized Class A Waste placement/backfill test pad has been constructed and tests conducted. The Division has reviewed and approved successful procedures.

Unless otherwise approved by the Division, no more than three layers of drums will be placed before backfilling commences. The height of a layer of boxes or stack of boxes will not exceed 5 feet before backfilling commences. Waste packages will be placed or stacked in a manner that minimizes the volume of voids between the waste drums and/or boxes.

Only one lift of drums (layers three drums deep, as described above) will be placed in any column of the CWF. Up to two lifts of HICs, disposed as the Division approves may be placed in the CWF. Under these constraints, the integrity of the cover system will not be compromised and the facility will perform better than conservative projections suggest, limiting releases and resulting potential radiation doses to values well below the limits allowed by the Utah regulations.

Containerized waste would be laid in two layers and backfill materials then applied over and around the circular containers. Alternatively, boxes of uniform size would be placed tightly against each other either in a single layer, or to a height not to exceed 5 feet, depending on the size of the box(es), in a manner ensuring that void spaces are minimized.

The Division has evaluated and approved waste placement configurations. Currently approved waste placement configurations include vertical drums, boxes up to four feet tall, and right circular cylinders ('liners or high integrity containers') up to 331 cubic feet external volume (9 feet tall). Unusually shaped packages are placed and backfilled to ensure that voids are filled. In no case will packages be placed such that significant voids are created that cannot be filled.

Decomposable materials (usually framing lumber used for bracing waste packages in transportation conveyances) to be disposed are placed in small stacks near the bottom of a layer of waste packages. This is done to ensure that the bracing materials do not impede the downward flow of backfill into the void spaces. In order to minimize potential differential settlement, decomposable materials will not be accumulated into large piles for placement. Once wastes are stacked, back filling is conducted by placing free flowing, cohesionless soil over the waste packages. Backfill soil must meet gradation and moisture content specifications approved through a Division-approved configuration based on waste placement test pad results. Backfilling procedures and compacting effort is determined through an approved test pad.

Debris and Large Component Placement:

Disposal of debris and containerized waste in the Large Component Area involves Controlled Low Strength Material (CLSM) pyramids to minimize differential settlement within the embankment. Following acceptance and unloading, debris and/or large components are placed in order to minimize the volume of void spaces between containers/components. Debris and large components are placed to minimize entrapped air in each debris lift. Associated container debris such as container lids or other incidental debris is placed in such a manner to minimize entrapped air pockets. Once debris or large components are placed in the debris lift, the lift is backfilled by pouring CLSM over the waste so that it flows to fill void spaces within the emplacement.

CLSM is a low strength, flowable concrete. Standard concrete mixing delivery equipment is used to pour CLSM in each CLSM pour. The flow characteristic of CLSM is controlled to ensure adequate filling of the voids within the oversized debris pour. Debris, large component, and CLSM requirements are defined in the CQA/QC Manual, Attachment II-A, "Work Element - Waste Placement". Quality Control Inspectors test the CLSM against CQA/QC Manual specifications, document each CLSM pour, and ensure adequate filling of the void spaces within the pour.

Oversized containers and large components will be disposed of according to provision of the CQA/QC Manual. The Division has authorized the Applicant to dispose of Large Components in the Class A disposal area. Equipment capable of offloading and handling the large component, personnel qualifications, and safety precautions are provided. Procedures detail offloading and disposal activities, including backfilling voids within the large component.

Bearing load calculations assure that the in-place weight and bearing area of the large component does not exceed the bearing capacity of the embankment foundation.

Bulk Waste Placement: Former Method

Following acceptance and unloading, bulk waste is emptied and spread into bulk waste lifts that are twelve inches thick or less. After spreading, bulk waste is compacted to at least 90 percent of a Standard Proctor (ASTM D-698). The moisture content of each bulk waste lift is controlled to between 2 percent (absolute) and 3 percentage points over optimum. After the bulk waste lift is compacted, the density and moisture content of the bulk waste is tested in accordance with the CQA/QC Manual, Attachment II-A (through Revision 19), "Work Element – Waste Placement." Quality Control Inspectors document the testing and approval of each bulk waste lift. These primary controls utilized during waste placement create a stable engineered fill that will provide a suitable foundation for the final cover.

Waste emplacement and backfilling operations would be performed concurrently. Table 3-3 of the 2005 revision of the LRA summarizes characteristics of the Class A Waste Emplacement and Backfill design.

Based on the foregoing summary of information contained in the 2005 revision of the LRA, and other relevant documents, the Division concludes that the requirements of URCR R313-25-7(2) as they pertain to the Class A Waste Emplacement and Backfill have been met.

Required function performed by the waste placement and backfill are listed in Table 4 of this SER. In addition to those listed in Table 4, the waste placement and backfill assist in minimizing infiltration by providing a stable foundation upon which the cover is constructed, thereby preserving cover system integrity so that infiltration can be minimized.

Bulk Waste Placement: Current Method

A new method for waste placement at the facility, which represents a major change to the procedures and equipment, occurred with approval of Attachment II-A Revision 20 of the CQA/QC Manual. Basically the changes include the following activities and equipment:

1. New Compaction Equipment – including use of a 826 Caterpillar wedge-foot compactor instead of the former rubber-tired waste haul trucks,

2. New CAES Control Systems – including new Caterpillar Computer Aided Earthmoving Software (CAES) based on Global Positioning System (GPS) technology to track the location of the new compactor, the number of passes it makes over each waste lift, and the response of the waste material to the compactive effort, i.e., difference in the compactor's elevation before and after each pass over the waste lift. In summary, an adequately compact waste lift will be one where: 1) the 826 Caterpillar compactor has made at least 4 passes over the waste material, and 2) 80% of the CAES grid points demonstrate a satisfactory compaction response via post-compaction elevation measurements.

3. Increase in Waste Lift Thickness – from the previous 1-foot thick waste to layers that are now 2-feet thick or less. Increase in list thickness will provide gains in disposal efficiency, and are possible thanks to the design of the 826 Caterpillar compactor and the CAES control system.

4. Elimination of Waste Moisture / Density Testing – the former CQA/QC Manual required: 1) pre-disposal testing of the waste materials to determine Proctor curves for the material and appropriate moisture / density conditions for acceptable waste compaction, and 2) post-compaction field testing to verify that the appropriate moisture / density properties had been met. Such field testing required more workers to be present on the waste form, resulting in certain radiation exposures. Thanks to the new CAES waste placement system, less manual labor and testing will be required during waste placement activities, which will result in added safety and reduced dose to site workers. Also, the GPS technology in the CAES system will allow more information to be collected on a unit area basis, for both waste elevation, and its response to the compactive effort. Consequently, the CAES system represents a major improvement in both worker safety, reducing radiation doses to workers, and verifying proper waste embankment construction.

5. Change in Construction Point of Compliance and Settlement Monitoring – previously post-compaction field testing of moisture / density characteristics were used to determine compliance with waste embankment construction requirements. With the new CAES system, compliance with construction requirements will be determined at a later point in the construction history of the facility, after:

   A. Emplacement of the final waste and construction of a temporary radon cover soil layer, and

   B. Installation of a network of settlement monitoring stands to measure settlement of the waste column. These stands will be installed at on a 50-foot grid over the disposal cell,

   C. A period of at least 2 years of settlement monitoring to verify that waste column is a stable platform for the final cover system.

6. New Shredder Facility – the goal of this new facility is to size reduce and otherwise pre-treat debris type wastes so that they will pass a 4-inch screen. Material thus pre-treated before placement will have a more uniform particle size gradation, and greatly reduce the potential for differential settlement of the embankment. Such size reduction pre-treatment should not only provide efficiencies in waste handling and disposal, but also improve long-term embankment stability, cover system performance and isolation of the waste from the environment. This facility was approved by the DRC in License Amendment 22E.

7. Minimization of Debris Disposal – thanks to the pre-treatment process to be rendered by the new Shredder facility, we anticipate a significant reduction in the need to disposal of structural debris. However, in cases where debris cannot be re-sized by the new Shredder

facility, the amount of large debris disposed directly into the embankment should be minimized. Negotiations are currently ongoing with EnergySolutions to determine acceptable criteria for dimensions, proportions, and handling and disposal procedures for such debris.

Reference Notes:

ASTM International Committee D18.03 on Texture, Plasticity and Density Characteristics of Soils, 2000a

Code of Federal Regulations, 1985

Envirocare of Utah, Inc., 2004d

Envirocare of Utah, Inc., 2005a

Envirocare of Utah, Inc., 2005b

Envirocare of Utah, Inc., 2005c

Envirocare of Utah, Inc., 2005d

Envirocare of Utah, Inc., 2005e

Utah Division of Radiation Control, 2005

Whetstone Associates, Inc. to Envirocare of Utah, Inc., 2000

5.4.2.2.2 Principal Design Criteria

Requirement 2507-3: Descriptions of the principal design criteria and their relationship to the performance objectives. [URCR R313-25-7(3)]

Basis: The principal design criteria pertinent to the design of the waste placement and backfill are listed in Table 3-2 and are justified in Section 3.1.2 of the 2005 revision of the LRA. A key design criterion is the limitation of allowable distortion in the cover to less than 0.02 ft/ft. That is, the waste placement and backfill must not result in a magnitude of differential settlement within the Disposal Embankment that would contribute to a distortion that exceeds 0.02 ft/ft in the cover. Practically, this means that cover system settlement is acceptable so long as it is less than 1 foot of vertical displacement in less than any 50-foot horizontal distance.

Based on the foregoing summary of information contained in the 2005 revision of the LRA, and other relevant documents, the Division concludes that the requirements of URCR R313-25-7(3)) as they pertain to the disposal of Class A waste in the Disposal Embankments have been met. The Division's review of more recent information has shown that areas with the highest rate of differential settlement at three different areas of the LARW Cell cover system have all been at or below 1.5 percent, or 0.75 ft vertical displacement in 50-feet horizontal (Utah Division of Radiation Control, 2006).

Reference Notes:

Envirocare of Utah, Inc., 2003a

Envirocare of Utah, Inc., 2005c

Utah Division of Radiation Control, 2006

5.4.2.2.3 Design Basis Conditions and Design Criteria Justification

Requirement 2507-4: Descriptions of the natural events or phenomena on which the design is based and their relationship to the principal design criteria. [URCR R313-25-7(4)]

Basis: Projected performance of the containerized waste placement and backfill is presented and justified in Section 3.3.2 and summarized in Table 3.4 of the 2005 revision of the LRA. The Applicant utilized applicable guidance issued by the NRC, including those described in NRC NUREG-1199 and NUREG-1200, pertaining to normal, abnormal, and accident (where applicable) conditions that should be considered during design of NRC-licensed LLRW disposal facilities. Table 3.2 of the 2005 revision of the LRA summarizes the conditions considered in the design of the Class A Waste Placement and Backfill principal design feature and the relationship between the normal, and abnormal, and accident (as applicable) conditions evaluated to the principal design criteria. Table 3-4 of the 2005 revision of the LRA summarizes the results of evaluations conducted to assess the projected performance of the Class A Waste Placement and Backfill.

For the abnormal conditions evaluated, all distortions were calculated to be less than or equal to the design criterion of 0.02 ft/ft or less.

Factors of safety associated with all of the normal and abnormal conditions evaluated are summarized in the 2005 revision of the LRA. The safety factors represent the design criteria distortion of 0.02 ft/ft divided by the calculated distortions, with all calculated values rounded to three decimal places. Overall, the average safety factor associated with the three normal conditions and the average safety factor associated with the five abnormal conditions were ascertained. The safety factor is greater than or equal to 1.00 under abnormal conditions.

Structural stability was evaluated in terms of global and veneer stability. The Applicant selected minimum design criteria safety factors of 1.5 for static conditions and 1.2 for dynamic conditions based on the minimum factors of safety for static and seismic conditions specified in Utah Statutes and Administrative Rules for Dam Safety, Rule R625-11-6. The 2005 revision of the LRA references seismic stability and deformation analyses that were completed in 1996 and 1999 for the Low Activity Radioactive Waste embankments by AGRA Earth and Environmental. The static and seismic factors of safety derived in both studies were greater than the design criteria values established for the disposal embankment. A letter report by AMEC Earth and Environmental, dated October 25, 2000, discusses the applicability of these studies to the disposal embankment.

Material shear strength versus depth was compared between the LARW Embankment and the Class A Disposal Embankment. Review of the appropriate shear strength parameters revealed that under short-term conditions (institutional control period), the shear strength of the Class A Disposal Embankment was slightly lower in the upper part of the embankment than the LARW embankment. Based on this finding, the Applicant performed supplemental stability calculations for the Class A Disposal Embankment. Results of the stability analyses indicate the minimum static factor of safety exceeds the minimum design criteria (static factor of safety ≥ 1.5) established for normal conditions.

For the abnormal condition, the Applicant performed evaluations for the case of seismic loading due to earthquakes, as well as for the case of saturated conditions within the embankment under static loads. The calculated minimum seismic factor of safety for the seismic loading condition based on the slightly lower shear strength of the Class A Disposal Embankment materials (Shear strength values were selected based on an assumed effective anisotropic shear strength distribution for drum waste/backfill layers) was determined to be 1.3, which exceeds the minimum design criteria (seismic factor of safety ≥ 1.2).

Additional analyses were performed for abnormal saturated conditions within the embankment (AMEC, Report dated November 8, 2000; and are included in the 2005 revision of the LRA). The first case evaluated a hypothetical condition in which water infiltrates the clay cover faster than it drains out of the embankment through the liner, creating a shallow, "perched" water table within the embankment. The analysis indicated a factor of safety against sliding on the clay liner of approximately 4.3. The second case evaluated a condition involving water flowing parallel to the cover layers, due to a large precipitation event or rapid snowmelt. For this condition, an infinite slope analysis was performed and a minimum factor of safety of approximately 4.1 was calculated. This factor of safety exceeds the minimum design criteria for both static and seismic conditions (static factor of safety ≥ 1.5 and seismic factor of safety ≥ 1.2), indicating that saturation of the embankment cover components will not compromise the slope stability of the embankment.

Based on the foregoing summary of information contained in the 2005 revision of the LRA, and other relevant documents the Applicant has submitted, the Division concludes that the requirements of URCR R313-25-7(4) as they pertain to the waste emplacement and backfill of the disposal embankment have been met.

Reference Notes:

AGRA Earth & Environmental, Inc., 1996

AGRA Earth & Environmental, Inc., 1999

AMEC Earth & Environmental, Inc., 2000a

AMEC Earth & Environmental, Inc., 2000b

Envirocare of Utah, Inc., 2005c

US Nuclear Regulatory Commission, 2001

US Nuclear Regulatory Commission, 2004

5.4.2.2.4 Applicable Codes and Standards

Requirement 2507-5: Descriptions of codes and standards which the applicant has applied to the design, and will apply to construction of the land disposal facilities. [URCR R313-25-7(5)]

Basis: Section 1.6 of the 2005 revision of the LRA, "Conformance to Regulatory Guides" provides a summary of the codes, standards, and guidelines that the Applicant considered and applied to the design. The primary standards considered by the Applicant in the design of the waste placement and backfill are those codified in URCR R313-25-24 and R313-25-25. The Applicant has also incorporated by reference minimum design criteria safety factors of 1.5 for static conditions and 1.2 for dynamic conditions from Utah Statutes and Administrative Rules for Dam Safety, Rule R625-11-6.

The CQA/QC Manual provides specifications for constructing the Class A Disposal Embankments. The CQA/QC Manual also includes QC and QA procedures to be used during its construction.

Based on the foregoing summary of information contained in the 2005 revision of the LRA, the Applicant has submitted, the Division concludes that the requirements of URCR R313-25-7(5) as they pertain to the waste emplacement and backfill of the disposal embankment have been met.

Reference Notes:

Envirocare of Utah, Inc., 2004d

Envirocare of Utah, Inc., 2005c, Section 1

5.4.2.3 Cover System

5.4.2.3.1 Description of Design Feature

Requirement 2507-2: Descriptions of the design features of the land disposal facility and of the disposal units for near-surface disposal shall include those design features related to infiltration of water; integrity of covers for disposal units; structural stability of backfill, wastes, and covers; contact of wastes with standing water; disposal site drainage; disposal site closure and stabilization; elimination to the extent practicable of long-term disposal site maintenance; inadvertent intrusion; occupational exposures; disposal site monitoring; and adequacy of the size of the buffer zone for monitoring and potential mitigative measures. [URCR R313-25-7(2)]

Basis: The Cover of the Class A Disposal Embankment is described in Sections 3.1.3 and 3.2.3 of the 2005 revision of the LRA. The Cover is depicted on Drawings 9407-4A, 9407-4B, 03046A-V01, and 03046A-V02. As shown in the cross sections of the Drawings, the Disposal Embankment cover is a multi-layer system consisting from bottom to top of a two-component

compacted clay radon barrier, lower granular filter zone (Type B Filter Zone), sacrificial soil layer, upper granular filter zone (Type A Filter Zone), and erosion (rock rip rap) barrier layer. Table 3.3 of the 2005 revision of the LRA provides material specifications for each layer of the cover. The top slope of the cover would be sloped at 2.8 percent, with the top slope inclined away from a level center crest line oriented east-west. Side slopes of the cover would be sloped at 20 percent (5H : 1V).

The radon barrier layer is detailed in Drawings 03046-V01 through V05 and is comprised of a 1-foot-thick layer of compacted clay having an as-built saturated permeability of 1 x 10^{-6} cm/sec and an overlying 1-foot-thick layer of compacted clay having an as-built permeability of 5 x 10^{-8} cm/sec or less. The radon barrier would be constructed using soil borrow materials having 85 percent fines < 0.075 mm in diameter; plasticity index ranging from 10 to 25; and liquid limit values ranging from 30 to 50. The radon barrier would be placed and constructed in lifts and compacted to meet the specified design criteria. As-built clay permeability is field tested and verified via single-ring infiltrometer measurements as per CQA/QC Manual requirements.

A six-inch-thick lower ("Type B") filter zone, consisting of small and medium aggregate layers, with an overlying sacrificial soil layer, would be placed directly over the radon barrier. The sacrificial soil layer would serve as a freeze/thaw barrier layer above the lower filter zone. Specifications for the thickness of and gradation requirements for the lower filter layer (D_{100} of 1 ½ inch or less, D_{40} of 3/8 inch or more, and D_{10} of No. 4 sieve (4.75 mm) or more) are found in Table 3.3 of the 2005 revision of the LRA. In addition, the filter materials for this layer would have a rock score of at least 50, and the constructed layer would exhibit a minimum saturated hydraulic conductivity (permeability) of 3.5 cm/sec. As-built verification of minimum filter permeability and determination of filter stability is accomplished and benchmarked by soil gradation testing.

The sacrificial soil layer would have a minimum as-built thickness of 12 inches. This layer would serve as a freeze/thaw barrier layer above the lower filter zone. Specifications for the thickness of, and gradation requirements for this layer (D_{100} of 3/4 inch or less, D_{60} of 3/8 inch or more, D_{35} of No. 4 sieve [4.75 mm] or more, and D_{15} of No. 200 sieve [~0.075 mm] or more), are found in Table 3.3 of 2005 revision of the LRA. The Applicant indicates (Section 3.2.3 of the 2005 revision of the LRA) that the sacrificial soil would be placed and spread ahead of construction equipment in order to minimize potential impact to the completed radon barrier. Field verification of the moisture retention capability and filter stability of this layer is verified and benchmarked by soil gradation testing results.

The upper, six-inch-thick ("Type A") filter zone overlying the sacrificial soil layer, and the surficial erosion barrier layer, would comprise the final (uppermost) layers of the embankment cover. The Type A filter zone layer would be placed over the sacrificial soil layer. The Type A filter zone layer would consist of poorly graded aggregates of less than 6 inches in diameter. Specifications for thickness, gradation, and rock durability (minimum 6 inches thick, D_{100} of 6 inches or less, D_{70} of 3 inches or less, D_{50} of 1.57 inches (40 mm) or less, D_{15} of 0.85 inch or less, D_{10} of No. 10 sieve (about 2 mm) or more, and D_5 of No. 200 sieve [~0.075 mm] or more; and rock score of at least 50) are found in Table 3.3 of the 2005 revision of the LRA. This layer would serve a similar purpose to the lower ("Type B") filter zone, serving as a drainage layer and

providing a transitional gradation between the sacrificial soil layer and the overlying riprap erosion barrier. Field verification of filter stability is verified by soil gradiation testing.

The Erosion Barrier (minimum 18 inches thick) would be constructed of large, durable rock (having a rock score of at least 50) meeting the specifications provided in Table 3.3 of the 2005 revision of the LRA. The top cover portion of the riprap layer would have the following gradation: D_{100} of 4 ½ inches or less, D_{50} of 1 1/4 inches or more, D_{10} of 3/4 inch or more, and D_5 of No. 200 sieve [~0.075 mm] or more. The side cover portion of the riprap layer would have the following gradation: D_{100} of 16 inches or less, D_{90} of 12 inches or less, D_{50} of 4 ½ inches or more, D_{10} of 2 inches or more, and D_5 of No. 200 sieve [~0.075 mm] or more. The gradation of erosion barrier for the top slopes of the embankment ("Type B Riprap") would be smaller than that for the side slopes ("Type A Riprap") due to the generally flat slope of the top compared to the sides.

The purpose of the cover system is to contain and control contaminants in the waste embankment, thereby isolating them from the public and the environment. Table 3.2 of the 2005 revision of the LRA summarizes the required functions of the Cover. The 2005 revision of the LRA sections that address the required functions are listed in are Table 3.1 of the 2005 revision of the LRA.

- Minimize infiltration of water;
- Ensure integrity of covers for disposal units;
- Ensure structural stability of backfill, wastes, and ensure integrity of cover; and
- Minimize contact of wastes with standing water; and

The Cover would fulfill the above-required functions by performing the following primary complementary functions:

- Minimizing infiltration after final closure
- Encouraging runoff
- Protecting the radon barrier from desiccation
- Protecting the radon barrier from frost damage
- Limiting biointrusion-related damage to radon barrier
- Withstanding differential settlement without damage (e.g., cracking)
- Maintaining slope stability

In addition to fulfilling the above-described principal required functions and primary complementary functions; the Cover will also provide the following additional secondary functions

- Ensure disposal site closure and stabilization (through construction of a stable cover system)

- Eliminate to the extent practicable long-term disposal site maintenance (through construction of a stable cover system)
- Protect against inadvertent intrusion (by providing an inadvertent intruder barrier)
- Limit occupational exposures (by limiting exposures at the cover surface); and
- Provide for disposal site monitoring (by allowing settlement monitoring of the cover to be conducted).

Based on the foregoing summary of information contained in the 2005 revision of the LRA, and other relevant documents the Applicant has submitted, the Division concludes that the requirements of URCR R313-25-7(2) as they pertain to the Class A disposal embankment Cover have been met.

Reference Notes:

AMEC Earth & Environmental, Inc., 2000a

Bingham Environmental, 1996

Envirocare of Utah, Inc., 2004d

Envirocare of Utah, Inc., 2005c, Section 3

Miller *et al*, 1973

Nelson *et al*, 1986

Schroder *et al*, 1994

Seed, 1983

US Army Corps of Engineers, 1990

US Army Corps of Engineers, 1991

US Department of Energy, 1989

Whetstone Associates, Inc., 2000a

Whetstone Associates, Inc., 2000b

5.4.2.3.2 Principal Design Criteria

Requirement 2507-3: Descriptions of the principal design criteria and their relationship to the performance objectives. [URCR R313-25-7(3)]

Basis: Section 3.1.3 of the 2005 revision of the LRA provides information regarding the design criteria pertinent to the Cover principal design feature of the Disposal Embankment. Section 3.1.3 and Table 3.2 of the 2005 revision of the LRA summarize the principal design criteria for

the Cover. Section 1.7 of the 2005 revision of the LRA provides a listing of sections in which the regulatory requirements are discussed as they apply to the design of the Disposal Embankment, including the cover.

The design criteria used by the Applicant for each required function of the cover are summarized in Table 6 of this SER.

Table 6 - Summary of Cover Design Criteria

Required Function	Design Criteria Used
Provide inadvertent intruder barrier	Top of cover shall be a minimum of (5.5 feet) above the top of any Class A wastes
Minimize Infiltration	
• Minimize infiltration	• Average infiltration rate through cover < 0.104 inches/yr (0.265 cm/yr) for top slopes and < 0.143 in/yr (0.364 cm/yr) for side slopes
• Encourage runoff	• (1) Surface slope must be adequate to maintain positive drainage; • (2) maximum calculated design velocity within the drainage layer must be greater than the predicted maximum drainage velocity for extreme storm events; and • (3) accumulation of water must not occur on the surface of the embankment
Protect the radon barrier from desiccation	No desiccation cracking allowed in radon barrier
Protect the radon barrier from frost damage	Thickness of rock erosion barrier plus sacrificial soil plus filter zone layers > maximum projected depth of frost penetration (maximum frost depth estimated based on a minimum 500-year recurrence interval)
Limit biointrusion-related damage to radon barrier	Cover shall discourage biointrusion and shall not cause infiltration through cover to increase above base case infiltration levels (given in second column, second row of this table)
Limit occupational exposures (by limiting exposures at the cover surface)	Dose rate at cover surface shall be less than 100 mrem total effective dose equivalent (TEDE) per year
Ensure cover integrity	
• Mitigate differential settlement	• Maximum allowable distortion of cover shall be 0.02 ft/ft.
• Prevent internal erosion	• Runoff water velocity shall be < 3 feet/sec on surface of radon barrier and to minimize piping, particle size specification for Type B Filter Zone material shall conform to the following*: • D_{15} (filter)/D_{85} (soil) shall not exceed 5; and • D_{50} (filter)/D_{50} (soil) shall not exceed 25 • * Same filter stability criteria also apply to the Type A Filter and underlying Sacrificial Soil (frost barrier layer).

Required Function	Design Criteria Used
• Exhibit material stability and resist external erosion	• Rock erosion barrier shall exhibit internal stability and endure weathering/external erosion for at least 1,000 years
Ensure Structural Stability	
• Withstand settlement without damage	• Total settlement shall be less than 15 percent of embankment height in order to not compromise drainage capability of cover (*i.e.*, cause slope reversal)
• Maintain slope stability	• Embankment shall meet minimum global factor of safety against sliding instability of 1.5 under static conditions and 1.2 under dynamic (earthquake) condition

Based on the foregoing summary of information contained in the 2005 revision of the LRA and other relevant documents, the Division concludes that the requirements of URCR R313-25-7(3) as they pertain to the Class A Disposal Embankment Cover have been met.

Reference Notes:

AMEC Earth & Environmental, Inc., 2000a

Bingham Environmental, 1996

Envirocare of Utah, Inc., 2004d

Envirocare of Utah, Inc., 2005c, Section 3

Miller *et al*, 1973

Nelson *et al*, 1986

Schroder *et al*, 1994

Seed, 1983

US Army Corps of Engineers, 1990

US Army Corps of Engineers, 1991

US Department of Energy, 1989

Whetstone Associates, Inc., 2000a

Whetstone Associates, Inc., 2000b

5.4.2.3.3 Design Basis Conditions and Design Criteria Justification

Requirement 2507-4: Descriptions of the natural events or phenomena on which the design is based and their relationship to the principal design criteria. [URCR R313-25-7(4)]

Basis:

Provide Inadvertent Intruder Barrier

Several features of the facility design have the effect of protecting an inadvertent intruder from exposure to the disposed materials and the effects of radiation. These features include:

- Lack of nearby residential population
- Embankment cover system including large diameter riprap and filter rock layers
- Structural and other waste debris encased in CLSM
- Waste Form (in the case of containerized waste disposal)

As per Section 3.2 of NUREG-1199, analyses of radiation exposure doses to inadvertent intruders were assessed by the Applicant. Section 6.4.1.1.5 of the 2005 revision of the LRA discusses the design performance objectives of the facility to protect inadvertent intruders from exposure. Section 6.4.1.3 of the 2005 revision of the LRA and in Streamline Consulting, LLC., 2005 the modeled dose to an inadvertent intruder is discussed. The radiation dose to an inadvertent intruder is not expected to exceed radiation limits.

Division regulations do not specify design features or dose rates to inadvertent intruders that are applicable to disposal of Class A LLRW. In contrast, Division's regulations identify two design features the Licensee might choose from to protect potential inadvertent intruders for exposure to Class C LLRW. Since disposal of Class C LLRW is illegal in the State of Utah and is not disposed of in the subject facilities, these design features are not applicable and the Division judges that potential inadvertent intruders will be adequately protected by the proposed and previously approved designs.

Minimize Infiltration

The required function of minimizing infiltration is evaluated via five complementary aspects: minimize infiltration, encourage runoff, provide protection against desiccation damage, provide protection against frost penetration damage, and provide protection against biointrusion-related damage.

The design criterion that the average infiltration into the disposal cell less than or equal to 0.067 inches per year (0.169 cm/year) for the side top slopes and less than or equal to 0.110 inches per year (0.280 cm/year) for the side slopes was selected based on average infiltration rates modeled using the Hydrologic Evaluation of Landfill Performance (HELP) computer model (Schroeder *et al*, 1994). At the maximum average infiltration rate of 0.067 inches per year, the Applicant's PATHRAE modeling of the fate and transport of hazardous constituents within the waste disposed demonstrates that Ground Water Protection Levels will not be exceeded for at least 500 years following closure for radiological constituents and at least 200 years following closure for heavy metals.

The Applicant evaluated a normal precipitation condition that was generated using the HELP model's synthetic precipitation generator to stochastically generate 100 years of daily precipitation data. This 100-year synthetic data set provided a mean precipitation of 7.92 inches/year, compared to a long-term mean precipitation for the site calculated at 7.85

inches/year, based on 50 years of data from Dugway, Utah, scaled to Clive using 7 years of Clive data. The abnormal condition considered by the Applicant involved evaluation of increased infiltration due to inadequate runoff from extreme weather events as well as damage to the radon barrier clay due to desiccation, frost penetration, or biointrusion. The Applicant did not conduct analyses to evaluate an accident condition (such analyses are not required for evaluations of water infiltration, per Section 3.2 of NUREG-1199).

Infiltration modeling was performed using precipitation data for the last 50 years at Dugway, Utah, correlated to site-specific data generated over the last seven years at Clive facility. The Dugway data, scaled to the Applicant's historical data, yielded a long-term average annual precipitation value of 7.85 inches. Application of the HELP model's synthetic weather generator returned an average annual precipitation of 7.92 inches. The synthetic data set was applied for infiltration modeling. Using this precipitation data, HELP infiltration modeling arrived at an average predicted minimum infiltration parameter rate of 0.066 cm/sec for the top slope and 0.110 cm/sec for the side slopes (with run-on from the top slope). These values were then used as inputs to the PATHRAE transport modeling to demonstrate that performance criteria for ground water protection levels at the monitoring wells are met at 500 years. The Applicant identified the following factors to support the assertion that these average annual infiltration values would be achieved and be maintained after closure:

- The primary factor relating to minimizing infiltration is the permeability of the upper 1-foot-thick portion of the radon barrier clay (5×10^{-8} cm/sec). Engineering controls provided in the CQA/QC Manual, Revision provide quality assurance checks that the required permeability or lower values will be obtained during construction of the radon barrier clay. Therefore, at construction, and under normal conditions, the projected performance of the cover to minimize infiltration meets or exceeds the design criteria.
- Results of infiltration performance evaluations performed to assess cover hydraulic performance under abnormal conditions caused by desiccation, frost penetration, and biointrusion, (Sections 3.3.3.1.3 through 3.3.3.1.5 and Appendix T of the 2005 revision of the LRA) indicate that the radon barrier permeability would not increase, or not increase sufficiently, when considered in the context of changes in other cover factors that would likely occur that also relate to infiltration rate (including increased evapotranspiration that would occur following the establishment of plant species), to cause the rate of infiltration to increase above the levels indicated by the base-case analysis.

Based on the above analyses, the Applicant concluded, and the Division concurs, that the specified cover design requirements to minimize infiltration will be met for all abnormal conditions considered. Many conservative assumptions with regard to cover performance were included in the infiltration analysis. In addition, a sensitivity analysis of key parameters, such as precipitation, was included.

Minimize Infiltration - Encourage Runoff

The three design criteria selected for evaluating surface drainage from the embankment are intended to ensure that runoff of precipitation that falls on the surface of the completed embankment will be maintained and maximized under expected, as well as extreme, future

environmental conditions. By maximizing runoff, the design approach of minimizing the volume of precipitation available to infiltrate into the embankment can be achieved.

The normal condition evaluated to assess surface water runoff from the cover is the 100-year, 24-hour storm event of 2.4 inches of precipitation (NOAA Atlas 2, Volume VI, Figure 30). The Applicant notes that this storm event might occur up to 5 times during the 500-year time period following embankment closure.

The abnormal condition evaluated involved assessing the impacts of the Probable Maximum Precipitation (one-hour storm of 6.1 inches), as the worst-case precipitation event, on projected infiltration rates through the cover. Appendix KK to the Applicant's 1998 LRA develops Probable Maximum Precipitation (PMP) depths for local storms of one to six hours duration. The one-hour event was selected to maximize velocity of precipitation and thereby assess flow rates through the cover drainage component units. The Applicant evaluated an accident condition involving an assessment of the effects on runoff due to downstream blockage potentially caused by plant growth on the embankment surface or piping of fines into filter layers.

Results of the Applicant's evaluation of long-term stability and maintenance of the design slopes for maintaining positive drainage to ensure run-off of precipitation under both normal and abnormal conditions (included under Section 3.3.3.4.1 of the 2005 revision of the LRA) indicates that the settlement criteria, which include that there be no slope reversal in the cover system that would cause accumulation (e.g., ponding) of water to occur on the cover, would be met.

Normal conditions relating to allowable velocities within the drainage layer were not evaluated because the Applicant determined that performance with respect to this complementary function would be bounded by the abnormal condition analysis. Infiltration and transport modeling, provided as a supplementary report to the 2005 revision of the LRA (Whetstone, 2000) conducted for the abnormal conditions analysis, showed that the majority of the drainage within the cover would occur in the lower (Type B) filter layer, below the sacrificial soil, at the surface of the radon barrier clay. The modeling report assumed a hydraulic conductivity associated with this filter layer of 3.5 cm/sec (0.115 ft/sec). Maximum potential velocities through this layer, given the 3 percent minimum top slope and 5H : 1V side slope inclinations, are therefore estimated at 3.45×10^{-3} ft/sec (top slope) and 2.3×10^{-2} ft/sec (side slopes).

Results of rock cover calculations (Envirocare 2000b) evaluate the one-hour PMP rainfall intensity of 36.72 inches/hour (8.5×10^{-4} ft/sec) for the top slope and 34.01 inches/hr (7.9×10^{-4} ft/sec) for the side slope. Under the worst possible scenario, the rainfall intensity will equal the maximum flow velocity and would reach the lower filter layer at this same rate. Using this scenario, the lower filter zone is designed to exceed the volume flow associated with the worst-case scenario related to the one-hour PMP. The Applicant concluded that flow would not back up in the lower filter layer and therefore that the design criteria would be met and maintained.

A sensitivity analysis performed to assess potential effects of native plants that might become established on the surface of the embankment (Section 3.3.3.1.5 of the 2005 revision of the LRA) indicates that, although roots associated with native plants might be considered a concern

if they should cause a blockage in drainage layers of the cover system, by reducing the effectiveness of the cover to promote lateral run-off of percolation, potential blockage of drainage layers was found to be more than compensated for by the increased amount of evapotranspiration that would likely occur as a result of the establishment of the plant communities.

Results of piping calculations (Section 3.3.3.3.2 of the 2005 revision of the LRA) indicate that minimal migration of soil particles would likely occur from the sacrificial soil layer into the filter zone layers. The Applicant also noted that the extremely low flow velocities predicted to occur at the filter/clay interface would prevent or minimize erosion, and thereby prevent or minimize migration of the radon barrier clay materials away from that layer.

Based upon these findings, the Applicant concluded, and the Division concurs, that minimal to no blockage of the lower filter layer would likely occur due to migration of particles from the soil and/or clay layers. The Division concludes that the design criteria for minimizing infiltration by expediting run-off from the cover, while minimizing erosion and migration of radon barrier clay materials, during abnormal conditions have been met.

Provide Protection from Effects of Desiccation

The selected design criterion that there be no desiccation cracking of the radon barrier clay is based on the fact that the top foot of radon barrier clay is the primary infiltration barrier, and, therefore, the hydraulic barrier efficiency of this barrier must not be compromised by desiccation effects.

The normal condition evaluated by the Applicant with respect to desiccation considers performance of the cover under historic weather patterns of precipitation and evaporation. The abnormal condition evaluated by the Applicant includes an analysis of the effects of a prolonged drought on moisture content of the radon barrier clay. The Applicant did not identify any credible accident scenario that would cause desiccation of the radon barrier clay in excess of the evaluated abnormal condition. Evaluation of an accident condition for evaluation of desiccation effects is not addressed in Section 3.2 of NUREG-1199.

The Applicant identified the critical time period for desiccation of radon barrier clay as occurring during construction, when the cover is exposed to the elements. Section 3.2.3.1.2 of the 2005 revision of the LRA provides a discussion of protective measures that would be applied during construction to prevent or minimize desiccation of the radon barrier. One of these is the timely placement of the overlying filter material and other layers to prevent drying. Once constructed, the lower filter zone, sacrificial soil, upper filter zone, and erosion barrier would help isolate the radon barrier clay from the atmosphere.

The Applicant performed moisture content modeling for the cover and embankment system, using the UNSAT-H Model [The document under Table 15 of supplementary information submitted in support of the LRA (Whetstone 2000a)] indicated that steady-state moisture contents for the radon barrier layers of the cover are projected to remain relatively constant, at

approximately 0.42 by volume. This projected moisture content is consistent with construction requirements for the radon barrier.

For normal conditions, the Applicant indicates (Section 3.3.3.1.2 of the 2005 revision of the LRA) that the native undisturbed clay found in local borrow sources for radon barrier construction would have an average moisture content of about 18.6 percent by weight at the plastic limit based on evaluation of (90 data points from January through November 2000). The plastic limit is a laboratory-derived measurement (ASTM D4318) of the moisture content at which a soil begins to crack, or desiccate. This converts to a moisture content at which onset of cracking would occur of approximately 22 percent by volume; or roughly half the steady-state moisture content of the radon barrier clay of 42 percent by volume.

Under abnormal conditions, the Applicant indicates that there is no credible evaporative mechanism to dry out the radon barrier, and therefore concludes that the moisture content of the radon barrier would remain relatively constant for the life of the embankment. Potential evapotranspiration effects of plant life on moisture content within the layers of the cover system are discussed in Section 3.3.3.1.3 of the 2005 revision of the LRA.

The Applicant identified (Section 3.3.3.1.3 of the 2005 revision of the LRA) the following two aspects of the cover design that are intended to contribute to maintenance of moisture content in the radon barrier clays at the modeled steady-state condition:

- The cover is designed to promote run off of moisture that enters the cover [as percolation] at the interface between the lower filter zone and the surface of the radon barrier. Runoff at this interface provides a recharge re-wetting mechanism for radon barrier clays, should they fall below optimum moisture content; and
- The field capacity of the lower filter zone is over an order of magnitude less than that of the radon barrier (Table 7, Whetstone 2000a). Accordingly, moisture in the system should preferentially migrate to the radon barrier clay. The difference in field capacities should help the lower filter zone serve as a capillary break, because the lower filter zone would not be able to pull moisture from the radon barrier clay for transport to the surface of the cover.

Based on the above arguments, the Applicant concluded that the design criteria of "no desiccation cracking in radon barrier clay" would be met. The Division concludes that the design criterion for protection of the clay radon barrier from desiccation, during normal and abnormal conditions, has been met.

Provide Protection from Effects of Frost Penetration

The potential for frost penetration into the LARW Cover is addressed in a March 1, 2000 Montgomery-Watson letter report from John Pellicer and Patrick G. Corser to Tim Orton of Envirocare (Montgomery Watson 2000). The selected design criterion that the maximum depth of frost be less than or equal to the combined thickness of rock erosion barrier, sacrificial soil, and filter zone materials (3.5 feet) was based on the criterion that there be no frost damage to the radon barrier clay. The top foot of radon barrier clay is the primary infiltration barrier.

Therefore, the hydraulic effectiveness of this barrier must not be compromised by frost penetration.

The normal condition considered by the Applicant with respect to frost penetration examined performance of the cover under historic temperature patterns. The Applicant did not conduct any specific assessments of cover performance under normal conditions for this required function and design criteria because performance of the cover for this criterion would be bounded by the abnormal conditions analysis. The abnormal condition evaluated the effects of an extreme (greater than 500-year recurrence interval) freeze event. . The Applicant did not identify any credible accident scenario that would cause frost damage to the radon barrier clay in excess of that due to this evaluated abnormal condition. Evaluation of an accident condition for frost penetration is not addressed in Section 3.2 of NUREG-1199.

Two frost penetration analyses were completed to assess frost penetration under abnormal conditions for varying sacrificial soil layer designs incorporated into the design for the Class A Disposal Embankment cover. The analyses are included in the March 1, 2000 Montgomery-Watson letter report from John Pellicer and Patrick G. Corser to Tim Orton of Envirocare (which assesses frost penetration in the cover top slope containing a sacrificial soil layer, and in the cover side slope without a sacrificial soil layer [Montgomery Watson 2000]). The same report evaluates frost penetration in the cover where both the top slope and side slopes contain a sacrificial soil layer. Slightly different projected frost depths result for the top and side slopes because the erosion protection rock is larger on the side slopes. Both analyses incorporated a temperature data set based on the lowest recorded high and low temperature on each day through the freezing season (October through April) over the 47 years of data available from Dugway, Utah. This modeled average monthly temperature data set contains lower average temperature values than the projected 500-year return rate temperature values estimated by the Western Regional Climate Center, making the frost penetration modeling provided by the Applicant a conservative representation of maximum projected abnormal condition frost depths. The reports calculated frost depths of 3.4 feet for the top slope area and 3.2 feet for the side slope area with the sacrificial soil layer as designed (*i.e.*, included in both the top slope and side slopes). These frost penetration depths are less than the combined thickness of the rock rip rap/filter zone layers/sacrificial soil layer design depths of 3.5 feet.

Based on the above considerations, the modeled maximum frost penetration depths would not reach the surface of the clay radon barrier, and degradation of this layer would therefore not likely occur as a result of freeze/thaw processes. Therefore, the projected performance meets the established cover design criteria for protection of the radon barrier from frost penetration under normal and abnormal conditions (for at least a 500-year recurrence interval).

Limit Biointrusion-Related Damage

The Applicant-selected design criterion that the cover design must discourage plant growth and accommodate indigenous species growth without increasing infiltration above the base case modeled in the (Appendix T to the 2003 LRA) is based on the fact that the top foot of radon barrier clay is the primary infiltration barrier, and, therefore, the hydraulic barrier efficiency of

this barrier must not be compromised, by plant root penetration. The Applicant arranged for botanical specialists to conduct a literature review regarding typical plant rooting depths for shrub species identified growing at and around the Clive facility and to conduct a reconnaissance of the site to confirm vegetation types and a subsurface testing program to verify the depth of root penetration of one deeper-rooted indigenous shrub species growing at the site (Black greasewood). Based on the results of this work, the Applicant acknowledged that it might not be possible to totally prevent establishment of vegetation on the cover following the 100-year period of institutional controls.

The normal condition for biointrusion evaluated the effects of shallow-rooted, indigenous plant species that might become established on the completed embankment following the 100-year period of institutional controls. In response to the potential future condition involving root penetration to a possible maximum depth exceeding the base of the (total 5.5-foot thick) cover, the Applicant evaluated an abnormal condition wherein the effects of deep-rooted, indigenous plant species that may become established on the completed embankment following the 100-year period of institutional controls by performing a series of infiltration sensitivity analyses quantify the effects of deep root penetration. The Applicant concluded, and the Division concurs, that damage to the lower radon barrier clay would not result from the potential for biointrusion. The configuration of the cover, with rip rap and sacrificial soil underlain by a lower filter zone (Type B) may further retard and discourage deep-rooted plants this is because the soil layer will retain moisture whereas the filter will readily conduct moisture out of the top cover layers. Evaluation of an accident condition for biointrusion is not required to be addressed in Section 3.2 of NUREG-1199.

In Section 3.3.3.1.5 of the 2005 revision of the LRA, the Applicant presents a discussion of the factors relating to the ability of the proposed embankment cover to deter the establishment of deep-rooted plant communities on the final cover, including the relatively high specified compaction density of the surface of the radon barrier [thereby providing some resistance to root intrusion compared to the native soil deposits (SWCA, Inc., November 2, 2000 "Assessment of Vegetation Impacts on LLRW," presented as Table 16 in supplemental information provided in support of the 2003 LRA)], and published information relating to the reported isolated, sparse vegetation observed on the Vitro embankment cover at the Clive facility, coupled with the fact that the Class A disposal embankment cover would include a cover design having double the minimum rock thickness of rock erosion barrier and upper "Type A" filter zone) above soil-like materials compared to the Vitro cover. The Applicant indicates that infilling of fines in the LLRW cover should be significantly delayed compared to the limited infilling of soil particles that was reported observed on the Vitro cover (which was found to allow vegetation to take root on that cover).

For the normal conditions analysis, the Applicant performed a sensitivity analysis to assess potential impacts on infiltration, should shallow-rooted (root depth 3.5 feet or less beneath the completed embankment surface) plants become established on the cover following closure. Results of this analysis (Whetstone 2000a) indicate that siltation and root penetration of the top 3.5 feet of the cover system would result in a net *decrease* in infiltration (due to the beneficial effects evapotranspiration at reducing net infiltration rates through the cover).

"Assessment of Vegetation Impacts on LLRW," presented as supplemental information provided in support of the 2005 revision of the LRA (SWCA, 2000, Section 2.4), indicated that black greasewood (*Sarcobatus vermiculatus*) is the plant in western Tooele County most likely to have deep taproots. Black greasewood may have taproots with a probable maximum effective depth of 11.8 feet. The field investigation of individual specimens on the Clive site found taproots extending to 11 and 11.5 feet, with fine roots extending as deep as 13 feet beneath the surface. The soils in which the roots occurred had mostly fine textures (silty clay loams and silty clays) with generally accompanying moist to slightly moist soil conditions (SWCA 2000). Coarser and drier soils (in riprap, filters, and sacrificial soil), such as utilized in the Applicant's cover, may not offer a hospitable environment for the fine roots of black greasewood. However, if black greasewood were to become established on the surface of the embankment, after final closure, this would be deep enough to theoretically penetrate the rock and soil layers of the cover into the radon barrier. The report included in Whetstone & Associates, Technical Memorandum "Effects of Greasewood Root Penetration on Mixed Waste Cell Cover" (Whetstone 2001b) concluded that it could not be definitively ruled out that the soil type expected on the embankment surface as a result of potential future infilling of voids in the erosion barrier would exclude greasewood establishment not applicable for 5.5-ft cover, based on 10.5-ft cover. Accordingly, the Applicant assumed that a black greasewood population might become established on an unfilled embankment cover at some time following closure and that individual black greasewood plants could potentially extend tap roots deep enough to penetrate the entire radon barrier.

Results of the above analysis, discussed in the Whetstone Technical Memorandum dated September 13, 2001 indicate that the infiltration rate of 0.077 in/yr could result from root penetration. This infiltration rate is less than the design criterion of average infiltration not greater than 0.104 in/yr. Thus, based on the assumption that the speculated future plant community remains established, robust, and healthy, the possible root penetration should allow the infiltration rate to remain below the design criterion basis. However, should this plant community be established and at some point be eliminated, the projected infiltration performance may be overstated.

Limit Occupational Exposures

The design criterion that the dose rate at the surface of the completed embankment must be less than 100 mrem TEDE per year is a regulatory requirement contained in URCR R313-15-301. Information presented in Table 4.1 of the 2005 revision of the LRA indicates that most workers at the current facility receive annual doses less that 100 mrem/yr, when the regulatory limit is 5,000 mrem/yr. According to the Applicant's ALARA program, the investigation level for quarterly radiation exposure is a TEDE of 50 mrem/quarter (or equivalently 200 mrem/yr if exposure is sustained). Typical experience indicates that 1 to 2 percent of the 400 workers at the facility receive doses in excess this investigation level. Clearly, the Applicant's occupational radiation doses are well less than regulatory limits.

The normal condition evaluated with respect to limiting occupational exposures involved assessment of exposures for the case where wastes received for disposal have gamma dose rates less than 90 R/hr (2005 revision of the LRA, Section 7.2).

No analyses were performed to evaluate cover performance with respect to normal exposure conditions because the Applicant determined that such a performance evaluation would be bounded by their analysis done for the case of abnormal exposure conditions. For their abnormal conditions analysis, the Applicant estimated the maximum dose rate that could possibly be experienced through the cover. The MicroShield® computer model was used to calculate estimated dose rate at the surface from gamma radiation, assuming Class A waste at a concentration higher than the Class A limit were present at the top of the closed disposal embankment (2005 revision of the LRA, Section 3.3.3.2). A MicroShield® model was developed using the input parameters of a 55-gallon drum composed of 11 curies of Co-60 (slightly above the Class A limit of 10.8 curies Co-60 for this container size) placed on its side at the top of waste, just below the cover. The cover was then assumed to consist of 24 inches of clay. The calculated dose rate attributable to the drum at the surface of the clay cover was well below 1 mR/hr. This dose rate is acceptable and well below regulatory limits.

The Applicant noted that this analysis was purely theoretical because a package of this magnitude would not be shipped to a LLRW disposal facility. The deep dose equivalent (DDE) at the surface of the cover is below the 100 mrem TEDE even assuming that some of the TEDE was available for committed effective dose equivalent (CEDE).

Allow Site Monitoring

Settlement monitoring is discussed in Section 5.3.5 of the 2005 revision of the LRA. The Applicant has updated and revised its Settlement Monitoring Plan since the 2003 LRA was submitted and the Division has reviewed and approved those changes. In its approval, the Division directed, and subsequently approved revised language for, inclusion of settlement monitoring in Revisions 20 and 20C of the CQA/QC Manual.

The devices used to measure settlement in the embankment cover are called settlement plate monuments and are defined in Attachment 4 of the Applicant's "Settlement Monitoring Plan" and subsequently added to the CQA/QC Manual. These settlement plate monuments provide precise elevation measurements, accurate to the nearest 0.01 foot. The settlement plate monuments are located so that the magnitude of total and differential settlement can be measured effectively. This measurement accuracy corresponds to the estimated accuracy of settlement and differential settlement modeling for these disposal embankments. The Applicant will place settlement plate monuments to monitor anticipated zones of maximum and minimum settlement to enable evaluation of distortion magnitudes. Said plates will be installed on top of the temporary radon barrier layer and monitoring for a period of up to about 3 years, before construction of the final cover system. For additional details, see the discussion in Section 5.4.2.2.1 of this document about new waste placement operations.

Settlement plate monuments will consist of a four-foot- long #5 rebar welded to an 18-in.-square 3/16-in.-thick steel plate. The plate is placed on top of the temporary radon barrier layer. After satisfactory settlement is established and documented, the settlement plates on the temporary cover will be removed. New settlement plates will be placed on the final cover system, specifically on top of the radon barrier. The settlement plate monuments will be strategically placed to allow locations of maximum and minimum

settlement to be observed and measured. Settlement plate monitors will be placed in uniformly spaced grids as specified in the CQA/QC Plan.

The Applicant indicates that the settlement monitoring system will be maintained during the 100-year-long post-closure monitoring period, with any deterioration occurring to system components as a result of abnormal conditions will be repaired during this monitoring period. Because institutional controls would encompass maintenance of these monuments, normal and abnormal conditions have no bearing on the design of this feature. The Applicant concludes that, along with institutional control program addressing maintenance of the monitoring equipment, the settlement monitoring system will be implemented, maintained and will provide reliable information about settlement and differential settlement within the disposal embankments.

Ensure Cover Integrity

Ensuring cover integrity involves the following five complementary functions:

- Mitigate Differential Settlement
- Prevent Internal Erosion
- Maintain Material Stability/Withstand External Erosion
- Ensure Structural Stability – Settlement
- Ensure Structural Stability – Maintain Slope Stability

These complementary functions are addressed in the following paragraphs.

Mitigate Differential Settlement

Results of differential settlement design requirements and projections are presented in Sections 3.1.3.3.1 and 3.3.3.3.1 of the 2005 revision of the LRA. These results indicate that the maximum projected differential settlement was estimated to be 0.009 ft/ft under abnormal conditions evaluated by the Applicant (AGRA 2000a). The design criterion for distortion in the Disposal Embankment cover is 0.02 ft/ft (AMEC 2000a).

Normal conditions for this required function and design criteria were not assessed because the cover performance with respect to settlement was bounded by the abnormal conditions analysis.

The Applicant indicates that (Section 3.3.3.3 of the 2005 revision of the LRA) that differential settlement within the layers of the cover is not considered to be a major design issue because the layers of the cover system would be constructed to tight engineering specifications. Recent Division observations and analyses of settlement measurements made at the Applicant's site (LARW Cell) show distortion significantly less than 0.015 ft/ft in the first few years following cover placement. For the settlement monuments that were monitored, all displayed decreasing distortion trends over the period of measurement. These tangible measurements of settlement indicate that the design criterion for distortion were met, for the initial phases of LARW Cell cover placement and facility closure (with the waste placement techniques in use prior to 2006).

Prevent Internal Erosion

Design criteria for and projections of internal erosion are presented in Sections 3.1.3.3.2 and 3.3.3.3.2 of the 2005 revision of the LRA. The Applicant presented rock rip rap cover design calculations in a July 26, 2000 report titled "Rock Cover Design" and provided an analysis of the interstitial velocities associated with the clay/rock interface. This analysis uses the slopes of the embankment and the hydraulic conductivity of the Type B Filter to calculate a maximum interstitial velocity at the interface. The maximum estimated calculated interstitial flow velocities, representing maximum possible velocities at the interface, which are not dependent on the amount of water flow, are both orders of magnitude below the selected design criteria velocity (3 ft/sec). Based on this result, the Applicant concluded that significant erosion of the radon barrier clay would not occur.

The Applicant determined (Section 3.3.3.3.2 of the 2005 revision of the LRA) that abnormal conditions are not applicable for the internal water velocity calculations because the calculated interstitial velocity at the clay/rock interface is a maximum velocity (*i.e.*, any further water would flow through zones above the interface and would not cause erosion of the radon barrier clay layer.)

Internal erosion related to piping (the movement of material from a soil layer to a rock/filter layer), was evaluated based on procedures developed for saturated embankment dams. Filter criteria were originally developed by evaluating the gradation limits between dissimilar materials so that the voids of the finer material cannot migrate into the voids of the coarse material (thereby creating the potential for internal erosion). The Applicant indicated that normally, the embankment cover soils are dry or partly saturated, and internal erosion is not considered to be a design issue. Under temporary saturated flow conditions, internal erosion is considered as an abnormal design event. The Applicant used U.S. Army Corps of Engineers (USACE) guidance, including published filter design equations, to demonstrate that movement of particles between a soil and a filter layer would not occur.

The design criteria for preventing internal erosion involve specifications for the size distribution of soils placed adjacent to each other. These criteria are:

- D_{15}(filter)/D_{85}(soil) ≤ 5
- D_{50}(filter)/D_{50}(soil) ≤ 25

Both criteria must be satisfied.

For the final cover design, the Applicant indicated that the only interface applicable to the piping analysis is the interface between the lower (Type B) filter zone material and the (overlying) sacrificial soil layer. The filter specifications summarized on in Table 3.3 of the 2005 revision of the LRA were used to demonstrate that piping of the underlying filter zone layer would not occur within the final cover under any conditions.

No piping calculations were done to assess cover performance with respect to this design criterion for the normal conditions because piping calculations performed for the abnormal

saturated condition bound the normal condition analysis. However, by specification stated in the CQA/QC Manual, these criteria will be satisfied during construction. The actual values for the above ratios are projected to be

- D_{15}(filter)/D_{85}(soil) ≈ 0.5 < 5
- D_{50}(filter)/D_{50}(soil) ≈ 1.4 < 25

Thus, the design criteria are satisfied.

Using these characteristics, the interstitial water velocities in the Type B Filter were projected to be about 1.5 x 10^{-2} ft/sec for the top slope and about 9.7 x 10^{-2} ft/sec for the side slopes. These velocities are very small and not expected to contribute to piping instabilities.

Maintain Material Stability/Withstand External Erosion

The Applicant noted (Section 3.3.3.3.3 of the 2005 revision of the LRA) that normal conditions would be bounded by the abnormal condition analyses. Therefore, an analysis was performed for abnormal conditions, for a 1,000 -year cover life span.

Rock cover design calculations performed by the Applicant to evaluate cover performance with respect to erosion under abnormal conditions (Section 3.3.3.3.3 "Rock Cover Design" under Tab 12 of supplementation information submitted in support of the 2003 LRA) indicate that the average rock size (D_{50}) for the top slope area needs to be at least 0.75 inches and D_{50} for the side slope areas needs to be at least 2.65 inches for slopes of 4 percent and 40 degrees, respectively. Embankment specifications call for a top slope of only 3 percent and a side slope of only 20 percent or 11.3 degrees (refer to Drawing 04080-C02). Since the specified slopes are considerably less than those assumed in the rock sizing calculations, the rock size selected is conservatively large and can be expected to preclude erosion of the cover system. Moreover, the rock sizes specified for use in constructing the erosion barrier are 1.25 inches for the top slopes and 4.5 inches for the side slopes. Thus, erosion of the cover system is not expected to compromise cover performance within 1,000 years. The rock design calculations were performed in accordance with guidance contained in NUREG-1623. These calculations account for effects of the one-hour PMP including erosion velocities that would be attained over the embankment from this design event.

Ensure Structural Stability - Settlement

The 2005 revision of the LRA Sections 3.1.3.4.1 and 3.3.3.4.1 address settlement within foundation materials, waste placement, backfill, and cover system. The maximum total settlement criterion used for design was based on reviewing the total settlement that other "earthen" embankments with demonstrated satisfactory performance have undergone. Highway embankments (similar in height to the Class A disposal embankment) located on the soft clay deposits in the Salt Lake valley typically settle from 12 to 18 percent of their height (average 15 percent) during construction. The Applicant indicates, and the Division concurs, that these embankments have performed adequately in supporting pavements and bridge abutments.

To evaluate settlement performance, the Applicant evaluated a normal condition involving weight loading (from the cover, waste, and backfill) uniformly distributed with loads maximized at the center of the embankment and gradually decreasing to either side. The abnormal condition evaluated consisted of evaluating a column of extreme loading within the center of the embankment. This condition was considered because such a condition might be caused by placement of a column of extremely dense waste forms such as large metal components or solid concrete.

The Applicant did not perform analyses of increased settlement resulting from accidents (such analyses are not required per Section 3.2 of NUREG-1199).

If embankment settlement should cause the slope of the top of the embankment to be flattened or reversed (*i.e.*, the elevation of the centerline of the embankment were lower than an area to either side), drainage off the top of the embankment would be compromised and infiltration could increase. To evaluate the cover performance criterion of maintaining positive drainage off the cover slopes with respect to this design criterion, the Applicant evaluated the effects of foundation settlement on the slopes of the cover system. Results of the settlement analysis (Section 3.3.3.4.1 of the 2005 revision of the LRA) indicate a maximum projected settlement of 3.0 feet for the normal condition. The design criterion is 15 percent of the embankment height. As the embankment height is 45.3 ft, total settlement less than 6.8 ft satisfies the design criterion. Based on this analysis, the Applicant concluded that the total settlement design criteria would be met under normal conditions. The normal conditions associated with the design criteria of long-term cover drainage are bounded by the abnormal conditions analysis.

Foundation settlement is evaluated in Section 4.6 and Figure 15 of the AGRA report "Evaluation of Settlement of Compressible Debris Lifts, LARW Embankments" (Agra 2000a). This analysis concludes that a maximum of 8 in. (0.7 ft) of secondary settlement would be expected over 500 years. The cumulative effects of secondary settlement (0.7 ft) plus CWF settlement (1.7 ft) plus half of the compressible debris settlement (0.6 ft) [the CWF is about half of the embankment height] yields a maximum potential settlement of 3.0 ft. This value is far below the design criterion of 6.8 ft for the proposed embankment height. Therefore, the total settlement design criterion is met.

The Applicant's analysis of the embankment cover slope drainage postulated that water accumulation could develop on the surface of the embankment as a result of differential settlement creating a "bowl-shaped" depression. Because the large components would be placed beneath the crest of the embankment, settlement of the embankment would tend to improve the ability of the cover to shed water in all conditions. The analysis concluded, with the Division's concurrence, that slope reversal will not occur on the surface of the embankment, and that the design criteria will be met for both normal and abnormal conditions. The same requirement and observation apply to mixed waste placement and disposal.

The Applicant noted that calculation of a safety factor is not appropriate for the long-term cover drainage design criteria. The normal and the abnormal conditions are projected to produce total settlements of 1.75 ft for normal conditions and 1.96 ft for abnormal conditions. These values are well below the design criterion of 15 percent of the embankment height, or 6.8 ft.

Ensure Structural Stability - Maintain Slope Stability

The minimum factors of safety of 1.5 under static conditions and 1.2 under dynamic (*i.e.*, earthquake) conditions that the Applicant selected for static and seismic conditions are contained in the State of Utah Statutes and Administrative Rules for Dam Safety, rule R625-11-6. These minimum recommended factors of safety were based on reviewing case histories of embankment dams founded on non-liquefiable clay foundations or bedrock, which demonstrated adequate performance under seismic conditions (Seed, H. B. 1983).

The same requirement and observation apply to mixed waste placement and disposal.

The normal condition considers the performance of the embankment under static conditions. Two abnormal conditions were evaluated. The first evaluation for abnormal conditions compares the calculated safety factor inherent to the embankment design against the expected peak ground acceleration due to an earthquake that might affect the site. The second abnormal condition evaluated involved assuming saturated conditions occur within the embankment, as saturated soils may be more prone to liquefaction under earthquake conditions. The Applicant did not perform analyses of reduced structural stability associated with accidents (such analyses are not required per NUREG-1199, Section 3.2).

The Applicant has assessed performance of the embankment under abnormal conditions for the case of seismic loading of the Class A embankments due to earthquakes, and for the static case of saturated conditions within the embankment. The calculated minimum seismic factor of safety based on the slightly lower shear strength of the Class A embankments (selected based on an assumed effective anisotropic shear strength distribution for drum waste/backfill layers) compared to the Class A embankment was determined to be 1.3 [AMEC report "Stability Considerations – Addendum: Proposed LLRW Embankment" (dated November 8, 2000)]. This projected safety factor exceeds the safety factor required by the design criteria, *i.e.*, seismic factor of safety $\geq$ 1.2.

Additional analyses were performed for abnormal saturated conditions within the embankment (AMEC 2000b). The first case examines the hypothetical condition in which water infiltrates the clay cover faster than it drains out of the embankment through the liner, creating a shallow, "perched" water table within the embankment. The analysis indicated a factor of safety against sliding on the clay liner of approximately 2.3. The second case examines water flowing parallel to the cover layers, due to a large precipitation event or rapid snowmelt. For this condition, an infinite slope analysis was performed and a minimum factor of safety was calculated at approximately 2.1. This factor of safety exceeds the minimum design criteria for both static and seismic conditions (static factor of safety $\geq$ 1.5 and seismic factor of safety $\geq$ 1.2), indicating that saturation of the embankment cover components should not compromise the slope stability of the embankment.

To recap, the minimum static factor of safety is 2.1 under saturated conditions and 2.3 under unsaturated conditions; the minimum seismic factor of safety is 1.3. These values exceed the design criteria static factor of safety $\geq$ 1.5 and seismic factor of safety $\geq$ 1.2 which were established based on information in R625-11-6. These design criteria factors of safety are for operating dams; the Division considers that these factors of safety are conservative for the

Applicant's site because these landfill embankments 1) are not designed to retain water such as a dam and 2) have gentle side slopes (5H:1V) around the entire perimeter and lower total height compared to many dams in the western United States. Based on the foregoing summary of information contained in the 2005 revision of the LRA, and other relevant documents the Applicant has submitted, the Division concludes that the requirements of URCR R313-25-7(4) as they pertain to the Cover have been met.

Reference Notes:

(See Also: Sections 5.4.2.2.1 of this document)

AGRA Earth & Environmental, Inc., 2000a

AGRA Earth & Environmental, Inc., 2000b

AMEC Earth & Environmental, Inc., 2000a

AMEC Earth & Environmental, Inc., 2000b

AMEC Earth & Environmental, Inc., 2000c

AMEC Earth & Environmental, Inc., 2001

AMEC Earth & Environmental, Inc., 2002

ASTM International Committee D18.03 on Texture, Plasticity and Density Characteristics of Soils, 2000b

Bingham Environmental, 1996

Envirocare of Utah, Inc., 2000b

Envirocare of Utah, Inc., 2004d

Envirocare of Utah, Inc., 2004e

Envirocare of Utah, Inc., 2005c

Miller *et al*, 1973

Montgomery-Watson, 2000

Rogers and Hung, 1987

Schroder *et al*, 1994

Seed, 1983

SWCA Environmental Consultants, Inc., 2000

US Department of Energy, 1989

US Nuclear Regulatory Commission, 2001

US Nuclear Regulatory Commission, 2002

Utah Division of Radiation Control, 2006a

Whetstone Associates, Inc., 2000a

Whetstone Associates, Inc., 2001b

Whetstone Associates, Inc., 2004

Whetstone Associates, Inc. to Envirocare of Utah, Inc., 2000

5.4.2.3.4 Applicable Codes and Standards

Requirement 2507-5: Descriptions of codes and standards which the applicant has applied to the design, and will apply to construction of the land disposal facilities. [URCR R313-25-7(5)]

Basis: Section 1.6 and Section 1.7 of the 2005 revision of the LRA provide a summary of the codes, standards, and guidelines that the Applicant considered and applied to the design. The primary standards the Applicant considered in designing the Cover are those codified in URCR R313-25-24.

According to the CQA/QC Manual as-built thickness and slope of each layer would be confirmed before construction of the next layer of the cover. The slope grades of the embankment would be maintained by survey inspection and approved by CQA/QC personnel before the placement of radon barrier. The Division would be notified that waste placement has ceased for a section of the embankment and that cover construction would begin for that section.

The CQA/QC Manual includes a listing of ASTM Standards that would be applied to the construction of the Cover. Radon barrier clay construction methods would be approved by the satisfactory construction of a radon barrier test pad, as detailed in the CQA/QC Manual (Attachment II-A, "Work Element: Radon Barrier Test Pad"). The equipment and procedures used for the test pad would be reviewed and approved by a professional engineer qualified to certify such soil considerations. Because the design specifications are identical for clay liner and the initial foot of radon barrier clay (1×10^{-6} cm/sec permeability), the clay liner test pad results (described in Section 3.2.3.1 of the 2005 revision of the LRA) will be utilized for this portion of the radon barrier. A separate test pad has been constructed for the top foot of radon barrier clay (5×10^{-8} cm/sec permeability) and results presented to and accepted by the Division.

Soil borrow materials proposed for use in constructing the radon barrier would be sampled and tested to verify their physical characteristics (*i.e.*, 85 percent fines < 0.075 mm; plasticity index range 10 to 25; liquid limit range 30 to 50) in accordance with the requirements outlined in the CQA/QC Manual (Attachment II-A, "Work Element: Radon Barrier Borrow Material"). These characteristics are summarized in Table 3.3 of the 2005 revision of the LRA. Once CQA/QC testing is complete and approved, the radon barrier borrow materials would become radon barrier

materials approved for radon barrier construction. Borrow materials that fail testing might be re-worked or might be discarded and replaced with materials meeting the criteria.

The radon barrier materials would then be placed in lifts and compacted to meet design criteria. Inspection, testing, and surveys performed on the placed radon barrier are described in the CQA/QC Manual (Attachment II-A, "Work Element: Radon Barrier Placement").

Testing frequency for the 1-foot-thick layer of 5 x 10^{-8} cm/sec permeability clay would be greatly increased compared to that for the one-foot-thick layer of 1 x 10^{-6} cm/sec permeability clay, to provide additional assurance that design performance is achieved. Inspection, testing, and surveys performed on the placed radon barrier are described in the CQA/QC Manual (Attachment II-A, "Work Element: Radon Barrier Placement, Specification: Permeability").

A number of CQA/QC Manual specifications (Attachment II-A, "Work Element: Radon Barrier Placement") are applied to protect approved radon barrier against damage. These include measures for preventing drying, seasonal limitations on radon barrier construction to protect against winter weather extremes, and minimization of heavy equipment travel on completed radon barrier (CQA/QC Manual Attachment II-A," Work Element: Radon Barrier Placement) Specifications: Radon Barrier Drying Prevention, Snow Removal, Placement of Radon Barrier During the Winter, Frozen Material, Contamination of Radon Barrier, and Heavy Equipment on Radon Barrier of the CQA/QC Manual.

All filter zone and sacrificial soil material would be handled in such a manner as to minimize concentration of finer materials in localized areas. Inspections and testing to be performed on the placed lower filter zone, sacrificial soil, and upper filter zone materials are described in CQA/QC Manual (Attachment II-A, "Work Element: Filter Zone", and "Work Element: Sacrificial Soil").

Inspection, testing, and surveys performed on the placed erosion barrier are described in the CQA/QC Manual (Attachment II-A, "Work Element: Rock Erosion Barrier"). The Applicant proposes to use guidance contained in NUREG-1623 providing criteria to assess the suitability of rock to be used as protective cover based on laboratory tests that determine the physical characteristics of the rock. The reference states that the rock should be screened for about three to five durability test methods to classify the rock as being of poor, fair, or good quality. For top and side slopes of embankments, it is recommended that a rock quality score less than 50 be rejected. The Applicant proposes to apply these rock-scoring criteria as provided in the CQA/QC Manual to ensure that the design criteria would be met through quality assurance/quality control measures. Specific rock quality criteria are found in the CQA/QC Manual, Attachment II-A, "Work Element: Filter Zone; Specifications" (Quality of Rock and Quality Assurance Sampling); as well as "Work Element: Rock Erosion Barrier" (Specifications; "Quality of Rock" and "Quality Assurance Sampling"). The following four durability tests are proposed:

- Specific Gravity – ASTM C-128
- Absorption (percent) – ASTM C-127

- Sodium Soundness (percent) – ASTM C-88
- LA Abrasion (percent) – ASTM C-131 & ASTM C-535

Based on the foregoing summary of information contained in the 2005 revision of the LRA, the CQA/QC Manual and other relevant documents, the Division concludes that the requirements of URCR R313-25-7(5) as they pertain to the Cover have been met.

Reference Notes:

ASTM International Committee C09.20 on Normal Weight Aggregates, 1999

ASTM International Committee C09.20 on Normal Weight Aggregates, 2003a

ASTM International Committee C09.20 on Normal Weight Aggregates, 2003b

ASTM International Committee C09.20 on Normal Weight Aggregates, 2004a

ASTM International Committee C09.20 on Normal Weight Aggregates, 2004b

Envirocare of Utah, Inc., 2004d

Envirocare of Utah, Inc., 2005c

US Nuclear Regulatory Commission, 2002

5.4.2.4 Drainage Systems

5.4.2.4.1 Description of Design Feature

Requirement 2507-2: Descriptions of the design features of the land disposal facility and of the disposal units for near-surface disposal shall include those design features related to infiltration of water; integrity of covers for disposal units; structural stability of backfill, wastes, and covers; contact of wastes with standing water; disposal site drainage; disposal site closure and stabilization; elimination to the extent practicable of long-term disposal site maintenance; inadvertent intrusion; occupational exposures; disposal site monitoring; and adequacy of the size of the buffer zone for monitoring and potential mitigative measures. [URCR R313-25-7(2)]

Basis: Drainage systems provided in conjunction with the Class A Disposal Embankment are described in Sections 3.2.4 and 3.4.4 of the 2005 revision of the LRA and are depicted on Engineering Drawings 9821-01, 9821-02, 9821-03 and 9821-04 in Appendix G of the 2005 LRA. The drainage systems are included in the design of the Class A Disposal Embankment to control precipitation and surface water run-on and run-off during operations. Drainage system components include a 4-foot-deep "V"-shaped perimeter drainage ditch, constructed with 5H:1V side slopes, to be installed adjacent to the embankment. Bottoms (bases) of drainage ditch segments would be constructed of either in-place CL or ML soils (ASTM D-2487) or imported CL or ML soil borrow materials compacted to at least 95 percent of the Standard Proctor (ASTM D-698) density for the soils. The compacted bases would be overlain by a minimum 6-inch-thick

layer of "type A" filter material, which in turn, would be overlain by either a minimum 12-inch-thick layer (on the portion of the ditch exterior to the ditch centerline) or minimum 18-inch-thick layer (on the portion of the ditch inside the centerline, *i.e.*, the extended cover side slope side) of Type A rip rap material. The specifications for the Type A filter materials and Type A rip rap would be identical to the specifications identified for these materials in the cover system

After closure, the drainage system, including the drainage ditches and cover, are designed to promote embankment stability and protection during extreme storm and flood events, as described in Section 5.1.1.1 of the 2005 LRA. The drainage ditches are constructed to a sufficient depth to promote drainage of storm waters offsite, preventing waters from backing up and infiltrating into the embankment. These ditches intercept runoff from the various embankments and direct the flow into natural drainage patterns to the southwest of the site. Infiltration and rock erosion barrier cover the drainage ditches, consistent with the rest of the embankment, in order to protect them from erosion forces. Drainage systems would continue to function to ensure that these surface features will direct surface water away from the disposal units as velocities and gradients which will not result in erosion that will require ongoing active maintenance. Section 5.15.5 of this document also discusses surface water drainage.

During operations, the embankment would also be protected against off-site floodwaters by run-on berms. Likewise, the off-site environment is protected by run-off berms against potentially contaminated water running off the open embankment. Once a section of the embankment cover is completed to the design toe of waste, run-off berms for that section would be replaced by drainage ditches (Sections 3.1.4, 3.2.4, and 3.3.4 of the 2005 revision of the LRA).

Run-on berms would surround the perimeter of the disposal embankment at all times during operations. These berms would be constructed to a minimum height of 3 feet above the original ground surface at that location (as determined by original engineering drawings showing site topographic contours) and have a minimum width of 10 feet at the top. The berms would be compacted to 90 percent of the Standard Proctor density. These berms would also serve as inspection/travel roads.

Run-off berms would be constructed immediately following approval of clay liner construction for a zone of the embankment to be opened for waste placement. Run-off berms would be constructed directly on the clay liner to a height of 3 feet above the liner. Run-off berms have a minimum width of 3 feet at the top and are compacted to 90 percent of the Standard Proctor density for the soils used to construct them.

Once the run-off berms are constructed, waste materials would be placed on the clay liner. However, a minimum separation of 10 feet would be maintained between the toe of the run-off berm and the toe of waste. This 10-foot separation is designed to allow for collection of run-off water from the active embankment and minimize potential contact of waste with standing water.

Table 3.2 of the 2005 revision of the LRA identifies the required functions of the Drainage Systems, which are summarized below.

- Provide disposal site drainage; and

- Ensure ditch integrity

The Drainage Systems would fulfill these required functions by performing the following complementary functions:

- Facilitating flow away from embankment,
- Minimizing infiltration under flood conditions,
- Preventing internal erosion.

However, the analyses reviewed have not sufficiently addressed the Division's concern regarding the potential affects of the Applicant's clay mining activities in areas adjacent to Section 32, as discussed in Section 5.3.3 of this document. Additional discussion regarding these concerns and resulting license conditions are in Section 6 of this document.

Based on the foregoing summary of information contained in the 2005 revision of the LRA, and other relevant documents, the Division concludes that the requirements of URCR R313-25-7(2) as they pertain to the Drainage System have been met.

Reference Notes:

(See Also: Sections 5.3.3 and 5.15.5 of this document)

ASTM International Committee D18.03 on Texture, Plasticity and Density Characteristics of Soils, 2000a

ASTM International Committee D18.07 on Identification and Classification of Soils, 2000

Envirocare of Utah, Inc., 2005c, Section 3

5.4.2.4.2 Principal Design Criteria

Requirement 2507-3: Descriptions of the principal design criteria and their relationship to the performance objectives. [URCR R313-25-7(3)]

Basis: Section 3.1.4 of the 2005 revision of the LRA provides information regarding the design criteria pertinent to the Drainage system of the Class A Disposal Embankment. Table 3.2, Design Criteria of the Principal Design Features, summarizes the principal design criteria for the Drainage system. Table 3.4 of the 2005 revision of the LRA also provides a summary of some of the projected performance relating to the design of the Class A Disposal Embankment, including the Drainage systems.

For the complementary function "Facilitate flow of precipitation away from embankment" under the Principal Required Function "Provide site drainage," the design criteria identified by the Applicant (2005 revision of the LRA Section 3.1.4.1.1) are that during operations, storm water must remain within the drainage ditch system with a minimum freeboard of 0.5 foot under the normal precipitation event and no overflow occur (*i.e.*, that the depth of water be less than the

depth of the ditches) under the abnormal precipitation event. An additional identified criterion is that drainage ditch systems must have a sufficient slope to allow drainage of surface water run off away from the embankment.

For the complementary function "Minimize infiltration under flood conditions" under the Principal Required Function "Provide site drainage," the design criterion identified by the Applicant (2005 revision of the LRA Section 3.1.4.1.2) is that water, under flood condition, shall be present vertically above waste for a time period less than the calculated travel time through the cover of the embankment. The calculated travel time through the upper radon barrier at the side slope is 6.6 years (Whetstone 2000a), which is many times longer than flood conditions. This design criterion ensures that surface water due to flooding that could potentially accumulate above the toe of waste but is not present for longer than this duration (6.6 years) for infiltration into the waste.

For the complementary function "Prevent internal erosion" under the Principal Required Function "Ensure ditch integrity," the design criterion identified by the Applicant (2005 revision of the LRA Section 3.1.4.2) is that run-off water velocity not exceed 3 feet per second on the surface of the compacted ditch bottom, in order to not result in erosion of the underlying material.

Based on the foregoing summary of information contained in the 2005 revision of the LRA, and other relevant documents, the Division concludes that the requirements of URCR R313-25-7(3) as they pertain to the Drainage System have been met.

Reference Notes:

Bingham Environmental, 1996

Envirocare of Utah, Inc., 2004d

Envirocare of Utah, Inc., 2005c, Section 3

Miller *et al*, 1973, Figures 28 and 30

Nelson *et al*, 1986

Whetstone Associates, Inc., 2000a

5.4.2.4.3 Design Basis Conditions and Design Criteria Justification

Requirement 2507-4: Descriptions of the natural events or phenomena on which the design is based and their relationship to the principal design criteria. [URCR R313-25-7(4)]

Basis: The Applicant utilized applicable guidance issued by the NRC, including those described in NUREG-1199 and NUREG-1200, pertaining to normal, abnormal, and accident (where applicable) conditions that should be considered during design of NRC-licensed LLRW disposal facilities. Table 3.2 of the 2005 revision of the LRA also summarizes the conditions considered

in the design of the Drainage Systems principal design feature and the relationship between the normal, and abnormal, and accident (as applicable) conditions evaluated to the principal design criteria. Table 3.4 of the 2005 revision of the LRA summarizes the results of evaluations conducted to assess the projected performance of the Drainage Systems principal design feature.

Facilitate Flow of Precipitation Away from Embankment

The normal condition evaluated by the Applicant for the complementary function "facilitate flow of water away from the embankment included an analysis of the drainage ditch design with respect to impacts of the 25-year, 24-hour storm event for the site of 1.9 inches of rain (NOAA Atlas 2, Volume VI, Figure 28). The 25-year storm event was identified as representing the probable precipitation event that might be encountered during active site operations. The Applicant indicated that it selected the design criteria of ensuring that storm water remain within the drainage ditch system with a minimum of 0.5 foot freeboard, and ensuring that the drainage ditch system have sufficient slope to allow drainage away from the embankment.

The abnormal condition evaluated by the Applicant for this complementary function assessed the impacts of the 100-year, 24-hour storm event for the site of 2.4 inches of rain (NOAA Atlas 2, Volume VI, Figure 30) on the Drainage systems. The 100-year storm event was selected as a sensitivity case to represent the worst-case precipitation event that might reasonably be expected to occur during active site operations. For the abnormal event, the design criteria are that the ditch is able to contain the flow; but no freeboard is necessary.

The Applicant has performed calculations using simple geometry and slope of the ditches and Manning's formula to arrive at design flow velocities and storage capacity of the drainage ditch system surrounding all embankments on site, including the previously proposed Class B & C embankment. Section 4 of these calculations provides drainage flow estimations for drainage ditches adjacent to the 11e.(2) embankment. The 11e.(2) embankment is the critical design case because it is downstream of all of the other embankment drainage ditches.

During the normal storm event, water would rise in the 11e.(2) embankment ditch to a depth of slightly less than 3.5 feet, leaving 0.5 feet of freeboard in the ditch above the water level. This maximum storage amount would occur approximately one hour into the 24-hour event and would quickly subside to lower water levels.

Under the abnormal storm event, the ditches will fill to a maximum depth of 3.79 feet, leaving approximately 0.21 feet of freeboard. This maximum required storage amount would occur approximately one hour into the 24-hour event and would quickly subside to lower water levels within the ditch (Envirocare 2001).

Based on these results, it is concluded that the drainage ditches is adequately designed to contain run-off from the embankments associated with normal and abnormal storm events. Thus, design criteria under both normal and abnormal conditions are satisfied.

The Applicant evaluated the impacts of an accident condition involving downstream blockage of the drainage ditch system on adherence to the Drainage Systems design criteria. The Applicant noted that downstream blockage in the drainage ditch would lead to a localized flood situation in

that section of the ditch. Once the water level reaches the outside berm height, water would disperse away from the embankment as overland flow. Additional discussion relating to justification for these design criteria is provided under the subheading "*Minimize Infiltration Under Flood Conditions*" below.

However, the analyses reviewed have not sufficiently addressed the Division's concern regarding the potential affects of the Applicant's clay mining activities in areas adjacent to Section 32, as discussed in Section 5.3.3 of this document. Additional discussion regarding these concerns and resulting license conditions are in Section 6 of this document.

Minimize Infiltration Under Flood Conditions

Performance of the drainage systems related to normal condition for the complementary aspect of minimizing infiltration under flood conditions was not analyzed because the performance is bounded by the abnormal conditions analysis. The Applicant referenced results of HEC-1 and HEC-2 Modeling analyses conducted by Bingham Environmental (presented in Appendix KK of the 1998 LRA) providing data pertaining to the depth of water expected from the Probable Maximum Flood (PMF) for the watershed encompassing the Clive site. That analysis indicated a calculated depth of the PMF across the site at approximately one foot above grade. The depth of the 100-year flood would be considerably less. Based on this geometry of water accumulation in the ditch, with respect to the embankment, the Applicant concluded that the abnormal flood event would not cause water to accumulate above the toe of the waste in the embankment, and that the drainage system is therefore adequately designed to minimize infiltration of water through the waste under both normal and abnormal conditions.

The Applicant evaluated the impacts of a worst-case accident condition involving complete infilling of the ditch system, to the level of the inspection road (depicted on Drawings 9407-4A, 9821-02, 9821-03 and -9821-04 with silt *i.e.*, to a height above natural grade of 1 ft.). The calculated depth of PMF floodwater at the Class A Disposal Embankment is stated in the 2005 revision of the LRA, Section 3.3.4.1.2 also to be about 1 ft (above natural grade). Thus, only minor contact of floodwater with the disposal embankment would be expected under worst flooding conditions.

Moreover, the PMF floodwaters are expected to remain in contact with the Class A Disposal Embankment no longer than 15 hours (2005 revision of the LRA, Section 3.3.4.1.2). The time required for water to infiltrate through the 2-ft radon barrier was estimated to be less than 90 years (2005 revision of the LRA, Section 3.3.4.1.2). Clearly, minimal floodwater would infiltrate into and certainly no floodwater would infiltrate through the radon barrier in the 15 hours the water would be in contact with the disposal embankment.

The Applicant also notes that all drainage ditches have the same four-foot deep "V" ditch design and the entire ditch system slopes toward eventually to the south and east southwest corner of 11e.(2) Embankment and discharge to the natural grade (Drawing 9821-04). Therefore, the Applicant concluded that complete siltation of ditches in the site drainage network would result in less accumulation of water than the amounts discussed above.

However, the analyses reviewed have not sufficiently addressed the Division's concern regarding the potential affects of the Applicant's clay mining activities in areas adjacent to Section 32, as discussed in Section 5.3.3 of this document. Additional discussion regarding these concerns and resulting license conditions are in Section 6 of this document.

Ensure Ditch Integrity

The Applicant's evaluation of ditch integrity focused on evaluation of the drainage ditch's ability to prevent internal erosion of the soils beneath the rock erosion barrier. The design criterion used by the Applicant for this complementary function, that runoff water velocity not exceed 3 feet per second on the surface of the compacted base of the perimeter drainage ditch segments, was selected based on guidelines contained in NUREG/CR-4620, "Methodologies for Evaluating Long-Term Stabilization Designs of Uranium Mill Tailings Impoundments." This document provides tables of recommended maximum permissible velocities of flowing water over different surfaces so as to preclude erosion of the underlying material. Based on the limiting velocities for cohesive materials provided in Table 4.9 of NUREG/CR-4620, the Applicant selected a design criteria velocity of 3 ft/sec or less (based on a permissible velocity of 3.94 ft/sec for "compact clay") listed in this table.

The Applicant evaluated a normal design condition that included evaluation of drainage system performance under the 100-year, 24-hour storm event of 2.4 inches of precipitation (NOAA Atlas 2, Volume VI, Figure 28).

The Applicant has calculated interstitial velocities for Type A filter rock on the top slope of the Class A embankment at 1.39×10^{-3} ft/sec. Results discussed in Section 3.3.3.3.2 may be considered conservative for analysis of the performance of the ditch system. As detailed in Table 3.3, the drainage ditch is constructed of the same Type A filter rock as used in the embankment cover. The drainage ditch slope is much less than that of the embankment top slope. This velocity is the maximum possible velocity at the interface and is not dependent on the amount of water flow. This velocity is orders of magnitude below the design criteria velocity at which erosion may occur (3 ft/sec). Therefore, significant erosion of the ditch clay surface will not occur.

The Applicant notes that abnormal conditions are not applicable for the internal water velocity calculations because the calculated interstitial velocity at the compacted base/granular filter layer ditch interface is a projected maximum velocity. Based on this line of reasoning, the Applicant concluded that any further water would flow in areas above the interface and would not affect erosion of the compacted ditch base.

The Applicant did not perform any analysis of drainage system performance for accident conditions with respect to the complementary function. Analyses of the effects of accidents on drainage ditch integrity are not required per Section 3.2 of NUREG-1199.

Based on the foregoing summary of information contained in the 2005 revision of the LRA and other relevant documents the Applicant has submitted, the Division concludes that the requirements of URCR R313-25-7(4) as they pertain to the Drainage System have been met.

However, the analyses reviewed have not sufficiently addressed the Division's concern regarding the potential affects of the Applicant's clay mining activities in areas adjacent to Section 32, as discussed in Section 5.3.3 of this document. Additional discussion regarding these concerns and resulting license conditions are in Section 6 of this document.

Reference Notes:

(See Also: Section 5.3.3 of this document)

Bingham Environmental, 1996

Envirocare of Utah, Inc., 1998a

Envirocare of Utah, Inc., 2005c

Miller *et al*, 1973

Nelson *et al*, 1986

US Nuclear Regulatory Commission, 2001

US Nuclear Regulatory Commission, 2004

Whetstone Associates, Inc., 2001a

5.4.2.4.4 Applicable Codes and Standards

Requirement 2507-5: Descriptions of codes and standards which the applicant has applied to the design, and will apply to construction of the land disposal facilities. [URCR R313-25-7(5)]

Basis: QA/QC requirements for constructing run-on and run-off berms are provided in Attachment II-A, "Work Element: General Requirements", specifications "Run-on Control During Project" and "Runoff Control During Project," of the CQA/QC Manual. Run-on berms would be inspected regularly during operation of the facility for degradation or low spots caused by erosion or frequent traffic. In addition, run-on berms would be surveyed and improved semi-annually to verify compliance with height requirements. As for the run-on berms, run-off berms would be inspected regularly for low spots or degradation, and all run-off berms surveyed and improved semi-annually.

Attachment II-A, "Work Element - Drainage Ditches," of the CQA/QC Manual provides specifications and QC/QA procedures to be used during construction of the drainage ditch system. This section of the Plan identifies ASTM Standards that would be used for determining appropriate borrow materials that might be used for constructing the base of the ditch segments.

However, the analyses reviewed have not sufficiently addressed the Division's concern regarding the potential affects of the Applicant's clay mining activities in areas adjacent to Section 32, as discussed in Section 5.3.3 of this document. Additional discussion regarding these concerns and resulting license conditions are in Section 6 of this document.

Reference Notes:

(See Also: Section 5.3.3 of this document)

Envirocare of Utah, Inc., 2004d

Envirocare of Utah, Inc., 2005c

5.4.2.5 Buffer Zone

5.4.2.5.1 Description of Design Feature

Requirement 2507-2: Descriptions of the design features of the land disposal facility and of the disposal units for near-surface disposal shall include those design features related to infiltration of water; integrity of covers for disposal units; structural stability of backfill, wastes, and covers; contact of wastes with standing water; disposal site drainage; disposal site closure and stabilization; elimination to the extent practicable of long-term disposal site maintenance; inadvertent intrusion; occupational exposures; disposal site monitoring; and adequacy of the size of the buffer zone for monitoring and potential mitigative measures. [URCR R313-25-7(2)]

Basis: The Buffer Zones associated with the disposal embankments are described in Sections 3.1.5 and 3.3.5 of the 2005 revision of the LRA. Section 3.1.5 discusses the design criteria, including the justification and the conditions evaluated. Section 3.3.5 discusses projected performance under both normal and abnormal conditions. The Buffer Zones are depicted as strips of ground lying between the edges of the disposal cell footprint (waste limits of the embankment) and the fenceline as shown on Figure 7 provided in the 2005 revision of the LRA. Figure 7 also includes the northing and easting coordinates of each Buffer Zone. The Buffer Zone would be approximately 100 feet wide in all directions extending out from the limit of the embankment. Groundwater monitoring wells are located within the Buffer Zones

The buffer zone performs the required functions of providing an area for site monitoring and the space necessary for conducting corrective actions if required.

Based on the foregoing summary of information contained in the 2005 revision of the LRA and other relevant documents the Applicant has submitted, the Division concludes that the requirements of URCR R313-25-7(2) as they pertain to the Buffer Zone have been met.
Reference Notes:

Envirocare of Utah, Inc., 2005c, Section 3

US Nuclear Regulatory Commission, 2004

Utah Division of Water Quality, 2005

Whetstone Associates, Inc., 2000a

5.4.2.5.2 Principal Design Criteria

Requirement 2507-3: Descriptions of the principal design criteria and their relationship to the performance objectives. [URCR R313-25-7(3)]

Basis: The design criterion established for the Buffer Zone is that it be adequately sized to allow site monitoring and corrective measures to be performed if necessary.

Based on the following summary of information contained in the 2005 revision of the LRA and other relevant documents the Applicant has submitted, the Division concludes that the requirements of URCR R313-25-7(3) as they pertain to the Buffer Zone have been met.
Reference Notes:

Envirocare of Utah, Inc., 2005c, Section 3

US Nuclear Regulatory Commission, 2004

Utah Division of Water Quality, 2005

Whetstone Associates, Inc., 2000a

5.4.2.5.3 Design Basis Conditions and Design Criteria Justification

Requirement 2507-4: Descriptions of the natural events or phenomena on which the design is based and their relationship to the principal design criteria. [URCR R313-25-7(4)]

Basis: Justification provided by the Applicant (Section 3.3.5 of the 2005 revision of the LRA) for the selected Buffer Zone criteria and minimum 100-foot buffer zone width included consideration of the following factors:

- Site monitoring is required during the 100-year period of institutional control to confirm performance of the disposal facility;
- Should unacceptable migration of radionuclides be identified, through the above monitoring program, adequate area must be available for implementation of corrective measures;
- Utah's Water Quality Rules state: "The distance to the compliance monitoring points must be as close as practicable to the point of discharge." The location of the monitoring wells, therefore, is determined by the cell geometry and other related cell configurations. The average distance from the edge of waste to the center of the perimeter ditch (as shown in Figure 7 in the 2005 revision of the LRA) for each of the active disposal cells is between 35 and 50 feet and the distance from the center of the ditch to the inner edge of the inspection road is approximately 55 feet. These two distances added together mean that the closest practical location for a monitoring well is between 90 and 105 feet from the edge of waste;
- Section 4.3.6 of SRP 4.3, Waste Disposal Operations, of NUREG 1200, which states, "An acceptable buffer zone shall be a minimum of 30 meters wide around the entire facility."

Additionally, the Applicant's property boundary is at a distance of at least 300 feet from the limits of waste disposal; and

- The 90-foot distance to a monitoring well is also found in the Statement of Basis for the Applicant's Groundwater Quality Discharge Permit (GWQDP), No. UGW450005.

The normal design condition evaluated by the Applicant for the buffer zone includes the condition where site-monitoring activities are performed and no unacceptable releases occur from the embankment. Under the normal condition of no releases, the Applicant noted in Section 3.3.5 of the 2005 revision of the LRA that the monitoring network within the buffer zone would not be necessary and the design of the buffer zone and system would be adequate.

The abnormal design condition evaluated for the buffer zone assesses adequacy of the buffer zone for allow a response to a hypothetical contaminant release. The Applicant referred to groundwater infiltration and transport modeling showing that no contaminants would reach the compliance groundwater monitoring wells within 500 years (Whetstone, 2000). The groundwater monitoring wells would be located approximately 90 feet from the edge of the waste embankments, within the boundary of the buffer zone. Based on this finding, the Applicant concluded that if contaminants were to be detected at the monitoring wells within the 100-year monitoring period, remediation measures could be easily accommodated due to the extremely slow linear velocity of the groundwater underlying the site area [2.74 ft/year, derived in Section 7.2.4 in Whetstone (2000)]. The Applicant indicated that, in addition, the Applicant's property boundary is located at least 300 feet from the edge of waste; allowing adequate space as well as time for implementation of remedial measures.

The Applicant did not conduct an analysis of any accident condition for the buffer zone. Analyses of the effects of accidents on the buffer zone are not required per Section 3.2 of NUREG-1199.

Based on the foregoing summary of information contained in the 2005 revision of the LRA and other relevant documents the Applicant has submitted, the Division concludes that the requirements of URCR R313-25-7(4) as they pertain to the Buffer Zone have been met.

Reference Notes:

Envirocare of Utah, Inc., 2005c

US Nuclear Regulatory Commission, 2001

US Nuclear Regulatory Commission, 2004

Utah Division of Water Quality, 2005

Whetstone Associates, Inc., 2000b

5.4.2.5.4 Applicable Codes and Standards

Requirement 2507-5: Descriptions of codes and standards, which the applicant has applied to the design, and will apply to construction of the land disposal facilities. [URCR R313-25-7(5)]

Basis: Section 1.6, Conformance to Regulatory Guides, and Section 1.7, Summary of Principal Review Matters, in the 2005 revision of the LRA provide a summary of the codes, standards, and guidelines that the Applicant considered and applied to the design. The primary standards considered by the Applicant in the design of the Buffer Zone are those codified in URCR R313-25-25 and URCR R313-25-26, which include the requirement that an adequate buffer zone be provided, and specify required environmental monitoring activities.

The minimum buffer zone width is also consistent with guidelines contained in SRP 4.3 of NUREG-1200, which states that an acceptable buffer zone should have a minimum width of 30 meters (approximately 98 feet), and with the 90-foot distance to a monitoring well that is also found in the Statement of Basis for the Applicant's Groundwater Quality Discharge Permit (GWQDP), No. UGW450005.

Based on the foregoing summary of information contained in the 2005 revision of the LRA and other relevant documents the Applicant has submitted, the Division concludes that the requirements of URCR R313-25-7(5) as they pertain to the Buffer Zone have been met.

Reference Notes:

Envirocare of Utah, Inc., 2005c

US Nuclear Regulatory Commission, 2001

US Nuclear Regulatory Commission, 2004

Utah Division of Water Quality, 2005

Whetstone Associates, Inc., 2000b

5.4.3 Land Disposal Facility Construction and Operation

Requirement 2507-6: 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 URCR R313-25: Descriptions of the construction and operation of the land disposal facility. The description shall include as a minimum the methods of construction of disposal units; waste emplacement; the procedures for and areas of waste segregation; types of intruder barriers; onsite traffic and drainage systems; survey control program; methods and areas of waste storage; and methods to control surface water and ground water access to the wastes. The description shall also include a description of the methods to be employed in the handling and disposal of wastes containing chelating agents or other non-radiological substances which might affect meeting the performance objectives of URCR R313-25. [URCR R313-25-7(6)]

Basis: The information contained in the 2005 revision of the LRA and other relevant documents the Applicant has submitted indicate that the requirements of URCR R313-25-7(6) have been or will be met.

Methods of Construction of Disposal Units

The Applicant's methods for constructing and operating the Class A disposal embankment are described in Sections 3 and 4 of the 2005 revision of the LRA. Construction of the disposal unit will involve a continuous cut, backfill, and cover construction. To ensure that the Class A disposal embankment is built to design requirements, construction activities will be performed under a QA/QC program and conform to the requirements of the CQA/QC Manual. The primary activities involved in construction of the Class A Disposal Embankment include:

- Excavation.
- Preparation of the disposal area Foundation
- Construction of liner.
- Construction of run-on and runoff protection.
- Waste emplacement and backfill
- Construction of Temporary Cover over completed portions of disposal embankments
- Settlement monitoring to determine compliance with waste compaction / stability requirements. May include surcharging efforts to ensure embankment is stable for final cover,
- Construction of Final Cover, as per CQA/QC Manual requirements, and
- Construction of permanent drainage ditches surrounding the disposal unit(s).

The construction of these components is specified in the Applicant's CQA/QC Manual. .

Waste Emplacement

Of particular interest is the placement of waste received and generated by site operations. The general procedures for waste emplacement and for CLSM Pyramid in the Class A Disposal Embankment are described in Sections 3.3.2 and 4.3.1 of the 2005 revision of the LRA. After the Liner has been constructed over a specific area of the Class A Disposal Embankment, at least 12 inches of debris-free soil will be placed on top of the Liner; followed by another 12-inches of waste as a protection to the integrity of the Liner. Both of these layers of protective soil will be compacted with rubber tired equipement. Thereafter, the area will be available for placement of waste containers and materials. Bulk wastes at this point will be compacted with a Caterpillar 826 wedge-foot compactor. Wastes (containerized waste, debris and large components, and bulk waste) will be placed in these open clay-lined areas as summarized in Section 5.2.2 of this SER.

Waste handling procedures are those identified in Appendices C "Operating Procedures, and "M "Waste Characterization Plan," of the 2005 revision of the LRA. Waste handling and interim storage will be managed in accordance with existing controls and at existing facilities provided

by the existing radioactive materials license and the GWQDP, according to the waste type being managed. There will be no changes to these requirements for purposes of constructing the Class A and Class A North disposal embankments.

The Applicant will ensure that waste is properly identified, that the waste meets license limits for disposal, and consequently that LLRW, 11e.(2) waste, and mixed waste are neither co-located nor cross-contaminated. The Operations Procedures (included as Appendix C to the 2005 revision of the LRA) related to waste handling and material segregation in the Envirocare Operating Procedures Manual also require that waste management and storage occur independently for each generator (with each waste stream being considered a different generator).

Finally, any waste determined to be hazardous waste or that does not satisfy waste characteristic requirements of the Radioactive Materials License or Groundwater Quality Discharge Permit will not be unloaded, handled, or accepted at the Applicant's Class A or Class A North disposal embankments. Based on a review of the information summarized above, the Applicant has provided an adequate description of the procedures to be followed and areas to be used for waste segregation.

Intruder Barriers

The protection of inadvertent intruders from radiation exposures during facility operations focuses on prevention of inadvertent intrusion. Operational areas will be surrounded by fencing as described in the Applicant's CQA/QC Manual. Additional security features are presented in the Applicant's Security Plan (Envirocare of Utah, Inc., 2004f). Several features of the facility design have the effect of protecting an inadvertent intruder from exposure to the disposed materials and the effects of radiation . These features include:

- Lack of nearby residential population
- Embankment cover system
- Structural and other waste debris encased in CLSM
- Waste Form (in the case of containerized waste disposal)

Onsite Traffic and Drainage Systems

Drawing 04080-U01 presents the layout of the entire the Applicant site. Onsite earth-roadways are continuously changing to meet the demands of current disposal needs. As the height of an active disposal cell increases, as the activity in a portion of the embankment decreases, or as the activity for a new portion of the embankment increases, access roads are constructed or removed to facilitate safe hauling and disposal of materials. Roadways are constructed to ensure that water properly drains off from them, thus minimizing ponding or ponded road conditions. Haul roads to disposal units generally are sloped at no greater than 3:1 in accordance with safety guidelines adhered to by the site's prime contractor.

Road base is not generally used to construct onsite roadways; rather, natural soils are graded and continuously compacted by frequent use and application of water for dust suppression. Certain

haul roads with high traffic use have recently been improved with asphalt pavement. For final cover conditions at the site, inspection roads are tied into the drainage ditches' final rock cover. For waste disposal and final cover activities, the prime contractor is required to use haul trucks that are capable of climbing the 20-percent slope of the embankment.

The Applicant describes the onsite drainage systems in Sections 3.1.4, 3.2.4, and 3.3.4 of the 2005 revision of the LRA. The Applicant has developed a berm system to direct water flow from precipitation, winter runoff, or other precipitation occurrences away from the site and stored materials. It also has developed an embankment drainage system surrounding each embankment to help minimize any water accumulation. The drainage systems are constructed of an erosion barrier rock of the same type used to cover the embankments. The design of the berms is sufficient to withstand the PMF without overtopping. The ditches will have triangular cross sections with side slopes of 1:5, and will have gentle longitudinal slopes, with depths great enough to carry the runoff from the 100-year, 1-hour storm event without exceeding their bounds.

Survey Control Program

The Applicant states that surveys at the disposal site will be tied to both the United States Geological Survey (USGS) survey of Section 32 T1S, R11E and to the state plane coordinate system in Section 1.2.3.11 of the 2005 revision of the LRA. The Applicant performs an annual as-built survey of each embankment which is accomplished by a Utah licensed land surveyor. Survey control is the responsibility of the licensed land surveyor, in accordance with Utah licensing standards.

Methods and Areas of Waste Storage

The Applicant has described its plans for temporarily storing containerized LLRW in Section 4.2 of the 2005 revision of the LRA. That discussion refers also the Operating Procedures (Appendix C of the 2005 revision of the LRA)

Methods to Control Surface & Ground Water Access to the Wastes

The Applicant's plans for controlling the access of surface water to the LLRW are presented in Section 3.1.4, 3.2.4, and 3.3.4 of the 2005 revision of the LRA. The vertical minimum separation between the bottom of the disposed LLRW and the historic high water table is determined as being 13 feet. This value is based on: 1) the groundwater contour map for February 2004 included in the letter number CD04-0287 provided to the Division dated June 9, 2004, and the June 1999 through December 2003 contour maps provided in the Revised Hydrogeologic Report dated August 2004, and 2) the minimum depth from the base of the liner (4263 feet elevation) to the groundwater below the liner for the Class A Disposal Embankment over the past five years is approximately 13 feet (4250 feet elevation).

Based on the information summarized above, the Division has concluded that the Applicant has adequately described its methods for emplacing the LLRW in the disposal embankment.

Reference Notes:

Envirocare of Utah, Inc. to Utah Division of Radiation Control, 2004

Envirocare of Utah, Inc., 2000c

Envirocare of Utah, Inc., 2004a

Envirocare of Utah, Inc., 2004d

Envirocare of Utah, Inc., 2004e

Envirocare of Utah, Inc., 2004f

Envirocare of Utah, Inc., 2005c, Sections 3 and 4

Envirocare of Utah, Inc., 2005d

5.4.4 Description of Site Closure Plan

Requirement 2507-7: 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 URCR R313-25: A description of the disposal site closure plan, including those design features which are intended to facilitate disposal site closure and to eliminate the need for active maintenance after closure. [URCR R313-25-7(7)]

Basis: The information contained in the 2005 revision of the LRA and other relevant documents the Applicant has submitted indicate that the requirements of URCR R313-25-7(7) have been or will be met. The Applicant provides a description of the anticipated disposal site closure activities in Appendix U of the 2005 revision of the LRA. This section of the application discusses design features that are designed to provide surface drainage controls, prevent erosion and flooding of the embankment, and provide long-term geotechnical stability of the embankment and drainage systems to eliminate the need for active maintenance of the facility after closure. A discussion of decontamination and decommissioning procedures are also referenced in this section and described in Appendix U of the 2005 revision of the LRA.

Post-operational environmental monitoring and surveillance procedures are also discussed by the Applicant. Section 5.3 of the 2005 LRA summarizes closure and post operational environmental monitoring. The locations and analyte suites are presented in Appendix R for each of the matrices described below.

- Air Monitoring (2005 LRA, Section 5.3.1) will continue at operating stations for at least one quarter following final cleanup and closure. Analysis will be for non-gamma emitting isotopes disposed during the final year with an acceptable suite of radiochemical analyses for total uranium, radium-226, thorium-230 and lead-210. The Applicant has included provisions for continuing sampling if the results are greater than the most recent year's control locations mean value plus two standard deviations.

- Radon Monitoring (2005 LRA, Section 5.3.2) will continue at stations operating during the post-closure period for at least one year, exchanged quarterly, following final cleanup and closure. The Applicant has included provisions for continuing sampling if the results are greater than the limit of R313-15-18 for radon-222.

- Gamma Radiation Exposure (2005 LRA, Section 5.3.2) using thermoluminescent dosimeters (TLD) will continue at radon stations operating during the post-closure period for at least one year, exchanged quarterly, following final cleanup and closure. The Applicant has included provisions for continuing sampling if the net exposure rate exceeds baseline values plus three standard deviations when corrected for fallout.

- Vegetation Samples (2005 LRA, Section 5.3.3) will be collected during the first growing season following closure. The samples will be ashed and analyzed for radionuclides. The Applicant has included provisions for repeat sampling if results are greater than the mean plus two standard deviations of a corresponding background sample, and to determine if the exceedance is due soil adhered to the vegetation.

- Soil Samples (2005 LRA, Section 5.3.3) will be collected following site closure for one sampling round. The Applicant has included provisions for repeat sampling if results are greater than the mean plus two standard deviations of a corresponding background sample.

- Water Samples (2005 LRA, Section 5.3.4) will be collected as prescribed by the Groundwater Quality Permit, Appendix F that is in force at the time of closure. The Applicant has included provisions for additional sampling and increased sampling frequency if results are greater than the predicted results. The Applicant has committed to a sampling program will also address UMTRA surveillance guidance. Procedure "ENG-2.0" in 2005 LRA Appendix C provides technical instructions for groundwater sampling.

These environmental post-closure monitoring plans meet the intent of the Utah Administrative Code.

Information is also presented in Section 5.3 of the 2005 revision of the LRA. Additional information is provided in Section 3.0 of the 2005 revision of the LRA regarding design features and procedures that are designed to facilitate disposal unit stabilization and site closure.

Once waste placement has reached design fill grades within an area of the embankment, a temporary cover layer is placed and settlement monitoring is initiated. After verification that the waste form is stable, the remaining overlying components of the cover are subsequently placed (Sections 3.1.3, 3.2.3, and 3.3.3 of the 2005 revision of the LRA).

The design of the embankment allows for isolation of the embankment after it has been filled and covered. Cover construction within each filled section of the embankment would follow waste placement activities to minimize the time that a cell is open. Final cover construction in each section would also include removal of the run-off berms and construction of the perimeter drainage ditch to manage clean storm water that falls on the completed final cover. Once each

completed section of the embankment is closed, separation barriers (rope marker fences and/or other fencing) would be placed to preclude entry by operated equipment into the areas of the completed disposal units (Section 6.3.4 of the 2005 revision of the LRA).

The results of open-cell modeling and the Division's decision allow the Applicant to leave any portion of a disposal embankment open for no longer that 12 years from the time waste is first placed in that portion of the cell. Construction of the temporary cover does not qualify as closure of the cell. Therefore, the final cover system must be in place on any portion of the embankment no later than 12 years from the date waste was first placed in that portion of the cell.

The cover and perimeter drainage ditch system have been designed to prevent erosion and flooding of the embankment following embankment closure without active maintenance in order to meet the requirements of URCR R313-25-7(7) , R313-25-8(4) , R313-25-24, and R313-25-25. Information has been provided in Sections 3.1.4, 3.2.4, and 3.3.4 of the 2005 revision of the LRA demonstrating that the drainage ditch system will have sufficient depth and slope to promote flow of storm water off-site and prevent water from accumulating and infiltrating into the Class A Disposal Embankment. The compacted CL or ML soil base of the drainage ditch segment, together with the rock filter layer and durable rock riprap erosion protection layer lining the ditch, will protect against erosion-induced damage to the ditches.

The durable rock riprap cover layer will protect against erosion of the cover as well as discourage biointrusion. The 5H:1V cover side slopes and minimum 3 percent top slope of the cover, combined with the design measures incorporated into the of the liner, waste placement and backfill plan, and cover system (Section 3 of the 2005 revision of the LRA), will contribute to the geotechnical stability of the embankment (Section 3.3.3.4.2 of the 2005 revision of the LRA), so that the performance objectives of URCR R313-25 can be achieved.

Decontamination and decommissioning of the facility would be performed in accordance with the Decontamination and Decommissioning Plan (Appendix U to 2005 revision of the LRA). The post-operational monitoring and surveillance program (Section 5.3 of the 2005 revision of the LRA) will provide information to confirm the extent to which the performance of the closed facility is acceptable and to help demonstrate compliance with regulatory requirements. The Licensee is responsible for conducting the post-operational monitoring and surveillance program until five years after the Division transfers the license (URCR R3130-25-15). The Division, as the responsible regulatory agency, would review results generated by the post-operational monitoring and surveillance program

Based on review of the information summarized above, the Applicant has adequately described the disposal closure plan, including design features intended to facilitate disposal site closure and eliminate the need for active maintenance after closure.

Reference Notes:

Envirocare of Utah, Inc., 2004b

Envirocare of Utah, Inc., 2005c

Envirocare of Utah, Inc., 2005d

Envirocare of Utah, Inc., 2005h

US Department of Energy, 1989

Utah Division of Water Quality, 2005

5.4.5 Natural Resources

Requirement 2507-8: 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 URCR R313-25: Identification of the known natural resources at the disposal site whose exploitation could result in inadvertent intrusion into the wastes after removal of active institutional control. [URCR R313-25-7(8)]

Basis: The information contained in the 2005 revision of the LRA and other relevant documents the Applicant has submitted indicate that the requirements of URCR R313-25-7(8) have been met. Section 2.9.1 of the 2005 revision of the LRA states that there are no known natural geologic resources at the site and that there are no active or pending mining claims or mineral leases located on the site.

Section 2.9.2 of the 2005 revision of the LRA discusses natural water resources at the site. The closest known operating well is located approximately 2 to 3 miles east of the site and is used for watering livestock. The Applicant owns water rights in the area. As previously reported in the 1998 LRA and restated in the 2005 revision of the LRA, two aquifers underlie the site: a shallow unconfined aquifer and a deeper confined aquifer. According to Section 2.6.1 of the 2005 revision of the LRA, the shallow unconfined aquifer and the deeper confined aquifer at the site are classified as State of Utah Class IV groundwater based on the criterion of total dissolved solids greater than 10,000 mg/l. Section 2.6.1 of the 2005 revision of the LRA state that the groundwater quality in the unconfined shallow aquifer at the site is considered saline with concentrations of several chemical species (sulfate, chloride and total dissolved solids) significantly exceeding the EPA secondary drinking water standards. More importantly, total dissolved solids in the shallow aquifer range from 24,000 to 61,000 mg/l. Therefore, the shallow unconfined aquifer is not considered a significant exploitable natural resource. Due to a natural upward hydraulic gradient, there is no downward vertical transport from the emplaced waste horizon to the deeper confined aquifer. So long as this upward hydraulic gradient is maintained between these two aquifers, exploitation of the deeper aquifer should not have an impact on the ability of the site to meet performance objectives.

However, the analyses reviewed have not sufficiently addressed the Division's concern regarding the potential affects of the Applicant's clay mining activities in areas adjacent to Section 32, as discussed in Section 5.3.3 of this document. Additional discussion regarding these concerns and resulting license conditions are in Section 6 of this document.

Reference Notes:

(See Also: Section 5.3.3 of this document)

Envirocare of Utah, Inc., 1998a

Envirocare of Utah, Inc., 2005c

Utah Division of Water Quality, 2005

5.4.6 Classification and Specifications

Requirement 2507-9: 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 URCR R313-25: Descriptions of the kind, amount, classification and specifications of the radioactive material expected to be received, possessed, and disposed of at the land disposal facility. [URCR R313-25-7(9)]

Basis: 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 URCR R313-25: Descriptions of the kind, amount, classification and specifications of the radioactive material expected to be received, possessed, and disposed of at the land disposal facility. [URCR R313-25-7(9)]

Basis: The information contained in the 2005 revision of the LRA and other relevant documents the Applicant has submitted indicate that the requirements of URCR R313-25-7(9) have been met. Sections 6.1 and 6.2 of the 2005 revision of the LRA refer to Appendix J "Projected Waste Streams" and Appendix K "LLRW Surety Review" of the 2005 revision of the LRA. Appendix J describes the types and volumes of waste to be received for disposal, including the physical, chemical, and radiological properties of the waste. Appendix J describes 16 waste streams that are expected for receipt and disposal. The waste streams include environmental remediation wastes, such as contaminated soil and debris, as well as operational and decommissioning wastes from nuclear power plants. Waste generators include nuclear electric utilities, industry, universities, government, and the military. All waste accepted for disposal will be at or below the Class A concentration limits. Appendix J describes the sources of each waste stream and the typical and maximum concentrations of principal radionuclides in the waste. Physical and chemical properties are included in the descriptions of the 16 waste streams. According to Appendix J, the Applicant expects to receive a maximum waste volume of about 11 million cubic feet per year.

The 16 waste streams adequately represent the range of waste streams by including soil, debris, rubble, equipment, and containerized wastes. While variations between actual wastes and the 16 waste streams described by the Applicant are possible (and likely) the 16 waste streams encompass the expected range of waste forms. Radionuclide release characteristics of the waste streams may also vary, but the radionuclide release rates in the performance assessment are modeled in a conservative manner that does not take credit for improved waste forms. The 16

waste streams conservatively represent the radionuclide release characteristics of all waste streams accepted for disposal.

Section 6.2 and Appendix K of the 2005 revision of the LRA also discuss the waste volumes generated during final closure of the Clive facility. According to information contained in the latest surety proposal, a waste volume of about 331,000 cubic yards could be generated during facility closure. Embankment capacity must be reserved to accommodate this volume of decommissioning waste in an appropriate disposal embankment.

In summary, the waste information presented in the 2005 revision of the LRA is sufficiently complete and detailed to support the necessary calculations and analyses to show that the facility will meet the performance objectives and the applicable technical requirements of URCR R313-25.

Reference Notes:

Envirocare of Utah, Inc., 2005c, Section 6

Envirocare of Utah, Inc., 2005f

Envirocare of Utah, Inc., 2005g

EnergySolutions LLC, 2007

Utah Division of Radiation Control (Dane Finerfrock) to Envirocare of Utah, Inc. (Daniel Shrum), 2007

5.4.7 Quality Assurance Programs

Requirement 2507-10: 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 URCR R313-25: 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. [URCR R313-25-7(10)]

Basis: The information contained in the 2005 revision of the LRA and other relevant documents the Applicant has submitted indicate that the requirements of URCR R313-25-7(10) have been met. The QAM in Appendix T of the 2005 revision of the LRA document provides a general description of the QA program. Although the Quality Assurance Program (QAP) document does not reference specific QA and implementing procedures tailored to LLRW disposal, Section 3.0 of the 2005 revision of the LRA discusses the CQA/QC Manual. These documents are tailored to a LLRW disposal facility. In addition, the operating procedures in the 2005 revision of the LRA supplement the general requirements of the QAP.

The Applicant's description of the QAP to be used for the ongoing activities relies on the same description presented above and related appendices of the 2005 revision of the LRA. The QAP is defined by the following documents:

- Quality Assurance Manual,
- Operating Procedures Manual,
- Safety and Health Manual,
- Construction Quality Assurance/Quality Control Manual.

Implementation of the procedures in these documents provide adequate controls to ensure the quality of activities during the design, construction, operation closure of the LLRW disposal facility and during the receipt, handling, and emplacement of waste.

Section 9.0 of the 2005 revision of the LRA provides a general description of the QAP. This section describes how the Applicant ensures the independence and authority of the quality assurance program and the quality assurance personnel. It also describes the reporting relationship between contractor quality assurance personnel, the Applicant's quality assurance personnel and the Applicant's management.

The QAP Document is presented in Appendix T of the 2005 revision of the LRA. The QAM commits to implement managerial controls to ensure the accuracy, reproducibility, and documentation of quality affecting activities. The CQA/QC Manual describes the procedures that are used to ensure the quality of construction activities. The CQA/QC Manual provides a description of procedures which control inspection, approvals, change control, documentation, and construction project plans.

The Operating Procedures are presented in Appendix C of the 2005 revision of the LRA. These procedures describe the steps that are used to ensure and document quality affecting operational activities. Waste receipt, handling, and emplacement procedures are in the LLRW Operations Manual.

Appendix T of the 2005 revision of the LRA describes how audits are scheduled, implemented, reported, and documented. The controls used to ensure the independence, control, and reporting relationships of auditing personnel are described in the manual. In addition, response to non-conformances and corrective action requests are described in the manual.

The QAP as described in the 2005 revision of the LRA contains adequate controls to ensure the quality of activities performed at the Clive facility.

Reference Notes:

Envirocare of Utah, Inc., 2002

Envirocare of Utah, Inc., 2004d

Envirocare of Utah, Inc., 2005c

Envirocare of Utah, Inc., 2005d

Envirocare of Utah, Inc., 2005e

5.4.8 Radiation Safety Program

Requirement 2507-11: 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 URCR R313-25: A description of the radiation safety program for control and monitoring of radioactive effluents to ensure compliance with the performance objective in URCR R313-25-19 and monitoring of occupational radiation exposure to ensure compliance with the requirements of URCR R313-15 and to control contamination of personnel, vehicles, equipment, buildings, and the disposal site. The applicant shall describe procedures, instrumentation, facilities, and equipment appropriate to both routine and emergency operations. [URCR R313-25-7(11)]

Basis: The information contained in the 2005 revision of the LRA and other relevant documents the Applicant has submitted indicate that the requirements of URCR R313-25-7(11) have been met. The Applicant has included radiation safety implementing procedures in Appendix Q of the 2005 revision of the LRA. They have also provided four years of their Quarterly Environmental Monitoring Program Reports. These documents contain a description of the radiation safety program for control and monitoring of radioactive effluents to ensure compliance with the performance objective in URCR R313-25-19 and a description of the monitoring of occupational radiation exposure to ensure compliance with the requirements of URCR R313-15 and to control contamination of personnel, vehicles, equipment, buildings, and the disposal site. They also contain descriptions of procedures, instrumentation, facilities, and equipment appropriate to both routine and emergency operations.

Occupational radiation exposures are governed through the Radiation Protection Program and the Applicant's management policy is included in the ALARA Program document. The documents are in Appendix H of the 2005 revision of the LRA. Appendix H includes the methods used to define the plans and procedures for radiation protection. Radiation safety operating procedures are presented in Appendix Q of the 2005 revision of the LRA.

Environmental monitoring is addressed in Appendix R of the 2005 revision of the LRA. Matrices of soil, water, air and vegetation are included. The analytical suites address radiological contaminants of concern, and the frequencies are appropriate to provide identification and early warning in advance of materials passing the site boundary.

Reference Notes:

Envirocare of Utah, Inc., 1999

Envirocare of Utah, Inc., 2003b

Envirocare of Utah, Inc., 2004b

Envirocare of Utah, Inc., 2005b

Envirocare of Utah, Inc., 2005c

5.4.9 Environmental Monitoring Program

Requirement 2507-12: 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 URCR R313-25. A description of the environmental monitoring program to provide data and to evaluate potential health and environmental impacts and the plan for taking corrective measures if migration is indicated. [URCR R313-25-7(12)]

Basis: The information contained in the 2005 revision of the LRA and other relevant documents the Applicant has submitted indicate that the requirements of URCR R313-25-7(12) have been met. The needed information is supplied in the 2005 revision of the LRA and in the Environmental Monitoring Plan (2005 revision of the LRA Appendix R). These documents list the types and frequency of measurements, and a plan for taking corrective measures if mitigation is indicated. The Applicant is providing environmental monitoring data as described in the 2005 revision of the LRA in a timely manner. Surveillances and audits of the environmental monitoring program are managed through the Quality Assurance program (2005 revision of the LRA Appendix T).

Reference Notes:

EnergySolutions to Utah Division of Radiation Control, 2006

Envirocare of Utah, Inc., 1999

Envirocare of Utah, Inc., 2002

Envirocare of Utah, Inc., 2004b

Envirocare of Utah, Inc., 2005c

Streamline Consulting, LLC., 2005

5.4.10 Administrative Procedures

Requirement 2507-13: 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 URCR R313-25: Descriptions of the administrative procedures that the applicant will apply to control activities at the land disposal facility. [URCR R313-25-7(13)]

Basis: The information contained in the 2005 revision of the LRA and other relevant documents the Applicant has submitted indicate that the requirements of URCR R313-25-9(13) have been met. The 2005 revision of the LRA lists specific documents that address administrative procedures recommended in NUREG-1199. Section 4.8 of the 2005 revision of the LRA identifies the Applicant's specific procedures corresponding to the categories of administrative procedures recommended in NUREG-1199 as follows:

- Review and Approval of Procedures (Procedure Admin-1 "Document Control)
- Equipment Control (Section 4.0 and 7.0 of Quality Assurance Manual)
- Maintenance and Modifications (Procedures Admin-1, MW-10 through MW-16, and QAM Section 3.0)
- Temporary Changes to Procedures (Procedure PMP-4, "Radiation Work Permit")
- Training and orientation (Procedures Train-1, "General Training Requirements" and Train-2, "New Employee Training")
- Access control to area (Procedure RS-1.2)
- Quality Assurance/Quality Control (QAM, CQA/QC Manual)

Reference Notes:

Envirocare of Utah, Inc., 2002

Envirocare of Utah, Inc., 2003b

Envirocare of Utah, Inc., 2004d

Envirocare of Utah, Inc., 2004f

Envirocare of Utah, Inc., 2005c

Envirocare of Utah, Inc., 2005d

US Nuclear Regulatory Commission, 2001

5.4.11 Electronic Recordkeeping System

Requirement 2507-14: 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 URCR R313-25: A description of the facility electronic recordkeeping system as required in URCR R313-25-33. [URCR R313-25-7(14)]

Basis: The information contained in the 2005 revision of the LRA and other relevant documents the Applicant has submitted indicate that the requirements of URCR R313-25-7(14) have been met. Procedure ADMIN 6.0 of the 2005 revision of the LRA (Appendix C) presents a

description of the Applicant's electronic recordkeeping system. The description identifies the data that are collected and maintained. The implementation involves the use of two appropriate software packages. For the maintenance of records the Applicant uses **OnBase**, a commercially available package, for all compliance and quality assurance records (*i.e.*, forms, correspondence, licenses, permits, manuals, profiles, notebooks, verifications of compliance and quality, shipping & receiving records, logs, or any written or pictorial information describing, defining, specifying, reporting, or certifying activities, requirements, procedures, or results) stored by the Applicant that are maintained by the Electronic Document Imaging System (EDIS). This system will define record storage, capture, security and administration. The **OnBase** system provides the following key benefits for QA documents: prevention from loss and damage; timely retrieval of archived documents; ease of use; accountability; security; and duplicate record storage.

The Applicant also uses software titled "Electronic Waste Information System" (EWIS). EWIS is a centralized location of data that retains customer data, including waste streams, and the actual waste material sent to the Applicant for management and disposal. The information contained in the database is obtained from required hard copy quality assurance documentation. The data can also be used as an indicator for tracking waste through its various operational activities

Condition 72 of the Applicant's existing radioactive materials license specifies that records will be maintained for each shipment of waste disposed at the Applicant's facility. Section 5.4.2, "Records Compilation and Transfer," in the 2005 revision of the LRA provides for the Applicant maintaining records of waste disposed at the facility, decontamination and closure certification records. Records are maintained with procedure QAP-17.0 "Quality Assurance Records."

Reference Notes:

Envirocare of Utah, Inc., 2002

Envirocare of Utah, Inc., 2005c

Envirocare of Utah, Inc., 2005d

Hyland Software, 2005

Shrum to Baird, 2005

5.5R313-25-8; TECHNICAL ANALYSIS

5.5.1 General Population Protection

Requirement 2508-1: The specific technical information shall also include the following analyses needed to demonstrate that the performance objectives of URCR R313-25 will be met: 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 URCR R313-25-19 [URCR R313-25-8(1)].

Basis: The information contained in the LRA and other relevant documents the Applicant has submitted indicate that the requirements of R313-25-8(1) have been met. Each of the major media pathways of this requirement is addressed in the following paragraphs. The principal sources of information for the exposure assessment are Sections 6.3 and 6.4 of the 2005 revision of the LRA, Appendix A of the 2005 revision of the LRA, and Section 5.3, Appendix F, Appendix J, and Appendix K of the Application for License Amendment (Classes A, B & C waste) dated December 13, 2000 (ABC ALA) (Envirocare 2000c). Both normal operating conditions (Section 6.3.1 of the 2005 revision of the LRA) and accident scenarios (Section 6.3.2 of the 2005 revision of the LRA) were evaluated.

Air Pathway

The potential releases of radionuclides through the air pathway have been assessed for the facility. During operation of the facility, the transport of dust to the site boundary is affected mainly by the natural site characteristics. These characteristics include the wind speed, wind direction, and atmospheric stability conditions. The highest dose to the public is estimated to occur during operations from the atmospheric pathway at less than 5 mrem/yr. The Applicant state in LRA section 6.3.1.1 "Control of Windborne Dispersion" that engineering and operational controls are in use to prevent the resuspension and dispersion of particulate radioactivity. Waste generators are normally required to ship bulk soil-type waste at a moisture content that allows movement without creating visible dust. Water spray is used in the cells as need to prevent resuspension of radioactivity. The railcar rollover facility is now an enclosed area, further reducing the potential for a measurable airborne release at the boundary. Haul roads are wetted and maintained to prevent the resuspension and dispersion of particulate radioactivity. Polymers are spread on inactive, open areas to bind the surface and prevent resusepension. The applicant also has air samplers placed and the data reviewed to identify if a airborne situation is developing that may require corrective actions.

After final placement of the waste and closure of the disposal embankment, the facility design prevents any further migration of radioactivity through the air pathway because all waste will be beneath a thick earthen cover.

As discussed in Appendix A to the 2005 revision of the LRA, the Applicant demonstrated that the maximum dose to a member of the public was less than 25 mrem/yr, even if the individual is continually present at the disposal site boundary. The analysis estimates the quantities of radioactively contaminated dust that are suspended into the atmosphere from the unloading facilities, the hauling activities, and from waste placement in the disposal cells – under normal operating conditions. The waste concentrations used as the source term in the atmospheric transport calculations are the average concentrations accepted at the facility in the past as listed in Appendix J of the 2005 revision of the LRA.

Radon releases will be negligible because the cover design includes a clay radon barrier designed to limit the surface radon flux to less than 20 pCi/m^2-s, resulting in potential radon exposures well within limits. The design is based on the disposal of uranium mill tailings, which are higher in radium-226 than the Class A waste.

For accident conditions, dust or particulate matter could be released to the atmosphere and inhaled by individuals. The application evaluates a tornado and severe wind, train derailment, truck turnover or collision, and truck fire. All analyses show that the maximum dose to a member of the public is less than 25 mrem/yr, even if the individual is continually present at the disposal site boundary.

In public comments during hearings on the Division's previous Siting Evaluation Report for the proposed Class A and Class B disposal facility, concern was expressed over the potential that the proximity of the US Air Force bombing test range might create conditions that would be inconsistent with the safe operation of the proposed facility. In its response to Interrogatory 2523-11, The Applicant provided information to defend the proposed licensing action. The Applicant defends the safety of the proposed facility by asserting that ". . . the probability of a military aircraft crash or accidental bomb drop onto the site is extremely remote. . ." The Applicant also compares the probability of such an incident to that nearer Hill Air Force Base, where the consequences would be much more severe. Given the occurrence of such an incident, the Applicant argues that the potential dispersal of radioactive materials would be limited to the immediate vicinity of the proposed facility and would be cleaned up at the expense of some other entity. The Applicant demonstrates that the proposed facility is located outside restricted airspace and concludes that the probability of such an accident involving the facility is insignificant.

Soil Pathway

The soil pathway involves the exposure of the public to contaminated soil from the facility. If an exposure occurred, doses could result from external radiation or ingestion of soil on dirty hands. The primary site characteristic that prevents the likelihood of such exposures during operations is the site's remote location (the low population density in the site vicinity, and the lack of natural resources to provide for population expansion). Therefore, this pathway was not considered.

The design of the embankment also contributes to minimizing exposures to contaminated soil by members of the public. After closure of the embankment, all contaminated soil will be covered in the disposal cells. The cover system contains a surface layer of riprap to protect against erosion and human intrusion. Beneath the riprap, the cover system contains a drainage layer and a clay radon barrier. The thickness of the cover system prevents penetration of the waste by roots or burrowing animals. No contaminated soil material is expected to be brought to the ground surface, or otherwise removed from the disposal cell.

During operation, the facility will be monitored as described in Appendices Q and R of the 2005 revision of the LRA, to ensure that no releases or doses have occurred via the soil pathway.

Groundwater Pathway

The groundwater pathway was analyzed in Adrian Brown (1997) and by Whetstone (2000a, 200b). The primary site characteristics that prevent public exposures via the groundwater pathway are the very poor groundwater quality at the site, the low population density, and the relatively slow groundwater flow velocities. The groundwater is not potable because of its very high concentration of salts. This characteristic alone prevents any appreciable consumption of the water by humans or livestock. The horizontal groundwater flow velocity is approximately 0.5 meters per year, resulting in groundwater travel times of approximately 60 years from the toe of the side slope region of the embankment to the compliance well.

Several embankment design features provide additional protection of the public from exposure via the groundwater pathway. The cover system to be placed over the disposal waste allows very little water to flow into the disposed waste. This limits the contamination of the groundwater by minimizing the contact of water with the waste. Another design feature of the disposal embankment is the bottom clay liner below the disposed waste. The clay absorbs many of the radionuclides and slows their potential release from the cell and subsequent transport to the water table aquifer.

In the ABC ALA, the Applicant demonstrated that the infiltration and radionuclide transport models show that any Class A waste disposed will satisfy all of the groundwater protection criteria, provided that the concentrations of four radionuclides (Bk-247, Ca-41, Cf-249, and Cl-36) are limited to the concentrations used in the transport modeling. All other radionuclide concentrations are limited only by what is necessary for the waste to qualify as Class A. This groundwater modeling provides a conservative estimate for the groundwater exposure scenario. While the model used in the ABC ALA assumed a different radon barrier thickness, (as required for the disposal of Classes B & C wastes), it was determined that the thickness of this radon barrier does not change the modeling results.

Infiltration through the cover system was modeled with the HELP code. The model used precipitation data taken from seven years of measurements at Clive Utah and longer term measurements from Dugway Utah. The Dugway data were scaled to match the annual precipitation total at Clive. The HELP model used the measurements and generated synthetic rainfall data that varied from year to year about the appropriate long term average for Clive. Synthetically generated rainfall data for 100 years were used in the infiltration calculations. The rainfall data do not have the same total rainfall every year. The rainfall totals used in the HELP model vary from year to year in the same way that actual rainfall varies from year to year. This approach is more realistic because it allows the calculations to account for yearly variations about the mean rainfall. Both the top slope and side slopes of the cell were evaluated. The net water infiltration through the cover is calculated as 0.169 cm/yr for the top slope and 0.280 cm/yr for the side slopes.

Infiltration modeling using the HELP codes is sensitive to the choice of value for the EZD parameter that represents the evaporation zone depth, or the depth below which evaporation at the cover surface has no effect on moisture movement. The choice of value for this important parameter has been the object of much discussion between the Applicant and the Division. To address the uncertainty surrounding the choice of value for EZD, the Applicant designed and has

acquired data for many years from a Cover Test Cell (CTC) with the objective of investigating moisture movement within the cover system on surface conditions.

The Division performed a detailed evaluation of data generated by the CTC and the associated observations (Utah Division of Radiation Control (Loren Morton) to EnergySolutions (Tye Rogers), 2006). That evaluation concluded that observed behavior as reported by instrumentation in the CTC was internally inconsistent and raised significant questions about the reliability of the data. Thus, the infiltration testing at the CTC has currently not achieved its objective of producing better understanding of the behavior of moisture movement within the cover system.

On the basis of its evaluation of CTC data, the Division has decided the following (see new License Condition 28):

- The apparent problems with the CTC must be investigated and remedied as necessary so that only reliable data are reported.
- After repair or replacement of the CTC, data must continue to be taken from the properly functioning CTC.
- The data must be reported to the Division annually.
- Subject to future findings from the CTC, the Division may revise license related conditions.

The UNSAT-H code was used to calculate the moisture contents in the soils and waste from the ground surface down to the shallow unconfined aquifer. The moisture contents were necessary to calculate the flow velocity of infiltrating water through the soil and waste profile.

Radionuclide transport was modeled with the PATHRAE-RAD code. The model calculated the release and transport of radionuclides from the waste cell, through the unsaturated zone, and horizontally through the shallow unconfined aquifer to a compliance-monitoring well located 90 feet from the edge of the disposal facility. The groundwater modeling included many conservative assumptions that helped to ensure that the radionuclide concentrations at the compliance monitoring well were not underestimated. For example, the distance from the bottom of the waste to the aquifer was decreased from its actual value by 1.3 feet to conservatively account for the effects of the capillary fringe at the water table and to account for variations in the water table level. No delay factors for waste container life were used to delay the onset of radionuclide releases from Class A waste under side slopes.

Other conservative assumptions include setting the water table gradient at 0.001, which is about twice as high as the average measured site value of 0.00049 (Whetstone Associates, Inc., 2000a). The hydraulic conductivity was based on measured values from the site and was set at the 90 percent confidence level, which is 7.67×10^{-4} cm/sec (the geometric mean is 6.09×10^{-4} cm/sec) (Whetstone Associates, Inc., 2000a). In the end, this resulted in the model using a horizontal interstitial groundwater velocity of 2.7 ft/year, which is about 2.6 times greater than what the velocity would be if it were based on the average gradient and geometric mean hydraulic conductivity.

With few exceptions, the Class A radionuclide concentrations were set at the Class A limits specified in 10 CFR 61. Exceptions were made for radionuclides whose specific activities were less than the Class A limit, in which cases the specific activity was used. The only other exceptions were the four radionuclides mentioned above (Bk-247, Ca-41, Cf-249, and Cl-36) whose concentrations were set lower than the applicable Class A limit in order to meet the groundwater protection criteria.

Sensitivity studies were also conducted to assess the range of precipitation values for the site. The HELP model was used to predict annual precipitation rates for higher and lower than normal precipitation. The baseline analysis used an annual average precipitation of 7.85 inches. The high precipitation case, based on data for the two highest rainfall years at Clive, showed an average annual rainfall of 12.78 inches. The low precipitation case, based on the two lowest rainfall years, showed an average rainfall of 7.01 inches. Therefore, even under extreme conditions that are very unlikely, the precipitation would increase by less than a factor of two above the baseline value.

Radionuclide transport was modeled with the PATHRAE code assuming a 4 mrem/year groundwater protection level. The model calculated the release and transport of radionuclides from the waste cell, through the unsaturated zone, and horizontally through the shallow unconfined aquifer to a compliance monitoring well from the edge of the disposal facility. The transport modeling shows that, for most radionuclides at the Class A limits, groundwater protection levels are met for 500 years after disposal of the waste. Groundwater protection levels are met for all radionuclides, provided that concentration limits in the waste are imposed for Cl-36, Al-26, Bk-247, and Cf-250. Even though the groundwater is not potable, potential doses to the public from groundwater were calculated and meet all applicable limits.

Surface Water Pathway

Due mainly to the natural site characteristics, there are no radioactive releases expected through the surface water pathway. The annual precipitation is low and the evaporation is high. No permanent surface water bodies exist in the site vicinity. In addition, the site is far from populated areas. The Class A embankment design features also minimize the potential for releases by the surface water pathway. Embankment design includes drainage ditches around the waste disposal areas. After precipitation events, these ditches divert runoff from the disposal cell cover to areas away from the disposal cells.

Vegetation

The application evaluated the effects of vegetation on the cover system. Vegetation had two primary effects on the cover system: increasing the hydraulic conductivity of the cover material and root clogging of the lateral drainage layers. During operation of the embankment, releases and doses through the plant pathway are limited by the design, operation, and maintenance of the facility. Plants on the site will be removed and prevented from contacting waste materials. After final placement of the cover, releases and doses from the plant pathway are limited by the site's natural characteristics, which include low rainfall, thin plant cover, and the presence of plants that are highly efficient at removing water from the soil and transpiring the moisture back to the atmosphere.

The plant uptake pathway is not a viable exposure pathway at the embankment because of natural site characteristics and design features of the embankment. Exposure by the plant uptake pathway could occur by (1) the production of food crops in contaminated soil at the site, and (2) root intrusion into the waste by native plants that are subsequently consumed by humans or animals.

The natural site characteristics help prevent exposures via the plant uptake pathway because there is insufficient water at the site for the production of food crops. In addition, saline soils present at the site limit the number and type of plant species that can tolerate such conditions. Additionally, there are few deep-rooted native plants in the site vicinity and no plants of any kind will exist on the disposal cell cover system at closure.

Design features of the facility also help prevent exposures via the plant uptake pathway. A thick earthen cover will be placed over the disposal cells to make the waste inaccessible to plant roots after closure of the facility. The possibility of native plants extending their roots into the waste is prevented by the configuration of the earthen cover with the lower Type B filter functioning as a capillary break with minimal moisture storage to attract or even support plant roots. After closure, some limited plant species may set roots in the overlying Sacrificial Soil which possesses a higher moisture storage capacity. The overall scarcity of deep-rooted plant species in the site vicinity and the configuration of the earthen cover will offer an inhospitable environment for extension of these types of roots into the waste.

Burrowing Animals Pathway

Burrowing animals are not considered a viable exposure pathway, given the combination of site characteristics and design features. Burrowing animals at the site include jackrabbits, mice, foxes, and ants. The first deterrent to burrowing animals is the rip-rap erosion barrier. While this may be only partially effective in deterring animals, the primary protective barrier is the clay radon barrier. The burrowing species at the site are not known to dig to such a depth that their burrows could penetrate through the entire cover and into the waste. During operation of the facility, releases and doses from the burrowing animal pathway will be prevented by the design, operation, and maintenance of the facility. Burrowing animals will be prevented from contacting the waste materials. After final placement of the cover, the design features of the facility, primarily the thick soil cover that isolates the waste from burrowing animals, will control releases and doses. Because of this, the likelihood of any animals burrowing through the entire cover and exhuming waste materials is sufficiently low that it was not included in the safety assessment calculations. As such, the burrowing animals pathway is not expected to result in any exposures to humans.

Doses to the Public

Appendix A of the 2005 revision of the LRA shows that doses to members of the public will be within established regulatory limits. The highest dose to the public is estimated to occur during operations from the atmospheric pathway at less than 5 mrem/yr. The groundwater pathway is not viable because of the high salinity and general poor quality of the groundwater; however, it was evaluated via the groundwater modeling and found to be less than 4 mrem/yr.

Reference Notes:

Adrian Brown Consultants, 1997

Envirocare of Utah, Inc. to Utah Division of Radiation Control, 2000c

Envirocare of Utah, Inc. to Utah Division of Radiation Control, 2005

Envirocare of Utah, Inc., 2000c

Envirocare of Utah, Inc., 2004b

Envirocare of Utah, Inc., 2005c

Gaynor, 2000

Rogers and Hung, 1987

Schroder *et al*, 1994

Streamline Consulting, LLC., 2005

Utah Division of Radiation Control (Loren Morton) to EnergySolutions (Tye Rogers), 2006

Whetstone Associates, Inc., 2000a

Whetstone Associates, Inc., 2000b

5.5.2 Protection of Inadvertent Intruders

Requirement 2508-2: The specific technical information shall also include the following analyses needed to demonstrate that the performance objectives of URCR R313-25 will be met: 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. [URCR R313-25-8(2)]

Basis: Analyses of radiation exposure doses to inadvertent intruders were assessed by the Applicant. Section 6.4.1.1.5 of the 2005 revision of the LRA discusses the design performance objectives of the facility to protect inadvertent intruders from exposure. Section 6.4.1.3 of the 2005 revision of the LRA and in Streamline Consulting, LLC., 2005 the modeled dose to an inadvertent intruder is discussed. The radiation dose to an inadvertent intruder is not expected to exceed radiation limits. Several design features provide the required protection. Overall features include:

- Lack of nearby residential population
- Embankment cover system

- CLSM
- Waste Form (in the case of containerized waste disposal)

- Operations specific features include:
  - Fences
  - Buffer zone
  - Security plan
- Post-Closure specific features include:
- Granite markers

Reference Notes:

(See Also: Sections of this document regarding requirements 2507-2, 2507-8, 2508-2, and 2525-7)

Envirocare of Utah, Inc., 2005c

Streamline Consulting, LLC., 2005

5.5.3 Exposure Assessment

Requirement 2508-3: The specific technical information shall also include the following analyses needed to demonstrate that the performance objectives of URCR R313-25 will be met: Assessments of expected exposures due to routine operations and likely accidents during handling, storage and disposal of waste. The analysis shall provide reasonable assurance that exposures will be controlled to meet the requirements of URCR R313-15. [URCR R313-25-8(3)]

Basis: The information contained in the 2005 revision of the LRA the Applicant has submitted indicate that the requirements of URCR R313-25-8(3) have been met. The Radiation Protection Program that is required by URCR R313-15-101(1) is included in Section 7.4 of the 2005 revision of the LRA, which outlines the facility's radiation protection program. Appendix B of the 2005 revision of the LRA, "Safety and Health Manual," describes site safety, incident reporting, emergency response, equipment operation, personal protective equipment, respiratory protection, medical surveillance, exposure monitoring, hazard communication, confined space entry, and other safety related programs. Appendix H of the 2005 revision of the LRA describes the ALARA program, including dose goals that are significantly below the regulatory dose criteria for workers. Appendix Q of the 2005 revision of the LRA contains the Applicant's general radiation safety manual.

Reference Notes:

Envirocare of Utah, Inc., 2003b

Envirocare of Utah, Inc., 2005b

Envirocare of Utah, Inc., 2005c

Envirocare of Utah, Inc., 2005e

5.5.4 Long-Term Stability of Disposal Site

Requirement 2508-4: The specific technical information shall also include the following analyses needed to demonstrate that the performance objectives of URCR R313-25 will be met: 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. [URCR R313-25-8(4)]

Basis: The description and justification of the principal design features of the facility are provided in Section 3.0 of the 2005 revision of the LRA. These principal design features have been designed to perform their required functions over the period of hundreds of years such that the facility will not require ongoing active maintenance following facility closure. Further discussion of these features is presented under Requirements 2507-2, through 2507-5 (Sections 5.4.2) of this SER in sections dealing with the liner (Section 5.4.2.1), waste placement and backfill (Section 5.4.2.2), cover (Section 5.4.2.3), and drainage systems (Section 5.4.2.4).

However, the analyses reviewed have not sufficiently addressed the Division's concern regarding the potential affects of the Applicant's clay mining activities in areas adjacent to Section 32, as discussed in Section 5.3.3 of this document. Additional discussion regarding these concerns and resulting license conditions are in Section 6 of this document.

Reference Notes:

(See Also: Sections 5.3.3 and 5.4.2 of this document)

Envirocare of Utah, Inc., 2005c, Section 3

5.6R313-25-9; INSTITUTIONAL INFORMATION

5.6.1 Certification by Federal or State Agency

Requirement 2509-1: The institutional information submitted by the applicant shall include: A certification by the federal or state agency which owns the disposal site that the agency is prepared to accept transfer of the license when the provisions of URCR R313-25-16 are met and will assume responsibility for institutional control after site closure and for post-closure observation and maintenance. [URCR R313-25-9(1)]

Basis: The regulatory provision of URCR R313-25-9(2) allows for ownership other than by a federal or state agency. Since the land is privately owned, this requirement (URCR R313-25-9(1)) does not apply. The provisions of URCR R313-25-9(2) apply as described in Section 5.6.2 of this document.

Reference Notes:

(See Also: Section 5.6.2 of this document)

5.6.2 Evidence of Land Ownership

Requirement 2509-2: The institutional information submitted by the applicant shall include: Evidence, if the disposal site is on land not owned by the federal or a state government, that arrangements have been made for assumption of ownership in fee by the federal or a state agency. [URCR R313-25-9(2)]

Basis: By action of the former Division of Radiation Control of the Division of Environmental Health, Utah Department of Health (predecessor agency to the Division of Radiation Control), the Applicant was granted an exemption from the requirement to provide evidence that arrangements have been made for assumption of ownership in fee (for the land on which the LLRW disposal facility was to be developed) by the federal or a state agency. This exemption extended an exemption from a similar requirement applicable to disposal of waste containing low levels of naturally occurring radioactive material.

The exemption was requested for Section 32 of Township 1 South, Range 11 West, Salt Lake Base and Meridian containing 640 acres except for:

> "Beginning at a point located 1120.32 feet N89 59' West along a section line and 329.49 feet South from the Northeast corner of Section 32, Township 1 South, Range 11 West, SLB&M, and running thence N89 56' 32" W 1503.72 feet; thence S0 03' 28" W 288.50 feet thence S89 56' 32" E 1503.72 feet; thence N0 03' 28" E 2880.50 feet to the point of beginning. Containing 99.437 acres, more or less."

The Division's justification for granting this exemption was based on the Division's conclusion that "private ownership is not contrary to public health and safety" and conditioned on the Applicant actually providing appropriate surety arrangements as determined by the Division.

Reference Notes:

Tooele County Recorder, 1993

Utah Bureau of Radiation Control to Envirocare of Utah, Inc., 1987

Utah Bureau of Radiation Control to Envirocare of Utah, Inc., 1991

Utah Department of Environmental Quality and Envirocare of Utah, Inc., 1993

5.7R313-25-10; FINANCIAL QUALIFICATIONS TO CARRY OUT ACTIVITIES

Requirement 2510-1: This information shall demonstrate that the applicant is financially qualified to carry out the activities for which the license is sought. The information shall meet other financial assurance requirements of URCR R313-25. [URCR R313-25-10(1)]

Requirement 2511-9: A license for the receipt, possession, and disposal of waste containing radioactive material will be issued by the Executive Secretary upon finding that the financial or surety arrangements meet the requirements of URCR R313-25. [URCR R313-25-11(9)]

Requirement 2530-1: The applicant shall show that it either possesses the necessary funds, or has reasonable assurance of obtaining the necessary funds, or by a combination of the two, to cover the estimated costs of conducting all licensed activities over the planned operating life of the project, including costs of construction and disposal. [URCR R313-25-30(1)]

Basis: The information contained in the 2005 revision of the LRA and Revision 22 of its Annual Surety Review the Applicant has submitted indicates that the requirements of URCR R313-25-10(1) , 25-11(9) , and 25-30(1) have been met. The Division has concluded that the Applicant is financially qualified to carry out the activities for which the license is sought. The Applicant submitted information to the Division that it claimed as confidential. The Division has reviewed the information and determined that the information (Revision 22 of the Applicant's Annual Surety Review) contained a reasonable estimate of the cost to develop, operate, close, monitor, and maintain the facility as required by R313-25. In addition, the Applicant provided a statement by its bank, affirming that the bank would be prepared to extend additional credit within the total estimated capital cost provided to the bank by the Applicant. Therefore, by the Applicant's bank together with the Division's assessment that the estimated cost provided by the Applicant is reasonable, justifies the Division's conclusion that the requirement is satisfied

The Applicant will, by license condition, provide assurances prior to the commencement of operations that sufficient funds will be available to carry out disposal site closure and stabilization, including (a) decontamination or dismantlement of land disposal facility structures, and (b) closure and stabilization of the disposal site so that following transfer of the disposal site to the site owner, the need for ongoing active maintenance is eliminated to the extent practicable and only minor custodial care, surveillance, and monitoring are required. The Executive Secretary has approved cost estimates reflecting the plan for disposal site closure and stabilization that was also approved by Executive Secretary. The Applicant's cost estimates take into account total costs that would be incurred if an independent contractor were hired to perform the closure and stabilization work. Under License condition, the Applicant is required to update and revise these cost estimates annually. In turn, the Executive Secretary reviews them annually, and asks for changes as necessary to ensure the cost estimates are current and adequate.

Reference Notes:

Envirocare of Utah, Inc., 2005c

EnergySolutions LLC, 2007

Utah Division of Radiation Control (Dane Finerfrock) to Envirocare of Utah, Inc. (Daniel Shrum), 2007

5.8R313-25-11; REQUIREMENTS FOR ISSUANCE OF A LICENSE

5.8.1 Risk to Health and Safety

Requirement 2511-1: A license for the receipt, possession, and disposal of waste containing radioactive material will be issued by the Executive Secretary upon finding that the issuance of the license will not contribute an unreasonable risk to health and safety of the public [URCR R313-25-11(1)]

Basis: The information contained in the 2005 revision of the LRA and other relevant documents the Applicant has submitted indicate that the requirements of URCR R313-25-11(1) have been or will be met. The LRA shows that the groundwater protection requirements will be met for at least 500 years, as required. Doses to offsite members of the public will be below the 25 mrem/yr limit, as described below in Section 5.10. The bases for this finding are summarized in this SER. Given that these conditions are met, in concert with the other requirements of URCR R313-25-11, it would be appropriate for the Executive Secretary to issue the requested license renewal application.

Reference Notes:

Envirocare of Utah, Inc., 2005c

Streamline Consulting, LLC., 2005

Utah Division of Water Quality, 2005

5.8.2 Training and Experience

Requirement 2511-2: A license for the receipt, possession, and disposal of waste containing radioactive material will be issued by the Executive Secretary upon finding that the applicant is qualified by reason of training and experience to carry out the described disposal operations in a manner that protects health and minimizes danger to life or property (URCR R313-25-11(2)].

Basis: The information contained in the 2005 revision of the LRA and other relevant documents the Applicant has submitted indicate that the employee training and experience requirements of URCR R313-25-11(2) and License Conditions 20 (procedures for employee training program) and 30 (maintenance of employee training records) have been met. The Applicant's training program, detailed in Appendix C of the 2005 revision of the LRA contains detail about required worker experience, qualifications and training. It also describes the content of the training, the tests that the workers must pass before handling the subject waste, and the nature of the dry runs

that would be conducted for the workers before handling the waste. Given that these training program and records requirements referenced above are met, in concert with the other requirements of URCR R313-25-11, it would be appropriate for the Executive Secretary to issue the requested license renewal application.

Reference Notes:

Envirocare of Utah, Inc., 2005c

Envirocare of Utah, Inc., 2005d

5.8.3 Protection to Public Health and Safety

Requirement 2511-3: A license for the receipt, possession, and disposal of waste containing radioactive material will be issued by the Executive Secretary upon finding that the applicant's disposal site, disposal design, land disposal facility operations, including equipment, facilities, and procedures, disposal site closure, and post-closure institutional control, are adequate to protect the public health and safety as specified in the performance objectives of URCR R313-25-19 [URCR R313-25-11(3)]

Basis: The information contained in the 2005 revision of the LRA and other relevant documents the Applicant has submitted indicate that the requirements of URCR R313-25-11(3) have been or will be met. The Applicant's disposal site, disposal design, land disposal facility operations, including equipment, facilities, and procedures, disposal site closure, and post-closure institutional control features are addressed under several other requirements, as shown in Table 7 of this SER. The LRA shows that the groundwater protection requirements will be met for at least 500 years, as required (Whetstone 2000a, 2004). Doses to offsite members of the public will be below the 25 mrem/yr limit, as described below in Section 5.10 (Streamline 2005).

Table 7 - Protection of Public Health and Safety Requirements.

Condition	SER Requirement	SER Section(s)
Protection to the public health and safety	Requirements 2508-1 and 2518-1	5.5, 5.9, 5.10
Disposal Site	Requirements 2523-1 through 2523-11	5.14
Disposal Design	Requirements 2507-1 through 2507-6	5.4
Land Disposal Facility Operations	Requirement 2507-6	5.4
Disposal Site Closure	Requirement 2507-7	5.4
Post-closure Institutional Control	Requirement 2509-1 and 2509-2	5.6

Thus, based on the affirmative findings presented in this SER, the Executive Secretary would be justified in issuing the requested license. Given that these conditions are met, in concert with the other requirements of URCR R313-25-11, it would be appropriate for the Executive Secretary to issue the requested license renewal application.

Reference Notes:

(See Also: Sections of this document as shown in Table 7)

Envirocare of Utah, Inc., 2005c

Streamline Consulting, LLC., 2005

Whetstone Associates, Inc., 2000a

Whetstone Associates, Inc., 2004

5.8.4 Health and Safety Performance Objectives

Requirement 2511-4: A license for the receipt, possession, and disposal of waste containing radioactive material will be issued by the Executive Secretary upon finding that the applicant's disposal site, disposal site design, land disposal facility operations, including equipment, facilities, and procedures, disposal site closure, and post-closure institutional control are adequate to protect the public health and safety in accordance with the performance objectives of URCR R313-25-20 [URCR R313-25-11(4)]

Basis: The information contained in the 2005 revision of the LRA indicates that the applicant's disposal site, disposal site design, land disposal facility operations, including equipment, facilities, and procedures, disposal site closure, and post-closure institutional control are adequate to protect the public health and safety in accordance with requirements of URCR R313-25-11(4). The basis for this affirmative finding is presented in the description and justification of the design of the intruder barrier. The basis is presented under findings contained in this SER for Requirements 2507-2 through 2507-5 and is addressed in Section 6.0 of the 2005 revision of the LRA. Given that these criteria are met, in concert with the other requirements of URCR R313-25-11, it would be appropriate for the Executive Secretary to issue the requested license renewal application.

Reference Notes:

(See Also: Sections of this document discussing requirements 2507-2 through 2507-5)

Envirocare of Utah, Inc., 2005c

5.8.5 Land Disposal Facility Operations, Including Equipment, Facilities, and Procedures

Requirement 2511-5: A license for the receipt, possession, and disposal of waste containing radioactive material will be issued by the Executive Secretary upon finding that the applicant's proposed land disposal facility operations, including equipment, facilities, and procedures, are adequate to protect the public health and safety in accordance with R313-15 (URCR R313-25-11(5)]

Basis: In Section 6.3 of the 2005 revision of the LRA, the Applicant has projected that radiation exposures to members of the general public in unrestricted areas and to facility workers will not exceed the limits during facility operations (Streamline Consulting, LLC., 2005). Furthermore, the Applicant will reduce radiation exposures to the extent reasonably achievable under the company's ALARA program. The Applicant has submitted operational procedures and descriptions of facilities which incorporate features to protect worker and public health and safety. These requirements are discussed further under requirements 2508-1 through 2508-3 of this document. Given that these conditions are met, in concert with the other requirements of URCR R313-25-11, it would be appropriate for the Executive Secretary to issue the requested license renewal application..

Reference Notes:

(See Also: Sections of this document discussing requirements 2508-1 through 2508-3)

Envirocare of Utah, Inc., 2005b

Envirocare of Utah, Inc., 2005c

Envirocare of Utah, Inc., 2005d

Envirocare of Utah, Inc., 2005h

Streamline Consulting, LLC., 2005

5.8.6 Long-Term Stability

Requirement 2511-6: A license for the receipt, possession, and disposal of waste containing radioactive material will be issued by the Executive Secretary upon finding that the applicant's disposal site, disposal site design, land disposal facility operations, disposal site closure, and post-closure institutional control plans are adequate to protect the public health and safety in that they will provide reasonable assurance of the long-term stability of the disposed waste and the disposal site and will eliminate to the extent practicable the need for continued maintenance of the disposal site following closure. [URCR R313-25-11(6)]

Basis: The information contained in the 2005 revision of the LRA and other relevant documents the Applicant has submitted indicate that the disposal site, disposal site design, land disposal facility operations, disposal site closure, and post-closure institutional control plans are adequate to protect the public health and safety in that they will provide reasonable assurance of the long-term stability of the disposed waste and the disposal site and will eliminate to the extent practicable the need for continued maintenance of the disposal site following closure in accordance with the requirements of URCR R313-25-11(6). The basis for this affirmative finding is presented in the description and justification of the design of the principal design features planned for the disposal facility as discussed in Section 3.0 of the 2005 revision of the LRA. These principal design features have been designed to perform their required functions over an appropriate period of time such that the facility will meet applicable performance

objectives without the need for ongoing active maintenance following facility closure. Section 6.4.3 in the 2005 revision of the LRA provides additional information concerning site stability, settlement and subsidence, and the prevention of degraded conditions. The basis for this affirmative finding is presented under Requirements 2507-2 through 2507-5, 2508-4, and 2522-1.

Given that the required criteria discussed above are met, in concert with the other requirements of URCR R313-25-11, it would be appropriate for the Executive Secretary to issue the requested license renewal application.

Reference Notes:

(See Also: Sections of this document discussing requirements 2507-2 through 2507-5, 2508-4, and 2522-1)

Envirocare of Utah, Inc., 2005c

5.8.7 Reasonable Assurance

Requirement 2511-7: A license for the receipt, possession, and disposal of waste containing radioactive material will be issued by the Executive Secretary upon finding that the applicant's demonstration provides reasonable assurance that the requirements of URCR R313-25 will be met. [URCR R313-25-9(7)]

Basis: The information contained in the 2005 revision of the LRA the Applicant has submitted indicate that the requirements of URCR R313-25 have been or will be met, as described and justified in this document. This finding is a global rollup of all the requirements contained in URCR R313-25. The basis for this affirmative finding is contained in the individual sections addressed in this SER. As demonstrated in the individual sections of this SER section, the Division concludes, with reasonable assurance that each requirement has been or will be met, subject to the license conditions identified and described in Section 6 of this document.

Reference Notes:

(See Also: Sections of this document discussing requirements related to R313-25)

Envirocare of Utah, Inc., 2005c

5.8.8 Institutional Control Assurance

Requirement 2511-8: A license for the receipt, possession, and disposal of waste containing radioactive material will be issued by the Executive Secretary upon finding that the applicant's proposal for institutional control provides reasonable assurance that control will be provided for the length of time found necessary to ensure the findings in URCR R313-25-11(3) through (6)

and that the institutional control meets the requirements of URCR R313-25-28. [URCR R313-25-11(8)]

Basis: The information contained in the 2005 revision of the LRA the Applicant has submitted indicate that reasonable assurance exists that control will be provided as necessary to ensure the findings in URCR R313-25-11(3) through (6) will be met. The information provided also indicates that reasonable assurance exists that that the provisions for institutional control meet or will meet the requirements of URCR R313-25-28.

Given that these conditions are met, in concert with the other requirements of URCR R313-25-11, it would be appropriate for the Executive Secretary to renew the license, subject to license conditions stated and described in Section 6 of this document.

Reference Notes:

(See Also: Sections of this document discussing requirements 2511-3 through 2511-6 and 2528)

Envirocare of Utah, Inc., 2005c

5.8.9 Financial or Surety Arrangements

Requirement 2511-9: A license for the receipt, possession, and disposal of waste containing radioactive material will be issued by the Executive Secretary upon finding that the financial or surety arrangements meet the requirements of URCR R313-25. [URCR R313-25-9(9)]

Basis: The information contained in Section 10 of the 2005 revision of the LRA indicate that the requirements of URCR R313-25 have been or will be met as descrined in the document and subject to license conditions stated an described in Section 6 of this document. The basis for an affirmative finding to this requirement is presented under Requirements 2510-1, 2530-1, 2532-1, and 2532-2. These requirements summarize the extent to which the Applicant's application satisfies the financial or surety requirements of URCR R313-25.

Given that these conditions are met, in concert with the other requirements of URCR R313-25-11, it would be appropriate for the Executive Secretary to issue the requested license amendment with the license conditions stated and described in Section 6 of this document.

Reference Notes:

(See Also: Sections of this document discussing requirements 2510-1, 2530-1, 2532-1, and 2532-2)

Envirocare of Utah, Inc., 2005c

5.9R313-25-18; INDIVIDUAL EXPOSURE ASSURANCE

Requirement 2518-1: Land disposal facilities shall be sited, designed, operated, closed, and controlled after closure so that reasonable assurance exists that exposures to individuals do not exceed the limits stated in URCR R313-25-19 through 25-22. [URCR R313-25-19(1)]

Basis: The information contained in the 2005 revision of the LRA and other relevant documents the Applicant has submitted indicate that the requirements of URCR R313-25-18 will be met. The basis for this affirmative finding is embodied in the Technical Analyses required in support of each and are presented individually for each of the cited regulatory requirements as follows:

- R313-25-19 in Requirement 2508-1,
- R313-25-20 in Requirement 2508-2,
- R313-25-21 in Requirement 2508-3, and
- R313-25-22 in Requirement 2508-4.

Reference Notes:

(See Also: Sections of this document referencing requirements and 2508-1 through 2508-4)

Adrian Brown Consultants, 1997

Envirocare of Utah, Inc. to Utah Division of Radiation Control, 2000c

Envirocare of Utah, Inc., 2000c

Envirocare of Utah, Inc., 2003b

Envirocare of Utah, Inc., 2004b

Envirocare of Utah, Inc., 2005b

Envirocare of Utah, Inc., 2005c

Envirocare of Utah, Inc., 2005e

Rogers and Hung, 1987

Schroder *et al*, 1994

Streamline Consulting, LLC., 2005

Whetstone Associates, Inc., 2000a

Whetstone Associates, Inc., 2000b

5.10 R313-25-19; PROTECTION OF THE GENERAL POPULATION FROM RELEASES OF RADIOACTIVITY

Requirement 2519-1: Concentrations of radioactive material which may be released to the general environment in ground water, surface water, air, soil, plants or animals shall not result in an annual dose exceeding an equivalent of 25 millirems (0.25 mSv) to the whole body, 75 millirems (0.75 mSv) to the thyroid, and 25 millirems (0.25 mSv) to any other organ of any member of the public. Reasonable efforts should be made to maintain releases of radioactivity in effluents to the general environment as low as is reasonably achievable. [URCR R313-25-19(1)]

Basis: The information contained in the 2005 revision of the LRA and other relevant documents the Applicant has submitted indicate that the requirements of URCR R313-25-19(1) have been met. These documents present the results of extensive analyses addressing the potential radionuclide releases to media including groundwater, surface water, air, soil, plants and animals, and discuss potential exposure pathways resulting from these releases. The analyses consider both normal conditions and unusual or accident conditions. Transport of releases from disposed wastes was evaluated. The annual doses resulting from the postulated releases for reasonably likely conditions were found to be within the regulatory limit of 25 mrem to the whole body, 75 mrem to the thyroid, and 25 mrem to any other organ (Streamline Consulting, 2005). The annual doses are found to be in compliance with the regulations.

The following text provides a discussion of releases to all environmental media and their corresponding doses. The information on releases and dose assessment presented in the 2005 revision of the LRA and is qualitatively summarized below to demonstrate that the construction, operation, and closure Clive operations will satisfy all applicable regulatory dose limits.

The Applicant's consultants concluded that that future intruder constructor, intruder agriculture and off-site receptor scenarios are considered unreasonable. An intruder explorer would not receive a significant dose. Conclusions are based upon the poor water quality, arid conditions and institutional controls.

The Applicant's radiological control program has successfully maintained worker exposures as a fraction of the regulatory limit, as demonstrated by worker dosimetry records and calculation of committed effective dose equivalents (CEDE). The Applicant actively reviews work practices, performs operational radiological surveys and has a functional ALARA review committee. The Division recognizes the Applicant's proactive approach that has resulted in successfully maintaining worker doses ALARA.

Maximum Dose

The maximum dose for normal conditions at the Clive facility was estimated to be 10.2 mrem to an individual at location A-21 from dust inhalation at the facility boundary due to operations in the Class A cell. This is a highly unlikely scenario as no credit was given during the analysis for actions taken to minimize releases other than dust control measures. Dust control measures will ensure that the releases are ALARA. The maximum dose for unusual or accident conditions were estimated to be 0.18 mrem to a person at the site boundary following a truck accident of uranium and other nuclides (2005 revision of the LRA Section 6.3.2). Although there are no

regulatory dose criteria that apply specifically to accident conditions, the dose from the truck fire scenario is below the 25 mrem dose criterion. A complete discussion of the scenarios is present in 2005 revision of the LRA Section 6.3.2.

Groundwater Pathway

The groundwater protection criteria are based on an annual dose of 4 mrem to an individual drinking groundwater. The expected dose from the groundwater pathway is zero because of the poor groundwater quality. The high salinity of the groundwater, without rigorous treatment, prevents its use for drinking, livestock watering, or crop irrigation. Groundwater protection requirements place limits on the individual radionuclide concentrations in the groundwater at the compliance-monitoring well. The radionuclide concentration limits must not be exceeded for at least 500 years following closure of the facility. Computer modeling of the groundwater pathway has shown that the groundwater protection criteria are satisfied for all radionuclides for at least 500 years (2005 revision of the LRA Section 6.4.1.1.1). The waste acceptance criteria, waste emplacement methods, and water management practices ensure that current and future releases to the groundwater pathway are kept ALARA.

Surface Water Pathway

Long-term surface water pathway doses are expected to be zero because of the absence of permanent surface water bodies at the site. The nearest stream channel is about two miles east of the facility. Surface water from precipitation is directed away from the waste disposal embankment by drainage ditches and berms. During facility operations, possibly contaminated contact stormwater is recovered and conveyed to evaporation ponds where it is monitored and controlled. No contact stormwater is released offsite, thereby maintaining releases from surface water ALARA.

Air Pathway

Air pathway doses under normal operations and accident conditions are addressed in Section 6.3 and 6.4 of the 2005 revision of the LRA. Under both normal and accident conditions, projected doses are well within the acceptable limits of regulatory requirements. For accident conditions, dust or particulate matter could be released to the atmosphere and inhaled by individuals. The 2005 revision of the LRA evaluates doses resulting from a tornado and severe wind, train derailment, truck turnover or collision, and truck fire. The highest likely dose rate occurs to an individual near a dry active waste fire for one hour. The individual inhales particulate matter from the fire and receives a dose estimated at 0.02 mrem. Other air pathway doses could occur from routine operations. A receptor standing at various locations on the fenceline for 8760 hr/yr would receive a maximum estimated dust inhalation dose of 10.2 mrem. This is a highly unlikely scenario as no credit was given during the analysis for actions taken to minimize releases other than dust control measures. The regulatory requirements for protecting members of the general public will be met during operations of the Clive facility.

Soil Pathway

Soil pathway doses involve exposure of the public to contaminated soil from the facility. If an exposure occurred, doses could result from external radiation or ingestion of soil on dirty hands. External radiation levels at the top of the final cover will be at or below background radiation for the site, so no doses are anticipated. During operation, the facility will be monitored as described in Appendix R of the 2005 revision of the LRA to ensure that no releases or doses occur via the soil pathway.

Plant Pathway

The plant pathway is not expected to cause any doses to humans. Edible crops or animal forage are not expected to grow on the waste embankment. During operations all plants will be prevented from contacting the waste. After closure, the site's low precipitation and cell cover design will prevent crop production or growth of animal forage on the embankment (2005 revision of the LRA Sections 6.4.1.1.4 and 6.4.2.1.4).

Animal Pathway

The burrowing animal pathway is not expected to cause any doses to humans. Burrowing animals at the site include jackrabbits, mice, foxes, and ants. None of these species typically burrow deep enough to penetrate through the cover system and disturb the waste materials (2005 revision of the LRA Section 6.4.2.1.4).

The Applicant has committed in Section 6.3.1 of the 2005 revision of the LRA to conduct operations in a manner that keeps exposures and doses ALARA. The Applicant's ALARA Program is defined in Appendix H of the 2005 revision of the LRA.

Reference Notes:

Envirocare of Utah, Inc., 2004b

Envirocare of Utah, Inc., 2005b

Envirocare of Utah, Inc., 2005c

Streamline Consulting, LLC., 2005

5.11 R313-25-20; PROTECTION OF INDIVIDUALS FROM INADVERTENT INTRUSION

Requirement 2520-1: Design, operation, and closure of the land disposal facility shall ensure protection of any individuals inadvertently intruding into the disposal site and occupying the site or contacting the waste after active institutional controls over the disposal site are removed. [URCR R313-25-20]

Basis: Occupation of the site by inadvertent intruders after site closure is not likely due to a lack of natural resources in the area, particularly a lack of potable water. Contacting the waste after site closure is not likely due to the lack of natural resources (no reason to drill or dig) and the design of the embankment cover system. The design features and operations will minimize radiation dose to inadvertent intruders, as well. Several design features provide the required protection. Overall features include:

- Lack of nearby residential population
- Embankment cover system
- CLSM
- Waste Form (in the case of containerized waste disposal)

Operations specific features include:

- Fences
- Buffer zone
- Security plan

Post-Closure specific features include:

- Granite markers

Reference Notes:

(See Also: Sections of this document regarding requirements 2507-2, 2507-8, 2508-2, and 2525-7)

Envirocare of Utah, Inc., 2005c

5.12 R313-25-21; PROTECTION OF INDIVIDUALS DURING OPERATION

Requirement 2521-1: Operations at the land disposal facility shall be conducted in accordance with the standards for radiation protection set out in URCR R313-15, except for release of radioactivity in effluents from the land disposal facility, which are governed by URCR R313-25-19. Every reasonable effort shall be made to maintain radiation exposures as low as reasonably achievable, ALARA. [URCR R313-25-21]

Basis: The information contained in the 2005 revision of the LRA and other relevant documents the Applicant has submitted indicate that the requirements of URCR R313-25-21 will be met. NUREG-1199 describes the items that together encompass Conduct of Operations. The topics, and references to the components are shown in Table 8 of this SER:

Table 8 - References Related to Protection of Individuals During Operations.

Subject	Related References
Organizational Structure	2005 revision of the LRA Section 1.1.3 and Appendix I
Qualifications of Applicant	2005 revision of the LRA Section 1.1.2 and Appendix I
Training Program	2005 revision of the LRA Section 7.4.3, Appendices C and Q
Emergency Planning	2005 revision of the LRA Section 4.5 and Appendix B
Review and Audit	2005 revision of the LRA Section 4.6 and Appendix T
Facility Administration & Operations	2005 revision of the LRA Section 4.8 and Appendix C
Physical Security	2005 revision of the LRA Section 4.7 and Appendix P

Additional justifications for this conclusion are provided in this SER.

Reference Notes:

(See Also: As referenced in Table 8)

Envirocare of Utah, Inc., 2002

Envirocare of Utah, Inc., 2003b

Envirocare of Utah, Inc., 2004f

Envirocare of Utah, Inc., 2004g

Envirocare of Utah, Inc., 2005c, Sections 1,4 and 7

Envirocare of Utah, Inc., 2005d

Envirocare of Utah, Inc., 2005e

US Nuclear Regulatory Commission, 2001

5.13 R313-25-22; STABILITY OF THE DISPOSAL SITE AFTER CLOSURE

Requirement 2522-1: The disposal facility shall be sited, designed, used, operated, and closed to achieve **long-term stability** of the disposal site and **to eliminate**, to the extent practicable, **the need for ongoing active maintenance** of the disposal site following closure so that only surveillance, monitoring, or minor custodial care are required. [URCR R313-25-21]

Basis: The regulatory requirements related to this requirement are shown in Table 9. However, the analyses reviewed have not sufficiently addressed the Division's concern regarding the potential affects of the Applicant's clay mining activities in areas adjacent to Section 32, as discussed in Section 5.3.3 of this document. Additional discussion regarding these concerns and resulting license conditions are in Section 6 of this document.

Table 9 - Requirements Related to the Stability of the Disposal Site After Closure.

Subject	Requirement	SER Sections
Facility Siting	Requirement 2523-1 through 2523-11	5.14
Facility Design	Requirement 2507-2 through 2507-5	5.4
Facility Use and Operation	Requirement 2511-1 through 2511-5 and 2508-4	5.4.3
Facility Closure	Requirement 2511-6 through 2511-9	5.17.3

Reference Notes:

(See Also: Sections 5.3.3, 5.4, 5.4.3, 5.14, and 5.17.3 of this document)

Envirocare of Utah, Inc., 2005c

5.14 R313-25-23; DISPOSAL SITE SUITABILITY REQUIREMENTS FOR LAND DISPOSAL NEAR-SURFACE DISPOSAL

5.14.1 Long-Term Performance

Requirement 2523-1: The primary emphasis in disposal site suitability is given to isolation of wastes and to disposal site features that ensure that the long-term performance objectives are met. [URCR R313-25-23(1)]

Basis: The information contained in the 2005 revision of the LRA the Applicant has submitted indicate that the requirements of URCR R313-25-23(1) have been met. The 2005 revision of the LRA and its references adequately demonstrate that the primary emphasis in disposal site suitability is given to isolation of wastes and to disposal site features that ensure that the long-term performance objectives are met. Bases for this affirmative finding are presented under Requirements 2523-2 through 2523-11 of this SER.

Reference Notes:

(See Also: Sections of this document discussing requirements 2523-2 through 2523-11)

Envirocare of Utah, Inc., 2005c

5.14.2 Characterization of Disposal Site

Requirement 2523-2: The disposal site shall be capable of being characterized, modeled, analyzed and monitored.

Basis: The information contained in the 2005 revision of the LRA and other relevant documents the Applicant has submitted indicate that the requirements of URCR R313-25-23(2) have been met. The South Clive site has been adequately characterized. The characteristics of the disposal site are described in Section 2 of the 2005 revision of the LRA.

Based on the characterization of the site and the design of the disposal facility, the performance of the site and facility have been adequately modeled and analyzed, as described in Section 6 of the 2005 revision of the LRA and this SER. Section 6.3 of the 2005 revision of the LRA describes the modeling and analysis of the site and facility performance during operations under normal conditions and accidental conditions. Section 6.4 of the 2005 revision of the LRA describes the modeling and analysis of the site and facility performance following operations under expected conditions, design-basis conditions, and degraded conditions.

Review of the modeling and analyses described in 2005 revision of the LRA Sections 6.3 and 6.4 found the modeling and analyses to be adequate, as described under Requirements 2508-1 of this SER.

The 2005 revision of the LRA also contains adequate information to demonstrate that the site can be monitored. Pre-operational monitoring studies are described in Section 4.9.1 of the 2005 revision of the LRA. The operational environmental monitoring program is described in Section 4.9.2 and Appendix R. The Applicant's environmental monitoring program has been underway since 1988. The collected environmental monitoring data has been submitted to the Division in the form of annual and quarterly environmental reports. The monitoring program includes airborne particulate, radon and gamma radiation monitoring and soil, vegetation and water sampling. Experience has demonstrated that site conditions do not preclude successful monitoring of the site and facility. The adequacy of environmental monitoring programs is described in the Environmental Monitoring Program section of this SER.

Reference Notes:

(See Also: Sections of this document discussing requirements 2508-1)

Adrian Brown Consultants, 1997

Envirocare of Utah, Inc., 1999

Envirocare of Utah, Inc., 2005c

Envirocare of Utah, Inc., 2005d

Streamline Consulting, LLC., 2005

US Nuclear Regulatory Commission, 2001

Utah Division of Water Quality, 2005

Whetstone Associates, Inc., 2000a

5.14.3 Population Growth and Future Development

Requirement 2523-3: Within the region where the facility is to be located, a disposal site should be selected so that projected population growth and future developments are not likely to affect the ability of the disposal facility to meet the performance objectives of URCR R313-25. [URCR R313-25-23(2)]

Basis: The information contained in the 2005 revision of the LRA the Applicant has submitted indicate that the requirements of URCR R313-25-23(3) have been met. Section 2.1 of the 2005 revision to the LRA describes the location of the disposal facility and nearby facilities and the distribution of populations in the region of the facility. Section 2.1.1.1 states that disposal facility is located within Section 32, Township 1 South, Range 11 West, SLB&M, Tooele County, Utah. Section 32 is entirely owned by the Applicant, with the exception of 100 acres used in the Vitro Remedial Action project and owned by the U.S. Department of Energy. Section 2.1.1.2 of the license renewal application states that most of the land within a 10-mile radius of the site is administered by the U.S. Bureau of Land Management. The area surrounding the facility is designated as a Hazardous Industrial District MG-H by Tooele County, limiting its future use to heavy industrial processes and to industries dealing with hazardous wastes. No other nearby facilities presently deal with radioactive material.

Section 2.1.3 of the 2005 revision of the LRA describes present and projected population distributions in the region of the facility. The closest residents live approximately 7 miles from the facility. The nearest sizable population center is the Tooele-Grantsville area, located 30 to 50 miles from the facility. Approximately 41,000 people lived within 50 miles of the facility based on 2000 census data. The Tooele County projects an average population growth of between 5 and 6 percent annually for Tooele, Grantsville, and surrounding areas, with a projected population of approximately 62,000 in 2010. The remoteness from sizable populations and the projected population growth rate support the finding that growth and future developments are unlikely to affect the ability of the disposal facility to meet the performance objectives of URCR R313-25.

Reference Notes:

Envirocare of Utah, Inc., 2005c

5.14.4 Natural Geologic Resources

Requirement 2523-4: Areas shall be avoided having known natural resources that, if exploited, would result in failure to meet the performance objectives of URCR R313-25. [URCR R313-25-23(4)]

Basis: Section 2.9.1 of the 2005 revision of the LRA states that there are no known natural geologic resources at the site and that there are no active or pending mining claims or mineral leases located on the site. However, the analyses reviewed have not sufficiently addressed the Division's concern regarding the potential affects of the Applicant's clay mining activities in areas adjacent to Section 32, as discussed in Section 5.3.3 of this document. Additional discussion regarding these concerns and resulting license conditions are in Section 6 of this document.

Section 2.9.2 of the 2005 revision of the LRA discusses natural water resources at the site. Two aquifers underlie the site: a shallow unconfined aquifer and a deeper confined aquifer. According to Section 2.6.1 of the 2005 revision of the LRA, the shallow unconfined aquifer and the deeper confined aquifer at the site are classified as State of Utah Class IV groundwater based on the criterion of total dissolved solids greater than 10,000 mg/l. Section 2.6.1 states that the groundwater quality in the unconfined shallow aquifer at the site is considered saline with concentrations of several chemical species (sulfate, chloride and total dissolved solids) significantly exceeding the EPA secondary drinking water standards. Total dissolved solids in the shallow aquifer range from approximately 14,000 to 69,000 mg/l. Therefore, the shallow unconfined aquifer is not considered a significant exploitable natural resource. In addition, since both aquifers have TDS well above 10,000 mg/l, the Clive site is not in a recharge zone of an aquifer with TDS of less than 10,000 mg/l. This is a siting criteria requirement per URCR R313-25-3(3)(a)(xiii). However, these brines do form a potential mineral resource that could be exploited someday. In order to guard against any potential intrusion that could be accomplished via acquisition of a State water right for these brines, or for any other reason, the Ground Water Discharge Permit held by the Applicant requires the Licensee to perform an annual survey of local water rights and submit a report to the Executive Secretary. If it is determined that the State Division of Water Rights has issued any right to said groundwater steps would be taken to prevent development of said well(s) in order to prevent any resulting human exposure.

As discussed in Section 2.6.2 of the 2005 revision of the LRA and Section 5.2 of the Revised Hydrogeologic Report submitted to the DRC dated August 2004, there is no downward vertical transport from the emplaced waste horizon to the deeper confined horizon, due to the upward hydraulic gradient. So long as this upward hydraulic gradient is maintained between these two aquifers, exploitation of the deeper aquifer should not have any impact on the ability to meet performance objectives.

Reference Notes:

(See Also: Section 5.3.3 of this document)

Envirocare of Utah, Inc., 2004a

Envirocare of Utah, Inc., 2005c

Utah Division of Water Quality, 2005

Whetstone Associates, Inc., 2000a

5.14.5 Site Well Drained and Free of Flooding or Ponding

Requirement 2523-5: The disposal site shall be generally well drained and free of areas of flooding or frequent ponding. Waste disposal shall not take place in a 100-year flood plain, coastal high-hazard area or wetland, as defined in Executive Order 11988, "Floodplain Management." [URCR R313-25-23(5)]

Basis: Section 2.5 of the 2005 revision of the LRA discusses surface water hydrology of the site, stating that the site is located in the semi-arid desert of western Utah and that there are no surface-water bodies present at the site and the lack of surface water features within 5 miles. The nearest stream channel is two miles east of the site.

Section 2.5 of the 2005 revision of the LRA provides the following information to support the conclusion that the lack of surface water bodies, the sparse precipitation and the high evaporation rate make it unlikely that any condition creating a permanent body of standing water will occur. The embankments have been designed to divert any water that may flow toward the facility during flooding and to drain incident precipitation away from the embankment and any disposed waste. The design criteria, characteristics, performance criteria, and operational design and construction of the drainage systems designed to prevent ponding and flooding is provided in Sections 3.1.4, 3.2.4, 3.3.4, and 3.4.4, respectively, of the 2005 revision of the LRA. Disposal site areas are managed to remove standing water when necessary (currently, the Applicant uses a mobile pumping truck to access and remove water from disposal site areas which are not designed to free-drain into an evaporation pond or equipped with permanent pumps). Short-term bodies of standing water in other areas of the property will not affect the performance of the existing disposal embankments.

Periodic ponding has been observed in the past in the area west of the existing 11e.(2) embankment, due to the removal of 5 to 7 feet of the Unit 4 clay in this localized area as part of construction operations. This area is depressed below the general topography, which has resulted in ponding of surface runoff water from the Vitro landfill. In 1996, the Applicant completed construction of three culverts designed to direct drainage away from this area. These culverts have been effective in minimizing ponding in the area. Measures taken to eliminate this depression and the resulting ponding, and a discussion of the historical groundwater mounding resulting from this ponding are discussed in Section 5.14.7.

However, the analyses reviewed have not sufficiently addressed the Division's concern regarding the potential affects of the Applicant's clay mining activities in areas adjacent to Section 32, as discussed in Section 5.3.3 of this document. Additional discussion regarding these concerns and resulting license conditions are in Section 6 of this document.

The Utah Geological and Mineral Survey Map 111 shows that the Applicant's site is outside of flood areas that have become inundated by water during the past several hundred years due to lake flooding. It also shows that there are no dams whose failure would influence the Applicant's site. Section 2.5 of the 2005 revision of the LRA indicates that the water flow from a 100-year flood is about 13-times lower than the probable maximum flood water flow assumed for HEC-1 and HEC-2 analyses that showed negligible impacts on disposed wastes (Bingham, 1996). The Final Environmental Impact Statement (EIS) prepared for the Vitro site indicates

that stream flows from the Cedar Mountain area usually evaporate and infiltrate into the ground before reaching the lower, flatter lands east of Clive. Based on this information the Division has concluded the site of the embankments do not to lie within a 100-year flood plain.

In the Siting Evaluation Report published by the Rogers and Associates in May 2000, the site was found not to lie within five miles of surface waters, including intermittent streams, perennial streams, rivers, lakes, reservoirs, and wetlands. Inspection of USGS orthophoto maps (topographic maps) that include all land areas within five miles of the site reveal the presence of no perennial streams, rivers, lakes, or reservoirs in that area. These same maps do, however, indicate several features that are either intermittent streams or narrow washes in this area, using USGS definitions for symbols used in its maps. Because the site may not be sited within five miles of any intermittent stream but may be sited without regard to the presence of narrow washes, the USGS maps are not conclusive on the existence of intermittent streams. Therefore, the Division directed the Applicant to provide additional information to resolve the question.

To resolve this ambiguity, the applicant procured the services of Mr. Ronald K. Gaynor, a Professional Civil Engineer, registered in the States of Utah, Kentucky, Ohio, and North Carolina. He is knowledgeable of surface water phenomena by virtue of his training and experience. By reason of his training, experience, and professional registration, the Department judges him to be an authoritative source and his statements to be authoritative.

On March 7, 2000, Mr. Gaynor inspected and reported his findings of at least 22 surface water drainage features within five miles of the facility. Mr. Gaynor represented that he had inspected all surface water drainage features in this area. The inspection involved observation from a helicopter at low altitudes and surface walkovers as he deemed appropriate.

Mr. Gaynor's results are summarized below:

> "All of the drainage channels inspected appear to be typical erosion features created by periodic runoff from the upgradient mountain fronts and hilly areas. Even though this inspection was performed in the wettest season of the year, with 0.10-inch precipitation in the previous 24 hours, all of the channels were dry. None of the channels extended into the mountains and all appeared to be experiencing episodic erosion at their uppermost extents as they gradually advance toward the source of runoff. At their lower most extents, they all disappear before reaching the valley floor as their storm induced flows dissipate into the soil and through evaporation.
>
> There was no evidence that flow in any of the channels is ever sustained through bank seepage and base flow from ground water. No significant vegetation was present in any greater density around the drainage features than across the desert in general. It was also observed that, although there are many cattle grazing in the area, there was no evidence of cattle having found and used any of the surface water features for drinking, at any time in the past.
>
> It is my professional opinion that all of the surface water drainage features within 5 miles of the Envirocare site are ephemeral in nature and consist of dry washes and arroyos

which may contain water only in immediate response to episodic precipitation, or snow melt. There is no evidence that perennial or intermittent streams exist within this area."

Accepting Mr. Gaynor's statement as authoritative, the Division concludes that no intermittent streams exist within five miles of the site.

Mr. Gaynor also contacted Mr. Anthony Vigil of the U.S. Army Corps of Engineers in Bountiful, Utah to determine the presence of any wetlands near the site. Mr. Vigil also referred Mr. Gaynor to the U.S. Fish & Wildlife Service, which maintains the National Fish & Wildlife Wetlands Inventory. The Division considers Mr. Vigil by virtue of his position with the U.S. Army Corps of Engineers to be an authoritative source for information to determine whether wetlands exist within five miles of the site. The Division also recognizes the U.S. Fish & Wildlife Service as an authoritative source of the same information. Mr. Vigil checked his records and confirmed that no wetlands delineations had been performed in Tooele County west of Grantsville, UT. The applicant provided a copy of a map from the Fish & Wildlife Wetlands Inventory database showing no wetlands data within about 10 miles of the site. Since the wetlands inventory lacks data within five miles of the facility, and based on Mr. Vigil's statement, the Division concludes that no wetlands exist within five miles of the site.

Thus, the Division concludes that the facility will not be located within five miles of surface waters, including intermittent streams, perennial streams, rivers, lakes, reservoirs, and wetlands.

.**Reference Notes:**

(See Also: Section 5.3.3 of this document)

Bingham Environmental, 1996

Envirocare of Utah, Inc., 2000a

Envirocare of Utah, Inc., 2005c, Sections 2 and 3

Executive Order 11988, 1977

Gaynor, 2000

Rogers and Associates Engineering for the Utah Division of Radiation Control, 2000

US Department of Energy, 1984

Utah Geological and Mineral Survey, 1988

5.14.6 Upstream Drainage Area

Requirement 2523-6: Upstream drainage areas shall be minimized to decrease the amount of runoff, which could erode or inundate waste disposal units. [URCR R313-25-23(6)]

Basis: Figure 27 included in the 1998 LRA shows the upstream drainage area used in modeling the probable maximum flood for the site. Bingham (1996) describes the modeling of the probable maximum precipitation and probable maximum flood for the site. The probable maximum precipitation and flood have been taken into account in the design of the facility and are not expected to significantly impact the performance of the facilities. Furthermore, according to Sections 3.1.4, 3.2.4, 3.3.4, and 3.4.4 of the 2005 revision of the LRA, run-on control berms around the perimeter of the disposal cells have been designed and will be constructed to prevent water from flowing into the cells and contacting waste during operations.

However, the analyses reviewed have not sufficiently addressed the Division's concern regarding the potential affects of the Applicant's clay mining activities in areas adjacent to Section 32, as discussed in Section 5.3.3 of this document. Additional discussion regarding these concerns and resulting license conditions are in Section 6 of this document.

Reference Notes:

(See Also: Section 5.3.3 of this document)

Bingham Environmental, 1996

Envirocare of Utah, Inc., 1998a

Envirocare of Utah, Inc., 2005c, Section 3

5.14.7 Depth to the Water Table

Requirement 2523-7: The disposal site shall provide sufficient depth to the water table that ground water intrusion, perennial or otherwise, into the waste will not occur. The Executive Secretary will consider an exception to this requirement to allow disposal below the water table if it can be conclusively shown that disposal site characteristics will result in molecular diffusion being the predominant means of radionuclide movement and the rate of movement will result in the performance objectives being met. In no case will waste disposal be permitted in the zone of fluctuation of the water table. [URCR R313-25-23(7)]

Basis: Section 2.6 of the 2005 revision of the LRA, Section 5.2 of the Revised Hydrogeologic Report dated August 2004, and letter number CD04-0287 provided to DRC dated June 9, 2004, discuss hydrogeology and the depth to the groundwater underlying the disposal facilities. Based on the groundwater contour map for February 2004 included in the letter number CD04-0287 provided to DRC dated June 9, 2004, and the June 1999 through December 2003 contour maps provided in the Revised Hydrogeologic Report dated August 2004, the minimum below-grade depth to the groundwater below the liner for the disposal embankments over the past five years is approximately 13 feet. Therefore, these data indicate that groundwater is not likely to rise sufficiently to intrude into the waste disposal cells during the 500-year performance period.

However, the analyses reviewed have not sufficiently addressed the Division's concern regarding the potential affects of the Applicant's clay mining activities in areas adjacent to Section 32, as

discussed in Section 5.3.3 of this document. Additional discussion regarding these concerns and resulting license conditions are in Section 6 of this document.

Discussion of Groundwater Mounding

Groundwater mounding began in 1993, when non-contact storm water from the closed Vitro embankment was diverted into an excavation within the 11e.(2) footprint. The DOE contractor had left the excavation after mining clay for construction of the Vitro embankment. The excavation ran from the southwest corner of the 11e.(2) embankment to the northeast corner. The uppermost clay material (Unit 4) was removed exposing the lower silty sand (Unit 3).

The first mound was created between April 7, 1993, and May 12, 1993, when spring run-off storm water ran off of the Vitro embankment and ponded in the excavation, infiltrated through the Unit 3 silty sand, and into the shallow, unconfined aquifer.

In 1996, the Applicant built the Vitro drainage ditch that re-directed storm water from the Vitro embankment west to the edge of Section 32, then south where it discharged into the unlined southwest pond. The intent of the southwest pond was to collect run-off water for engineering purposes.

The unlined southwest pond was also constructed into the Unit 3 silty sand. The pond was determined to be leaking in May 1997 when the pond became full from spring precipitation events. During the winter of 1997 to 1998, the Applicant installed a single HDPE liner in the pond. This liner was determined to be leaking in March 1998. The Applicant installed a second liner on top of the first liner during this time period. Unfortunately, the Applicant did not repair the lower liner, and the new liner was determined to be leaking in the spring of 1999.

The pond was shut down from July of 1999 until the spring of 2000, when the bottom liner was repaired; a new upper liner was installed with a leak detection system. The leak detection system is similar to the system installed for the contact water ponds located within the restricted area. In addition, a piezometer (PZ-1) was installed next to the pond and was included in the monthly depth to water measurement.

Between February 9, 2004 and March 22, 2004, the pond was again found to be leaking. The Applicant pumped the pond dry and shut down the pond for water storage. Investigations suggested that the leak was not within the pond, but at the inlet, specifically at the HDPE liner/concrete inlet interface. The mound near the southwest pond has been dissipating since that time.

The Applicant's operating procedure ENG-9.1 provides controls that limit excavations at the Applicant's facility. These limitations should prevent future groundwater mounding problems; monthly groundwater elevation monitoring provides an early indicator should a new groundwater mound begin to develop. However, this is one area of additional analysis that will be performed to address the Division's concerns regarding impacts of clay mining by the Applicant, as discussed further in Section 6 of this document.

Groundwater elevations have been collected on a monthly basis at the monitoring wells that surround the disposal embankments for several years. The data collected has been transmitted in

both quarterly and annual groundwater monitoring reports to the DRC on the required basis as detailed in the facility Groundwater Quality Discharge Monitoring Permit issued by the State. To date, there has been no indication of mounding beneath the disposal embankments other than that discussed above.

Reference Notes:

(See Also: Section 5.3.3 of this document)

Envirocare of Utah, Inc., 2004a

Envirocare of Utah, Inc., 2005a

Envirocare of Utah, Inc., 2005c, Sections 2 and 3

Envirocare of Utah, Inc. to Utah Division of Radiation Control, 2004

Utah Division of Water Quality, 2005

5.14.8 No Ground Water Discharge to the Surface Within the Disposal Site

Requirement 2523-8: The hydrogeologic unit used for disposal shall not discharge ground water to the surface within the disposal site. [URCR R313-25-23(8)]

Basis: The information contained in the 2005 revision of the LRA the Applicant has submitted indicates that the requirements of URCR R313-25-23(8) have been met. According to the information presented in Sections 2.5 and 2.6 of the 2005 revision of the LRA, no groundwater discharges to the surface within the disposal site.

Reference Notes:

Envirocare of Utah, Inc., 2005c, Section 2

5.14.9 Avoided Areas of Tectonic Processes

Requirement 2523-9: Areas shall be avoided where tectonic processes such as faulting, folding, seismic activity, volcanism, or similar phenomena may occur with such frequency and extent to significantly affect the ability of the disposal site to meet the performance objectives of URCR R313-25 or may preclude defensible modeling and prediction of long-term impacts. [URCR R313-25-23(9)]

Basis: The information contained in the 2005 revision of the LRA, and other relevant documents the Applicant has submitted indicate that the requirements of URCR R313-25-23(9) have been met. Section 2.4 of the 2005 revision of the LRA describes the geologic and seismic characteristics of the site and surrounding region. The information presented in Section 2.4 supports a positive finding. Section 2.4.1 states that recent evaluations of the area by the Utah

Geological Survey concluded that the site is not susceptible to geologic hazards other than ground shaking due to potential earthquake activity.

Section 5.2.2 states that the facility has been designed for a maximum credible earthquake located 10 miles from the site with a magnitude 6.5 resulting in a maximum bedrock and surface acceleration of 0.37 g. The design earthquake was specified based on seismic data for the region as described in Section 2.4.2.1 of the 2005 revision of the LRA. Section 2.4.2.1 references reports that assessed and mapped evidence of surface faulting in late Quaternary time (past 500,000 years) and concluded that there is no evidence of a capable fault within 10 miles of the site. Only five active or possibly active faults were detected within 45 miles of the site. Section 2.4.2.1 identifies these five faults. The maximum magnitudes of these five faults range from 6.5 to 7.3 and the maximum accelerations range from 0.19 to 0.31 g. The maximum earthquake that would affect the site without producing surface fault rupture was characterized as a 6.5-magnitude earthquake centered 10 miles from the site and producing a maximum acceleration of 0.22 g and an acceleration of 0.42 g at the mean-plus-one-standard-deviation level. There is a probability of 90% that 0.37 g design acceleration will not be exceeded in 5,000 years at the site. Thus, the facility design has adequately taken into account the seismic characteristics of the site and the seismic characteristics of the site do not preclude defensible modeling or predictions of long-term impacts and are not expected to affect the ability of the site to meet the performance objectives.

Maps presented in Appendix D of the March 15, 2000 Pre-licensing Plan Approval Application (Figures H-19 and H-20 copied from the Applicant's original Part B license application) show approximate five-mile distances from the site to possible Holocene faulting. The text in Appendix D of the Pre-licensing Plan Approval Application also presents Section 3.4.2 of the Applicant's 1998 LRA, quoting Arabasz *et al*, 1989 as evidence that the nearest Holocene fault is 18 miles away. Much of this information is also presented in Sections 2.4.1 and 2.4.2 in the 2005 revision of the LRA.

Additional information contained in the 1990 RCRA Part B permit application indicates that young (Holocene) fault scarps are subtle and very hard to detect even when present in the lake mud and gravel around the site. This difficulty could conceivably leave open the possibility that Holocene faults are present at the site, but have not been detected because of the difficulty in detecting Holocene faults in the site materials. However, the application is judged to adequately demonstrate that Holocene faults are not located within the 200 feet of the site because several different studies are cited where Holocene faults are identified in the region, and none is within proximity of the disposal embankments. This issue was also addressed in finding EU-S08 in the Siting Evaluation Report (Rogers and Associates Engineering, 2000).

Reference Notes:

Arabasz, 1989

Envirocare of Utah, Inc., 1990

Envirocare of Utah, Inc., 1998a

Envirocare of Utah, Inc., 2000a

Envirocare of Utah, Inc., 2005c

Rogers and Associates Engineering for the Utah Division of Radiation Control, 2000

5.14.10Avoid Areas of Surface Geologic Processes

Requirement 2523-10: Areas shall be avoided where surface geologic processes such as mass wasting, erosion, slumping, land sliding, or weathering occur with sufficient such frequency and extent to significantly affect the ability of the disposal site to meet the performance objectives of URCR R313-25, or may preclude defensible modeling and prediction of long-term impacts. [URCR R313-25-23(10)]

Basis: The information contained the 2005 revision of the LRA the Applicant has submitted indicate that the requirements of URCR R313-25-23(10) have been met. Section 2.4 of the 2005 revision of the LRA describes the geologic and seismic characteristics of the site and surrounding region. The information presented in Section 2.4 supports a positive finding. Section 2.4.1 states that recent evaluations of the area by the Utah Geological Survey concluded that the site is not susceptible to geologic hazards other than ground shaking due to potential earthquake activity.

Section 2.4.1.3 of the 2005 revision of the LRA states that the site is located in the Basin and Range Province on Quaternary lakebed deposits of ancient Lake Bonneville. Before development of the facility, the site had a topographic relief of approximately 11 feet, sloping in a southwest direction with a gradient of approximately 0.0019 ft/ft. Thus, gravity-driven geomorphologic processes such as mass wasting, slumping and land sliding do not occur. Erosion and weathering related to climatic and meteorologic conditions are not expected to have any significant impact at the South Clive site.

Reference Notes:

Envirocare of Utah, Inc., 2003c

Envirocare of Utah, Inc., 2005c, Section 2

5.14.11Nearby Facilities or Activities

Requirement 2523-11: The disposal site shall not be located where nearby facilities or activities could adversely impact the ability of the site to meet the performance objectives of URCR R313-25 or significantly mask the environmental monitoring program.

Basis: The information contained in the 2005 revision of the LRA and other relevant documents the Applicant has submitted indicate that the requirements of URCR R313-25-23(11) have been or will be met. Section 2.1.1.2 of the 2005 revision of the LRA describes facilities located near

the Applicant's facility. The facility will lie within and area designated as a Hazardous Industrial District MG-H by Tooele County. This limits the present and future use of the land surrounding the facility to heavy industrial processes and to industries involving hazardous wastes. Two operations are currently located near the Applicant's facility: Clean Harbors, Inc. and the Vitro uranium mill tailings disposal embankment.

Clean Harbors, Inc. owns two hazardous waste incinerators. One of the two incinerators is located one mile to the west of the Site and in currently being decommissioned. The other hazardous waste incinerator is operated by Clean Harbors, Inc. and is located 7 miles to the east of the Site. Clean Harbors, Inc. also owns and operates a hazardous and industrial waste treatment, storage and disposal facility 8 miles to the northwest of the Site. Neither of these operations involves radioactive materials. Therefore, they will not interfere with the performance or the successful monitoring of the performance of the Applicant's facility with respect to releases of radionuclides.

The presence of the Vitro uranium mill tailings disposal embankment and other of the Applicant's disposal embankments located adjacent to and nearby the disposal facilities have the potential of releasing some of the same radioactive constituents into the environment that may be released from the facilities whose license is being considered. for renewal. The Division has addressed this issue in the past. Should radioactive constituents be observed at any of the Applicant's environmental monitoring stations, the Applicant's environmental monitoring report submitted annually to the Division will reveal the situation and discuss its significance and effects.

Having been notified that radioactive contaminants have been observed at any of the Applicant's environmental monitoring stations, the Division will require a report that details the determination of the contamination's origin. Upon receipt of this report, the Division will critically evaluate the data, data evaluations, other evidence, and the Applicant's conclusion about origin. Should the Division determine that the contamination has originated from the Applicant's facilities, the Division will hold the Applicant responsible to stabilize, mitigate, and remediate the situation as necessary to ensure that the facility does not fail to satisfy the applicable performance objectives. Should the Division conclude that the contamination originates from the Vitro embankment, it will notify the US DOE of the observed condition and communicate its expectation that DOE will address the problem.

In public comments during hearings on the Division's Siting Evaluation Report, concern was expressed over the potential that the proximity of the US Air Force bombing test range might create conditions that would be inconsistent with the safe operation of the facility. In its response to Interrogatory 2523-11, the Applicant provided information to defend the proposed licensing action. The Applicant defends the safety of the proposed facility by asserting "…the probability of a military aircraft crash or accidental bomb drop onto the site is extremely remote..." The probability of such an accident at the proposed Private Fuel Storage facility was estimated at no more than one chance in a million. The same probability applies to a similar accident at the waste disposal units. Events with a probability of less than one in one million are not considered credible and do not require a quantitative analysis of potential radioactive

releases. The Applicant also compares the probability of such an incident to that nearer Hill Air Force Base, where the consequences would be much more severe due to surrounding urbanization. Given the occurrence of such an incident, the Applicant argues that the potential dispersal of radioactive materials would be limited to the immediate vicinity of the facility and would be cleaned up at the expense of some other entity. The Applicant demonstrates that the proposed facility is located outside restricted airspace and concludes that the probability of such an accident involving the facilities is insignificant.

The Division concludes that adjacent facilities do not significantly impact the ability of the site to meet the performance objectives of URCR R313-25 and do not significantly mask the facility's environmental monitoring program.

Reference Notes:

Envirocare of Utah, Inc., 1998b

Envirocare of Utah, Inc., 2005c, Section 2

Envirocare of Utah, Inc. to Utah Division of Radiation Control, 2000c

Utah Department of Environmental Quality, 2000a

5.15 R313-25-24; DISPOSAL SITE DESIGN FOR NEAR-SURFACE LAND DISPOSAL

5.15.1 Long-Term Isolation Without Active Maintenance

Requirement 2524-1: Site design features shall be directed toward long-term isolation and avoidance of the need for continuing active maintenance after site closure. [URCR R313-25-24(1)]

Basis: Requirements 2508-1 through Requirements 2508-4 provided in Section 5.5 of this SER discuss the primary emphasis in determining disposal site suitability was given to isolation of wastes and to disposal site features that ensure that the long-term performance objectives will be met. Requirements 2507-1 through Requirements 2507-5 in Section 5.4 of this SER also demonstrate that the Principal Design Features have been designed to perform as intended for many years following the Institutional Control period without reliance on active ongoing maintenance.

However, the analyses reviewed have not sufficiently addressed the Division's concern regarding the potential affects of the Applicant's clay mining activities in areas adjacent to Section 32, as discussed in Section 5.3.3 of this document. Additional discussion regarding these concerns and resulting license conditions are in Section 6 of this document.

Reference Notes:

(See Also: Sections of this document referencing requirements 2507-2 through 2507-5 and 2508-1 through 2508-4)

(See Also: Section 5.3.3 of this document)

Envirocare of Utah, Inc., 2005c

5.15.2 Design Compatible with Closure and Stabilization

Requirement 2524-2: 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. [URCR R313-25-24(2)]

Basis: The information contained in the 2005 revision of the LRA and other relevant documents indicate that the requirements of URCR R313-25-24(2) have been met. Sections 3 and 5 of the 2005 revision of the LRA discuss design considerations and procedures for ensuring structural stability and demonstrate that performance criteria are met. As described in the "Basis" section above under Requirement 2507-7, waste would be covered soon after each embankment section is filled. Waste containers placed in the embankment would be placed concurrently with backfill placement and compaction efforts. The waste placement and backfill plan, including the specific waste/backfill and geometry of waste areas, as well as the conditions and extent of compaction required for each type of backfill, were developed based waste placement test pads whose plans and results were reviewed and accepted by the Division.

Under provisions of the license "disposal" is the locating of radioactive waste into a lift of the disposal embankment but does not include (1) the storage of waste in containers on a lift when the container will ultimately be emptied, (2) the staging of containerized waste in the disposal embankment; or (3) bulk waste in storage as "In Cell Bulk Disposal". The Licensee has temporarily managed bulk waste destined for the shredder facility under provisions stated in Attachment II-A of the CQA/QC Manual, "Work Element Waste Placement"; "In-Cell Bulk Disposal". The combined volume of waste being temporarily managed in this manner (taken to be "stockpiled waste") and in storage at the LLRW Container Storage Pads may not exceed the volume of waste allowed in the Annual Surety Evaluation as of August 31, 2006 (see 8/31/06 ES submittal entitled "Radioactive Material License UT2300249 Annual Surety Review", CD06-0347). Revision 22 of the Applicant's Annual Surety Review proposed storage of a total of 28,000 cubic yards as containerized waste (20,000 in railcars, 8,000 in containers), and 45,000 cubic yards as "bulk stockpiled waste") in areas outside of the waste embankments.. Another 700,000 cubic yards of staged waste material awaiting final disposal is also accounted for in the surety as stockpiled storage on the Class A and Class A North Embankments.

Sections 4.3.4 and 5 of the 2005 revision of the LRA describe design provisions and operational procedures that are intended to facilitate cell closure and satisfy the performance objective of eliminating the need for active maintenance of the closed embankment. As described under

Requirement 2507-7, closed sections would not be disturbed by continuing operations at the site once progressive closure of the embankment sections has been completed.

Based on a review of the information summarized above and discussed in this SER, the Applicant has adequately demonstrated that the design and operation of the embankment would be compatible with the site's closure and stabilization plan. The design of the embankment and proposed operational procedures will likely result in a closure that provides reasonable assurance that the performance objectives relating to closure will be met.

Reference Notes:

(See Also: Sections of this document referencing requirement 2507-7)

Envirocare of Utah, Inc., 2004d

Envirocare of Utah, Inc., 2005c

Envirocare of Utah, Inc., 2005d

EnergySolutions LLC, 2007

Utah Division of Radiation Control (Dane Finerfrock) to Envirocare of Utah, Inc. (Daniel Shrum), 2007

5.15.3 Complement and Improve the Disposal Site's Natural Characteristics

Requirement 2524-3: 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. [URCR R313-25-24(3)]

Basis: The information contained in the 2005 revision of the LRA and other relevant documents the Applicant has submitted indicate that the requirements of URCR R313-25-24(3) have been and will be met. This requirement is addressed in Sections 3, 4, and 6 of the 2005 revision of the LRA. The liners, compaction, moisture control, and surface cover improve the site's natural characteristics to meet performance objectives.

Section 2 of the 2005 revision of the LRA describes principal site characteristics of the disposal site. According to this information, the site is situated in a desert area with an extremely dry climate. The nearest residents to the site are approximately 7 miles away, with the nearest community located approximately 35 miles from the site. Groundwater at the site is of extremely poor quality, and thus is unlikely to be useful in the future for beneficial purposes. This fact will likely discourage development of the land for purposes other than its present use. The alluvial soil on the site drains relatively freely. Furthermore, no significantly perched groundwater zone has been encountered in soil borings at the site. The waste disposal facility is not located in a 100-year flood plain. Additional information on site characteristics and relevant

siting criteria that address URCR R313-25-23(1) through R313-25-23(11) requirements is provided in Section 5.14 of this SER.

Section 3 of 2005 revision of the LRA demonstrates that the site grading plan and runoff drainage features will direct surface water away from the disposal area, and consequently will distribute the water across the surface of the alluvial slope in a manner similar to that occurring naturally. The disposal unit cover has been designed to resist water infiltration (clay radon barrier and overlying filter layer). This design feature, coupled with the site's arid climate, will result in most precipitation at the site returning to the atmosphere through evaporation. During the open cell conditions while waste is being placed, the low-permeability clay layer in the bottom of the embankment will inhibit contaminants in the disposed waste from migrating away from the disposal unit.

Section 6.0 of the 2005 revision of the LRA discusses how the natural conditions of the site will be enhanced to control potential releases to the environment to meet the performance objectives. The principal design features of the Class A Disposal Embankment have been designed with consideration for actual site conditions and required performance objectives. Thus, the very favorable natural site conditions are complemented by the design of the disposal facility. Moreover, facility operations will be conducted and the facility will be closed, stabilized, maintained, and monitored to ensure that releases to environmental media are minimized.

The discussions related to performance objectives are presented in Section 5.15.2 of this SER.

Based on a review of the information summarized above, the Applicant has adequately demonstrated that the disposal site will complement and improve, where appropriate, the ability of the disposal site's natural characteristics to ensure that the performance objectives will be met.

Reference Notes:

(See Also: Section 5.15.2 of this document)

Arabasz, 1989

Bingham Environmental, 1996

Envirocare of Utah, Inc. to Utah Division of Radiation Control, 2000c

Envirocare of Utah, Inc. to Utah Division of Radiation Control, 2004

Envirocare of Utah, Inc., 1990

Envirocare of Utah, Inc., 1998a

Envirocare of Utah, Inc., 1998b

Envirocare of Utah, Inc., 2000a

Envirocare of Utah, Inc., 2004a

Envirocare of Utah, Inc., 2005a

Envirocare of Utah, Inc., 2005c, Section 2, 3, 4, and 6

Executive Order 11988, 1977

Gaynor, 2000

Rogers and Associates Engineering for the Utah Division of Radiation Control, 2000

US Department of Energy, 1984

Utah Division of Water Quality, 2005

Utah Geological and Mineral Survey, 1988

5.15.4 Minimize Water Infiltration

Requirement 2524-4: Covers shall be designed to minimize, to the extent practicable, water infiltration, to direct percolating or surface water away from the disposed waste, and to resist degradation by surface geologic processes and biotic activity [URCR R313-25-24(4)]

Basis: The information contained in the 2005 revision of the LRA and other relevant documents the Applicant has submitted indicate that the requirements of URCR R313-25-24(4) have been met. The infiltration calculations in the application support the finding that the groundwater protection criteria for Class A wastes will be met. In order to meet this objective the infiltration must be minimized to limit leaching and transport of radionuclides from the waste through the unsaturated zone and the shallow water table. The open cell analysis demonstrates, through modeling, that the waste cells may be left open for as long as 12 years after initial construction without any adverse effects on the leaching or groundwater transport of radionuclides (Whetstone 2003a, 2003b).

As is presented in Section 3 of the 2005 revision of the LRA, when the Class A and Class A North Embankments are filled to the maximum height and found structurally stable, a compacted low-permeable layer of clay will be placed on top and compacted to form a radon/infiltration barrier. The clay layer will provide a large moisture storage capacity relative to the amount of water expected to infiltrate through the cover system and the rate at which that infiltration is expected to occur as discussed in Section 5.4.2.3.3 of this document.

Also presented in Section 3 of the 2005 revision of the LRA, the Applicant also has developed embankment drainage ditches surrounding each disposal unit to help remove any water buildup. The disposal unit cover also will be sloped to encourage runoff of surface water at low enough velocities that the potential for erosion will be acceptably small. The drainage systems are constructed of a rock-type erosion protection system.

To minimize the potential for settlement and subsidence of the disposal unit covers, which could lead to ponding and infiltration of surface water, void spaces in the disposal units will be limited through pre-sizing debris materials by shredding, the orderly placement of waste, thoroughly backfilling around the emplaced waste, and compacting the backfill. Even if the maximum

possible subsidence were to occur, only modest local depressions in the cover surface would result. Most water accumulating in these small depressions would evaporate in a relatively short time because of the site's dry climate.

The disposal unit cover is composed of natural materials with long-term durability characteristics, providing resistance to degradation from both surface geologic and biotic processes. A layer of riprap with a gravel filter or bedding and sacrificial layer on the top of the cover will provide protection from erosion and help limit biointrusion. This gravel layer, coupled with the thickness of the entire cover system, provides significant resistance to biotic intrusion.

Reference Notes:

(See Also: Section 5.4.2.3.3 of this document)

Envirocare of Utah, Inc., 2005c, Section 3

Utah Division of Water Quality, 2005

Whetstone Associates, Inc. 2003a

Whetstone Associates, Inc. 2003b

Whetstone Associates, Inc., 2004

5.15.5 Direct Surface Water Drainage Away from Disposal Units

Requirement 2524-5: 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. [URCR R313-25-24(5)]

Basis: Drainage systems for installation in conjunction with construction and operation of the Class A Disposal Embankments have been designed to prevent run-on of surface water onto the facility from adjacent areas under flooding conditions and facilitate run-off of storm water resulting from precipitation at velocities that would not cause excessive erosion to the drainage system components. Drainage system components include run-on protection berms and run-off berms, which would be constructed and used during operations, and a permanent drainage ditch system, to be constructed and retained for long-term use. More information about how the Drainage System satisfies regulatory requirements has been presented in this SER.

During operations, the embankment would be protected against off-site floodwaters by run-on berms. The off-site environment would also be protected from potentially contaminated water running off the open embankment by run-off berms constructed near the disposal area.

Run-on berms would surround the perimeter of the disposal embankment at all times during operations. These berms would be constructed to a minimum height of 3 feet above the design grade at that location (as determined by original engineering drawings showing site topographic

contours) and have a minimum width of 10 feet at the top. The berms would be compacted to 90 percent of the Standard Proctor density (ASTM D-698). In addition, inspection/travel roads constructed 1 foot above natural grade with a 12-ft width will also be provided.

Run-off berms would be constructed immediately following approval of clay liner construction for a zone of the embankment to be opened for waste placement. Run-off berms would be constructed directly on the clay liner to a height of 3 feet above the finished grade. Run-off berms have a minimum width of 3 feet at the top and are compacted to 90 percent of the Standard Proctor density for the soils used to construct them. Once the run-off berms are constructed, waste materials would be placed on the clay liner. However, a minimum separation of 10 feet would be maintained between the toe of the run-off berm and the toe of waste. This 10-foot separation is designed to allow for collection of run-off water from the active embankment and minimize potential contact of waste with standing water.

In order to facilitate the flow of precipitation away from embankment, the Applicant (Sections 3.1.4, 3.2.4 and 3.3.4 of the 2005 revision of the LRA) designed the drainage ditch system so that during operations, storm water would remain within the drainage ditch system (including the ditch east of the Class A Disposal Embankment and the ditches surrounding the 11e.(2) embankment) with a freeboard of greater than 0.5 foot under the normal precipitation event and no overflow occur (*i.e.*, that the depth of water be less than the depth of the ditches) under the abnormal precipitation event. Calculations performed by the Applicant indicate that the proposed drainage ditch systems surrounding the Class A Disposal Embankment, as well as downstream drainage ditch systems, on the eastern side of the Class A Disposal Embankment and surrounding the 11e.(2) embankment, has a sufficient slope to allow drainage of surface water run off away from the disposal embankment. The 25-year storm event was identified as representing the probable worst-case precipitation event that might be encountered during active site operations. Based on these results, and under the assumed conditions, the drainage ditch system should promote the collection of precipitation as well as promote flow away from the embankment, thus minimizing standing water adjacent to the embankment; thereby minimizing potential infiltration into the waste.

In order to prevent erosion, the Applicant demonstrated that run-off water velocities would be much less than 3 feet per second on the surface of the compacted ditch bottom (which is the velocity at which the Applicant projected that onset of erosion of the underlying compacted ditch bottom material could occur).

Results of drainage calculations addressing flow for drainage ditches adjacent to the 11e.(2) embankment associated with the normal conditions (the 25-year, 24-hour storm event) and abnormal conditions (the 100-year, 24-hour storm event) indicate that the ditches would fill to a maximum depth of 3.5 feet and 3.79 feet respectively, leaving approximately 0.5 feet and 0.21 feet of freeboard under normal and abnormal storm events respectively. Based on these results, it is concluded that the site drainage ditches, with a full depth of 4 feet, are adequately designed to contain the run off from the designed storm events.

Results of an accident condition involving downstream blockage of the drainage ditch system on Section 3.3.4.1 of the 2005 revision of the LRA indicate that, although downstream blockage in

the drainage ditch would lead to a localized flood situation in that section of the ditch, once the water level reached the outside berm height, water would disperse away from the embankment as overland flow.

Results of HEC-1 and HEC-2 Modeling analyses conducted by Bingham Environmental (1998 LRA Appendix KK) provide data pertaining to the depth of water expected from the Probable Maximum Flood (PMF) for the watershed encompassing the Clive site, indicate that, based on the geometry of water accumulation in the ditch, with respect to the Class A Disposal Embankment, the abnormal flood event would not cause water to accumulate above the toe of the waste in the embankment, and that the drainage system is therefore adequately designed to minimize infiltration of water through the waste under both normal and abnormal conditions.

The Applicant selected a design criteria velocity of three ft/sec to prevent internal erosion of the soils beneath the rock erosion barrier of the ditches. The Applicant has calculated interstitial velocities for Type A filter rock on the top slope of the Class A embankment at 1.39 x 10-3 ft/sec. The drainage ditch slope is much less than that of the embankment top slope. This velocity is the maximum possible velocity at the interface of rock barrier and clay soil. This velocity is orders of magnitude below the design. Therefore, significant erosion of the ditch clay surface will not occur.

Based on the information summarized above, the Applicant has discussed how the facility's surface features will direct surface water away from the disposal units at velocities and gradients which will not result in erosion that will require ongoing active maintenance in the future. However, the analyses reviewed have not sufficiently addressed the Division's concern regarding the potential affects of the Applicant's clay mining activities in areas adjacent to Section 32, as discussed in Section 5.3.3 of this document. Additional discussion regarding these concerns and resulting license conditions are in Section 6 of this document.

Reference Notes:

(See Also: Section 5.3.3 of this document)

ASTM International Committee D18.03 on Texture, Plasticity and Density Characteristics of Soils, 2000a

Bingham Environmental, 1996

Envirocare of Utah, Inc., 2005c

5.15.6 Minimize the Contact of Water with Waste

Requirement 2524-6: The disposal site shall be designed to minimize to the extent practicable the contact of water with waste during storage, the contact of standing water with waste during disposal, and the contact of percolating or standing water with wastes after disposal. [URCR R313-25-24(6)]

Basis: The information contained in the 2005 revision of the LRA and other relevant documents the Applicant has submitted indicate that the requirements of URCR R313-25-24(6) have been and will be met. The Applicant proposes a number of measures to minimize the potential for water contacting waste during and following operations. The liner would be comprised of a 2-foot-thick layer of compacted clay having an in-place, as-built design saturated hydraulic conductivity (permeability) of 1 x 10^{-6} cm/sec. The liner materials would be compacted to at least 95 percent of the Standard Proctor (ASTM D-698) density for the soils used in constructing the liner, at a moisture content between optimum and plus 5 percent of the optimum moisture content. The liner would be constructed of soil borrow materials having 85 percent fines less than 0.075 mm in diameter; plasticity index range 10 to 25; and liquid limit values ranging between 30 and 50. The completed liner would be flat and level. The liner has been designed to have sufficiently low permeability to encourage run-off of water accumulating on liner surface. A vacuum truck will remove water that accumulates on the working surface during operations.

During operations, the embankment would also be protected against off-site floodwaters by run-on berms. The off-site environment will be protected by run-off berms against potentially contaminated water running off the open embankment. Once a section of the embankment cover is completed to the design toe of waste, run-off berms for that section would be replaced by drainage ditches (2005 revision of the LRA Sections 3.1.4, 3.2.4, and 3.3.4).

The run-on berms would surround the perimeter of the Class A Disposal Embankment at all times during operations.

Run-off berms would be constructed immediately following approval of clay liner construction for a zone of the embankment scheduled to be opened for waste placement. Run-off berms would be constructed directly on the clay liner to a height of 3 feet above the liner. Run-off berms will have a minimum width of 3 feet at the top and be compacted to 90 percent of the Standard Proctor density for the soils used to construct them.

Once the run-off berms are constructed, waste materials would be placed on the clay liner. However, a minimum separation of 10 feet would be maintained between the toe of the run-off berm and the toe of waste. This 10-foot separation is designed to allow for collection of run-off water from the active embankment and minimize potential contact of waste with standing water during operations. Ground Water Quality Discharge Permit requirements (Parts I.E.10.a) mandate that EnergySolutions immediately remove accumulations of such contact stormwater, followed by management in approved and lined evaporation ponds found on site.

During waste placement, rainwater may enter the active disposal unit. Water will be directed away from the active disposal area within the unit. Water would then be allowed to evaporate if it is not contaminated and does not present an operations problem. If it presents an operations problem, it will be pumped, monitored, and processed, as appropriate.

The cover system has been designed to minimize the infiltration of water through the waste after waste disposal. A series of simulations using the HELP Model (Version 3.06) (Schroder *et al*, 1994 and Whetstone Associates, Inc., 2001a) showed that the amount of water infiltrating through the cover and waste is sufficiently low to meet all of the groundwater protection criteria. The model used precipitation data taken from seven years of measurements at Clive, Utah and

longer-term measurements from Dugway, Utah. Both the top slope and side slopes of the embankment were evaluated. The net water infiltration through the cover was calculated as 0.169 cm/yr for the top slope and 0.280 cm/yr for the side slopes. This is sufficiently low to meet the groundwater protection criteria for Class A waste.

The Applicant has designed the clay liner to be more permeable (by a factor of 20) than the final cover in order to minimize the possibility of water accumulating on the liner after closure, thereby limiting the possibility of standing water coming into contact with waste following final closure of the disposal cell (Section 3.3.1.1.2 and Table 3-4 of the 2005 revision of the LRA). This design minimizes the potential for any "bathtub effect" of water to occur within the embankment following closure.

Several infiltration sensitivity analyses were conducted to evaluate the effects of possible future establishment and growth of vegetation on the cover system. Plant roots had two primary effects on the cover system: increasing the hydraulic conductivity of the cover material and clogging of the lateral drainage layers. Both of these effects were evaluated with the HELP model to determine if they adversely affected the net water infiltration rate through the cover system. Nine sensitivity cases with plant roots were conducted. The analyses showed that the presence of roots in the cover system did not adversely affect the net amount of water infiltrating to the waste. In fact, in all nine cases the transpiration of water by the roots more than compensated for the increased soil hydraulic conductivity that the roots cause. When plant roots were present in the cover system, the net water infiltration rate through the waste was lower because the plant roots transpired water from the soil back to the atmosphere. These sensitivity analyses provided increased confidence that the cover system would perform as designed over long periods of time and would be resistant to the effects of natural ecological processes at the site.

Reference Notes:

ASTM International Committee D18.03 on Texture, Plasticity and Density Characteristics of Soils, 2000a

Envirocare of Utah, Inc., 2005c

Utah Division of Water Quality, 2005

Whetstone Associates, Inc., 2001a

Whetstone Associates, Inc., 2001b

5.16 R313-25-25; NEAR SURFACE LAND DISPOSAL FACILITY OPERATION AND DISPOSAL SITE CLOSURE

5.16.1 Class A Segregated from Other Classes of Waste

Requirement 2525-01: Waste designated as Class A pursuant to R313-15-1008 shall be segregated from other wastes by placing them in disposal units which are sufficiently separated

from disposal units for other waste classes so that any interaction between Class A waste and other wastes will not result in the failure to meet the performance objectives of URCR R313-25. This segregation is not necessary for Class A wastes if they meet the stability requirements R313-15-1008(2) .

Basis: This requirement applies only to the disposal of Class B and Class C waste in the presence of Class A waste. Since the 2005 revision of the LRA addresses only the disposal of Class A waste, this requirements is not directly applicable.

The Applicant describes its waste segregation procedures in Appendix C of the 2005 revision of the LRA. Class A, 11e.(2) waste, and mixed wastes will not be intermingled at the disposal facility. This objective will be accomplished through the following waste control and characterization procedures:

- Pre-shipment Waste Characterization
- Incoming Waste Acceptance Control
- Incoming Waste Sampling and Analysis
- Incoming Waste Unloading / Handling
- Waste Disposal
- Interim Storage

These procedures will ensure that waste is properly identified, that the waste meets license limits for disposal, and consequently that Class A, 11e.(2) waste, and mixed waste do not become cross-contaminated and are not co-mingled. These procedures also require that waste management and storage occur independently for each generator prior to disposal in the LLRW facility. The waste management procedures at each facility require that the work areas and equipment be cleaned sufficiently between waste types to ensure no cross-contamination between facilities. Finally, any waste that is determined to be hazardous waste or to exceed the restrictions of the Radioactive Materials License or Groundwater Quality Discharge Permit will not be unloaded or handled at the Applicant's LLRW facility. Any such waste that arrives at the facility will not be accepted.

Reference Notes:

Envirocare of Utah, Inc., 2005c

Envirocare of Utah, Inc., 2005d

Utah Division of Radiation Control, 2005

Utah Division of Water Quality, 2005

5.16.2 Class C Waste Provided with Intruder Barriers

Requirement 2525-02: Wastes designated as Class C pursuant to R313-15-1008 shall be disposed of so that the top of the waste is a minimum of five meters below the top surface of the cover or shall be disposed of with intruder barriers that are designed to protect against an inadvertent intrusion for at least 500 years. [URCR R313-25-25(2)]

Basis: This requirement applies only to the disposal of Class C waste. Since this LRA addresses only the disposal of Class A waste, this requirements is not applicable.

Reference Notes:

Envirocare of Utah, Inc., 2005c

5.16.3 Only Class A, B, and C Suitable for Near-Surface Disposal

Requirement 2525-03: Except as provided in URCR R313-25-1(1), only waste classified as Class A, B, or C shall be acceptable for near-surface disposal. Wastes shall be disposed of in accordance with the requirements of URCR R313-25-25(4) through 11. [URCR R313-25-25(3)]

Basis: The information contained in the LRA the Applicant has submitted indicates that the requirements of URCR R313-25-25(3) will be met. The scope of the LRA is for near-surface disposal of only Class A waste. Waste acceptance criteria are discussed in the Waste Characterization Plan (Appendix M), and operations procedures included in Appendix C.

Reference Notes:

Envirocare of Utah, Inc., 2004e

Envirocare of Utah, Inc., 2005c

Envirocare of Utah, Inc., 2005d

5.16.4 Maintain Package Integrity and Minimize Void Space

Requirement 2525-04: Wastes shall be emplaced in a manner that maintains the package integrity during emplacement, minimizes the void spaces between packages, and permits the void spaces to be filled [URCR R313-25-25(4)].

Basis: The information contained in the 2005 revision of the LRA and other relevant documents the Applicant has submitted indicate that the requirements of URCR R313-25-25(4) will be met. The Applicant has waste handling procedures that give reasonable assurance that the integrity of waste containers will not be compromised, as described in Sections 4.2 and 4.3 of the 2005 revision of the LRA. Furthermore, the Applicant has developed an embankment design that permits void spaces to be filled and has described and justified a backfilling procedure that

ensures that voids spaces between packages will be minimized (2005 revision of the LRA Section 3).

Reference Notes:

Envirocare of Utah, Inc., 2004d

Envirocare of Utah, Inc., 2005c

Envirocare of Utah, Inc., 2005d

5.16.5 Void Spaces Between Waste Packages Filled

Requirement 2525-05: Void spaces between waste packages shall be filled with earth or other material to reduce future subsidence within the fill [URCR R313-25-25(5)].

Basis: The information contained in the 2005 revision of the LRA and other relevant documents the Applicant has submitted indicate that the requirements of R313-25-25(5) will be met. The Applicant fills void spaces between waste containers routinely, so that several layers of waste packages are not placed without intermediate backfill. The primary objective is to minimize potential differential settlement within the embankment, thereby maximizing long-term stability of the facility after closure. The Applicant's current procedures call for void spaces between Class A waste packages to be filled, using cohesionless soil, to the maximum extent practicable, to assure long-term stability of the cap and inhibits potential cap slumping or subsidence. The Applicant has also adopted the more conservative placement specifications discussed in Section 4.3.1 of the 2005 revision of the LRA and Appendix N of the 2005 revision of the LRA for the purpose of conducting settlement evaluations for Class A waste and backfill.

Reference Notes:

Envirocare of Utah, Inc., 2003a

Envirocare of Utah, Inc., 2005c

5.16.6 Limits the Radiation Dose Rate at the Surface of the Cover

Requirement 2525-06: 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 URCR R313-15-105 at the time the license is transferred pursuant to R313-25-16 [URCR R313-25-25(6)]

Basis: The information contained in the 2005 revision of the LRA and other relevant documents the Applicant has submitted indicate that the requirements of URCR R313-25-25(6) will be met. Appendix A of the 2005 revision of the LRA demonstrates that radiation doses to any member of the public will be less than required after placement of the final cover over the disposal cells.

The Executive Secretary deems the period of time during which the temporary cover is in place and settlement measurements are being made to be part of the operational phase of the facility. The Applicant has agreed to the decontamination of all areas around the disposal cells to the cleanup criteria levels included in Appendix R of the 2005 revision of the Application. The very thick earthen cover over the waste will shield persons on the cover surface so that they are exposed to levels of radiation that are no greater than the specified, acceptable levels. Moreover, should radiation levels at the time of closure exceed allowable levels, additional soil cover can be provided to further reduce radiation levels.

Section 6.4 of the 2005 LRA is titled "Potential Releases Following Operations." The 2005 LRA Section 6.4.1.1.5 specifies that the embankment cover design will limit the direct radiation dose to any member of the public from direction radiation to less than 15 mrem/yr. The Applicant does not provide a reference to supporting evidence in this section that the dose rate to any member of the public from direction radiation to less than 15 mrem/yr while on the completed cover. 2005 LRA Section 6.4.1.2 addresses doses to members of the general public and refers to Appendix A "Dose Assessment." This document by Streamline Consulting does not address closed cells with intact cover systems. The cover letter in the appendix refers to dose assessments for open cells with limited occupancy factors, and the supporting calculations have a cover thickness of zero meters. While the assumption could be made that the doses to the public would be less than Streamline Consulting's dose rates in an open cell, the assumption is not clearly stated in the Applicant's documentation.

Reference Notes:

Envirocare of Utah, Inc., 2005c

Streamline Consulting, LLC., 2005

5.16.7 Boundaries and Locations of Disposal Units

Requirement 2525-07: The boundaries and locations of disposal units shall be accurately located and mapped by means of a land survey. Near-surface disposal units shall be marked in such a way that the boundaries of the units can be easily defined. Three permanent survey marker control points, referenced to USGS or National Geodetic Survey (NGS) control stations, shall be established on the site to facilitate surveys. The USGS or NGS control stations shall provide horizontal and vertical controls as checked against USGS or NGS record files. [URCR R313-25-25(7)]

Basis: The information contained in the 2005 revision of the LRA the Applicant has submitted indicate that the requirements of R313-25-25(7)] will be met. As is presented in Sections 3 and 5 of the 2005 revision of the LRA, closed embankments will be marked in the same way as a closed uranium mill tailings cell. Permanent granite markers, similar to those placed at the Vitro embankment, will be placed at the closed embankment. Markers will consist of unpolished granite of specified minimum dimensions, inscribed with lettering of specified characteristics.

The markers will be set in a bed of reinforced concrete and slightly raised from the ground/cover surface.

Markers will be placed at the entrance to the site and near the center of the crest of the completed embankment. They will identify the site; the general location of the disposed materials; dates of construction and closure; volume, mass, or tonnage of disposed material; kilograms of source material, grams of special nuclear material; and total activity of radioactive material disposed of in the embankment.

Reference Notes:

Envirocare of Utah, Inc., 2005c

5.16.8 Buffer Zone

Requirement 2525-08: 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 URCR R313-25-26(4) and take mitigative measures if needed [URCR R313-25-25(8)]

Basis: The information contained in the 2005 revision of the LRA and other relevant documents the Applicant has submitted indicate that the requirements of URCR R313-25-25(8) will be met. As indicated in Section 3 of the 2005 revision of the LRA, the horizontal buffer zone is identified as the 100-foot-wide area between the edge of the emplaced waste and site perimeter fence. During construction and waste emplacement operations, a 300-foot buffer zone exists between the closest edge of any embankment and the site perimeter fence.

A vertical buffer zone is provided between the bottom of the embankment and the underlying unconfined aquifer water table. This buffer zone consists of the 2-foot-thick clay liner and at least 10 feet of undisturbed soils. Although the water surface elevation may rise slightly over time, it is not anticipated that this elevation will exceed the 10 feet of buffer zone in addition to the 2-foot clay liner. In the event that remedial actions are required, they will be performed as a corrective action for a specific nonconforming event. As such, an event-specific plan will be developed at that time under the direction and approval of the Utah Division of Radiation Control and the Utah Division of Water Quality.

Based on a review of the information summarized above, the Applicant has adequately demonstrated its commitment to maintain a buffer zone between any buried waste and the disposal site boundary, and beneath the disposed waste. The dimensions and characteristics of the buffer zone are such that monitoring and mitigative measures can be undertaken as needed.

Reference Notes:

Envirocare of Utah, Inc., 2005c

Whetstone Associates, Inc., 2000a

Utah Division of Water Quality, 2005

5.16.9 Closure and Stabilization Measures Carried Out As the Disposal Units Are Filled and Covered

Requirement 2525-09: Closure and stabilization measures as set forth in the approved site closure plan shall be carried out as the disposal units are filled and covered [URCR R313-25-25(9)]

Basis: The information contained in the 2005 revision of the LRA and other relevant documents the Applicant has submitted indicate that the requirements of URCR R313-25-25(9) will be met. Facility closure activities are discussed in Section 5 of the 2005 revision of the LRA (with reference to design features in Section 3). This discussion describes closure activities that consist of constructing the cover system and the maximum height if the LLRW embankment is achieved.

The description of embankment closure activities, as discussed in Appendices L and V of the CQA/QC Manual, constitute a rudimentary closure plan. The application also states that the site will undergo post-operational decontamination and decommissioning. According to provisions of License Condition 74, the Licensee must submit a closure plan one year before it intends to commence closure activities.

Reference Notes:

Envirocare of Utah, Inc., 2004d

Envirocare of Utah, Inc., 2005c

5.16.10 Active Waste Disposal Operations Shall Not Adversely Affect Closed and Stabilized Areas

Requirement 2525-10: Active waste disposal operations shall not have an adverse effect on completed closure and stabilization measures. [URCR R313-25-25(10)]

Basis: The information contained in the 2005 revision of the LRA the Applicant has submitted indicates that the requirements of URCR R313-25-25(10) will be met. The Applicant has designed the Class A and Class A North embankments so that they will be progressively closed and stabilized as waste emplacement is completed within the embankments. Once the cover is constructed and the embankments are closed, continuing disposal operations will not produce the need to disturb the stabilized portions of the embankments. The open cell modeling indicates that the cells may remain open (i.e., with their final cover installed) for as long as 12 years without adversely affecting their performance. The progressive closure referred to above means that each waste cell could receive its final cover system as long as 12 years after initial waste placement in the cell.

Once the detailed closure plan is submitted for Division review and approval, the results of the settlement monitoring program will be evaluated in determining the extent to which the Licensee must provide additional cover to provide a smooth and stable surface for constructing the final cover system.

As is discussed in Section 4.3.1 of the 2005 revision of the LRA, facility waste placement operations will be conducted within open embankments. Movement of equipment around the edges of these embankments will be kept to a minimum, as will the disturbance of adjacent closed embankments. Active disposal areas will be separated from both completed embankment areas and unused areas by runoff berms to prevent water from flowing into the active open areas.

As described earlier in this document, placement of the temporary cover is considered an operational activity. Placement of the final cover constituted closure and must occur no later than 12 years from the time any portion of the disposal embankment was constructed. However, closure may only be done with the Division's explicit approval

Reference Notes:

Envirocare of Utah, Inc., 2005c, Section 4

5.16.11 Only Radioactive Waste Is Acceptable

Requirement 2525-11: Only wastes containing or contaminated with radioactive material shall be disposed of at the disposal site [URCR R313-25-25(11)]

Basis: The information contained in the 2005 revision of the LRA the Applicant has submitted indicates that the requirements of URCR R313-25-25(11) will be met. All of the waste streams disposed of in the embankment must contain radioactive constituents. The waste streams are described in Appendix J of the 2005 revision of the LRA. The wastes come from nuclear power plants, industries, research facilities, hospitals, universities, and military generators. The nuclear power plant wastes consist of process wastes, dry active wastes (trash), and equipment. Wastes from the institutional generators include trash, absorbed liquids, and biological waste (provided it has been treated to be non-pathogenic and non-infectious). Military waste streams are similar to institutional waste streams. Military waste streams are acceptable for disposal, provided they meet the waste acceptance criteria and do not contain sealed radiation sources, which are explicitly prohibited by license condition.

Reference Notes:

Envirocare of Utah, Inc., 2005c

Envirocare of Utah, Inc., 2005f

5.17 R313-25-26; ENVIRONMENTAL MONITORING

5.17.1 Preoperational Monitoring Program

Requirement 2526-1: At the time a license application is submitted, the applicant shall have conducted a preoperational monitoring program to provide basic environmental data on the disposal site characteristics. The applicant shall obtain information about the ecology, meteorology, climate, hydrology, geology, geochemistry, and seismology of the disposal site. For those characteristics that are subject to seasonal variation, data shall cover at least a 12-month period. [URCR R313-25-26(1)]

Basis: The information contained in the 2005 revision of the LRA and other relevant documents the Applicant has submitted indicate that the requirements of URCR R313-25-26(1) have been met. The Applicant supplied the results of their environmental monitoring program in the Siting Evaluation Report. Section 4.9.1 of the 2005 revision of the LRA discusses the pre-operational monitoring program in detail. Site characteristics are discussed in detail in Section 2.0 of the 2005 revision of the LRA. Section 2.0 of the 2005 revision of the LRA includes information about the ecology, meteorology, climate, hydrology, geology, geochemistry, and seismology of the site.

Reference Notes:

Envirocare of Utah, Inc., 1999

Envirocare of Utah, Inc., 2005c

Rogers and Associates Engineering for the Utah Division of Radiation Control, 2000

5.17.2 Operational Environmental Monitoring Program

Requirement 2526-2: 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. [URCR R313-25-26(2)]

Basis: The information contained in the 2005 revision of the LRA and other relevant documents the Applicant has submitted indicate that the requirements of URCR R313-25-26(2) will be met. Since the Applicant has ongoing waste disposal operations at the site, the operational environmental monitoring program for those activities is sufficient to constitute the pre-operational environmental monitoring program for the subject facility. Section 4.9.2 in the 2005 revision of the LRA includes the current environmental monitoring plan as Appendix R. Quarterly environmental monitoring reports have been developed by the Applicant following this Plan and submitted to the Division since 1999 to document and evaluate potential long-term

effects and the need for mitigative measures. The Division has determined that the current environmental monitoring plan is capable of providing early warning of releases of waste from the disposal site before they leave the site boundary.

Reference Notes:

Envirocare of Utah, Inc., 1999

Envirocare of Utah, Inc., 2004b

Envirocare of Utah, Inc., 2005c

5.17.3 Post-Operational Surveillance

Requirement 2526-3: 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. [URCR R313-25-26(3)]

Basis: The information contained in the 2005 revision of the LRA and other relevant documents the Applicant has submitted, albeit preliminary due to the long delay until such activities would be performed, indicate that the requirements of URCR R313-25-26(3) will be met. The Applicant has provided a description of the needed information in Section 5.3, Appendix C, and Appendix R of the 2005 revision of the LRA. The Applicant commits to conduct a satisfactory post-operational surveillance program for the site, as summarized in Section 5.4.4 of this document. The monitoring system will be similar to the monitoring system currently in place during operations. The similarities allow a comparison between historical data collected throughout operations and during the closure and post closure periods. The Applicant also discusses comparison of post closure data to earlier data throughout 2005 LRA Section 5.3, "Post-Operational Environmental Monitoring and Surveillance."

The Applicant has defined its environmental monitoring and surveillance plan in Appendix R of the 2005 LRA and commits that its provisions will ". . . remain in effect as written until the Utah Division of Radiation control (UDRC) approves changes." As noted above, the license will remain in effect until the Division authorizes transfer of the license and the Licensee will continue monitoring the closed site for five additional years.

Reference Notes:

Envirocare of Utah, Inc., 2004b

Envirocare of Utah, Inc., 2005c

Envirocare of Utah, Inc., 2005d

5.17.4 Taking Corrective Measures

Requirement 2526-4: The licensee shall have plans for taking corrective measures if the environmental monitoring program detects migration of waste which would indicate that the performance objectives may not be met. [URCR R313-25-26(4)]

Basis: The information contained in the 2005 revision of the LRA and other relevant documents the Applicant has submitted indicate that the requirements of URCR R313-25-26(4) have been or will be met. The Applicant has provided the needed information in the Emergency and Contingency Plan (2005 revision of the LRA Section 4.5 and Appendix B, Section 10). The identification of potential responses is identified in the facility's Ground Water Quality Discharge Permit (No. UGW450005).

Reference Notes:

Envirocare of Utah, Inc., 2005c

Envirocare of Utah, Inc., 2005e

Utah Division of Water Quality, 2005

5.18 R313-25-28; INSTITUTIONAL REQUIREMENTS

5.18.1 Land Ownership

Requirement 2528-1: Disposal of waste received from other persons may be permitted only on land owned in fee by the Federal or a State government. [URCR R313-25-28(1)]

Basis: By action of the Division, the Applicant has been granted an exemption from the requirement that the federal or state agency [that owns the land on which the disposal facility is constructed and operated] is prepared to accept transfer of the license when the provisions of URCR R313-25-16 and that it will assume responsibility for institutional control after site closure and for post-closure observation and maintenance. Thus, this requirement does not apply to the Class A Disposal Embankment.

Reference Notes:

Envirocare of Utah, Inc., 2000b

US Nuclear Regulatory Commission, 2000

Utah Bureau of Radiation Control to Envirocare of Utah, Inc., 1991

Utah Department of Environmental Quality and Envirocare of Utah, Inc., 1993

Utah Department of Environmental Quality, 2000a

Utah Department of Environmental Quality, 2000b

Utah Division of Radiation Control to Envirocare of Utah, Inc, 2000

Utah Division of Radiation Control to US Nuclear Regulatory Commission, 1999

Utah Division of Radiation Control to US Nuclear Regulatory Commission, 2000

Utah Radiation Control Board, 2000

5.18.2 Land Owner or Custodial Agency Conducts Institutional Control Program

Requirement 2528-2: Institutional Control. The landowner or custodial agency shall conduct an institutional control program to physically control access to the disposal site following transfer of control of the disposal site from the disposal site operator. The institutional control program shall also include, but not be limited to, conducting an environmental monitoring program at the disposal site, periodic surveillance, minor custodial care, and other equivalents as determined by the Executive Secretary, and administration of funds to cover the costs for these activities. The period of institutional controls will be determined by the Executive Secretary, but institutional controls may not be relied upon for more than 100 years following transfer of control of the disposal site to the owner. [URCR R313-25-28(2)]

Basis: The information contained in the 2005 revision of the LRA and other relevant documents the Applicant has submitted indicate that the requirements of URCR R313-25-28(2) will be met. The Applicant is the owner/operator of the disposal site and, as stated in Section 5.4.1 of the 2005 LRA, accepts responsibility ". . . for site closure, as well as the long-term maintenance and monitoring of the disposal site.". The application contains financial assurances to cover the estimated costs for a long-term surveillance program that includes environmental monitoring, site inspections, maintenance, and minor repairs during the 100-year institutional control period. These cost estimates are evaluated by the licensee and revised as necessary in the annual surety evaluation report required by License condition 73.

Reference Notes:

Envirocare of Utah, Inc., 2005c

URS Corporation, 1998

5.19 R313-25-32; FINANCIAL ASSURANCES FOR INSTITUTIONAL CONTROL

Requirement 2531-1: The applicant shall provide assurances prior to the commencement of operations that sufficient funds will be available to carry out disposal site closure and stabilization, including:

(a) decontamination or dismantlement of land disposal facility structures, and

(b) closure and stabilization of the disposal site so that following transfer of the disposal site to the site owner, the need for ongoing active maintenance is eliminated to the extent practicable and only minor custodial care, surveillance, and monitoring are required.

These assurances shall be based on Executive Secretary approved cost estimates reflecting the Executive Secretary approved plan for disposal site closure and stabilization. The Applicant's cost estimates shall take into account total costs that would be incurred if an independent contractor were hired to perform the closure and stabilization work. [URCR R313-25-31(1)]

Requirement 2532-1: Prior to the issuance of the license, the applicant shall provide for Executive Secretary approval, a binding arrangement, between the applicant and the disposal site owner that ensures that sufficient funds will be available to cover the costs of monitoring and required maintenance during the institutional control period. The binding arrangement shall be reviewed annually by the Executive Secretary to ensure that changes in inflation, technology, and disposal facility operations are reflected in the arrangements. [URCR R313-25-32(1)]

Requirement 2532-2: Subsequent changes to the binding arrangement specified in URCR R313-25-32(1) relevant to institutional control shall be submitted to the Executive Secretary for prior approval. [URCR R313-25-32(2)]

Basis: The information contained in the 2005 revision of the LRA and other relevant documents the Applicant has submitted indicate that the requirements of URCR R313-25-31, 25-32(1) , and 25-32(2) have been **or will be met**. The Applicant annually submits supplemental information to justify the financial assurances it proposes. These annual reports supplement sureties already provided for licensed activities, in an amount adequate to cover any additional costs attributable to closing, stabilizing, decontaminating, decommissioning, monitoring, and maintaining the Class A Disposal Embankment.

The Applicant has provided a binding arrangement between the Applicant, the Division, and the Applicant’s fiduciary agent that ensures that sufficient funds will be available to cover the costs of closing and stabilizing the disposal facility, and monitoring and maintaining it during the institutional control period.

The binding arrangement has been and continues to be periodically reviewed by the Executive Secretary to ensure that changes in inflation, technology, and disposal facility operations are reflected in the arrangements. The Applicant is required by regulation to support similar reviews on an annual basis. Any changes to the binding arrangement will be submitted to the Executive Secretary for review and approval before becoming effective.

Reference Notes:

Envirocare of Utah, Inc., 2005c

EnergySolutions LLC, 2007

Utah Division of Radiation Control (Dane Finerfrock) to Envirocare of Utah, Inc. (Daniel Shrum), 2007

6.0 RECOMMENDATIONS FOR IMPROVING SAFETY AND REGULATORY COMPLIANCE

The following recommendations were developed in response to the matters identified in Sections 4 and 5 of this document.

6.1 QUALITY ASSURANCE OF ENGINEERING PROCESSES

Issues relating to quality assurance of engineering processes were identified in Section 4 of this document. The following sections deal with engineering process issues:

- From Section 4.1, items 2 and 5
- From Section 4.2.1, items 1, 2, 4, 5, 6, 7, 8, 12, 13, and 14

The Division has reviewed these issues and the associated quality assurance procedures, and determined that the underlying procedures are sufficient to meet the intent of the regulations. Therefore, the Division is developing a new inspection procedure to inspect the Applicant to ensure these engineering procedures are being appropriately implemented. The engineering procedure inspection module will be added to the inspection schedule in 2007.

6.2 QUALITY ASSURANCE OF HUMAN RESOURCES

Issues relating to quality assurance of human resources processes were identified in Section 4 of this document. The following sections deal with human resources related issues:

- From Section 4.1, items 4, 5, 7, 8, and 9
- From Section 4.2.1, items 3, 11, 12, and 15

The Division has reviewed these issues and determined the underlying procedures are sufficient to meet the intent of the regulations. The Division currently inspects the Applicant on human resource issues. Therefore, the Division will review its radiation safety inspection modules to ensure the issues of training and employee turnover are sufficiently reviewed during future inspections.

6.3 IMPACT OF CLAY MINING

The Division has formally expressed concern about potential affects of the Applicant's clay mining activities in areas adjacent to but outside Section 32 regarding possible impacts near these borrow areas in several Division letters (see November 12, 2004, February 23, 2005, April 22, 2005, and February 16, 2007). Two possible impacts are (1) changes to the groundwater hydrology system that would compromise the ability of the licensed facility to meet performance

objectives and (2) headward erosion caused by runoff from the licensed area into the adjacent mining excavations that could destabilize waste embankments. These possible impacts are a product of soil borrow areas both inside and outside Section 32.

To address Division concerns regarding excavations inside Section 32, the Applicant modified the annual surety proposal in a February 23, 2007 submittal to include backfilling these excavations at the time of site closure. As for excavations outside of Section 32, the Division is not satisfied that the licensed facility is adequately protected from possible future impacts.

The Division has determined that it will renew the license with conditions identifying submittals with specified content that are due to the Division on a stated schedule (see new License Condition 34, stated below). The submittals will address groundwater and erosion modeling and will account for the inability of either the Division or the Applicant to control the use and activities in adjacent land areas. If analyses reveal that the ability of the disposal facility to meet applicable performance objectives may be compromised, the Division will impose additional license conditions. Such license conditions might involve the design and construction of features capable of preserving disposal embankment structural stability or of protecting the groundwater under licensed areas from the influences of changes in groundwater in adjacent areas.

The following sections of this document deal with clay mining issues:

- From Section 5.3.3
- From Sections 5.4.2.4.1, 5.4.2.4.3, and 5.4.2.4.4
- From Section 5.4.5
- From Section 5.5.4
- From Section 5.13
- From Sections 5.14.4, 5.14.5, 5.14.6, and 5.14.7
- From Sections 5.15.1 and 5.15.5

The February 16, 2007 Division letter provided the Applicant an Interrogatory regarding the clay mining activities and a list of needed additional information. To ensure that these technical issues are resolved, License Condition 34 has been added, as follows:

> *34. The Licensee shall address all concerns the Division has raised with Interrogatory CAC R313-22-32(1)-05/3 (transmitted to the Licensee on March 3, 2007) regarding clay mining activities in areas adjacent to Section 32. The Licensee shall deliver detailed analyses, explanations, descriptions, and appropriate justification to the Division no later than 30 days after issuance of this License. If the Executive Secretary determines that unacceptable adverse conditions exist or might develop or evolve, the Licensee shall submit a remedial action plan within 30 days of written notice of the determination by the Executive Secretary. The remedial action plan will address, among other topics, description of proposed activities, justification that the proposed activities will be*

adequate to protect the facilities in Section 32 from possible impacts of clay mining, and engineering design, specifications, and construction of proposed remedial actions.

Reference Notes:

Envirocare of Utah, Inc., 2005d

Utah Division of Radiation Control (Dane Finerfrock) to Envirocare of Utah, Inc. (Tye Rogers), 2004

Utah Division of Radiation Control (Dane Finerfrock) to Envirocare of Utah, Inc. (Tye Rogers), 2005a

Utah Division of Radiation Control (Dane Finerfrock) to Envirocare of Utah, Inc. (Tye Rogers), 2005b

Utah Division of Radiation Control (Dane Finerfrock) to Envirocare of Utah, Inc. (Tye Rogers), 2007

6.4 COVER TEST CELL REMEDIATION

As discussed in Section 5.5.1, the Applicant designed and built a Cover Test Cell (CTC) to demonstrate the performance of the disposal embankment covers. The CTC is a small-scale mockup of the cover system using the same materials, geometry, and layer thicknesses as the final covers for the waste embankments. The CTC contains instrumentation to provide data on precipitation, soil moisture, temperature, water seepage, and other factors that reveal or indicate cover performance.

Data were gathered from the CTC with the objective of verifying the predicted water seepage rate through the cover and correlating measured CTC data (e.g., soil temperature, moisture, wetting/drying trends) with meteorological data, such as rainfall and air temperature. The data was also intended to verify and/or strengthen computer modeling of the cover system and long-term waste protection objectives. Under an October 13, 2005 transmittal letter, the Applicant submitted an October 5, 2005 report detailing CTC monitoring data collected between January, 2002 and September, 2005.

The Division conducted a detailed review of the CTC data provided. Details of this review are found in Round 3 Interrogatory CAC R313-22-32(1)-05/3 (and the associated Attachment A) transmitted to EnergySolutions on March 3, 2006. Initially, the sacrificial soil layer (SSL) moisture content data showed a cyclical pattern that was suggestive of seasonal wetting and drying, but after about two years (early 2004) the sensor response dramatically declined to a steady state condition, suggesting that the instruments might no longer be functioning correctly. The CTC SSL moisture content data were not consistent with one another and raised questions about the reliability of the data. CTC drainage volumes reported from the Type B Filter layer were also inconsistent with reported SSL soil moisture content data, and local precipitation recorded.

As a result, the Division concluded that the CTC data was inconclusive. The root cause for these problems is currently unknown. However, it may have been caused by faulty CTC design, construction, or instrumentation failure. Therefore, the Division has concluded that the CTC has not achieved its objective of producing a better understanding of moisture storage and movement within the cover system. Section 5.5.1 of this document deals with CTC related issues.

On the basis of the CTC evaluation, the Division has decided the following:

- The apparent problems with the CTC must be investigated and remedied so that the CTC functions in a manner to provide consistent and reliable data.
- Data must continue to be taken from the properly functioning CTC.
- Data from the CTC is to be reported to the Division annually.
- Subject to future findings from the CTC, the Division may revise existing or develop new License Conditions.

To resolve these technical issues, the Division will add a new License condition to require submittal and implementation of a corrective action plan and schedule subject to the Division's approval. The plan will do one of the following: 1) correct / repair the CTC instrumentation, or 2) re-design and re-construct the CTC and all related instrumentation, and 3) provide a system that allows collection of representative cover system performance data. This change will be implemented in License Condition 28, as shown below:

> *28. The Licensee shall submit the following to the Executive Secretary for review and approval pending resolution of all issues as judged by the Executive Secretary:*
>
> > *A. The Licensee shall submit a corrective action plan for the Cover Test Cell for Executive Secretary approval by September 30, 2007. The corrective action plan shall identify all means necessary to collect valid data to verify actual performance of the cover system. Said plan shall include Cover Test Cell design, construction, instrumentation, monitoring, reporting, and comparison of actual performance to projected performance. The Cover Test Cell corrective action plan shall include:*
> >
> > *i. Performance goals to meet the objective of verifying modeled cover system performance.*
> >
> > *ii. Methodologies and plans that provide quantitative and qualitative results capable of satisfying the objective.*
> >
> > *iii. Design, construction, and operational plans to implement the methodologies and plans.*
> >
> > *iv. Quality control and quality assurance requirements of work to be performed. Quality control and quality assurance specifications and procedures shall state specific actions and processes the Licensee will use to ensure compliance with designs and specifications, monitoring, reporting, ensure data validity, timely detect data deficiencies, enhance*

accuracy of data interpretation, and ensure correctness of results prior to being submitted to the Division.

v. In the event that the plan results in new instrumentation or construction, the Licensee shall complete all such activities within 30-days of Executive Secretary approval. Within 30-days of completion of said construction, the Licensee shall submit an As-Built report for Executive Secretary approval.

B. The Licensee shall submit an annual report for Executive Secretary approval by March 1 of each calendar year. This annual report shall detail the Licensee's progress in implementing the corrective action plan, provide the data collected in the past year, analyze the data, and interpret the meaning of the data relative to the overall objective of the corrective action plan.

Reference Notes:

Envirocare of Utah, Inc., 2003a

Envirocare of Utah, Inc. to Utah Division of Radiation Control, 2005

Utah Division of Radiation Control (Loren Morton) to EnergySolutions (Tye Rogers), 2006

6.5 ORGANIZATIONAL STRUCTURE

With the issues raised regarding the quality assurance programs of the Applicant (refer to Sections 6.1 and 6.2 of this document), the Division judges that the quality assurance functions need further emphasis from management and further independence from operational objectives and influence. The following sections of this document also deal with quality assurance issues:

- From Section 4.1, items 2, 5, and 10
- From Section 4.2.1, items 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, and 14
- From Sections 6.1 and 6.2

The Division has reviewed these issues and the associated quality assurance procedures, and determined that the organizational structure, as listed in Appendix B of this document, needs to be modified to ensure quality is not compromised by the pressures of operations. The Division will reiterate this regulatory criterion as new License Condition 32.D. Quality assurance and administrative objectives are required in R313-25-7(10) and R313-25-7(13).

32. D. The Licensee shall maintain the organizational independence of the programs that monitor and enforce employee safety, environmental protection, and public safety from programs responsible for production and profitability and other influences or priorities that might compromise quality and radiation safety.

Reference Notes:

See Also: Appendix B and Sections 5.3.2, 5.4.7, and 5.4.10 of this document

Envirocare of Utah, Inc., 2002

Envirocare of Utah, Inc., 2005d

6.6 DISCRIMINATION PROTECTION

The Division judges that the Applicant should be more proactive in involving employees in the safety process. Of particular concern is the ability of the Applicant to protect employees from discrimination, as outlined in Form DRC-04. The following sections of this document deal with employee job protection related issues:

- From Section 4.1, item 6
- From Section 4.2.1, item 10

To address this concern, a new License Condition 32.E, will be added to require that the Licensee establish a method enabling any employee or contractor to anonymously submit questions, concerns, ideas, or other comments regarding employee radiation safety, environmental radiation protection, and public radiation safety to the Corporate Radiation Safety Officer. The method must include documentation of all comments submitted, the Applicant's response to each comment, and a method for communicating the response to employees and contractors.

32. E. The Licensee shall establish a method for any employee or contractor to anonymously submit questions, concerns, ideas, or other comments regarding employee safety, environmental protection, and public safety to the Corporate Radiation Safety Officer. The method shall include documentation of all comments submitted, the Applicant's response to each comment, and a method for communicating the Licensee's response to employees and contractors.

6.7 CLOSEOUT CONDITIONS

The Division references documents submitted by the Applicant in License Condition 88. By referencing these documents the conditions and obligations stated within the documents become part of the radioactive materials license. License Condition 88.DD will be added to the License to include documents related to this license renewal application.

88. DD. The following documents refer to revisions made in Revision 0:

(1) *AGRA Earth & Environmental, Inc. 1999. Summary Seismic Stability and Deformation Analysis: Envirocare LARW Disposal Facility, Clive, Tooele County, Utah. September 1, 1999. (1998 LRA Appendix J)*
(2) *AGRA Earth & Environmental, Inc. 2000a. Evaluation of Settlement of Compressible Debris Lifts: LARW Embankments, Clive, Tooele County, Utah. June 1, 2000.*
(3) *AGRA Earth & Environmental, Inc. 2000b. Evaluation of Settlement of Incompressible Debris Lifts: LARW Embankments, Clive, Tooele County, Utah. June 1, 2000.*
(4) *AMEC Earth & Environmental, Inc. 2000a. Letter Report: Allowable Differential Settlement and Distortion of Liner and Cover Materials. October 4, 2000.*
(5) *AMEC Earth & Environmental, Inc. 2000b. Letter Report Stability Considerations: Proposed LLRW Embankment. October 25, 2000.*
(6) *AMEC Earth & Environmental, Inc. 2000c. Letter Report Stability Considerations - Addendum: Proposed LLRW Embankment. November 8, 2000.*
(7) *AMEC Earth & Environmental, Inc. 2001. Response to Interrogatory Number 2: Placement if HICs in Caissons. October 1, 2001.*
(8) *AMEC Earth & Environmental, Inc. 2002. Placement of Large Liners in Caissons. June 19, 2002.*
(9) *Bingham Environmental. 1996. Project Memorandum HEC-1 and HEC-2 Analysis, LARW Application for License Renewal, Envirocare Disposal Facility, Clive Utah. November 26, 1996. (1998 LRA Appendix KK)*
(10) *EnergySolutions (Rebeccah McCloud) to Utah Division of Radiation Control (Dane Finerfrock). 2006. Correspondence concerning corporate ownership and name changes. February 6, 2006.*
(11) *EnergySolutions (Tye Rogers) to Utah Division of Radiation Control (Dane Finerfrock). 2006. Correspondence concerning corporate ownership and name changes. February 3, 2006.*
(12) *EnergySolutions LLC. 2007. "2006 Annual 083106 Rev 052107.xls" [annual surety review], Revision 22, May 21, 2007*
(13) *EnergySolutions to Utah Division of Radiation Control. 2006. Letter number CD06-0348, Radioactive Materials License No. UT2300249 – Revision to License Condition 26, Appendix R request submitted to DRC on March 17, 2006. September 1, 2006.*
(14) *Envirocare of Utah, Inc. to URS Corporation. 2005. Personal communication via electronic mail (Sean McCandless and Robert D. Baird, PE). January 27, 2005.*
(15) *Envirocare of Utah, Inc. to Utah Division of Radiation Control. 2004. Letter number CD04-0287, Updated Specific Gravity Report and Request for Eliminating Specific Gravity Monitoring. June 9, 2004.*

(16) *Envirocare of Utah, Inc. to Utah Division of Radiation Control. 2005. Letter number CD05-0487, Cover Test Cell Evaporative Zone Depth (EZD) Report. October 13, 2005 June 9, 2004.*
(17) *Envirocare of Utah, Inc. 2000a. Pre-Licensing Plan Approval Application for a License Amendment Allowing Disposal of Class B & C Low-Level Radioactive Waste. (revision of January 5, 2000 plan) March 15, 2000.*
(18) *Envirocare of Utah, Inc. 2000b. Rock Cover Design. July 26, 2000.*
(19) *Envirocare of Utah, Inc. 2001. "Clive Facility Total Ditch Flow Calculations." October 30, 2001.*
(20) *Envirocare of Utah, Inc. 2003c. Application for Renewal: Radioactive License Materials License Number UT-2300249. July 2, 2003.*
(21) *Envirocare of Utah, Inc. 2005d. Application for Renewal: Radioactive License Materials License Number UT-2300249, Revision 2 (including all Appendices). June 20, 2005.*
(22) *Montgomery-Watson (John Pellicer and Patrick Corser) to Envirocare of Utah, Inc. (Tim Orton). 2000. Letter Report LLRW Cover Frost Penetration. March 1, 2000.*
(23) *Rogers and Associates Engineering for the Utah Division of Radiation Control. 2000. Siting Evaluation Report for Proposed Disposal Under URCR R-313-25-3 of Class B & C Low Level Radioactive Waste. May 2, 2000.*
(24) *Shrum, Dan to Robert D. Baird, PE, CCE (URS Corporation). 2005. Via electronic mail. February 28, 2005.*
(25) *SWCA Environmental Consultants, Inc. 2000. Assessment of Vegetative Impacts on LLRW.*
(26) *Tooele County Recorder. 1993. Entry No. 5489, Book 348, Page 104. March 16, 1993.*
(27) *Utah Bureau of Radiation Control (Larry F. Anderson) letter to Envirocare of Utah, Inc. (Khosrow B. Semnani, President). 1987. "Radioactive Material License No. UT 2300249." November 18, 1991.*
(28) *Utah Department of Environmental Quality (Diane R. Nielson, Executive Director) and Envirocare of Utah, Inc. (Khosrow B. Semnani, President). 1993. "Agreement Establishing Covenants and Restrictions." March 16, 1993.*
(29) *Utah Division of Radiation Control (Dane Finerfrock) to Envirocare of Utah, Inc. (Daniel Shrum). 2007. "EnergySolutions 2006 Annual Surety Submittal, May 21, 2007 Update." June 1, 2007.*
(30) *Utah Division of Radiation Control (Dane Finerfrock) to Envirocare of Utah, Inc. (Tye Rogers). 2004. "Restoration of Site Drainage." November 12, 2004.*
(31) *Utah Division of Radiation Control (Dane Finerfrock) to Envirocare of Utah, Inc. (Tye Rogers). 2005a. "Response to December 4, 2004 Report - Restoration of Site Drainage: Request for Additional Information." February 23, 2005.*

(32) *Utah Division of Radiation Control (Dane Finerfrock) to Envirocare of Utah, Inc. (Tye Rogers). 2005b. "Response to March 25, 2005 Envirocare Response to the February 27, 2005 DRC Request for Information - Restoration of Site Drainage." April 22, 2005.*

(33) *Utah Division of Radiation Control (Dane Finerfrock) to Envirocare of Utah, Inc. (Tye Rogers). 2007. "Restoration of Grade - Round 1 Interrogatories: Notice of Upcoming Requirements and Request for Schedule." February 16, 2007.*

(34) *Utah Division of Radiation Control (Loren Morton) to EnergySolutions (Tye Rogers) . 2006. Correspondence regarding "DRC Response to Eight Submittals by EnergySolutions Regarding Proposed Class A Combined (CAC) Disposal Cell: Request for Additional Information, Round 3 Interrogatory." March 3, 2006.*

(35) *Utah Division of Radiation Control to EnergySolutions, LLC. 2006. Letter of approval of Revision 20 of the CQA/QC Manual. September 21, 2006.*

(36) *Utah Division of Radiation Control (William Sinclair) to Envirocare of Utah, Inc. 2000. Correspondence concerning expectations in addressing the land ownership issue. March 6, 2000.*

(37) *Utah Division of Radiation Control. 2006a. Memorandum: Analysis of the December 20, 2005 Envirocare Submittal of Settlement Monitoring Plan Update. February 2, 2006. (Johnathan P. Cook to Loren Morton)*

(38) *Whetstone Associates, Inc. memorandum to Envirocare of Utah, Inc. 2000. Technical Memorandum 41010 Infiltration Through Lower Radon Barrier, Class A, B, & C Cell Cover. November 7, 2000.*

(39) *Whetstone Associates, Inc. 2000a. Revised Envirocare of Utah Western LARW [Class A] Cell Infiltration and Transport Modeling. July 19, 2000.*

(40) *Whetstone Associates, Inc. 2001a. "Travel Time Through Class A Cell Cover." June 22, 2001.*

(41) *Whetstone Associates, Inc. 2003b. Memorandum to Dan Shrum, Envirocare of Utah, "Open Cell Modeling Results for Years 7 – 12," Technical Memorandum 4101T, August 28, 2003.*

(42) *Whetstone Associates, Inc. 2004. Revised Western LARW Cell Infiltration and Transport Modeling. July 19, 2004.*

(43) *Zion's Bank and Energy Solutions, LLC, 2007. Surety Details. March 27, 2007.*

(44) *"Envirocare's Cover Test Cell Evaporative Zone Depth (EZD) Report", Daniel B. Shrum of Envirocare of Utah, LLC to Dane L. Finerfrock of Utah Division of Radiation Control, CD05-0487, October 13, 2005.*

(45) *"Cover Test Cell Data Report Addendum: Justification to Change EZD from 18-inches to 24-inches", Envirocare of Utah, LLC, October 5, 2005.*

(46) *"October 13, 2005 Envirocare Submittal Regarding Cover Test Cell Evaporative Zone Depth (EZD) Report: CAC Cell Round 2 Interrogatory", Loren B. Morton of Utah Division of Radiation Control to Daniel B. Shrum of Envirocare of Utah, LLC, November 1, 2005.*

(47) *"Class A Combined Embankment Interrogatories: Clarification of Envirocare October 13, 2005 Evaporative Zone Depth Report", Daniel B. Shrum of Envirocare of Utah, LLC to Dane L. Finerfrock of Utah Division of Radiation Control, CD05-0518, November 2, 2005.*

(48) *"Response to DRC Letter dated November 1, 2005 in Regards to Envirocare's October 13, 2005 Evaporative Zone Depth Report", Daniel B. Shrum of Envirocare of Utah, LLC to Dane L. Finerfrock of Utah Division of Radiation Control, CD05-0520, November 3, 2005.*

(49) *"Cover Test Cell As-Built Report", Envirocare of Utah, LLC, January 24, 2002.*

(50) *Appendix N, "Cover Test Cell Monitoring Report" dated June 20, 2003, Envirocare of Utah, LLC, License Renewal Application, Revision 2, dated June 20, 2005*

(51) *Appendix G, "Drawings" variously dated, Envirocare of Utah, LLC, License Renewal Application, Revision 2, dated June 20, 2005.*

(52) *"Attachment 4: EZD Cover Test Cell Data" CD-ROM attached to "Radioactive Material License #UT2300249 and Groundwater Quality discharge Permit No. UGW450005. Class A Combined Disposal Embankment – Response to September 19, 2005 Interrogatories", Tye Rogers of Envirocare of Utah, LLC to Dane L. Finerfrock of Utah Division of Radiation Control, CD05-0574, December 16, 2005.*

(53) *"HDU Data", Mike LeBaron of Envirocare of Utah, LLC to Loren Morton of Utah Division of Radiation Control and Robert Baird of URS Corporation, e-mail dated December 19, 2005.*

(54) *"Cover Test Cell WCR Data", Mike LeBaron of Envirocare of Utah, LLC to Loren Morton of Utah Division of Radiation Control and Robert Baird of URS Corporation, e-mail dated December 20, 2005.*

(55) *"Matric Potential Conversion Factor", Mike LeBaron of Envirocare of Utah, LLC to Loren Morton of Utah Division of Radiation Control and Robert Baird of URS Corporation, e-mail dated December 21, 2005.*

(56) *"RE: Evaporative Pan Data (39400085.10300 OUT)", Mike LeBaron of Envirocare of Utah, LLC to Loren Morton of Utah Division of Radiation Control and Robert Baird of URS Corporation, e-mail dated December 22, 2005.*

(57) *"Report Combined Embankment Study: Envirocare", AMEC Earth and Environmental, Inc., December 13, 2005.*

(58) *"Geotechnical Study Increase in Height and Footprint: Envirocare LARW Facility Near Clive, Utah", AMEC Earth and Environmental, Inc., May 27, 2005.*

(59) *"Class A Disposal Cell: Containerized Waste Facility: Engineering Justification Report", Envirocare of Utah, April 12, 2001.*

(60) *"Class A Disposal Cell: Containerized Waste Facility: Engineering Justification Report: Addendum 15 Percent Void Space Criteria", Envirocare of Utah, October 2, 2001.*

(61) "Mixed Waste Embankment Engineering Justification Report" Revision 2, Envirocare of Utah, October 20, 2001
(62) "Minimum Temperature Return Rates", personal communication from Jim Ashby, November 1, 2000.
(63) "Review of Cover Design for LARW Cell", TerraMatrix/Montgomery Watson to Envirocare of Utah, February 5, 1998.
(64) "Cover Test Cell As-Built Report", Envirocare of Utah, January 24, 2002.
(65) Letter CD02-0097, "Revised CQA/QC Manual - Containerized Waste Facility: Placement of Large Liners/HICs", Envirocare of Utah to Utah Division of Radiation Control, March 18, 2002.
(66) Letter CD02-0269, "Revised CQA/QC Manual - Containerized Waste Facility: Placement of Large Liners/HICs - Response to Interrogatories", Envirocare of Utah to Utah Division of Radiation Control, July 3, 2002.
(67) Letter CD02-0315, "Revised CQA/QC Manual - Containerized Waste Facility: Placement of Large Liners/HICs - Revised Settlement Analysis and CQA/QC Language", Envirocare of Utah to Utah Division of Radiation Control, August 7, 2002.
(68) Letter CD02-0339, "Revised CQA/QC Manual - Containerized Waste Facility: Placement of Large Liners/HICs - Proposed Revision 15 of the LLRW CQA/QC Manual", Envirocare of Utah to Utah Division of Radiation Control, August 26, 2002.
(69) Letter CD01-0212, "Engineering Justification Report - Waste Placement with CLSM", Envirocare of Utah to Utah Division of Radiation Control, May 16, 2001.
(70) Letter CD01-0296, "Containerized Waste Facility - Placement of Class A Ion-Exchange Resings in Polyethylene HICs and Steel Liners", Envirocare of Utah to Utah Division of Radiation Control, July 5, 2001.

6.8 MISCELLANEOUS CHANGES

The Division has made several formatting and editorial changes to the license. In addition, the following license conditions will have minor changes:

6.8.1 Staff Qualifications

License Condition 32.A specifies the Applicant's staff qualification requirements. The license condition will be updated to reflect the most current requirements.

32. A. The Licensee's staff shall meet the qualifications as described in Appendix I (October 6, 2006, rev 19).

6.8.2 Construction Drawings

License Condition 48 specifies the requirements for drawings of the licensed facilities. The license condition will be modified to provide clearer directions and objectives for drawings submitted to the Division.

48. A. The Licensee shall provide a comprehensive set of drawings for the entire Clive site. The drawings shall correctly: (1) locate all structures, utilities, fences, ponds, drainage features railroad tracks, roads, storage facilities, loading and off-loading facilities, disposal embankments, all environmental monitoring locations including instruments/devices, and any other appurtenances related to the operation, maintenance and closure of the disposal facility; and (2) provide survey control including elevations in sufficient detail to fully describe the site. The drawings shall be developed in accordance with the standards of professional care. A drawing index shall be included that identifies drawings by discrete number. Each drawing shall include a revision block that documents the latest changes or modifications by date and includes the initials of the responsible reviewer for QA/QC tracking purposes.

B. Drawings showing approved future designs shall be marked as "Final Drawings." Final drawings or drawings developed for construction shall be sealed by a Utah registered professional engineer. The drawings shall be developed in accordance with the standards of professional care.

C. Within 30 days of completion of any project that requires approval by the Executive Secretary, a set of "As-Built" drawings shall be submitted for review. The drawings shall indicate as-built conditions as they existed no earlier than 30 days prior to the submittal. Drawings of finished construction shall be marked as "As-Built" in the final entry in the revision block.

6.8.3 Annual Report Certification

License Condition 73.D specifies the requirements for professional licensure of the preparer of the annual financial surety report. The license condition will be clarified to provide clearer directions and objectives for certification of the annual report submitted to the Division.

73. D. Report Certification – the annual report shall be prepared under the direct supervision of and certified by a Professional Engineer or Professional Geologist currently licensed by the State of Utah with at least five (5) years of construction cost estimation experience. The annual report shall be developed in accordance with the standards of professional care.

7.0 REFERENCES

Adrian Brown Consultants. 1997. *Final Slug Test Results, Envirocare of Utah South Clive Facility, Tooele County, Utah*.

AGRA Earth & Environmental, Inc. 1996. *Stability & Deformation Analyses Low Activity Radioactive Waste Disposal Facility; Clive, Tooele County, Utah*. February 27.

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AMEC Earth & Environmental, Inc. 2000a. Letter Report: Allowable Differential Settlement and Distortion of Liner and Cover Materials. October 4, 2000.

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Arabasz, W. J., *et al*. 1989. Evaluation of Seismicity Relevant to the Proposed Siting of a Superconducting Supercollider (SSC) in Tooele County, Utah, for Dames & Moore, Utah SSC Proposal Team, Salt Lake City, UT.

ASTM International Committee C09.20 on Normal Weight Aggregates. 1999. C88-99a *Standard Test Method for Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate*.

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_____. 2003b. C535-03e1 *Standard Test Method for Resistance to Degradation of Large-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine*.

_____. 2004a. C127-04 *Standard Test Method for Density, Relative Density (Specific Gravity), and Absorption of Coarse Aggregate*.

_____. 2004b. C128-04a *Standard Test Method for Density, Relative Density (Specific Gravity), and Absorption of Fine Aggregate*.

ASTM International Committee D18.03 on Texture, Plasticity and Density Characteristics of Soils. 2000a. D698-00ae *Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft^3 (600 kN-m/m^3))*.

_____. 2000b. D4318-00 S*tandard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils*.

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Code of Federal Regulations. 1985, as amended. 10 CFR 40, Appendix A, Criterion 6, Criteria Relating to the Operation of Uranium Mills and the Disposition of Tailings or Wastes Produced by the Extraction or Concentration of Source Material From Ores Processed Primarily for Their Source Material Content.

EnergySolutions (Rebeccah McCloud) to Utah Division of Radiation Control (Dane Finerfrock). 2006. Correspondence concerning corporate ownership and name changes. February 6, 2006.

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