Technical Memorandum

Date: November 8, 2006

To: Loren Morton, Dave Rupp, Utah Department of Radiation Control

From: Britt Quinby, URS Corporation

Subject: **Technical review of IUC proposed work plan for field hydration testing of GCL to be used in the liner for Cell 4A**

Due to the significance of hydration on the ability of the GCL to sustain a low hydraulic conductivity, the DRC requested that IUC provide data indicating approximate predicted levels of hydration of the GCL to occur over time based on the GCL being in direct contact with the subgrade materials at the site (based on their estimated moisture content and subgrade material type). IUC provided in their June 30, 2006 response a plot on the expected level of hydration that the GCL would likely achieve in the field prior to active usage of Cell 4A. IUC also provided additional data on the extent of rate of hydration of bentonite (in this case the granular bentonite component adhered to one side of a geomembrane) in the GCL. However, this information was not conclusive as to the degree of hydration that could be expected for the GCL under site conditions, and if the degree of hydration would be comparable to levels of GCL hydration of the GCL specimens evaluated by Ruhl and Daniel that were tested against acidic liquids. To address this issue, IUC proposed the performance of a field test to demonstrate that the GCL has hydrated to the desired level.

IUC's proposed work plan was submitted to the DRC in a letter from GeoSyntec Consultants dated October 20, 2006. The contents of this plan were reviewed and the overall approach and objectives of the plan appear reasonable. However, the following concerns were identified:

1. **Surface Water Controls:** IUC needs to demonstrate that the proposed test pad will be constructed with sufficient controls to ensure that surface water runoff does not impact the GCL, and GCL hydration is accomplished due to the moisture in the underlying subgrade soil (not from surface water infiltration). In particular, the impact of surface water infiltration on the edges of the GCL needs to be considered (any potential edge effects minimized). Possible controls include diversion ditches and/or berms to direct the surface water flow around and away from the test location, the anchoring of the HDPE liner in a perimeter trench, and the placement of the HDPE/GCL test pad so surface water will run off and away from the pad area and not pond. The development of anchoring and surface water controls needs to also consider the means by which the HDPE liner will be removed and replaced during the collection of the samples. This impact to the exposed GCL needs to be minimized during sampling.

2. **GCL Sampling Frequency:** The work plan indicates that laboratory testing of the GCL will be conducted on samples collected 1 week and 2 weeks following initial GCL panel placement on the subgrade soil. Other test data indicate that, depending on subgrade characteristics; the time

required for GCLs to reach moisture equilibration with subgrade soils onto which they are placed may be longer. For example, Daniel and Gilbert (2004) presented data indicating that the water content in a sample of a Claymax GCL placed onto a sandy soil was substantially higher 42 days after placement than it was 7 days following placement. The Claymax GCL likely has a more open weave fabric encasing the bentonite than would the type of GCL proposed for use in the Cell 4A construction, which suggests that the moisture equilibration time for the GCL in this test could be even longer. Therefore, at a minimum please include the collection of samples after 28 and then 42 days.

3. **Number of GCL Samples:** It is unclear if six samples will be collected during each sampling event or if six samples were to be collected total (three during each sampling event). There should be a minimum of 3 samples collected for each sampling event. In consideration of this increase in the number of samples per event, the size of the section of GCL may need to be increased to a minimum of 8-feet by 8-feet. This will also allow for more available sample locations. In addition, two of the samples during each event are to be collected from the inner (i.e., 6-feet by 6-feet section), with the remaining one from the outer edges. All sample locations will be documented and identified on a scaled drawing.

4. **Subgrade Soil Samples and Testing:** Available test data suggest that other soil characteristics in addition to soil moisture content, such as clay and content can influence the hydration behavior of GCLs that are placed into contact with soil. Because soil characteristics could change across the Cell 4A floor, it will be beneficial (and provide additional insights) to also perform soil gradation and pH testing on the subgrade soil samples collected from the area of the test as well as testing for moisture content. In addition, to provide for a more statistically reliable estimation of the soil properties tested, a minimum of three soil samples need to be collected.

5. **Subgrade Conditions:** IUC needs to demonstrate that the GCL will hydrate properly under anticipated subgrade soil conditions. There are several concerns relating to the conditions of the subgrade soil that need to be considered. They are:
   a. The subgrade soils need to meet the free release criteria for radioactivity.
   b. The subgrade soil in the area of Cell 4A typically contains elevated levels of salts that can dissolve and may impact the ability of the GCL to hydrate. To simulate the actual subgrade conditions under which the GCL is to be placed, an area in the higher range of salt levels in the cell subgrade soil should be used. Higher salt levels would expected to be most prevalent in the southwest corner of the cell.
   c. There is concern that the moisture content of the subgrade soil will not be sufficient to allow for acceptable hydration of the GCL in a reasonable time frame. There have been discussions in the past on wetting the subgrade prior to GCL placement to facilitate the hydration process. IUC may want to consider the performance of more than one test pad with varying initial moisture contents. If the subgrade is to be wetted, the water quality of the water needs to be evaluated (i.e., have acceptable salt content and pH).

6. **GCL Placement:** The proposal should clearly state which side of the GCL (nonwoven side or woven side, if a NW/Woven GCL is proposed for use) would be placed against the subgrade. If a double non-woven GCL is proposed for use in the cell construction, the characteristics of both of the nonwoven sides of the GCL should be clearly described. The choice of nonwoven vs. woven side (or the specific nonwoven side) selected for placement against the subgrade could affect the testing results. The precise placement method used in the testing program should be clearly documented and the side of the GCL placed downward needs to be the same as the side of the GCL that will be placed downward in the final GCL installation in the cell.

7. **GCL Moisture Content Testing and Criteria:** The work plan stated that the moisture testing of the GCL would be performed in “general” accordance with ASTM D 5993, and for the soil in “general” accordance with ASTM 2216. This indicates that there will variances to these procedures. These variances need to be explained and provided. In addition, it is important to note that the moisture content defined by these tests and the referenced acceptable level of hydration is 150% and is defined by mass of water divided by mass of dry bentonite clay in the GCL.

8. **Test Pad Inspection and Maintenance:** Included should be periodic inspections of the test site for disturbance and damage. If damage is identified, it needs to be repaired as soon as possible, documented, and an assessment on the impact on the testing prepared. This assessment to be provided to the DRC for review.

9. **Test Pad Implementation and Supervision:** There are no specifics on the implementation of the proposed field-testing presented in the work plan. At a minimum, the implementation needs to be by qualified and experienced geotechnical professionals under the supervision of a qualified Professional Engineer licensed in the State of Utah. A qualified and experienced geotechnical professional is someone who has, at a minimum, a two-year degree in an environmental, geotechnical, and/or engineering field with at least 2 years of field material or environmental testing experience.

10. **Documentation:** The work makes reference to the preparation of a letter report that will present the results of the testing. However, there is no mention of the documentation to be generated during the test. At a minimum, the performance of the test needs to be documented via a field logbook and/or data sheets and photographs, which are then organized and included with a final report. Because the data generated by the testing and documented in the report will provide a basis for the liner design, and to be consistent with the requirements of R317-3-1.2 A.1, the final report will need to be prepared by, or under the supervision of, and bear the seal of a Professional Engineer licensed in the State of Utah.

    Information included in the documentation needs to include (but is not limited to):
    a. Date/time
    b. Weather conditions
    c. Names of those performing the work

d. Methods used to place GCL/HDPE
e. Condition of subgrade
f. Sample ID's, locations, packaging and shipment details
g. Photos of samples during collection
h. Description of samples during collection
i. Field diagrams (as needed)
j. Results of periodic inspections though out the testing period (including photos)
k. Repairs performed (if needed)
l. Records of weather conditions though out the testing period (particularly daily temperatures and precipitation)
m. Formal and informal test results as well as the methods used to obtain the results

11. The documentation will be included in the report to be provided. At a minimum, the report will include:
    a. Introduction
    b. Objectives
    c. Methodology
    d. Results
    e. Discussion
    f. Conclusions
    g. Attachments (testing documentation)

REFERENCES:

"Cell 4A Lining System Design Report for the White Mesa Mill, Blanding, Utah," by GeoSyntec Consultants, January 2006. Prepared for International Uranium (USA) Corporation.

Daniel, D.E. and Gilbert R. 2004. "Comparison of Gundseal and Claymax at Initial and Latter Stage of Hydration". Data presented at Geosynthetic Clay Liners for Waste Containment, Short Course, University of Texas at Austin, May 19-20, 2004.

IUC, March 7, 2005 Request to Amend Radioactive Material License, White Mesa Mill and Environmental Report.

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Letter from IUC to DRC dated June 22, 2006; Re: Cell 4A Lining System Design Report, Round 2 Interrogator Response.

Letter from IUC to DRC dated June 30, 2006; Re: Cell 4A Lining System Design Report, Response to DRC Request for Additional Information – Round 2 Interrogatory, Cell 4A Design.

Letter from IUC to DRC dated August 28, 2006; Re: Cell 4A Lining System Design Report, Response to DRC Request for Additional Information – Round 4 Interrogatory, Cell 4A Design.

Ruhl, J., and Daniel, D. 1997. "Geosynthetic Clay Liners Permeated with Chemical Solutions and Leachates", Journal of Geotechnical and Geoenvironmental Engineering, Vol. 123, No. 4, pp. 369-381.

State of Utah Ground Water Discharge Permit No. UGW370004.

Smith R.D.1987, U.S. Nuclear Regulatory Commission, Sampling of Uranium Mill Tailings Impoundments for Hazardous Constituents, Memorandum, Februarey9, 1987, Division of Waste Management.

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cc: Robert Baird, URS